FINAL REGULATORY ECONOMIC ANALYSIS

AND

FINAL REGULATORY FLEXIBILITY ANALYSIS

FINAL RULE ON 30 CFR PARTS 57

FINAL STANDARDS AND REGULATIONS

DIESEL PARTICULATE MATTER EXPOSURE OF UNDERGROUND

METAL AND NONMETAL MINERS

RIN: 1219-AB11

Office of Standards, Regulations, and Variances

Mine Safety and Health Administration

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Table of Contents

I. EXECUTIVE SUMMARY

INTRODUCTION

This rule is designed to reduce exposures of miners in underground metal/nonmetal (MNM) mines to diesel particulate matter (DPM). Of all groups in the U.S. work force and population at large, underground miners have by far the highest levels of DPM exposure. MSHA field studies indicate that median DPM concentrations observed for underground miners range up to 200 times as high as average environmental exposures in the most heavily polluted urban areas and up to 10 times as high as median exposures estimated for the most heavily exposed workers in other occupational groups. The DPM rule will reduce DPM exposures in underground M/NM mines to levels similar to the highest exposure levels found in other occupational groups. These reduced DPM exposure levels will result in reductions in significant health risks of illness and premature death for underground miners.

This standard for underground M/NM mines is a performance standard, with an interim DPM concentration limit of 500 micrograms/m^3, followed by a final DPM concentration limit of 200 micrograms/m^3. MSHA assumes that these concentration limits will be met by a combination of ceramic filters and cabs on diesel powered equipment and ventilation improvements. New engines will also play a significant role in meeting the final concentration limit, but MSHA projects that these engines will be replaced in the baseline, and so their costs are not attributed to the rule.

The rule also includes a variety of specific requirements. These include requirements for newly introduced engines to be approved by MSHA or to meet listed EPA standards; a diesel particulate matter control plan; fueling practices; maintenance training, miner health training, and recordkeeping of the training; tagging and examination of equipment with apparent emission defects; environmental monitoring; and maintenance of DPM records. The rule also includes provisions for a single extension of the deadline for the final concentration limit and for respirator use under limited circumstances. Further discussion of regulatory compliance measures is provided in Chapter IV of this document.

Section 101 of the Federal Mine Safety and Health Act of 1977 provides the authority for this rulemaking. Executive Order 12866 requires that regulatory agencies complete a Regulatory Economic Analysis (REA) for any rule having major economic consequences for the national economy, an individual industry, a geographic region, or a level of government. The Regulatory Flexibility Act (RFA) similarly requires regulatory agencies to consider the impact of the rule on small entities. This REA and Regulatory Flexibility Analysis have been prepared to fulfill the requirements of Executive Order 12866 and the RFA.

SCOPE: MINING SECTORS AFFECTED BY THE RULE

The M/NM Mine DPM Rule applies only to underground M/NM mines that use diesel powered equipment. Thus, the rule applies only to a portion of all M/NM mines. MSHA data indicate that there are 196 mines affected by this rule, or 74 percent of all underground M/NM mines. Underground M/NM mines account for 2.3 percent of all M/NM mines and 8.7 percent of all M/NM miners. Of the mines affected by the rule, 7 are large by SBA's definition (more than 500 employees), 77 are small by MSHA's definition (fewer than 20 employees), and the other 112 are small by SBA's definition and large by MSHA's definition. Further discussion of mining sectors affected by the rule is provided in Chapter II of this REA.

BENEFITS

MSHA's DPM rule for M/NM mines will reduce a significant health risk to underground miners. This risk includes the potential for illnesses and premature death, as well as the attendant costs of the risk to the miners' families, to the miners' employers, and to society at large.

Benefits of the rule include reductions in lung cancers. In the long run, as the mining population turns over, MSHA estimates that a minimum of 8.5 lung cancer deaths will be avoided per year. Note that this lower bound figure could significantly underestimate the magnitude of the health benefits. For example the estimate based on the mean value of all the studies examined is 49 lung cancer deaths avoided per year.

