OCCUPATIONAL SAFETY
AND HEALTH
For Technologists, Engineers, and Managers

Ninth Edition

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PREFACE

BACKGROUND
The field of occupational safety and health has undergone significant change over the past three decades. There are many reasons for this. Some of the more prominent reasons include the following: technological changes that have introduced new hazards in the workplace; proliferation of health and safety legislation and corresponding regulations; increased pressure from regulatory agencies; realization by executives that workers in a safe and healthy workplace are typically more productive; health care and workers’ compensation cost increases; increased pressure from environmental groups and the public; a growing interest in ethics and corporate responsibility; professionalization of health and safety occupations; increased pressure from labor organizations and employees in general; rapidly mounting costs associated with product safety and other types of litigation; and increasing incidents of workplace violence.

All of these factors, when combined, have made the job of the modern safety and health professional more challenging and more important than it has ever been. These factors have also created a need for an up-to-date book on workplace safety and health that contains the latest information needed by people who will practice this profession in an age of global competition and rapid technological change.

WHY WAS THIS BOOK WRITTEN AND FOR WHOM?
This book was written to fulfill the need for an up-to-date, practical teaching resource that focuses on the needs of modern safety and health professionals practicing in the workplace. It is intended for use in universities, colleges, community colleges, technical schools, and corporate training settings that offer programs, courses, workshops, and seminars in occupational safety and health. Educators in such disciplines as safety engineering, engineering, industrial technology, manufacturing technology, industrial engineering, engineering technology, occupational safety, management, and supervision will find this book both valuable and easy to use. The direct, straightforward presentation of material focuses on making the theories and principles of occupational safety and health practical and useful in a real-world setting. Up-to-date research has been integrated throughout in a down-to-earth manner.

ORGANIZATION OF THE BOOK
The text contains 31 chapters organized into five parts, each focusing on a major area of concern for modern safety and health professionals. The chapters are presented in an order that is compatible with the typical organization of a college-level safety and health course. A standard chapter format is used throughout the book. Each chapter begins with a list of learning objectives and ends with a comprehensive summary. Following the summary, the chapters include review questions, key terms and concepts, and endnotes. Within most chapters are case studies to promote classroom discussion, as well as at least one safety fact or myth. These materials are provided to encourage review, stimulate additional thought, and provide opportunities for applying what has been learned.

SUPPLEMENTS
To access supplementary materials online, instructors need to request an instructor access code. Go to www.pearsonhighered.com/irc to register for an instructor access code.
Within 48 hours of registering, you will receive a confirming e-mail including an instructor access code. Once you have received your code, locate your text in the online catalog and click on the Instructor Resources button on the left side of the catalog product page. Select a supplement, and a login page will appear. Once you have logged in, you can access instructor material for all Pearson textbooks. If you have any difficulties accessing the site or downloading a supplement, please contact Customer Service at http://support.pearson.com/getsupport

HOW THIS BOOK DIFFERS FROM OTHERS

This book was written because in the age of global competition, safety and health in the workplace have changed drastically. Many issues, concerns, and factors relating specifically to modern workplace environments have been given more attention, greater depth of coverage, and more illumination here than other textbooks. Some of the areas receiving more attention and specific occupational examples include:

- The Occupational Safety and Health Act (OSH Act) and Occupational Safety and Health Administration (OSHA)
- Standards and codes
- Laws and liability
- Stress-related problems
- Life safety and fire hazards
- The evolving roles of health and safety professionals
- Health and safety training
- Human factors in safety
- Environmental issues and ISO 14000 standards
- Computers, robots, and automation
- Ethics and safety
- Bloodborne pathogens in the workplace
- MRSA in the workplace
- Product safety and liability
- Ergonomics and safety
- The relationship between safety and quality
- Workplace violence
- Workers’ compensation
- Repetitive strain injuries (RSIs)
- Terrorism threats in the workplace
- Safety-first corporate culture
- Off-the-job safety

