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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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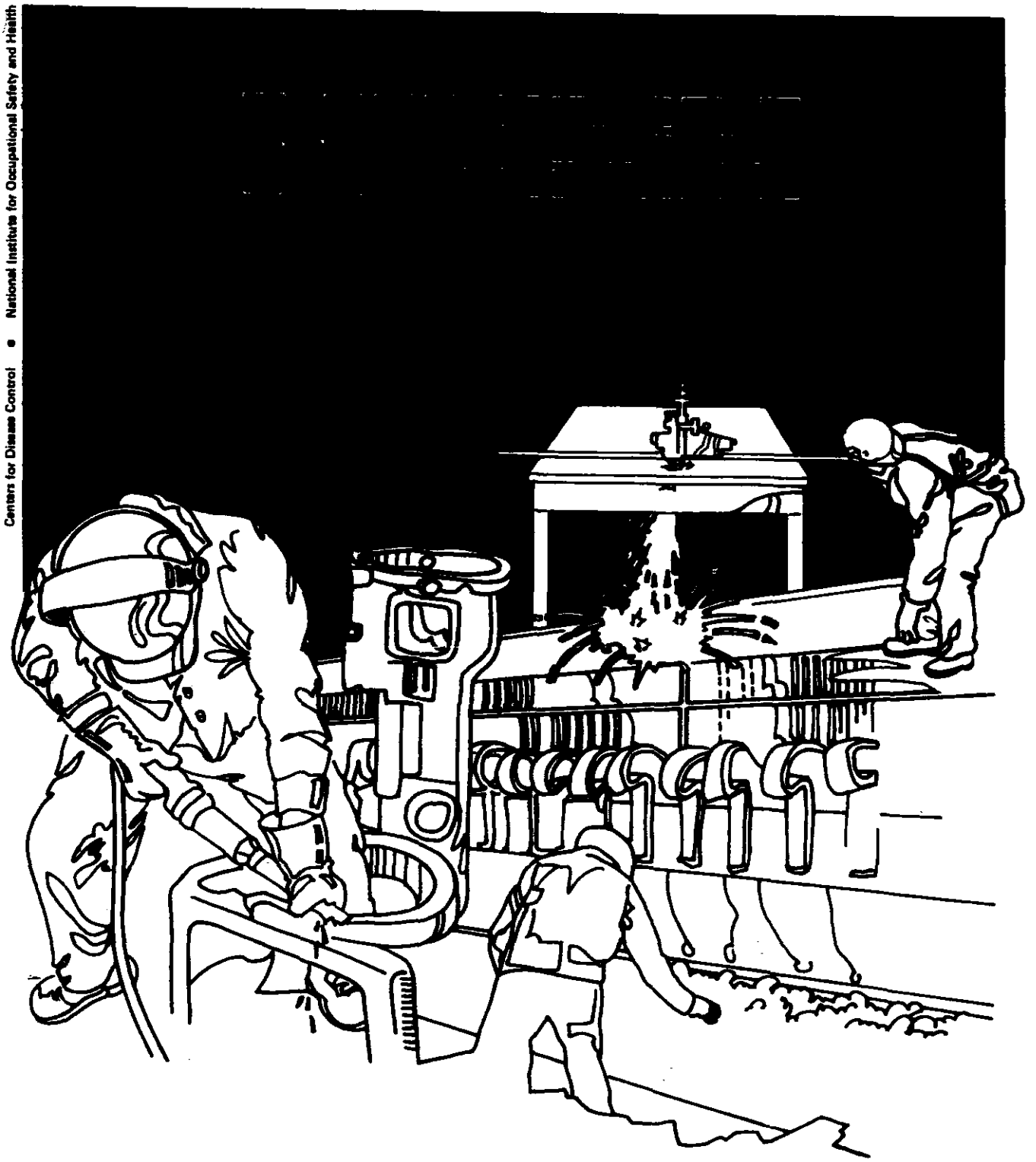

Health Hazard Evaluation Report

MHETA 87-173-1882
JEDDO HIGHLAND COAL CO.
WEST PITTSTON, PA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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

MHETA 87-173-1882
JEDDO HIGHLAND COAL CO.
WEST PITTSTON, PA
AUGUST 1987

NIOSH INVESTIGATOR
RONNIE J. CORNWELL, CIH

I. SUMMARY

On 17 March 1987, a United Mine Workers of America (UMWA) Health and Safety Representative requested the Division of Respiratory Disease Studies (DRDS), National Institute for Occupational Safety and Health (NIOSH) to evaluate highwall drill crew exposure to respirable dust at the Jeddo Highland Coal Company J-44 Strip Mine located near Hazelton, Pennsylvania.

