Performance of Protective Clothing

SIXTH VOLUME

Jeffrey O. Stull
Arthur D. Schwoppe

EDITORS

ASTM

STP 1273
STP 1273

Performance of Protective Clothing: Sixth Volume

Jeffrey O. Stull and Arthur D. Schwope, Editors

ASTM Publication Code Number (PCN)
04-012730-55

ASTM
100 Barr Harbor Drive
West Conshohocken, PA 19428

Printed in the U.S.A.
Foreword

This publication, *Performance of Protective Clothing: Sixth Volume*, contains papers presented at the Sixth International Symposium on Performance of Protective Clothing: Emerging Protection Technologies held in Orlando, Florida on 18-19 June 1996. The symposium was sponsored by ASTM Committee F23 on Protective Clothing. Jeffrey O. Stull of International Personnel Protection, Inc. in Austin, Texas and Arthur D. Schwope of Arthur D. Little, Inc. in Cambridge, Massachusetts served as symposium cochairmen and also editors of the resulting publication.
Contents

Overview ix

NEW PROCEDURES FOR TESTING MATERIALS

Determining the Sensitivity of International Test Methods Designed to Assess the Gas-Tight Integrity of Fully Encapsulating Garments—TODD R. CARROLL, CHRIS J. RESHA, CHUCK T. VENCILL, AND JOHN D. LANGLEY 3

A Novel Apparatus for Measuring the Penetration of Chemical Vapors Through Air Permeable Materials—KAMAL RAJAGOPALAN, MARIAN MCCORD, AND ROGER BARKER 16

Asbestos Penetration Test System for Clothing Materials—ORVIL D. BRADLEY, JOSEPH F. STAMPFER, ALEX N. SANDOVAL, CLEVELAND A. HEATH, AND MICHELLE H. COOPER 26

Evaluation of a New Mechanical Pressure Tester for Barrier Fabrics—ELIZABETH A. MCCULLOUGH AND PHILLIP W. JOHNSON 37

A Modified Version of Proposed ASTM F23.20.05: Correlation with Human Body Experiments on Static Propensity—JOSE A. GONZALEZ, SYED A. RIZVI, ELIZABETH M. CROWN, AND PETER R. SMY 47


Basic Principles Used in the Development of a New Cut-Test Machine for Standardization—SERGE MASSÉ, JAIME LARA, CHRISTIAN SIRARD, AND RENAUD DAIGLE 66

Cut Protection Performance Test for Measuring Cut Resistance of Materials Used in Protective Clothing—N. TEJANI, R. W. BLOCKER, P. SCHIFFELBEIN, AND E. RIVET 84

An Automated Dynamic Water Vapor Permeation Test Method—PHILLIP W. GIBSON, CYRUS E. KENDRICK, DONALD RIVIN, AND MAJID CHARMCHEI 93

Development of a New Cut Test for Protective Gloves Against Machine-Driven Knives—RICHARD H. TURNER AND DAVID M. SMITH

RESULTS OF TESTING MATERIALS BY ESTABLISHED PROCEDURES

Performance of Chemical Protective Gloves in the Film and Print Processing Industry—Q. J. SUN, R. M. LAING, B. E. NIVEN, AND C. A. WILSON

Limiting Dermal Exposure of Workers to Pesticides from Contaminated Clothing—LAURETTA WELCH AND S. KAY OBENDORF

Impact of Computational Methods Used on Pesticide Residue Reported in Cotton, Polyester, and Cotton/Polyester Blend Fabrics—ANUGRAH SHAW AND YAW-JIAN LIN

Bloodborne Hazard Protective Apparel with Reasonable Comfort—CASSANDRA R. BARNES, MARIAN G. MCCORD, PAUL A. TUCKER, ROGER L. BARKER, ITZHAK SHALEV, AND JESSICA L. ZINGELMANN

History of the Development of the Total Heat Loss Test Method—DANIEL J. GOHLKE


How the Requirements of the EN-Standard on Welders’ Protective Clothing Meet the Demands of Normal Use—HELENA MAKINEN, HANNA KANNINEN, AND RIIKKA NURMI

Evaluation of the Protective Performance of Fabrics and Fabric Combination Against Molten Iron—HELENA MAKINEN, HANNA LAIHO, AND PÄIVI PAJUNEN

Breathability and Protection Aspects of Moisture Barriers Used in Fire Fighters Protective Clothing After Thermal Aging—RENÉ M. ROSSI AND TRAUGOTT ZIMMERLI

