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Effect of Coal Mine Health and Safety Act of 1969 on Respirable Dust Concentrations in Selected Underground Coal Mines

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EFFECT OF COAL MINE HEALTH AND SAFETY ACT OF 1969 ON RESPIRABLE DUST CONCENTRATIONS IN SELECTED UNDERGROUND COAL MINES

by

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ABSTRACT

The respirable dust standard in the Federal Coal Mine Health and Safety Act of 1969 is designed to prevent disability and death from coal workers' pneumoconiosis. Beginning June 30, 1970, the operators of coal mines were required to maintain the average concentration of respirable dust in the active workings at or below 3.0 milligrams of dust per cubic meter of air. The standard is reduced to 2.0 milligrams per cubic meter after Dec. 30, 1972.

This paper presents the equipment and procedures used by the coal mine operators in implementing the respirable dust sampling program established by the Secretary of the Interior and the Secretary of Health, Education, and Welfare and shows the effect of the law, during the first year, on the reduction of dust levels in selected mines. The system employed by the Bureau of Mines for analyzing and processing the dust samples is also presented.

INTRODUCTION

The mandatory health standards of the Federal Coal Mine Health and Safety Act of 1969 pertaining to respirable dust have been in effect since June 30, 1970. The provisions established strict respirable dust standards for the coal-mining industry for the first time in its history. The effort leading up to the establishment and enforcement of the standards and some of the findings during the first year are presented.

Early in 1965, the Bureau of Mines proposed a program for conducting a comprehensive dust survey in underground bituminous coal mines. The effort was divided into the two following major categories:

1. To provide information relative to levels of dustiness associated with various coal-mining methods, ventilating conditions, types of coal, and specific occupations.

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2. To provide information relative to dust concentrations in coal mines as obtained by a variety of instruments and evaluation techniques.

By 1967, suitable equipment and procedures had been developed to initiate the survey of the mines. The prototype instruments were tested during initial work in operating mines, and they proved to be rugged enough for use at the working face. There are two types of sampling instruments suitable for assessing respirable dust concentrations in the coal mine environment.

The coal mine dust personal sampler unit, shown in figure 1, is one of these instruments. The first stage, a 10-millimeter nylon cyclone, performs as an elutriator or separator. Its collecting efficiency closely approximates the criterion established by the Atomic Energy Commission and the American Conference of Government Industrial Hygienists when operated at a flow rate of 2 liters per minute. The second stage, a membrane filter, collects the respirable fraction of dust which passes through the cyclone. The dust collected is weighed to the nearest 0.1 milligram, and concentrations are expressed as milligrams of dust per cubic meter of air sampled.

Another device, shown in figure 2, is the MRE gravimetric dust sampler, which was developed by the Mining Research Establishment of the National Coal

