

Introduction

This publication is an outgrowth of a symposium of the same title presented during the 1978 Annual Meeting of the American Society for Testing and Materials (ASTM) in Boston, Mass. The symposium was a project of ASTM Committee E05 on Fire Standards, Subcommittee E05.32 on Research.

In view of the large increase in work devoted to fire science and technology over the last ten years, the Subcommittee believed that their objectives could best be met by presenting a critical review of recent, significant developments in fire technology, and then showing how these developments can be applied to the design of buildings for fire safety. Because of the variety of topics and range of interests that needed to be included in the program, it was decided to select experts in the general areas to be covered and ask them to prepare papers meeting the objectives: to review recent developments in their area of expertise and to apply them to the design of more fire-safe structures.

While trying to break down the whole of fire technology into a manageable number of topics, two different aspects of design became apparent: (a) design of the structure—for a fire of a given severity level—so that neither the fire nor significant amounts of products generated by the fire will cause a hazard to life or property beyond the compartment of origin, and (b) design of combustible items and “loading” within the building to prevent a fire from spreading beyond its ignition source due to lack of suitable fuel.

The two design options are not mutually exclusive; good design would consider both. The separation occurs when basic information needed for the design is considered.

In the first case, physical and dynamic properties of the system and its components as a function of fire exposure are needed. In the second case, “combustibility” as a function of exposure for materials and products making up the fuel load, is the principal type of information needed for design.

A basic need in each case is information, derived from *tests* performed on materials and products, that give a meaningful measure of their performance under fire exposures.

Through the development and promulgation of these tests, ASTM has provided an important service to the fire community. But both ASTM and the fire community recognize that proper interpretation of existing tests and new, more definitive and relevant tests are needed to achieve the goal expressed by the title of this publication.

Let it be understood that this publication does *not* present a simple or complete description of unwanted fires or how to design them out of existence. There *is* no simple description of such a complex situation as unwanted fires. Hence there can be no simple test that adequately describes unwanted fires.

The complexity of fires arises from the interdependence of all elements in the fire that determines the nature of the fire itself. Fire performance of a specific item or structure is not a constant but a variable which depends on the environment to which it is exposed. The exposure the item or structure sees depends in turn on the performance of other items in the fire as well as its own properties. Add to these factors the dependent heat, mass, and momentum transfer processes that should be considered in analyzing a fire system and it becomes obvious that there are no simple descriptors of an unwanted fire. In fact, one of the problems in getting data for the design of more fire-safe structures is to know what to measure in addition to how to measure it.

Fire tests of greater relevance, which in turn will permit a better analysis of fire systems, will come from a more complete understanding of fundamental principles controlling the physical and chemical changes occurring in the fire. This is the general theme running through all the papers—the use of more basic information for analyzing fire problems.

One critical area of fire safety not covered in this publication is toxicity or toxic hazard. Illness of Dr. Donald Dressler, who prepared the symposium paper on this subject, prevented expansion and updating of his symposium paper which Dr. Dressler believed necessary before publication.

The papers describe fundamental information that has been generated in recent years to aid design for fire safety. In the first paper, Roux and Berlin have taken a systems engineering approach in order to place the various aspects of fire safety analysis in proper perspective. Mr. Abrams and Dr. Hilado discuss fire performance of materials and products and their relationship to fire safety. Dr. Pape and Dr. Quintiere emphasize the use of this information to describe how fire develops and spreads through and from the compartment of origin. Prof. Bryan and Dr. Harmathy discuss means of controlling and abating the developing fire and the fully developed fire.

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