

NIOSH TECHNICAL REPORT
RESULTS FROM THE NATIONAL OCCUPATIONAL
HEALTH SURVEY OF MINING (NOHSM)

Mark F. Greskevitch, Shib S. Bajpayee
Janet M. Hale, Dennis W. Groce, Frank J. Hearl

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Division of Respiratory Disease Studies
Morgantown, West Virginia 26505-2888

September 1996

DISCLAIMER

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

Publication Dissemination, EID
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226

For information on other occupational safety and
health problems, call
1-800-35-NIOSH

DHHS (NIOSH) Publication No. 96-136

ACKNOWLEDGEMENT

The individuals who collected data during this field survey deserve special recognition. They were asked to endure the rigors of transition assignments in a variety of geographic settings; usually without the aid of fellow workers. Their work took them into a broad spectrum of worksites where they encountered a staggering array of potential exposure agents. The National Occupational Health Survey of Mining owes much to their grace under pressure, their persistence in the face of adversity, and their commitment to the goals of the survey.

Shib S. Bajpayee	Kenneth D. Linch
David M. Birney	Paul Mattox
Clayton B. Doak	Chris A. Piacitelli
Mark F. Greskevitch	Sherry J. Pofahl
Jane Hicks	Keith D. Schmidt

We would also like to thank the following people for their critical review of this document:

Mr. Heinz Ahlers
Section Chief, Priority Setting and Hazard
Review Section
Document Development Branch, DSDDT
National Institute for Occupational Safety and
Health

Mr. Jerome Flesch
Senior Reviewer
Policy Development Activity, OD, DSDDT
National Institute for Occupational Safety and
Health

Mr. Clayton Doak
Document Manager
Document Development Branch, DSDDT
National Institute for Occupational Safety and
Health

Mr. John Odencrantz
Research Statistician
Epidemiological Investigations Branch, DRDS
National Institute for Occupational Safety and
Health

Mr. J. Drew Potts
Mining Engineer
Dust Control & Ventilation
Bureau of Mines

Mr. Winthrop F. Watts, Jr.
Industrial Hygienist
Diesel Research
Bureau of Mines

CONTENTS

	Page
I. Introduction	1
A. Field Survey Summary	1
B. Previous Similar NIOSH Surveys	1
C. NOHSM Purpose	1
II. NOHSM Sample Selection	1
A. Commodity Adjustments	1
B. Basis of Mine Selection	2
C. Systematic Sampling Description	2
III. Survey Description	6
A. Questionnaire	6
B. Inventory	6
1. Chemical Substance Definition	6
2. Trade Name Product Definition	6
3. Product Categories	6
4. Associated Data for Each Inventoried Item	7
C. Worksite Observations	7
1. Potential Exposure Definition	7
2. Categories of Potential Exposures	7
a. Physical Agent Potential Exposures	7
b. Musculoskeletal Overload Potential Exposures	7
c. Welding, Brazing, and Soldering Potential Exposures	7
d. Abrasive Grinding Potential Exposures	7
e. Chemical Substance Potential Exposures	7
f. Trade Name Product Potential Exposures	8
g. Bulk Dust Potential Exposures	8
3. Potential Exposure Exclusions	8
4. Associated Data for Each Potential Exposure	8

CONTENTS

	Page
IV. Data Projection and Variance Calculation Formulas	8
A. Introduction	8
B. Notation	9
C. Projection Techniques	9
D. Variance Calculations	10
V. NOHSM Commodity Reports	11
VI. NOHSM Database	11
A. Processing of Datasets	11
B. Types of SAS Datasets Created	11
C. Other Types of Datasets Created	12
D. PC-Based NOHSM Query System	13
1. Basic Options to Form a Query	13
2. Availability of PC-Based Query System	13
3. Query Example	13
VII. Limitations of the NOHSM Data	16
A. Annual Usage Data	16
B. Large Variances in Projections	16
C. Trade Secret Data Exclusions	16
D. Time Dependency of Data	16
E. Lack of Trade Name Product Resolution	16
F. Bulk Dust	16
VIII. Results	17
A. Questionnaire	17
B. Inventory	17
C. Worksite Observations	17
1. Physical Agent Potential Exposures	17
2. Musculoskeletal Overload Potential Exposures	18
3. Welding, Brazing, and Soldering Potential Exposures	18

