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58th NATIONAL SAFETY CONGRESS

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PULP and PAPER SESSIONS

KEYNOTE ADDRESS

By E. E. ELLIS, JR.
Vice Pres., International Paper Co. and General Mgr., Southern Kraft Div., Mobile, Ala.

Paper products make up the 575 pounds of paper each individual in this country consumes each year. These products signify the important role that paper plays in the conduct of business, in education, in packaging, in sanitation and in our daily lives. We are surrounded by paper, in one form or another, to such a degree that it is taken for granted.

Our mills are usually situated along a body of water, but far too often indentified by a white plume of smoke coming from their stacks. These mills are located in hundreds of communities large and small across the nation. They provide jobs for over 200,000 men and women and contribute immensely to this country's economy at local, regional, and national levels. These mills normally have two things in common: a need for a large quantity of water and a characteristic aroma. The general public is usually fully aware of the distinguishing features.

Behind the mills, stretching to the horizon, are our own forest lands—lands that are well managed and provide not only our principal raw material, pulpwood, but are the source of many other forest products. We depend on this forest for some 60 million cords of pulpwood each year. These same forest lands also protect our watersheds, provide a good habitat for game and protect the soil. These are dynamic forest lands which are being managed for many uses!

There should be a sign that reads, "A Responsible Industry." This slogan could mean many things, but in the context it is used here, it means to me that the paper industry has much to be proud of.

Certainly, there are many issues today which are of special significance to our industry, issues surrounding conservation of natural resources and environmental quality. I, for one, feel that we as an industry have been cognizant and responsive to our responsibilities in these areas; but, regrettably, few people know or realize what has been accomplished. Maybe we haven't advanced as fast and as far as some believe we should have; but I question whether many know that almost 30 years ago, 1943, long before environmental quality was an issue, our industry created and funded the National Council for Stream Improvements. This Council was organized to conduct research in the specific area of water pollution abatement, and in later years its mission was expanded to include air pollution abatement. There have been many success stories coming from this endeavor and our industry and the public have profited.

We all know there is a great national concern over environmental quality, and when you take into account the volume of water we use and discharge and the atmospheric emissions originating at our mills, we are involved in this subject. Fortunately, we can talk from a position of achievement and accomplishment.

For instance, only half as much water is needed to make a ton of paper as was needed at the close of World War II. Perhaps the best way to appreciate the progress which has been made is simply to visit a mill put into operation in the past three to five years and compare it with an older mill. At the new mill, odor is being controlled either by black liquor oxidation or modified recovery boilers. Highly efficient electrostatic precipitators are operating in 99 per cent plus efficiency range, and nearly all particulate matter from stack gases is removed. Recycling of gases through lime kilns and past scrubbers has further improved air emission. The new mill is conspicuous by the absence of smoke, which for so long marked the location of a paper mill. Water treatment goes beyond primary treatment and includes secondary and sometimes tertiary treatment. Even after such treatments, discharges to

receiving streams are controlled and monitored.

My point is simply this: our industry has been responsible in the area of air and water management. The account of each company, of course, is different; but the record will show that continuing improvements have been made. And current spending for abatement equipment is at the highest level ever.

The other great concern today in our nation seems to be conservation of our natural resources and, of course, here we are directly involved in the management and use of our forest lands.

The forest based industries own and manage more than 65 million acres of timberland. With few exceptions, these lands owned by forest based industries are the most intensively managed forest lands in the nation. As a group, we have recognized that our lands can accommodate multiple uses and, in many instances, satisfy objectives other than the primary one of supplying a basic raw material. Today's industrial forester knows he must take these other uses and other objectives into account as he works toward his principal objective of a continuous source of wood and fiber.

Our industry has an outstanding record of accomplishment in helping to rebuild and maintain the forest lands of this country to the extent that the growth of the forest has exceeded the drain since the mid-1950's.

Our backdrop is titled "A Responsible Industry," and I feel we have the record to support this claim. It is time we let others hear this record. Each of us in the paper industry should be acquainted with the story his industry has to tell and then repeat it to whoever will listen.

And so it is against this backdrop of our industry that I want to speak about safety and the paper industry.

It would be most comforting to all of us if we could say that safety in the paper industry has shown each year a continuing improvement. As you know, this is not the case. For about 16 years, we have been riding a statistical plateau. Only the status quo has been maintained, and this certainly does not equate with progress. I am sure that each of you share my concern over this stagnation. This condition is characteristic of the entire industrial safety scene and not just our industry. It is no doubt the cause for the occupational health and safety legislation which is now before the Congress of the United States.

The Daniels Bill (H. R. 16785) in the House and its companion Bill in the Senate (S. 2193) would vest unlimited authority in the Secretary of Labor with regard to industrial safety. These bills would give him the power to set, police, and enforce all Federal safety regulations. Not surprisingly, such strong legislation is controversial, and in the House the industry-supported Steiger-Sikes Bill will be offered in the form of a substitute. Congress recessed before any of these Bills came to the floor of the House or Senate; but it was generally conceded that whichever Bill was placed to a vote would pass. Such is the mood of Congress with regard to industrial safety and it reflects the will of the people!

It is reasonable to assume some sort of new health and safety legislation will be passed in the coming months. Our own record tells us, and now the Congress is about to tell us, that we just must do a better job in industrial safety.

Industry can do a better job. Within our own ranks certain companies consistently demonstrate this by maintaining safety performances far better than the pulp and paper industry average. This is no accident and luck has nothing to do with it. It is because top management of these consistently high performers gives safety a high priority. You will find that these companies have made safety a line responsibility. Their safety directors are, in reality, staff specialists whose responsibility is to train line management to be on-the-job safety directors. When safety performance slips within a department, it is this front line management who answers to the plant manager, not the safety director. When safety carries this priority, accidents decrease.

An article, "Zero In On Safety . . . To Bring Injury Rates Down," in the July issue of *National Safety News*, contained a paragraph which I believe states the requirements for improving safety performance:

"A firm commitment by management, backed by a clear and unequivocal statement of safety policy, is the foundation upon which a program of accident reduction must be based. Enthusiastic and intelligent leader-

ship by first line supervisors will provide the basic structure of a renewed safety program. Such a campaign will be capped by vigorous and persuasive action to motivate and enlist mass cooperation on the part of rank-and-file employees."

It is my firm conviction that the failure we have experienced in our safety programs these past years, the reason we have not progressed from the plateau on which we find ourselves, is because we have not been able to achieve total involvement with our work force. Our company has been as guilty of this position as anyone, and it was just recently that we realized we were not involving our hourly employees in our safety programs to the extent they should be involved. I am afraid we have been over zealous in guarding our rights to manage to the extent we have prevented the hourly workers and their unions from helping us to achieve a better safety performance.

Too often, we felt the worker was just trying to find some excuse to leave his job when he expressed a desire to serve on a safety program, and when the union asked for representation on our safety committees we too often felt they were trying to usurp our management rights. Frankly, I do not believe this was true in the majority of the cases.

In our recent labor negotiations with the Southern Kraft group, we listened for hours to representatives from some mills who expressed dissatisfaction with our safety program. We left there feeling we were not getting a direct involvement of our workers. We have taken some steps since that time to correct that situation.

We have contacted other companies within our industry and many companies outside the paper industry in an effort to determine just what is the best way to effect such an involvement with hourly workers. I suggest that you take a critical look at your own position, and if you feel there is something lacking do not hesitate to bring it to the attention of your top management.

I am a firm believer now that we can involve these hourly workers in a productive safety program without any waste of manpower and without any danger of giving up any rights to manage. Let me suggest to you that this be the subject of your discussions and that you direct your attention to this matter of total involvement.

Let me mention one facet of our master plan which touches on this area of employee involvement and is based on the National Safety Council's Job Analysis Program. We have inaugurated this program in our Southern mills and have concentrated on those mills and departments where the need was the greatest. Up until the inauguration of our new program, job safety analysis was originally made by the department head, the foreman, and the safety director. In many cases, these analyses did a good job and many improvements and techniques were discovered. It was excellent training for department heads and foremen, but did very little or nothing for employees doing the work.

In talking with some of our hourly employees, they felt, and rightly so, that they should and could participate in this job analysis and could actually work up a list of "do's and dont's" from an employee's viewpoint which would be even more effective than the analyses we had been preparing. This started us on a brand new approach of employee involvement. We are now making our job analysis with the man on the job, his line foreman, and with the help of the safety director. We have found that the employee involvement has contributed greatly to the development of a simple but practical list of do's and don'ts. When finished, each job in our mills will have a complete analysis of safety do's and don'ts. As each employee moves into a new job, this job safety analysis will be the first item in which he will be trained. We have found that this approach, based on the hourly employee involvement, has been a powerful motivation for the employee has seen his contribution in print and the items on the job analysis are his. Consequently, he feels much stronger about complying with his own recommendations and in conveying these recommendations to his fellow employees.

We feel that in changing this part of our program we are now working toward a total commitment to safety on the job. So far this year, our safety performance has indicated an improvement over the past year; but we still have room for improvement. We have additional plans for further involvement of our total work force in the coming year and hope we can move off the plateau on which we have found ourselves in recent years.

The paper industry, like all industries, is being propelled faster and faster by technological and sociological changes and some may view these changes with apprehension, but the smart ones view them as opportunities. I see nothing in the long range forecast for our industry to suggest anything but a bright future and each of us in our way, using our own talents, must work to use the opportunities which are ours. The paper industry has much to be proud of. In the years to come, let us see that our safety record be an object of pride.

PRESENTATION OF PIMA AWARD

By WYATT SHORTER
Plant Mgr., Union Camp Corp., Montgomery, Ala.

In contemplating what would be appropriate to reflect on at a time such as this, I thought of perhaps the simplest, wisest, and most accurate safety lesson that I have ever heard, "Take care of the little things and the big things will fit in place themselves." How true this is in our mills. If we take care of the small things, each individual's attitude, his individual habits, his motivation to work in a safe environment, and his whole outlook on personal safety, then surely you will arrive at this unique position enjoyed by the recipients of these two awards. Having been in neither plant, I can picture them as clean plants run by concerned management. Safety records compiled by these two operations are not accidental—they occurred by design and attention to all of the little things that it takes to be so outstanding.

The first award goes to Division I (pulp and paper manufacturing operation) Continental Can Company, Pulp and Paper Mill, Hodge, Louisiana. This pulp and paper mill compiled in 1969 and 1970 a 1,496,722 manhour injury free record. The safety director of this very successful mill is Dallas E. Henry.

The safety award for Division II (converting operation) happens to go to the same state—Louisiana—to the Standard Bag Division of Olinkraft Corporation in West Monroe, Louisiana. This plant operated from February 24, 1965 until July 31, 1970 without a lost time injury. The safety director for this mill is F. E. Patterson.

To each of you, on behalf of your company, you have the admiration and respect of all of us in this room. It brings to mind the possibility that we should have this meeting somewhere between your mills in Louisiana and get some first hand learning, for apparently you have found a magic solution, which I imagine could be simply stated as "hard work."

PRESENTATION OF ARTHUR HOYT SCOTT SAFETY AWARD

By WILLIAM J. BREECE
Vice Pres., Industrial Relations, Scott Paper Co., Philadelphia, Pa.

The recognition of outstanding safety achievement in our industry has perhaps never been more important. A few years have passed since *Pulp and Paper* magazine shocked us all with some sobering facts about our safety records. I don't need to tell you that matters have not improved significantly since then. Our overall accident frequency as an industry has increased, and the comparisons with other major manufacturing industries are still highly unfavorable. A great deal of work needs to be done, and some of the leadership must come from the larger companies which compete for the award I am about to present.

This award was conceived in the early 1950's by a former associate of mine who was also a long-time friend of this Section. Clair Lyon came here to present the award several times before his untimely death in 1961. Those of you who knew Clair remember him, I'm sure, as an outstanding personnel man and a dedicated safety manager in the finest tradition of your field. As Scott's corporate safety manager, and later as our corporate employee relations manager, he was very much aware of the importance of corporate leadership in the safety program of multi-plant company and the special problems of managing safety in that kind of company. He was struck by the fact that public recognition of outstanding safety performance tended to be on a plant-by-plant basis, and that overall achievement by large companies often went unrecognized. He conceived of this award, to be presented under NSC auspices, as a means of filling that gap, and he proposed that it be named for the man who was the father of the modern Scott Paper Company. Scott's management and the NSC agreed enthusiastically, and the first award was presented to Kimberly-Clark in 1953.

There have now been 16 winners of the Athur Hoyt Scott award, unfortunately not including Scott Paper Company, although we have come close once or twice. Consolidated Paper Corporation, Ltd., scored a remarkable record by winning it three years in a row in 1959, '60 and '61. There have been a few other repeat winners, but generally it has gone to a variety of major companies, and we like to believe that it has been a factor of some importance in fostering competition among those companies for safety achievement.

The contest for the 1969 Award was based upon four separate measures of achievement: 1969 frequency rate; 1964-68 average frequency rate; per cent improvement 1969 over 1968, and per cent improvement 1969 over the 1964-68 average. Twenty-five companies submitted their applications to the Council and were entered in the contest. In order of finish behind the winners, the "honorable mention" companies this year were Olinkraft (which incidentally, was the 1967 award winner), Price Company, Ltd., Consolidated Bathurst, and Crown-Zellerbach.

The winners for 1969—marking the first tie in the history of the Award—are two fine companies neither of which has won before: American Can Company and ITT Rayonier.

American Can Company had eight pulp and paper mills entered in the contest and had an overall frequency of 3.26 in 1969, down from 4.09 in 1964. One of their larger mills, Naheola, with over 1,500 employees, had a 1.82 frequency last year.

ITT Rayonier entered four mills and had an overall frequency of 2.78, down from 4.07 in 1964. One of the contributors to their performance was their Port Angeles mill, with 450 employees and an accident-free year in 1969. Their Jessup mill was also a strong contributor with a 1.20 frequency.

General Safety Supervisor for ITT Rayonier is Jack C. Smith, and American Can's Corporate Safety Manager is Allen C. Guy.

HOW TO GET MANAGEMENT SUPPORT FOR YOUR SAFETY PROGRAMS

By PHILLIP R. MUELLER
Assistant Department Safety Manager, U. S. Department of the Interior, Washington, D.C.

Since I began my career as a safety manager, nearly five years ago, one of the chief complaints I have heard from safety officers is, "How do you get management support?" My experience has been that administrators only become involved with safety management when policy is set or a catastrophe occurs. Why this lack of concern at other times, when safety officers have so much to contribute to management?

In many cases the fault lies not with management but with the safety officer. A communications gap exists! Management does not understand the language used by safety officers, and safety officers do not understand the language used by managers. So, first of all, to get management support, a common terminology must be developed. After this goal has been attained, safety officers must prove to management that they deserve to be a part of the management team. How better can management support be obtained than by actually being a part of management?

These two separate phases of my program to obtain management support will be discussed in depth, beginning with the development of common terminology.

The Communications Gap

Frequency Rates

Let's begin with one of the most common phrases in our vocabulary, frequency rates. We ask management to understand that this is actually a measure of our safety programs progress. If this figure goes from 10.0 to 10.5, improvement is necessary. Should the figure go from 10.0 to 9.0, progress has been made.

Frequency rates are strongly emphasized in annual safety reports prepared by most safety departments. Management is told that it must understand that frequency rates are most important and a vital indicator of program progress. Suppose management called your bluff and asked you to support that statement. It would be hard to do. Frequency rates only refer to the number of reportable disabling injuries. The normal method of recording disabling injuries is through the "Method of Recording and Measuring Work Injury Experience" (USA Standard Z16.1). One of the abused portions of this standard is Section 1.4 (Regularly Established Job). The section reads, "One which has not been established especially to accommodate an injured employee, either for therapeutic reasons or to avoid counting the case as a temporary total disability." How easy it is to get around that one. It is conceivable that an employee with a broken arm could be placed in a regularly established light duty job, not lose a full day's work and, therefore, not be included in the disabling injury rate. I have recited only one example of abuse. There are many others, I am sure.

It is apparent that frequency rates are suspect, and also it is apparent that they only measure the magnitude of the disabling injury problem. It does not measure the degree of problem associated with nondisabling injuries or property damage. The experience in my agency indicates that only about 10 per cent of our accidents result in disabling injuries. The rest are either nondisabling or property damage accidents. It's pretty hard to ask management to support program progress in the form of frequency rates based on 10 per cent of the total problem.

Accident

Another communication gap exists in a simple word used by safety officers in annual safety reports. That word is "accident." Webster defines this as "an event occurring by chance or from unknown causes."

Now let us dissect a typical statement which might be contained in a safety report: "Much work needs to be done in our accident prevention efforts in order to reduce our high injury frequency rate of 10.0." This means to management that much work needs to be done to prevent events which occur by chance or from unknown causes, in order to improve 10 per cent of our problem. This

may sound absurd, but let me assure you that the word accident has little significance to management.

Safety

Safety is a word with numerous connotations. The definitions of this word are endless and depend on the context in which it is used and who is using it.

