THIRD EDITION

THE BASICS OF OCCUPATIONAL SAFETY

DAVID L. GOETSCH

Third Edition

THE BASICS OF OCCUPATIONAL SAFETY

David L. Goetsch

Vice President Emeritus and Professor,
Northwest Florida State College

Pearson

330 Hudson Street, NY, NY 10013

Vice President, Portfolio Management: Andrew Gilfillan
Editorial Assistant: Lara Dimmick
Senior Vice President, Marketing: David Gesell
Marketing Coordinator: Elizabeth MacKenzie-Lamb
Director, Digital Studio and Content Production: Brian Hyland
Managing Producer: Jennifer Sargunar
Content Producer (Team Lead): Faraz Sharique Ali
Manager, Rights Management: Johanna Burke
Operations Specialist: Deidra Smith
Cover Design: Cenveo Publisher Services
Cover Photo: Lucidio Studio, Inc./ Moment/ Getty Images
Full-Service Project Management: Integra Software Services Pvt. Ltd.
Composition: Integra Software Services Pvt. Ltd.
Printer/Binder: LSC Communications, Inc.
Cover Printer: Phoenix Color/Hagerstown
Text Font: Times Ten LT Std

Library of Congress Cataloging-in-Publication Data

Names: Goetsch, David L., author.
Title: The basics of occupational safety / David L. Goetsch, vice president emeritus and professor, Northwest Florida State College.
Description: Third edition. | Boston : Pearson, [2019] | Includes index.
Identifiers: LCCN 2017018773 | ISBN 9780134678719 | ISBN 0134678710
Subjects: LCSH: Industrial safety. | Industrial hygiene.
Classification: LCC T55 .G5848 2019 | DDC 363.11—dc23
LC record available at https://lccn.loc.gov/ 2017018773

1 17

Pearson

ISBN-10: 0-13-467871-0
ISBN-13: 978-0-13-467871-9

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 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; healthcare and workers' compensation cost increases; increased pressure from environmental groups and the public; a growing interest in ethics and corporate social 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 the basics of workplace safety and health that contains the latest information needed by people who will have responsible positions in today's fast-paced, competitive workplace.

WHY IS THIS BOOK WRITTEN AND FOR WHOM?

This book is written to fulfill the need for an up-to-date, practical teaching resource that focuses on the basic safety-related needs of people 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 and students in such disciplines as safety engineering, engineering, industrial technology, manufacturing technology, industrial engineering, safety 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 20 chapters, each focusing on a major area of concern in workplace safety and health. 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. There is a list of learning objectives at the beginning of each chapter. All chapters include review questions, key terms and concepts, and endnotes. These materials are provided to encourage review, stimulate additional thought, and provide opportunities for applying what has been learned.

INSTRUCTOR RESOURCES

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 is 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 in other textbooks. Some of the areas receiving more attention and specific occupational examples include the following:

- The Occupational Safety and Health Act (OSH Act) and Occupational Safety and Health Administration (OSHA)
- Standards and codes
- Laws and liability
- Stress-related problems
- Fire hazards and life safety
- The evolving roles of health and safety professionals
- Health and safety training
- Human factors in safety
- Bloodborne pathogens in the workplace
- Ergonomics and safety
- Workers' compensation
- Repetitive strain injuries (RSIs)

NEW TO THIS EDITION

The third edition of *The Basics of Occupational Safety* is a major revision encompassing new regulations, revised regulations, and other new and updated material of importance for the students of occupational safety and health. Specifically, the following revisions are made in the third edition:

CHAPTER 1:

1. Added a section about safety applying to all work sectors: manufacturing, retail, hospitality, healthcare, etc.
2. Added information on the Chemical Safety Board.
3. Added information on ergonomics as a trend in safety in the 1990s.
4. Added information on the West Fertilizer Company tragedy.
5. Added information on whether the accident rate has decreased because America has lost so many manufacturing jobs.

CHAPTER 2:

1. Moved "Heat Burns and Chemical Burns" sections to Chapter 15.
2. Moved "Repetitive Strain/Soft Tissue Injuries" section to Chapter 8.
3. Added a reference year to Figures 2–1, 2–2, and 2–3 so students know when the data was compiled.
4. Added a brief section on OSHA reports and logs here (and reference where they appear in detail in Chapter 5).
5. Converted Figure 2–4 into a chart.
6. Added a link to Bureau of Labor Statistics for more detailed information.

