BRADY FIRE SERIES

FUNDAMENTALS OF FIRE AND EMERGENCY SERVICES

THIRD EDITION

Jason B. Loyd
James D. Richardson

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Third Edition

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FOREWORD

Every year numerous young men and women make the choice to become firefighters. Many of these individuals are fortunate to learn about the fire service from close friends and family members who are already involved in the profession. Armed with this first-hand knowledge, they know for a fact that they want to be a firefighter. Some people join the fire service because they think it is a noble profession.

When I joined the fire service 31 years ago, I really had no idea what I was getting myself into. Jason Loyd and James Richardson have written *Fundamentals of Fire and Emergency Services* to help those seeking a career in the fire service. Jason and James share in this book the extensive knowledge they have gained throughout their fire service careers. Through this book, they become the "close friends and family members" of the men and women pursuing careers as firefighters.

I met Jason Loyd while serving with him on the Texas Commission on Fire Protection Curriculum and Testing Committee in 2004. Jason's passion for the fire service is remarkable. He continues to guide young men and women into fire service careers as an instructor and mentor. This book is an extension of his passion for mentoring new firefighters.

While all of the chapters of this book are important for the education of prospective firefighters, Chapter 3—The Selection Process, is particularly insightful. Once basic firefighter training is complete, new firefighters will face intense competition for jobs. Chapter 3 helps the new firefighter candidate navigate the steps of the hiring process to secure a job.

Fundamentals of Fire and Emergency Services is an essential tool in the new firefighter's toolbox. Just as a Halligan tool and an axe can open doors to allow firefighters to do their jobs, this book can be used as the tool to open the doors to an awesome firefighting career.

Chris Angerer, Public Sector Program Director
Texas A&M Engineering Extension Service (TEEX)

PREFACE

The fire service in the United States has evolved almost exponentially since the late 20th and early 21st centuries. New concepts have birthed new technologies, which, in turn, have birthed new concepts. This pattern has continued since 1970. The authors have stated many times that during the early years of the U.S. fire service, firefighters were only required to "wear a size 50 coat and size 2 hat." Brute force and aggressive firefighting were all that was needed to accomplish their mission. All this began to change after World War II. Some of the technologies used in the military began to be adapted for civilian use, such as breathing apparatus and fire-resistive clothing. However, the new technologies did not begin to show favor in the fire service until the early 1970s when the focus of the fire services mission began to change. Emergency Medical Services was integrated into the fire service. By the late 1970s, Hazardous Materials Teams and Heavy Rescue Teams were incorporated into the system. This inspired the development of new technologies to improve their operations, which created new training methods and operation techniques. In 2001, Emergency Management was added to the list of fire department's functions. The increased responsibilities placed on the fire service required a dramatic change in the requirements for fire service applicants. Being able to only perform the physical aspects of the fire service is no longer adequate. The "size 50 coat and size 2 hat" days are gone forever. The men and women seeking careers in the fire service are now expected to possess a high level of critical thinking and problem-solving abilities. Continuous training is mandated and achieving a higher education degree is encouraged.

The modern fire service is a dynamic profession and is faced with ever-increasing challenges. This text is not a "how to" text, such as those used in fire academy training schools. This text is designed to introduce students to the firefighting profession and remind career firefighters that the fire service is a profession requiring continuous learning.

NEW TO THIS EDITION

Chapter 1

- Updated statistics
- Metric conversion
- Information on Hurricane Harvey

Chapter 2

- Updated statistics
- Metric conversions added
- Updated Smokey Bear Campaign
- Updated contract firefighting opportunities
- Updated Senate Bill S2399 and similar bills
- Updated section on future of fire emergency careers and Eddie Burns Section

Chapter 3

- Metric conversions added
- Updated statistics

Chapter 4

- Metric conversions added

Chapter 5
- Updated statistics and information
- Added information on mobile data systems
- Metric conversions have been added
- Updated and new photos

Chapter 6
- Updated photos
- Metric conversions added
- Explanation of the SI system

Chapter 7
- Metric conversions are added
- Information on cross-laminated timbers
- Information on tilt-up construction
- Updated photos

Chapter 8
- Metric conversions have been added
- Updated information on occupancy classification

Chapter 9
- Metric conversions added
- Updated and new photos

Chapter 10
- Updated statistics
- Metric conversions added

Chapter 11
- Metric conversions have been added
- Updated information
- Statement on drone technology

Chapter 12
- Metric conversions are added
- Roles and responsibilities of the Medical Director
- Roles and responsibilities of the Emergency Support Function
- Expanded explanation of the roles and responsibilities of the LEPC
- Roles and responsibilities of the National Disaster Recovery Framework
- Updated statistics
- Pathways to emergency management added

HOW TO USE THIS TEXT

Throughout the text, there are several features that enhance the material presented. Stop and Think questions ask the student to pause, consider what they have just learned, and apply the concept. General safety icons point out areas where extra precaution is required. The icon of the National Fallen Firefighter's Foundation is used appropriately to promote

the 16 life-safety initiatives that ensure that "Everyone Goes Home." Each chapter concludes with an "On Scene," bridging the gap between classroom learning and experience. Review questions reinforce the chapter content by providing a final check that the student has mastered the chapter content.

Chapter 1: History of the Fire Service

This chapter introduces students to the history of the fire service—how it began, where it is now, and what the future of the fire service profession may be. This chapter covers the ever-changing role and needs of the fire service. The instructor may utilize particular historical information pertaining to the audience to personalize the lecture and link the past to the future fire service.

Chapter 2: Fire and Emergency Services Career Opportunities

This chapter will acquaint new and experienced students with the variety of career opportunities that the fire service offers. The basic role of a fire service worker has evolved into many aspects and new careers over the ages. This chapter focuses on the many specialized opportunities available to a firefighter. It also notes that although a specific job may have various titles, depending on the area or locale, the job description remains the same. The text provides basic information that the instructor can expand on to make the information more relevant to the student's environment.

Chapter 3: The Selection Process

This chapter gives an overview of the procedure that is typically followed in the fire service. It is recommended that the instructor give real examples of this process and possibly carry out a mock interview to illustrate the significance of learning this process. This chapter emphasizes that, no matter what a person's background is, the selection process is a structured venue. The more prepared an applicant is for the job, the more likely he or she will get the job.

Chapter 4: Training and Higher Education

This chapter can be used to impress on new students that training and education does not end when they graduate from the fire academy. Experienced students can also benefit from this chapter by learning different avenues that will allow them to further their career in ways that may not have been available before. Continual training and education are paramount for a safe department and for individuals to move through the fire service ranks. To give relevance to the students' environment, instructors can describe firefighters they know who have used training and education to their advantage.

Chapter 5: Fire Department Resources

This chapter can be used either to introduce new students to a variety of apparatus, facilities, and equipment that are used in the fire service today or the instructor's focus on the resources that are available in the instructor's area. The text provides basic information that the instructor can expand on to make the information more relevant to the students' environment.

Chapter 6: Fire Dynamics

This chapter is an overview of the chemistry and physics of fire and the phenomena that occur during the combustion process. The instructor may utilize the entire chapter to give new students an overview of fire dynamics or focus on certain topics to emphasize areas of concern to the more experienced student. The instructor may choose to use demonstrations to enhance the lecture.

Chapter 7: Building Construction

The focus of this chapter is to enlighten the student on the hazards that buildings pose under fire conditions. The emphasis is on the dangers of a building collapse and how to "read" a building during fire operations. It is recommended that the instructor obtain samples of various forms of structural elements for the student to view and manipulate. The information presented is appropriate for new and experienced students.

Chapter 8: Fire Prevention Codes and Ordinances

This chapter is designed to introduce students to the codes and ordinances that regulate the actions of the fire service. Students will learn why the codes and ordinances were created, the historical events that inspired them, and the constitutional challenges that set judiciary precedents. It is recommended that the instructor utilize the entire chapter to maintain a smooth, chronological flow of information.

Chapter 9: Fire Protection Systems

This chapter introduces the various forms of water-based automatic extinguishing systems, public water supplies, special extinguishing systems, and fire detection and alarm systems. The instructor may choose the level of instruction based on the level of experience of the students.

Chapter 10: Organizational Structure and Emergency Incident Management Systems

Using this chapter, the instructor may choose to introduce new students to the fire service organizational and rank structure before detailing the history and functions of incident management systems. For more experienced students, the instructor may want to give a brief history of how the incident management system was developed before moving to the National Incident Management System (NIMS). The dynamic nature of this system should be emphasized.

Chapter 11: Preincident Planning, Fire Strategy, and Tactics

When covering this chapter, the instructor should continually emphasize the importance of preincident planning. This chapter will be best utilized with scenario-based problem-solving activities that are founded on the information from the text. This will challenge new students and maintain the interest of experienced students.

Chapter 12: Emergency Medical Services and Emergency Management

The focus of this chapter is to introduce EMS and emergency management, which play an important role in the fire service. The basic role of a fire service worker has evolved into many aspects and new careers over the ages. The chapter also notes that although a specific job may have various titles, depending on the area or locale, the job description remains the same. Emergency medical responses and emergency management procedures are major forces in today's private and public emergency services; therefore, it is essential that there is a framework for federal, state, and local communities to work together in our nation's security.

STUDENT SUPPLEMENTS

To access the material on student resources that accompany this book, visit www.pearsonhighered.com/bradyresources. Click on view all resources and select Fire Science from the choice of disciplines. Find this book and you will find the complimentary study materials.

INSTRUCTOR RESOURCES

To access supplementary materials online from Pearson's Instructor Resource Center (IRC), instructors will need to use their IRC login credentials. If they don't have IRC login credentials they will 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 book 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. This book has the following instructor's resources.

- PowerPoint lecture slides
- TestGen
- Instructor Resources

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The most important person I want to acknowledge is my loving wife, Melissa, for her unwavering support during this endeavor. This text would never have been possible without her. Many thanks are due to my coauthor, J.D. Richardson, for his encouragement to never stop learning and to achieve the highest education possible to prepare for the future. I would like to thank Chief Mike Wisby and Angela Israel at Brayton Fire Training Field for their assistance in providing photos. I am grateful for the support that Brazos County Precinct 3 Volunteer Fire Department has given me during the writing of this book. This has truly been the most rewarding project with which I have ever been involved.

I would like to thank the reviewers in helping shape the third edition to make this the best possible textbook you will read and learn from. I know I probably missed many other people who have given me support and information throughout this project, and to them—thank you.

Finally, this textbook is dedicated to Firefighter Dick Danes who lost his life during a training exercise May 17, 2012. Firefighter Danes was the first line of duty death (L.O.D.D.) at Brazos County Precinct 3 Volunteer Fire Department. Firefighter Danes and his family will always be a part of our family. Thank you, Betsy, for being so loving and caring. You will always be in my heart.

—Jason B. Loyd

I would like to thank my wife, Dianne, for her patience and understanding while I worked on this project. She has always been my rock and my foundation, and I would not have completed this book without her support. She is, and always will be, the love of my life.

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Also to Captain Elmer Wayne (Red) Blevins (1932–2012), who served 52 years and 9 months with the Houston Fire Department Suppression Division. He was an inspiration to three generations of firefighters. God bless you Red.

—James D. (J.D.) Richardson

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ABOUT THE AUTHORS

Jason B. Loyd

Jason B. Loyd started his career in 1996 as a volunteer firefighter/EMT with Medina Valley in Castroville, Texas, while also attending San Antonio College. In 1998, he completed the San Antonio College Regional Fire Academy and was offered a job overseas as a contract firefighter on a U.S. military base. He was stationed in Hungary for two years and then promoted to Bosnia for two years. In Bosnia, he was responsible for training local national Bosnians to the Department of Defense firefighter standards for Fire Fighter I and II, Hazardous Materials—Awareness and Operations, Airport Fire Fighter, Driver/Operator-Pumper, and Driver/Operator-ARFF in addition to being a crew chief.

