ELECTRICAL FIRE ANALYSIS

Second Edition

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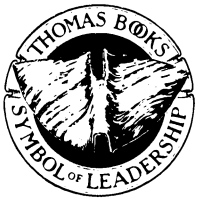
By

ROBERT A. YEREANCE



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PREFACE TO THE SECOND EDITION

I didn't start out to establish a career in electrical fire analysis. About twenty to twenty-five years ago I was working happily as an engineer and scientist at Battelle Memorial Institute, in Columbus, Ohio. My work was largely concerned with electronic reliability, the effort to make electronic equipment that never fails. The sponsors represented many of the larger organizations with interests in this field, including Boeing, General Electric, ITT, Lockheed, Martin-Marietta, Westinghouse, NASA, the U.S. Army and Air Force, and numerous small organizations whose names you probably would not recognize.

When electronic parts fail there may be a plane crash, or you may simply miss your favorite TV show. The failure can also cause a fire. Thus, I was called upon to investigate a few fires. Purely by chance, these were in TV sets and other household equipment.

Somehow, through a series of strange circumstances, I rose to the position of Division Chief, with about twenty-five excellent scientists working for me. In making this progress I also acquired a boss with whom I violently disagreed on virtually every aspect of management. I cast about, looking for some place, any place but where I was, to go. I had an offer of a different position within Battelle and an offer as Reliability Manager for a major industrial organization, but I decided that I had had enough of bosses, took courage in hand, and went into business for myself. My intent was to do engineering consulting, chiefly in the field of military electronic reliability, and I did get a good project in that area. However, the U.S. Consumer Products Safety Commission (CPSC) was looking for a consultant, and friends at Battelle recommended me.

The CPSC was, at that time, deeply involved in efforts to reduce the hazards associated with TV sets, and the major hazard, from the standpoint of property damage and death, was fire. Thus, in the next few years I became an expert in fires involving TV sets. I began to pick up additional work from insurance companies who had sustained losses, and lawyers who were representing clients who had sustained losses from

fires in which TV sets were suspected of being the points of origin. Still, some of the early years were very lean. If my wife, Staci, had not worked long and faithfully to support us, we surely would have starved.

My first appearance in court, on behalf of a TV manufacturer, was a total disaster. An hour before my court appearance I got the first hint that my lawyer had withheld information. When I got on the stand, I found he had withheld much information. This, coupled with my great nervousness at my first court appearance, completely unsettled me. I barely escaped alive.

In spite of this terrible beginning, clients came to me with additional TV fires. They apparently liked what I was doing, because they began to ask me to look at other types of equipment. Stoves, refrigerators, hot water heaters, electric paint removers, almost any electrical item found in the home. I also found myself investigating fires in various vehicles, including automobiles, RV's and tractors. To date, I have investigated about 1000 fires involving some type of electrical equipment. I have also investigated a fair number of fires that were not of electrical origin, the suspect items including various types of gas appliances and kerosene space heaters. However, I am an electrical engineer, and most of my efforts have been concentrated on fires in electrical equipment.

As I gained experience, I began to observe and understand fire-damage patterns that made my analyses easier and faster. I also began to be on the winning side in lawsuits and in cases that never got to court. I wasn't on the winning side in all of them but certainly in the great majority of cases. I don't mean to imply that I won these cases single-handedly. I have presented winning arguments and have been on the losing side because lawyers handled the case poorly or because the judge or jury was heavily biased against us. I have also presented arguments that I felt were weak and have been on the winning side because the lawyers did an outstanding job and the judge or jury was sympathetic. I have testified for both the injured party and for the appliance manufacturer, although most of my work has been for the injured party. The manufacturer has many knowledgeable experts at his disposal. The injured party may find it difficult to locate one.

In this book I describe the patterns which make it easier to determine where an electrical fire started and give you the information you need to convince others that your analysis is correct. The best and easiest way to win the case is to present an analysis that explains all the known facts and which leads from them to a solution to the origin of the fire. If your

analysis is firmly founded, you will have the confidence you need to present your findings clearly and convincingly in depositions and in court.

Many people have helped me and have contributed to my success. I particularly want to thank Robert L. Northedge of the CPSC in the Washington, D.C. area for the freedom he provided to pursue investigations without bias, and for numerous interesting and informative discussions.

I also want to express my thanks to Staci, who proofread and checked endlessly in an effort to eliminate every possible mistake from my manuscript.

This book is dedicated to all those fire investigators and analysts who work diligently to determine and explain the causes of fires, and to all other seekers of the truth.

R.A.Y.

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Chapter 1

GENERAL BACKGROUND

INTRODUCTION

No one knows how many electrical fires there are each year in the United States, nor how many lives and how much property damage they cause. For years, many fire departments have classified essentially any fire of unknown or uncertain origin as electrical. Their chief interest in analyzing a fire scene is to determine whether or not there is a possibility of arson. If arson does not appear to be a factor, they lose interest and the easiest culprit to blame is electricity, as this is seldom questioned. Thus, the basic inputs to any statistics-gathering effort are distorted, and any conclusions drawn from the statistics will also be distorted.