For example, safety to the young mother is probably closely related to the activities of her children; to the community-minded individual, it may signify "law and order"; to those who may be approaching retirement, the word could embrace freedom from want; to a banker it might signify the security he demands on loans; to a building manager, it sometimes is the symbol of a "busybody" inspector who insists on checking his fire extinguishers.[1] The list goes on and on. The important point is that all of these definitions apply to management's concept of the function of safety officers. Consequently, the safety officer may be involved in a multiplicity of duties which are not directly connected with safety programs management.

His functions may include tort claims and accident investigation, first aid instruction, health programs, training, engineering design, etc. Organizationally, he may be under the health officer, personnel, property management (or plant management), training, security, engineering, etc. In other words, the safety officer's program responsibilities may be so voluminous that his overall effectiveness is diluted. Likewise, his diverse responsibilities lead to his being placed nearly anywhere in an organization.

This is a problem that many of us in the profession have encountered. The solution may be to develop a title, other than safety officer, that clearly defines the safety officer's role in the system of management.

Improving the Communications Program

I have given three illustrations of communications problems between safety managers and other management officials. Now, what can be done to improve this situation?

Frequency Rates vs. Cost

First, isn't there a better method to determine program effectiveness, rather than using frequency rates? One method that certainly would appeal to management is cost-effectiveness of loss prevention programs. Management understands this language. However, to effectively promote such a program, a total accident reporting system must be developed. Property damage and all injuries (minor as well as disabling) must be reported. One problem many loss prevention departments will encounter is the increased statistical workload due to increased accident reporting. At this point, consideration should be given to data processing accident information.

Costs for nondisabling and disabling injuries can be developed based on average cost per injury in each of these categories. Property damage could easily be calculated from the cost to repair or replace the damaged property.

Accident vs. Error

There should be a substitute for the word "accident," which will cause management some concern. There are several words that could be used to replace accident, such as performance failure or performance error. Words such as these have more relevance to management than the term "accident." Management feels that errors or failures are avoidable and can be corrected. Consequently, it will show some concern. The term "accident" is a good excuse word to explain away a situation as being noncorrectible.

Safety vs.....?

Let's better define the role of a so-called "safety officer" and look for a word to delineate his responsibilities. Some possibilities are: loss control manager, loss prevention manager, error prevention manager, performance improvement manager, and risk control manager. By redefining the safety officer's role, management will come to understand that you do have a vital role to play in the organization.

"With All Thy Getting Get Understanding" Management Support From Whom?

One misconception that safety officers have is that management is a single entity. Management is usually looked upon as the head of an organization (president, secretary of an agency, chairman of the board, etc.). The safety director feels that he must have this manager's support in order to function. The average safety officer looks upon management

1. Pope, W. C. and Nicolai, E. R. *Safety Aids Decision-Making*. page 5.

much as the average taxpayer views the government. The taxpayer says that the government ought to do this or that. The government is not a man or a handful of people seeing that responsibility gets done as intended. The government is lots of people, hundreds of thousands of them.

The government is made up of political systems and subsystems. The President normally cannot make decisions without consulting Congress, Congress relies on constituent pressure when taking positions; and Congress relies on the executive agencies for information used to support their position.

Just as politics is made up of systems and subsystems, so is management. There is no single entity which safety directors should seek for support of their function. The systems and subsystems of management must function together for the wellbeing of the whole. The titles of these functions may vary but generally are recognized as personnel, property, law, finance, engineering, public relations, etc. The management system is influenced by external systems as, for example: competitors, contractors, customers, labor organizations, federal, state, and municipal polities and labor law, suppliers, and others.[2]

The safety director must reach these people for management support. They have decision-making responsibility that has a direct impact on the safety management programs.

Support How?

Now we have found out who to seek for management support (personnel, property, law, finance, engineering, public relations, etc.). The next question becomes; how do you get their support?

No manager will support another function of management unless he benefits in some way. This is not such a difficult hurdle as it would appear.

First, I have said that the term accident is no longer applicable. We now use "error" or "failure." These terms do concern management.

Second, as management is characterized by systems, when all of these systems do not function correctly, an error results. The safety management function is ideally suited to pointing out where errors are occuring in these systems. All good managers wish to know how their function can be improved. So, the role of the safety manager becomes one of providing functional managers with information, which can be utilized to improve management.

Systems Approach to Management Improvement

The vehicle for this communication is a Safety Management Information System. It involves the redesigning of the accident report to obtain this information.

Nearly every safety department has an accident reporting system of one form or another. However, few if any systems contain management information data. Most accident reports stop at the human error and condition defect portion of the report. In essence, a wealth of data available to safety managers is never collected. For example, many employees are injured lifting objects. An analysis of the situation by safety officers invariably conclude with the recommendation that instructions be given in proper lifting techniques.

Is this the answer? This is the assumption that is made, and it is only an assumption. No data is available as to where the personnel or property functions of management may have failed the injured employee. Was the employee physically fit to perform the task? Was he working out of his normal occupation (this could be due to understaffing)? Was the material too heavy for one person to lift? Are mechanical lifting devices needed? These are just some of the possible solutions to the problem, that could actually be included on the accident report, using the systems approach.

A report form must be developed that will include information as to where personnel, property, law, finance, engineering, etc. failed the employee.

Data Processing

One of the first considerations in redesigning an accident report is whether the data should be computerized. This will determine the format of the form.

I see four prime objectives in computerizing data: (1) to improve services; (2) to

2. Johnson, R. A., Kast, F. E., and Rosenzweig, J. E.; *Theory and Management of Systems*. McGraw-Hill Book Co., N. Y., 1967, 2nd Ed., page 8.

generate information for management; (3) to reduce administrative costs; and (4) intangible benefits, such as rapid access to data.

In many instances, safety directors will find their objectives meet all of these criteria. They will be providing information to management through identification of system failures, administrative costs probably will be reduced (no requirement for use of statisticians), and certainly there now will be a more rapid access to data for analytical purposes.

After the decision is made to turn to data processing, contact should be established with a computer systems analyst. He can assist you in developing an appropriate reporting form for data processing purposes and advise you concerning data retrieval systems available. The question of what type of data retrieval system to use is extremely important. Getting the data into the system in many cases is much easier than getting it out. I have experience using a system known as QUERY. This is a generalized retrieval program used to generate reports.

The generalized program introduces new elements. First, the safety manager or analyst can interrogate the file directly without the intervention of a computer programmer. Second, it eliminates lengthy applications programming and can be used for many applications. There is only one program to learn. It allows data bases to change and evolve with changing management needs. Third, it allows ad hoc querying of the data base. Conventional cyclic reports produce a fixed output regardless of information needs. The ability to ask specific questions and to format the output according to the needs of the moment is essential. Fourth, the system is user oriented. The data base manager or analyst should be able to interrogate his own file without the intervention of a programmer.

Another thought to keep in mind is the possibility of placing a table dictionary in the computer. Such a table would decode the coded information contained in the computer. Codes placed on the source document would be translated into their language equivalent. Printouts analyzed would then be in language rather than coded format. This would greatly ease the analysis of data. Printouts could be presented to management officials without the necessity for providing them with code books.

After the accident report form has been developed, a code book must be fomulated to code accident reports. A good starting point in developing codes is the American National Standards Institute. "Method of Recording Basic Facts Relating to the Nature and Occurrence of Work Injuries." However, from this source, you will not get codes for the management problem involved. These should be obtained only after conferring with functional managers.

After the form and code book is prepared, training in reporting performance errors will be required. Those completing accident reports must realize that the system will not be used to find fault with individuals. It is a method used to communicate to management where it has failed the employee. Performance errors are the result of some failure in the system of management.

Data Feedback for Management Decision-Making

After the system is in effect and a data bank accumulated, analysis can be made of the data. Costs of accidents will be contained in the data bank. Large clusters of performance failures can be reviewed for a function or subfunction of management involved. This information, along with the costs involved, can be supplied to the appropriate manager for decision-making purposes.

The safety manager is now providing other managers with significant information for the purpose of management improvement. He is pointing out where, why, and how errors are occuring and the costs involved. Once errors are corrected by management, the accident rate will also go down and the safety director will be achieving his goals. Likewise, safety directors will be considered truly a member of the management team.

Summary

The safety director must learn as much about how management operates as possible. He must realize that management support is to be obtained on a program function basis. This is where the real payoff lies. And the safety director must reciprocate this request for program support.

PROCEDURES FOR ANALYZING SAFETY EFFECTIVENESS

By W. C. LOCKHART
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The difficulties surrounding the job of accident prevention indicate there is no single cure-all which will solve all the problems encountered. In the process of advancement, new ideas and concepts are being introduced with increasing rapidity; various authorities issue volumes of printed material; an increasing necessity for attendance at lectures and training sessions is becoming more important and, in addition, there is the information which is gained from fellow workmen. These exposures have provided varying degrees of motivation. Much of this information has been adopted to suit existing requirements, but despite all this, one is still confronted with familiar doubts: "Why doesn't it work?" "Why haven't the procedures produced the intended result?" Wise use of a program which allows for objective evaluation will assist in providing answers to these questions. A collection of meaningful factors will indicate areas where a degree of improvement can be realized. The following program has been developed to provide managers with the means to avoid misdirected effort.

Program Analysis

A great deal of effort has been directed toward assessing "guarding" requirements, evaluating hazards, and to the motivation of the individual in the practice of safe work habits. This has all been of benefit and has achieved considerable success relative to practices of the time. In conjunction with these activities, varied statistics were produced to rate, or grade, our functions and procedures. These were mainly developed to provide an indication and measurement of severity or frequency of injury. The introduction and degree of corrective action has frequently been based on the results reflected by these variables. This is not stated as a criticism of policy but as a statement of conditions that can exist. Consideration will indicate how large the area of concern really is between the occurrence of the injury, its recording as a statistic, and the eventual implementation of the corrective measures which might be deemed necessary.

In keeping with this, could it not be stated that the choice of corrective action would be decided, mainly, by management and/or supervisory personnel? The knowledge, practical experience, and the feelings of the majority of our 40,000 strong work force can also be of great value. Would it be logical to assume that some of those with delegated safety responsibilities are unaware of a practical method of attaining this information?

This program has been developed and designed to satisfy this need and to provide a relatively simple tool to determine the feelings of workmen. What degree of acceptance does the program receive? Which areas lack effectiveness? The information obtained in answer to these questions will define the quality which can be attached to each program component.

The availability of this information provides a means whereby the safety supervisor can determine the extent of re-adjustment which is required. The area which is rated low or ineffective can readily be strengthened. The items causing concern can be changed or re-arranged to make them more acceptable, with subsequent improvement.

Program Administration

To ensure that standard procedures are employed, the following points are amplified:

Administrator Duties

The program administrator will determine the composition required to represent a cross section of the activities under analysis. For example, the area employs forty individuals comprised of supervisors, machine tenders, technicians, clerks and laborers. Selection of participants should represent each function. To reach valid conclusions, a ratio of representation must be not less than 1:10.

Hold an initial meeting with all participants to explain the function of the program

and its relevant procedures: the method for determining the rating of a component; advise each group involved that they are to select a moderator for their deliberations.

Make arrangements for suitable accommodation for each group. An atmosphere favorable to group discussion must be present. Availability of space may require establishing different time schedules for the various groups to complete their studies. Once a group has started, however, sufficient time must be allowed to complete the rating form and arrive at mutually agreeable recommendations. These, along with rating form B will be returned to the administrator.

Using Form A, assess and record the returns of the completed forms B. Determine the feasibility and priority of the recommendations, schedules, and follow-up dates. Solicit from concerned management concurrence of the findings to establish a program result. These results and any future review action is to be made known to the participants.

Additional meetings with the group(s), or selection of new groups of participants, will be determined by the requirements and/or the need for carrying out further analysis.

Moderator Duties

The moderator is an individual selected by the group to lead their discussion. He will distribute program material to the individuals in the group and, using rating form B, record the group rating for each component.

Where the ratings for a component covers a wide range, determine through discussion why this exists. Normally, the individuals will have valid reasons for their assessments. Be aware that conflict of personalities or misunderstanding can influence an assessment.

Apply the group rating on form B. Rating is the average of the total for all members assessments. For example, five members in the group with ratings of 3, 1, 6, 2, 4; group rating = 3½. The fraction is not pertinent to the overall result. In such cases the rating would be recorded as the nearest whole number (3). The example stresses the area for discussion to determine why the variation between the high and low assessment (1 as opposed to 6).

To maintain continuity of thought while the "reasons" are fresh in the individuals minds, participants should note those conditions which influenced rating conclusions. Where low ratings are applied, what corrective action does he recommend? These operations should be completed in sequence.

On completion of the deliberations for all components, develop on the blackboard, easel board, etc. the group recommendations by headings. These recommendations must be of a positive nature, workable, and attainable. Statements of a general nature will not satisfy the intent.

Develop a schedule for completion of required action, and follow-up or review.

Participant's duties

The participant is an individual from an area that has been selected for analysis, who is representative of a particular function or operation. He will assist in selecting a moderator for the group to which he is assigned and participate in the group discussion. He will analyze the components of the program, from his point of view, on form C, using a rating scale 1 to 6.

The rating applied to each component should reflect his assessment of the condition. Give consideration to those areas where improvements could be made. Recommend the corrective action(s) to improve these conditions. It is practicable to implement the recommendations, considering all factors?

Present ideas and recommendations during group discussion. The assessment may provide the basis for establishing the correct answer to the problem—his experiences may not have been encountered by other group members.

Assist in establishing the group recommendation schedule and follow-up review dates.

Ratings

Ratings are applied to reflect the relative quality or condition, and not merit or value. (There are other procedures available for determining worth.) The factors involved in the evaluation processes are the results obtained from the "group-determined" rate figures. The choice of rate figures available range from (1) to (6). They represent the descriptive condition normally associated with the term "bad," "poor," "fair" "good," "excellent," and "exceptional," respectively. The use of the figure is introduced solely to provide a method of control and an assessment value to the analysis.

Rate	Represents
1	Bad (very poor, nil, non existent, critical)
2	Poor (not bad, just so-so, indifferent, needs improvement, substandard, unsatisfactory, lip service only provided, little or no involvement of employees, etc.)
3	Fair (pretty good, nothing special, should be improved, a few employees indicate interest and involvement, etc.)
4	Good (satisfactory, average, adequate, etc.)
5	Excellent (very good, above average, little room for improvement, superior, most employees indicate personal involvement and interest, etc.)
6	Exceptional (ideal, tops, the most, highest possible, uncommon, extraordinary, etc.)

Analysing Safety Effectiveness
Components to be Rated

The following list of components is to be considered and rated by each participating individual.

1. Physical condition of plant and plant areas. Exits and approaches; lighting; ventilation; marking of aisles; lunch room; smoking areas; washroom facilities; painted surfaces are suitable; "danger" and "warning" are indicated by approved colors; drinking fountains and deluge showers are adequate; walks, paths, roadways are maintained and guarded where necessary; etc.

2. Physical condition of production and associated equipment. Installed guards are adequate; maintenance and cleaning of equipment; layout of equipment; industrial trucks, dollies, carts in good operating condition—safely stored when not in use; tools and equipment required for job are adequate and available; consideration is given to the level and frequency of noise; equipment is operated within specified limits and controls; established controls governing tag-out, and lock-out are effective and adequate; etc.

3. Housekeeping. Cleanliness of the operation, storage, washroom, lunch, smoking, and external plant areas; loose equipment, tools, hose, water and air lines are properly stored when not in use; waste receptacles in sufficient quantities and locations; waste is not allowed to accumulate; etc.

4. Safety objectives. Plant, department, or section has established objectives; personnel are familiar with the goals; goals are considered reasonable and attainable; targets established for current, intermediate and long range objectives; goals create a sense of involvement through participation, etc.

5. Safety regulations (rules). Are published and available to employees; operations which are hazardous are defined and controlled; procedures governing emergency conditions are known; etc.

6. Accident investigation. Gathers information from personnel in the immediate area; corrective action considers the recommendations of employees; publicize decisions and follow-up procedures; investigations are carried out thoroughly; etc.

7. Information media. Safety information, bulletins, letters, posters, statistics are circulated and kept current; issued material is complete and comprehensive; out-dated material is withdrawn from use; etc.

8. Incentives, awards, contests. Are meaningful to employees; create interest and participation of individuals and groups; recognize oustanding performances of the individual or group; involve all management levels; create an air of friendly competition; etc.

9. Co-operation. Departments, sections and individuals work together to attain safety objectives; assistance is freely offered; etc.

10. Personal protective equipment. Is available in all required areas; hazardous areas and protective equipment required are defined; equipment fulfills its intended purpose and is acceptable to employees; etc.

11. Motorized equipment. Operators are selected, trained and qualified; driver training programs are established; limitations governing vehicle operations in plant, yard, haul-roads are followed; etc.