Mr. Loyd earned his Associate of Applied Science degree from San Antonio College in Fire Science and his baccalaureate degree from Empire State College in Business Management and Economics with a concentration in Fire Service Administration. Mr. Loyd went through the National Fire Academy Distance Degree Program (DDP) to obtain his baccalaureate degree. After completing his BS degree in 2001, he was offered a full-time position at Weatherford College in Fire Science Technology. Mr. Loyd and his wife then relocated back to the United States from Bosnia. At Weatherford, he was responsible for the curricula of two associate of applied science degrees, the regional fire academy, and all fire service training courses offered at the college. He holds various certifications with the Department of Defense (DoD) and Texas Commission on Fire Protection (TCFP), including Master Fire Fighter, Aircraft Rescue Fire Fighter, Fire Officer IV, Fire Instructor III, Driver/Operator-Pumper, Fire Inspector II, Fire Investigator, and field examiner. Mr. Loyd was awarded the Texas Association of Fire Educators George Hughes Instructor of the Year Award for 2003 and was recognized in the Who's Who Among America's Teachers. In 2004, he was appointed to the Texas Commission on Fire Protection Curriculum and Testing Committee and in the same year appointed to the International Fire Service Accreditation Congress (IFSAC) Degree Assembly Board of Governors. In 2005, he completed his Master of Arts degree in Education with a concentration in Higher Education. Furthermore, he remains a volunteer firefighter and EMS Training Coordinator with Brazos County Precinct 3 Volunteer Fire Department. In May 2007, Jason was hired as an industrial fire instructor for the private sector group for the Emergency Services Training Institute (ESTI) Division of the Texas A&M Engineering Extension Service (TEEX), a part of the Texas A&M University System. In 2011, Mr. Loyd was selected as the subject matter expert (SME) to develop the new online fire academy program. In 2012, Mr. Loyd was promoted as the training manager to run the new Online Recruit Academy at Brayton Fire Training Field. As of 2019, twenty-one sessions of the online recruit class/boot camp have been conducted and he continues to teach new recruits utilizing new technologies and promoting safety and education. He has been married to his wife Melissa since 1993; she also works at Texas A&M University as Supervisor for Water Production and Wastewater Treatment. They have two daughters, Keeley and Arabella.

James D. (J.D.) Richardson

James D. (J.D.) Richardson is a Vietnam Veteran who served four years with the United States Air Force. In 1973, following his military service, he joined the Houston Fire Department. J.D. enrolled in the Fire Science Program at Houston Community College, but before completing his Associates degree, he transferred to the University of Houston and achieved a Bachelor of Science in Technology degree in 1977. He served as an Engineer/Operator from 1979 to 1991. During this time he fulfilled his duties as an EMT, Hazardous Materials team member, Heavy Rescue Technician, and pumper and ladder truck operator. He was promoted to the rank of captain in 1991.

During his tenure as a captain with the Houston Fire Department, J.D. developed a hydraulic rescue tool training program that was used to train more than 500 Houston firefighters in the use of the Hurst rescue tools. He was also chosen to be a member of a hazardous materials training team with the International Association of Fire Fighters and helped initiate the 24-hour hazardous material awareness and operations pilot program now being mandated for the fire service.

Captain Richardson retired from the Houston Fire Department in 1997 and began a new career as an instructor of fire science with San Antonio College. During his tenure with the college, J.D. achieved his Master of Arts in Education at the University of Texas San Antonio and achieved the rank of Assistant Professor. He was instrumental in developing the college's Associates of Applied Science Degree in Emergency Medical Services in 1998. In 2003, J.D. developed and initiated the first Associates of Applied Science Degree in Emergency Management in the State of Texas. The program was modified to Emergency Management and Homeland Security Administration in 2006. He later developed and initiated a Certificate and Associates of Applied Science Degree for the Department of Homeland Security, Transportation Security Agency. J.D. served as Co-director of the Fire Science Degree Program and Chairperson of the Protective Services Department. Before his retirement, he was instrumental in developing the first public university bachelor degree program in Fire Administration in Texas at Texas A&M University-San Antonio. He is certified by the Texas Commission on Fire Protection as a Master Firefighter and Level III Master Instructor.

J.D. retired in 2012 and now enjoys being with Dianne, his wife of 46 years, their son R.J., daughter-in-law Kate, and beautiful grand-daughter Cadwyn.

16 FIREFIGHTER LIFE SAFETY INITIATIVES

In March 2004, a Firefighter Life Safety Summit took place in order to address the need for reform within the fire service profession. As a result of this meeting, the 16 firefighter initiatives were developed. The National Fallen Firefighter's Foundation promotes programs and resources that facilitate in preventing line-of-duty deaths and injuries through the Everyone Goes Home website. These training programs like Firefighter Life Safety Resources Kit—Volume 1, 2, 3, and Courage to Be Safe, to name a few, can be downloaded off the website. Examples of the 16 Firefighter Life Safety Initiatives are stressed throughout this textbook in order to show how these initiatives can be applied in practice. Consider what other initiatives you can apply to practice as you read the chapters.

The following list includes each of the 16 initiatives and how they are applied in the chapters:

1. Define and advocate the need for a cultural change within the fire service relating to safety; incorporating leadership, management, supervision, accountability, and personal responsibility.

   Chapter 4 discusses the challenges firefighters have had to adapt to in order to keep up with today's society while continuing to provide the best service to their community/customers.

2. Enhance the personal and organizational accountability for health and safety throughout the fire service.

   Chapter 3 illustrates the need to be in excellent physical fitness. This applies not only to individuals wanting to become firefighters but to current volunteer and career firefighters as well. For more information on this topic, refer to NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Department Members, 2008 Edition*.

3. Focus greater attention on the integration of risk management with incident management at all levels, including strategic, tactical, and planning responsibilities.

   Chapter 11 discusses preincident planning, fire strategy, and tactics, which allows the instructor to facilitate talking points to students concerning greater attention on integration of risk management in the fire service today and in the future.

4. All firefighters must be empowered to stop unsafe practices.

   Chapter 10 discusses not only organizational structure but emergency incident management systems as well. Instructors should emphasize that everyone on the fire ground is empowered to stop an unsafe act. For more information on this topic, refer to NFPA 1521, *Standard for Fire Department Safety Officer, 2008 Edition.*

5. Develop and implement national standards for training, qualifications, and certification (including regular recertification) that are equally applicable to all firefighters based on the duties they are expected to perform.

   This initiative in Chapter 4 emphasizes the importance of training and higher education in fire and emergency services. Ultimately this initiative is paramount for national standardization for emergency personnel in all ranks and levels alike. Through lessons learned from September 11, 2001, plus Hurricanes Katrina and Rita, we have trained and educated our responders across the nation to be better prepared to mitigate these types of large-scale emergencies. It's important that our future fire and emergency services leaders have the knowledge required to perform to a certain level set by these national standards for the safety of our responders no matter where they're responding from (local or state).

6. Develop and implement national medical and physical fitness standards that are equally applicable to all firefighters, based on the duties they are expected to perform.

   This initiative in Chapter 3 discusses the selection process and the importance of national standards for medical and physical fitness for fire department members. For more information on this topic, refer to NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Department Members, 2008 Edition*.

7. Create a national research agenda and data collection system that relates to the initiatives.

   Chapter 12 discusses support functions from different organizations. Instructors should introduce students to research, data collection systems, and the benefits to the department as a whole.

8. Utilize available technology wherever it can produce higher levels of health and safety.

   Chapter 2 discusses the career opportunities in occupational health and safety. An occupational health and safety specialist is an invaluable asset to the fire and emergency services industry. This career position might have a different title like health and safety officer (HSO) or incident safety officer (ISO). Regardless of the title, the key point is to promote higher levels of health and safety. For more information on this topic, refer to NFPA 1521, *Standard for Fire Department Safety Officer, 2008 Edition*.

9. Thoroughly investigate all firefighter fatalities, injuries, and near misses.

   This initiative in Chapter 2 discusses the career of fire investigators. This role can be different from locale to locale and even state to state. Regardless of the position title, it is of the utmost importance that every firefighter fatality, injury, or near miss be documented so others can learn from these events. Although this chapter may touch on basic information, the instructor should expand on this subject to make the information more relevant to the students' environment.

10. Grant programs should support the implementation of safe practices and/or mandate safe practices as an eligibility requirement.

    This initiative in Chapter 12 focuses on several support organizations and the vital role they play in the fire and emergency services industry. There are grant programs that assist fire departments with the essential funds to implement safe practices programs, although certain requirements may apply before a department is eligible for this type of assistance.

11. National standards for emergency response policies and procedures should be developed and championed.

    This initiative in Chapter 10 discusses the organizational structure and emergency incident management systems concerning policies and procedures for emergency response.

12. National protocols for response to violent incidents should be developed and championed.

    This initiative in Chapter 11 emphasizes the importance of preincident planning. It is vital that instructors stress to students about responding to violent incidents and the need to have national protocols in place before the incident occurs.

13. Firefighters and their families must have access to counseling and psychological support.

    This initiative in Chapter 2 discusses the many dangers firefighters face today. Because of the added responsibilities of the fire and emergency services personnel, it is important that firefighters have access to proper counseling and psychological care if needed.

14. Public education must receive more resources and be championed as a critical fire and life safety program.

    Chapter 8, on fire prevention codes and ordinances, discusses the importance of life-safety education programs. It is recommended that instructors utilize the entire

chapter so students will have a greater appreciation of fire prevention codes and ordinances, public education, and life-safety programs resources available.

15. Advocacy must be strengthened for the enforcement of codes and the installation of home fire sprinklers.

    This initiative in Chapter 8 discusses fire prevention codes and ordinances and why they were created. Instructors should emphasize to students the importance of becoming an advocate for enforcement of codes and the installation of home fire sprinklers.

16. Safety must be a primary consideration in the design of apparatus and equipment.

    This initiative in Chapter 2 discusses not only career opportunities in the fire and emergency services field but also new technology geared towards safety for responders. For example, new technology in apparatus and equipment has enhanced firefighter safety like Global Positioning Systems (GPS), Automatic Vehicle Location (AVL), and Geographical Information Systems (GIS), to name a few.

FIRE AND EMERGENCY SERVICES HIGHER EDUCATION (FESHE) GRID

The following grid outlines Principles of Emergency Services course requirements and where specific content can be located within this text:

COURSE REQUIREMENTS	1	2	3	4	5	6	7	8	9	10	11	12
Illustrate and explain the history and culture of the fire service.	X											
Analyze the basic components of fire as a chemical reaction, and the major phases of fire; and examine the main factors that influence fire spread and fire behavior.						X	X					
Differentiate between fire service training and education and explain the value of higher education to the professionalism of the fire service.				X								X
List and describe the major organizations that provide emergency response service and illustrate how they interrelate.										X		
Identify fire protection and emergency service careers in both the public and in the private sector.		X	X									X
Define the role of national, state, and local support organizations in fire and emergency services.										X		X
Discuss and describe the scope, purpose, and organizational structure of fire and emergency services.										X		
Describe the common types of fire and emergency services facilities, equipment, and apparatus.					X							
Compare and contrast effective management concepts for various emergency situations.										X		
Identify the primary responsibilities of fire prevention, including code enforcement, public information, and public and private protection systems.									X		X	
Recognize the components of career preparation and goal setting.			X	X								X
Describe the importance of wellness and fitness as it relates to emergency services.			X									

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CHAPTER 1

History of the Fire Service

Courtesy of Jason Loyd.

