Industrial Safety and Health Management

Sixth Edition

C. Ray Asfahl
David W. Rieske

Industrial Safety and Health Management

Sixth Edition

C. Ray Asfahl
David W. Rieske
University of Arkansas

Prentice Hall

Upper Saddle River Boston Columbus San Francisco New York
Indianapolis London Toronto Sydney Singapore Tokyo Montreal
Dubai Madrid Hong Kong Mexico City Munich Paris Amsterdam Cape Town

Vice President and Editorial Director, ECS: *Marcia J. Horton*
Senior Editor: *Holly Stark*
Associate Editor: *Dee Bernhard*
Editorial Assistant: *Keri Rand*
Director of Team-Based Project Management: *Vince O'Brien*
Senior Managing Editor: *Scott Disanno*
Production Liaison: *Jane Bonnell*
Production Editor: *Sangeetha Parthasarathy, Laserwords*
Senior Operations Supervisor: *Alan Fischer*
Operations Specialist: *Lisa McDowell*
Senior Marketing Manager: *Tim Galligan*
Marketing Assistant: *Mack Patterson*
Art Director, Cover: *Jayne Conte*
Cover Designer: *Bruce Kenselaar*
Art Editor: *Greg Dulles*
Media Editor: *Daniel Sandin*
Media Project Manager: *Danielle Leone*
Composition/Full-Service Project Management: *Laserwords Private Limited, Chennai, India*

Library of Congress Cataloging-in-Publication Data

Asfahl, C. Ray, 1938-
Industrial safety and health management / C. Ray Asfahl, David W. Rieske.
-- 6th ed.
p. ; cm.
Includes bibliographical references and index.
ISBN-13: 978-0-13-236871-1
ISBN-10: 0-13-236871-4
1. Industrial safety. 2. Industrial hygiene. I. Rieske, David W. II.
Title.
[DNLM: 1. Occupational Health Services--organization &
administration--United States. 2. Accidents, Occupational--prevention &
control--United States. 3. Occupational Diseases--prevention &
control--United States. WA 400 A817i 2010]
T55.A83 2010
613.6'2--dc22

2009025500

Prentice Hall
is an imprint of

PEARSON

10 9 8 7 6 5 4

www.pearsonhighered.com

ISBN-13: 978-0-13-236871-1
ISBN-10: 0-13-236871-4

Preface

The sixth edition of *Industrial Safety and Health Management* continues the tradition of earlier editions in providing common sense rationales for safety and health standards and work practices along with new developments in the field. This edition also has more case studies, examples, exercises, and illustrations to add realism to the learning process.

Much progress has been made in the field of industrial safety and health management, but the job is not done. Cranes continue to fall in dramatic, recent accidents in downtown metropolitan areas, killing workers and the public as well. New health concerns are shifting the focus to tinier concentrations of contaminants and even tinier nanoparticles that have the potential of bringing about new hazards from dangerous fibers. In the economic climate of the deep recession of 2008 to 2009, safety and health managers need analysis tools to support their cause with top management. There is little doubt that safety and health managers are facing new challenges and need effective tools for dealing with them.

Recent developments in technology impact the field of industrial safety and health, and the sixth edition has new sections devoted to robotics, nanotechnology, heat processes, and controlling indoor air quality by carbon dioxide monitoring and the use of variable air volume (VAV) ventilation systems.

The chapter on ergonomics has been completely reworked and places more emphasis on workplace musculoskeletal disorders (WMSDs). More illustrations are used, and a case study demonstrates the revised NIOSH lifting equation. A focus has been given to explaining the factors responsible for WMSDs and the actions that can be taken for their remedy.

Other added topics in this edition include systems safety, fishbone diagrams, Swiss cheese theory, safety "from the ground up," the mechanics of fire, metalworking fluids, chip removal, arc flash, and controlled decking zones.

In recent developments of the twenty-first century, national security has become a priority, and the issue of workplace security has risen with it. The Department of Homeland Security represents one of the largest reorganizations of the federal government in history, and the department becomes the third largest cabinet-level agency in the government. The presidential administration of Barack Obama and the Democratic sweep of both houses of Congress introduce a new political climate that is bound to affect OSHA and the field of industrial safety and health. This edition

addresses new political developments including national crisis management, immigrant workers, international standards, and workplace security.

Green engineering, the challenge of global warming, the reduction of the carbon footprint, and energy consumption and management are bringing about change to work methods and impact safety and health, too. The sixth edition recognizes these new challenges to the function of Industrial Safety and Health Management.

OSHA policies, procedures, and inspection priorities have changed, and this edition explains DART, TRC, and DAFWII inspection criteria and keys to the NAICS system that is replacing the SIC system of classification of industries. Added to OSHA benchmarks for health standards are NIOSH Recommended Exposure Levels (RELs).