Comparison of Conductive Heat Resistance and Radiant Heat Resistance with Thermal Protective Performance of Fire Fighter Protective Clothing—JEFFREY O. STULL

NEW METHODS FOR TESTING ITEMS OF PROTECTIVE CLOTHING

Overview

The Sixth International Symposium on the Performance of Protective Clothing and the publication of this STP marks the twentieth anniversary of ASTM Committee F23 on Protective Clothing. During the past two decades, ASTM Committee F23 has been a world focal point for improving worker health and safety through the advancement of best practices for protective clothing evaluation and use. At the committee, subcommittee, and task group levels, ASTM Committee F23, which is populated mostly by North Americans, promotes the free exchange and development of ideas and standards that are practical, yet never forgetting the well-being of the workers who must perform their jobs while wearing protective clothing and the employers who must pay for it.

ASTM Committee F23 recognizes the necessity of seeking out the leading-edge thinking of the larger, worldwide, protective clothing community. Consequently, ASTM Committee F23 convenes an international symposium every two to three years. Our sixth symposium was held in Orlando, Florida in June of 1996. The symposia have been highly successful. Perhaps more importantly, the set of proceedings books, which are published by ASTM as Standard Technical Publications (STPs), from our symposia represent the single most comprehensive collection of knowledge on the subject of protective clothing.

We have organized these proceedings into four areas of critical importance to the development and application of protective clothing:

- new procedures for testing materials,
- results of testing materials by established procedures,
- new methods for testing items of protective clothing, and
- results for testing items of protective clothing.

This organization recognizes the continuum of first understanding how the materials perform and then fabricating those materials into clothing that protect workers. The continuum also includes:

- the economics of clothing use,
- the effect of clothing on the worker’s ability to perform his job,
- the attractiveness of the clothing to the wearer, and
- regulations, guidelines, and policies that govern the use of protective clothing.

These subject areas were not addressed at the sixth symposium but are critical to development and use of protective clothing. We strongly hope that and encourage the community to make these topics key themes of ASTM Committee F23’s next symposium. After all, the use of protective clothing is a tradeoff among:

- protection;
- ability of the worker to function while wearing the clothing;
likelihood that the worker will embrace the use of the clothing, in other words, elect to use the clothing and use it properly; and
• cost, the whole life cycle from purchase to training to disposal, and effects on worker productivity while wearing protective clothing.

Back to the content of these proceedings. Materials development and testing are fundamental to improvements in protective clothing. Without measuring and understanding the fundamentals, we cannot advance to implementation. Consequently, we consolidate at the beginning of this publication all papers that address materials test methods and the results of such testing. Within this heading, we have included the papers by subject area, for example, thermal protection, physical hazards, and biological hazards. These papers describe several novel techniques for measuring material performance or reassessing current test methods.

Next, we focus on the testing and performance of entire items of protective clothing. As evident from several of the papers, industry continues to make large strides forward in supplying clothing that provides protection and is durable to the challenges of diverse work environments. Several papers are presented that examine new ways to evaluate whole items.

Finally, we address the subject of comfort and human factors. To define and produce protective clothing items in which a worker is productive, efficient, and comfortable is industry’s greatest challenge. These goals are also important to persons charged with selecting and recommending protective clothing. Again, how do we provide just enough but not too much protective clothing? The papers in this section provide insights intended to answer this question.

The papers in this STP have benefited from technical peer reviews by ASTM Committee F23 members and editorial improvement from the publications group at ASTM. We are certain that you will find information and insights that will aid you in your day-to-day activities. We also call your attention to the references associated with each paper. The references are the connection to the body of knowledge. There is richness in the references.

Finally, we would encourage you to communicate with the authors—by letter, telephone, and so forth. You will both learn something from the interaction. We know of no authors who would not be pleased to help you.

In summary, the community, which includes protective clothing specialists, industrial hygienists, human factors engineers, and others, has made great progress in the past 20 years. These proceedings represent only a sampling of the information available to you. We hope that your interest is stimulated and that you dig deeper into the field of your activity. If you are not already a member, we invite you to join ASTM Committee F23.

Much goes into organizing a symposium and its documentation into an STP. We acknowledge and extend our thanks to Steve Mawn, ASTM Committee F23’s connection to ASTM, Shannon Wainwright and Peter Few of ASTM’s publications group, and Ken St. John on the Committee on Publications.

Jeffrey O. Stull
International Personnel Protection, Inc.
Austin, TX; symposium cochairman and coeditor.

Arthur D. Schwope
Arthur D. Little, Inc.
Cambridge, MA; symposium cochairman and coeditor.