KEY TERMS

apparatus Aldini, *p. 10*
conflagration, *p. 2*
couvre feu, *p. 3*
EMT, *p. 14*
***familia publica*,** *p. 2*
FESHE, *p. 15*
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siphon, *p. 6*
steam engine, *p. 7*

WHAT'S NEW IN THIS CHAPTER

- Updated statistics
- Metric conversion
- Hurricane Harvey

LEARNING OBJECTIVES

After reading this chapter, you should be able to:

- Describe the evolution of firefighting in the United States and other countries.
- Explain the history of early firefighting organizations.
- Describe early fire vehicles.
- Describe early personal protective equipment.
- Understand fire service traditions.
- Describe the origins of fire facilities.
- Explain the fire dilemma in the United States and its causes.
- Discuss the changing role of the modern firefighter.

Introduction

Early humans experienced fire as a great and powerful mystery, a force to be feared. Gradually, as their knowledge of fire's properties grew, humans began to appreciate its potential as a tool for safety and protection against cold, darkness, and other dangers posed by harsh environments. The ability to control fire eventually was an important factor in the formation of stable communities of individual family dwellings and businesses. Fear slowly turned into respect for this great force. However, as humans became more and more accustomed to using fire in their everyday lives, their carelessness caused accidents that resulted in death and destruction. As communities grew in size, so did the need for protective measures against out-of-control fires. Unfortunately, most safeguards were not enacted until after a tragic loss of life and property made the need for prevention obvious.

Fire remains something of a mystery to this day, but over the centuries, the study of fire science has disclosed many of its secrets. The work of fighting fires has evolved into a highly respected occupation for many people, both full-time professionals and dedicated volunteers. The history of firefighting is a fascinating, inspiring story. It is the record of how our inventive and courageous forefathers fought to control one of nature's most useful and potentially most destructive forces. Their efforts lay the foundations on which our modern fire service is built and pioneered the field of study that we call **fire science**.

fire science ■ Study of the behavior, effects, and control of fire.

The term *field of study* is used because fire science is not a single discipline. Topics studied in a fire science curriculum include, but are not limited to, protective systems, building construction, fire codes and ordinances, hazardous materials, chemistry, strategy and tactics, and, of course, fire behavior. Each of these areas has a history that explains its importance to the study of fire science. Each became part of this field of study because lives had been lost in the past, inspiring efforts to prevent similar losses in the future. The fire science student must learn not only the when and where of developments in the field but also the why. We will begin exploring the "why" by looking back at the evolutionary history of firefighting services and firefighting technology.

The Evolution of Firefighting Services

The earliest recorded effort to organize a firefighting service dates to the Roman Republic. In the first century BCE, the crowded city of Rome was subject to repeated **conflagrations** that resulted in massive loss of life and property damage. A body of approximately 600 public slaves (the ***familia publica***), strategically positioned at the gates of the city, were assigned the task of alerting the public to existing fires and fighting the conflagrations (Dio Cassius, 54.2–3). They were, however, notoriously ineffective and slow to react, perhaps in the interests of preserving their own safety.[1] After a particularly devastating fire in 6 AD, Emperor Augustus organized a corps of 7,000 freedmen, the *vigiles* (watchmen), who patrolled the streets at night. They began to combat fires using bucket brigades, as well as poles and hooks to tear down buildings in advance of the flames. It is generally thought that this is where the "hook" in "hook and ladder" originated.

conflagration ■ A fire that increases in size and spreads beyond human-made and natural barriers.

familia publica ■ "Servants of the commonwealth." These men were strategically positioned near the city gates to protect the city from fire.

Rome continued to suffer from serious fires, most notably the July 19, 64 AD, conflagration that started near the Circus Maximus and eventually destroyed two-thirds of the city. Emperor Nero was blamed; although it is unlikely that Nero actually ignited the blaze, some historians believe that he did permit it to burn unchecked. Evidence exists that at least one Roman citizen profited richly from this fire, buying properties in advance of the flames and using teams of slaves to defend his recent acquisitions from being consumed.[2] Whatever his faults, Nero was apparently a man of some vision and intelligence who recognized the dangers of the unregulated construction that was the norm in Rome before his reign. Much wealth and many resources had been expended on the construction of enduring public edifices, but almost all other structures were built of wood without

care for safety standards. Nero can be credited with rebuilding Rome in accordance with sound principles of construction, sanitation, and utility. From 64 CE until the fall of the Roman Empire, both public and private building projects were closely regulated.

It was not until the 11th century that fire prevention was again addressed. William the Conqueror of England instituted one of the first recorded fire prevention regulations, which required that candles and all fires used for heating and cooking must be extinguished at nightfall. Every day about 8 PM, a bell was rung, which was the signal to "cover the fire" (*couvre feu* in William's native French). **Couvre feu** gradually was corrupted to the English word *curfew*. The curfew bell was utilized in parts of England and France for over 800 years, long after its original purpose had been forgotten. However, this simple precaution was not always adequate, and the archives of French towns and churches contain records of many disastrous fires and rebuilding works.

couvre feu ■ A French name for a metal lid used to cover an open hearth. The English word *curfew* was derived from this name.

In 60 AD, four years before Nero's fire in Rome, a fire ignited by rebellious natives leveled the fledgling Roman town of Londinium. This was the first of many conflagrations that would destroy large sections of London (as the town would later be named). History preserves a record of major blazes in 675 and 1087, three in the course of the 12th century, and a massive blaze in 1212. These tragedies pale, however, in comparison to the blaze that has come to be known as the **Great Fire of London**. The Great Fire started on September 2, 1666, in the royal baker's shop on Pudding Lane. It burned relentlessly for four days, consuming about 430 acres (174 Hectares) (80% of the city's center), and destroying 13,000 homes, 89 churches, and 52 guild halls.[3] Tens of thousands were left homeless and financially ruined. Much of central London today shows the results of the reconstruction ordered by King Charles II, which called for wider streets and brick buildings to replace the earlier structures built of highly flammable wood and pitch.

Great Fire of London ■ A devastating fire in central London that was considered one of the major events in the history of England.

One result of the Great Fire was the formation of what may well have been the world's first insurance company. Dubbed "The Insurance Office," it was the first of a number of such companies that took on the responsibility not only of indemnifying the insured against losses but also of actually fighting fires. Each company formed its own private fire brigade that would battle the flames—but only in those buildings insured by the company. Insured buildings were marked with the company's badge, called a **firemark**, and any building without this identifying mark was left to burn. Clearly, this was not the best solution to the problem of protecting the public. (See Figure 1-1.)

firemark ■ Metal marker that used to be produced by insurance companies for identifying their policyholders' properties.

FIGURE 1-1 Firemark. *Courtesy of James D. Richardson.*

FIGURE 1-2 The fire rattle was used to alert the town of an emergency. *Dorling Kindersley Media Library.*

fire wardens ■ Volunteers who patrolled the cities, inspected chimneys, and issued fines for noncompliance. Funds collected from fines were used to purchase new fire equipment.

The fire problem was not limited to European countries, of course. In 1631, a major fire broke out in Boston, which prompted the implementation of fire regulations banning thatched roofs and wooden chimneys. Colonial laws also required each house to have a bucket of water on its front stoop for the use of bucket brigades. In 1648, New Amsterdam (later renamed New York) created an organization of volunteer **fire wardens** who patrolled the city, inspected chimneys, and issued fines for noncompliance. Funds collected from fines were used to purchase new fire equipment. New Amsterdam also appointed a so-called Rattle Watch—men dressed in long capes who would patrol the city's streets by night. They carried wooden rattles to sound an alarm, rousing citizens to form bucket brigades whenever a fire broke out (see Figure 1-2).

FIGURE 1-3 American Founding Father Benjamin Franklin wears a fire helmet. *Courtesy of James Foley.*

Public interest in firefighting continued to increase. In 1679, Boston took the first step toward what has become today's professional fire department, initiating the efforts in establishing the first paid firefighting service. The firefighters were part-time employees of the city who were assisted by volunteer organizations known as mutual fire societies. However, it was not until 1736 that Benjamin Franklin organized what is known today as the first formal volunteer fire company. This volunteer assembly was named the Union Volunteer Fire Company of Philadelphia.[4] The amount of staffing and skill necessary for firefighting eventually prompted Franklin, like the citizens of Boston, to institute a paid fire company, but the concept of volunteer companies had caught on and was spreading across America (see Figure 1-3).

Men (this was before women joined the fire service) joined their local volunteer company for social reasons as well as to serve the public and to protect their homes and towns. Membership was considered prestigious, the mark of a public-spirited citizen, and would earn a man community respect. The result was long waiting lists of eager volunteers. The volunteer firefighter remains a proud American tradition to this day and is the heartbeat of any community public service.

Even after the formation of paid fire companies, there were still disagreements and fights over territory, because insurance money was awarded to the company that was first on the scene of the fire.[5] This was the beginning of a long-standing relationship between fire departments and fire insurance companies. The situation was complicated by the nature of water delivery in the towns. Public water systems consisted of mains constructed of wooden logs hollowed out to carry water down a street. Approximately every half block, wooden plugs were inserted in the logs. These plugs could be removed to access the water supply for firefighting, which has given us the term **fireplug**. Some fire companies would hire saboteurs to race ahead to the scene of the fire and hide the plug from competing fire companies. These miscreants were called "plug uglies." Even after fire hydrants replaced the fireplug, sabotaging a responding fire company's access to the water supply continued. New York City companies were famous for sending runners out to fires with large barrels to cover the hydrant closest to the fire in advance of the engines. Fights would often break out between the runners and the responding fire companies for the right to fight the fire, which continued to rage while they squabbled. Town parades were another occasion for spirited competition as each company marched down Main Street in its own elaborate, colorful uniforms, helmets, and hand-painted stovepipe-shaped "fire hats." Fancy fire axes and torches, lavishly painted fire buckets, and, if the company had one, a **hand pumper** decorated by a famous artist, added to the finery. Most striking of all, perhaps, were the engraved silver speaking trumpets that each company used to shout insults at its rivals.

fireplug ■ A wooden plug inserted in logs that carried the town's water supply approximately every half block. These plugs could be removed to access the water supply for firefighting.

hand pumper ■ A fire engine that has long bars (also known as brakes or pumping arms) running parallel to the body that operate the pump. Firefighters physically use the pumping arms to make a full up and down motion to build up pressure, allowing water to spray out of a hose.

The earliest steam pumpers were used in the 1800s. Volunteer firefighters viewed these as a threat to their existence as they needed less manpower to run and thus could diminish their ranks. Another change in equipment in the 1800s was the use of horses to pull the engines. Then, the motorized era began in the 1900s. The earliest motorized fire vehicles were used by the chiefs to drive to the scene of the fire and take control. After that came the motorized pumpers that pumped the water for the firefighters. The motorized pumpers worked much faster than did the steam or hand pumpers.

The profession of full-time paid firefighter was not a reality until around the mid-19th century. There were exceptions, but typically rural areas were served by volunteer firefighters, while paid organizations dominated urban areas. Today in the United States and around the world, fire and rescue remains a patchwork of both paid and volunteer responders. Of the approximately 29,727 fire departments in the United States, for instance, approximately 70% are totally or mostly volunteer (see Figure 1-4).