An environmental survey was conducted in May 1987. The environmental sampling indicated a median quartz content by weight on the respirable samples of approximately 27 percent. Workers exposure to respirable dust containing quartz exceeded the Mine Safety and Health Administration (MSHA) adjusted standard and the NIOSH recommendation for respirable free silica in all measurements.

Based on the results of the environmental sampling, a respiratory health hazard did exist for the drill crew. Shortly after this survey was conducted, it was learned that the company had instituted engineering controls and that subsequent dust sample results were within MSHA compliance standards.

Key Words: Standard Industrial Classification (SIC):1111, Drilling, Silica, Quartz

II. INTRODUCTION

In March 1987, the Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the United Mine Workers of America (UMWA) Health and Safety Representative, District 25. The UMWA representative submitted the request because he was concerned about the respirable silica dust exposures for the highwall drill crews employed at Jeddo Highland Coal Company J-44 Strip Mine located near Hazelton, Pennsylvania.

Overburden drilling may generate substantial exposure to respirable quartz dust. Although the Mine Safety and Health Administration (MSHA) standard for respirable coal dust is 2 milligrams per cubic meter (mg/m^3), the agency enforces a reduced standard for situations in which the quartz content of dust is greater than 5 percent. In 1981, an MSHA review of reduced dust standards due to dust quartz content revealed that approximately one-half of the surface coal mine reduced dust standards involved members of the highwall drill crews.

III. PROCESS DESCRIPTION

The basic objective in strip mining is to remove the surface material, or overburden, from the coal seam so that the coal can be removed for marketing. Usually the first step in the mining process is to remove the topsoil which is later used in the reclamation process. Once the topsoil has been removed, overburden materials (generally sandstones, shales, limestones, and unconsolidated soils) can be removed.[1] The preparation required to remove this material requires drilling either vertical or horizontal holes into the formation, packing the holes with explosives and detonation. The resulting explosion breaks the overburden sufficiently to enable the draglines or shovels to remove the loose material and thereby expose the coal seam.

The type of drill used at the J-44 mine is a Bucyrus Erie 61R, which is a large rotary type drill. The drill is equipped with air pressure to keep the drill holes free from cuttings and to cool the bit cutting points and bearings (dry drilling technique). The use of compressed air generates a tremendous dust cloud in the area where the drill is operating.

To reduce the operator exposure to the dust cloud, the 61R employs three devices. An enclosure (cab) is provided for the operator. However, the cab has doors and windows which are kept open during hot weather. During cold weather, as was the case during the survey, the doors and windows are usually closed. Also, suspended from the deck of the drill is a rubber "skirt" which surrounds the drill hole in an effort to contain the dust. A local exhaust system is employed to collect the dust at the drill hole, convey it to a dust collector, which discharges the dust onto the ground away from the operator. In addition to these engineering controls, respiratory protection (dust masks) are provided but are only occasionally worn.

IV. METHODS AND MATERIALS

An environmental evaluation of the drilling operation was conducted 19-21 May 1987. The evaluation consisted of collecting: (1) personal respirable dust samples on the drill operator and driller helper; (2) area respirable dust samples inside and outside the drill cab; (3) area dust samples for particle sizing; and (4) bulk samples of settled dust for determination of free crystalline silica content.

Respirable dust samples were collected in the breathing zone by drawing air through a personal dust cyclone pre-selector and a 37mm, 5.0 um PVC filter at a flow rate of 1.7 liters per minute (lpm). Tared filters were analyzed for total gravimetric weight and percent of free silica using x-ray diffraction.

Dust samples for which time-weighted average (TWA) concentrations were computed were collected over the length of the normal work period. To compute TWA concentration for individual workers who had less than eight hours of dust exposure, only the period of dust exposure was sampled and a zero value was assigned to the unsampled portion of the workshift.