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. Changed the section on "Drugs and Accident Causation" to "Individual Factors and Accident Causation" (includes 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 on indirect costs of OSHA fines (bad PR, loss of goodwill, corporate image, legal fees, paperwork, etc.).
2. Replaced Figure 5–4 with instructions for finding consultation services in your state.
3. Revised Figure 5–5 to include website addresses for each agency instead of street addresses.
4. Updated the OSHA standard subparts listed 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 6:

1. Replaced Figure 6–1 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 6–2 with a photograph.

CHAPTER 7:

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 8:

1. Added information on ergonomic assessment tools such as NIOSH guidelines, RULA, and REBA.
2. Moved section on "lifting" from Chapter 11 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 using recommended training materials from OSHA.
6. In the section on "Identifying Specific Ergonomic Problems" added material on "anthropometry" (body size).
7. In the section on "Helpful Assessment Tools: NIOSH, RULA, REBA, and HAL" (added information on analysis tools including RULA, REBA, HAL, and Strain Index).

CHAPTER 9:

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 10:

1. Added information about how a given type of machine guard is chosen.
2. Added information on advanced sensors and Bluetooth technology.

CHAPTER 11:

1. Dropped "Lifting" from the title to this chapter, and moved the section on lifting to Chapter 8.
2. Changed title to "Falling, Impact, Acceleration, and Vision Hazards with Appropriate PPE."

CHAPTER 12:

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 13:

1. Added a note that refers students to Chapter 16 for coverage of "Confined Spaces."
2. Added information on 29 CFR 1910 Subpart H (OSHA's standards on pressure hazards).

CHAPTER 14:

1. Added information about power strips and daisy chains.
2. Made minor updates corrections to the text.

CHAPTER 15:

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" from Chapter 2 to this chapter.
3. Added information to the "egress" section about lighting and signage.
4. Strengthened the material on "egress."

CHAPTER 16:

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

CHAPTER 17:

1. Expanded the explanations of risk reduction strategies.

CHAPTER 18:

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.
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 19:

1. Added a section on "active shooter" response.
2. Added a section on "reporting suspicious activities."

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 cofounder 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 and founder of the Leadership Institute of Northwest Florida State College.

ACKNOWLEDGMENTS

The author acknowledges the invaluable assistance of the following people in developing this book: Dr. Lissa Galbraith, Florida A&M/Florida State University, for the material she contributed on electrical and fire hazards in the first edition.

Introduction

SAFETY VERSUS HEALTH

Throughout the text, the titles "safety and health professional" 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 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 prolonged exposure to dangerous, but less intense, 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, 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 overlook safety precautions and thus may cause an accident. In this case, stress is a safety concern.

Because personnel in this evolving profession 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 page intentionally left blank

Brief Contents

This page intentionally left blank

Contents

This page intentionally left blank

CHAPTER

1

SAFETY AND HEALTH MOVEMENT, THEN AND NOW

Learning Objectives

- Summarize key developments relating to workplace safety and health prior to the Industrial Revolution
- List the most important milestones in the safety movement
- Explain how workplace tragedies have changed the safety movement
- Describe the role of organized labor in the safety movement
- Describe the roles specific health problems have played in the safety movement
- Explain how safety and health standards apply to more than just manufacturing
- Describe the development of accident prevention programs as part of the safety movement
- Describe the safety and health movement today
- Explain the integrated approach to safety and health
- Describe how new materials, new processes, and new problems are affecting the safety and health movement today
- Summarize the rapid growth that has occurred in the safety and health profession
- Explain how the movement of manufacturing jobs overseas has affected the accident rate in the United States

The **safety movement** in the United States has developed steadily since the early 1900s. In that time period, industrial accidents were commonplace in this country; for example, in 1907, more than 3,200 people were killed in mining accidents. Legislation, precedent, and public opinion all favored management. There were few protections for workers' safety.

Working conditions for industrial employees today have improved significantly. The chance of a worker being killed in an industrial accident is less than half of what it was 60 years ago.[1] According to the National Safety Council (NSC), the current death rate from work-related injuries is approximately 4 per 100,000, or less than a third of the rate 50 years ago.[2]

Improvements in safety until now have been the result of pressure for legislation to promote safety and health, the steadily increasing costs associated with accidents and injuries, and the professionalization of safety as an occupation. Improvements in the future are likely to come as a result of greater awareness of the cost-effectiveness and resultant competitiveness gained from a safe and healthy workforce.