NEW TO THIS EDITION

The ninth edition of Occupational Safety and Health is a major revision encompassing new regulations, revised regulations, and other new and updated material of importance to students of occupational safety and health. Specifically, the following revisions were made in the ninth edition:

CHAPTER 1:
1. Added information on the Triangle Fire as a famous accident.
2. Added a section about safety applying to all work sectors: manufacturing, food service, retail, hospitality, health care, etc.
3. Added the following to the time line: Hawthorn Light Experiment, Gilbreth’s Motion Study, and ergonomics.
4. Added information on the Chemical Safety Board.
5. Added information on ergonomics and CTDs as a trend in safety in the 1990s.
6. Added information on the West Fertilizer Company tragedy.
7. Added information on whether the accident rate has decreased because America has lost so many manufacturing jobs.

CHAPTER 2:
3. Added a reference year to Figures 2–1, 2–2, and 2–3 so students know when the data were compiled.
4. Added a brief section on OSHA reports and logs here (and reference where they appear in detail in Chapter 6).
5. Converted Figure 2–4 into a chart.

CHAPTER 3:
1. Bolded the sentence about Heinrich’s Theory being discounted by contemporary research for emphasis.
2. Added information on James Reason’s Swiss Cheese Model of accident causation.
3. Revised Figure 3–1 as a simple checklist.
4. Changed the section on “Drugs and Accident Causation” to “Individual Factors and Accident Causation” (include drugs, depression, obesity, fatigue, personality, etc.).

CHAPTER 4:
1. Added information on the importance of the employee on safety teams and the employee’s role in safety.
2. Replaced Figures 4–9 and 4–10 with photographs.

CHAPTER 5:
1. Added information about the growth of manufacturing in China.
2. Strengthened the definition of competitiveness and Figure 5–1.
3. Added a section on how OSHA and other government regulations affect the competitiveness of American companies.

CHAPTER 6:
1. Added information on indirect costs of OSHA fines (bad PR, loss of goodwill, corporate image, legal fees, paperwork, etc.).
2. Replaced Figure 6–4 with instructions for finding consultation services in your state.
3. Revised Figure 6–6 to include website addresses for each agency instead of street addresses.
4. Updated the OSHA standard subparts to ensure they are up to date.
5. Added information on where the fines go when OSHA collects them and discussion plus examples about the size of fines.

CHAPTER 7:
1. Replaced Figure 7–1 with a figure showing how students can access workers’ compensation information for their states.
2. Added information on Workers’ Compensation abuse (employees trying to take advantage of the system).
3. Replaced Figure 7–2 with a photograph.

CHAPTER 8:
1. Added information about why safety professionals who do accident reports need to be familiar with common causes of accidents (added to the “Common Causes of Accidents” section).
2. Added a section on “Who Is responsible for reporting.”
3. Added an accident investigation exercise to the end of the chapter.

CHAPTER 9:
1. Added information about warning labels (when to have them, how to design them, do they work, etc.).

CHAPTER 10:
1. Added information on ergonomic assessment tools such as NIOSH guidelines, RULA, and REBA.
2. Moved section on “lifting” from Chapter 15 to this chapter and expanded the content of the section.
3. Expanded the section on “Human Factors and Safety.”
4. Added information on choosing which workstations/operations to evaluate for ergonomics to the section on “Worksite Analysis Program.”
5. In the section titled “Training and Education,” referred students to Chapter 12 and recommended using training materials from OSHA.
6. In the section on “Identifying Specific Ergonomic Problems” added material on “anthropometry” (body size).
7. In the section on “Cumulative Trauma Disorders” added information on analysis tools including RULA, REBA, HAL, and strain index, etc.).

CHAPTER 11:
1. Explained how the list of “common causes” can be used and how it relates to the rest of the chapter.
2. Added explanations for the strategies for dealing with stress.
3. Added physiological measures of stress (heart rate, pupil dilation, perspiration, etc.).
4. Added information about 24/7 use of technology and multitasking as causes of stress.
5. Added information about Employee Assistance Programs (EAPs) and company wellness programs for dealing with stress.