Benefits of the rule will also include reductions in the risk of death from cardiovascular, cardiopulmonary, or respiratory causes and reductions in the risk of sensory irritation and respiratory symptoms. However, MSHA has not included these health benefits in its estimates because the Agency cannot currently make reliable or precise quantitative estimates of them. Nevertheless, the expected reductions in the risk of death from cardiovascular, cardiopulmonary, or respiratory causes and the expected reductions in the risk of sensory irritation and respiratory symptoms are likely to be substantial.

Further discussion of the benefits of the rule is provided in Chapter III of this REA.

COMPLIANCE COSTS

Summary of Costs

Yearly Industry Costs. The estimated total yearly cost[1] of this final rule to the underground M/NM mining industry is $25.1 million. Of these costs, $24.1 million (96 percent) is attributable to controls to meet DPM concentration limits, and the remainder is for monitoring,

[1] Capital costs are discounted to the present and amortized over the life of the investment using an annual discount rate of 7.0 percent.

training, respirator protection, and recordkeeping. Further discussion of costs and their estimation is provided in Chapter IV of this REA.

Initial Costs. The estimated capital outlays and other one-time costs imposed on M/NM mine operators by this regulation are $40.5 million over the first two years. Because of phasing of the requirements, almost all of this ($40.1 million) occurs in the second year. There is, however, some flexibility available to the mine operators. If these expenditures were spread out over the time as evenly as possible, taking advantage of the available time frames to make the investments (18 months for filters and cabs; 30 months for ventilation improvements), the $40.1 million would be allocated as $22.7 million in the first year, $14.3 million in the second year, and $3.1 million in the third year. With the $40.1 million occurring in the second year, initial costs represent 35 percent of total costs in the first year and 90 percent of total costs in the second year.

Costs by Mine Size. Of the yearly costs to M/NM mine operators, $17.7 million (70.6 percent) will be incurred by mines with 20 to 500 employees; $3.3 million (13.1 percent) will be incurred by mines with over 500 employees; and $4.1 million (16.3 percent) will be incurred by mines with fewer than 20 employees. Thus, using SBA's definition of "small," small mines will incur $21.8 million in yearly costs (86.9 percent). Using MSHA's definition of "small," small mines will incur $4.1 million in yearly costs (16.3 percent). Further discussion of costs by mine size is provided in Chapter V of this REA.

Changes in Cost Estimation from the Proposed Rule

This standard for underground M/NM mines is a performance standard, with an interim DPM concentration limit of 500 micrograms/m^3, followed by a final DPM concentration limit of 200 micrograms/m^3. The rule encourages mine operators to use any combination of a "toolbox" of measures to meet these concentration limits. In the PREA—based on an optimizing approach, in which the most cost-effective additional measures were selected for additional DPM reductions at each stage—MSHA assumed a specific set and sequence of control measures:

- The interim standard would be met by replacing engines, installing oxidation catalytic converters, and improving ventilation; and

- The final standard would be met by adding cabs and filters.

Comments on the PREA and data collected by MSHA since its publication indicate that engine replacement is more expensive and filters are more effective than were previously understood.

These changes in information have made filters much more cost effective relative to engine replacement. Accordingly, MSHA has gone back to the toolbox and rethought the optimized compliance strategy. The revised compliance strategy, upon which MSHA bases its revised estimates of compliance costs, reverses the two most widely used measures from the toolbox. MSHA now anticipates that:

- The interim standard of 500 micrograms/m^3 will be met with filters, cabs, and ventilation; and

- The final standard of 200 micrograms/m^3 will be met with more filters, ventilation, and such turnover in equipment and engines as will have occurred in the baseline.

This new approach uses the same toolbox and optimization strategy that was used in the PREA. Since relative costs are different, however, the tools used and costs estimated are quite different.

Impacts

Estimated yearly compliance costs are 0.675 percent of revenues of underground M/NM mines that use diesel powered equipment. This is not a significant impact.

By mine size, estimated yearly costs are 2.16 percent of revenue for mines with fewer than 20 employees; 0.21 percent of revenue for mines with 20 to 500 employees; and 1.28 percent of revenues for mines with over 500 employees.

MSHA has determined that compliance by the M/NM mining industry with the requirements of the final rule is both technologically and economically feasible.

EXECUTIVE ORDER 12866 AND THE REGULATORY FLEXIBILITY ACT

Executive Order 12866 requires that regulatory agencies assess both the costs and benefits of intended regulations. MSHA has fulfilled this requirement for the final rule and determined that this rulemaking is not economically significant but is a significant regulatory action under Executive Order 12866.