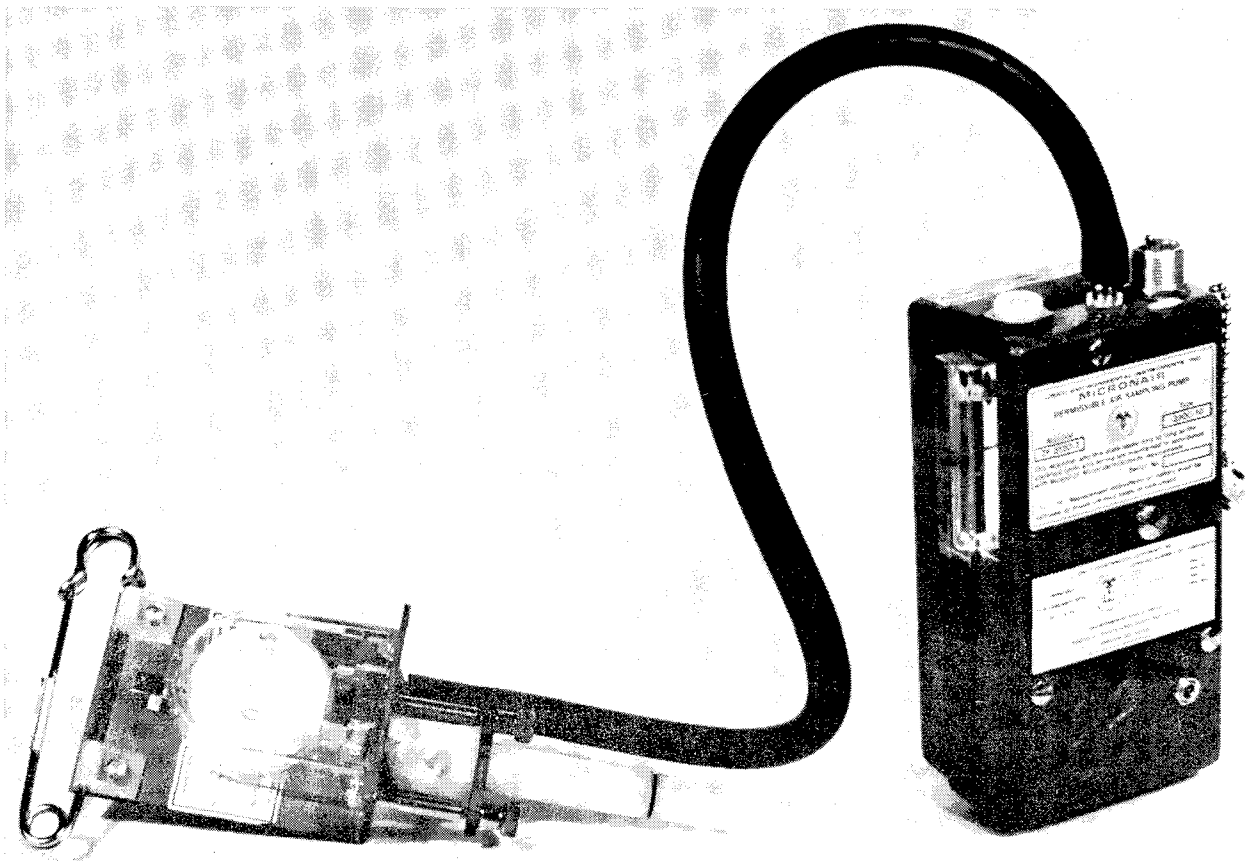


FIGURE 1. - Coal Mine Dust Personal Sampler.

