

Guarded Hot Plate and Heat Flow Meter Methodology

Shirtliffe/Tye, *editors*



STP 879

GUARDED HOT PLATE AND HEAT FLOW METER METHODOLOGY

A symposium
sponsored by
ASTM Committee C-16 on
Thermal Insulation and
The National Research
Council of Canada
Quebec, Can., 7, 8 Oct. 1982

ASTM SPECIAL TECHNICAL PUBLICATION 879
C. J. Shirliffe, National Research Council
of Canada, and
R. P. Tye, Dynatech R/D Company, editors

ASTM Publication Code Number (PCN)
04-879000-10



1916 Race Street, Philadelphia, PA 19103

Library of Congress Cataloging-in-Publication Data

Guarded hot plate and heat flow meter methodology.

(ASTM special technical publication; 879)

“ASTM publication code number (PCN) 04-879000-10.”

Includes bibliographies and index.

1. Insulation (Heat)—Thermal properties—
Congresses. 2. Heat—Transmission—Measurement—
Equipment and supplies—Congresses. I. Shirtliffe,
C. J. II. Tye, R. P. (Ronald Phillip) III. ASTM
Committee C-16 on Thermal Insulation. IV. National
Research Council of Canada. V. Series.

TH1715.G8 1985 621.402'4 85-18531

ISBN 0-8031-0423-5

Copyright © by AMERICAN SOCIETY FOR TESTING AND MATERIALS 1985

Library of Congress Catalog Card Number: 85-18531

NOTE

The Society is not responsible, as a body,
for the statements and opinions
advanced in this publication.

Foreword

The papers in this publication, *Guarded Hot Plate and Heat Flow Meter Methodology*, were presented at a symposium held in Quebec, Canada, 8, 9 October 1982. The symposium was sponsored by ASTM Committee C-16 on Thermal Insulation and the National Research Council of Canada. C. J. Shirtliffe, National Research Council of Canada, and R. P. Tye, Dynatech R/D Company, are editors of this publication.

Related ASTM Publications

Thermal Insulation, Materials, and Systems for Energy Conservation in the '80s, STP 789 (1983), 04-789000-10

Thermal Insulation Performance, STP 718 (1980), 04-718000-10

Thermal Transmission Measurements of Insulation, STP 660 (1979), 04-660000-10

Thermal Insulations in the Petrochemical Industry, STP 581 (1975), 04-581000-10

Heat Transmission Measurements in Thermal Insulations, STP 544 (1974), 04-544000-10

A Note of Appreciation to Reviewers

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.

ASTM Committee on Publications

ASTM Editorial Staff

Helen M. Hoersch
Janet R. Schroeder
Kathleen A. Greene
Bill Benzing

Contents

Introduction	1
---------------------	---

APPARATUS ANALYSES AND ERROR ANALYSES

Analysis of Errors in Guarded Hot Plate Measurements as Compiled by the Finite Element Method—LOUIS R. TROUSSART	7
Thermal Conductivity Measurements with the Plate Apparatus: Influence of the Guard Ring Width on the Accuracy of Measurements—KARL-HEINZ BODE	29
Error Analysis of Measuring Thermal Conductivity by Circular and One Side Heat Flow Type Guarded Hot Plate Apparatus—KAZUO EGUCHI	49
Summary of Error Analysis for the National Bureau of Standards 1016-mm Guarded Hot Plate and Considerations Regarding Systematic Error for the Heat Flow Meter Apparatus—BRIAN RENNEX	69
Evaluation of Thermal Conductance of Liquefied Natural Gas Tank Insulation—EINAR BRENDENG	86

APPARATUS AND INSTRUMENTATION

Present and Future Research on Guarded Hot Plate and Heat Flow Meter Apparatus—FRANCESCO DE PONTE	101
A Flat Insulation Tester That Uses an Unguarded Nichrome Screen Wire Heater—DAVID L. MCELROY, RON S. GRAVES, DAVID W. YARBROUGH, AND J. PEYTON MOORE	121
Discussion of Heat Flow Meter Apparatus and Transfer Standards Used for Error Analysis—MARK BOMBERG AND K. RICHARD SOLVASON	140

Use of a Heat Flow Meter Apparatus for Testing Loose-Fill Materials Prepared for Laboratory Testing—	DAVID J. MCCA	154
A Review of Current Commercially Available Guarded Hot Plate and Heat Flow Meter Apparatus and Instrumentation—	KARL G. COUMOU	161
Development of a Large Area Heat Flow Meter—	YUKIHARU MIYAKE AND KAZUO EGUCHI	171
Recent Developments with the Thin-Heater Thermal Conductivity Apparatus—	NATHANIEL E. HAGER, JR.	180

METHODOLOGY

Development of a Company Wide Heat Flow Meter Calibration Program Based on the National Bureau of Standards Certified Transfer Specimens—	CHARLES M. PELANNE	193
Field Measurements of Steady-State Thermal Transfer Properties of Insulation Systems—	DONALD C. LARSON	206
Surface Temperature Sensor Calibration: <i>In Situ</i> Technique—	STANLEY P. SCHUMANN	220

SUMMARY

Summary	229
Index	241

ISBN 0-8031-0423-5