The Regulatory Flexibility Act (RFA) requires regulatory agencies to consider a rule's economic impact on small entities. Under the RFA, MSHA must use the Small Business Administration's (SBA's) criterion for a small entity in determining a rule's economic impact unless, after consultation with the SBA Office of Advocacy, MSHA establishes an alternative definition for a small mine and publishes that definition in the Federal Register for notice and comment. For the mining industry, SBA defines "small" as a mine with 500 or fewer workers. MSHA traditionally has considered small mines to be those with fewer than 20 workers. To ensure that the final rule conforms with the RFA, MSHA has analyzed the economic impact of the final rule on mines with 500 or fewer workers (as well as on those with fewer than 20 workers).

Using SBA's definition of a small mine, which is one employing 500 or fewer workers, the estimated cost of the final rule on small underground M/NM mines would be about $21.8 million. This estimated cost for these small underground M/NM mines, using SBA's criteria, is equal to about 0.8 percent of their estimated annual revenues of approximately $2.7 billion. MSHA has determined that the final rule would not have a significant economic impact on these small mines, when considered as a group.

However, MSHA has determined that the final rule would have a significant economic impact on a subset of small underground M/NM mines, using SBA's definition: those with fewer than 20 workers (which the Agency has traditionally defined as small mines). This subset of affected mines constitutes a substantial number of small entities. For small underground M/NM mines which employ fewer than 20 workers, the estimated cost of the final rule would be about $4.1 million. This estimated cost for these small mines, based on MSHA's traditional definition, is equal to about 2.2 percent of their estimated annual revenues of approximately $189.3 million. The economic impact on these small mines is larger than one percent of revenues, and is therefore economically significant. The Agency has prepared a final regulatory flexibility analysis, as required by law, which explains the steps MSHA has taken to minimize the burden on these small entities and justifies the costs placed on them.

Consistent with SBREFA, the Agency has attempted to minimize the compliance burden on small mines. The Agency plans to provide extensive compliance assistance to the mining community. MSHA intends to focus these efforts on smaller metal and nonmetal operators, including training them to measure DPM concentrations and providing technical assistance on available controls. The Agency will also issue a compliance guide, continue its current efforts to disseminate educational materials and software, and hold workshops to inform the mining community.

MSHA's regulatory flexibility certification and final regulatory flexibility analysis are presented in Chapter V of this REA.

II. INDUSTRY PROFILE

This industry profile provides background information about the structure and economic characteristics of the mining industry. It provides data on the number of mines, their size, the number of employees, and the diesel powered equipment used.

THE STRUCTURE OF THE METAL/NONMETAL MINING INDUSTRY

MSHA divides the mining industry into two major segments based on commodity: (1) coal mines and (2) metal and nonmetal (M/NM) mines. These segments are further divided based on type of operation (e.g., underground mines or surface mines). MSHA maintains its own data on mine type, size, and employment, and the Agency also collects data on the number of independent contractors and contractor employees by major industry segment.

MSHA categorizes mines by size based on employment. For the past 20 years, for rulemaking purposes, MSHA has consistently defined a small mine to be one that employs fewer than 20 workers and a large mine to be one that employs 20 or more workers. To comply with the requirements of the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the Regulatory Flexibility Act (RFA), however, an agency must use the Small Business Administration's (SBA's) criteria for a small entity—for mining, 500 or fewer employees—when determining a rule's economic impact.

Table II-1 presents the total number of small and large mines and the corresponding number of miners, excluding contractors, for the M/NM mining segment. The M/NM mining segment consists of metal mines (copper, iron ore, gold, silver, etc.) and nonmetal mines (stone including granite, limestone, dolomite, sandstone, slate, and marble; sand and gravel; and others such as clays, potash, soda ash, salt, talc, and pyrophyllite.) As Table II-1 indicates, 98 percent of all M/NM mines are surface mines, and these mines employ some 90 percent of all M/NM miners, excluding office workers. Table II-2 presents corresponding data on the number of independent contractors and their employees working in the M/NM mining segment.