12. Industrial hygiene. Procedures to control the inhalation of toxic dust, fumes or mist are established; chemicals and solvents used in the operation are labeled to indicate their properties, health and fire hazards; procedures to control dermatitis are established; etc.

13. Safety committees. Actively participate in the program; method of rotating members maintains continuity; members are identified and are representative of the group; etc.

14. Safety inspections. Are carried out at frequent intervals; consideration given to surprise unscheduled inspections; findings are processed as quickly as possible and given proper priority; follow-up action is taken as required; etc.

15. Meetings. Safety meetings are held at frequent intervals; are informative and constructive in content; all personnel participate in discussions; suggestions and recommendations are considered; employees are advised of all decisions and contemplated action; etc.

16. Indoctrination. New employees are familiarized with safety program requirements and responsibilities, the hazardous areas, emergency procedures; etc. All personnel are informed of changes in regulations or hazards resulting from installation of new equipment or new procedures; etc.

17: Effectiveness of training. Training programs are effective, comprehensive, and well planned; personnel are familiarized with emergency procedures and warning signals; program includes fire and emergency drills in the use of various equipment—fire extinguishers, respirators, etc.; follow-up checks are carried out to ensure personnel are following recommended procedures; training is carried out on a continuing basis; etc.

18. Morale. Employees are enthusiastic and endorse the program; department, interdepartment relationships are cooperative and complementary to the overall program; employees believe their departments are good places to work; etc.

RECOGNITION & CLASSIFICATION OF HAZARDS

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We in the safety profession must not only be expert in recognizing hazards, we must be equally expert in classifying them from both the probability and severity standpoints. We will then fly less by the seat of our pants and more by the "seat of learning," by what is recognized as tried and true in business management techniques. This will enable us to bring our greatest efforts to bear on our largest and most pressing problems.

The general problem of recognition reminds me of the school boy who, after a class discussion on how a portrait painter might do a likeness of God, went eagerly to the blackboard with the announcement that he was going to draw a picture of God. "But that's impossible!" the teacher exclaimed, "because no one knows what God look like." "They will when I get through," the boy said. Perhaps I can't draw a precise picture of a hazard, but when I get through, I hope that my summary of some modern techniques available to the safety professional will help you recognize significant hazards more readily.

My intent is not to make you proficient in modern business management or methodology, nor to discuss these techniques in detail. Rather, I will briefly illustrate the many modern management tools available to the safety professional to help him recognize and classify hazards. Perhaps, if you are not already using these tools, you will see fit to become proficient in applying some of them as a result of this discussion.

Natural Sense Organs

Before we consider any of the more advanced techniques, let's examine the earliest and perhaps most primitive means of identification—the natural sense organs. They have carried us a long way, but I doubt that we can continue to show satisfactory progress if we cling to them as our sole source of hazard recognition. Let's examine some of the limitations that develop as we rely on the natural sense organs.

One of a workman's most important hazard recognition sense organs is his eyes; yet, it is easy to demonstrate the severe limitations imposed on a man if this were his sole means of recognizing hazards. The normal person has a vertical field of view of 140 degrees and a horizontal field of 200 degrees. Thus it is obvious that this sense organ attains less than 50 per cent efficiency.

Even if we add hearing, motion control sensors, skin sensors, taste, and smell, we still have not given the workman a means of recognizing hazards that even closely approximate the insight we can obtain from more specific analytical procedures. Furthermore, we do not always have advance notice, and this can be critical.

Even the transmission of the message detected by these natural sense organs from a workman to a safety professional does not provide as efficient a method of hazard recognition as do the many specific analytical systems. There are many analytical methods which, when applied to a given situation, will help the safety professional recognize hazards of both the potential and real variety. These methods vary from a simple check list to the use of mass statistics and network analysis. It must be recognized, however, that, as with any system, the greater the input, the greater will be the output. What I am trying to emphasize is that even with an analytical system, the user must have a considerable background in safety if he is to recognize a hazard. We must also realize that the greater the analytical effort of the safety professional, or the more the input, the better will be the results. Of paramount importance is that the person seeking to recognize hazards have practical knowledge of the industry involved as well as knowledge common to the field of safety.

Check List

As an opener for discussion, let's consider the simple, yet reliable, check list. A check list can be one of specifics which requires a "yes" or "no" response, or it can be a less specific and more provocative list which requires analysis in regard to time, place, things, and people.

A good example of a yes-no check list approach is one employed in many mills by digester operators. The use of the check list guarantees that the hazard will be recognized if the operator proceeds in accordance with standard operating procedure. In effect, it forces the operator to recognize the hazard and provide the necessary control. Psychologists have found that providing a workman with a check list can greatly improve his efficiency. We in safety should never forget this!

A more exploratory check list, which fits the need of the imaginative safety director, deals with identification techniques. One form commonly in use analyzes a problem from the standpoint of time, place, things and people. Just considering time from the standpoint of duration and its cause and effect opens many new avenues. The people aspect is more intriguing if we consider it from the standpoint of management, supervisor, and worker. You will readily recognize the implication of evaluating the place and thing factors without my commenting on them.

Codes, Standards, and Technical Manuals

A logical next step in the quest for hazard recognition aids is the study and interpretation of existing written word as available in technical manuals, codes, and standards.

I believe that there is general agreement that most safety standards were written in answer to a need for clearly delineating the minimum acceptable degree of protection for major hazards. Therefore, it should be readily apparent that standards will, for the most part, highlight the controls needed for the causes of the most severe injuries. American National Standards dealing with punch presses, ladders, and power transmission equipment are more specific than most, since they deal directly with major hazards. State codes similarly were drawn up in an effort to minimize some of the major causes of loss experience by certain industries in the state. The least that a code or standard can do is to provide a hazard inventory check list, and in the hands of a real pro it offers a great deal more.

Other excellent sources of information are the many safety manuals, handbooks, and other special safety literature. The National Safety Council *Accident Prevention Manual for Industrial Operations* is an outstanding example. Don't forget the manufacturer's directives, bulletins, brochures,

and user and maintenance manuals. These run the gamut from the instruction on a package of chemicals to those printed in a rotary lawn mower user's handbook. Without a doubt, a great amount of hazard recognition material can be gleaned from these sources.

Flow Charts

Flow charts provide an excellent source of hazard recognition for the man who knows the industry and its processes. To maximize results he must, of course, also be well founded in loss control principles. A flow chart in the hands of this kind of an individual provides a form of check list which can be invaluable because it relates past experience to present operating procedure and processes. The greater the detail on the chart, the more valuable it becomes.

The flow chart can alert the safety professional to machine hazards, material handling exposures, chemical exposure, and a myriad of others. The presence of the chart provides an avenue for an orderly search for hazards on a process-by-process basis. This device is not suggested as a tool for use by the uninitiated or embryo safety man. For maximum results, it requires comprehensive safety and industry knowledge.

Elementary System Analysis

A system is defined as a group of things (man-machine-environment) which are related to one another in some dependent manner so that collectively they represent a whole and accomplish a task. Analysis of a system will then consider man, machine, and the environment and, when viewed in this aspect, provides a device of wide horizons for one who has vision and imagination.

The paper industry has many examples of instant environmental change which creates a complete new set of hazards in a matter of minutes. The change from a dry to wet work surface brings with it a greatly increased tendency to slip which, in turn, could drastically affect the interface between man and machine. Another example is the rapid accumulation of broke, which brings with it an entirely new environment in a matter of minutes. What had, up until then, been a relatively hazard-free work area is suddenly transformed into one with such things as hidden broke holes, tripping and falling hazards compounded with nip points, and a sizable fire hazard. By the same token, a change from experienced to inexperienced personnel could convert an acceptable environment into one of great hazard.

A systematic evaluation of all possible man, machine, and environment combinations will, in all probability, reveal certain interfaces which do not have adequate hazard controls. Just a simple consideration such as the change from a summer to a winter environment is commonly overlooked when rebuilding or building new facilities.

The search for hazards through the use of this system can be most fully utilized by attempting to visualize what change might occur in the system—either man, machine, or environment—and how this change will effect the other system elements and subsequently alter the control of hazards in the system. It is a mental exercise designed to force the user to methodically expand his analysis of the effect that changes in the system might have in regard to the hazards in the system.

Critical Path Method

Critical path method is a management technique which helps the manager develop a procedure to completely plan and schedule a project without losing sight of any of the details required to complete it. The method demands complete and logical planning. The principal device for planning is the arrow-diagram. This is a pictorial description of the interrelationships of all aspects of the project and details the duration, manpower, and equipment requirements for each phase of a construction project. Because of its widespread use in construction, the critical path method provides the safety director with an excellent tool for planning hazard control during any construction or remodeling process, but is not limited to this application.

Progressive construction people have utilized the network or arrow-diagram for signaling hazards which will develop during the various phases of construction. Each construction phase is coded as to the degree of hazard and the hazards to be encountered. Pennant flags usually are used to designate hazardous phases. Within the pennant is marked the construction activity and the degree of hazard. Below the pennant, in a rectangular flag, the nature of the hazard to be encountered is shown in code form.

Application of this system makes it possible to consider in advance all hazards which might develop and then to devise the necessary check lists or other devices necessary to alert supervision of the controls which must be instituted during the various phases of construction. Its first application might seem cumbersome, but if it is your wish to search out hazards in a methodical manner, it will really do an admirable job!

Statistical Inferences

The use of statistics has been overlooked by many safety professionals, yet statistical inference provides one of our best guides to hazard recognition. This technique analyzes a sample of injuries which occured in the industry and theorizes that the same injury mix can be expected in the industry as a whole. The same procedure can be applied within a single plant or organization. Generally speaking, however, the bigger the sample, the more valuable and correct are the inferences which we draw from the sample. For this reason, mass statistics generally are considered of greater value than limited samples based on only one plant or corporation. Generally, industrial processes do not change rapidly. Add to this the fact that the processes from plant to plant do not vary significantly from the standpoint of hazards produced, and you can see why there is much credibility in the conclusions drawn from statistical analysis.

Statistics clearly isolate the major injury problems of an industry. Since the accumulation of mass statistics is a recent innovation, they will commonly highlight injury causes which have not received sufficient emphasis in earlier developed codes and standards. This is especially true in the case of standards which used injury frequency rather than cost as a criterion for the hazard emphasis. Injury cost statistics will prove, for example, that great concern about the adequacy of machine guarding is as necessary now as it ever was.

In our company we have assembled injury cause-cost data in excess of $275,000,000 which involves over 230,000 injuries. All injuries included in the study are tabulated according to accident type, agency, body part, and injury. Cost information is tied in with the accident information, and from this data we ascertain the major causes of injury cost for various workmen's compensation classifications. After the major causes of injury cost are known, we write Technical Guides which pose leading questions concerning the adequacy of controls over these sources of loss.

An example of the insight into hazard evaluation that this information can provide is brought out by a recent analysis of the corrugated or fiber board containers manufacturing workmen's compensation classification. The analysis revealed that 32 per cent of the injury cost resulted from machine-incurred injuries. It also revealed that these injuries were costing in the vicinity of $2,000 each. In contrast, material handling which was the second largest source of injury cost, accounted for 14 per cent of the cost with an average injury cost of only $600. Injury cause and cost information gives the hazard hunter a direct bearing as to where his hazard reduction efforts should be concentrated to get the greatest payoff in both reduction of human suffering and cost. Cost information of this kind is a very direct method of evaluating both the severity and probability of injury.

In this discussion we have been able to consider only a few of the management tools available to the modern hazard hunter. We need to use all such tools that will help us do a better job. And we need to use them with the greatest proficiency—with professional proficiency! The need is clearly seen in our slackening rate of progress in preventing occupational injuries. As we succeed in controlling the more obvious hazards, we must then learn to use new management tools that will help us ferret out hazards that have thus far eluded us.

NOISE AT THE SOURCE

By DR. PAUL L. MICHAEL
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Sound is produced when vibrating objects cause alternate regions of high and low pressure to be pushed away from the object through a conducting medium. A receiver such as the ear will detect or hear sound when the pressure variations have certain physical characteristics that may be described in terms of frequency or pitch and amplitude or loudness. Sound may have a single frequency and level, or it may be made up of many frequencies, each having different amplitudes. Common noise sources, such as machines, are usually made up of many frequencies, each having different amplitudes. The terms sound and noise are often used interchangeably, but, in general, noise has a complex frequency-amplitude structure and is considered to be unwanted sound.

The rate at which high and low pressure zones are produced by a vibrating object determines the frequency of the sound, which is described in terms of cycles per second

Frequency in Hz	Adjustment to be Added to Linear Spectrum Values to Obtain Equivalent dbA Levels in dB
25	− 44.8
32	− 39.2
50	− 30.2
63	− 26.1
100	− 19.1
125	− 16.2
250	− 8.6
500	− 3.3
1000	− 0.8
1600	0
2000	+ 1.0
2500	+ 1.2
3150	+ 1.2
4000	+ 1.0
5000	+ 0.5
6300	− 0.2
8000	− 1.1

(cps) or, more recently, Hertz (Hz). The frequency range of the human ear is highly depedent upon the individual and the sound level, but a normal-hearing ear will have a range of approximately 20 to 20,000 cps at moderate sound levels. The frequency of a propagated sound wave heard by a listener will be the same as the frequency of the vibrating source if the distance between the source and the listener remains constant; however, the frequency detected by a listener will increase or decrease as the distance from the source is decreasing or increasing (Doppler effect).

The reciprocal of the frequency is the time required for one cycle, or the period. The units for the period are seconds (sec). The distance which is required for one complete cycle is called one wavelength, which is usually measured in centimeters (cm).

The speed at which the pressure variations move away from the sound source is called the velocity of propagation (unit distance per unit time). The velocity of propagation of sound c in a particular medium may be described as the product of the frequency f, and the wavelength λ:

$$c = f\lambda \qquad (1)$$

The velocity of propagation varies directly with the square root of the density, inversely with the compressibility of the transmitting medium and with other factors but, for most practical purposes, the velocity of sound is constant in a given medium. For example, the velocity of sound is approximately 1,130 ft/sec in air, 4,700 ft/sec in water, 13,000 ft/sec in wood, and 16,500 ft/sec in steel.

The amplitude of sound is directly related to the vibration displacements of the noise-producing object and is usually described on a linear scale by dynes per square centimeter (d/cm²) or microbar (μbar) and, more recently, by newtons per square meter (n/m²). The sound pressure is also expressed as a level on a logarithmic scale in decibels (dB). In a free field where there are no obstacles to interfere with the propagation of the sound, the amplitude of sound will be decreased to half its value (6 dB) with each doubling of the distance from the sound source. In a semi-reverberant field, one which has obstacles that reflect sound, the pressure level will decrease at a lesser rate. In a highly reverberant field, the pressure level will change very little with distance from the source.

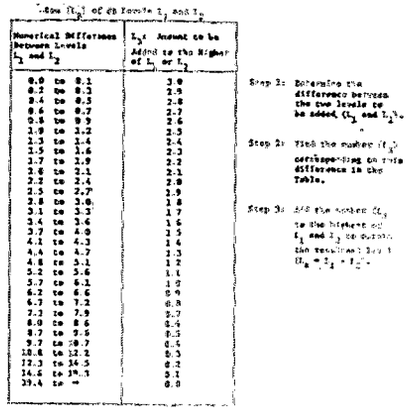
The Decibel (dB)

The range of sound pressures commonly encountered is very wide. For example, sound pressure well above the pain threshold (about 200 microbars) are found in many work areas, while pressures down to the threshold

of hearing (about 0.0002 microbar) are also of wide interest. This range of more than 10^6 microbars cannot be scaled linearly with a practical instrument, because such a scale might be many miles in length in order to obtain the desired accuracy at various pressure levels. In order to cover this very wide range of sound pressures with a reasonable number of scale divisions and to provide a means to obtain the required measurement accuracy at extreme pressure levels, the logarithmic decibel (dB) scale was selected. By definition, the dB is a dimensionless unit related to the logarithm of the ratio of a measured quantity to a reference quantity. The dB is commonly used to describe levels of acoustic intensity, acoustic power, hearing thresholds, electric voltage, electric current, electric power, etc., as well as sound-pressure levels; thus, it has no meaning unless a specific reference quantity is specified.