Area respirable dust samples were obtained inside and outside of the drill cab. The samples on the outside of the cab were attached to the railing around the deck of the drill 2 to 3 feet from the door of the cab. Samples on the inside were suspended from the ceiling of the cab 2 to 3 feet in front of, or behind, the operator.

Airborne particle size distribution was determined using a constant flow sampler at a flow rate of 2 lpm with a Sierria Instruments Series 290 Marple Personal Cascade Impactor. These samples were located with the area respirable dust samples described in the previous paragraph. Bulk samples of settled dust and drill tailings were analyzed using x-ray diffraction to determine the percent free silica.

In addition to our environmental survey, MSHA District 1 was contacted and asked to provide any information or data they had on the 61R drilling operation at the J-44 mine.

V. EVALUATION CRITERIA

Occupational health exposure limits for individual toxic substances are generally established at levels to which most workers can be repeatedly exposed during an 8 to 10 hour workday, 40 hour workweek for a working lifetime without significant adverse effects. NIOSH maintains that the worker should be protected by the standard or recommended levels that afford him the greatest degree of protection.

The current MSHA standard for permissible concentrations of respirable dust at surface coal mines requires that the average concentration of respirable dust to which each miner is exposed be continuously maintained at, or below, 2.0 mg/m^3. However, the standard is adjusted downward for mines where the respirable dust in the atmosphere contains more than five percent quartz. Under these conditions, the operator is required to maintain respirable dust below a concentration computed by dividing the percentage of quartz into the number 10. As the quartz content of respirable dust in the mine increases over five percent, the respirable dust standard is correspondingly reduced.(2)

NIOSH recommends that exposure to free silica (SiO_2) be controlled so that no worker is exposed to a time-weighted average (TWA) concentration greater than 0.05 mg/m^3.(3)

VI. RESULTS

The most notable result of the qualitative silica analysis of the bulk settled dust was that no cristobalite was found. Quartz was the only form of crystalline silica identified. Therefore, the airborne dust samples were analyzed only for quartz content.

The results of the respirable dust and free silica analysis are listed in Table I. All of the samples collected (5 personal, 6 area) exceeded the adjusted MSHA coal mine dust standard. Results of the personal samples revealed an average 8-hour TWA respirable dust exposure of 0.8 mg/m^3 (range 0.4 mg/m^3 to 1.7 mg/m^3) when the average calculated TLV was 0.4 mg/m^3. The NIOSH recommended standard (0.05 mg/m^3) for respirable free silica was also exceeded in every sample. The average percentage of quartz by weight was 25.4% (range 18.5% to 31.7%).

Aerodynamic particle size distribution data are contained in Figures 1, 2, and 3. The particle size of concern as a silicosis health hazard is generally considered to be below 10 micrometers (µm) in diameter. The mass of airborne dust particles that were 10 µm in aerodynamic diameter and below were approximately 69% inside the cab and 45% outside the cab.

Results of the area respirable dust samples indicated that the cab provided some degree of protection for the operator. The cab afforded approximately 76% reduction in concentration of respirable dust (average 4.2 mg/m^3 for outside and 1.0 mg/m^3 for inside).

Review of the MSHA data indicated an awareness of the dust problem on the 61R drill as early as October 1986. On October 17, 1986, MSHA in accordance with Section 104 of the Federal Mine Safety and Health Act of 1977 issued a 104(a) citation because the average concentration of respirable dust in the working environment of the driller was 1.3 mg/m^3, which exceeded the applicable

limit of 0.4 mg/m^3. At that time, the mine operator was instructed to take corrective action to lower the respirable dust level and sample each production shift until the average of five valid samples was below the 0.4 mg/m^3 standard. On January 7, 1987, the 104(a) citation was changed to a 104(b) order because dusts samples submitted by the mine operator indicated that the standard still had not been met. The 104(b) order was modified several times and on May 5, 1987, the order was terminated because dust samples submitted by the operator indicated an average respirable dust level of 0.3 mg/m^3, which was within the limit of 0.4 mg/m^3.