TABLE II-1: Distribution of M/NM Mine Operations and Employment (Excluding Contractors) by Mine Type and Size[a]

Size of M/NM Mine[b]		Mine Type			
		Underground	Surface	Office Workers	Total M/NM
Fewer Than 20 Employees	Mines	134	9,635	-	9,769
	Employees	1,054	54,356	9,160	64,570
20 to 500 Employees	Mines	124	1,419	-	1,543
	Employees	11,299	79,675	15,040	106,014
Over 500 Employees	Mines	7	18	-	25
	Employees	4,594	16,836	3,543	24,973
All M/NM Mines	Mines	265	11,072	-	11,337
	Employees	16,947	150,867	27,743	195,557

[a] Source: U.S. Department of Labor, Mine Safety and Health Administration, Office of Standards, Regulations, and Variances based on 1998 MS data, CM441/CM935LA cycle 1998/198. Data for Total Office workers from Mine Injury and Worktime Quarterly (1997 Closeout Edition) Table 2, p. 6.

[b] Based on MSHA's traditional definition, large mines include all mines with 20 or more employees. Based on SBA's definition, as required by SBREFA, large mines include only mines with over 500 employees.

TABLE II-2: Distribution of M/NM Contractors and Contractor Employment by Size of Operation[a]

Size of Contractor[b]		Contractors			
		Underground	Surface	Office Workers	Total
Fewer Than 20 Employees	Mines	399	2,783	-	3,182
	Employees	1,717	14,155	649	16,521
20 to 500 Employees	Mines	36	349	-	384
	Employees	1,639	17,979	802	20,420
Over 500 Employees	Mines	-	3	-	3
	Employees	-	2,560	105	2,665
Total Contractors	Mines	434	3 135	-	3,569
	Employees	3,356	34,694	1,556	39,606

[a] Source: U.S. Department of Labor, Mine Safety and Health Administration, Office of Standards, Regulations, and Variances based on 1998 MS data, CT441/CT935LA cycle 1998/198. Data for Total Office workers from Mine Injury and Worktime Quarterly (1998 Closeout Edition) Table 6, p. 21.

[b] Based on MSHA's traditional definition, large mines include all mines with 20 or more employees. Based on SBA's definition, as required by SBREFA, large mines include only mines with over 500 employees.

The M/NM mining sector consists of about 80 different commodities including industrial minerals. There were 11,337 M/NM mines in the U.S. in 1998, of which 9,769 (86%) were small mines and 1,568 (14%) were large mines, using MSHA's traditional definition of small and large mines. Based on SBA's definition, however, only 25 M/NM mines (0.2%) were large mines.[2]

[2] U.S. Department of Labor, MSHA, 1998 Final MIS data CM441 cycle 1998/198.

The data in Table II-1 indicate that employment at M/NM mines in 1998 was 195,557, of which 64,570 workers (33%) were employed by small mines and 130,987 miners (67%) were employed by large mines, using MSHA's definition. Based on SBA's definition, however, 170,584 workers (87%) were employed by small mines and 24,973 workers (13%) were employed by large mines. Using MSHA's definition, the average employment is 7 workers at a small M/NM mine and 84 workers at a large M/NM mine.[3] Using SBA's definition, there are an average of 15 workers in each small M/NM mine and 888 workers in each large M/NM mine.

Metal Mining

There are about 24 metal commodities mined in the U.S. Underground metal mines use a few basic mining methods, such as room and pillar and block caving. The larger mines rely more heavily on hydraulic drills and track-mounted haulage, and the smaller underground metal mines rely more heavily on hand-held pneumatic drills.

Surface metal mines normally include drilling, blasting, and hauling; such processes are typical in all surface mines, irrespective of commodity types. Surface metal mines in the U.S. rank among some of the largest mines in the world.

Metal mines constitute 3 percent of all M/NM mines and employ 23 percent of all M/NM miners. Under MSHA's traditional definition of a small mine, 45 percent of metal mines are small, and these mines employ 2 percent of all miners working in metal mines. Using SBA's definition, 94 percent of metal mines are small, and they employ 53 percent of all miners working in metal mines.[4]

Stone Mining

In the stone mining subsector, there are eight different stone commodities, of which seven are further classified as either dimension stone or crushed and broken stone. Stone mining in the U.S. is predominantly by quarrying, with only a few slight variations. Crushed stone mines typically drill and blast, while dimension stone mines generally use channel burners, drills, or wire saws. Diesel powered-haulage is used to transfer the broken rock from the quarry to the mill where crushing and sizing are done.