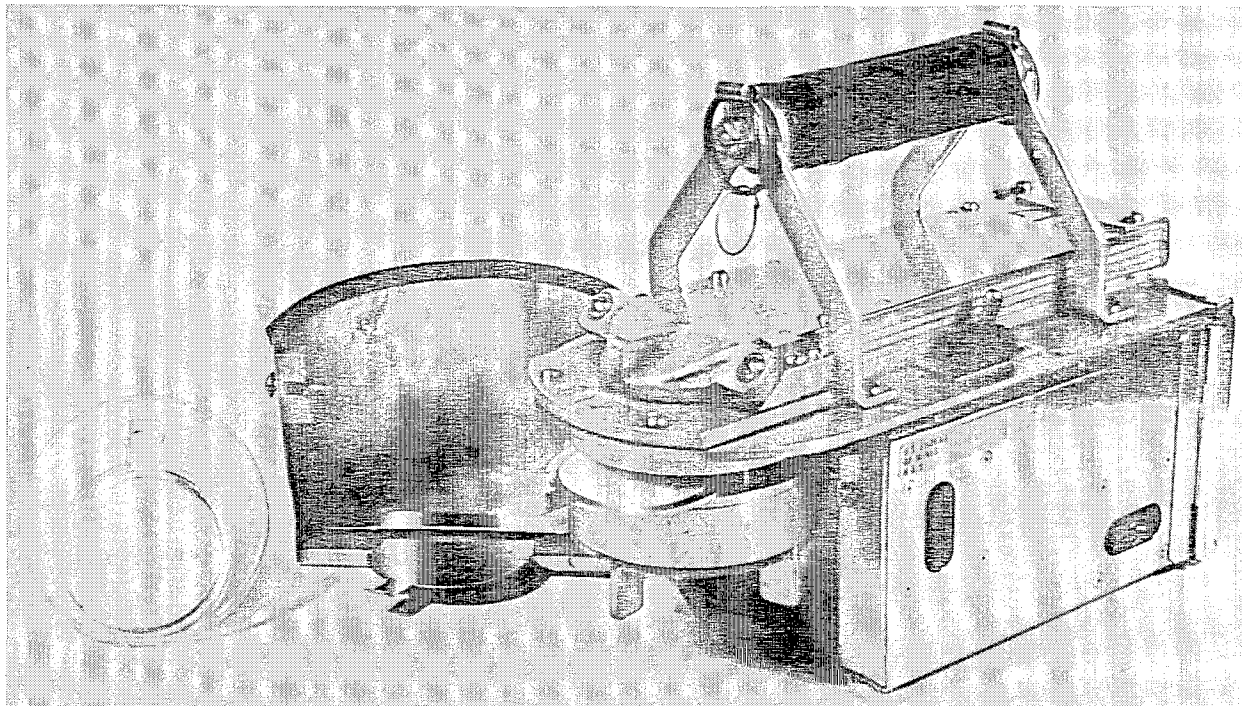


FIGURE 2. - MRE Gravimetric Dust Sampler.

Board at Isleworth, England. The first stage of the MRE, a four-plate horizontal elutriator, has a collecting efficiency that closely approximates the criterion recommended and adopted by the International Pneumoconiosis Conference at Johannesburg, South Africa, in 1969. This is obtained with the sampler operating at a flow rate of 2.5 liters per minute. The membrane filter used as the second, or collecting, stage is treated in the same manner as the filters from the personal sampler.

The environmental dust survey was initiated early in 1968, and 29 underground coal mines were evaluated by early 1969. The mines selected fulfilled the following criteria:

1. The bituminous coal mines selected had a minimum operational expectancy of 10 years and employed at least 20 men underground.
2. Ten consecutive days were required to be spent at each mine to obtain statistically valid data.
3. The mines selected had productivities ranging from less than 5 to greater than 50 tons per man shift.
4. The mines selected had seam thicknesses from less than 30 inches to greater than 121 inches and covered 19 different coal seams.
5. The types of sections sampled were continuous, conventional, a combination of continuous and conventional, and handloading. The selection of

the sections to be sampled in the mines was dependent on the number and types of sections in the mine, and the results were used in determining the average exposure of the miners employed in specific operations over the entire work shift.

6. The number of mines selected in each of the then five Health and Safety Districts in the continental United States was based on the percentage of underground bituminous mines in the relative districts.

Four crews were utilized to complete these 29 surveys. Each sampling crew consisted of four men: three working underground and one on the surface. The duties of the crew members working underground were to place the samplers in the designated locations, periodically changing and checking the appropriate samplers to maintain them in proper operating condition, and to obtain pertinent mining and ventilating information relative to airborne dust generation and removal. The crew member working on the surface weighed the gravimetric samples, kept record books, and prepared sampling equipment for the following day's test.

Each miner on the selected section crew was equipped with a personal gravimetric sampler operated for the entire shift. In addition, three sampling packages, each containing personal, MRE, total airborne, and midget impinger samplers, were employed on each section. One package was placed on or near the coal-cutting equipment adjacent to the operator; the second package was in the immediate vicinity of the workers who were indirectly involved with the coal-cutting operation, primarily the roof bolters; and the third package was placed in the intake air entry to the section. These samplers operated the entire time the working crew was on the section.

Data obtained were used to determine those occupations exposed to the highest concentrations of respirable dust in the face areas of the mines. In addition, a linear relationship was derived between data collected with the personal samplers and with the MRE. The average ratio of individual MRE to personal sampler data is approximately 1.6. The importance of this relationship must be emphasized. Since the regulations of the Coal Mine Health and Safety Act of 1969 state that respirable coal mine dust samples are to be collected with the MRE or any other device approved by the Secretary of the Interior and the Secretary of Health, Education, and Welfare, the empirical relationship of 1.6 permits the use of the personal sampler and the reporting of data in terms of equivalent MRE concentrations.