CHAPTER 12:
1. Added information about training available from the OSHA Training Institute (OTI).
2. Added information about OSHA’s nationwide network of training centers.

CHAPTER 13:
1. Expanded the explanations of risk reduction strategies.
2. Updated the “Emergency Preparedness” section to show the new “holistic approach” and the breadth of events safety professionals might have to respond to.
CHAPTER 14:
1. Added information about how a given type of machine guard is chosen.
2. Added information on advanced sensors and Bluetooth technology.

CHAPTER 15:
1. Dropped “Lifting” from the title to this chapter, and moved the section on lifting to Chapter 10.
2. Changed title to “Falling, Impact, Acceleration, and Vision Hazards with Associated PPE.”

CHAPTER 16:
1. Added information on CLO as a unit for measure for PPE temperature protection.
2. Added a section on OSHA recommendations and guidelines for temperature hazards.
3. Added a note to “Chemical Burns” explaining why it is in this chapter and not in the chapter on fire safety.

CHAPTER 17:
1. Added a note that refers students to Chapter 20 for coverage of “Confined Spaces.”
2. Added information on 29 CFR 1910 Subpart H (OSHA’s standards on pressure hazards).

CHAPTER 18:
1. Added information about power cords, surge strips, and daisy chains.
2. Made minor updates and corrections to the text.

CHAPTER 19:
1. Added information about the number of fire extinguishers needed, how to choose the type, and where they should be located in a facility.
2. Moved sections on “Chemical Burns” and “Heat Burns” from Chapter 2 to this chapter.
3. Added information to the “egress” section about lighting and signage.
4. Strengthened the material on “egress.”

CHAPTER 20:
1. Added information to describe TWA in more detail.
2. Removed the underline from the TWA side of the equation.

CHAPTER 21:
1. Added material and photos on signage.
2. Made minor corrections to the text.

CHAPTER 22:
1. Added a section about “earbuds” from handheld devices and potential hazards.
2. In the section on “Hazard Levels and Risks” added information from Chapter 16 on calculating TWA and TLV.
3. In the section on “Vibration Hazards” added information about tools insulation, tool mounting, and job rotation.
4. In the section on “Noise Control Strategies” added information on specific engineering controls (e.g., mufflers, insulation, wall panels, and sound absorption).
5. Added information about calculating noise reduction rating (NRR) and how to evaluate PPE based on the NRR.
6. Moved the section on “Fit Testing” to earlier in the chapter.
CHAPTER 23:
1. Added a new section on emerging technologies such as Google Glasses.
2. To the section on “Impact of Automation on the Workplace” added material about how the change from physical work to automated work shifts safety concerns from physical risk to repetitive strain injuries.
3. To the section on “VTDs in Offices and Factories” added information about OSHA tools and checklists that are available to evaluate workstations.
4. Added material on the expanded use of laptops, tablets, and handheld devices.
5. Added material on automated vehicles.

CHAPTER 25:
1. Added a section on “active shooter” response.
2. Added a section on “reporting suspicious activities.”

CHAPTER 26:
1. Added information on “whistleblowers” and how companies can protect them.
2. Added a section about “Professional Codes of Conduct” (such as the one used by NSPE).
3. Took out the statement “If something is illegal it is also unethical” since this is open to philosophical debate.

CHAPTER 27:
1. Added more explanation of FMEA and HAZOP.
2. Added information on LOPA.

CHAPTER 28:
1. Added a brief section on organizational culture and safety, and referred students to Chapter 31 for more detail.
2. Added material about the organization’s mission statement as it relates to safety and how the safety policy is related to management policy (i.e., performance appraisals, rewards and recognition, and firing).
3. To the section on “Safety Rules and Regulations” added an example of a rule/registration.
4. To the section on “Visual Awareness” added material about the requirements relating to signage and COLORS.
5. To the section on “Employee-Management Participation” added material on how a participative culture helps safety.
6. To the section on “Teamwork Approach to Promoting Safety” added material on the role of the team in promoting a safety culture.