The book's Companion Website at www.pearsonhighered.com/asfahl provides access to the latest available electronic database of detailed national inspection statistics, including numbers of standards citations, average penalty levels, numbers of serious citations, and statistics on contested citations. This database is proprietary and does not appear on the OSHA website. The database provides information at the OSHA citation level of detail at the individual paragraph level. The latest edition includes construction inspection statistics as well as general industry data. End-of-chapter exercises provide opportunities for students to practice research with the database. Also on the Companion Website are answers to selected end-of-chapter exercises.

WHAT'S NEW IN THIS EDITION?

For easy reference, the authors have summarized the new features of this edition as follows:

- New section on Workplace Security
- Inclusion of voluntary standards for Illumination
- Expanded chapter on Ergonomics, including the revised NIOSH Lifting Equation, Ergonomic Risk Analysis, and Sources of Ergonomics Hazards
- New section on Nanotechnology
- New section on the Mechanics of Fire
- New section on Heat Processes
- New section on Industrial Robots
- New section on Arc Flash
- Coverage of such topics as Systems Safety, Fishbone Diagrams, Swiss-Cheese Theory, Safety from the Ground Up, Metalworking Fluids, Chip Removal, Controlled Decking Zones, and Variable Air Volume Ventilation Systems
- Introduction to Global Warming and Green Engineering as they affect Safety and Health Management
- Coverage of current political developments, such as immigrant workers, international standards, and national crisis management
- Changes to the OSHA system of statistical recordkeeping, including the DART and DAFWII incidence rates, and the replacement of the SIC system by the NAICS system of classification of industries

- Updated database of detailed statistics on nationwide OSHA enforcement statistics, including expansion to include the OSHA Construction standards, accessible on the book's Companion Website
- Expanded exercises, case studies, and vivid graphic illustrations of concepts

ACKNOWLEDGMENTS

Both authors wish to express their appreciation to companies and individuals who have contributed ideas and support for the sixth edition. Special thanks go to Richard Wallace, Jimmy Baker, and the entire team at Pratt & Whitney for ideas, pictures, and best practices from their world-class facility. Andrew Hilliard, President of Safety Maker, Inc. and E. C. Daven, President of Safety Services, Inc. provided valuable insights and visual examples. Erica Asfahl provided mechanical engineering advice plus assistance with AutoCad. David Trigg and David Bryan answered questions and provided data on OSHA developments. John Brezinski provided assistance with conversion of computer files for the database. Jamie Snider, Tamara Ellenbecker, and Ashley Rieske provided assistance with production of the manuscript. We give grateful acknowledgment to the reviewers of this edition: Donald D. Buskirk, Purdue University; Clayton Ray Diez, University of North Dakota; Delbert L. Kimbler, Clemson University; Matthew Marshall, Rochester Institute of Technology; and Gary Maul, Ohio State University. Finally, we dedicate this edition to our patient and supportive families who have endured the process of bringing forth this sixth edition.

C. RAY ASFAHL
DAVID W. RIESKE

Contents

CHAPTER 1

The Safety and Health Manager

Everyone wants a safe and healthful workplace, but what each person is willing to do to achieve this worthwhile objective can vary a great deal. As a result, the management of each firm must decide at what level, along a broad spectrum, the safety and health effort will be aimed. Some managers deny this responsibility and attempt to leave the decision to employees. This strategy seems to square with hallowed principles of personal freedom and individual responsibility. But such a denial of responsibility by management results in a decision by default, and usually the result is a relatively low level of safety and health in the workplace.

Is the foregoing an indictment on the judgment of the individual worker? Not really, because without a commitment on the part of management, the worker usually is unable to build safety into his or her job station single-handedly. The behavior of the worker is the most important determinant for his or her safety, but behavior alone cannot make a dangerous job safe. Furthermore, even if a given worker has a strong inclination to be careful and to guard his or her health, there are plenty of production motivations and other quite natural incentives to undermine safe attitudes when management has not made a commitment to safety and health.

One person, usually designated as safety director or industrial hygienist, sets the tone of the safety and health program within a firm. In fact, right at the start, it says something about the commitment of management when a firm decides to designate a person by title to the responsibility of safety and health. But naming someone safety director or manager of safety and health is just a beginning step. Many such persons have little authority and have been largely ignored by management and worker alike, especially in the past. It was not unusual for a safety director's work to be typified by public relations activities, such as posting motivational signs and compiling statistics. These are still important functions, but much more responsibility for this function is now recognized.

The year 1970 changed the history of worker safety and health in general and the safety manager's role in particular. The landmark change that year was the passage of the Occupational Safety and Health Act that created the federal Occupational Safety and Health Administration (OSHA). The federal OSHA agency was given the authority to

establish mandatory standards that would have a dramatic impact on the role of the typical safety director of those times. Chapter 4 discusses this impact in detail, but the balance of this chapter discusses the enlarged role of the person within a firm charged with industrial safety and health.