Sound Pressure and Sound-Pressure Level

Most sound-measuring instruments are calibrated to provide a reading of root-mean-square (rms) sound pressures on a logarithmic scale in decibels. The reading taken



Numerical Difference between Levels L_1 and L_2	L_2: Amount to be Added to the Higher of L_1 or L_2
0.0 to 0.1	3.0
0.2 to 0.3	2.9
0.4 to 0.5	2.8
0.6 to 0.7	2.7
0.8 to 0.9	2.6
1.0 to 1.2	2.5
1.3 to 1.4	2.4
1.5 to 1.6	2.3
1.7 to 1.9	2.2
2.0 to 2.1	2.1
2.2 to 2.4	2.0
2.5 to 2.7	1.9
2.8 to 3.0	1.8
3.1 to 3.3	1.7
3.4 to 3.6	1.6
3.7 to 4.0	1.5
4.1 to 4.3	1.4
4.4 to 4.7	1.3
4.8 to 5.1	1.2
5.2 to 5.6	1.1
5.7 to 6.1	1.0
6.2 to 6.6	0.9
6.7 to 7.2	0.8
7.3 to 7.9	0.7
8.0 to 8.6	0.6
8.7 to 9.6	0.5
9.7 to 10.7	0.4
10.8 to 12.1	0.3
12.3 to 14.2	0.2
14.6 to 19.1	0.1
19.4 to ∞	0.0

from the instrument is called a sound-pressure level *(Lp)*. The term "level" is used because the pressure measured is at a level above a given pressure reference. For sound measurements in air, 0.0002 microbar (μbar)* or 0.00002 n/m² commonly serves as the reference sound pressure. This reference is an arbitrary pressure chosen many years ago because it was thought to approximate the normal threshold of human hearing at 1,000 Hz. The mathematical form of the Lp is written as:

$$Lp = 20 \log \frac{p}{p_o} \, dB \qquad (2)$$

where p is the measured rms sound pressure, p_o is the reference sound pressure, and the logarithm *(log)* is to the base 10. Thus, Lp should be written in terms of decibels referenced to a specified pressure level. For example, in air, the notation for Lp is commonly abbreviated as "dB re 0.0002 μbar" or "dB re 0.00002 n/m²."

The Lp referenced to 0.0002 microbar may be written in the form:

$$\begin{aligned} Lp &= 20 \log (p/0.0002) \\ &= 20 [\log p - \log 0.0002] \\ &= 20 [\log p - (\log 2 - \log 10^4] \\ &= 20 [\log p - (0.3 - 4)] \\ &= 20 (\log p + 3.7) \\ &= 20 \log p + 74 \end{aligned} \qquad (3)$$

Sound Intensity and Sound-Intensity Level

Sound intensity *(I)* may be defined as the amount of acoustic energy per unit time passing through a unit area that is normal to the direction of propagation. For a spherical or free-progressive sound wave, the intensity may be expressed by

$$I = \frac{p^2}{\rho c} \qquad (4)$$

where p is the rms sound pressure, ρ is the density of the medium, and c is the speed of sound in the medium. It is obvious from this definition that sound intensity describes, in part, characteristics of the sound in the medium, but does not directly describe the sound source itself.

Sound intensity units, like sound pressure units, cover a wide range, and it is often desirable to use dB levels to compress the measuring scale and to better approximate the ear's response characteristics. To be consistent with equations (2) and (4), intensity level (L_I) is defined as

$$L_I = 10 \log \frac{I}{I_o} \, dB \qquad (5)$$

where I is the measured intensity at some given distance from the source and I_o is a

*The microbar is often used interchangeably with the cgs unit dyne per square centimeter (d/cm²).

reference intensity. The reference intensity commonly used is 10^{-12} watts/m². In air, this reference corresponds to the reference pressure 0.0002 microbar used for sound-pressure levels.

Sound Power and Sound-Power Level

Sound power *(P)* is used to describe the sound source in terms of the amount of acoustic energy that is produced per unit time. Sound power may be related to the average sound intensity produced in free-field conditions around a point source by

$$P = I_{avg}\, 4\pi r^2 \qquad (6)$$

where I_{avg} is the average intensity at a distance r from a sound source whose acoustic power is P. The quantity $4\pi r^2$ is the area of a sphere surrounding the source over which the intensity is averaged. It is obvious from equation (6) that the intensity will decrease with the square of the distance from the source; hence, the well-known inverse-square law.

Power units are often described in terms of decibel levels because of the wide range of powers covered in practical applications. Power level L_P is defined by

$$L_P = 10 \log \frac{P}{P_o} \qquad (7)$$

where P is the power of the source, and P_o is the reference power. The arbitrarily chosen reference power commonly used is 10^{-12} watt.

Relationship of Sound Power, Sound Intensity, and Sound Pressure

Many noise-control problems require a practical knowledge of the relationship between pressure, intensity, and power. An example would be the prediction of sound-pressure levels that would be produced around a proposed machine location from the sound-power level provided for the machine.

For example: It is required to predict the sound-pressure level that would be produced at a distance of 100 feet from a pneumatic chipping hammer. The manufacturers of the chipping hammer states that the hammer has an acoustic power output of 1.0 watt. From equations (4) and (6) in free field for an omnidirectional source:

$$P = I_{avg}\, 4\pi r^2 = \frac{p^2_{avg}\, 4\pi r^2}{\rho c} \qquad (8)$$

where

$$p_{avg} = \sqrt{\frac{P\, \rho c}{4\pi r^2}} \qquad (9)$$

If P is given in watts, r in feet, and p in microbars, then, with standard conditions, equation (9) may be rewritten as

$$p_{avg} = \sqrt{\frac{3.5P \times 10^4}{r^2}}$$

and, for this example,

$$p_{avg} = \sqrt{\frac{3.5 \times 1.0 \times 10^4}{(100)^2}} = 1.87\ \mu bar$$

The sound-pressure level may be determined from equation (2) to be:

$$Lp = 20 \log \frac{1.87}{0.0002} = 79.4\ dB\ re\ 0.0002\ \mu bar$$

Noise levels in locations that are reverberant can be expected to be somewhat higher than predicted because of the sound reflected back to the point of measurement.

Combining Sound Levels

Often, it is necessary to combine sound levels (dB). An example is the combination of frequency-band levels to obtain the overall or total sound-pressure level. Another example is the estimation of total sound-pressure level resulting from adding a machine of known noise spectrum to an existing noise environment of known characteristics. Simple addition of individual dB pressure levels, which are logarithmic quantities, constitutes multiplication of pressure ratios; therefore, the sound pressure corresponding to each dB (sound-pressure level) must be determined and added with respect to existing phase relationships.

For the most part, industrial noise is broadband, with nearly random phase relationships. Sound-pressure levels of random noises can be added by converting the levels of pressure to intensity units, which may be added arithmetically, and reconvert the resultant intensity to pressure and finally to sound-pressure levels in dB. Equations (2) and (4) can be used in free-field conditions for this purpose.

A more convenient way to add the sound-pressure levels of two separate random noise sources is to use Table I. To add one random noise level $Lp(1)$, measured at a point to another, $Lp(2)$ measured by itself at the same point, the numerical difference between

the levels $Lp(2) - Lp(1)$ is used in Table I to find the corresponding value of $Lp(3)$ which, in turn, is added arithmetically to the larger of $Lp(1)$ or $Lp(2)$ to obtain the resultant of $Lp(1) + Lp(2)$. If more than two are to be added, the resultant of the first two must be added to the third, the resultant of the three sources to the fourth, etc., until all levels have been added, or until the addition of smaller values do not add significantly to the total.

Example: The overall sound-pressure level produced by a random-noise source can be calculated by adding the sound-pressure levels measured in octave bands shown in the following table:

Octave Band Center Frequency (Hz)	Sound-Pressure Level (dB)	Sound-Pressure Level (A-Weighted) dB
31.5	85	48
63	88	63.4
125	94	78.9
250	94	86.0
500	95	92.1
1000	100	100
2000	97	98.2
4000	90	90.0
8000	88	86.6

A good procedure for adding a series of dB values is to begin with the highest levels so that calculations may be stopped when lower values are reached which do not add significantly to the total. In this example, the levels of 100 and 97 have a difference of 3 that corresponds with $Lp(3) = 1.8$ in Table I. Thus, 100 dB + 97 dB = 100 + 1.8 = 101.8 dB. Combining 101.8 and 95, the next higher level, gives 101.8 + 0.8 = 102.6 dB, which is the total of the first three bands. This procedure is continued with one band at a time until the overall sound-pressure level is found to be about 104 dB.

The overall sound-pressure level calculated in the above example corresponds to the value that would be found by reading a sound level meter at this location with the frequency weighting switch set so that each frequency in the spectrum is weighted equally. Common names given to this frequency weighting are flat, linear, 20 kc, and overall.

The corresponding *A*-weighted sound pressure level (dB*A*) found in many noise regulations may also be calculated from noise spectrum values such as those in the above example if the correction numbers given in Table II are first applied. These octave band levels with *A*-frequency weighting can be added by the procedure described above to obtain the resultant *A*-weighted level, which is about 103 dB*A*.

A large majority of industrial noises have random frequency characteristics and may be combined as described in the above paragraphs. However, there are a few cases of noises with pitched or major pure-tone components where these calculations will not hold, and phase relationships must be considered. In areas where pitched noises are present, standing waves will often be recognized by rapidly varying sound-pressure levels over short distances. It is not practical to try to predict levels in areas where standing waves are present.

When the sound-pressure levels of two pitched sources are added, it might be assumed that the resultant $Lp(R)$ will be less as often as it is greater than the level of a single source; however, in almost all cases, the resultant $Lp(R)$ is greater than either single source. The reason for this may be seen if two pure-tone sources are added at several specified phase differences. At zero phase difference, the resultant of two like pure-tone sources is six dB greater than either single level. At a phase difference of 90°, the resultant is three dB greater than either level. Between 90° and 0°, the resultant is somewhere between three and six dB greater than either level. At a phase difference of 120°, the resultant is equal to the individual levels; and between 120° and 90°, the resultant is between zero and three dB greater than either level. At 180°, there is complete cancellation of sound. Obviously, the resultant Lp is greater than the individual levels for all phase differences from 0° to 120°, but less than the individual levels for phase differences from 120° to 180°—a factor of 2:1. Also, most pitched tones are not single tones but combinations thereof; thus, almost all points in the noise fields will have pressure levels exceeding the individual levels.

Comparing Levels Having Different Bandwidths

Noise-measurement data (rms) taken with analyzers of a given bandwidth may be converted to another given bandwidth if the frequency range covered has a continuous spectrum with no prominent changes in level.

The conversion may be made in terms of sound pressure levels by

$$Lp(A) = Lp(B) - 10 \log \frac{\Delta f(B)}{\Delta f(A)} \quad (10)$$

where $Lp(A)$ = the sound-pressure level, in dB, of the band having a width $\Delta f(A)$ cps.

$Lp(B)$ = the sound-pressure level, in dB, of the band having a width $\Delta f(B)$ cps.

Sound-pressure levels for different bandwidths of flat continuous spectrum noises may also be converted to spectrum levels. The spectrum level describes a continuous-spectrum wide-band noise in terms of its energy equivalent in a band one cps wide, assuming that no prominent peaks are present. The spectrum level, $Lp(S)$, may be determined by

$$Lp(S) = Lp(f) - 10 \log \Delta f \quad (11)$$

where $Lp(\Delta f)$ = the sound-pressure level of the band having a width of f cps,

Δf = the bandwith in cps, and

f = the center frequency of the band Δf.

It should be emphasized that accurate conversion of sound-pressure levels from one bandwidth to another by the method described above can be accomplished only when the frequency bands have flat continuous spectra.

Frequency Bandwidths

The most common frequency bandwidth used for industrial noise measurements is the octave band. A frequency band is said to be an octave in width when its upper band-edge frequency f_2 is twice the lower band-edge frequency f_1:

$$f_2 = 2f_1 \quad (12)$$

Octave bands are commonly used for measurements directly related to the effects of noise on the ear and for some noise-control work because they provide the maximum amount of information in a reasonable number of measurements.

When more specific characteristics of a noise source are required, such as might be the case for pinpointing a particular noise source in a background of other sources, it is necessary to use narrower frequency bandwidths than octave bands. Half-octave, third-octave, and narrower bands are used for these purposes. A half-octave bandwidth is defined as a band whose highest band-edge frequency f_2 is the square root of 2 times the low band-edge frequency f_1:

$$f_2 = \sqrt{2}\, f_1 \quad (13)$$

A third-octave bandwidth is defined as a band whose highest band-edge frequency f_2 is the cube root of 2 times the low band-edge frequency f_1:

$$f_2 = \sqrt[3]{2}\, f_1 \quad (14)$$

The center frequency f_m of any of these bands is the square root of the product of the high and low band-edge frequencies (geometric mean):

$$f_m = \sqrt{f_2 f_1} \quad (15)$$

It should be noted that the high and low band-edge frequencies describing a frequency band do not imply abrupt cut-offs at these frequencies. These band-edge frequencies are conventionally used as the 3-dB-down points of gradually sloping curves that meet the American Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets S1.11-1966.[1]

Noise Propagation Characteristics—Practical Solutions

The sound-power level supplied by the manufacturer of noise-making equipment can be used to predict sound-pressure levels that will be produced by the equipment in surrounding work areas if the acoustical characteristics of the work area are known. These calculations are complex if all factors are considered, but simple solutions to general cases are often helpful to estimate levels.

Noise Source in Free Field

A free field has been defined as one in which the sound pressure decreases inversely with the distance from the source. These ideal acoustical conditions are rarely found in work environments because of the reflecting surfaces of equipment, walls, ceilings, floor, etc.; however, free-field conditions may sometimes be approached outdoors or in very large rooms. For standard free-field conditions, the sound-pressure level L_p at a given distance r from a small omnidirectional noise source can be written in terms of the sound-power level L_P of the source as

$$L_p = L_P - 20 \log r - 0.5 \quad (16)$$

where r is in feet, L_p is in dB referenced to 0.0002 microbar, and L_P is in dB referenced to 10^{-12} watts.

Many noise sources have pronounced directional characteristics; that is, they will radiate more noise in one direction than another. Therefore, it will be necessary for the equipment manufacturer to provide the directional characteristics of the source, as well as the power levels, to predict the sound-pressure levels. The directional characteristics of the source are generally given in terms of the directivity factor Q. Q is defined as the ratio of the sound power of a small, omnidirectional, imaginary source to the sound power of the actual source where both sound powers produce the same sound-pressure level at the measurement position. The directivity factor may be added to equation (16) in the form

$$L_p = L_P - 20 \log r - 0.5 + 10 \log Q \quad (17)$$

where $10 \log Q$ is called the directivity index.

For example: It is necessary to predict the sound-pressure level that will be produced in a free field at a distance of 50 feet directly in front of a particular machine. A directivity factor of 5 is provided by the machine manufacturer for this location. The noise source has a continuous spectrum and a sound power of 0.1 watt.

From equation (17):

$$L_p = 10 \log \left(\frac{0.1}{10^{-12}}\right) - 20 \log 100 - 0.5 + 10 \log 5$$
$$= 10(\log 0.1 - \log 10^{-12}) - 20(2) - 0.5 + 10(0.7)$$
$$= 10(-1 + 12) - 40 - 0.5 + 7$$
$$= 77.5 \text{ dB re } 0.0002 \text{ } \mu bar$$

Noise Source in Semireverberant Field

In work areas where some reflecting surfaces are present, semireverberant fields are produced in which the wavelength λ of the sound becomes an important factor in calculations. When the wavelength is much larger than the objects in the sound field, the sound will bend around the object and, except in the immediate vicinity of the object, the sound wave will progress essentially undisturbed. However, when an object in the field is large compared with the wavelength, the sound will be scattered and reflected.

Standing waves, which are regions of enforcement and cancellation of sound and pressure, may be formed when sound with strong pure-tone components is reflected. In these cases, it is extremely difficult to predict the noise levels at particular locations. However, most work area noises have broadband characteristics and standing-wave pressure variations are relatively small; thus, simple relationships between sound pressure, sound power, and the acoustical characteristics of the room may be established.

A room's acoustical characteristics are strongly dependent upon the absorption coefficients of its surface areas. A surface that absorbs all energy incident on its surface is said to have an absorption coefficient of one, while a surface reflecting all energy has an absorption coefficient of zero. The absorption coefficient can be used to define the acoustical characteristics of most industrial areas in terms of a room constant R given by

$$R = \frac{\bar{\alpha}\, S}{1 - \bar{\alpha}} \quad (18)$$

where $\bar{\alpha}$ is the average sound absorption coefficient of the room's surface, and S is the total boundary surface area of the room. The average absorption coefficient is found by

$$\bar{\alpha} = \frac{\alpha_1 S_1 + \alpha_2 S_2 + \alpha_3 S_3 + \ldots \alpha_n S_n}{S_1 + S_2 + S_3 + \ldots S_n}$$

where α_1, α_2, and $\alpha_3, \ldots, \alpha_n$ are the coefficients of absorption of the various surfaces of the room having the corresponding areas S_1, S_2, $S_3, \ldots, S_n$. The coefficients of absorption for most surface materials are readily available.[2, 3, 4]

The relationship between average sound-pressure level, power level, and room constants for nondirection or directional sources with $Q = 1$ is shown in Figure 1. The equation describing the curves in Figure 1 is written as

$$L_p - L_P = 10 \log \left(\frac{1}{4\pi r^2} + \frac{4}{R}\right) + 10.5 \text{ dB} \quad (20)$$

where r is the distance in feet from the measurement point to the source, and R is the room constant in square feet.