VII. DISCUSSION/CONCLUSION

It is recognized that coal mine dust generated during surface mining operations may contain enough quartz (SiO_2) to increase the potential health hazard of environmental dust exposures. Banks et al. reported three cases of pneumoconiosis in drillers at a small surface mine in West Virginia.[4,5] Two of these cases were diagnosed in clinical situations. The third case was found during the examination of eight currently employed and retired drillers from this mine. No pneumoconiosis was found among 60 workers who had never worked as drillers. Banks et al. also reviewed the data of drillers employed in eight mines examined by NIOSH in 1972-73 and reported by Fairman, et al.[6] The prevalence of pneumoconiosis was approximately five times greater in the drilling group compared to other surface workers (6% vs 1%). Seven of eight cases among drillers were found in the group with 10 or more years of tenure. Subsequent analysis by NIOSH[7] showed that only one driller had Category 2 pneumoconiosis and was employed in an anthracite mine. All bituminous drillers with pneumoconiosis had Category 1.

The Federal Mine Safety and Health Act of 1977, Section 204 discusses dust from drilling operations. The Act states: "The dust resulting from drilling in rock shall be controlled by the use of permissible dust collectors, or by water or water with a wetting agent, or by ventilation, or by any other method or device approved by the Secretary which is at least as effective in controlling such dust. Respiratory equipment approved by the Secretary and the Secretary of Health, Education, and Welfare shall be provided persons exposed for short periods to inhalation hazards from gas, dusts, fumes, or mist. When the exposure is for prolonged periods, other measures to protect such persons or to reduce the hazard shall be taken." Controlling dust from drilling operations has never been an easy task because of the extremely small size range of dust particles. As demonstrated in this survey, approximately 69% of the particles collected inside the cab were 10 microns and below and results of the respirable dust samples indicated that the drill operator and

helper were exposed to excessive amounts of silica containing dust. These results are similar to the results obtained during a HHE conducted in 1981-82 of three large surface mines which employed various types of rotary drills.[8]

Based on the results of this survey, previous surveys,[4-8], the MSHA data and the NIOSH recommended standard [3] for exposure to respirable free silica, this investigator feels that the members of the drill crews are subjected to conditions which, over a working lifetime, could constitute a health hazard.

It is the opinion of several people in the mining industry that wet drilling techniques are very effective in controlling dusts, but cause problems especially during cold weather.[9] In June, shortly after this survey was conducted, the requester informed the NIOSH investigator that the company, on its own initiative, had reinstituted a wet drilling technique, which in turn had reduced worker dust exposure. MSHA was consulted and they confirmed that the company dust samples collected after starting the wet drilling indicated the drill was operating within compliance standards.

VIII. RECOMMENDATIONS

It is recommended that the recently installed wet drilling equipment be continually maintained to control dust exposures.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. UMWA Health and Safety Representative, District 25
2. Superintendent, Jeddo Highland Coal Co. J-44 Strip Mine
3. MSHA, Coal Mine Safety and Health District 1
4. MSHA, Arlington, VA
5. UMWA, Washington, DC

For the purpose of informing affected employees, copies of this report should be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I
Report No. MHETA 87-173
Results of Respirable Dust Sampling

Type Sample	Date/Shift	% Quartz	Calculated(*) TLV (mg/m^3)	8 Hr TWA Resp Dust (mg/m^3)	8 Hr TWA Resp Silica (mg/m^3)
Personal	5/20/87/1st	27	.4	.6	.2
Personal	5/20/87/1st	26.8	.4	.7	.2
Area-Inside Cab	5/20/87/1st	27	.4	.7	.2
Area-Outside Cab	5/20/87/1st	22.5	.4	2.7	.6
Personal	5/20/87/2nd	18.7	.5	1.7	.3
Area-Inside Cab	5/20/87/2nd	19.7	.5	1.8	.4
Area-Outside Cab	5/20/87/2nd	18.5	.5	6.5	1.2
Personal	5/21/87/1st	28.8	.3	.7	.2
Personal	5/21/87/1st	30	.3	.4	.1
Area-Inside Cab	5/21/87/1st	31.7	.3	.5	.2
Area-Outside Cab	5/21/87/1st	28.2	.4	3.4	1.0