CONTENTS

	Page
4. Chemical Substance and Trade Name Product Potential Exposures	18
a. Locations With the Highest Projected Number of Chemical Substance and Trade Name Product Potential Exposures	19
b. Projected Number of Workers Potentially Exposed to Chemical Substances and Trade Name Products by Location	19
c. Chemical Substance Potential Exposures	19
d. Trade Name Product Potential Exposures	20
5. Product Use Term (PUT) Potential Exposures	20
6. Bulk Dust Potential Exposures	20
a. Quartz	20
b. Elements	21
c. Asbestos	22
IX. Discussion	23
X. References	24
XI. Appendices	25

TABLES

Number	Page
Text:	
1. MSHA SIC Codes and Associated Mineral Commodities	3
2. NOHSM Mineral Commodities and Associated MSHA SIC Codes	4
3. MSHA Tapes Used for Selection of NOHSM Mineral Commodities	5
4. NOHSM Query System Options and Data Elements	14
5. Results of NOHSM Query Example	15
6. Bulk Dust Elements Results	21
7. Commodities With Highest Percent Arsenic in Bulk Dust Samples	22
8. Bulk Dust Asbestos Results	22
9. Locations Within NOHSM Commodities Where Bulk Dust Samples Containing Asbestos Were Collected	23
 For Appendix C:	
C1. MSHA SIC Codes and Associated Mineral Commodities	51
 For Appendix K:	
K1. MSHA Regulated Chemicals Found on Mine Property	143
K2. Chemicals Found on Mine Property That Have a NIOSH Recommended Exposure Limit But Are Not Regulated by MSHA	145
K3. Chemicals Found on Mine Property That Have no NIOSH Recommendation or MSHA Exposure Limit	146
K4. Trade Name Products Found on Mine Property	147
K5. Physical Agent Conditions Identified on Mine Property	154
K6. Musculoskeletal Overload Conditions Identified on Mine Property	156
K7. Welding Potential Exposures	159
 For Appendix L:	
L1. Mineral Commodities That Comprise Each Mineral Industry	161
L2. Projected Results Based on the NOHSM Questionnaire Question 7 — Years of Mining or Milling Activity	162
L3. Projected Results Based on the NOHSM Questionnaire Question 10 — Formal Occupational Health Agreements	163
L4. Projected Results Based on the NOHSM Questionnaire Question 11 — Formally Established Health Units	164

TABLES

Page

Appendix L Continued:

L5.	Projected Results Based on the NOHSM Questionnaire Question 12 — Medical Care by On-Site Physicians	165
L6.	Projected Results Based on the NOHSM Questionnaire Question 13 — Formal Arrangements With Outside Source for Physician’s Medical Care	166
L7.	Projected Results Based on the NOHSM Questionnaire Question 14 — Average Physician Hours for Employees	167
L8.	Projected Results Based on the NOHSM Questionnaire Question 15 — Medical Care From Payroll Nurses	168
L9.	Projected Results Based on the NOHSM Questionnaire Question 16 — Number of Nurses at Facility	169
L10.	Projected Results Based on the NOHSM Questionnaire Question 17 — Average Nursing Hours for Employees	170
L11.	Projected Results Based on the NOHSM Questionnaire Question 18 — Provision of Medical Tests on a Periodic Basis	171
L12.	Projected Results Based on the NOHSM Questionnaire Question 19 — New Employee Medical Exam Requirements	171
L13.	Projected Results Based on the NOHSM Questionnaire Question 20 — New Employee Health Data	172
L14.	Projected Results Based on the NOHSM Questionnaire Question 21 — Return to Work Medical Exam Requirements	172
L15.	Projected Results Based on the NOHSM Questionnaire Question 22 — Terminated Employee Medical Exam Requirements	173
L16.	Projected Results Based on the NOHSM Questionnaire Question 23 — Retention of Health & Medical Records	174
L17.	Projected Results Based on the NOHSM Questionnaire Question 24 — Industrial Hygiene Services on a Consulting Basis	174
L18.	Projected Results Based on the NOHSM Questionnaire Question 25 — Full-Time Industrial Hygienists	175
L19.	Projected Results Based on the NOHSM Questionnaire Question 26 — Number of Full-Time Industrial Hygienists	176
L20.	Projected Results Based on the NOHSM Questionnaire Question 27 — Monitoring for Physical Agents	177
L21.	Projected Results Based on the NOHSM Questionnaire Question 28 — Retention of Physical Agent Monitoring Records	178
L22.	Projected Results Based on the NOHSM Questionnaire Question 29 — Air Monitoring: Agent Categories	178
L23.	Projected Results Based on the NOHSM Questionnaire Question 30 — Air Monitoring Methods	179