For example: It is necessary to predict the sound-pressure level a distance of 10 feet from a noise source having a power level of 120 dB. The room constant is 2,000. From Figure 1, $(L_p - L_P)$ is found to be −15; therefore,

$$L_p - 120 = -15$$

and

$$L_p = 105 \text{ dB re } 0.0002 \text{ } \mu bar.$$

Similar relationships are shown in Figure 2 for directional noise sources. The equation describing these curves is written as

$$L_p - L_P = 10 \log \left(\frac{Q}{4\pi r^2} + \frac{4}{R}\right) + 10.5 \ dB \qquad (21)$$

where Q is the directivity factor.

Noise Source in Reverberant Field

In situations where a high percentage of reflected sound energy is present, the sound-pressure levels may be essentially independent of the direction and distance to the noise source. A region of this kind is called a reverberant field. Reverberant field conditions are indicated in Figures 1 and 2 by the flat portions of the curves where the ordinates $(L_p - L_P)$ do not change with distance or directivity.

Figures 1 and 2 also show that nearly free-field conditions exist near the source, and that reverberant field conditions are found at greater distances from the source. The distance at which conditions change from free-field to reverberant is determined by the room constant and the directivity factor.

In a reverberant field, the average sound-pressure level can be written as:

$$L_p = L_P - 10 \log R + 16.6 \ dB \ re \ 0.0002 \ \mu bar.$$

For example: Calculate the sound-pressure level in a one-cycle bandwidth at 1,000 cps produced in a reverberant room measuring 50 feet by 100 feet with a 20-foot ceiling by a nondirectional noise source if the sidewalls have an area S_1 of 4,000 sq. ft. treated with material X, the ceiling area S_2 of 5,000 sq. ft. treated with material Y, and the remaining area S_3 of 7,000 sq. ft. covered with a surface material Z. The absorption coefficients for the room surfaces are given below.

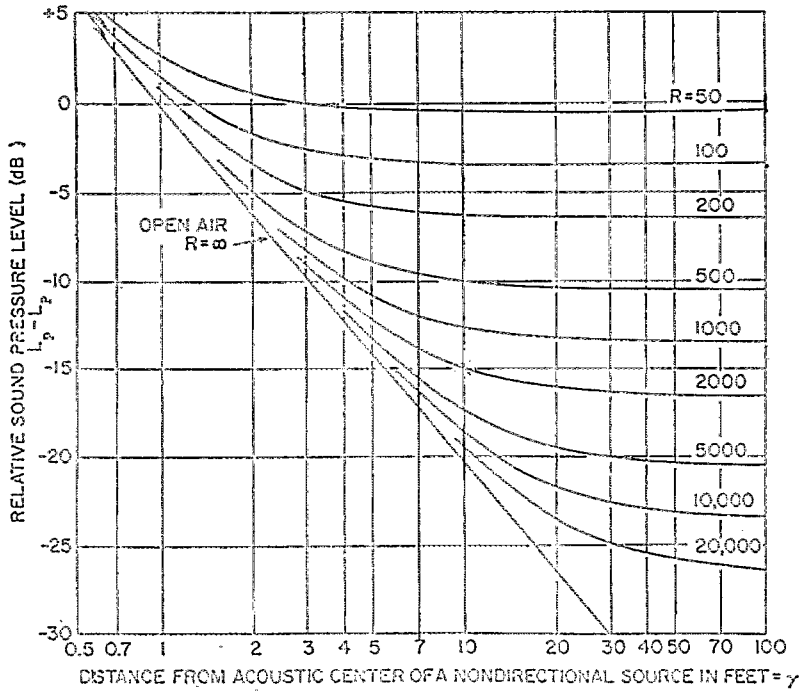


Figure 1

	Frequency (cps)					
Material	125	250	500	1000	2000	3000
X	0.08	0.15	0.58	0.75	0.78	0.65
Y	0.03	0.21	0.58	0.69	0.66	0.70
Z	0.01	0.01	0.02	0.02	0.02	0.04

From equation (19), the average absorption coefficient for 1,000 cps $\bar{\alpha}_{1000}$ can be found:

$$\bar{\alpha}_{1000} = \frac{0.75 \times 4000 + 0.69 \times 5000 + 0.02 \times 7000}{16{,}000}$$

$$\bar{\alpha}_{1000} = 0.41$$

From equation (18), the room constant for 1,000 cps, R_{1000}, is:

$$R_{1000} = \frac{0.41 \times 16{,}000}{1 - 0.41}$$

$$R_{1000} = 11{,}200 \text{ sq. ft.}$$

From Figure 1, or from equation (22), $(L_p - L_P)$ is found to be approximately −24 dB; therefore,

$$L_p - 100 = -24$$

and

$$L_p = 76 \ dB \ re \ 0.0002 \ \mu bar$$

The overall noise-absorbing efficiency of acoustic materials is sometimes expressed by a single number known as the noise reduction coefficient (NRC). The NRC is found by arithmetically averaging at least four absorption coefficients between 250 and 2,000 cps (usually 250, 500, 1,000, and 2,000 cps). Small differences in NRC may not be detectable; it is common practice to round off coefficients to the nearest 0.05.

A rule of thumb to determine the amount of noise reduction possible from the application of acoustic materials on room surfaces is as follows:

$$dB \ reduction = 10 \log \frac{absorption \ units \ after}{absorption \ units \ before}$$

where the absorption units are the sum of the products of surface areas and their respective noise absorption coefficients.

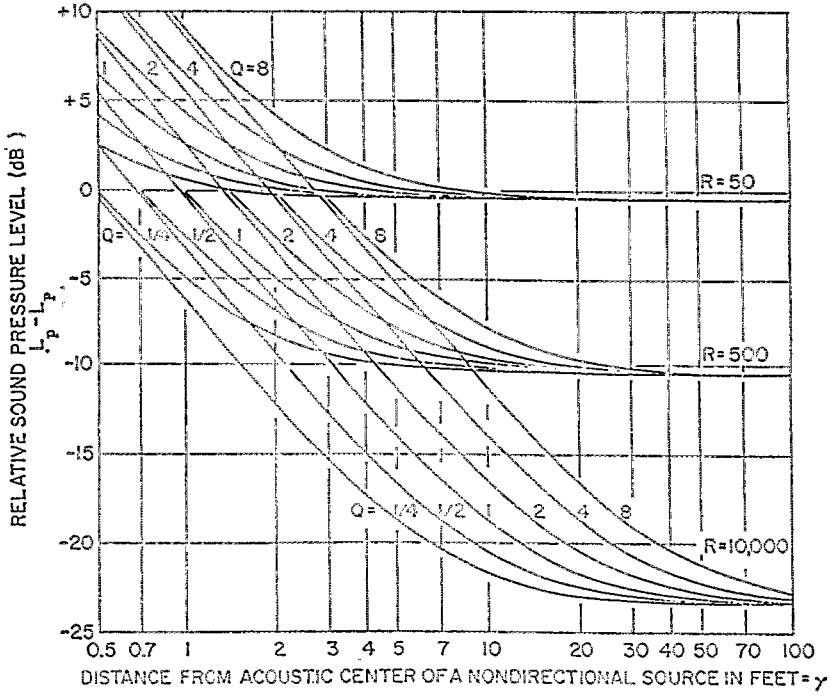


Figure 2

Transmission Loss (TL) of Barriers

Sound transmission loss through a barrier may be defined as ten times the logarithm (to the base 10) of the ratio of the acoustic energy transmitted through the barrier to the incident acoustic energy. The TL of a barrier is a physical property of the material used for a given wall construction. The TL for continuous, random noise commonly found in industry increases about five dB for each doubling of wall weight per unit of surface area, and for each doubling of frequency.

Multiple wall construction with enclosed air spaces provides considerably more attenuation than the single-wall mass law would predict.[5,6,7] However, considerable care must be taken to avoid rigid connections between multiple walls when they are constructed or any advantages in attenuation will be nullified.[8,9,10]

Noise leaks which result from cracks or holes, or from windows or doors, in a noise barrier can severely limit noise reduction characteristics of the barrier. In particular, care must be exercised throughout construction to prevent leaks that may be caused by electrical outlets, plumbing connections, telephone lines, etc., in otherwise effective barriers.

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SOUND LEVEL SURVEYS— AUDIOMETRIC TESTING—EAR PROTECTION

By DAN ADAIR
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Why a noise survey? We need to know the extent of the problem. How do you know whether or not a plant has a noise problem? Probably 98 per cent of pulp and paper mills and converting plants have one or more work areas with harmful noise. If you need to start raising your voice in any work area in order to carry on a conversation, the sound level probably is above 90 db*A*, and a sound level survey is needed.

With the new Federal sound level requirements, we need to know the sound level at each workplace to be able to establish that a certain sound level existed as of a certain date. Subsequently, as equipment changes and as equipment speeds are changed, sound levels should be recorded to provide a history of changes of sound levels in the plant. A workplace may change from a safe one to one in which harmful noise exists. If a Federal inspector finds noise levels above Federal requirements and your record shows that these levels are of recent origin, his attitude will certainly be different than if it appears an area has always been too noisy. Also, if you have partially eliminated the hazard or are working on eliminating it, he will be more considerate in dealing with you.

The states are beginning to change their standards on noise to conform to Federal requirements, so the more you have done about eliminating harmful noise and the more your sound survey records reflect an accurate history, the more cooperative the state inspectors will be.

It is as important to know that an area is not hazardous as to know that it is.

There are standards for the equipment needed for making an accurate sound level survey: A meter meeting specification for General Purpose Sound Level Meters S1.4-1961, ANSI and set on the *A* Scale is all you need to find out if any sound exceeds legal requirements. To analyze sound to help engineers in reducing sound levels, one needs an octave band analyzer: Specification for an Octave Band Filter Set for the Analysis of Noise and Other Sounds Z24.10-1953, ANSI. The standard for making a sound level survey is: Method for the Physical Measurement of Sound S1.2-1962, ANSI.

The sound level meters generally available in the United States are made by General Radio Company, Band K Instruments Co. (with instruments sold under their own name and under that of MSA), and H. H. Scott Company. I mention these brands specifically because they manufacture fine equipment. However, unknown brands—meters with non-standard weighting networks and meters built to lower standards—are appearing on the market. Please beware of claims made and make sure that you purchase a good, reliable instrument. You should purchase equipment or have access to equipment to check regularly the meter's calibration. Any sound level meter is a delicate instrument and should be treated as such. They should not be dropped nor exposed to vibration. They tend to be sensitive to high temperature and high humidity, so be careful how you store them and transport them. This sensitivity to high temperatures and high humidity is another reason to purchase only the best instrument for use in pulp and paper mills.

How do you make a noise survey? Probably the best publication on the subject is the *Handbook of Noise Measurement* available from General Radio Company, West Concord, Massachusetts.

Noise surveys made for hearing conversation purposes should be made with the microphone where the ear of the worker is. It is his exposure to noise that you are interested in. The location of the head makes a difference. Be sure it is not between the microphone and the sound source.

Sound level readings on the *A* scale are all that are needed for hearing conservation purposes and for checking compliance with Federal requirements. As a practical matter,

I am sure the states will accept *A* scale sound level figures.

When I make a noise survey I check the calibration of the meter several times during the day and make a written record of calibration checks. For the purposes of engineering sound reduction, an octave band analysis is needed. In the pulp and paper industry it is common for the sound in any work area to be made up of sound from a number of machines or sources. This also needs to be sorted out so you know how much of the total sound or noise comes from each source.

Let me add a word of caution. Unless you have a great deal of experience, when you make the first noise or sound level survey be sure to record the sound level at each workplace. Please do not assume that certain areas do not have harmful noise. People who are used to a plant are very likely to be in error about noise levels in certain areas. Also, many times it is more important to be able to establish that a certain job has a safe sound level than that the sound level is so many decibels above what it ought to be.

Some equipment will change in its role as a noise producer, either temporarily or permanently. Sound levels should be recorded after changes in speed, changes in substance processed, and changes in control settings. In no other way is it possible to keep up to date with a plant's noise control and hearing conservation program.

Many of you will recall that the Walsh-Healey regulations state that impulse or impact sound should not exceed 140 db*A*. An impact analyzer is needed to measure sounds of this type, as the peak is not of long enough duration for the needle to peak on the usual sound level meter.

Dr. Aram Glorig has told me that, as a practical measure, we can use an overall sound level meter set on the *A* scale and at slow response. If the needle does not swing beyond 115 db*A*, the impact sound can be considered safe; that is, equivalent to steady sound of 90 db*A*. This technique will serve, in most cases, in place of using an impact analyzer.

Audiometric Testing

Audiometric testing is your method of checking on the effectiveness of your hearing conservation program. Remember that Federal noise regulations are designed to protect only 85 per cent of the people in industry. People are susceptible to noise according to a normal distribution curve. Most of us belong to the great majority of normal people who are affected by noise in an average way. A few people have tough ears and can be exposed to high noise levels without loss of hearing. About 15 per cent will lose some hearing in sound levels between 85 and 90 db*A* after years of exposure, and a few will lose some hearing when exposed for a long time to steady sound levels of 80 to 85 db*A*. Hearing testing will help you pick out the people who will lose hearing in spite of your compliance with Federal or state noise regulations.

Hearing testing also will help you pick out the people who are losing hearing even when they wear protective devices. People have been known to cut off the ends of their ear plugs "to fool the boss" and on inspection appear to be wearing their ear plugs normally. Ear protectors do not always fit well.

How does one make an accurate hearing test—one that will be accepted by administrative agencies and boards and the courts, too, if necessary?

First, there is the environment in which the hearing test is made. A standard has been established for the test environment: S3.1-1960, American Standard Criteria for Background Noise in Audiometer Rooms. On the Pacific Coast we have checked most of the audiometer locations, and in every instance it has been necessary to use hearing testing rooms to eliminate background noise so that an accurate hearing test can be made. Not only that, but background noise is such that only the best hearing testing room available can be used, the Industrial Acoustics Company Series 400 Testing Room. I understand that Tracor now makes a room to the same specifications. A room manufactured in Italy and sold in this country, made of plastic and wood, is not adequate. Please don't be sold a bill of goods by some unethical salesman. Base your buying upon specification, guarantee, and performance. There is a great deal of misinformation being circulated about audiometric testing.

An ad in the October, 1970 issue of a major safety magazine refers to one company's audiometer as "a complete, precision screening unit for inplant hearing testing procedures" and goes on to say, "It can be used to test ten people at one time . . . and permits the operator to make an accurate audiogram." The ad continues, "It can be used in regular operating area without the need for a sound-proof booth." This description of inplant audiometric testing is a good example of the misinformation currently being disseminated and which can lead the uninitiated astray. Group screening is not industrial audiometry. Screening of the type mentioned in the ad is used in the school systems to locate children with poor hearing. Screening in groups of ten cannot provide the accuracy that is needed in industry.

Background noise, such as machine noise, exhausts, whistles, horns, truck noise, voices, etc., must be eliminated from the test environment. In certain instances, an area such as a vault may be satisfactory.

The audiometer itself should meet the requirements of ANSI Standard Specification for Audiometers, S. 36. The most commonly used audiometers in the United States today are the Beltone, Maico, and Eckstein. An automatic audiometer (the Tracor, Rudmose, or the Grason-Stadler) is sometimes used when large numbers of people must be tested. When accurately calibrated, all three makes are good. As with sound level meters, new ones will be coming on the market, so beware. An audiometer is a delicate instrument and should be treated as such. Careless handling can easily get it out of calibration. I recommend that you purchase your audiometer from a firm that can calibrate and service it.

At one time in the Pacific Northwest several salesmen claimed that their firms had service facilities in the area. A personal visit to their offices showed that only one operated an audiometer electronics shop. To this day, there is only one shop in the Pacific Northwest that is qualified to service audiometers.

The person giving the hearing test should be trained. We have used Dr. Aram Glorig to train our audiometric technicians. Dr. Roger Maas of Employers Insurance of Wausau teaches many classes for audiometric technicians on a continuing basis. Medical schools and local centers for speech and hearing sometimes provide such training. Do not let some hearing aid salesman train your audiometric technician. I know of instances where this has been done, and retraining was necessary before accurate hearing tests could be made.

The experts agree that an audiometer should be calibrated at least once a year.

So a legally accurate audiogram involves four elements:

1. The right environment—one that meets the ANSI standard (usually a special, small room).
2. The right audiometer—one that meets the ANSI standard and, if possible, from a company that has high class service facilities in the area.
3. A trained audiometric technician.
3. Once-a-year audiometer check and calibration in a qualified audiometer electronics shop—not a field check with a coupler and sound level meter.

We believe that Dr. Aram Glorig is the leading expert in the field of hearing conservation. He has written two books that should be in the library of every plant with a hearing conservation program. They are:

Noise and Your Ear (Grune and Stratton, New York) and *Audiometry—Principles and Practice* (William and Wilkins Company, Baltimore, Maryland).

An excellent film to help train audiometric technicians or to be used for their review is "An Approved Technique for Pure Tone, Air Conduction Audiometry," produced by the Research Center, Subcommittee on Noise, American Academy of Opthalmology and Otoloryngology. It is a 14-minute film and is available from Price/Vowell Filmakers, Inc., Hollywood, California.