COAL MINE HEALTH AND SAFETY ACT

Requirements

The Federal Coal Mine Health and Safety Act of 1969 provides for the protection of the health and safety of persons working in the coal-mining industry of the United States. It is also known as Public Law 91-173.

As specified in Section 202(a), Title II of the Act, each operator of a coal mine shall take accurate samples of the amount of respirable dust in the

mine atmosphere. Beginning June 30, 1970, the operator of each coal mine was required to maintain the average concentration of respirable coal mine dust at or below 3.0 milligrams of dust per cubic meter of air. The standard is reduced to 2.0 milligrams per cubic meter after Dec. 30, 1972.

The Act requires frequent sampling by the mine operator in accordance with the regulations prescribed by the Secretary of the Interior and the Secretary of Health, Education, and Welfare. Every coal mine operator is required to take monthly samples of the "high risk" occupation in each coal-producing section. The high risk occupation is that which previous information has indicated to be exposed to the highest concentration of respirable dust. Therefore, if the high risk occupation is in compliance with the dust standard, then all other occupations in the area are assumed to be in compliance.

In addition to those "high risk" samples required in coal-producing sections, a sample of the intake air is required monthly, and all underground workers must be sampled periodically. All samples are taken portal-to-portal, and the respirable dust concentrations are computed based on the worker's total time underground.

Processing

All samples collected by the mine operators are analyzed at the controlled environment laboratory of the Bureau of Mines in Pittsburgh, Pa. The laboratory and procedures followed in processing respirable dust samples are described in Bureau of Mines Information Circular 8520, Respirable Mine Dust Sample Processing Laboratory.

A flow diagram of the mine dust monitoring system is shown in figure 3. As of June 30, 1971, a total of 278,931 samples had been processed in the laboratory, which equated to approximately 30,000 samples per month, or 1,600 per day. The laboratory has a planned peak capacity of about 3,000 to 3,500 samples per day. Upon completion of the analysis, the information is transmitted to the Bureau of Mines automatic data processing center in Denver, Colo., where dust concentrations are determined and stored for calculation and comparison against existing dust standards. This facility is linked with the various Coal Mine Health and Safety district and subdistrict offices to provide reliable and rapid printouts of respirable dust data within hours after receipt of the sample in Pittsburgh.

RESULTS

To study the effect of the mandatory dust program on the reduction of the respirable dust exposure of the miners, a comparative evaluation of dustiness for high risk occupations by sections in the 29 previously surveyed mines was conducted. In the 1968-69 survey, 155 sections were sampled. The data are reported as the cumulative frequency percent of the sections whose MRE equivalent dust concentrations fall in the following categories: equal to or less than 1.0 mg/m³; 2.0 mg/m³; 3.0 mg/m³; and 4.5 mg/m³. These data are shown in figure 4.