(*) Calculated TLV - $\frac{10}{\text{Percentage of Quartz}}$

FIGURE 1

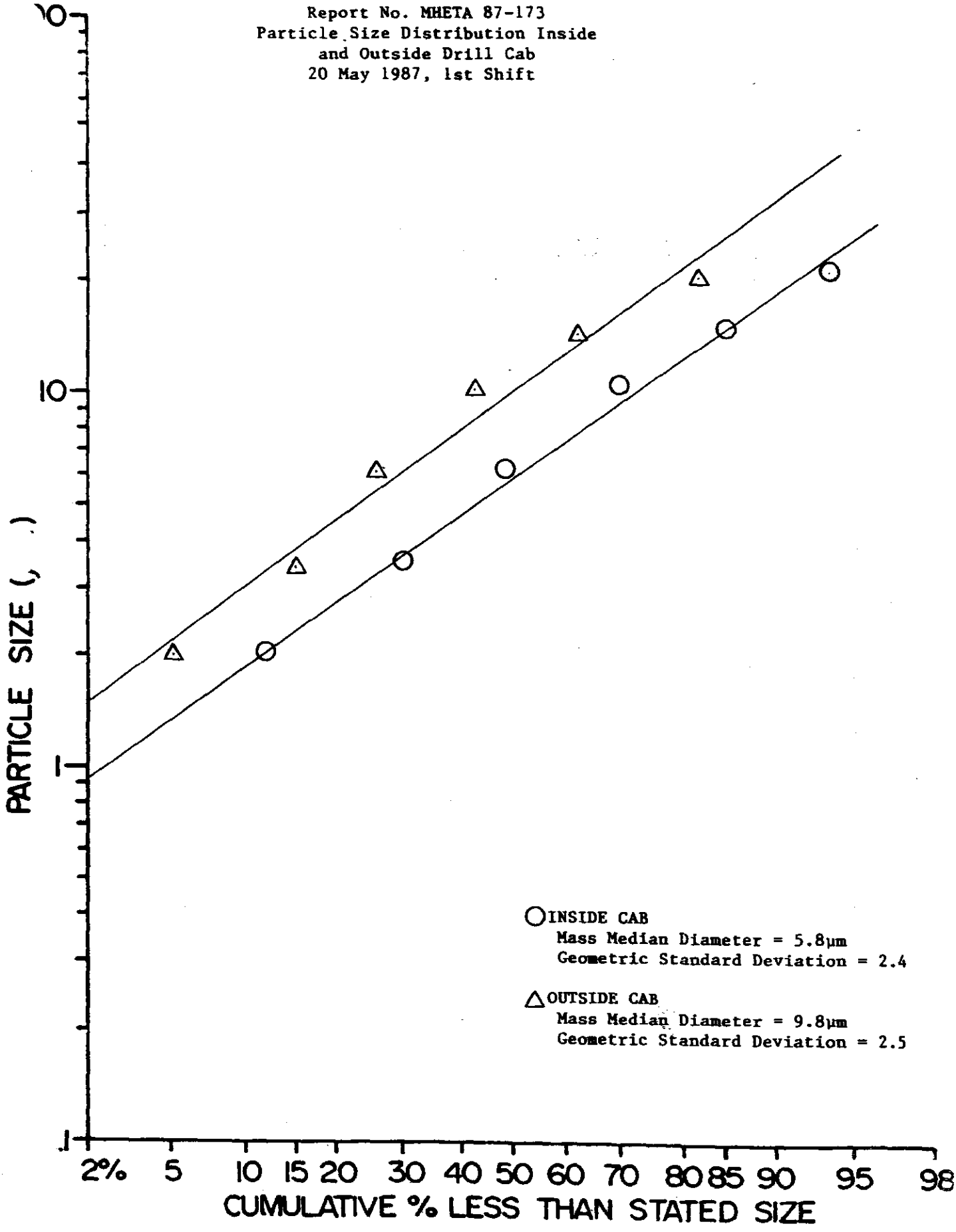

Report No. MHETA 87-173
Particle Size Distribution Inside
and Outside Drill Cab
20 May 1987, 1st Shift
PARTICLE SIZE (, .)
10
1
.1
2%
5
10
15
20
30
40
50
60
70
80
85
90
95
98
CUMULATIVE % LESS THAN STATED SIZE
INSIDE CAB
Mass Median Diameter = 5.8μm
Geometric Standard Deviation = 2.4
OUTSIDE CAB
Mass Median Diameter = 9.8μm
Geometric Standard Deviation = 2.5

