

NIOSH Manual of Analytical Methods (NMAM) 5th Edition

Chapter content and the Glossary can be viewed or downloaded from

<https://www.cdc.gov/niosh/nmam/chapters.html>



NIOSH Manual of Analytical Methods (NMAAM), 5th Edition

Purpose, Scope and Use of the NIOSH Manual of Analytical Methods

by **Karla Ashley, Ph.D.** and **Paula Fay O'Connor, NIOSH**

1	Purpose and scope	PS-1
2	How to use NMAAM	PS-3
3	References	PS-6

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Development and Evaluation of Methods

by Eugene E. Kennedy, Ph.D., Thomas J. Fischbach, Raigang Song, Ph.D., Peter M. Eller, Ph.D., Stanley A. Shuman, Ph.D., and R. DeLoe Hall, Ph.D., NIOSH

1	Method Development	MS-1
2	Method Evaluation	MS-5
3	Field Evaluation	MS-13
4	Documentation	MS-14
5	Appendix - Accuracy and its Evaluation	MS-15
6	References	MS-17

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Measurement Uncertainty and NIOSH Method Accuracy Range

by David L. Bentley, PhD, Stanley A. Shelton, PhD, and Paul C. Schmitt, MEd, NIOSH

1	Introduction	UA-3
2	ISO-GUM	UA-4
3	The systematic accuracy range A as used by NIOSH	UA-6
4	Discreteness and analytical lab procedures	UA-9
5	Discussion	UA-15
6	Technical notes	UA-14
7	References	UA-20
8	Terminology	UA-23

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

General Considerations for Sampling Airborne Contaminants

by Charles E. McCormack, Ph.D., CIH and Mary Lynn Workbenberg, Ph.D.; revision by Erin Ashley, Ph.D., NIOSH

1. Choosing measurement methods and sampling media	SA-3
2. Types and uses of solid sorbents	SA-3
3. Types and uses of screen samplers	SA-5
4. Factors affecting the collection of gases, vapors, and aerosols	SA-5
5. Establishing sampling parameters	SA-7
6. Bulk samplers	SA-10
7. Blinks	SA-11
8. Direct-reading methods	SA-13
9. Sampling strategy	SA-15
10. Sampling and calibration techniques	SA-15
11. References	SA-20

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Factors Affecting Aerosol Sampling

by Paul A. Baron, Ph.D., MIOSH

The NMAM team gratefully acknowledges Ben-El Ki, Kevin Ashby and Prasad Kulkarni for insightful review of this chapter.

1. Introduction	AE - 2
2. Inlet efficiency of the sampler	AE - 8
3. Classifier accuracy	AE - 11
4. Sampler accuracy	AE - 16
5. Electrostatic losses	AE - 16
6. Sampler deposition uniformity	AE - 18
7. Sampler wall losses	AE - 19
8. Collection media and analytical issues	AE - 20
9. Sampler field comparisons	AE - 22
10. Conclusions	AE - 24
11. References	AE - 25

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Sampling and characterization of bioaerosols

By William S. Lindsley, Brett J. Brown, Francesca M. Blawie, Stephen B. McGuire, Brandon F. Lee, Paul A. Janssen and Willie P. Schaefer, NIOSH

1	Introduction	BA-2
2	Principles of bioaerosol collection	BA-7
3	Devices used for bioaerosol sampling	BA-10
4	Considerations for bioaerosol sampling	BA-28
5	Selection of bioaerosol samplers	BA-36
6	Sample preparation for culturable bioaerosols	BA-39
7	Identification of culturable bioaerosols	BA-42
8	Enumeration of culturable bioaerosols	BA-46
9	Sample analysis methods for non-viable and non-culturable bioaerosols	BA-49
10	Limitations of bioaerosol sampling and characterization	BA-52
11	Safety considerations	BA-67
12	Resources	BA-62
13	References	BA-66
14	Appendix 1 - List of manufacturers/distributors of common bioaerosol samplers and related products	BA-101
15	Appendix 2 - Commonly used bioaerosol samplers	BA-104

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Filter Pore Size and Aerosol Sample Collection

by William G. Anderson, Ph.D. NIOSH

1	Introduction	FP-2
2	Physical structures of filters	FP-3
3	Determination of equivalent pore diameter	FP-3
4	How an aerosol filter collect particles	FP-6
5	Aerosol filter efficiency and pore size	FP-8
6	Significance of pore size	FP-10
7	Filter selection	FP-11
8	Condensation	FP-12
9	References	FP-13

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





Measurement of Fibers

by Paul A. Borge, Ph.D., NIOSH
Adapted from Borge (2011)

The NMAM team gratefully acknowledges Chen Wang, Joe Foubert and Alan Doster for insightful review of this chapter.

1	Introduction	ES-2
2	Fiber classification	ES-5
3	Phase contrasting light microscope counting (PCM)	ES-6
4	Polarizing light microscopy (PLM) of both materials	ES-14
5	Electron microscopy	ES-17
6	Scanning electron microscopy (SEM)	ES-18
7	Transmission electron microscopy (TEM)	ES-18
8	Optical detection (light scattering)	ES-20
9	Fiber classification	ES-21
10	Conclusions	ES-23
11	References	ES-23



NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Sampling and Analysis of Soluble Metal Compounds

by **Karla Ashley, Ph.D., NIOSH** and **Richard Feltzer, CH, OSHA**

[Much of this chapter was adapted from Feltzer and Rotner 1994, and Ashley 2001.]

1	Introduction	301-3
2	Soluble and traceable metal compounds	301-3
3	Health effects	301-4
4	Sampling considerations	301-8
5	Analytical considerations	301-9
6	EPA procedures for soluble metals and metalloids	301-7
7	Summary	301-10
8	References	301-11
9	Appendix - Solubilities of selected metals and metal compounds	301-14

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Monitoring Diesel Exhaust in the Workplace

by **K. Elmer Fink, Ph.D., NIOSH**

1. Introduction	DL-3
2. Analytical method	DL-4
3. Interlaboratory cooperation	DL-33
4. Occupational exposure criteria (U.S.)	DL-37
5. Appendix	DL-38
6. References	DL-39

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Analysis of Carbon Nanotubes and Nanofibers on Mixed Cellulose Ester Filters by Transmission Electron Microscopy

by M. Eileen Birch, Chen Wang, Joseph E. Fomback, R. Ann Frazee, Quinn T. Birch, and Alan K. Drexler
NIOSH

1	Introduction	CN-3
2	Sample Preparation	CN-3
3	TEM Analysis and Counting Method	CN-6
4	Conclusions	CN-18
5	References	CN-18

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health





NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Glossary of Abbreviations, Definitions and Symbols

Compiled by Kevin Adley, Ph.D., NIOSH

A	GI-3
B	GI-4
C	GI-7
D	GI-9
E	GI-11
F	GI-12
G	GI-13
H	GI-15
I	GI-19
L	GI-24
M	GI-25
N	GI-26
O	GI-28
P	GI-17
Q	GI-18
R	GI-19
S	GI-20
T	GI-22
U	GI-23
V	GI-24
W	GI-25
X	GI-25

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