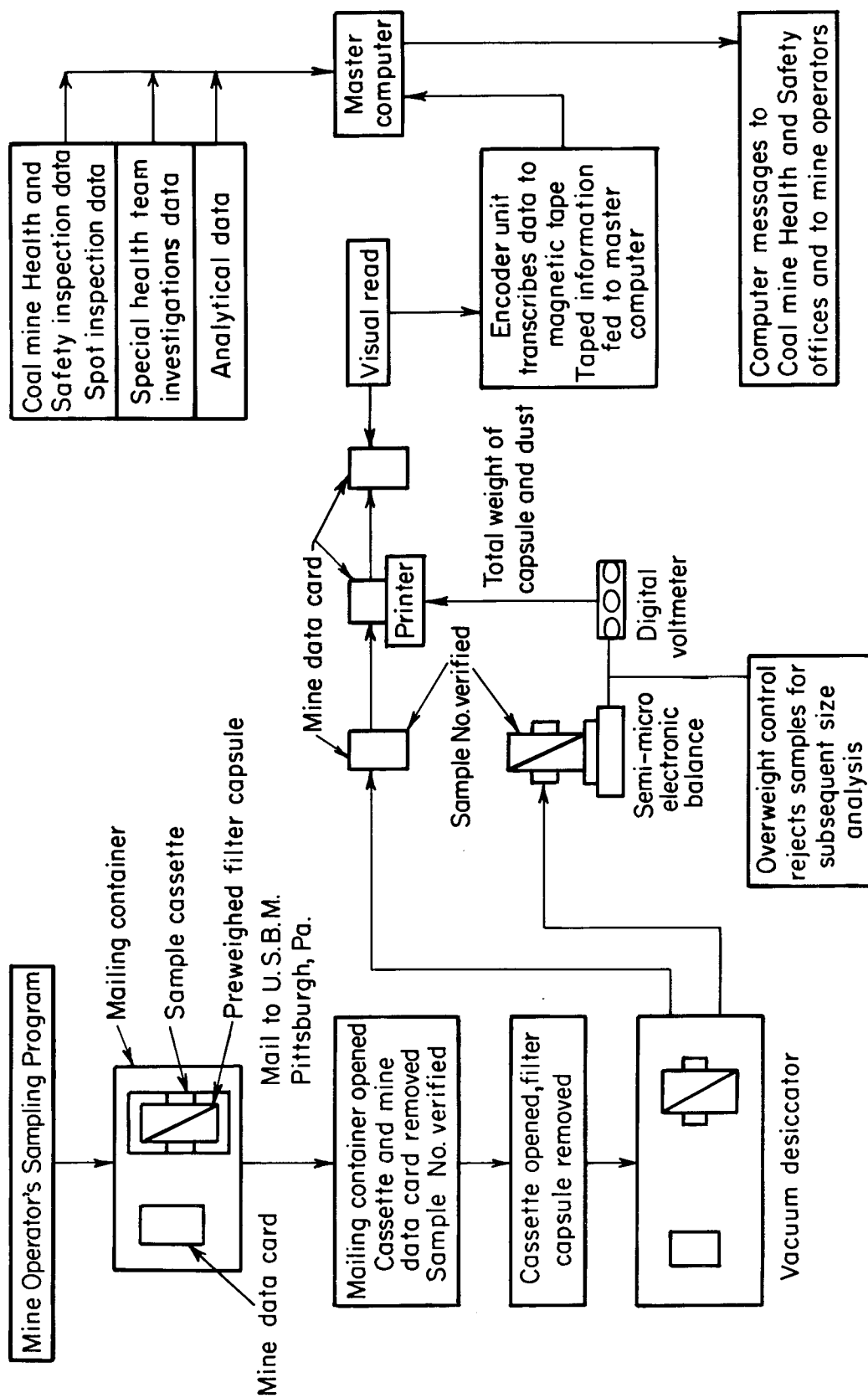


FIGURE 3. - Flow Diagram of Mine Dust Monitoring System.