Stone mines constitute 33 percent of all M/NM mines, and they employ 41 percent of all M/NM miners. Using MSHA's definition of a small mine, 71 percent of stone mines are small, and these mines employ 29 percent of all miners working in stone mines. Using SBA's definition, 99.9 percent of stone mines are small, and they employ 99 percent of all miners working in stone mines.[5]

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[3] U.S. Department of Labor, MSHA, 1998 Final MIS data CM441 cycle 1998/198.

[4] U.S. Department of Labor, Mine Safety and Health Administration, Office of Program Policy Evaluation, Mine Employment Size-Average Employment 1998.

[5] U.S. Department of Labor, Mine Safety and Health Administration, Office of Program Policy Evaluation, Mine Employment Size-Average Employment 1998.

Sand & Gravel Mining

Sand and gravel, for construction, is generally extracted from surface deposits using dredges or draglines. Further preparation involves washing and screening. As in other surface mining operations, sand and gravel uses diesel-driven machines, such as front-end loaders, trucks, and bulldozers, for haulage. The preparation of industrial sand and silica flour involves the use of crushers, ball mills, vibrating screens, and classifiers.

The sand and gravel subsector represents the single largest commodity group in the U.S. mining industry when the number of mining operations is being considered. Sand and gravel mines comprise 57 percent of all M/NM mines, and they employ 22 percent of all M/NM miners. Using MSHA's definition of a small mine, 95 percent of sand and gravel mines are small, and these mines employ 76 percent of all miners working in sand and gravel mines. Using SBA's definition, almost 100 percent of sand and gravel mines are small, and they employ approximately 42,800 miners.[6]

Other Nonmetal Mining

For enforcement and statistical purposes, MSHA separates stone and sand and gravel mining from other nonmetal mining. There are about 35 other nonmetal commodities, not including stone, and sand and gravel. Nonmetal mining uses a wide variety of underground mining methods such as continuous mining (similar to coal mining), in-situ retorting, block caving, and room and pillar. The mining method is dependent on the geologic characteristics of the ore and host rock. Some nonmetal operations use kilns and dryers in ore processing. Ore crushing and milling are processes common to both nonmetal and metal mining.

As with underground mining, there is a wide range of mining methods utilized in extracting minerals by surface mining. In addition to drilling and blasting, other mining methods, such as evaporation and dredging, are also utilized, depending on the ore formation.

"Other" nonmetal mines comprise 7 percent of all M/NM mines, and they employ 14 percent of all M/NM miners. Using MSHA's definition of a small mine, 66 percent of other nonmetal mines are small, and they employ 12 percent of all miners working in these nonmetal mines. Using SBA's definition, 99 percent of other nonmetal mines are small, and they employ 92 percent of all miners working in these nonmetal mines.[7]

[6] U.S. Department of Labor, Mine Safety and Health Administration, Office of Program Policy Evaluation, Mine Employment Size-Average Employment 1998.

[7] U.S. Department of Labor, Mine Safety and Health Administration, Office of Program Policy Evaluation, Mine Employment Size-Average Employment 1998.

ECONOMIC CHARACTERISTICS OF THE METAL/NONMETAL MINING INDUSTRY

The value of all M/NM mining output in 1998 was estimated at $40 billion.[8] Metal mines, which include copper, gold, iron, lead, silver, tin, and zinc mines, contributed $17.8 billion. Nonmetal production was valued at $22.2 billion: $9.0 billion from stone mining, $5.2 billion from sand and gravel, and $8 billion from other nonmetals such as potash, clay, and salt.

The end uses of M/NM mining output are diverse. For example, iron and aluminum are used to produce vehicles and other heavy duty equipment, as well as consumer goods such as household equipment and soft drink cans. Other metals, such as uranium and titanium, have more limited uses. Nonmetals, like cement, are used in construction while salt is used as a food additive and for road deicing in the winter. Soda ash, phosphate rock, and potash also have a wide variety of commercial uses. Stone and sand and gravel are used in numerous industries and extensively in the construction industry.