This chapter examines the history of the safety movement in the United States and how it has developed over the years. Such a perspective will help practicing and prospective safety professionals form a better understanding of both their roots and their future.

DEVELOPMENTS BEFORE THE INDUSTRIAL REVOLUTION

It is important for students of occupational health and safety to first study the past. Understanding the past can help safety and health professionals examine the present and future with a sense of perspective and continuity. Modern developments in health and safety are neither isolated nor independent. Rather, they are part of the long continuum of developments in the safety and health movement.

The continuum begins with the days of the ancient Babylonians. During that time, circa 2000 BC, their ruler, Hammurabi, developed his **Code of Hammurabi**. The code encompassed all the laws of the land at that time, showed Hammurabi to be a just ruler, and set a precedent followed by other Mesopotamian kings. The significance of the code from the perspective of safety and health is that it contained clauses dealing with injuries, allowable fees for physicians, and monetary damages assessed against those who injured others.[3] This clause from the code illustrates Hammurabi's concern for the proper handling of injuries: "If a man has caused the loss of a gentleman's eye, his own eye shall be caused to be lost."[4]

This movement continued and emerged in later Egyptian civilization. As evidenced from the temples and pyramids that still remain, the Egyptians were an industrious people. Much of the labor was provided by slaves, and there is ample evidence that slaves were not treated well—that is, unless it suited the needs of the Egyptian taskmasters.

One such case occurred during the reign of Rameses II (circa 1500 BC), who undertook a major construction project, the Ramesseum. To ensure the maintenance of a workforce sufficient to build this huge temple bearing his name, Rameses created an industrial medical service to care for the workers. They were required to bathe daily in the Nile and were given regular medical examinations. Sick workers were isolated.[5]

The Romans were vitally concerned with safety and health, as can be seen from the remains of their construction projects. The Romans built aqueducts, sewerage systems, public baths, latrines, and well-ventilated houses.[6]

As civilization progressed, so did safety and health developments. In 1567, Philippus Aureolus produced a treatise on the pulmonary diseases of miners. Titled

On the Miners' Sickness and Other Miners' Diseases, the treatise covered diseases of smelter workers and metallurgists and diseases associated with the handling of and exposure to mercury. Around the same time, Georgius Agricola published his treatise *De Re Metallica*, emphasizing the need for ventilation in mines and illustrating various devices that could be used to introduce fresh air into mines.[7]

The eighteenth century saw the contributions of Bernardino Ramazzini, who wrote *Discourse on the Diseases of Workers*. Ramazzini drew conclusive parallels between diseases suffered by workers and their occupations. He related occupational diseases to the handling of harmful materials and to irregular or unnatural movements of the body. Much of what Ramazzini wrote is still relevant today.[8]

The Industrial Revolution changed forever the methods of producing goods. According to J. LaDou, the changes in production brought about by the Industrial Revolution can be summarized as follows:

- Introduction of **inanimate power** (i.e., steam power) to replace people and animal power
- Substitution of machines for people
- Introduction of new methods for converting raw materials
- Organization and specialization of work, resulting in a division of labor[9]

These changes necessitated a greater focusing of attention on the safety and health of workers. Steam power increased markedly the potential for life-threatening injuries, as did machines. The new methods used for converting raw materials also introduced new risks of injuries and diseases. Specialization, by increasing the likelihood of boredom and inattentiveness, also made the workplace a more dangerous environment.

MILESTONES IN THE SAFETY MOVEMENT

Just as the United States traces its roots to Great Britain, the safety movement in this country traces its roots to England. During the Industrial Revolution, child labor in factories was common. The hours were long, the work hard, and the conditions often unhealthy and unsafe. Following an outbreak of fever among the children working in their cotton mills, the people of Manchester, England, began demanding better working conditions in the factories. Public pressure eventually forced a government response, and in 1802 the Health and Morals of Apprentices Act was passed. This was a milestone piece of legislation: It marked the beginning of governmental involvement in workplace safety.