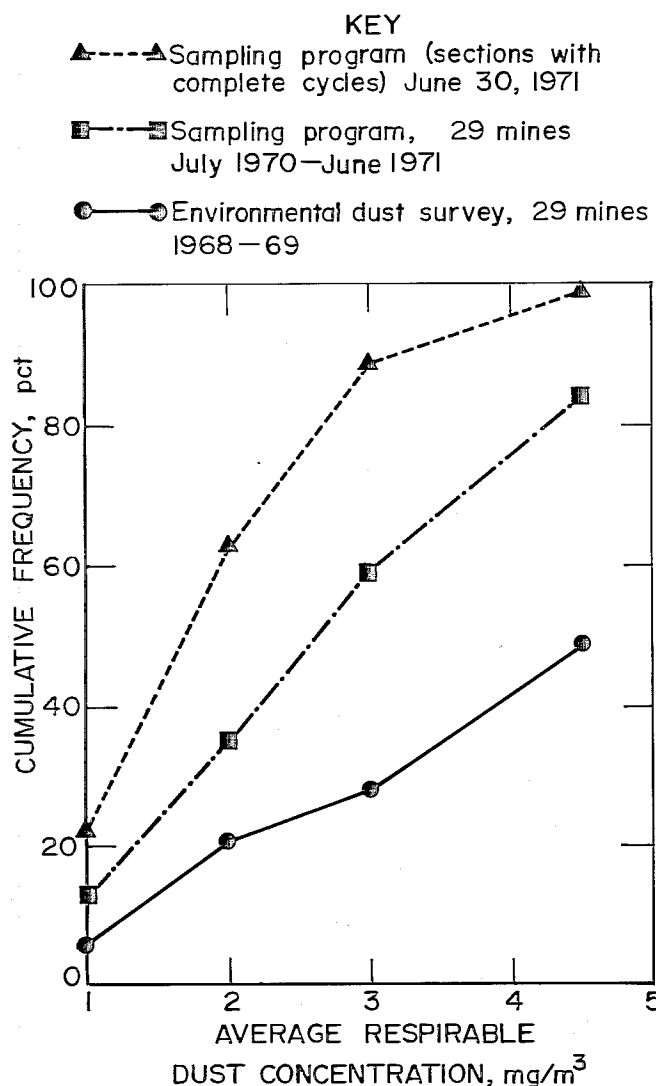


FIGURE 4. - Evaluations of Dustiness for High Risk Occupations in 29 Mines.

complete sampling cycle by June 30, 1971. They indicate that 89 percent of these 2,217 sections were in compliance with the 3.0 mg/m³ standard, and 63 percent were at or below a level of 2.0 mg/m³.

A further comparative evaluation of the dust concentrations was performed on all occupations where comparative data were present between original survey data and data obtained under the Act. These data are shown in figure 5.

Of the 22 occupations studied, eight had average dust levels below 3.0 mg/m³, whereas three occupations sampled below 2.0 mg/m³ at the time of the original survey. At the end of the first year only one occupation, the continuous miner operator, had an average dust level above 3.0 mg/m³. Half of the occupations had average concentrations at 2.0 mg/m³ or below.

Data obtained from the coal mine operators' sampling program for these 29 selected mines, during the first year of the Coal Mine Health and Safety Act of 1969 (July 1, 1970-June 30, 1971), are similarly presented in figure 4. Current results in these mines were available from 288 working sections. These results represent the average of total data available for the sections in the 29 mines, and not the average of 10 samples. It must be remembered that specific section comparisons cannot be performed owing to the relatively short life of a coal mine working section.

Comparing the data, it is evident that the percentage of sections complying with a 3.0-mg/m³ standard is approximately twice as much as it was prior to the Law--59 percent as opposed to 28 percent. Increases are likewise shown for the other concentration levels.

It is also shown in figure 4 that the distribution of respirable dust concentrations for high risk occupations for all mine sections from which data was available at the end of the first year of the Coal Mine Health and Safety Act of 1969 is considerably higher than results obtained from the original survey in the 29 mines. These data are for 2,217 mine sections which had a complete sampling cycle by June 30, 1971.