Ear Protection

There are few industrial operations in which all sounds can immediately be reduced to safe levels. So most of us will be working with ear protectors for quite a few years in the future. Like much safety equipment, there are both good and bad ear protectors.

Ear protectors are of two main types—ear plugs and ear muffs. The well known ear muffs are David Clark, MSA, Willson, and American Optical. Half a dozen new

brands are in the marketing process. The important thing is that they fit right and make an airtight seal. A well fitting ear muff usually gives more attenuation than any other type of ear protector. Muffs require maintenance. There have been some problems with the plastic ear seals—plastic has hardened and, on liquid filled seals, the liquid has run out. Hardened plastic will not give a good seal and should be replaced.

There is one ear protector that is a sort of cross between the ear muff and the ear plug. It is the Sound Sentry and is an excellent ear protector. I am surprised that it is not in wider use. The well known ear plugs are MSA, SMR, Willson, Comfit, American Optical and Sepco. New brands are in the process of coming on the market.

I have noted a tendency of many persons in management to look for an easy solution to problems in the hearing conservation field. Workmen complain of discomfort when wearing ear protectors. In the case of earmuffs the complaint is usually discomfort due to perspiring. In the case of ear plugs the complaint is usually discomfort or pain due to too tight a fit.

An ear plug that is not fitted tightly enough to be somewhat uncomfortable at the start is not tight enough to keep out sound. After a few days—sometimes as long as a week—a person becomes accustomed to the plugs and they are no longer uncomfortable. The ear canal is just bone covered by skin, so an exact fit helps a great deal.

What about a number of other products used as ear plugs?

Do not use ear plugs made with metal. An explosion or a blow on the side of the head can drive one into the inner ear, destroying it. Cotton has been used as an ear plug for years. It is worthless.

Probably the most expensive ear plug is the Lee Sonic-Valv. It has a metal valve with a spring to keep it closed most of the time. According to claims, it lets good sound through and keeps bad sound out

Cotton impregnated wax is sometimes used. It is warmed by holding in the hands, then molded and placed in the ear canal. There are two problems with this product: unless a person's hands are clean, dirt (and possible infection) is introduced into the ear canal; also, after the wax warms even more in the ear, it conforms completely to the shape of the ear canal. The normal working of the jaw when speaking or chewing loosens the wax from the ear canal and sound gets through alongside it.

A products that seems to be fairly popular in some quarters today, since it is rather new, is spun fiberglass, sometimes called "Swedish Wool." Dr. Glorig has told me that this product gives fairly good protection when placed in the ear in the quantity recommended by the manufacturer, but in practice no workman uses enough because of discomfort and, as a result, gets little protection. Also, small bits and pieces break off, become imbedded in the ear wax, and this sometimes leads to infection.

In short, go first class: use first class products and have a first class hearing conservation program. Realize that people's complaints are mostly the same as those we have experienced with other types of safety equipment. All of us like the status quo. We don't like to change. We tend to be skeptical of new products, including ear muffs and ear plugs.

Before you become too forceful in requiring ear protectors for your employees, some education is in order. Your supervisors and workmen should be told the results of the plant's noise survey. They should be told what the company can do and will do to reduce noise to safe levels. They should be told in what work areas the use of ear protectors will be required and why.

There are two aids available to help sell an ear protection program to management and workmen alike. They are: (1) A tape recording titled, "Degrees of Hearing Impairment" (audio demonstration tape). This tape recording vividly demonstrates how the human voice sounds to people with different amounts of noise induced hearing loss. The 7½-minute tape (speed 7½ ips) is available from Price /Vowell Filmakers Incorporated, Hollywood, California; (2) a 16 mm. sound/color film, 12 minutes in length, produced by the Research Center, Subcommittee on Noise, A.A.O.O.A., titled, "Ear Protection in Noise." The cost of production was paid for by the Pacific Coast Association of Pulp and Paper Manufacturers and we also acted as script advisers. It also is available from Price/Vowell Filmakers.

The Pacific Coast Association of Pulp and Paper Manufacturers has had a hearing conservation program since 1968. Due to good advice, we have made no serious mistakes. There have been no serious unsolvable problems in dealing with workmen or their unions. As a matter of fact, it was a constructive push from the unions in 1957 that started our hearing conservation program. The majority of our member mills had noise surveys made in 1958 and 1959. As I stated before, we paid for the production of a film to use in a selling campaign with management and workmen. Hearing conservation and ear protection have been discussed openly at our labor-management safety conference. Results have only been good. There have been no bad effects at all.

PRINTING and PUBLISHING SESSIONS

FIRE AND SAFETY IN THE PRINTING AND PUBLISHING INDUSTRY

By BERNARD AXELROD
Fire and Safety Manager, The News, New York

No accident in the printing and publishing industry should be considered a minor accident. It does not necessarily have to involve a personal injury. Most accidents are caused by human factors.

The field of accident or loss prevention is so large and complex that fortunately there are local and state regulations which automatically include many protective features as part of building construction and operating conditions. These regulations were established over many years of bitter experiences. They cover general conditions and usually indicate the minimum requirements. Modern industry recognizes accident prevention as good business. It begins with knowing the hazards involved in manufacturing a specific product and setting up building designs, procedures, and equipment in accordance with the local regulations plus added features.

These added features are the procedures and devices which experience has shown are required for safe operating conditions in each individual shop. In the main, we lose control over the hazards due to human failures through our complacency, our lack of knowledge, a tendency to ignore the many less frequent hazards, and improper or careless housekeeping and maintenance.

We can install the best accident prevention equipment and procedures available, but we can't control our worst hazards—people. Topics such as fire education, fire fighting and training, safety education, accident prevention are amply covered in publications easily available from insurance companies, and various national and local organizations such as the National Fire Protection Association, the National Safety Council, Factory Mutuals, Underwriters Laboratories, etc.

The average lost time accident in the printing and publishing industry according to the National Safety Council involves a loss of 36 days per injury. The average lost time injury costs about $1,000 in direct costs alone; that is, in compensation payment and medical costs. There are many hidden additional costs which some authorities say are three to eight times the amount of the direct costs.

The difference between a minor injury and a lost time injury is a fraction of an inch or a fraction of a second. A breakdown of 2,600 reported injuries shows the following:

Part of The Body	*No Lost Time Plus Lost Time (per cent)*	*Lost Time (per cent)*
Hands & fingers	48.7	17.3
Arms	9.4	10.9
Feet & toes	4.5	7.6
Legs	10.4	18.5
Head (including face and eyes)	13.8	7.9
Back	6.0	21.1
Chest	1.5	3.5
Multiple parts	2.7	7.6
Miscellaneous	3.1	5.6

Your own records would indicate the actual cost within your own shop. You must keep records in order to determine how you're doing and to compare against the record of the previous years in your own shop.

I would recommend that you consider the use of safety glasses in areas where eye injuries might be prevalent. A plastic safety goggle can fit over your prescription lenses should you need it. A man wearing his goggles was splashed by hot stereotype metal at over 600°F, but the metal did not reach his eyes. Those of you who have children who wear prescription glasses should specify tempered glass so that there would be less chance of face and eye injury during play and other activities.

Solvents in industry are a continuous hazard. We normally use solvents every day. The one we forget about and do not usually

consider as an application of solvents is the well-known cigarette lighter. This produces a friendly fire. The small spark ignites the flammable solvent vapors of lighter fluid but since it is under controlled conditions, there is no hazard. But, situations can arise without your knowledge in which solvent vapors have accumulated in the area and one spark can create a fire or explosion.

For example, a can of duplicating fluid was kept in an office duplicating room and placed on a window sill. Apparently, the heat from the sun caused sufficient vapors to escape through the pouring spout into the room. The office boys who were working in this room normally smoked. One boy, while standing near the can, started to light his cigarette with a cigarette lighter. The flames passed through the pouring spout, into the partially empty can and blew it up, tossing solvent throughout the entire duplicating room. The heat was so intense that the solder melted on the can and the handle came free. Plastic deflectors on the room air conditioning units melted and flowed. Papers in the area burnt. Luckily, no one was hurt. The boys ran out of the room and closed the doors so it could not spread to other areas.

Proper ventilation should be provided to keep concentration of solvent vapors below the explosive and toxic limits. Your nose cannot tell you whether it's safe. Instruments are available to test the atmosphere to determine whether concentration of solvent in the atmosphere is explosive and/or toxic. If there is a spill, extra care should be observed so that the chance of accidental ignition is avoided. A man fell into a floor spill of solvents when an electric spark accidentally ignited vapors around him, and he suffered extensive burns on his lower body and extremities.

In making photoengravings, it has generally been the practice to strip on negative materials to glass, giving a glass negative. This is exposed to photosensitized metal, developed, and processed by etching in acid to make a metal printing plate. The glass for the glass negative was used over and over again, but some method was required to strip the dried negative material from the glass. We used to soak it in dilute nitric acid. This after a time softened the negative material and it was easily peeled away. However, it appeared that this process caused a chemical reaction between the film and the nitric acid to produce a substance that was explosive in its burning rate as compared to the original negative material, which was slow burning.

What we did was to actually produce an impure grade of gun-cotton—nitro-cellulose—highly explosive, highly sensitive to heat and flame. Just imagine this dried material thrown all over the floor, in waste baskets, being carried through the building, and thrown into the garbage. Also think of small particles of it being sucked into the exhaust ducts of the room. My experience has shown that when these dust particles accumulate in the exhaust ducts, one spark from an electric drill or a match has caused extensive fires within these ducts. They are difficult fires to put out because they are hard to find within the duct. You have to shut off the exhaust fans, but the shut off switches are usually in some out of the way place. Easily available remote switches should be provided for exhaust ducts which have the potential for internal fires.

This stripping method has been replaced by a simple technique of mounting the dried negative material on a plastic base by static electricity. Incidentally, as a bonus, we no longer have injuries from broken glass.

Photoengraving in a modern shop requires large amounts of concentrated nitric acid. This as you know, is a very hazardous and dangerous chemical to work with. In the past, large volumes were lifted by hand in pitchers and poured into the acid etching machines. New designs have been made to enable automatic dispensing of this acid from the original shipping container into any etching tank required. This has eliminated the manual handling.

With progress in photoengraving etching, magnesium is now a fairly common metal used. Magnesium as a solid is no major fire hazard, but as chips and filings it is a major potential fire hazard. Special saws and containers should be provided for magnesium work and magnesium waste. I have seen magnesium chip fires caused in photoengraving departments not by photoengravers but by outside men, such as contractors who might be coming in to do a job, let us say on sheet metal or duct work. The man sees a saw and decides that it would be easier to cut the piece on this saw rather than use hand cutting tools or his own equipment. The sparks produced have ignited containers

of magnesium chips in the area. Those of you who have seen a magnesium fire know that it is spectacular, like fireworks, bright lights. But they are easy to put out if you avoid using water. Special powder extinguishing agents for magnesium fires are available.

Don't think that accidents occur only in production areas. Many accidents occurred in the so-called safe office areas. Filing cabinets with top drawers pulled out have tipped over. A simple solution would be just to bolt all the cabinets together or to the wall so that the individual cabinet cannot fall.

Computer rooms may seem like safe areas but when a heavy load of key punch cards falls off a shelf on to a man's foot, it smarts. Equipment in computer rooms and other electronic equipment usually have automatic shut offs when doors or guards are opened. Many times the operators will bypass these safety switches, leaving themselves open to injury. One man lost the tip of his finger when the micro safety switch was bypassed. He opened the cover to release a jam and was pulled in.

A simple thing like a spindle has caused a number of injuries. I have seen men walking to the medical department with spindles sticking through their palms or fingers.

Composing rooms, because their operation consists primarily of manual handling, are an area subject to many types of accidents. Type washers have caused fires and various skin ailments. Heavy chases and galleys are difficult to lift, causing back injuries. When a man slips or falls, he can receive extensive injuries, especially in overcrowded areas.

In a newspaper operation, speed is of the essence. The papers must be gotten out at a specific time in order to meet various schedules. Speed alone is the cause of many injuries. Falls and slips, lifting injuries, and cuts are quite common.

Heavy machinery in the printing industry is a source of much noise. Some frequencies are potentially dangerous to the ear. In the newspaper industry, there is a tendency for some of the old timers to lose a portion of their normal hearing beyond that amount caused by aging. Many attempts are made to reduce the exposure to this noise by modifying equipment, enclosing noisy equipment, by supplying rooms or areas so that men can get out of the noisy locations for a portion of their workday, and by supplying various earplugs and ear muffs to be worn in the noisy areas.

Fire in the printing industry is a continuous problem. Let's stop a moment to see what we have to help us in case of a fire:

1. Personnel who are not professional fire fighters and have little experience with fires. (True, you have some local volunteer firemen in a few of the shops, but they are rare.)

2. Fire equipment as required by law, plus equipment added voluntarily.

3. Local municipal departments, either full time or voluntary, depending upon the location.

4. Limited knowledge of many potential fire hazards of the industry.

Fire prevention equipment is expensive and non-productive. It sometimes gets in the way. The time spent on fire education is also non-productive. But experience shows that it pays off. Advanced planning for an emergency can be the difference between minor damage, minor injuries, and a major catastrophe. It means education and training, cooperation with the local fire department, having the right equipment at the right place and at the right time. It means learning from the experience of others as well as your own.

Here are a few examples of fires in the printing and publishing industry as reported by the National Fire Protection Association in their bulletin FR55-4, 'Occupational Fire Records of Printing Plants."

1. Four hours after a printing shop was closed down, a pedestrian saw smoke coming from a sixth floor unsprinklered building and gave the alarm. The fire was traced to a fire in a stock room. The fire was put out with hose lines, with $40,000 damage.

2. In a magazine printing plant, an employee was cleaning ink rolls with a naphtha base solvent; there was a flash fire. The ink in the fountain ignited. Flames spread to the paper dust on top of the presses and in the ducts of the exhaust system of the presses. The fire was held in check by a well-trained plant fire brigade and by one sprinkler that went off. When the public fire department came, they had a small fire to put out in the duct system. The total damage was only $2,500.

3. In another large printing shop that was unsprinklered, nobody reported the fire to the local fire department when it started,

and this delayed report caused a damage of over $200,000.

Electrical fires in this industry, particularly in areas where high voltage equipment is used, can be very spectacular with flames, arcing, and much smoke. They can cause large equipment damage and production stoppages.

A fire in a high voltage (440 volts) electrical control panel supplied by copper buss bars a quarter inch thick and two inches wide was so intense that the buss bars melted and flowed like water. The radiated heat from the closed cabinet was able to ignite blueprints hanging three feet away from the cabinet and burn them to a white ash.

Let us look at what this means. Copper has a melting point of about 2,000°F. That means any unprotected steel in the area, which fails at about 1,400°, may collapse. Glass will flow and melt at about 1,500°F. Some of the glass panel indicator covers melted and flowed during this fire. Any brass, with a melting point of about 1,725°F, in the area would melt. Any aluminum, with a melting point of 1,100° to 1,500°F, would melt. Any magnesium, with a melting point of about 1,200°F, would melt. Various solvents close by, whether high flash or low flash, would ignite because in general, the auto-ignition temperatures of the solvents used in the printing industry is lower than the melting point of the copper. Your ink oils would automatically go up in flames if they are nearby. So would any naphtha or textile spirits. Any alcohols, any fuel oils, any gasoline would all automatically go up in flames if they are sufficiently close to the fire. Paper, having an auto-ignition temperature of about 450°F would start to burn on its own. Any rubber or synthetic rubbers would be ignited. Thus you see the need for keeping electrical control gallerys clean and neat and in accordance with the local electrical code.

Water seepage can be a cause of electrical fires. This type of fire is relatively easy to fight. It is generally localized and contained but nothing can be done to fight it until the current is shut off and much time can be wasted if you do not know where the shut off switches are. Remote shut-off switches also are helpful. Smaller electrical equipment can be just as hazardous if not properly used, such as a non-explosion proof extension cord used in an area with flammable solvents and vapors.

An instant immersion heater was used to make a cup of coffee or tea. After making her hot water, the woman draped it over a hook and left the room. The heater fell onto an upholstered chair igniting the chair. In a short time smoke billowed out of the lounge with smoke so intense that smoke masks were required to douse the chair with a bucket of water.

It's vital to get all the preparation and training you can give. An unexpected event took place and the result was a major fire, but proper training resulted in only minor injuries. In 1954, at the *News*, there was a major fire with estimated damages of over $300,000. Due to the nature of the materials used, such as paper, paper inks, greases, and rubber, the amount of smoke was so intense that little could be done by our non-professional fire fighters, the fire brigade. The building had to be evacuated to the point where some of the employees were removed from the third floor press room by fire ladders.

After the fire, an investigation indicated that a large portion of the smoke and flames was caused by the natural rubber rollers used in the rotary printing presses. Field tests were made on actual full-size rubber covered rollers. The rubber melted, dripped molten flames, and spread the initial fire to a larger area. In testing various synthetic rubbers, we found some to be slow burning and self-extinguishing.

