

# Liquid Particle Size Measurement Techniques

**Tishkoff/Ingebo/Kennedy**  
editors

**ASTM STP 848**

# LIQUID PARTICLE SIZE MEASUREMENT TECHNIQUES

A symposium  
sponsored by ASTM  
Committee E-29 on  
Particle Size Measurement  
Kansas City, MO, 23–24 June 1983

ASTM SPECIAL TECHNICAL PUBLICATION 848  
J. M. Tishkoff, Air Force Office of Scientific Research,  
R. D. Ingebo, NASA Lewis Research Center,  
and J. B. Kennedy, United Technologies  
Research Center, editors

ASTM Publication Code Number (PCN)  
04-848000-41



1916 Race Street, Philadelphia, PA 19103

## Library of Congress Cataloging in Publication Data

Liquid particle size measurement techniques.

(ASTM special technical publication; 848)

Includes index.

1. Particle size determination—Congresses. 2. Spraying equipment—Congresses.  
3. Drops—Measurement—Congresses. I. Tishkoff, J.M. (Julian M.) II. Ingebo,  
Robert D. III. Kennedy, J. B. (Jan B.) IV. ASTM Committee E-29 on Particle Size  
Measurement. V. Series.

TA418.8.L57 1984 620'.43 83-73515

ISBN 0-8031-0227-5

Copyright © by AMERICAN SOCIETY FOR TESTING AND MATERIALS 1984  
Library of Congress Catalog Card Number: 83-73515

### NOTE

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

Printed in Ann Arbor, MI  
September 1984

## Foreword

The symposium on Liquid Particle Size Measurements was held in Kansas City, MO, 23–24 June 1983. The symposium was sponsored by ASTM Committee E-29 on Particle Size Measurement. Julian M. Tishkoff, Air Force Office of Scientific Research, Robert D. Ingebo, NASA Lewis Research Center, and Jan B. Kennedy, United Technologies Research Center, presided as symposium chairmen and editors of this publication.

## Related ASTM Publications

Stationary Gas Turbine Alternative Fuels, STP 809 (1983), 04-809000-13

Pesticide Formulations and Application Systems: Second Conference, STP 795  
(1983), 04-795000-48

Compilation of ASTM Standard Definitions, Fifth Edition, 1982, 03-001082-42

## 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

Janet R. Schroeder  
Kathleen A. Greene  
Rosemary Horstman  
Helen M. Hoersch  
Helen P. Mahy  
Allan S. Kleinberg  
Susan L. Gebremedhin

# Contents

<b>Introduction</b>	1
INTRODUCTORY TOPICS	
<b>Droplet Analysis Techniques: Their Selection and Applications—</b> W. D. BACHALO	5
<b>Investigating the Commercial Instrument Market—</b> H. C. SIMMONS	22
PARTICLE SIZING BY OPTICAL, NONIMAGING TECHNIQUES	
<b>Particle Sizing by Optical, Nonimaging Techniques—</b> E. D. HIRLEMAN	35
<b>Measurement of Drop-Size Distribution by a Light-Scattering Technique—</b> N. K. RIZK AND A. H. LEFEBVRE	61
<b>Extending the Applicability of Diffraction-Based Drop Sizing Instruments—</b> L. G. DODGE AND S. A. CERWIN	72
<b>Liquid Rocket Injector Atomization Research—</b> A. J. FERRENBURG	82
<b>A Review of Ultrahigh Resolution Sizing of Single Droplets by Resonance Light Scattering—</b> T. R. LETTIERI AND W. D. JENKINS	98
PARTICLE SIZING WITH IMAGING TECHNIQUES	
<b>Droplet Characteristics with Conventional and Holographic Imaging Techniques—</b> B. J. THOMPSON	111
<b>An Instrumentation System to Automate the Analysis of Fuel-Spray Images Using Computer Vision—</b> L. M. OBERDIER	123
<b>Sizing Study of Drops Produced by High Diesel Fuel Injection Pressure Sprays—</b> D. M. POPA AND K. S. VARDE	137
NONOPTICAL PARTICLE SIZING	
<b>Hot-Wire Technique for Droplet Measurements—</b> D. S. MAHLER AND D. E. MAGNUS	153
CLOSURE	
<b>Comparative Measurements Using Different Particle Size Instruments—</b> N. CHIGIER	169
SUMMARY	
<b>Summary</b>	189
<b>Index</b>	195



ISBN 0-8031-0227-5