CHAPTER 29:
1. Added new section on “sustainability.”
2. Revised the title to reflect broader coverage than just ISO 14000.

CHAPTER 30:
1. Added a section warning against Lean/Six Sigma teams removing safety processes and devices.
2. Made minor corrections to the text.

CHAPTER 31:
1. Added information on hiring employees who “fit” into the culture.
2. Added information about BP and the Deep Water Horizon tragedy to illustrate a bad culture.
ABOUT THE AUTHOR

David L. Goetsch is Vice-President Emeritus of Northwest Florida State College and professor of safety, quality, and management. In addition, Dr. Goetsch is president and CEO of the Institute for Organizational Excellence (IOE), a private consulting firm dedicated to the continual improvement of organizational competitiveness, safety, and quality. Dr. Goetsch is co-founder of The Quality Institute, a partnership of the University of West Florida, Northwest Florida State College, and the Okaloosa Economic Development Council and founder of the Leadership Institute of Northwest Florida State College.

ACKNOWLEDGMENTS

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INTRODUCTION

SAFETY VERSUS HEALTH

The title of this book intentionally includes the words safety and health. Throughout the text, the titles “safety and health professional,” “safety and health engineer,” and “safety and health manager” are used. This, too, is done by design. This approach underscores the point that the field of occupational safety has been broadened to encompass both safety and health. Consequently, managers, technical personnel, and engineers in this field must be knowledgeable about safety and health and be prepared to oversee a corporate program that encompasses both areas of responsibility.

Safety and health, although closely related, are not the same. One view is that safety is concerned with injury-causing situations, whereas health is concerned with disease-causing conditions. Another view is that safety is concerned with hazards to humans that result from sudden severe conditions; health deals with adverse reactions to exposure to toxic or otherwise dangerous hazards. Both of these views are generally accurate in portraying the difference between safety and health. However, the line between these two concepts is not always clearly marked.

For example, on the one hand, stress is a hazard that can cause both psychological and physiological problems over a prolonged period. In this case, it is a health concern. On the other hand, an overly stressed worker may be more prone to unintentionally forget safety precautions and thus may cause an accident. In this case, stress is a safety concern.

Because professionals in this evolving field are likely to be responsible for safety and health, it is important that they have a broad academic background covering both. This book attempts to provide that background.

This broadening of the scope of the profession does not mean that specialists in safety and health are not still needed. They are. Chapter 4 shows how today’s safety and health manager is a generalist who often heads a team of specialists such as safety engineers, health physicists, industrial hygienists, occupational nurses, occupational physicians, and risk managers. In order to manage a team of specialists in these various areas, safety and health managers must have the broad and comprehensive background that this book provides.
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ILO standards on occupational safety and health provide essential tools for governments, employers, and workers to establish such practices and to provide for maximum safety at work. In 2003 the ILO adopted an global strategy to improve occupational safety and health which included the introduction of a preventive safety and health culture, the promotion and development of relevant instruments, and technical assistance. Selected relevant ILO instruments. The ILO has adopted more than 40 standards specifically dealing with occupational safety and health, as well as over 40 Codes of Practice. Ne BASF Corporate Health Management system promotes and maintains the health and productivity of its employees. Supported by numerous emergency drills and health promotion measures, our worldwide standards for corporate health management are specified in a directive implemented by a global network of experts. BASF’s 2017 global Health Campaign focused on lung and respiratory health. To this end, we have set ambitious goals for occupational safety and constantly monitor progress towards these goals with a set of comprehensive preventive measures. In order to prevent work-related accidents, BASF promotes risk-conscious behavior and safe working practices for every individual, while constantly refining and enhancing safety requirements.