A detailed economic picture of the M/NM mining industry is difficult to develop because most mines are either privately held corporations or sole proprietorships, or subsidiaries of publicly owned companies. Privately held corporations and sole proprietorships are not required to make their financial data available to the public. Parent companies are not required to separate financial data for subsidiaries in their reports to the Securities and Exchange Commission. As a result, financial data are available for only a few M/NM companies, and these data are not representative of the entire industry.

UNDERGROUND METAL/NONMETAL MINES THAT USE DIESEL POWERED EQUIPMENT

The Metal/Nonmetal Mine DPM Rule applies only to underground M/NM mines that use diesel powered equipment. Because most M/NM mines do not have the risk of explosion due to methane gas that is present in coal mines, the adoption of diesel power for equipment has been unimpeded. Thus the rule covers most underground M/NM mines. Most of the exceptions are small mines with fewer than 20 employees.

MSHA conducted a census of underground metal/non-metal mines to identify the number of diesel powered machines used in these mines. MSHA inspectors collected data from a total of 203 mines. They reported a total of 4,081 pieces of diesel equipment and 18,922 employees.

A few of the mines in the data base were designated as non-producing. In developing this industry profile, therefore MSHA consulted the district offices to determine which mines were not operating. MSHA then removed these mines from the data base. This adjustment reduced the number of underground M/NM mines to 196. These mines reported 3,998 pieces of diesel equipment and 18,702 employees.

[8] U.S. Department of Energy, Energy Information Administration, Annual Energy Review 1998, July 1999, pp. 3, 6, 142, 144, 158, and 160.

The adjusted data from this census, which are the basis for the analysis of this rule, are shown in Table II-3. Of the 196 mines, seven are large by SBA's definition (500 or more employees), and 77 are small by MSHA's definition (fewer than 20 employees). Overall, about 74 percent[9] of underground M/NM mines use diesel equipment, but the proportion declines as mine size decreases. Of mines with 20 to 499 employees, 90 percent use diesel equipment, but only 57 percent of mines with fewer than 20 employees do.

TABLE II-3: Underground Metal/Nonmetal Mines and Miners Using Diesel Powered Equipment, by Mine Size Class

	Size of Mine					
	Fewer Than 20 Miners		20 to 500 Miners		More Than 500 Miners	
	Mines	Miners	Mines	Miners	Mines	Miners
Number	77	811	112	11,360	7	6,531
Percentage of All Underground M/NM Mines and Miners[b] in Size Class	57%	77%	90%	[a]	100%	[a]
Percentage of All Underground M/NM Mines and Miners With Diesel Equipment	39%	4%	57%	61%	4%	35%

[a] MSHA's census data indicate more mines and miners in this size class than does MSHA's industry database.

[b] Data on all underground M/NM mines taken from Table II-1.

Table II-4 shows the number and size distribution of underground M/NM mines for different commodity groups.[10] These groupings differ according to the way the commodity lies in the ground and in the mining techniques used. The size distribution of mines reflects these underlying differences:

[9] Since the data for all underground M/NM mines and underground M/NM mines using diesel equipment came from different sources, these percentages may not be completely accurate. Nevertheless the differences in data sources should make little difference for comparisons between mine size classes.

[10] These groups closely approximate those suggested by Head in his comments on the proposed rule. (See H. John Head, "Review of Economic and Technical Feasibility of Compliance Issues Related to: Department of Labor – MSHA 30 CFR Part 57 – Proposed Rule for Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners," report prepared under contract with the National Mining Association, July 21, 1999.)

- Stone mines[11] have a broad size distribution, although a majority of underground stone mines (56 percent) have fewer than 20 employees.

- Precious metals mines[12] also have a broad size distribution, but fewer (only one third) have fewer than 20 employees.

- Other metals mines[13] tend to be relatively large. Only about one in eight underground base metal mines has fewer than 20 employees.

- Evaporates mines[14] as a class are the largest of all. None of this group has fewer than 20 employees.

- Other mines[15] are extremely small; all but one have fewer than 20 employees.

[11] This group includes granite, lime, limestone, marble, and sandstone mines.

[12] This group includes gold, platinum, and silver.

[13] This group includes copper, iron ore, lead/zinc, molybdenum, uranium, and zinc.