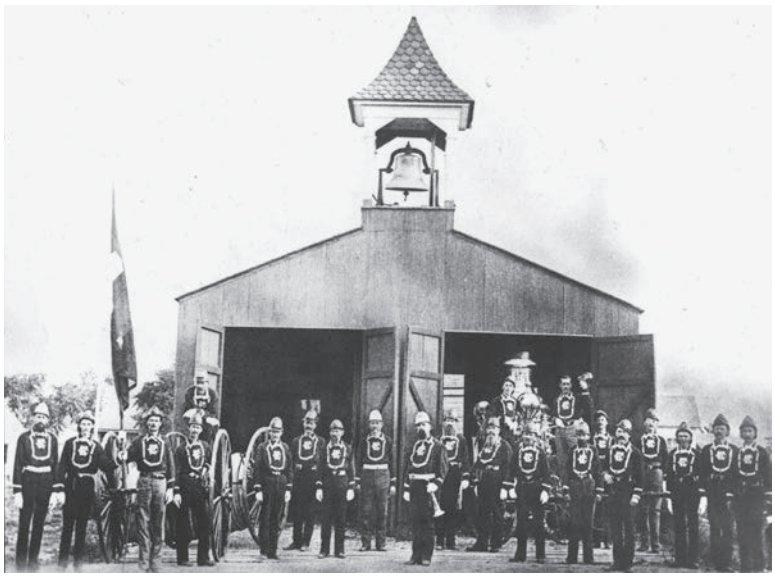


FIGURE 1-4 Early volunteer fire company with station and equipment in the late 1800s. *Courtesy of Andrea Franks/Franks Photography and Weatherford Fire Department.*

FIGURE 1-5 National Fallen Firefighters Memorial. *Courtesy of James D. Richardson.*

The U.S. Congress created the National Fallen Firefighters Foundation to lead a nationwide effort to remember America's fallen firefighters. This foundation is located in Emmitsburg, Maryland, and one of its tasks was to create a National Fallen Firefighters Memorial Park. This memorial was constructed in 1981 and lists the names of all members of the fire service who have died in the line of duty since 1981. Future plans include the creation of a special area in the park to honor pre-1981 fallen firefighters. The Memorial Park also features a brick Wall of Honor that connects the monument, the historic Fallen Firefighters Memorial Chapel, and memorial plazas. (See Figure 1-5.) Since 2017, the foundation has been vastly focussing on providing resources to assist the survivors in rebuilding their lives, research in understanding cancer in the fire service, providing scholarships to families, and retreats for families and partnerships that provide training.

As mentioned earlier, fire departments and fire insurance companies have a long intertwined history. Today the Insurance Service Office, Inc. (ISO) exists, playing an integral part in how insurance rates are assessed for the community that the fire department serves. Special committees are usually formed with members consisting of firefighters and government officials. Their mission is to find ways to improve their ISO rating.

Early Firefighting Apparatus, Vehicles, and Extinguishers

siphon ■ A large syringe used to deliver a stream of water.

The use of technology for firefighting dates back to the second century BCE. The Greek engineer Ctesibius of Alexandria is credited with inventing a basic hand pump that operated on the principle of a **siphon** (Latin *siphona*) and could propel a jet of water toward a blaze.[6] For reasons unknown, this technology fell out of use, and we know of it today only because archaeologists have unearthed parts of the machinery.

The only apparatus available to fight the Great Fire of London in 1666 were buckets, hooks, axes, ladders, and hand-operated water syringes called "squirts." This equipment proved woefully ineffective as the fire continued to burn for four days.

Elsewhere in 17th-century Europe and in the American colonies, firefighting equipment was equally rudimentary. The ravages of London's Great Fire were a timely wake-up call, however, and the late 1600s saw a surge of technological advancements in firefighting equipment, especially in Europe. Hand-operated pumps were placed on wagons, greatly enhancing their mobility. A number of different designs were attempted, including

FIGURE 1-6 Old Silsby steam engine. *Courtesy of Andrea Franks/ Franks Photography and Weatherford Fire Department.*

one that required 28 men to work its levers and could shoot a stream of water 80 feet into the air. In 1672, the Dutch inventor Jan van der Heiden designed the first fire hose. It was constructed of flexible leather and coupled with brass fittings at intervals of 50 feet (15.25 m)—the interval that remains the standard to this day.[7] These inventions changed the way fires were fought, enabling more sophisticated strategies and tactics.

In 1679, Boston imported America's first fire engine. Our nation would continue to rely on European technology until 1743, when Thomas Lote of New York produced the first American-built fire pump.

A steam-powered fire pump, capable of pumping 30–40 tons (27,240–36,320 kg) of water per hour, was constructed in London in 1829 by John Braithwaite. One of these new marvels was brought to America, but volunteer firefighters saw the invention as a threat to their social organizations because the **steam engine** would eliminate the need for large numbers of men to operate the hand pumps. Acceptance of the new technology was delayed for several years, but by the second half of the century, the steam-driven pump had become the norm (see Figure 1-6).

steam engine ■ A heat engine that performs mechanical work using steam as its working fluid.

In 1841, a group of insurance companies in New York contracted the construction of a self-propelled steam fire engine that resembled a train engine. Again, firefighters resisted its use. Existing pump wagons required numbers of men to push and pull them through the streets, and a self-propelled model would put them out of work.

Steam-powered vehicles may have been out of favor, but the early 19th century did see the advent of horse-drawn fire wagons. Volunteers at the New York Mutual Hook and Ladder Company No. 1 voted in 1832 to purchase a horse to pull their engine. A yellow fever epidemic had reduced available manpower in the city, and it is suspected that this led to the purchase of the horse. Another theory is that the volunteers had simply tired of pulling heavy steam-driven pumpers through the streets. Whatever the reason, the idea caught on fast, and horses became an integral part of the fire service all over the world. They were often trained to the pitch of the bell that signaled an emergency. This pitch prompted them to get out of their stalls and stand at attention in front of the fire apparatus (see Figure 1-7).

Great Fire of Boston ■ Boston's largest urban fire and one of the largest fires in American history.

In the United States, the end of the horse-drawn era was no doubt accelerated by the **Great Fire of Boston** in 1872. Tragically, the fire began at a time when the horses

FIGURE 1-7 Horses pulling a large hook and ladder truck. *Courtesy of Andrea Franks/ Franks Photography and Weatherford Fire Department.*

used to pull the heavy steam pumpers were suffering from an epidemic of equine influenza. Without horses, firefighters again had to pull heavy steam pumpers through narrow, twisting streets to the scene of the fire. This, of course, greatly reduced their efficiency. The fire burned for 20 hours, consuming over 60 acres (24.28 hectares) of downtown Boston (776 buildings).[8] Thirty people lost their lives, and property losses were estimated at over $70 million (over one billion in today's dollars). A review of the problems faced during the Boston fire accelerated the search for alternative ways to transport firefighters and equipment to fire scenes, but Boston did not lead the way.

Earlier, about the middle of the century, the citizens of Cincinnati, Ohio, had become disgusted with the delayed responses and inefficient firefighting that resulted from the use of old-fashioned hand-pulled pumps. They insisted the fire department modernize. The Cincinnati Fire Department was organized in 1853 and is the nation's oldest fully paid professional fire department. Furthermore, in 1853, the first steam-powered fire engine in America came into service. Designed by Cincinnati engineers Able Shank and Alexander Latter, it was affectionately named "Uncle Joe Ross." "Uncle Joe" was able to shoot water 225 feet (68.625 m) to a fire and required only three men to operate. The advantages of the new-fangled technology could no longer be ignored. By the end of the century, steam fire engines could be found in numerous municipal fire stations, although horses continued to be used well into the 20th century. Chicago retired its last team on February 6, 1923.

Once the popularity of the new engines was established, inventors and firefighters started thinking of ways to further ease the difficulty of their mission. The aerial ladder wagon made an appearance in the fire service by 1870, followed by the hose elevator in 1871.

An Englishman, Captain George Manby, had invented the first portable fire extinguisher in 1816. It consisted of an air-pressurized copper vessel containing three gallons of pearl ash (potassium carbonate). The late 19th century saw the introduction of the soda-acid extinguisher, which consisted of a cylinder containing a solution of sodium bicarbonate in one to two gallons of water.[9] Inside the cylinder was a vial of concentrated sulfuric acid. The device was activated by striking a plunger to break the vial or inverting the extinguisher, which released a lead bung from the vial. When the sulfuric acid met the sodium bicarbonate, it generated carbon dioxide gas, which forced the water out through a nozzle.[10]

FIGURE 1-8 Early 1913 American LaFrance gasoline fire apparatus. *Courtesy of Andrea Franks/Franks Photography and Weatherford Fire Department.*

Internal combustion fire engines, built in the United States, first saw service in 1907. At first they were used either as pumping engines or as tractors to pull pieces of equipment. By 1910, both functions were combined, and one gasoline-powered engine was used to both propel the truck and drive the pump. On the same day as the city retired its last team of fire horses (February 6, 1923), the Chicago Fire Department, serving 500,000 residents, implemented the use of their motorized fire department (see Figures 1-8 and 1-9).[11] However, in 1911 Savannah, Georgia, was the first city to have a fully mechanized fire department in the United States.

Firefighting vehicles today have evolved to serve highly specialized functions and to enable firefighters to respond quickly to a variety of emergencies. Usually diesel-powered vehicles include ladder trucks with aerial platform apparatus that can access high-rise buildings, sending heavy stream applications to heights up to 130 feet (39.65 m). Rescue trucks, brush trucks, mobile command vehicles, smoke ejectors, high-pressure spray trucks, and foam trucks add versatility to the firefighter's arsenal. Industry-specific fire stations and equipment make it possible to handle fires of highly specialized origin. For example, airports under the direction of the Transportation Security Administration (TSA) have introduced fire trucks especially designed to handle fires created by airplane crashes. Refineries have also adapted to their own specialized needs by developing various chemical applicators not used by the typical fire service.

The diesel pump on a modern fire engine is capable of delivering up to 2,000 gallons (7,570 L) of water per minute through a lightweight hose line reinforced with artificial

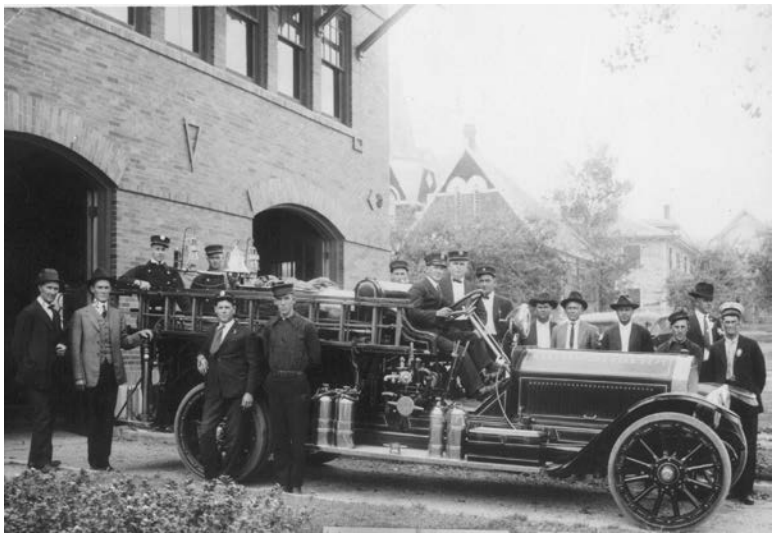


FIGURE 1-9 Gasoline fire apparatus of 1924. *Courtesy of Andrea Franks/Franks Photography and Weatherford Fire Department.*

fibers and measuring up to three inches in diameter. A fireboat, not limited to hydrant supply, can easily deliver as much as 10,000 gallons (37,850 L) per minute.

Even the fire extinguisher has evolved into a state-of-the-art fire suppression tool. Fire extinguishers now come in various sizes and designs and employ a variety of extinguishing agents, such as water, dry chemicals, dry powder, carbon dioxide, foam, and special halocarbon agents.

These tools have immeasurably increased the effectiveness and ease of firefighting, but the innovations most appreciated by working firefighters are the improvements to their personal protective gear.

Respiratory Protective Equipment or Self-Contained Breathing Apparatus

Early firefighters faced not only fire but also the effects of smoke with little or no personal safety equipment. Try to imagine responding to an out-of-control structure fire without water- and heat-resistant bunker gear, a state-of-the-art fire helmet, and self-contained breathing apparatus (SCBA).