When the industrial sector began to grow in the United States, hazardous working conditions were commonplace. Following the Civil War, the seeds of the safety movement were sown in this country. Factory inspection was introduced in Massachusetts in 1867. In 1868, the first barrier safeguard was patented. In 1869, the Pennsylvania legislature passed a mine safety law requiring two exits from all mines. The Bureau of Labor Statistics (BLS) was established in 1869 to study industrial accidents and report pertinent information about those accidents.

The following decade saw little new progress in the safety movement until 1877, when the Massachusetts legislature passed a law requiring safeguards for hazardous machinery. This year also saw passage of the Employer's Liability Law, establishing

the potential for **employer liability** in workplace accidents. In 1892, the first recorded safety program was established in a Joliet, Illinois, steel plant in response to a scare caused when a flywheel exploded. Following the explosion, a committee of managers was formed to investigate and make recommendations. The committee's recommendations were used as the basis for the development of a safety program that is considered to be the first safety program in American industry.

Around 1900, Frederick Taylor began studying efficiency in manufacturing. His purpose was to identify the impact of various factors on efficiency, productivity, and profitability. Although safety was not a major focus of his work, Taylor did draw a connection between lost personnel time and management policies and procedures. This connection between safety and management represented a major step toward broad-based safety consciousness.

In 1907, the U.S. Department of the Interior created the Bureau of Mines to investigate accidents, examine health hazards, and make recommendations for improvements. Mining workers definitely welcomed this development, since more than 3,200 of their fellow workers were killed in mining accidents in 1907 alone.[10]

One of the most important developments in the history of the safety movement occurred in 1908 when an early form of **workers' compensation** was introduced in the United States. Workers' compensation actually had its beginnings in Germany. The practice soon spread throughout the rest of Europe. Workers' compensation as a concept made great strides in the United States when Wisconsin passed the first effective workers' compensation law in 1911. In the same year, New Jersey passed a workers' compensation law that withstood a court challenge.

The common thread among the various early approaches to workers' compensation was that they all provided some amount of compensation for on-the-job injuries regardless of who was at fault. When the workers' compensation concept was first introduced in the United States, it covered a very limited portion of the workforce and provided only minimal benefits. Today, all 50 states have some form of workers' compensation that requires the payment of a wide range of benefits to a broad base of workers. Workers' compensation is examined in more depth in Chapter 6.

The Association of Iron and Steel Electrical Engineers (AISEE), formed in the early 1900s, pressed for a national conference on safety. As a result of the AISEE's efforts, the first meeting of the **Cooperative Safety Congress (CSC)** took place in Milwaukee in 1912. What is particularly significant about this meeting is that it planted the seeds for the eventual establishment of the NSC. A year after the initial meeting of the CSC, the **National Council of Industrial Safety (NCIS)** was established in Chicago. In 1915, this organization changed its name to the National Safety Council. It is now the premier safety organization in the United States.

From the end of World War I (1918) through the 1950s, safety awareness grew steadily. During this period, the federal government encouraged contractors to implement and maintain a safe work environment. Also during this period, industry in the United States arrived at two critical conclusions: (1) there is a definite connection between quality and safety, and (2) off-the-job accidents have a negative impact on productivity. The second conclusion became painfully clear to manufacturers during World War II when the call-up and deployment of troops had employers struggling to meet their labor needs. For these employers, the loss of a skilled worker due to an injury or for any other reason created an excessive hardship.[11]

The 1960s saw the passage of a flurry of legislation promoting workplace safety. The Service Contract Act of 1965, the Federal Metal and Nonmetallic Mine Safety Act, the Federal Coal Mine and Safety Act, and the Contract Workers and Safety Standards Act all were passed during the 1960s. As their names indicate, these laws applied to a limited audience of workers.

These were the primary reasons behind passage of the **Occupational Safety and Health Act (OSH Act)** of 1970 and the Federal Mine Safety Act of 1977. These federal laws, particularly the OSH Act, represent the most significant legislation to date in the history of the safety movement. During the 1990s, the concept of Total Safety Management (TSM) was introduced and adopted by firms that were already practicing Total Quality Management (TQM). TSM encourages organizations to take a holistic approach to safety management in which the safety of employees, processes, and products is considered when establishing safe and healthy work practices.

