Physical and Technical Aspects of Fire and Arson Investigation

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Second Printing

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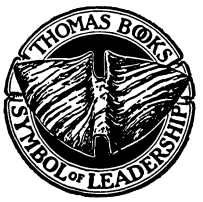

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To "them"–they know who they are

Preface

FIRE INVESTIGATORS, fire marshals, policemen and firemen will find this book useful in the investigation of fires. It will also be of interest to insurance investigators, adjusters, engineers and attorneys who are involved in litigation.

The main objective of any fire investigation is to determine the cause of the fire and eliminate all other possible causes. Once this is done, the next objective may be to develop a case for litigation. In civil code, only a preponderance of the evidence is required for the jury's decision. The legal requirements of proof in a criminal case are more strict because the liberty of the defendant is often at stake. This contrasts with a civil case in which the outcome of the trial is generally limited to an exchange of money for damages. Where the liberty of the defendant is involved, the court requires that "proof beyond a reasonable doubt" be provided by the prosecution.

In either case, criminal or civil, if it is possible to show that another cause of the fire could have been the true cause, then the prosecution or the plaintiff has failed to remove "reasonable doubt" or has failed to provide a "preponderance of the evidence."

This is particularly true in an arson case, where the case is usually based upon circumstantial evidence. In an arson case, it is usually easily shown that other causes could have started the fire.

The elimination of other possible causes is the main subject to be dealt with in this book. In eliminating other possible causes, it is probable that the true cause of the fire may be discovered. This could save an innocent person from prosecution and could guarantee prosecution of the guilty.

This book is based upon years of practical experience in the field of fire investigation. Many of the techniques presented are based upon original methods developed in determining the cause of fires.

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CHAPTER I

Introduction

COSTS OF FIRES

ON OCTOBER 6, 1975, "Dear Abby" devoted her entire column to the subject of fire prevention–and with good reason. According to the statistics of the National Fire Protection Association, more than 11,700 lives were lost in 1974 as a result of nearly 3 million fires.

Americans were appalled by the loss of life during the Vietnam conflict. The total loss of United States military personnel from 1961 to 1972 was 45,925. In that same period, deaths resulting from fires in the United States totalled 143,550. These statistics, from the Department of Defense and the National Fire Protection Association, dramatically point out the need for a more conscientious and detailed study of the origin and cause of fires which result in these tragedies. Through this vital step the loss of lives can be reduced.

In addition to the tragic death toll, the cost in dollars is in excess of $3 billion a year. Local and state government efforts to solve this problem resulted in the creation of the National Commission on Fire Prevention and Control. This commission has developed a *National Uniform Fire Reporting System* of standardized fire reporting. The purpose of this system is to gain a clearer picture of fire incidents.

CAUSES AND TRENDS

The current statistical studies by the National Fire Protection Association (NFPA) are based upon approximately 2,000 reporting fire departments from the 50 states. The data from these sources are extrapolated to a national average. The figures in Table I are estimates intended to show the relative order of magnitude of fire causes and annual trends. The NFPA cautions that the figures do not show the relative safety in the use of the various

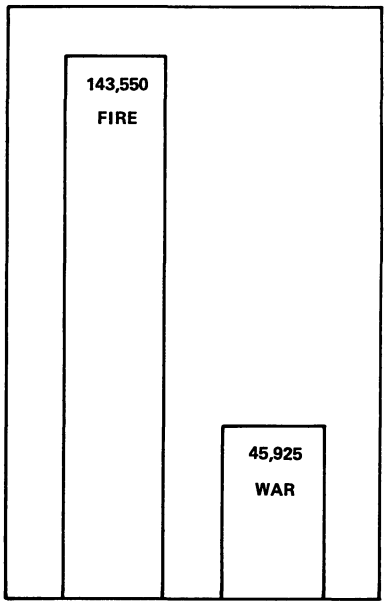

Figure 1. Deaths—United States Fires versus Vietnam War. Comparisons of deaths in United States military personnel (Army, Navy, Coast Guard, Marine Corps and Air Force) resulting from actions by hostile forces in Vietnam, 1961 through 1972, and deaths from United States fires for the same period. (Statistics from the Department of Defense and the National Fire Protection Association.) From *America Burning,* National Commission on Fire Prevention and Control, 1975.

types of materials, devices, fuels or services involved and should not be used for that purpose.