Early photography shows Victorian firemen using their own long beards as their only defense against smoke inhalation. Before entering a burning structure, they would wet their beards with water, then clench them in their teeth to act as air filters.[12] Firefighting was never an occupation for the faint-hearted!

apparatus Aldini ■ One of the earliest recorded attempts to improve breathing difficulties in toxic environments was tested in 1825 in France. This was not the most desirable breathing apparatus for firefighters to wear, but scientific testing was conducted under actual fire conditions.

One of the earliest attempts to reduce breathing difficulties in toxic environments was the French **apparatus Aldini**, which was tested under actual fire conditions in 1825. The Aldini cannot have been comfortable to wear; it consisted of an asbestos mask covered by a second mask made of iron wire, but it may have provided some measure of protection. The space between the two masks trapped a small amount of breathing air. In the 1870s, fire departments began buying and using "Neally's Smoke Excluding Mask." The mask was a simple invention, consisting of a snug-fitting facemask with mica or glass eyepieces and a water bag suspended from rubber tubes that led to a mouthpiece. Two sponges kept wet by the water bag filtered clean air to the wearer. It was marketed as "a most perfect apparatus" and sold for an amazing $15.[13] The first successful American SCBA, known as the Gibbs, came into use in the first decade of the 20th century. The air pack, introduced in late 1945, was the product of research aimed at helping World War II pilots breathe at high altitudes. This unit consisted of a pressurized oxygen cylinder made of steel and a pressure-regulating device that allowed firefighters to breathe fresh air in smoke-filled environments.

The modern SCBA bears little resemblance to these predecessors. The air pack's heavy steel cylinder has been replaced by a lightweight cylinder developed by the National Aeronautics and Space Administration (NASA) and the space industry.[14] Pressure regulators provide positive pressure to the wearer and allow the firefighter to monitor the amount of air remaining in the cylinder through a "heads-up" display. The amount of air in the cylinder has greatly increased from a 15-minute supply to one hour or more.

Firefighting has certainly come a long way since the days of breathing through wet whiskers![15]

Fire Facilities

Just as changes in personal equipment have kept pace with modern technology, so has the design of the firehouse. In the early volunteer days, firefighters needed only a place to store their fire pumps. A small shed was perfectly suitable, and stables for the horses were added later. The advent of the professional full-time firefighter created a need for sleeping quarters and for personal space where each individual could store equipment and fire apparatus. To meet this need, many communities built a firehouse to serve the needs of

firefighters serving 24-hour shifts. A firehouse usually consists of a kitchen, a bedroom, and an apparatus bay where fire equipment is stored. As technology and engineering design improve, so does the state of the firehouse. (The design of the modern fire and emergency services facility is discussed in more depth in Chapter 5.)

Fire Service Insignias and Traditions

Firefighting and tradition seem to go hand in hand. Since time immemorial, certain emblems have been virtually synonymous with firefighting. The best known of these are the red fire engine, fire badges, **Maltese cross**, and Dalmatian fire dog.

Maltese cross ■ Symbol representing the traditions and ideals of the fire service. The arms and the tree of the Maltese cross are equal in length. The arms and the tree widen as they extend from a central point. In most cases, the edges are flat or curved slightly outward.

RED FIRE ENGINE

The tradition of painting fire engines red dates back to at least the early 1920s. When Henry Ford made motor cars affordable for the average American family, he let it be known that his vehicles could be bought in any possible color—just as long as it was black. Soon the nation's highways and byways were crowded with black vehicles, and quite logically the fire service began painting its vehicles red in an effort to stand out. Today's consumers can buy vehicles in just about any imaginable color, and so can the fire service. In addition to the traditional red fire engine, it is not uncommon to see white, yellow, blue, orange, green, or even black fire trucks. Many fire departments, however, have stuck loyally to the time-honored red engine.

BADGES

Throughout fire service history, the firefighter has been identified by the badge in much the same way as medieval knights were identified by the insignia on their shields. Insignias allowed knights to be recognized on the battlefield despite the heavy armor that concealed their person. Firefighters' badges serve a similar identifying function and provide a means to distinguish rank and departmental affiliation. Today, badges are used more for Class A uniforms and special occasions; however, they still hold the symbolism of rank and honor and the traditions of the fire service. Badges are a symbol of courage and a commitment to protect the public. (See Figure 1-10.)

MALTESE CROSS

The Maltese cross has become the symbol of protection. It means the person who wears this cross is willing to lay down his or her life for you. The Maltese cross was originally the insignia worn by the crusading Knights of St. John. During the battle for Jerusalem, the Saracens atop the city's walls poured oil down on the attackers and dropped lighted torches to ignite the oil. The knights, witnessing this horror, dropped their weapons and ran into the flames to rescue their comrades. On their way home from the Crusades, the knights established a hospital on the island of Malta to care for the injured, and they flew

FIGURE 1-10 Various badges. *Courtesy of Jason Loyd.*

FIGURE 1-11 Maltese cross. *Courtesy of Jason Loyd.*

their insignia on a flag to let all know that they would render aid to the needy. Their descendants continued this charitable work for the next 400 years, and the cross of St. John became a symbol of generosity to friend and foe alike and a mark of protection for the weak. Not knowing the history of the insignia, many referred to it as the Maltese cross and the name stuck, becoming an international symbol of aid. The fire service adopted this symbol because it proudly upholds the very same standards and traditions as the Knights of St. John. The Maltese cross is a firefighter's badge, signifying that he or she works in a profession of courage, pride, honor, and danger. Over the years the Maltese cross has taken on different forms for various agencies that uphold the same moral standings such as hospitals, ambulances, hospice organizations, police, and other emergency personnel. However, the spirit of the crusade that initiated the Maltese cross still lives strong today. (See Figure 1-11.)

DALMATIAN DOG

For years, the loyal Dalmatian has been the trusted companion of firefighters. Few realize that this breed was originally chosen because of the strong bonds that the dogs formed with fire horses, protecting them and keeping them company at the station. The dogs were also expected to rouse the horses at the sound of the alarm bell, then run out and bark a warning at anyone who might be obstructing the firehouse exit. The dogs would then chase the fire apparatus all the way to the scene, sometimes barking the whole way. They served the same function, essentially, as the emergency traffic signals located outside many fire stations today and the sirens on fire trucks.

When horses were replaced by steam- or gasoline-driven fire engines, many departments opted to keep their beloved mascots. It is not unusual even today to see a proud Dalmatian riding on a fire engine as it races to the scene of an emergency.

The Fire Dilemma in the United States

The United States has a severe fire problem and will continue to worsen drastically if not addressed. Fire statistics show that our nation, one of the richest and most technologically sophisticated countries in the world, lags behind its peer nations in fire security. Nationally, there are millions of fires, thousands of deaths, tens of thousands of injuries, and billions of dollars lost each year—figures that far exceed comparable statistics for other industrialized countries.[16] In 2001, the direct value of property destroyed in fires was $11 billion ($44 billion if the World Trade Center loss is included).[17] In 2015 the National Fire Protection Association reported that there were 1,345,500 fires in the United States. The fires were categorized as follows:

1. 501,500 were structure fires that caused 2,685 civilian deaths and 13,000 civilian injuries with $14.3 billion in property damage.
2. 204,500 were vehicle fires that caused 500 civilian deaths and 1,875 civilian injuries with $1.8 billion dollars in property damage.
3. 639,500 were outside and other fires that caused 95 civilian deaths, 825 civilian injuries with $252 million in property damage.

A fire department responded to a fire every 23 seconds and one structure fire was reported every 63 seconds. There was one home structure fire reported every 86 seconds, one civilian fire injury reported every 34 minutes, one civilian fire death reported every 2 hours and 40 minutes, one outside and other fire reported every 52 seconds, and one highway vehicle fire reported every 3 minutes and 1 second.[18]

Americans tend to remember the great fires in our history—the Chicago fire of 1871 and the fire set off by the San Francisco earthquake of 1906—but the thousands of smaller tragedies that occur yearly have failed to generate the reforms our nation so badly needs. We get an eye-opening look at how U.S. citizens view fire danger in a 1973 report issued by the U.S. Fire Administration, *America Burning*. The America Burning document has shaped the fire service today. A committee was commissioned to research the rising number of fire fatalities occurring at the time. They held public hearings around the country and unearthed problems in these areas: fire prevention code in single family dwellings—mobile homes in particular, the fact that high rise buildings were not required to have fire escapes or even sprinkler systems, and the dangerous profession of firefighting was researched in respect to proper personal protective clothing and foremost public education and prevention. Congressional hearings began in 1974 and led to a presidential effort that led to the passage of the Federal Prevention and Control Act of 1974. And later the U.S. Fire Administration was born out of these efforts.

As examples of views and attitudes that the average American holds about fires, the report cites the following:

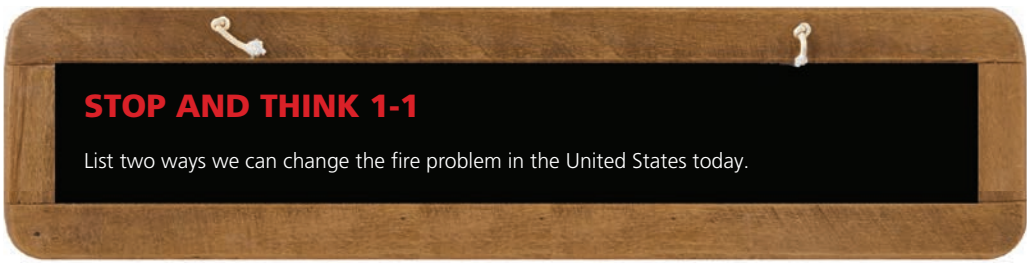
- "It can't happen to me."
- "Odds are that it won't happen to me."
- "The insurance company will take care of me."
- "It is not a disgrace to have a fire."
- "I can set fires for revenge."
- "They're just children playing; they didn't know any better."[19]

Such casual attitudes contrast starkly with the more responsible approach taken by European and some Asian nations, where advanced training is required of fire professionals, and building codes tend to be more stringent than in the United States. (For a more in-depth discussion of building construction, see Chapter 7.)

In 1987, *America Burning—Revisited* was issued and because of this together with the 1973 report, perceptions and attitudes of the fire service began to change. One was that fire prevention was now advocated by firefighters. They don't just sit at the firehouse waiting for the alarm to ring. They now go to schools and teach kids about fire safety and they go to community activities to inform the public about dangers and prevention awareness. Cultural influences have changed the way firefighters take their message to the masses. Education should always be paramount because people need facts to act and facts build a rationale to change. Multilingual pamphlets are distributed, personnel with bilingual speaking abilities are used, and cultural diversity classes are taken prior to field activities.

The terrorist attacks of September 11, 2001, have greatly affected the fire and emergency services in the United States. The passing of the Patriot Act and the inception of **Homeland Security** have changed the way national fire policy is written and implemented. New laws and newly formed government entities affect fire service administration, and the new threats posed by terrorism have required greater vigilance from all emergency personnel as well as training in new levels of hazardous material handling and transport, new security measures, and new strategies for emergency response.

Homeland Security ■ The department created after the events of September 11, 2001, that is responsible for assessing the nation's vulnerabilities.



The Scope of Fire and Emergency Services Today

In U.S. communities, the fire and emergency services department is the only entity trained and equipped to deal with multiple kinds of disasters. Fire departments respond to all manner of emergencies and confront all manner of risks and hazards.