At the turn of the century, workplace violence, including terrorism, began to concern safety and health professionals. In addition, the twenty-first century saw a trend in which older people were returning to work to supplement their retirement income. This trend led to a special emphasis on the safety and health of older workers. A more recent trend is greater concern of U.S. companies for the safety and health of employees in foreign countries that manufacture goods that are sold in the United States.

The Superfund Amendments and Reauthorization Act was passed by Congress in 1986, followed by the Amended Clean Air Act in 1990; both were major pieces of environmental legislation. Another milestone that occurred in the decade of the 1990s was the trend toward safety professionals making ergonomics part of their overall approach for preventing accidents and injuries. Ergonomics involves fitting the work to the worker rather than the worker to the work. It is concerned with, among other things, the prevention of musculoskeletal disorders (MSDs) and injuries.

Figure 1–1 summarizes some significant milestones in the development of the safety movement in the United States.

TRAGEDIES THAT HAVE CHANGED THE SAFETY MOVEMENT

The pace of the safety and health movement in the United States has been accelerated by the occurrence of workplace tragedies. These tragedies could have been prevented had appropriate safety and health measures been followed. Unfortunately, they were not. This section summarizes some of the more significant of these workplace tragedies; tragedies that have had a lasting effect on the safety and health movement.

Hawk's Nest Tragedy

In the 1930s, the public began to take notice of the health problems suffered by employees who worked in dusty environments. The Great Depression was indirectly responsible for the attention given to an occupational disease that came to be known as *silicosis*. As the economic crash spread, business after business shut down and laid off its workers. Unemployed miners and foundry workers began to experience problems finding new jobs when physical examinations revealed that they had lung damage from breathing silica. Cautious insurance companies recommended preemployment physicals as a way

FIGURE 1–1 Milestones in the safety movement.

1867	Massachusetts introduces factory inspection.
1868	Patent is awarded for first barrier safeguard.
1869	Pennsylvania passes law requiring two exits from all mines, and the Bureau of Labor Statistics is formed.
1877	Massachusetts passes law requiring safeguards on hazardous machines, and the Employer's Liability Law is passed.
1892	First recorded safety program is established.
1900	Frederick Taylor conducts first systematic studies of efficiency in manufacturing. Followed by the motion studies of Frank Gilbreth.
1907	Bureau of Mines is created by U.S. Department of the Interior.
1908	Concept of workers' compensation is introduced in the United States.
1911	Wisconsin passes the first effective workers' compensation law in the United States, and New Jersey becomes the first state to uphold a workers' compensation law.
1912	First Cooperative Safety Congress meets in Milwaukee.
1913	National Council of Industrial Safety is formed.
1915	National Council of Industrial Safety changes its name to National Safety Council.
1916	Concept of negligent manufacture is established (product liability).
1924	Hawthorne Light Experiments.
1936	National Silicosis Conference convened by the U.S. Secretary of Labor.
1970	Occupational Safety and Health Act passes.
1977	Federal Mine Safety Act passes.
1978	OSHA offers education and training grants.
1980	OSHA coverage extended to federal employees.
1986	Superfund Amendments and Reauthorization Act pass.
1990	Amended Clean Air Act of 1970 passes. Also, safety professionals begin to apply the principles of ergonomics.
1996	Total safety management (TSM) concept is introduced.
2000	U.S. firms begin to pursue ISO 14000 registration for environmental safety management.
2003	Workplace violence and terrorism are an ongoing concern of safety and health professionals.
2007	Safety of older people reentering the workplace becomes an issue.
2009	Global Harmonization System for chemicals established.
2010	Off-the-job safety becomes an issue.
2017	Pressure on foreign companies that produce goods sold in the United States to improve their safety standards.

to prevent future claims based on preexisting conditions. Applicants with silica-damaged lungs were refused employment. Many of them sued. This marked the beginning of industry-wide interest in what would eventually be called the "king" of occupational diseases.

Lawsuits and insurance claims generated public interest in silicosis, but it was the Hawk's Nest tragedy that solidified public opinion in favor of protecting workers from this debilitating disease.[12] A company was given a contract to drill a passageway through a mountain located in the Hawk's Nest region of West Virginia (near the city of Gauley Bridge). Workers spent as many as 10 hours per day breathing the dust created by drilling and blasting. It turned out that this particular mountain had an unusually high silica content. Silicosis is a disease that normally takes 10–30 years to show up in exposed workers. At Hawk's Nest, workers began dying in as little time as a year. By the time the project was completed, hundreds had died. To make matters even worse, the company often buried an employee who died from exposure to silica in a nearby field without notifying the family. Those who inquired were told that their loved one left without saying where he was going.