In recent years there has been a trend to correct this situation. Fire departments are becoming more sensitive to the need to analyze fires more accurately, in order to determine their origin with reasonable confidence. This, however, raises new problems. The majority of fire analysts have arrived at their position as a result of experience as fire fighters. Unfortunately, fighting fires often provides little experience in analyzing fires. The first priority in fighting fires is saving lives. When a blaze is extinguished, the weary fire fighters retreat to their respective fire stations, in no mood or condition to pore over the embers they have left behind. Thus many fire analysts have come through a hard-knocks school that has prepared them for one trade, only to find they are now expected to be experts in quite another trade.

This picture is further complicated by the fact that electricity is a mysterious and largely unfamiliar phenomenon to most people, and in this regard fire fighters that move into fire analysis are just like other people. They don't know a great deal about electricity. Yet, even though electricity may be blamed for more fires than it actually causes, it is undoubtedly responsible for most accidental fires.

There are additional interrelated problems. Insurance companies are

requiring more and more sophisticated analyses of fire origins, in order to make cases against companies or individuals in some way responsible for these fires. These companies and individuals resist being sued and fight back, not wanting to be unjustly, or perhaps even justly, held responsible for a catastrophe of whatever proportion. This means that fire analysts must not only be more accurate in their determination of the cause of a fire, they must be able to provide logical reasons to support their conclusions, and they must be able to present these reasons in a manner that is intelligible and convincing to lawyers and juries. Insurance companies also need to know when it is feasible to hire an outside fire expert and what can be expected of him. This book should provide insight into this problem.

Lawyers, in turn, are hopefully knowledgeable about legal matters but may be woefully ignorant about the technical aspects of cases they are hired to present or defend against. They need to know what they can reasonably expect of a fire analyst, both in his role as an analyst and in his role as an expert witness should a lawsuit ensue. Lawyers need to know what the analyst can do and what he cannot. They need to absorb a degree of background in the field of fire analysis in order to understand what their experts tell them and in order to question opposing experts intelligently.

Our legal community has created an environment for itself that is at the same time self-sustaining and self-defeating. Judgements often seem unreasonably high, far beyond the degree of damage sustained, and seemingly trivial cases are sometimes settled for large sums. This encourages others to bring suits, and forces those sued to fight the suits vigorously. All this makes business for lawyers. On the other hand, it also creates a feeling of distrust of the legal system that could result in a backlash against this system, ultimately doing lawyers great harm. There is a small but real glimmer of hope for a solution. More and more lawyers with whom I have contact are concerned about this situation. I recently worked on a case in which recompense in addition to recompense already received was being asked. The claim was denied, more on the basis that the sum asked for was unreasonable than on the basis that the claim had no foundation.

A single book cannot be all things to all people. It is not possible to write a book "to whom it may concern" and produce a result that is useful to anyone. Therefore, this book has been primarily directed to the fire analyst. However, every effort has been made to keep explanations simple

and understandable to persons without special knowledge, in the hope that this book may prove of value to all those with interests in the field of fire analysis.

The author welcomes any suggestions that may improve the contents or scope of any future editions and any corrections of the inevitable errors that creep into all books.

There is occasionally repetition in this book. Sometimes it is done for emphasis; sometimes it comes about because the same subject matter deserves discussion under more than one heading. I have tried to minimize this latter category of repetition by referring the reader to other sections of the book, where appropriate. Thus, you will find numerous cross-references throughout the text.

PURPOSE

The purpose of this book is to help you, a fire analyst, determine whether or not a particular piece of electrical equipment involved in a fire is the culprit that started the fire or is merely an innocent victim damaged by the fire. To do this requires, first, that you perform the role of an electrical fire investigator, gathering facts related to the fire that may help establish its origin, and second, that you perform the analysis required to interpret these facts in order to determine the roles of specific equipment in the fire. The field of this book is limited primarily to electrical equipment. Only a very limited attempt is made to instruct you in general fire investigation. There is little discussion of the effects of fire on concrete or wood. There are numerous other publications available that will give you that information. However, if you read this book carefully and apply the information given, you will not only be able to decide which electrical equipment is culprit and which victim, you will also have convincing arguments supporting your opinion. In short, you will have the means to convince yourself, and then a lawyer or insurance adjuster, and finally a jury, that you know what you are doing and have arrived at the only correct answer as to the source of the fire.

Although, as noted above, most accidental household fires are undoubtedly of electrical origin, you must remain constantly aware that many fires are not. There are a host of other ways in which a fire can start. Kerosene, gasoline, gas, cloth, paper and plastics are all excellent fuels and can be ignited with cigarettes, matches, spontaneous combustion and concentrated sunlight. It may seem ridiculous to emphasize this point so