TABLES

Appendix L Continued:	Page
L24. Projected Results Based on the NOHSM Questionnaire Question 31 — Air Monitoring: Direct Reading Instruments	180
L25. Projected Results Based on the NOHSM Questionnaire Question 32 — Retention of Monitoring Records for: Fumes, Gases, Mists, Dusts, and Vapors	181
L26. Projected Results Based on the NOHSM Questionnaire Question 33 — Personal Protective Health Equipment Requirements	182
L27. Projected Results Based on the NOHSM Questionnaire Question 34 — Personal Protective Health Equipment Responsibility	182
L28. Projected Results Based on the NOHSM Questionnaire Question 35 — Corrective Measures	183
L29. Projected Results Based on the NOHSM Questionnaire Question 36 — Economic Penalties	184
L30. Projected Results Based on the NOHSM Questionnaire Question 37 — Economic Penalty Assessment	185
L31. Projected Results Based on the NOHSM Questionnaire Question 38 — Retention of Records for Terminated Employees	186
L32. Projected Results Based on the NOHSM Questionnaire Question 39 - Absenteeism Records	186
L33. Projected Results Based on the NOHSM Questionnaire Question 40 — Unscheduled Absenteeism Rate (Results in Ranges of Days per Employee per Year)	187
L34. Projected Results Based on the NOHSM Questionnaire Question 41 — Production Worker’s Turnover Rate (Results in Ranges of Turnover Rate % per Year)	189
L35. Projected Results Based on the NOHSM Questionnaire Question 42 — Year Personnel System Begun	191
L36. Projected Results Based on the NOHSM Questionnaire Question 43 — Personnel System Items	192
L37. Projected Results Based on the NOHSM Questionnaire Question 46 — First Year Diesels Used Underground	192
L38. Projected Results Based on the NOHSM Questionnaire Question 47 - Equipment Using PCB-Containing Fluids	193
L39. Projected Results Based on the NOHSM Questionnaire Question 48 — Shift Rotation	193
L40. Projected Results Based on the NOHSM Questionnaire Question 49 — Labor-Management Health Committee	194
L41. Projected Results Based on the NOHSM Questionnaire Question 51 — Assay Reports	194

FIGURES

Number		Page
1.	Projected Number & Percent of Workers Potentially Exposed to Physical Agents	18
2.	Projected Number & Percent of Workers Potentially Exposed to Musculoskeletal Overloads	18
3.	Locations with the Highest Projected Number of Chemical Substance and Trade Name Product Potential Exposures and the Percent of Workers Potentially Exposed	19
4.	Projected Number & Percent of Workers Potentially Exposed to Chemical Substances and Trade Name Products by Location	19
5.	Cumulative Percent Frequency Distribution of Bulk Dust Samples Containing the Indicated Percentage Quartz or Less	20
6.	Unscheduled Absenteeism Rate (Days per Employee per Year)	188
7.	Cumulative Worker's Turnover Rate (%/Year)	190