A fictitious account of the Gauley Bridge disaster titled *Hawk's Nest*, by Hubert Skidmore, whipped the public outcry into a frenzy, forcing Congress to respond.

This tragedy and the public outcry that resulted from it led a group of companies to form the Air Hygiene Foundation to conduct research and develop standards for working in dusty environments. Soon thereafter, the U.S. Department of Labor provided the leadership necessary to make silicosis a compensable disease under workers' compensation in most states. Today, dust-producing industries use a wide variety of administrative controls, engineering controls, and personal protective equipment to protect workers in dusty environments. However, silicosis is still a problem. Approximately 1 million workers in the United States are still exposed to silica every year, and 250 people die annually from silicosis.

Asbestos Menace

Asbestos was once considered a "miracle" fiber, but in 1964, Dr. Irving J. Selikoff told 400 scientists at a conference on the biological effects of asbestos that this widely used material was killing workers. This conference changed how Americans viewed not just asbestos but also workplace hazards in general. Selikoff was the first to link asbestos to lung cancer and respiratory diseases.[13]

At the time of Selikoff's findings, asbestos was one of the most widely used materials in the United States. It was found in homes, schools, offices, factories, ships, and even in the filters of cigarettes. Selikoff continued to study the effects of asbestos exposure from 1967 to 1986. During this time, he studied the mortality rate of 17,800 workers who had been exposed to asbestos. He found asbestos-related cancer in the lungs, gastrointestinal tract, larynx, pharynx, kidneys, pancreas, gall bladder, and bile ducts of workers.

Finally, in the 1970s and 1980s, asbestos became a controlled material. Regulations governing the use of asbestos were developed, and standards for exposure were established. Asbestos-related lawsuits eventually changed how industry dealt with this tragic material. In the 1960s, industry covered up or denied the truth about asbestos. Now, there is an industry-wide effort to protect workers who must remove asbestos from old buildings and ships during remodeling, renovation, or demolition projects.

Bhopal Tragedy

On the morning of December 3, 1984, over 40 tons of methyl isocyanate (MIC) and other lethal gases, including hydrogen cyanide, leaked into the northern end of Bhopal, killing more than 3,000 people in its aftermath.[14] After the accident, it was discovered that the protective equipment that could have halted the impending disaster was not in full working order. The refrigeration system that should have cooled the storage tank was shut down, the scrubbing system that should have absorbed the vapor was not immediately available, and the flare system that would have burned any vapor that got past the scrubbing system was out of order.[15]

The International Medical Commission visited Bhopal to assess the situation and found that as many as 50,000 other people had been exposed to the poisonous gas and may still suffer disability as a result. This disaster shocked the world. Union Carbide Corporation, the owner of the chemical plant in Bhopal, India, where the incident occurred, was accused of many things, including the following:

- **Criminal negligence.**
- **Corporate prejudice.** Choosing poverty-stricken Bhopal, India, as the location for a hazardous chemical plant on the assumption that few would care if something went wrong.
- **Avoidance.** Putting its chemical plant in Bhopal, India, to avoid the stricter safety and health standards of the United States and the Occupational Safety and Health Administration (OSHA) in particular.

In February 1989, India's Supreme Court ordered Union Carbide India Ltd. to pay $470 million in compensatory damages. The funds were paid to the Indian government to be used to compensate the victims. This disaster provided the impetus for the passage of stricter safety legislation worldwide. In the United States, it led to the passage of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986.

Factory Fire in Bangladesh

In November 2012, a garment-factory fire in Bangladesh killed 112 employees. The magnitude of the tragedy was enhanced when it was discovered that the factory produced garments to sell in several major retail outlets in the United States. Fire inspectors suspect that an electrical short circuit caused the blaze, which spread quickly because of the flammable nature of material used to produce T-shirts in the factory. There were complaints that well-known retailers in the United States, and elsewhere in the Western world, were partially culpable in the tragedy because there was evidence that they knew of the unsafe conditions beforehand.

