

Journal of ASTM International
Selected Technical Papers



STP 1517

*Advances in
the State of the Art of*
**Fire
Testing**

JAI Guest Editor:

Arthur J. Parker

Journal of ASTM International
Selected Technical Papers STP1517
**Advances in the State of the Art of Fire
Testing**

JAI Guest Editor:
Arthur J. Parker, P.E.



ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

ASTM Stock #: STP1517

Library of Congress Cataloging-in-Publication Data

Advances in the state of the art of fire testing / JAI guest editor, Arthur J. Parker.
p. cm. -- (Journal of ASTM International selected technical papers; STP1517)

Reprinted from JAI, Vol. 6, No. 4.

Includes bibliographical reference and index.

ISBN: 978-0-8031-7502-2 (alk. paper)

1. Fire testing. I. Parker, Arthur J., 1967-

TH1091.A38 2010

628.9'22--dc22

2010011652

Copyright © 2010 ASTM INTERNATIONAL, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Journal of ASTM International (JAI) Scope

The JAI is a multi-disciplinary forum to serve the international scientific and engineering community through the timely publication of the results of original research and critical review articles in the physical and life sciences and engineering technologies. These peer-reviewed papers cover diverse topics relevant to the science and research that establish the foundation for standards development within ASTM International.

Photocopy Rights

Authorization to photocopy items for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by ASTM International provided that the appropriate fee is paid to ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9634; online: <http://www.astm.org/copyright>. The Society is not responsible, as a body, for the statements and opinions expressed in this publication. ASTM International does not endorse any products represented in this publication.

Peer Review Policy

Each paper published in this volume was evaluated by two peer reviewers and at least one editor. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM International Committee on Publications. The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of the peer reviewers. In keeping with long-standing publication practices, ASTM International maintains the anonymity of the peer reviewers. The ASTM International Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM International.

Citation of Papers

When citing papers from this publication, the appropriate citation includes the paper authors, "paper title", J. ASTM Intl., volume and number, Paper doi, ASTM International, West Conshohocken, PA, Paper, year listed in the footnote of the paper. A citation is provided as a footnote on page one of each paper.

Foreword

THIS COMPILATION OF THE *JOURNAL OF ASTM INTERNATIONAL (JAI)*, STP1517, on *Advances in the State of the Art of Fire Testing*, contains only the papers published in JAI that were presented at a symposium in Miami Beach, FL, on December 11, 2008 and sponsored by ASTM Committee E05 on Fire Standards.

The JAI Guest Editor is Arthur J. Parker, P.E., Hughes Associates, Inc., Baltimore, MD, USA.

Contents

Overview	vii
A History of Fire Testing: Past, Present, and Future	
J. R. Lawson	1
Using Directional Flame Thermometers for Measuring Thermal Exposure	
N. R. Keltner, J. V. Beck, and J. T. Nakos	27
Comparisons of Temperature and Heat Flux in Furnaces Controlled by Different Types of Temperature Sensors	
M. A. Sultan	44
Guide on Measuring Uniformity of Furnace Exposure on Specimens Representing Test Samples Used to Determine Fire Resistance Ratings	
R. Berhinig	63
Predicting Fire Behavior of Composite CFT Columns Using Fundamental Section Behavior	
S. Hong and A. H. Varma	78
Guidelines for Improving the Standard Fire Resistance Test Specifications	
V. K. R. Kodur and R. Fike	111
Fire Performance Testing of Building Element Interfaces and Connections	
A. J. Parker and N. R. Iwankiw	135
Cone Calorimeter—A Cautionary Tale	
M. Hermesky and J. Murrell	149
Heat Release Testing of Consumer Products	
M. M. Hirschler	162
A Materials Science-Based Approach to Characterizing Fire Resistive Materials	
D. P. Bentz, C. C. White, K. R. Prasad, D. R. Flynn, D. L. Hunston, and K. Tean Tan . . .	199
Measuring Properties for Material Decomposition Modeling	
C. Cain and B. Y. Lattimer	211

Overview

This book represents the efforts of presenters at the *Symposium on the Advances in the State of the Art of Fire Testing* held on December 11, 2008 in Miami, FL. The goal of the symposium was to highlight advances we have made, or areas where further research and modifications have been identified, when conducting standardized fire testing. This collection of publications provides an understanding and appreciation for what types of results standard fire tests have been and will be asked to provide to properly address the hazards associated with future technological advances.

Very large and costly fires which occurred in the late 19th century and early part of the 20th century highlighted the need for uniform building codes and fire-resistive assemblies capable of providing minimum levels of protection for life and property. Fire test standards developed in response to this need specified the minimum test specimen requirements, fire exposure conditions, and level of protection. By standardizing the testing, the performance of different materials, systems, and assemblies, using the latest available technologies, could be compared directly. These test standards are continuously being updated to reflect improvements in materials technologies and testing capabilities.

The recommendations presented in the NIST report for the 9/11 attacks resulted in many E05 Subcommittees reviewing existing standards under their jurisdiction to determine if the assemblies these standards are intended to evaluate are being correctly tested; in terms of test set-up, procedure, and conditions of acceptance. This collection of papers provide an overview of what types of testing have we conducted, what advances in testing capabilities we have encountered, and how we have reacted to new material technologies to ensure that the test specimen performance is being evaluated properly.

This collection of publications and the symposium where they were presented is dedicated to the memory of Richard Licht, our dear friend who passed away in July of 2007. Richard spent a great deal of time and effort in ASTM E05 advancing the state of the art of many fire standards. I hope that this collection of papers will continue to generate the interest level in all of us that Richard demonstrated in working to promulgate technically sound fire test standards to improve life safety.

Arthur J. Parker, P.E.
Hughes Associates, Inc.

www.astm.org

ISBN: 978-0-8031-7502-0

Stock #: STP1517