APPENDICES

Appendix	Page
A. Composition of the NOHSM Mine Sample	25
B. Part I — Questionnaire	36
C. Definitions, Guidelines, and Procedures for Preparing and Conducting the NOHSM Questionnaire	48
D. Product Use Terms (PUTs)	86
E. Definitions, Guidelines, and Procedures for Coding Physical Agent Potential Exposures	92
F. Definitions, Guidelines, and Procedures for Coding Musculoskeletal Overload Potential Exposures	95
G. Welding, Brazing, and Soldering Potential Exposures	100
H. NOHSM Occupation, Operation, and Location Codes, Titles, and Definitions for Metal & Non-Metal Mines	101
I. NOHSM Occupation, Operation, and Location Codes, Titles, and Definitions for Coal Mines	115
J. Intended Control Codes, Names, and Definitions	133
K. Stone, Dimension, NEC Commodity Report	137
L. Questionnaire Results	160
M. 100 Chemical Substances with Highest Annual Usage Rate (Gallons)	195
N. 100 Chemical Substances with Highest Annual Usage Rate (Pounds)	197
O. 100 Chemical Substances with the Highest Projected Number of Workers Potentially Exposed	199
P. Number of Workers Employed in Each Commodity at the Time the NOHSM Survey Was Conducted	202
Q. 100 Trade Name Products with the Highest Projected Number of Workers Potentially Exposed	204
R. 100 Product Use Terms (PUTs) with the Highest Projected Number of Workers Potentially Exposed	209

ABSTRACT

The National Occupational Health Survey of Mining (NOHSM) was conducted by the National Institute for Occupational Safety and Health (NIOSH) pursuant to the U.S. Federal Mine Safety and Health Amendments Act of 1977. This Act dictates that the Secretary of Health and Human Services "... shall, for each toxic material or harmful physical agent which is used or found in a mine, determine whether such material or agent is potentially toxic at the concentrations in which it is used or found in a mine."

The three main objectives of this report are: (1) document why and how NOHSM was conducted, for the benefit of future users of the NOHSM database; (2) provide results for most of the types of data which were gathered from NOHSM; and (3) encourage interested parties to use information from the NOHSM database by requesting specific information from the NOHSM project officer or by requesting a copy of the NOHSM PC-based query system.

NIOSH conducted the field portion of NOHSM from May 1984 to August 1989. The survey included a total of 491 mines (60 coal mines and 431 metal-nonmetal mines such as aluminum, gold, sand & gravel, etc.) which employed 59,734 miners, representing 66 mineral commodities. The 491 surveyed mines were selected from a total of 2,131 mines which employed 297,322 miners. Although NIOSH surveyed only a representative sample of mines in each mineral commodity, the data were projected over all of the mines in each of those mineral commodities.

Each mine's survey included three phases: questionnaire, chemical inventory, and worksite visit. The data obtained during the questionnaire described medical services, industrial hygiene practices, and

general facility information. The inventory data identified all chemical substances and trade name products found on the mine property and the annual usage rate of each chemical substance. NIOSH inventoried 2,570 chemical substances and 84,939 trade name products. During the work-site visit, the NOHSM surveyors observed and interviewed workers to determine their potential exposures at the worksite. The term "**potential exposure**" has two criteria. First, the NOHSM surveyor must have determined that the health-related agent was in sufficient proximity to a worker such that the agent could have entered or contacted the body of the worker, although the level of exposure was not measured by NIOSH. Second, the duration of the potential exposure must have met the minimum duration guidelines (i.e., a part-time duration was defined as the potential exposure time which was greater than 30 minutes per week [on an annual average] or at least once per week 90 percent of the weeks of the work year). The potential exposures recorded during the worksite visits included chemical substances; trade name products; physical agents; musculoskeletal overloads; welding, brazing, and soldering processes; abrasive grinding processes; and bulk dust. Workers were often potentially exposed to more than one agent. Therefore, the total projected numbers of potential exposures are often greater than the number of workers in the entire mining industry or in a given mining commodity.

The projected numbers of potential exposures, across the entire mining industry were: physical agents 365,332; musculoskeletal overload conditions 710,340; welding, brazing, and soldering agents 188,852. More than 1.1 million potential exposures to chemicals and trade name substances were found in surface shops, alone. Through the bulk dust samples, approximately 214,000 miners were found to be potentially exposed to dust that contained greater than 5 percent quartz.