The breakdown of fires by number and percentage according to cause is shown in Table I. *Unknown Fires* are shown to exceed 12 percent of all fires and *Incendiary Fires* approximately 10 percent. Assuming that 50 percent of *Unknown Fires* may be incendiary, the total number of *Incendiary Fires* may be as high as 16 percent. Some authorities estimate this total to be as high as 25 percent.

Incendiary fires are clearly a major factor in the total fire problem. This demands that qualified fire investigators be provided so that the numbers in this category can be reduced.

TABLE I

NUMBER OF FIRES CLASSIFIED BY CAUSE (1,000s)*

Classification	*%*	*1971*	*%*	*1972*	*%*	*1973*	*%*	*1974*	*%*	*1975*
H and C equipment	16	157.7	15	155.2	15	165.8	13	160.0	13	165.6
Smoking-related	12	118.4	10	109.7	11	115.2	10	121.6	11	137.8
Electrical	16	160.9	16	162.6	16	170.7	13	165.0	12	150.5
Trash burning	3	34.4	3	36.0	3	35.2	13	177.0	12	155.5
Flammable liquids	7	64.9	6	65.2	6	67.3	4	56.1	5	61.9
Open flames and sparks	7	74.1	7	71.9	6	70.0	6	77.5	7	85.5
Lightning	2	22.2	2	22.7	2	21.6	1	16.6	1	14.2
Children and fire	7	70.4	7	69.2	7	70.8	5	59.6	5	64.2
Exposure	2	23.2	2	25.4	2	25.2	3	44.2	3	34.1
Incendiary and suspicious	7	72.1	8	84.2	9	94.3	9	114.4	11	144.1
Spontaneous ignition	2	15.7	1	15.1	1	14.9	1	11.0	0.9	11.0
Gas fires and explosions	1	8.2	1	8.7	1	9.6	1	11.9	0.8	9.5
Fireworks, explosions	0.5	4.4	1	4.2	1	4.3	1	4.2	0.3	3.9
Miscellaneous known causes	0.5	3.8	6	65.9	6	70.5	7	91.7	7	89.3
Unknown causes	17	166.2	15	154.2	14	150.5	13	159.2	11	137.3
Total	100	996.6	100	1,050.2	100	1,085.9	100	1,270.0	100	1,264.4

* From National Fire Protection Association.

This book is intended to assist the fire investigator, whether he is employed as a fireman, fire chief, insurance adjuster, consulting engineer, attorney, police officer or police investigator. It can be a valuable tool in the determination of the origin and cause of fires.

Fire service personnel will find this book useful in completing the Uniform Fire Reporting form regarding cause of ignition and the type of material first ignited in the fire.

Classification of Fires

The estimates of the National Fire Protection Association are based upon the following classifications (see Table I):

Heating and Cooking Equipment

The greatest percentage of fires in this category are the result of defective or misused equipment. Subcategories include combustibles near heaters and stoves; chimneys and flues; and hot ashes and coals.

Smoking-related

This refers to cigarettes, pipes, tobaccos or matches used in the process of lighting smoking materials.

Electrical

This category has two major subdivisions: (1) Wiring distribution equipment and (2) motors and appliances. The former is responsible for twice the number of fires as the latter. This category does not include fires originating in heating and cooking equipment.

Trash Burning

This includes rubbish and waste material fires whose ignition source is unknown.

Flammable Liquids

This category includes all flammable liquids, excluding fires originating in heating and cooking equipment.

Open Flames and Sparks

An open flame is described as one exposed to the ambient