The fire service safeguards not only our homes and businesses but also our economy and its critical infrastructure—the electrical grid, interstate highways, railroads, pipelines, and petroleum and chemical facilities. In fact, the fire service is itself considered a vital part of the nation's infrastructure. The service also responds to emergencies in federal buildings, provides aid to military bases, and protects interstate commerce. Every passenger airliner that takes off from a runway is protected by a fire department. Every hazardous materials' spill results in a call to the fire service to protect lives and property and deal with the dangerous clean-up process.[20]

Today some municipalities, faced with tight budgets and limited personnel, are shifting to a triple-certification requirement for their emergency responders. It is obviously more cost-effective to hire one person to act in three roles—firefighter, police officer, and paramedic—at an emergency scene. Like most things that sound too good to be true, however, there is a downside to triple certification. It has resulted in a higher than usual turnover rate, with firefighters tending to burn out and leave the department either for a higher paying position or because they do not want to be police officers.

With or without triple certification, however, there is no doubt that the traditional job description of firefighters has changed radically in recent decades. For instance, they must be prepared to provide emergency medical services such as advanced life support. Many states and organizations now require, as a minimum standard, that all job applicants be certified as Emergency Medical Technicians (**EMT**) or National Registry Emergency Medical Technicians (**NREMT**). Previously, firefighters just needed to be volunteers with no formal medical training to apply for a job. Changes in educational requirements are also affecting the promotional hierarchy. Firefighter seniority was once key to moving up the ranks. Today, higher educational achievement is an equally important critical criterion, often providing a boost up the ranks ahead of candidates who have had less formal schooling. Advanced education can also help firefighters in their public relations role and in educating the public on fire prevention. Today, when we are seeing an increase in the retirement of the veteran firefighters of the baby boomer generation and an influx of new recruits, training and higher education are more important than ever. (This topic will be discussed in more detail in Chapter 4.)

EMT ■ Emergency Medical Technician. A specified level of medical training that usually consists of around 100 hours of classroom and on-site training.

NREMT ■ National Registry of Emergency Medical Technicians.

Since September 11, 2001, fire and emergency services have been given another tool to use to help all emergency responders at all levels communicate and work together. On February 28, 2003, President George Bush issued Homeland Security Presidential Directive 5, which created a National Incident Management System (**NIMS**). NIMS provides a consistent nationwide template to enable all government, private sector, and nongovernmental organizations to work together during incidents that threaten domestic security. This allows for the same terminology to be used whether you are a volunteer, paid, or from the North or the South. As a result, fire professionals must now be trained in emergency strategies designed to mitigate disasters at the national as well as the local level. (Chapter 10 will provide more information about the NIMS and the firefighter's role in Homeland Security.)

NIMS ■ National Incident Management System.

Not only have firefighting management and education changed, but also have basic firefighting techniques, gear, and equipment. In the past, the firefighter would leave the firehouse in a knee-length bunker coat and rubber boots. In some calls, modern firefighters are more likely to wear Emergency Medical Service (EMS) gloves than bunker gear. The typical call is still an emergency to which firefighters respond with sirens wailing, but when they get to the scene, they may not go in with axes and fire hoses and spray down the building. Instead, they may take out stethoscopes and blood pressure cuffs and begin

questioning victims about injuries. It may be time to change the title of firefighter to fire and emergency services technician or emergency preparedness specialist. Some already refer to firefighters as all hazard personnel because they respond to just about every type of emergency call you can imagine. In just the last 10 years, the firefighting profession has evolved into the nation's largest prehospital EMS provider as well as a frontline defense in homeland preparedness.

Some of the new standards and regulations that today's fire and emergency services are embracing were established during the annual Fire and Emergency Services and Higher Education (**FESHE**) conference. The role of FESHE is to provide a new strategic approach to professional development. The organization will help move fire and emergency services from a technical occupation to the status of a full-fledged profession similar to that of physicians, nurses, lawyers, and architects, who, unlike fire service personnel, have standardized course requirements for their respective degree programs. (A thorough discussion of FESHE will be presented in Chapter 4.)

FESHE ■ Fire and Emergency Services Higher Education. Working with coordinators of two- and four-year academic fire and emergency medical services (EMS) degree programs, the U.S. Fire Administration's National Fire Academy (NFA) has established the FESHE network of emergency services–related education and training providers. The FESHE mission is to establish an organization of postsecondary institutions to promote higher education and to enhance the recognition of the fire and emergency services as a profession to reduce loss of life and property from fire and other hazards.

On August 25, 2017, Hurricane Harvey became the first major hurricane to hit the United States since 2005 and a catastrophic flood disaster in southeast Texas. Harvey's center of circulation stalled over south Texas on August 26 and then meandered slowly east into the Gulf of Mexico before making a final landfall near Cameron, Louisiana, on August 30. The Harris County Flood Control District (HCFCD) estimated one trillion gallons of water was dumped on the county alone in four days. Harvey's flooding caused one of the worst weather disasters in U.S. history, with a price tag that will amount to billions of dollars. The HCFCD estimated 70% of Harris County was flooded by at least 1.5 feet of water, with an estimated 136,000 flooded structures in the county alone, as of August 31.[21] It was because of this catastrophic event that Federal Emergency Management Agency (FEMA) and Texas A&M Engineering Extension Service (TEEX) partnered to be the state operation center for staging in College Station, Texas. This was the staging and deployment area of water assets for over 470 rescue boats, and staging for FEMA 18-wheelers who brought in over 350 trailers full of commodities to replenish supplies needed in SE Texas, along with 121 industrial generators (Figures 1-12 and 1-13).

This is all very pertinent and relevant to the history of the fire service. It takes all kinds of training and an evolving fire and emergency service to be ready to handle all that

FIGURE 1-12 Water assets used for Hurricane Harvey. *Courtesy of Jason Loyd.*

FIGURE 1-13 Staging areas for Hurricane Harvey 2017. *Courtesy of Jason Loyd.*

this job entails. This one incident alone demonstrates that firefighters and emergency personnel need to be equipped with not only the knowledge of the past but also with emerging technologies and collaboration that training and national incident management systems offer.

ON SCENE

Tradition and history are deeply entrenched in the fire service, but in today's society, the fire service has also evolved into a new service. Fire and emergency services in the United States deals not only with fire suppression as in the past, but it also deals with emergency medical services, hazardous materials, code enforcement, wildland fires, wildland/urban interface, fire prevention and education, technical rescue, urban search and rescue, aircraft firefighting, arson investigation, explosive response, industrial fire safety, and much more. Some of the same challenges from the past still plague the fire service today. These challenges include staffing, funding, service demands, facilities, health and safety, and training.

1. As a firefighter in the 21st century, are you ready and equipped to carry out the duties and responsibilities of the new role a firefighter plays while still carrying on the traditions that the fire service holds dear? What organizations can help the firefighter hold on to the traditions yet move forward and learn from the past?
2. If problems from the past continue to plague the fire service today, where can you find information on what have we learned to help facilitate a resolution to these long-standing problems?

Summary

Fire has played a major role in the development of civilization as we know it today. As a human race, we have learned to use fire to our benefit, but we need to further increase our respect for its power and improve the ways in which we deal with its potential dangers.

The nature of firefighting requires an individual to be available to handle any crisis at a moment's notice and handle it with professionalism. Never before in the history of our country have the actions of firefighters been held to the level of scrutiny that is applied today. Although recent events across the nation have brought national attention to firefighters' jobs and how they perform their jobs, the modern fire and emergency services is being challenged to take on an increasing number of responsibilities every year. Fire and emergency services must handle the training needed to use the ever-changing technology of new equipment. Current trends suggest that the fire service industry of the future will emphasize fire prevention and education as much as fire suppression. This trend—as well as the requirement that firefighters be proficient in emergency medical procedures and be prepared to respond to Homeland Security crises—has increased the need for education and training.

The traditions and culture of the fire service are changing. The once Caucasian male-dominated profession is now open to all persons. This diversity has broadened the scope of the fire service by introducing new ideas and cultural concepts.

There is a long, colorful, and distinguished history associated with the fire service, but there is plenty of room for improvement. Although no crystal ball can predict the world of tomorrow, the 21st century will surely carry the fire and emergency services field in directions yet imagined.

Review Questions

1. The development and use of the first hand-operated fire pump dates back to _____.
2. The first public volunteer fire department in North America was formed in _____ at _____.
3. What is a "rattle watch"?
4. What was the "apparatus Aldini"?
5. Which insignia was worn by the crusading Knights of St. John?
6. What is the role of FESHE?

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CHAPTER 2

Fire and Emergency Services Career Opportunities

Courtesy of Jason Loyd.

KEY TERMS

bioterrorism, *p. 33*
Department of Homeland Security, *p. 33*
ergonomic, *p. 28*
FAA, *p. 23*
fire ecology, *p. 23*
fire lines, *p. 23*
GIS, *p. 32*
helitack, *p. 23*
hotshot, *p. 23*
pictometry, *p. 32*
prescribed fire, *p. 23*
smoke jumpers, *p. 23*
Smokey Bear, *p. 30*
Sparky the Fire Dog, *p. 30*
standard operating procedures (SOP) *p. 22*

WHAT'S NEW IN THIS CHAPTER

- Updated statistics
- Metric conversions
- Updated Smokey Bear campaign
- Updated contract firefighting opportunities
- Updated Senate Bill S. 2399 and similar bills
- Updated section on future of fire emergency careers and Eddie Burns Section
- Drone technology
- Wildland update

LEARNING OBJECTIVES

After reading this chapter, you should be able to:

- Identify fire protection jobs in the public and private fire service.
- List duties and requirements for the positions of firefighter trainee and firefighter.
- List duties and requirements for the position of firefighter/paramedic.

- Give examples of fire service jobs other than firefighter.
- List duties and requirements of search and rescue teams.
- List duties and requirements of the wildland firefighter.

Introduction

Firefighting jobs are not easy to obtain. They call for high levels of physical fitness and mental stamina, as well as a strong desire to serve others. Increasingly, these jobs also call for advanced education and specialized training. Candidates who meet these rigorous requirements, however, will find employment prospects to be generally favorable (see Figure 2-1). Employment of firefighters is expected to grow slower than the average for all occupations. According to the U.S. Bureau of Labor Statistics, employment of firefighters is projected to grow 5% from 2014 to 2024. All other occupations are projected to grow at 7% over the same time period. Physically fit applicants with high test scores and some postsecondary firefighter education and paramedic training should have the best prospects. Most of this growth will occur in suburban areas where volunteer firefighting positions are rapidly turning into paid positions. Replacements will also be needed for firefighters who retire, stop working for other reasons, or transfer to other occupations.[1]

This chapter is designed to describe traditional firefighting jobs and to introduce some of the new positions that have developed in fire and emergency services. In the fire service, as in any other business or industry today, the range of possible career paths, job duties, and skills required is expanding rapidly. This is the result of varied factors, including technological changes, increased concern for the environment, and radical changes in the nature of the dangers confronted by the fire service. In addition, fire service personnel are being asked to take on duties far beyond those they performed 50 or even 10 years ago. Frequently, firefighters double as emergency medical care specialists. They may also lend their expertise in areas as diverse as public education, forestry, architecture, engineering, insurance, and law enforcement.

However, please note that the names of some positions may differ per locale. The fire service offers a great variety of opportunities and challenges, but all professionals in the field share a common goal—bringing order to chaos and creating a safe environment for the public.