The field of occupational health has probably benefited even more from OSHA than has the field of occupational safety. Prior to OSHA, responsibility for occupational health rested principally upon the plant nurse. And the plant nurse had little authority to influence policy or even to take action to prevent hazards. Prior to OSHA, the plant nurse was chiefly concerned with first aid, after the fact, and physical examinations, not with hazard abatement and prevention.

In describing the functions of today's executive charged with the safety and health responsibility, this text will use the designation *safety and health manager*, recognizing the dual nature of the job. Also, the term *manager* envisions the enlarged scope of responsibility, which includes analysis of hazards, compliance with standards, and capital investment planning, in addition to the conventional functions described earlier. The purpose of this book is to provide tools and guidelines to safety and health managers to help them execute the broad scope of their duties.

Dealing with applicable standards is one of the greatest challenges facing today's safety and health manager. Since only 10% of the standards generate 90% of the activity, safety and health managers need guides to the important parts of the standards. Frequently cited standards should receive prime attention because they indicate areas in which industries are having difficulty complying or areas to which enforcement agencies are giving a great deal of attention. In either event, safety and health managers have a need to know these frequently cited standards so that they can bring their facilities within compliance. Information technology has made this task easier, and today's safety and health manager can take advantage of the full text of OSHA standards on the Internet by accessing the OSHA website. In addition, national inspection statistics are available for download from the book's Companion Website. Besides the frequency of citation, safety and health managers need to know the "why" behind the standards. Until the safety and health manager learns what hazards a particular standard is intended to prevent, he or she will have a difficult time persuading either management or employees that a given situation needs correction.

A REASONABLE OBJECTIVE

Top management sometimes turns a deaf ear to the pleas of the safety and health manager for plant improvements. But the safety and health manager is sometimes a crusader with a one-track mind. Any safety and health manager who feels that elimination of workplace hazards is an indisputable goal is naïve. In the real world, we must choose among the following:

1. Hazards that are physically infeasible to correct
2. Hazards that are physically feasible, but are economically infeasible to correct
3. Hazards that are both physically and economically feasible to correct

Many hazards are physically infeasible to correct. An example is the airplane that took off from LaGuardia airport on January 15, 2009. During take-off, both engines

were disabled by what is thought to have been birds entering the engine. This hazard is currently impossible to eliminate because of the current mechanics of jet engines. However, millions of people fly every year, taking this risk. Other hazards include exposure to radiation during x-ray procedures. Although precautions are taken, it is impossible to completely eliminate exposure to undesired radiation.

Other hazards are physically feasible to correct, but economically infeasible. Consider the crosswalks on a university campus. There is always the chance that someone will be struck by an automobile while in the crosswalk. The hazard can be eliminated through construction of elevated walkways, gates, or other mechanisms. However, owing to the cost, inconvenience, and low probability of accident, these measures are generally reserved for only the busiest of crosswalks.

Other hazards are physically and economically feasible, and should be corrected. Technology has led to safety innovation in the auto industry, such as air bags and antilock brakes, which are considered indispensable and included on every automobile. In reality, every hazard must fall into one of these categories.

Until the safety and health manager comes to grips with this reality, he or she cannot expect to enjoy the approval of top management. Some safety and health managers have faced this reality on the surface, but within their hearts they may resent the attitudes of top executives who are unwilling to support their efforts to eliminate all workplace hazards. However, this resentment is unjustified because it is an unrealistic and naïve strategy to attempt to eliminate all hazards.

It may be surprising to some readers to discover that this book, which is supposed to be about safety and health, does not really advocate the elimination of all workplace hazards. Such a goal is unattainable, and to reach for it is poor strategy because it ignores the need for discriminating among the hazards that *can* be corrected. To see how such a naïve strategy is not even in the interest of safety or health, consider Case Study 1.1.

CASE STUDY 1.1

A safety and health manager receives three suggestions from three different operating personnel as follows:

1. Install a drain to remove water that occasionally collects around the die-casting area.
2. Post a warning sign that advises forklift truck drivers to slow down.
3. Improve sanitation by cleaning the rest rooms more frequently.

There is a safety or health rationale for the correction of all three of these problems. Should they be corrected?