The garment factory in question had a functioning fire alarm and the alarm did go off properly. Unfortunately, supervisors demanded that workers go back to their sewing machines and even blocked an exit door workers could have used to escape the conflagration. It was learned in the subsequent investigation that the factory's fire extinguishers did not work and were displayed only to fool inspectors. A follow-up investigation revealed that 100 workers had been burned to death inside the factory while another 12 jumped to their deaths to escape the flames. This tragedy added to the mounting pressure for U.S. companies that contract with offshore manufacturers to pressure those manufacturers to implement safe and healthy work practices.

ROLE OF ORGANIZED LABOR

Organized labor has played a crucial role in the development of the safety movement in the United States. From the outset of the Industrial Revolution in this country, organized labor has fought for safer working conditions and appropriate compensation for workers injured on the job. Many of the earliest developments in the safety movement were the result of long and hard-fought battles by organized labor.

Although the role of unions in promoting safety is generally acknowledged, one school of thought takes the opposite view. Proponents of this dissenting view hold that union involvement actually slowed the development of the safety movement. Their theory is that unions allowed their demands for safer working conditions to become entangled with their demands for better wages; as a result, they met with resistance from management. Regardless of the point of view, there is no question that working conditions in the earliest years of the safety movement were often reflective of an insensitivity to safety concerns on the part of management.

Among the most important contributions of organized labor to the safety movement was their work to overturn antilabor laws relating to safety in the workplace. These laws were the fellow servant rule, the statutes defining contributory negligence, and the concept of assumption of risk.[16] The **fellow servant rule** held that employers were not liable for workplace injuries that resulted from the negligence of other employees. For example, if Worker X slipped and fell, breaking his back in the process, because Worker Y spilled oil on the floor and left it there, the employer's liability was removed. In addition, if the actions of employees contributed to their own injuries, the employer was absolved of any liability. This was the doctrine of **contributory negligence**. The concept of **assumption of risk** was based on the theory that people who accept a job assume the risks that go with it. It says employees who work voluntarily should accept the consequences of their actions on the job rather than blame the employer.

Because the overwhelming majority of industrial accidents involve negligence on the part of one or more workers, employers had little to worry about. Therefore, they had little incentive to promote a safe work environment. Organized labor played a crucial role in bringing deplorable working conditions to the attention of the general public. Public awareness and, in some cases, outrage eventually led to these **employer-biased laws** being overturned in all states except one. In New Hampshire, the fellow servant rule still applies.

West Fertilizer Company Explosion

On April 17, 2013, an explosion occurred at the storage and distribution center of the West Fertilizer Company in West, Texas. The explosion occurred when fire set off ammonium nitrate while emergency personnel were battling the blaze. The explosion killed 15 people and injured 160 others. More than 150 surrounding buildings were damaged or destroyed. In the ensuing investigation, it was determined that the fire had been deliberately set. Prior to the fire and explosion, OSHA had fined the company for improper storage of anhydrous ammonia and cited the company for violating its respiratory protection standards. The company had also been fined by the Environmental Protection Agency (EPA) in 2006 for failing to file a risk management program plan in a timely manner. Further, the company had been fined in 2012 by the U.S. Department of Transportation for violations pertaining to the improper storage of anhydrous ammonia.

ROLE OF SPECIFIC HEALTH PROBLEMS

Specific health problems that have been tied to workplace hazards have played significant roles in the development of the modern safety and health movement. These health problems contributed to public awareness of dangerous and unhealthy working conditions that, in turn, led to legislation, regulations, better work procedures, and better working conditions.

Lung disease in coal miners was a major problem in the 1800s, particularly in Great Britain, where much of the Western world's coal was mined at the time. Frequent contact with coal dust led to a widespread outbreak of anthracosis among Great Britain's coal miners. Also known as the *black spit*, this disease persisted from the early 1800s, when it was first identified, until around 1875, when it was finally eliminated by such safety and health measures as ventilation and decreased work hours.

In the 1930s, Great Britain saw a resurgence of lung problems among coal miners. By the early 1940s, British scientists were using the term *coal-miner's pneumoconiosis*, or CWP, to describe a disease from which many miners suffered. Great Britain designated CWP a separate and compensable disease in 1943. However, the United States did not immediately follow suit, even though numerous outbreaks of the disease had occurred among miners in this country.

