# Introduction

The papers contained in this Special Technical Publication address a broad range of topics relating to the performance of clothing used for protection against chemical and thermal occupational hazards. These papers were presented at the first International Symposium on the Performance of Protective Clothing, held in Raleigh, North Carolina, on 16–20 July 1984. The meeting was sponsored by ASTM Committee F-23 on Protective Clothing.

Topics in this volume under the general subject of chemical protection include test methodology for evaluating the permeation resistance of protective clothing materials, field evaluation methods for end-use items of protective clothing, decontamination techniques, and risk assessment in the selection and use of chemical protective clothing. Also, a number of papers deal with the performance of protective clothing used against pesticides, a chemical hazard that has recently begun to attract a high level of interest.

Topics under the general subject of thermal protective clothing include research studies on laboratory test methods for measuring the insulative effects of materials, as well as the protective performance of materials exposed to hazardous levels of heat. The specific role of new, heat-resistant fabrics in insulating against flame and molten metals is discussed, as are specialized clothing systems for industrial and fire-fighting applications. Subjects important to the design and selection of protective garments are covered, including garment fit, sizing requirements, and the impact of protective clothing on human comfort in hot environments.

## *Background*

In the mid-1970s, the Industrial Safety Equipment Association (ISEA), a protective clothing and equipment manufacturers' trade organization, voiced an opinion that the lack of standards for industrial protective clothing had created problems that have impact manufacturers and users alike. At the request of ISEA, and with agreement from protective clothing users, research organizations, and several government groups, ASTM sponsored the formation of its Committee F-23 on Protective Clothing in June 1977.

Initially, the focus of Committee F-23 was on chemical protective clothing. However, in 1980 a group sponsored by the Aluminum Association, and primarily concerned with protection against thermal hazards like molten metal splash, was invited to join Committee F-23 as a separate subcommittee. Be-

cause of this action, the scope of Committee F-23 was expanded to include all aspects of base materials and protective clothing end-use items used for protection against occupational exposures to chemical and thermal hazards.

Besides the paramount need for uniform standards for industrial protective apparel, there was a recognized need for available, reliable performance data for protective clothing. The purpose of the Raleigh symposium was to bring together, for the first time, all those interested in protective clothing for occupational exposures, to present the findings of relevant research and, perhaps most important, to stimulate discussion and further development efforts.

### *Response to the Symposium*

By every measure, the response to this symposium was overwhelming. More than 50 technical papers were presented by experts from the United States and abroad. The authors came from industrial, academic, and government laboratories; from technical organizations and corporate safety programs; and as private consultants. Many of these authors are widely recognized as current experts in diverse aspects of laboratory testing and materials development, in clothing design, and in occupational risk assessment procedures. Many have first-hand experience and knowledge of the needs and requirements of protective clothing in the workplace.

Truly international in scope, the 250 attendees brought a diversity of interests and perspectives. They included research scientists, engineers, apparel and materials manufacturers, industrial safety professionals, and fire fighters.

### *Overview of the Subject Matter*

The papers in this volume are separated into eight sections, each of which represents an important topic in the areas of testing, performance, selection, or use of protective clothing. The sections are arranged to distinguish between chemical protection, thermal protection, and other related topics that are generally important to the performance of protective clothing.

The first four sections are devoted to chemical protection. The first of these addresses the permeation resistance of base materials. The second focuses on field performance and cleaning processes for clothing systems used in protection against pesticides. Discussions on risk assessment as a part of the selection and use of chemical protection clothing are featured in the third. The testing of seams and closures, fully encapsulated ensembles, and procedures for maintenance and decontamination of protective clothing are presented in the fourth section.

The next three sections are concerned with thermally protective materials and clothing. Laboratory test methods and the evaluation of the thermal performance of clothing materials used against radiant heat or flame are dis-

cussed in the fifth section. New developments in the technology of flame-resistant fibers and finishes for fabrics are the subjects of papers in the sixth. The next section is concerned with clothing systems for industrial and fire-fighting applications.

The eighth section differs from the previous seven in that the papers address topics which, although distinct from thermal or chemical resistance, are critical nonetheless to the performance of protective clothing. These topics include sizing, fit testing, and heat stress.

### *Significance of This Special Technical Publication*

This volume represents the first Special Technical Publication (STP) by ASTM in the field of industrial protective clothing. These papers embody the understanding and diverse perspectives of many of the world's top experts in the field of protective clothing. This volume should be a valuable source of information for anyone interested in chemical- and heat-resistant materials and clothing, as well as in principles and applications of laboratory testing methodologies.

Further, this STP is intended to stimulate broader interest in the ongoing activities of ASTM Committee F-23 in the areas of chemical and thermal resistance and in the related activities of anthropometric sizing and comfort of protective clothing. ASTM will continue its efforts in this field by publishing papers from the second International Symposium on the Performance of Protective Clothing, scheduled to be held in Tampa, Florida, in January 1987.

Dr. J. Donald Millar, Director of the U.S. National Institute for Occupational Safety and Health (NIOSH), was the keynote speaker at this first symposium. Dr. Millar pointed out that "the ultimate goal [of NIOSH] is the prevention of occupational disease and injury" and that "protective clothing can help prevent some of the leading work-related illnesses and injuries." The goal of achieving superior industrial protective clothing is brought ever closer, not only by vigorous research efforts but also by forums that make results available to scientists, to manufacturers, and to users of protective apparel.

The research discussed herein contributes to the body of authoritative literature on protective clothing. The editors hope that these findings will focus additional efforts in this important area, an area that has impact on the safety and health of hundreds of thousands of workers throughout the world.

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