Some managers would accept the safety and health rationale as *all they need* to begin action to correct the problems listed in Case Study 1.1. But this would be a naïve response. More data are needed to decide what to do. While busying the plant maintenance department to correct the foregoing three problems (which may or may not be consequential), a serious electrocution or respiratory hazard may be going unchecked

or maybe even unnoticed. By reacting to every hazard or do-good suggestion that happens to arise, the safety and health manager may be missing opportunities to have a really significant impact on worker safety and health. At the same time, such overreaction may also be deteriorating the safety and health manager's credibility with top management. Even the law does not call for the elimination of all hazards, just the ones that are "recognized." Therefore, let it be clearly understood that our objective is to eliminate unreasonable hazards, *not all hazards* in the workplace. The goal of this book, then, is to assist the safety and health manager in (1) detecting hazards and (2) deciding which ones are worth correcting. The goal is an ambitious one, and this book certainly claims no breakthroughs for solving this difficult problem. However, any light that can be shed on the mystery of which hazards are most significant and which standards, among the thousands, are most critical is sorely needed by safety and health managers everywhere.

SAFETY VERSUS HEALTH

This chapter has already implied that early "safety directors" did not emphasize health problems. It is essential that today's safety and health manager give sufficient attention not only to safety hazards, but also to health hazards, which are steadily gaining in importance as new data about industrial disease are being uncovered.

What really is the difference between safety and health? The words are so common that almost everyone has a firm image of the concept of safety versus the concept of health. There is no question that machine guarding is a safety consideration, and that airborne asbestos is a health hazard. But some hazards—such as those associated with paint spray areas and welding operations—are not so easy to classify. Some situations may be both a health *and* a safety hazard. This book will draw the following line between safety and health:

> Safety deals with acute effects of hazards, whereas health deals with chronic effects of hazards.

An acute effect is a sudden reaction to a severe condition; a chronic effect is a long-term deterioration due to prolonged exposure to a milder adverse condition. Everyday concepts of health and safety fit this definition, which separates the two. Industrial noise, for instance, is usually a health hazard because it is usually the long-term exposure to noise levels in the range 90 to 100 decibels that leads to the permanent damage. But noise can also be a safety hazard because a sudden acute exposure to impact noise can *injure* the hearing system. Many chemical exposures have both acute and chronic effects and thus are both safety and health hazards.

Industrial hygienists, those who concentrate on health hazards, are known by their sophisticated instruments and scientific expertise. These tools are necessary to the industrial hygienist because of the tiny effects they must measure in order to determine whether a chronic hazard exists. By contrast, the safety specialist, instead of being an expert with precise scientific instruments, usually has more industrial process experience and practical on-the-job knowledge. This difference in backgrounds may generate some confrontation between safety professionals and health professionals—though they should be partners, they sometimes compete.

The bases of competition between safety and health professionals are classics: young versus old, new versus old, and education versus experience. Safety professionals are usually older and have more industrial experience; their career field is more traditional and more entrenched in industrial organizations. Health professionals are typically younger, have more college education, and occupy newer job positions. In the twenty-first century, however, the distinctions between the career safety professional and the career health professional are disappearing.

It is difficult to say whether safety hazards or health hazards are more serious. Safety professionals can point to fatalities on the job and feel a sense of urgency in protecting the worker from imminent danger from accidents. Industrial hygienists use sophisticated meters and pumps to test for microscopic, insidious, and unseen hazards that can ultimately be just as lethal as a falling crane.

There are probably more occupational health fatalities than safety fatalities, but the statistics will not reflect this difference because the health fatalities are delayed and often are never diagnosed.

Another problem with identifying health hazards is that the signs of occupational illness are often identical to common symptoms arising from normally occurring illnesses encountered off the job. For instance, a common cold causes respiratory congestion, headaches, and perhaps fever. These same symptoms could also be the result of a dangerous exposure to a toxic chemical or other occupational hazard. The industrial hygienist is tasked with sorting out these symptoms and identifying occupational hazards to be controlled. Considerable expertise is required to do this, and the problem is often more subtle than that of the person charged with controlling common safety hazards alone.

ROLE IN THE CORPORATE STRUCTURE

Most safety and health managers wear several hats, especially in smaller firms. Often, they are responsible for security; some are also personnel managers, and even more frequently they report to the personnel manager. This is a fairly natural arrangement in that it emphasizes the importance of worker training, statistics, job placement, and the industrial relations aspect of safety and health. The growing importance of engineering to workplace safety and health, however, strains the placement of the safety and health manager within the personnel department, which traditionally has little interaction with engineering.

The safety and health manager is virtually never associated with the purchasing function, but one of the first goals of the safety and health manager should be to obtain some input into the purchasing process. Used-equipment dealers, even new-equipment dealers, often have bargain-priced machines, compressors, tractors, forklifts, and other pieces of equipment that fail in some way or another to meet minimum safety standards. The purchasing agent usually is not knowledgeable in safety and health standards and is easy prey for these dealers because the price is right. What is needed is a knowledgeable person to check specifications and prevent the costly purchasing error of buying equipment that does not meet current safety and health standards. When standards change, another category of equipment sometimes becomes obsolete, and the safety and health manager should warn the purchasing department when these changes occur.