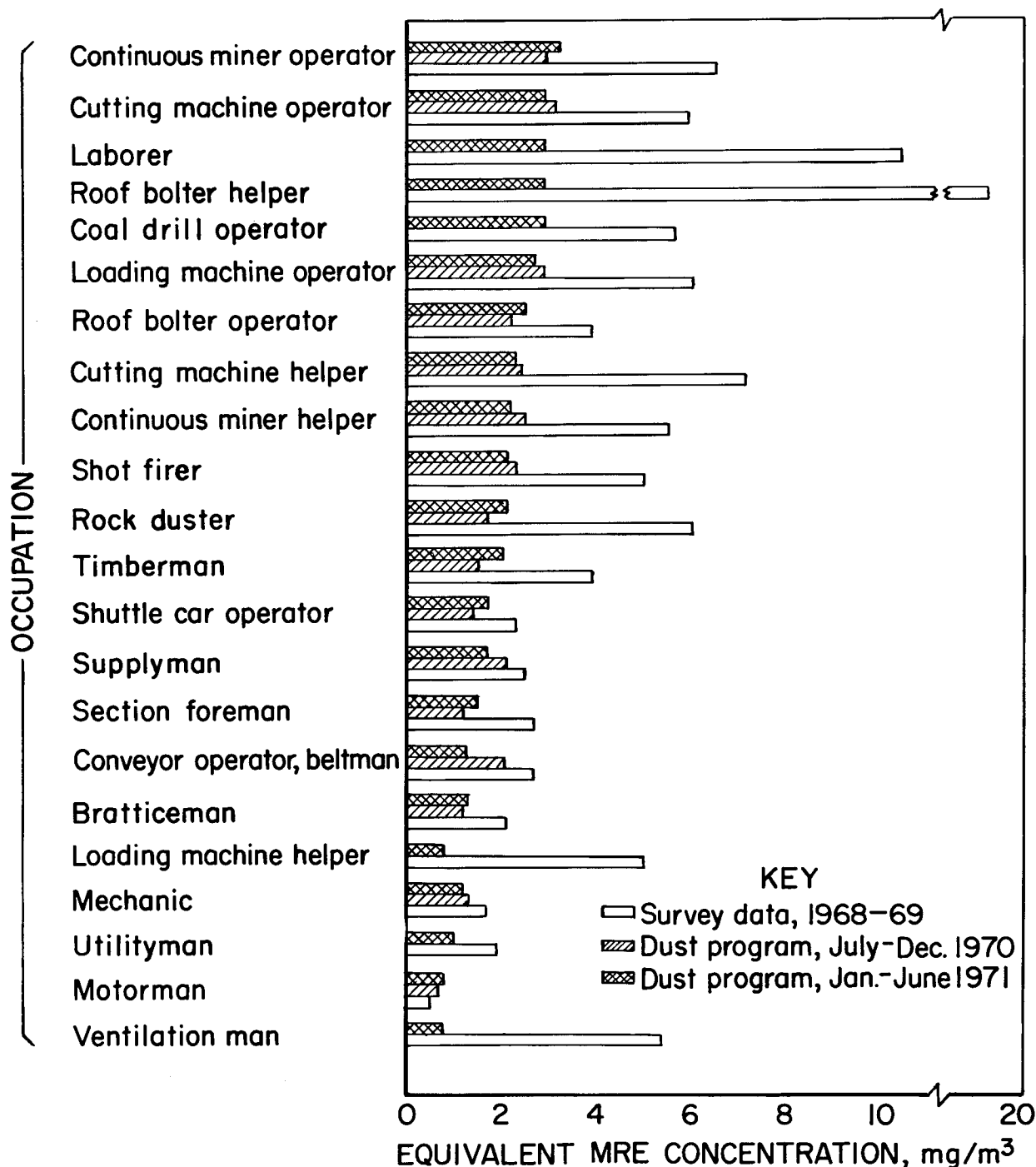


FIGURE 5. - Comparison of the Mean Dust Exposures Relative to Specific Occupations in 29 Selected Mines.

When the respirable dust in the mine atmosphere contains more than 5 percent quartz, the operator must maintain the average concentration at or below a concentration computed by dividing the percent of quartz into the number 10. The result of this calculation may not result in a concentration in excess of any standard previously established by the Act.

Approximately 99 percent of the samples collected in the face areas of the mines contain less than 5 percent quartz; 86 percent contain less than 2 percent quartz. This corroborates the previous estimate of approximately 2 percent of quartz in the respirable dust encountered in the working areas of operating coal mines.

CONCLUSION

These data clearly indicate that the first level of the Federal respirable dust standards is attainable at this time. Many mines are now demonstrating that coal can be mined without exposing the workers to excess concentrations of respirable dust and that there is real promise for achieving the 2.0-mg/m³ standard when it becomes effective after Dec. 30, 1972.