It is now standard procedure at the *News* for all press room rubber roller suppliers to send samples of their roller material for flammability tests. This test consists of a one-inch gas flame impinging on the sample of rubber for one minute. An acceptable roller material is one that does not drip and is self-extinguishing within three seconds after the removal of the gas flame. Also, one in which there is little flame spread. This test was done in cooperation with the local fire department so they would understand some of the hazards and problems that they would be involved in should they have to come to a fire at a newspaper plant.

SAFETY IN A GRAVURE PLANT

By E. C. DENNY
Maintenance & Safety Supervisor, Courier Journal and Louisville Times, Louisville, Ky.

First and foremost, to have a safety program the plant's top management must sincerely want a safe, fire resistant, and well-kept plant and be willing to support the program. Once this requirement is established, we can proceed. Without top management's active support, a safety program will be most difficult to acquire.

How can management support a program?

1. Establish, write, and distribute a safety policy stating the very fact that they want a good safety program and that they will support it.

2. Talk safety to middle management, first line supervisors, and wage roll employees. Positively show interest.

3. Show genuine concern about injured persons and spoiled materials and what will be done to prevent similar accidents in the future.

4. Get involved in safety inspections, investigations, and their follow-up.

Supervisors must be made aware of their key role and responsibility in safety, and employees must be trained. Train from the very beginning. Begin just after hiring and continue training and re-training until retirement. Training should be done when hired, when assigned to a job, when assigned to a new job, when safety is poor, or when returning from a long lay-off.

In addition to training, employees should be required to meet certain conditions of employment. Some of these conditions are: safety shoes—conductive; proper clothing—no jewelry; safety spectacles; and wearing of company furnished personal protective equipment such as gloves, hard hats, aprons, masks, etc.

Periodic safety housekeeping and fire prevention inspections should be conducted by the plant's top people along with area people. Deficiencies should be followed up and corrected without delay. The question of what to look for during an inspection in a gravure plant is interesting.

Charts of the plant process, beginning with the publisher through copy service, gallery, and various other stages to the proof press, paper routing, ink routing, routing of the cylinders, the product flow from the production press, and essential services such as maintenance are valuable in assisting the preparation of safety and production procedures.

In following the chart through from the publisher to positioning laydown, ordinary business office safety is about all that is involved. Desks, chairs, file drawers, scissors, staples, pens, etc. is about the story. It might be added that in some areas there is the hazard of subdued lighting.

Tremendous progress was made in economy and safety when film replaced glass in the gallery, page layout, etc. Many cut hands resulted from the glass. When a hazardous operation must exist, learn how to live with it; but better, eliminate the hazards with new material or procedures. The elimination of glass in this work is an excellent example.

In the carbon printing room, a potassium compound is used. Rubber gloves are not necessary, but the worker's hands should be kept clean and free of any open wounds. The printing frames tilt and present pinch points. The light source, when on, should not be looked at directly. The usual temporary wiring and other arrangements should be avoided. Housekeeping should be good, with a place for everything and everything in its place. A guillotine paper cutter is used in the operation and must be properly guarded.

In the preparation of a cylinder, it must first be stripped of the previous plating. This stripping involves sharp edges and hand tools which require gloves and know-how. The material stripped off the cylinder is valuable and must be baled with caution for resale. Handling the cylinder in the plating room should be done with electrical hoists and other power equipment. Copper electroplating involves a low voltage and high ampere current in a sulfuric acid electrolyte. Workmen should wear gloves, goggles, and other protective clothing and equipment. A safety shower and an eye wash fountain in the area is essential.

In plating, as in other industrial operations, written safety procedures should be prepared and used. They should be reviewed frequently and changed as necessary. Writing procedures does two things: first, it requires supervision to indirectly study and plan through an operation and to list all steps and hazards; second, it gives the employee a positive written procedure to follow and a reference if necessary.

One thing that should be included in procedures for plating, for instance, is how to lift manually even though machinery is provided, because no doubt there will be times when lifting manually will be necessary.

Grinding and polishing is an important part of cylinder preparation. Mechanical guards are necessary. Also, it is necessary to some way prevent the grinding dust from flying into the room. This can be done by grinding wet but, of course, this presents other problems, such as getting rid of the grinding compounds that are in water suspension.

The storage of prepared roto-gravure cylinders is relatively simple unless procedures are not followed exactly. Persons should not walk under loaded hoists. The arms on the storage racks should be properly positioned, chocks should be placed in the proper position—all part of safety in storage.

When the tissue first meets the printing cylinder at the laydown machine, is the first time that we get involved with heavy massive equipment that must be respected and operated correctly. This equipment must also be well maintained. The cylinder is loaded on a cylinder truck from the plated and polished storage cylinder rack and hand pushed to the laydown machine.

Cylinder trucks are huge, four caster, heavy steel monsters. For these trucks to operate properly, the floor should be smooth, level, and free of obstacles.

To get the cylinder from the truck to the laydown machine is more or less a hand-transfer operation. Transfer bars are hooked to the truck and to the laydown machine, and two men as a coordinated team roll the cylinder into the laydown machine. It is removed the same way.

The cylinder is moved from the laydown machine to the developer by cylinder truck. A power cylinder turner at the developing machine replaces a hand wheel. Again, it must be remembered that material handling and physical work are always potential hazards and should be avoided if possible. For a safe operation, involve the worker in as little lifting, bending, shoving, and twisting as possible.

Etching comes next. It has come a long way in recent years from the hand method where the etcher, in rubber boots, apron, and gloves hand-poured the iron chloride on the hand rotated cylinder. Many hazards were left behind when the automatic etcher was developed and put into regular use. Lifting, splashing, and slipping were hazards with the hand method of etching. Pumps, hoists, and turning motors have lightened the work and reduced the hazards tremendously. The moral again is to avoid strenuous, hazardous tasks. Management is in the best position to develop procedures and machinery to make safety a reality.

The completed cylinder now moves to the proof press, to quality control, to re-etching, correcting, and back to the proof press. When the cylinder is ready for the production press, it will be chrome plated. These chrome plating tanks must be under negative air pressure at all times. The exhaust must be water scrubbed, and care must be used in discarding the water used in chrome scrubbers.

Newsprint comes in large, heavy packages. It is difficult to handle, and a great quantity of it is used. Lifting, pushing, and any other man-handling should be avoided. Of course, training is necessary for fork drivers or other equipment operators.

Ink solvents are usually delivered in tank trucks. Ink should be piped, not carted in buggies. Solvents used should be brought into the press room in small quantities in specially designed safety cans. If solvents or ink are transferred in the press room, shut off spigot vents. Bonding and good housekeeping are all part of the scheme.

Automatic viscosity ink blending systems are now available which send ink to the press entirely in pipes. Leaky packed pumps have been replaced by sump pumps, and ink buggies are practically a thing of the past.

In the press room there are many potential hazards: ink and solvent vapors, dust, moving machinery, climbing, static electricity, heavy equipment, noise, and on and on.

Moving machinery should be guarded. Of course, guarding a rubber roll or a steel roller is difficult.

Static electricity is a tremendous problem. Bonding, temperature and humidity control, conductive shoes, and good ventilation all help. With heavy equipment, hoist procedures, special tools, and a good floor all help.

With the cylinder running in a fountain of ink, doctor blades take the ink off of the unetched portion of the cylinder. These doctor blades are extremely difficult to handle and many cut hands result. Gloves help.

Because of naphtha and naphtha vapor concentrations, the roto press room should be equipped with explosion proof electrical equipment. Dust is continuously generated in our roto gravure press room, and it is likewise a continuous job to keep it policed up. Blowing with air is not the answer; the answer is to in one way or another pick it up and discard it. Maybe some day a vacuum system will be devised that will eliminate the dust at its source.

Fire extinguishers should be adequate and advantageously located. Some gravure presses are protected by a central automatic CO_2 directed nozzle fire extinguishing system. If a fire occurs in a printing unit, a rate of rise sensor releases a bank of fifty-pound CO_2 cylinders. The CO_2 is piped to a group of units and directed into the ink fountain. This CO_2 extinguisher system may be activated manually also.

From the same rate of rise fire signal, all presses are stopped. The oven exhaust fans are stopped, the exhaust ducts are closed at their exit, and the air conditioning units are stopped. All equipment that is stopped in this manner must be manually restarted. In addition to the above system, ink fountains can be protected by manually operated CO_2 tanks permanently attached to the fountains.

The press room can be further protected by a water sprinkler system. Any fire protection system of any sophistication can actuate signals at the city fire department, ADT, or anywhere else. Each press can be stopped by an emergency switch located at a strategic place.

Other gravure presses can be protected by a central inundation fire extinguishing system that operates similarly to the nozzle type system.

Automation is fine as long as it works; consequently, all automatic fire protection systems should be tested frequently through a regular preventive maintenance system.

In the bindery, back injuries can be frequent and serious. Again, the avoidance of lifting, twisting, and carrying can reduce injuries. Machinery is the answer.

Marked off aisles, guard rails, etc. can usually do a good job of assisting in housekeeping in the bindery.

Skids are a problem. So are nails, strapping, etc. Procedures in training is the answer. The print shop again involves manual operations that can be avoided.

Maintenance is a problem in a gravure plant. Procedures in maintenance are absolutely essential. Lock-out procedures, welding procedures, spare parts procedures, and preventive maintenance procedures all contribute immensely to safety as well as economy.

The handling or rubber rolls is a constant problem, and again, hoists can be a problem and the proper equipment will do the job safely.

Waste paper—torn, wet, dirty, and out of register printing errors—gets to be a problem. Getting the paper to the baler sometimes is a big job. Paper boxes should be emptied and baled before anyone goes home.

Drums should be handled with machinery if at all possible. They should be stored at a specified place in a specified manner. Pollutants at times have to be hauled in drums. There is much work to be done in the pollution field to avoid polluting and manual handling of pollutants.

An easier method of getting rid of contaminants and pollutants is to collect them in a central location and haul them in a tank truck.

A readily accessible compactor or a place to put dry wastes encourages a safe and prompt disposal.

Stairs, doorways, etc. should be carefully respected.

Emergencies are possible in any plant. Equipment should be readily available and its use understood.

THE STRENGTHENING OF A LETHARGIC SAFETY PROGRAM

By PAUL V. McGUIRE
Manager, Safety-Security, Meredith Corp., Des Moines, Ia.

In the petro-chemical and refining industry, in which I spent many years, a frequency rate of 1.0 can be considered intolerable. In an automated chemical, petrochemical or refinery installation, there is an inherent respect for safety. A careless act, a mistake in procedure, can totally destroy such an installation. As a result, safety controls in process and human performance are mandatory factors before the fires are ever lighted. A large printing plant such as Meredith's may not have the latent possibility of total disaster if these same mistakes are made.

The roll paper fires and gravure plant explosions of the past few years have done much to dispel this sense of complacency. For the most part, it is generally accepted by an unfortunately large percentage of printing management, Meredith excepted, that safety and fire protection is not a big issue in printing management. Of course, there is deep concern when Willy Jones will not be able to work for six months because of a mangled hand which has been caught in a power roller. The fact of the matter is that the press was shut down only for the period of time needed to remove Willy. The press will continue to run during the time of Willy's convalescence.

Meredith Corporation is a medium corporation with a *Fortune* magazine ranking of 732. We are diversified into many fields—radio, television, microwave transmission, television production programs, mold injection globe manufacturing, consumer books, educational books, magazine publishing, and commercial printing. Recently we broke ground in Lynchburg, Va. for a gravure plant. In that operation, we have a one-half interest in a joint venture with Burda of West Germany. Burda is the largest and foremost gravure printer in Europe. We are rated as the sixth largest printer in the United States. At our Des Moines printing plant, with which this essay will be largely concerned, we employ about 1,600 people. Our corporate office in Des Moines employs an additional seven to eight hundred. Total number of employees for Meredith Corporation approximates 4,200 people. At Meredith Printing in Des Moines, we have a manufacturing complex of about thirteen acres under one roof and located on 107 acres. At this installation we compose, print, bind, ship, and mail our own *Better Homes & Gardens* and *Successful Farming*. *Better Homes & Gardens* has the third largest magazine circulation in the United States. In addition, we print the very successful *Better Homes & Gardens Cook Book* with the attendant specialty counterpart books. Additionally, we have an offset job printing department in which extensive commercial printing jobs are printed.

We have one of the most modern printing complexes in the United States. We have a vast array of fire fighting systems, both automatic and manual. With some 40 presses of varied types and styles, Meredith can produce quality printing matter in tremendous quantities. Our printing contract with Conde-Nast and other publishers are important adjuncts for our printing operation. Our continuing expansion, until very recently, has led to some of our very serious safety problems.

In October 1968 I assumed the position of Corporate Manager of Safety and Security for Meredith Corporation. My duties encompassed those areas of fire, safety, and security normally associated with the title. My new boss told me that much of my time would be devoted to our safety problems at Meredith Printing. It seems that safety at Meredith Printing had been allowed to limp. It was with a degree of confidence that this safety engineer from Houston, Texas, walked through the printing complex with its array of unfamiliar names such as Cottrell, Goss, Clayborn, and Hoe.

In walking through the plant, I thought that these big million or two million dollar presses would require similar safety engi-

neering to the distillation or fractionation columns of a refinery or a petro-chemical plant. To begin, it would be necessary to get a good communication system started, analyze the problems, write a few work orders, start a few "gimmick" programs, activate the fire brigade, establish some interest—and we would be "home free." Standard approaches had always worked heretofor, and there was no reason why these methods should not be successful at Meredith Printing.

Oh, how wrong, how very wrong one could be! I had assumed so much! Unlike the oil or petro-chemical industry, there was absolutely no established safety base. Top management had given sufficient support—but support of what! Belatedly I found that I must crawl, rather than to stroll proudly through the plant extolling the virtues of safety and commenting on the wonderful accomplishments and safety progress to be expected. As an example of our dilemma, we were competing most ably with the most hazardous of all industries, that of mining underground coal. The mining industry sustained a paltry 34.68 frequency for the year of 1968. We were rolling along with a 39.20 frequency without even trying. With a little more concerted effort, Meredith Printing could have smashed all records for lost time injuries. In 1969, we dropped considerably in frequency to 24.41 as compared to mining's 31.86. As for our severity rates, we were no competition to mining in 1968. Mining had 8,258 in 1968 as compared with our mere 516. In 1969, our severity index was 1,824 as compared to mining's 4,902. Of course, a fatality had boosted our average. And believe me, that is the roughest way to maintain a high severity rate. With a bit more effort our safety would have qualified us for an award of dishonor.

I had to ask many questions and try to find ways which would be successful even though unorthodox. It is with a great deal of admiration that I look to printing concerns such as R. R. Donnelly, Hallmark, and Rand-McNally who have gained such outstanding safety performances. What did these corporations have that we did not have at Meredith? At Meredith, I did find that all of the standard operating techniques that safety engineers customarily utilize, had achieved only a modicum of success. Believe me, all avenues were investigated.

Problems at Meredith Printing were staggering. How does one convince fourteen surging unions of our interest in their safety welfare? Unions could well shut down machinery and equipment on the pretense of safety when the overriding factor is that hazard elimination may be just another tool to use in the ever present management-union struggle. How can foremen be trained in good safety attitudes when, in reality, their attitudes may reflect little importance in safety being a part of the production process? How can middle and top management be expected to enforce safety and fire regulations, when the enforcement of these items can be negotiable contract items? How can effective fork truck training programs be initiated when seniority is the governing factor in the right to operate these potentially dangerous pieces of equipment? The fact that the potential "killer" has the mechanical responses of a duckbilled platypus can be of small importance. How can employees be expected to follow medical reporting procedures, when, in fact, an enforceable procedure was seldom utilized? How can employees be trained to use toxic chemicals when toxic and flammable materials have been used for years with no apparent deleterious effect? How can one expect to initiate safety revisions or repairs when maintenance is geared primarily to production repairs? How does one educate an employee in truthful accident reporting, when taking advantage of every possible shelter in company-sickness and accident plans is not an uncommon practice? What must we do to instill leadership in supervision when past union loyalties and memberships are important parts of their work heritage? It is obviously difficult to serve two masters. How can one expect to establish safety engineering specifications and follow-up on vital equipment when the pressures of expansion relegate safety design into areas of smaller importance? How does one expect the employee to adhere to safety and smoking regulations when safety rules can wrongfully be assumed to be a deterrent to production?

As an example of the ridiculous posture safety had assumed at Meredith Printing,

the following condition was present upon my arrival. In a central shop there was a sign that stated to the effect that all who passed through must wear safety glasses. Day after day, those who passed through did not, in fact, wear safety glasses, with little fear of recrimination. Your logical response is, of course, to get rid of the signs or enforce the rule, and to do neither is to appear utterly inane. We had that situation at Meredith Printing, and that condition aptly typifies the problems which led to our lack of safety progress.