The issue was debated in the United States until Congress finally passed the Coal Mine Health and Safety Act in 1969. The events that led up to the passage of this act were tragic. An explosion in a coal mine in West Virginia in 1968 killed 78 miners. This tragedy focused attention on mining health and safety, and Congress responded by passing the Coal Mine Health and Safety Act. The act was amended in 1977 and again in 1978 to broaden the scope of its coverage.

Over the years, the diseases suffered by miners were typically lung diseases caused by the inhalation of coal dust particulates. However, health problems were not limited to coal miners. Other types of miners developed a variety of diseases, the most common of which was silicosis. Once again, it took a tragic event—the Gauley Bridge disaster, discussed earlier—to focus attention on a serious workplace problem.

Congress held a series of hearings on the matter in 1936. That same year, representatives from business, industry, and government attended the National Silicosis Conference, convened by the U.S. secretary of labor. Among other outcomes of this conference was a finding that silica dust particulates did, in fact, cause silicosis.

Mercury poisoning is another health problem that has contributed to the evolution of the safety and health movement by focusing public attention on unsafe conditions in the workplace. The disease was first noticed among the citizens of a Japanese fishing village in the early 1930s. A disease with severe symptoms was common in Minamata, but extremely rare throughout the rest of Japan. After much investigation into the situation, it was determined that a nearby chemical plant periodically dumped methyl mercury into the bay that was the village's primary source of food. Consequently, the citizens of this small village ingested hazardous dosages of mercury every time they ate fish from the bay.

Mercury poisoning became an issue in the United States after a study was conducted in the early 1940s that focused on New York City's hat-making industry. During that time, many workers in this industry displayed the same types of symptoms as the citizens of Minamata, Japan. Because mercury nitrate was used in the production of

hats, enough suspicion was aroused to warrant a study. The study linked the symptoms of workers with the use of mercury nitrate. As a result, the use of this hazardous chemical in the hat-making industry was stopped, and a suitable substitute—hydrogen peroxide—was found.

As discussed earlier, asbestos was another important substance in the evolution of the modern safety and health movement. By the time it was determined that asbestos is a hazardous material, the fibers of which can cause asbestosis or lung cancer (mesothelioma), thousands of buildings contained the substance. As these buildings began to age, the asbestos—particularly that used to insulate pipes—began to break down. As asbestos breaks down, it releases dangerous microscopic fibers into the air. These fibers are so hazardous that removing asbestos from old buildings has become a highly specialized task requiring special equipment and training.

More recently, concern over the potential effects of bloodborne pathogens in the workplace has had a significant impact on the safety and health movement. Diseases such as acquired immunodeficiency syndrome (AIDS) and pathogens such as human immunodeficiency virus (HIV) and Hepatitis B (HBV) have caused changes to how safety and health professionals respond to medical emergencies and injuries in which blood and other bodily fluids may be present. Concern over the potential effects of bloodborne pathogens has introduced a whole new set of precautions as well as fears—some rational and some irrational—into the realm of workplace safety. Chapter 20 is devoted to the concept of bloodborne pathogens as it relates to workplace safety.

SAFETY AND HEALTH STANDARDS APPLY TO MORE THAN JUST MANUFACTURING

There is a misconception in some quarters that safety and health procedures such as those presented in this book apply only to manufacturing. While it is important for employers in the manufacturing sector to provide a safe and healthy work environment for their personnel, it is equally important for employers in all work sectors to do the same. The safe and healthy work practices advocated in this book apply to all work sectors, including natural resources and mining, manufacturing, construction, services, trade, transportation, utilities, information, financial, professional and business, education, government, healthcare, maritime, leisure, retail, and hospitality. As you will learn in Chapter 5, certain industry sectors such as construction and maritime have their own specific safety and health standards. But other sectors are covered by the rules set forth in 29 CFR 1910, OSHA's General Industry Standard.

DEVELOPMENT OF ACCIDENT PREVENTION PROGRAMS

In the modern workplace, there are many different types of **accident prevention** programs ranging from the simple to the complex. Widely used accident prevention techniques include failure minimization, fail-safe designs, isolation, lockouts, screening, personal protective equipment, redundancy, timed replacements, and many others. These techniques are individual components of broader safety programs. Such programs have evolved since the late 1800s.