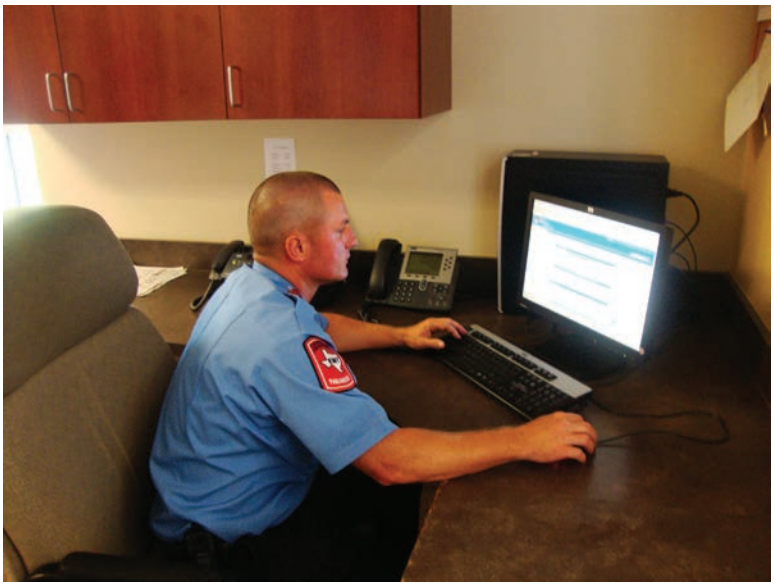

FIGURE 2-1 Firefighter/paramedic working at a desk. *Courtesy of Jason Loyd.*

Firefighting Career Opportunities

FIRE CADET/RECRUIT

The fire cadet, an entry-level training position, may be either a private individual interested in pursuing a career in the fire service or a recruit sponsored by a fire department or another organization. In the latter case, the recruit's fire academy education may be financed by the sponsoring group, which also typically guarantees his or her employment after graduation. Students without sponsors will have to finance their own education and conduct their own job search.

Fire academies may be part of a fire department, or they may be college based. In either case, the training is intellectually and physically arduous and demands commitment on the cadet's part. Typically, fire academy training is 12 to 16 weeks but may vary from state to state and even within the same state. A high school diploma or General Educational Development (GED) certificate of completion is generally the minimum educational requirement to apply for cadet training; however, this can be different from state to state. If the academy is sponsored by a fire department, the department's training officers supervise fire recruits until they have mastered basic firefighting skills and completed their examinations. Trainees are then assigned to a duty station where their progress is supervised by a fire company officer. Often, fire recruits remain on probationary status for their first year of service while their performance, both as an individual and as a team member, is assessed. The academy could even be administered through a career-technical training program through vocational schools. If the academy is based in a college or university, the graduating cadets begin the long road toward finding an entry-level job and establishing their own career paths with a fire department. Regardless of how cadets find employment, the tasks they face in their new job are the same. In addition to actual firefighting, cadets may be assigned rescue work, first aid, ventilation, forcible entry, salvage, overhaul, site inspections, emergency medical care, public fire education, hazardous materials work, dispatching—and the list goes on (see Figure 2-2).

FIREFIGHTER

Hiring requirements for firefighters are comprehensive and the testing competitive, reflecting the critical nature of the job and the need to work under stressful and physically demanding conditions. Applicants typically must pass a written test, an oral interview, a physical ability test, a medical evaluation, and a background investigation. Those who achieve the

FIGURE 2-2 Cadets attending fire academy. *Courtesy of Jason Loyd.*

highest scores are ranked at the top of the candidate list and have the best chances of being hired. New firefighters work under close supervision learning the department's policies and procedures, which are usually referred to as **standard operating procedures (SOP)** or standard operating guidelines (SOG). As with many other jobs, there is usually a probationary period that can last from six months to a year, depending on department policy. If the probationary period is successfully completed according to the probationary agreement, the probation status is lifted and the firefighter becomes a full-duty fire professional. However, this can vary from town to town or even state to state. There are different levels of basic firefighting, which include National Fire Protection Association (NFPA) levels such as Firefighter I (FF I) and Firefighter II (FF II). FF I and FF II differ on their levels of supervision and ability to operate independently. FF I follows *NFPA 1001: Standard for Fire Fighter Professional Qualifications* and covers Chapter 4 of that standard. FF II covers the same skills but goes into a more depth of knowledge as covered in Chapter 5 of NFPA 1001. A new edition of NFPA 1001 was updated January 2019 and replaces the one issued in 2013.[2] There is also a new standard for Hazmat NFPA 1072 so new rules and protocols might need to be reviewed at that time.

standard operating procedures (SOP) ■ Rules by which an organization or fire department operates for its day-to-day functioning. Usually these procedures are documented in a handbook or related source.

Firefighters respond to emergency calls of all types. Although their primary responsibility is to fight fires, they are more often called on to assist with other kinds of emergencies, such as medical calls and vehicle accidents. As a public service, firefighters often visit schools, day care centers, and senior centers to teach fire safety. Firefighters' schedules vary, but the typical shift is 24 hours on duty, followed by 48 hours off. Of course, firefighters cannot just leave the scene of an emergency and go home when their appointed shift ends. Long and irregular hours are not unusual, and applicants should consider this before entering the profession. Moreover, a firefighter's duty and responsibilities fluctuate, and written job descriptions can vary considerably. Candidates need to gather as much information about a department's requirements before applying for a job. The Internet and job boards are good resources, and it is also helpful to visit agencies in the area.

FEDERAL FIREFIGHTER

The federal government employs both civilian and military firefighters at some of their installations, especially at military bases. These jobs require the firefighter to deal with specialized on-base emergencies, such as aircraft crashes, in addition to performing the same tasks and responsibilities of a municipal firefighter. Goodfellow Air Force Base in Texas is the home of the Louis F. Garland Department of Defense Fire Academy. The academy serves all branches of the Department of Defense (DoD), including the Army, Marine Corps, Navy, Air Force, and Civil Service. It provides training for about 2,000 students a year, including allied forces, and can be a path to a variety of fire service careers in the DoD branches. DoD firefighting opportunities are readily available on military bases for both civilians and military personnel.

FIREFIGHTER/EMT OR HIGHER

Fire departments in the United States commonly respond to medical emergencies. In fact, about half of them provide ambulance service. This has led to the dual position of firefighter/EMT or EMT–P (paramedic), in which the same person serves in two capacities in an emergency situation. The position comes with increased responsibility and requires advanced medical training that can take from at least six months to a year to complete. The actual number of hours required for training can vary from state to state, so please check your local requirements. There may also be an intermediate level offered in your area. In addition to performing basic fire-suppressing duties, firefighter/medics must be prepared to assess injuries and acute illnesses, supervise ambulance transports, and take full responsibility for patient care until relieved by proper medical personnel. They provide emergency treatment working under standing orders or under the directions of a supervising physician. Personnel with this type of training are in great demand, with many

fire departments offering pay incentives to qualified applicants for the position. Specific training and certifications requirements are dependent on your state or jurisdiction. The job outlook for the firefighter/paramedic is also expected to rise 15% from 2016 to 2026.[3]

WILDLAND FIREFIGHTER

Fires set by lightning or careless human behavior consume thousands of acres of our precious wildlands annually. For example, from January 1 through September 2017, there have been 48,082 wildland fires that covered 8,159,989 acres. And as of September 2017, the following states have reported large wildland fires: California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.[4]

In national forests and parks, nonfirefighters are the first line of defense against these fires. Forest rangers patrol assigned areas to ensure that travelers and campers comply with fire regulations. Forest fire inspectors and prevention specialists spot fires from watchtowers and report their findings to headquarters by telephone or radio. When a fire is reported, wildland firefighters are brought in to suppress the blaze. In addition to basic firefighting training, these specialists study **fire ecology**, the science of how fire behaves in natural environments and how it affects both living and nonliving things in the environment.

fire ecology ■ The study of the interrelationship of wildland fires and living and nonliving things in the environment.

The work is physically demanding and can be emotionally taxing. Wildland firefighters are frequently required to work for days at a time—sometimes up to 14 days straight, without a day off or home leave. A typical shift is 16 hours or longer, and shifts over 24 hours are not unknown. In addition to the long hours, the crews must brave hazardous environments, enduring extremes of heat as well as smoky, dirty, and dusty conditions. It is important to note that there may be age requirements[5] for this specific role of firefighting—please check your local state or district.

A wildland firefighter may not always work directly in the front lines of an advancing fire. Other assignments might include creating **fire lines**—cutting down trees and digging out grass and other combustible vegetation in the path of the fire—to deprive it of fuel. This is one of the most efficient means of battling a blaze. Wildland firefighters may also work at setting and monitoring **prescribed fires**. These are fires purposely ignited by fire personnel or agencies under controlled conditions for specific management objectives. For example, setting a prescribed fire is a good, natural way to help put nitrates back into the soil. Furthermore, a prescribed burn can help decrease wildfires because it removes dead and dying trees to prevent heavy fuel loads during dry seasons.

fire lines ■ Boundaries around a fire area to prevent access except for emergency vehicles and relevant professionals.

prescribed fire ■ A fire that is purposely ignited by fire personnel or agencies under controlled conditions for specific management objectives.

There are a number of challenging specialist careers within the wildland firefighting field. Helicopter attack teams, or **helitack**, dump enormous buckets or belly tanks of water onto the fire. Some helitack crews rappel out of helicopters, gaining access the only way possible to fires in remote areas or in rugged terrain. **Smoke jumpers** parachute out of planes to reach areas not otherwise accessible, and **hotshot** crews hike into the area where the fire is burning to begin extinguishment. Employers for individuals interested in a wildland firefighting career include the U.S. Department of Agriculture Forest Service, California Department of Forestry and Fire Protection, and contract companies. In 2017, the U.S. Forest Service predicted a busier fire season than ever because of the drier than normal winter. Furthermore, having a reduction in its large air tanker fleet has not helped its resources. In Texas, the Texas A&M Forest Service has implemented the Texas Intrastate Fire Mutual Aid System (TIFMAS), which allows training to be conducted to make statewide use of local resources and to make sure everyone has had the same comprehensive training. Other states have implemented such programs such as CAL FIRE in California.

helitack ■ Used during wildfires when the location of the fire(s) is inaccessible to firefighting crews.

smoke jumpers ■ Firefighters who parachute from airplanes to suppress forest fires in remote locations.

hotshot ■ Highly trained firefighters used primarily in handline construction.

AIRCRAFT RESCUE FIREFIGHTER

The aircraft rescue firefighter (ARFF) goes through a highly specialized course of training to earn certification and then be assigned to a civilian airport. The Federal Aviation Administration (**FAA**), an agency of the U.S. Department of Transportation, sets

FAA ■ An agency in the U.S. Department of Transportation that oversees all aspects of civil aviation.

FIGURE 2-3 ARFF apparatus. *Courtesy of TEEX-Texas A&M System.*

minimum ARFF requirements for each airport, based on an index determined by the overall length of the aircraft it handles and the average daily departures of those aircraft.[6] ARFF training guidelines are outlined in the FAA's Federal Aviation Regulations, Part 139 (FAR Part 139). This requires that trainees receive airport and aircraft familiarization instruction, training in emergency aircraft evacuation assistance, and airport emergency communications systems. They also must be experienced in using the specialized equipment needed to fight aircraft fires and to minimize aircraft cargo hazards. In addition to this basic training, aircraft rescue firefighters must typically participate in an annual 24-hour ARFF refresher course as well as annual live flammable-liquids fire-suppression training to maintain their certification. In addition, they usually take part in annual multiple-casualty exercises at the airport (see Figure 2-3).

FIRE APPARATUS ENGINEER

The fire apparatus engineer is a promotion from the firefighter position and requires extensive training and experience. Apparatus engineers work in all kinds of firefighting situations (structural, wildlands, and so on) and have sole responsibility for driving and operating fire apparatus such as engines, water tenders, rescue squad vehicles, and aerial trucks. Emergency driving skills, and knowledge of traffic laws, departmental SOPs, and hydraulics are examples of additional training that a person must have to be successful in this position. It is important to note that this specific role in firefighting requires an enormous understanding of pumper hydraulics and the person must also be able to figure and understand pump calculations quickly in their head. Special driving certifications/licenses are required, and good driving records are compulsory.