It may appear that I am giving my management hell and placing the blame for everything directly in their lap. Meredith's dilemma may have happened to a great number of companies. Meredith management did exercise good judgment. When management saw their safety spinning out of control, they hired an "expert" with the intention of supporting this "expert." Some of you are "experts" and may have been hired for the same reason that Meredith hired me. In all honesty, it is my sincere belief that only a company with the safety status of a DuPont could have handled our burgeoning expansion during this period of affluence. The labor market was limited, the turnover was rapid, and inflation continued unchecked. All of this, coupled with a very busy over-burdened employer and unchecked employee-union desires, left little time for controlled plant safety progress.

To say the least, this Texan was overwhelmed. My Texas adventure in oil and petro-chemicals had reaped great rewards. National Safety Council Awards of Honor, Awards of Merits, Awards testifying to many long years with no lost time accidents and numerous other banners and trophies testified to our expertise in controlled safety. Somewhat wistfully, I tucked away the pictures of all this memorabilia and wondered what in the hell I had done to deserve this! What must be done! You may be thinking, "Oh! Oh! Here it comes. Now he will tell us how he as the knight in shining armor mounted his white charger and finally found the Holy Grail." If only it had been just that simple, and that I could report unparalleled success. I can do neither.

Presently, Meredith Printing is in the best position it has ever been from an accident loss viewpoint. Our results look fairly minimal compared to the records of those companies mentioned earlier in this report. From a percentage improvement aspect our successes have been phenomenal. We're still a very long way from the point of the doctor who was so successful that he could occasionally turn away a patient as not being ill. Our frequency rate for 1970 has been averaging between 10.0 and 12.0 and our severity is averaging between 400 and 425. With slightly better results, we, too, can be in a position to receive an award of merit—and, by golly, we'll have one too, if the corporation is willing to put up with our shennanigans for a little more time. Safety people are like French bread—little dough, but lots of crust.

The two advantages that I may have had over any of my predecessors were: (1) lack of knowledge of the printing business, and (2) being a patient man. Because I knew so little of printing, it was difficult to be impressed with a particular mode of operation that had gone relatively unchanged for twenty years. It seemed to me that to have people getting their hands caught in presses for twenty years was not a particularly brilliant mark of success. Oh yes, people still get caught in presses but, thankfully, not as often, and Meredith Printing people today very seldom say, "People get hurt. This is the nature of the business."

One of the first things that struck me as being quite unique in my experience was the total sense of apathy. There just did not seem to be any particular interest by anyone, other than top management, for anything concerning safety. There was no mechanism for fostering or encouraging safe practices. For all practical purposes, a plant safety budget was nil. Those hazards which were to be corrected were jumbled in with the respective department expense systems. The plant engineering department did not separate safety work orders from ordinary repair work orders. Obviously, safety did not receive any priority in the work environment. Help was needed badly, and there is a multitude of help available from various agencies. Insurance companies and our own beloved National Safety Council perform a tremendous task for American industry. I felt, however, that some of the

very detailed plans of these agencies were too stereotyped to be effective in solving our particular problem. If there is a criticism of such agency planning, it is that all segments of industry can be generalized into a hodge podge of safety methods. The ingenuous designer of a particular program is, generally, the only one impressed with the intricate and minute details of his planning. Certainly, the busy plant manager or production superintendent has little time to pour over the laborious data, charts, statistics, and safety performances so arduously prepared for their proper appreciation. Our safety programming would and must be keyed to our particular work structure. As this presentation unfolds, it may appear that our safety policies are a contradiction to that which has just been criticized. Parts of our safety planning are quite meticulous and detailed, but they are distinct in that they were prepared as a partial solution to our particular environment. Our work environment is quite different from our industrial neighbor down the street. At Meredith Printing, the members of the safety department are safety specialists. We are not social workers or psychologists. There are those in the safety profession who probe into areas which should be none of their concern. A case in point is in the motivation of the unsafe worker. At Meredith Printing, we were beset by many workers who were not motivated by anything more than making it through one more shift. Our approach to this problem at Meredith Printing is typical of the way we approached most of our safety problems at Meredith. For us it has been successful. For you it may be a complete fiasco.

In our sophisticated world, we toss the word motivation about as though it is a certain known quantity. We plug in the key and out come the right answers. Motivation is not an absolute term, and to each person it implies a personal meaning which cannot be formalized into an absolute. As a safety engineer interested in the safe work environment for employees of a large printing corporation, I have found that recognizing continuing unsafe acts of an employee is quite necessary, but professional psychological guidance is beyond the safety engineer's field. We recognize symptoms but we do not place ourselves in the position of a guidance counselor or psychologist.

At Meredith, we knew that we must be effective to the greatest number of people. In thinking differently, we could become as subjective as the unsafe worker. Many safety professionals may find that they are unable to see the forest for the trees if they embroil themselves in helping to extricate and redirect an unsafe worker who may sabotage a planned program by his pursuit of undesirable practices. Chronic symptoms of unsafe or poorly motivated workers at Meredith were generally present: (1) the worker may spend a great deal of time going to first aid for alleged minor injuries; (2) he may feign injuries which assure him of repeated and continuing time off; (3) his work performance may be, at best, only average; (4) his absenteeism may be excessive; and (5) his attitude will reflect resentment and non-cooperation. We tried to checkmate this unsafe worker. Although it is often difficult to have the unsafe employee terminated, because of contractual or other obligations, it is a waste to spend any more time than necessary in assessing the damage this poorly motivated individual can do to a well planned plant safety program. We have tried to take steps which prevented the wrecking of plant safety objectives by employees within this frame of reference.

In deference to our current social-work environment, our safety activities are geared so that the greatest number hear and understand the drum beat. Our world is composed of approximately 50 per cent young people. The stereotyped, slogan calling, "gimmick" ridden plant safety programs fail to be accepted by this majority of workers. Better educated and more socially conscious, the young worker is not susceptible to the self motivating principles of his individualistic father. The demands of the younger worker to know "why" should never go unheeded. Concurrently, a full explanation of the general and collateral goals of the corporation should be fully given. Many of our line management people, composed of older men, were at a loss to provide answers to these questions, as they were never sufficiently trained. Poor communication led to frustration on the part of both the foreman and the employee. The

result was less production with a corresponding greater number of lost time accidents. As safety engineers, we did try to give adequate answers to pointed questions of the intelligent young worker. We found that safety policies effective for many years may become sterile and obsolete in this fluid and dynamic society in which we all participate. A valid solution today may be entirely invalid tomorrow! In retrospect, we discovered also that effective safety programming is not gained by catering to the vagaries or whims of the work force. We chose our goals carefully and were most reluctant to be dissuaded.

It is difficult to stay abreast of the social and technical advances of today. At Meredith Printing we have been trying to make that effort. We must move fast if we are to make progress. Safety proficiency today can be compared to "skim reading." Quantities of knowledge are needed, and we don't have time to belabor any issue—particularly this overworked word, "motivation," used so often in industry today. We do things through people. Safety work is no exception; however, many of us do become so concerned in the poorly motivated unsafe individual that we may well win the battle but lose the war. Many personal problems of individual workers, who are constant industrial injury victims, are impossible to solve without professional help. At Meredith we are not reluctant to dismiss these people problem areas. The responsibility owed to the bulk of our coworkers is greater than that owed to any individual. We try not to lose sight of that general theme.

We can quote many aphorisms and cliches which negate such theories. No chain is stronger than its weakest link; united we stand, divided we fall, etc., etc. This para-logic is familiar to us all. We try to avoid the use of such faulty ideas in Meredith safety problems. Cold hard boiled analysis, such as management uses to solve complex managerial problems, is necessary for the safety professional.

The following thoughts have been most helpful in trying to carve through the confusion of our programmed industrial safety:

1. How much time is necessary to spend on a project to achieve a desirable result?

2. Is the time spent justified for the overall objectives?

3. Am I in tune with the objectives of the corporation?

4. Will this project be accepted by the majority of the employees?

In this discussion there is little comment about the emotion laden and often quoted humanitarian aspect of industrial safety. At Meredith Printing our industrial safety program encompasses these humanitarian areas as an integral part of that program. It is pompous to beg the issue of our just concern for the employees' safety welfare.

We have all heard, occasionally, from our safety professional brothers who decry the lack of cooperation from top management. We as professionals owe our failure or success to our personal performance as individuals. At Meredith, our managers are subjected to stresses and strains which in most cases exceed our particular pressures. Our areas of responsibility are limited. Their management problems extend from horizon to horizon. At Meredith, safety threw away its crutches. We have tried to help management to solve their problems rather than to add to their problems. Frankly, we worry less about those we fail to motivate, and we concentrate more on those who will accept contemporary safety. Having read my text book in college psychology, I am not prepared to sally forth and motivate that worker who for the fourth time has been run over by an industrial fork truck. The best thing for our friend is to make certain that he is in a position to do little damage. Perhaps a tool crib, fully surrounded by wire, would be a suitable environment for this peculiar ability.

Our socio-work environment at Meredith forced us to adopt a brand of safety engineering which is unique for its lack of public display and safety advertising. For instance, as you walk through Meredith Printing you will find very few National Safety Council safety posters, although we have been recipients of the National Safety Council poster service for many years. We find the shot gun saturation approach has very little lasting effect. We prefer to zero in on a particular problem. If a problem cannot be solved, we do not hesitate to

back out and find a new wind mill. We prefer to break our lances and to wear out our ass on those windmills which can be conquered. The quickest way for a safety professional to lose status or to reduce his image in the eyes of his associates and fellow employees is to engage in overt projects which have little chance.

At this point it may not come as a surprise that we do not present safety awards, or green cross pen and pencil sets, or any prize as a reward for any safety achievement. It is true that the occasions for safety awards until recently have been infrequent. It is our belief that programs of this nature can be attuned to the fringe benefit programs of a plant with little understanding or appreciation by the employee of the spirit behind the giving of the award. In the past, I have used such incentives successfully. I intend to use these incentives in the future—but only when there is reasonable assurance that a true understanding has been reached by the recipient of the concept behind the award.

At this point, Meredith Printing does not use safety committees, safety suggestion boxes, or union safety participation. In their place these methods are effective, providing there are sufficient controls. We think that presently the disadvantages of these methods far outweigh the advantages in our particular work environment. The tendency to air a personal grievance or to use safety as a lever in the perpetual management-employee confrontation leave little left for bonafide safety grievances.

Safety suggestion boxes can be a deterrent to effective plant safety. It is disheartening to a truly dedicated employee to have his legitimate suggestion lay dormant for months for lack of action by a maintenance force already stretched with production repairs. Cost economics may not warrant additional maintenance manpower. In my opinion, it is better not to have programs which will foster such discontent than to have a paper program which is a predestined failure.

With these rather iconoclastic views, what have we left to use to obtain reasonable safety? Our program is basically one of the three "E's" and stresses education. Our supervision is geared strictly to production. To offset, we utilized the National Safety Council's "Key Man Development" course for many of our supervisors. We are using foreman's meetings to instruct in safety. We have tried to force the responsibility of everything within the work area directly to supervision. If a fire extinguisher is missing within a particular area, the supervisor is asked, "Why?" In support of this responsibility, we have formulated safety rules, policies, and procedures which are helpful in the administration of a particular area. If we are to hold a supervisor responsible for the safety of his unit, then it is our staff responsibility to provide the technical and administrative tools for his use. As an aid for the supervisor, we have established a fairly extensive library within the safety department. An index of our library is provided for all supervision. Supervisors may check out any volume to aid in their understanding of the safety and fire protection discipline. We have provided first aid and other related training programs in an attempt to upgrade their safety proficiency.

An important part of our safety programming is plant fire protection through fire brigade training. Volunteer firemen are a particularly cooperative breed of people. Under the direction of a very able fire chief, our fire brigade has improved to the point where we can handle most fire emergencies. It is a rare pleasure to work with people whose only motive is to serve. In our plant, we have this cadre of people. Consequently, we have been able to enlarge their skills by professional training through state extension fire training and municipal department exchange of ideas. With our in-plant fire vehicle, the Meredith Fire Brigade quickly swings to the defense of the plant when a fire emergency arises. We are proud of our brigade system.

With the national emphasis on disaster, civil unrest, and disorder in general, the corporation has requested measures to respond effectively to such conditions. A totally unexpected result has occurred: management people have identified closely with the company. Emergency planning has been amazingly simple to implement by the active participation of those who head the various elements of the program. Perhaps a partial answer to better safety is to delegate elements of plant safety to specially chosen people within the plant.

At Meredith Printing, the departmental safety inspections are complete. Inspections are formal, and a thorough follow-up is maintained. We have devised priority systems which give safety work orders their proper important perspective in maintenance work order systems. The inspections are most thorough and encompass all areas which effect working conditions, practices, and habits.

We are very careful in our accident investigations. Our investigations have decreased professional malingering to the extent that it is very infrequent that an employee feigns a back injury. Our medical services are extensive—perhaps too much. I am not convinced that the multitude of services we provide reduces absenteeism one iota.

Our safety studies run the gamut. The safety department controls toxic chemical usage. All chemicals must be approved by the safety department before being admitted to the plant. We have won our battle on design problems. Members of the safety department are consulted on equipment changes and purchases.

We have been on a hazard elimination program for two years. Our maintenance of equipment is improved. It is seldom that a fork truck is seen spewing hydraulic oil through the plant. Our training of fork truck drivers is impeded by contract obligations; however, rules are now enforced regarding the operation of these trucks. Operator daily check lists are provided and followed.

The economic cut back across the country has afforded us an unforeseen and uncalculated windfall at Meredith Printing. Fewer flower children are seen throughout the plant. It may be that our pseudo-serious attempt to provide hair nets for male production workers can be shelved. For the first time in many years, there is some concern from workers about their job status and their economic future. Safety at our plant has become easier to manage, with the employees more responsive to in-plant safety policies just from economic pressures. It is a shame, but the affluency of an economic system does have a direct bearing on safety performance.

We constantly hammer away at the high cost of accidents. Using acceptable factors, we quote the tremendous number of dollar sales needed to offset accidents. We apply both direct and indirect costs in computing accidents. Our charts are loaded with dollar indicators which substantiate the fact that accidents drain money away needlessly from corporate assets. We cite unusually high accident rates within particular departments. Most importantly, if we see dangerous trends beginning to form from our accident fact sheets we try to solve our accident problems within that particticular area before the problem becomes acute. Foremen of problem areas are consulted. Department heads are made aware of the dangerous trend and they are held accountable for reversing a serious accident trend.

About the only dramatic parts of our safety programming concern our vivid safety memos and monthly accident fact sheets. We do play the role of the nagging fish-wife haggling with the tired husband. I'm certain that members of management consider us to be quite obnoxious and completely insufferable at times. Members of the safety department are certainly not the most popular of Meredith employees; however, we do not allow this lack of popularity to deter us from publicizing the unpleasant aroma of accident losses.

To Meredith employees, we have a relationship considered unusual among some safety people. We never directly instruct or criticise any employee who is performing an unsafe act. Unless the unsafe act is of immediate danger to life and limb, the incident is reported to his supervisor for correction. Our relationship is staff to line, and we are more effective in that capacity. I have worked as a safety engineer with direct line authority and have found it to be most unsatisfactory. With staff responsibility, most line people are really not quite certain of our true authority. We like to think that production people are convinced that the safety department "walks softly and carries a big stick." Considerable time and effort is spent in promoting that image.

The glaring discrepancy in our safety programming is employee participation. This area is being opened. Our groundwork has been laid. The foremen are becoming safety

conscious. Departmental plans are now designed with safety in mind. Employees are beginning to think that perhaps there is something to this safety bit. Our maintenance force responds in a reasonable time to safety work orders. We are sure of our ground and we are opening our plant to safety participation a section at a time. In time, our plant will have the safety suggestion boxes, the safety committees, the regular safety meetings, and the programs which some of you may take for granted. In reference to earlier comments, these programs will be controlled. Employees and supervision alike must understand the importance of the respective safety projects or the projects will just as readily be abandoned. The time has arrived, not only at Meredith Printing but throughout American industry, for safety to be a joint responsibility of manager and employee. If either party shirks his safety responsibility, both parties will lose.

Changing employees' attitudes today can be discouraging. Reaching these people and influencing the way they think appears so hopeless it hardly seems worth the effort. As indicated earlier, we do bypass those cases which not only appear but are, in fact, hopeless. We are also cognizant of the fact that effective safety communication is sorely needed. Today we have succeeded in selling constructive, commonsense safety attitudes to a few of our employees. Tomorrow we will sell more of our employees. The results are proving well worth the cost and effort.

A very popular milk company had the following slogan printed in big letters on the sides of its truck: "Our cows are not contented! They're anxious to do better." Safety at Meredith is not contented. We can and will do better.

Safety is at Meredith to stay. It will not go away as a bad dream as some may have wished two years ago. Meredith management recognizes safety as a most important tool in the production process. Next year or the year after Meredith Printing will have an Award of Merit. During the interim we're going to chip, chip away!

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