FIGURE 2

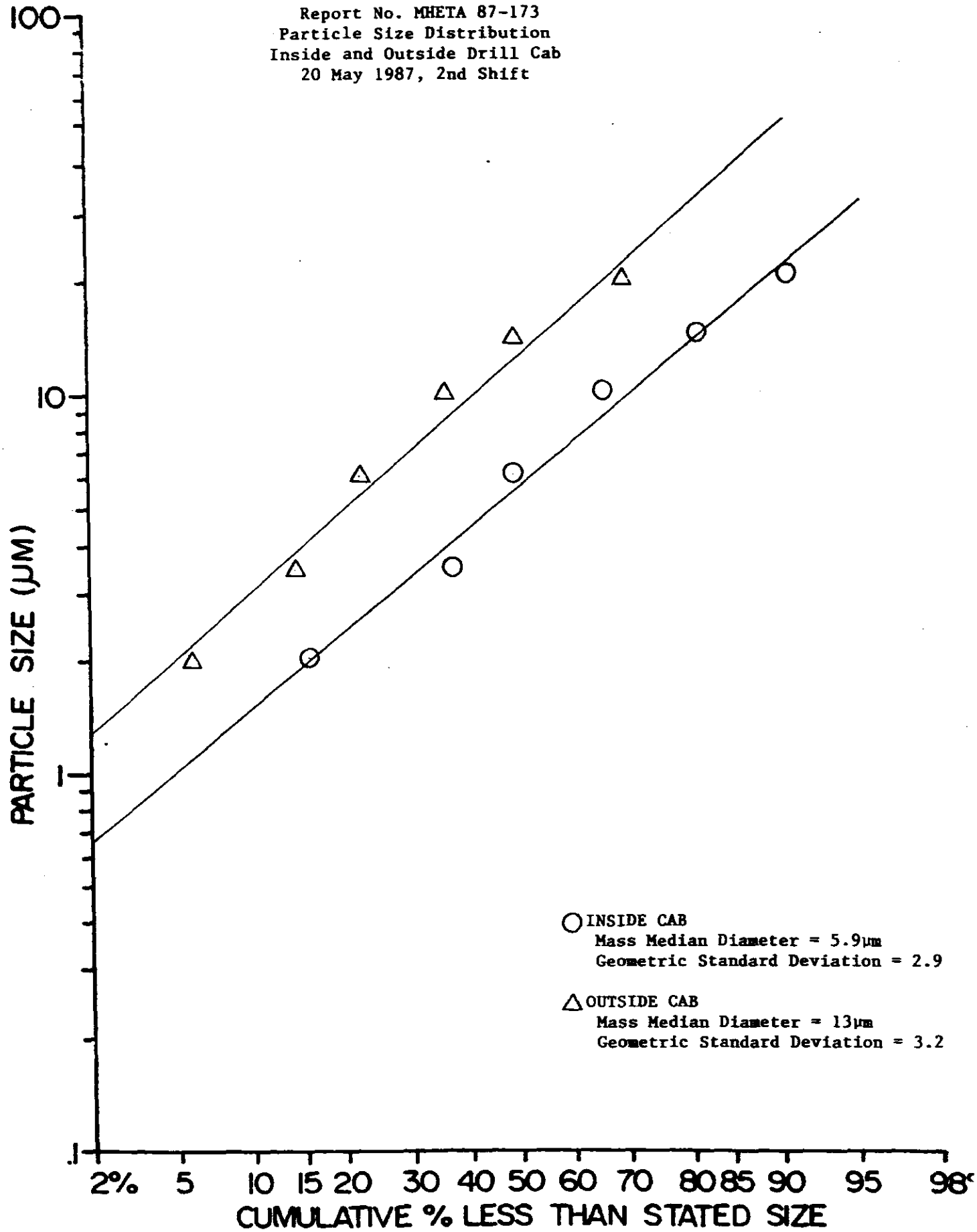
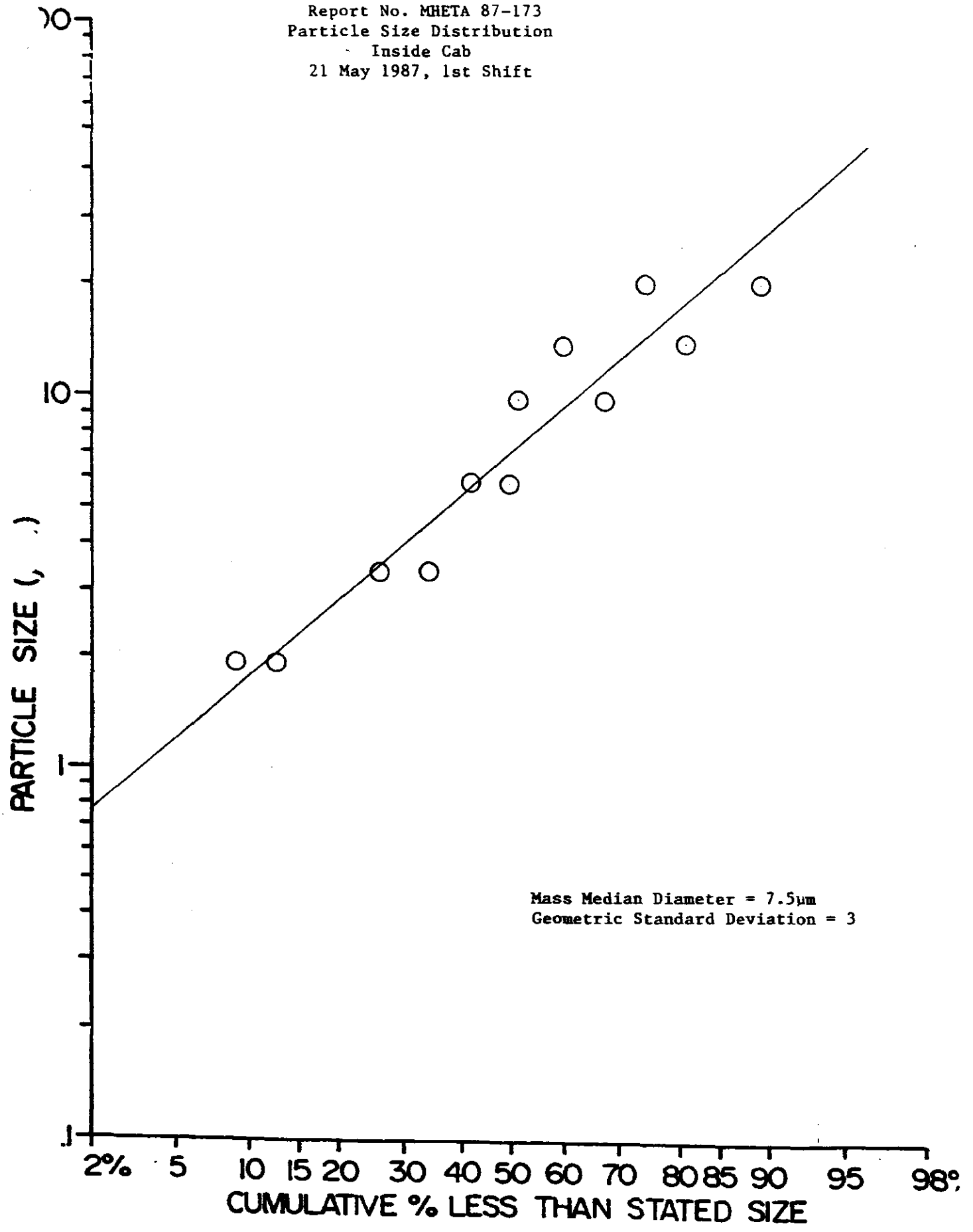

Report No. MHETA 87-173
Particle Size Distribution
Inside and Outside Drill Cab
20 May 1987, 2nd Shift
100
10
1
.1
PARTICLE SIZE (µM)
2%
5
10
15
20
30
40
50
60
70
80
85
90
95
98%
CUMULATIVE % LESS THAN STATED SIZE
INSIDE CAB
Mass Median Diameter = 5.9µm
Geometric Standard Deviation = 2.9
OUTSIDE CAB
Mass Median Diameter = 13µm
Geometric Standard Deviation = 3.2

FIGURE 3


Report No. MHETA 87-173
Particle Size Distribution
Inside Cab
21 May 1987, 1st Shift
PARTICLE SIZE (,)
10
1
.1
2%
5
10
15
20
30
40
50
60
70
80
85
90
95
98%
CUMULATIVE % LESS THAN STATED SIZE
Mass Median Diameter = 7.5μm
Geometric Standard Deviation = 3