SEARCH AND RESCUE

Search and rescue (SAR) teams consist primarily of volunteers, usually drawn from other emergency services. They are responsible for conducting missions in a wide range of emergency situations and almost any imaginable setting, including aircraft accidents or incidents, swift-water and open-water rescue, dive rescue and recovery, confined space rescue, mine rescue, high- and low-angle rescue (mountain and structure), and avalanche rescue (see Figure 2-4). The broad scope of their activities calls for a high degree of proficiency in a wide range of rescue techniques. Frequent and intensive training is required (see Figure 2-5). Each department or agency may have its own local SAR team. In addition, state-supported or regional SAR teams are deployed to cope with disasters of a larger scale.

FIGURE 2-4 Water rescue training. *Courtesy of TEEX-Texas A&M System.*

FIGURE 2-5 Collapsed structures training. *Courtesy of TEEX-Texas A&M System.*

One such state-supported team is Texas Task Force 1. Task Force 1, sponsored by the Texas A&M Engineering Extension Service (TEEX) a member of the Texas A&M University System, serves as the state's urban search and rescue team under the Governor's Division of Emergency Management and is one of 28 such teams in Federal Emergency Management Agency's (FEMA's) national urban search and rescue system. This task force, with more than 200 members drawn from 60 organizations across Texas, responded to one of the largest natural disasters in U.S. history. When Hurricane Katrina struck the Gulf Coast of Louisiana and Mississippi on August 29, 2005, Texas Task Force 1 swung into action, performing a variety of functions as the emergency developed:

- An 80-member urban search and rescue team was deployed by the FEMA on Saturday, August 27, in advance of the hurricane's landfall.
- A 41-member water rescue team was deployed by the Texas Governor's Division of Emergency Management on Monday, August 29.
- Another 75-member urban search and rescue team was deployed by FEMA to New Orleans on Tuesday, September 13.

The teams assisted with more than 13,000 rescues in downtown New Orleans, where thousands were stranded after the hurricane's storm surge broke levees and left much of

FIGURE 2-6 Bastrop, Texas, wildland fire. *Courtesy of TEEX-Texas A&M System.*

the city under water.[7] Another major deployment was on September 6, 2011. Task Force 1 was activated to deploy to the Bastrop, Texas, wildland fires. They searched over 2,600 damaged, destroyed, or remaining structures over a six-day period. Deployment involved 91 personnel[8](see Figure 2-6). Furthermore as mentioned in Chapter 1 about various agencies helping with Hurricane Harvey in 2017, Texas Task Forces I and II were deployed to assist in rescues in the Beaumont/Port Arthur area that received a record-breaking 51 inches of rain leaving much of the Houston/Galveston area under water for days.

INDUSTRIAL FIREFIGHTER

An industrial firefighter is specialized in meeting the needs of the manufacturing, refining, and petrochemical industries. The oil industry began in America in the late 1800s, and with it came fierce and uncontrollable petroleum fires. Twenty years ago, the technology and specialized training needed to extinguish such fires was not available, and they often burned until the fuel ran out. The cost to the environment, business, and human health was immense. The training and certifications required for this type of role varies from states and privately owned industries, so it is important to note that a potential industrial firefighter would need to research his or her specific place of employment. The need for industrial firefighting was obvious, but there were no facilities capable of handling the large-scale training exercises that would be required. This need is now met nationally and internationally through training facilities such as TEEX at the Brayton Fire Training Field, a part of the Texas A&M University System (see Figure 2-7).

HAZARDOUS MATERIALS TECHNICIAN

Hazardous materials technicians are concerned with the discovery, regulation, and recovery of hazardous materials. They must meet the standards for the hazardous materials technician level, as set by the National Fire Protection Association. States have different requirements, so please verify with your jurisdiction. In Texas, the minimum requirement to achieve full status on a hazardous materials response team (HazMat) is approximately 80 hours of training. A 40-hour annual recertification class is also required. In addition to hazardous materials training, personnel must possess basic first aid and rescue skills. As a rule, these technicians are also required to have specialized training in dealing with weapons of mass destruction as well as biological warfare agents and other hazardous materials that might be used in terrorist incidents (see Figure 2-8).

FIGURE 2-7
Simulated chemical complex fire training structure. *Courtesy of TEEX-Texas A&M System.*

FIGURE 2-8 Students suiting up for Hazmat scenario. *Courtesy of Jason Loyd.*

FIRE INVESTIGATION UNITS/ARSON UNITS

Fire Investigation Units (FIU) or Arson units are charged with combating arson and other fire-related criminal offenses. A large city might have its own arson team, but in smaller towns and in rural districts, these units tend to be multijurisdictional. The units fulfill their mission by bringing together and utilizing the talents and resources of experienced and dedicated fire, police, and prosecutorial personnel in a manner that maximizes results while minimizing taxpayer expense. Certification in this area often includes peace officer training, which gives arson team members the power to arrest.

Nonfirefighting Careers in Fire Protection

Other career paths in the fire service are available that do not require active, on-site firefighting. The physical, educational, and certification requirements for these positions differ. All require an understanding of fire and fire safety, and each serves a critical function in protecting the public.

DISPATCHER/COMMUNICATIONS OPERATOR

One of the most challenging civilian jobs in emergency services is that of fire dispatcher. The dispatcher's job is to support fire management operations, primarily by relaying information from those seeking emergency services to the appropriate responders. In most cases, dispatchers are not solely dedicated to fire emergencies but must handle police and medical emergency calls as well. It is their job to receive each incoming 9-1-1 telephone call, obtain essential incident information from the caller, evaluate what type of emergency service is required, determine the priority of the call, and then dispatch the appropriate unit. They must also relay all essential information about the emergency to the responding unit via voice radio or intercom while at the same time monitoring all other emergency frequencies. Dispatchers work at a fast pace and are under constant pressure. They must be expert communicators and proficient multitaskers and be able to handle high-stress situations calmly (see Figure 2-9). Training includes many different topics, including philosophy of law enforcement and firefighting, law, technical topics (radio, telephone, computers), stress management, handling difficult callers, emergency medical dispatching instructions, and listening and speaking skills. Although firefighting skills are not required for the position, many firefighters—whether paid or volunteer—are sometimes given special preference for this job because of their background.

OCCUPATIONAL HEALTH AND SAFETY SPECIALIST

Occupational health and safety specialists are employed in both the public and private sector. Their expertise is analyzing potential hazards in work environments and developing programs and procedures to eliminate or minimize these hazards. They may also serve in an enforcement capacity, conducting inspections and monitoring compliance with health and safety regulations and laws. The safety specialist is able to identify any condition—physical, chemical, biological, or **ergonomic**—that may cause disease or injury. The experience and education required may be different depending on the needs of the public or private sector area. Candidates should always find out what their potential employers may require.

ergonomic ■ The scientific principle that bases design around human needs, and the profession that applies science and data to this concept.

FIRE EQUIPMENT SALESPERSON

Because firefighters and other emergency personnel can have flexible work schedules, they may be able to work at dual occupations. A firefighter might elect to continue work in the fire service field by working as a part-time fire equipment salesperson. Companies such as Pierce Manufacturing and Tyco Fire & Security, which design and service fire protection

FIGURE 2-9 Dispatch communications center. *Courtesy of Jason Loyd.*

equipment, are always looking for experienced personnel to sell their products. Firefighter certification is not required for this position.

FIRE EXTINGUISHER SERVICE TECHNICIAN

Another occupation not directly related to firefighting duties is that of the fire extinguisher service technician who inspects and services firefighting equipment, including all types of hand-held fire extinguishers and fire hoses. Fire extinguisher service technicians must have the technical knowledge to disassemble extinguishers and examine them for defects, replace defective parts, clean the fire extinguishers, refill them with fire extinguishing agents, and then test them, using special testing equipment, to ensure that they meet specifications. This is another occupation that does not require firefighter certification.

FIRE MARSHAL

The fire marshal typically heads the fire prevention division. However, there are no concrete sets of rules on fire marshal positions. In addition, this type of position could be at a fire department, government entity, or both. Numerous different titles exist, but the basic definitions are the same. Fire marshals conduct inspections of the premises within their jurisdiction to identify unsafe conditions and ensure compliance with fire codes. Additional duties may include fire and arson investigation. Fire marshals also work with developers and city planners to check and approve plans for new buildings. In conjunction with the goals of the fire prevention division, fire marshals often speak before public assemblies and civic organizations to promote fire prevention. This position may require formal education such as a bachelor's degree as well as experience in fire prevention, plan review, inspections, and supervision (see Figure 2-10).

STOP AND THINK 2-1

Several different avenues are available for a career in fire and emergency services.

Select two different choices in the fire and emergency services field that an individual may pursue besides civil service employment. Explain your answer in detail.

FIGURE 2-10 FESHE professional model for fire marshal. *Courtesy of U.S. Department of Homeland Security.*

PUBLIC INFORMATION OFFICER

The job of a fire department's public information officer (PIO) is to communicate accurate information to the community and to members of the fire service in a timely, efficient manner. This information may relate to ongoing emergencies or to other aspects of the department's operations. A public information officer is often interviewed on television or on the radio, responding to questions from reporters. A public information officer must be available at any time of the day or night to cover significant events and serve as liaison between the incident commander and media outlets. The position requires proficient verbal skills and media knowledge. Applicants for the job typically have a bachelor's degree and meet the *NFPA's Standard 1035: Standard for Professional Qualifications for Public Fire and Life Safety Educator*. Although firefighting skills are not required for this position, many PIOs are hired out of the firefighter arena.

FIRE PREVENTION SPECIALIST/PUBLIC FIRE EDUCATION SPECIALIST

A fire prevention specialist is a unique kind of fire service professional who fights fire by promoting fire prevention training and education. The position involves visiting schools and community organizations to talk about fire safety, and it may also require performing routine checks of fire systems, such as sprinklers and hydrants. Fire prevention specialists use campaigns such as **Smokey Bear**, **Sparky the Fire Dog®**, and Fire Prevention Week to build awareness and educate the public. The Smokey Bear campaign, which was created in 1944, is the most well-known public service prevention program geared toward wildland and forestry fires. In 2014, the Smokey Bear campaign celebrated seven decades of public service announcements and reiterated that "Only You Can Stop Forest Fires." Examples of job opportunities as a fire prevention specialist are federal or state forestry services, city or county fire departments, municipalities (such as inspection bureaus), private companies, or through partnership with several of these. New information to aid in your department may be obtained through Smokey Bear's Facebook, Twitter, and Instagram accounts.

Smokey Bear ■ Created in 1944. The longest running public service campaign in U.S. history for fire prevention.

Sparky the Fire Dog® ■ Created in 1951. Used for NFPA's Risk Watch® and Learn Not to Burn® programs and has a special appeal to children's programs.

FIRE DEPARTMENT TRAINING SPECIALIST

A fire department's training specialist or training officer develops and coordinates programs to maintain and enhance skilled performance by the department's firefighters. The position also involves developing standard operating procedures for fire suppression and assuring that these procedures are in compliance with state and federal fire and safety regulations. This is typically a mid-management position that reports directly to the fire chief. The specific functions of the training officer are described in more detail in Chapter 4, "Training and Higher Education."

INSURANCE ADJUSTER

Insurance companies frequently hire people with backgrounds in the fire service to work in their loss prevention departments. They especially seek those with knowledge in the fields of fire protection engineering, fire risk management, fire prevention, and arson investigation. Such expertise is invaluable when it comes to inspecting fire-damaged properties to assess whether arson may have been involved. Adjusters also estimate the amount of loss, negotiate with policyholders, and when necessary, gather evidence to support contested claims. They may be called to testify in court on behalf of their employer.

FIRE INSPECTOR

The major goals of fire inspectors are to increase public awareness so that potential fire hazards can be avoided. They also have to keep sound records of their inspections and physically verify that fire protections systems are working and maintained in the building he/she is inspecting. To achieve these goals, fire inspectors examine the interior as well as the exterior of buildings and structures for fire hazards. Code enforcement plays a major role in their work. Fire inspectors may also collect fees for building licenses and permits. A fire inspector is