[14] This group includes gypsum, potash, salt, and trona.

[15] This group includes borate, calcite, clay, gemstones, perlite, sand (industrial), shale, and talc.

TABLE II-4: Underground Metal/Non-Metal Mines Using Diesel Powered Equipment by Commodity Group and Size Class

Commodity Group	Size of Mine			Total
	Fewer Than 20 Miners	20 to 499 Miners	500 or More Miners	
Stone[a]	54	42	1	97
Precious Metals[b]	10	19	2	31
Other Metals[c]	4	25	2	31
Evaporates[d]	-	25	2	27
Other[e]	9	1	-	10
TOTAL	77	112	7	196

[a] Includes Granite (1), Lime (4), Limestone (84), Marble (7), and Sandstone (1).

[b] Includes Gold (28),Platinum (1), and Silver (2).

[c] Includes Copper (8), Iron Ore (1), Lead/Zinc (8), Molybdenum (2), Uranium (2), and Zinc (10).

[d] Includes Gypsum (6), Potash (3), Salt (12), and Trona (6).

[e] Includes Borate (1), Calcite (1), Clay (1), Gemstones (1), Perlite (1), Sand-Industrial (1), Shale (3), and Talc (1).

INVENTORY OF DIESEL POWERED EQUIPMENT

MSHA Census Data

For purposes of analysis of costs, diesel powered equipment in underground metal/non-metal mines is classified into two principal types:

- **Production Equipment.** Production equipment is characterized by relatively continuously operation under heavy engine load. Haul trucks, loaders, and jumbo drills are examples of production equipment. Production equipment uses diesel engines with a wide range of horsepower. Accordingly, for DPM control and costing purposes, MSHA has divided production engines into two size classes:
  - Greater than 150 horsepower, and
  - 150 horsepower or less.

- **Support Equipment.** Support equipment is characterized by intermittent (and typically infrequent) operation, usually under relatively light engine load. Types of support equipment include roof bolters, anfo trucks, water trucks, personnel transport, and maintenance vehicles.

Table II-5 summarizes diesel powered equipment by type of equipment category, mine size class, and commodity being mined.

TABLE II-5: Number of Diesel Engines in Underground M/NM Mines by Mine Size Class, Commodity Group, and Equipment Type

Commodity Group	Type/hp of Equipment	Size of Mine			Total
		< 20 Miners	20-499 Miners	≥ 500 Miners	
Stone	Product. >150 hp	234	358	16	608
	Product. ≤150 hp	26	40	1	67
	Support	237	321	23	581
	TOTAL	497	719	40	1,256
Gold	Product. >150 hp	4	125	48	177
	Product. ≤150 hp	12	110	51	173
	Support	8	223	161	392
	TOTAL	24	458	260	742
Base Metal	Product. >150 hp	14	257	30	301
	Product. ≤150 hp	4	71	49	124
	Support	25	416	138	579
	TOTAL	43	744	217	1,004
Evaporates	Product. >150 hp	-	130	3	133
	Product. ≤150 hp	-	114	23	137
	Support	-	528	160	688
	TOTAL	-	772	186	958
Other	Product. >150 hp	11	-	-	11
	Product. ≤150 hp	7	15	-	22
	Support	2	-	-	2
	TOTAL	20	15	-	35
TOTAL	Product. >150 hp	263	870	97	1,230
	Product. ≤150 hp	49	350	124	523
	Support	272	1,491	482	2,245
	TOTAL	584	2,711	703	3,998

Production equipment with large diesel engines (over 150 hp) makes up 31 percent of diesel powered equipment in underground M/NM mines. Production equipment with large diesel engines is a larger proportion (45 percent of all diesel equipment) in mines with fewer than 20 employees and a smaller proportion (14 percent) in mines with over 500 employees. By commodity group, the largest proportions of diesel engines in large-engine production equipment are in stone (48 percent), and the smallest proportions are in evaporates (14 percent).

Production equipment with small diesel engines (150 hp or less) makes up 13 percent of diesel powered equipment in underground M/NM mines. The proportion of all diesel engines represented by these engines is smaller (8 percent) in mines with fewer than 20 employees and larger (18 percent) in mines with over 500 employees. By commodity group, production equipment with small diesel engines is the highest proportion of all diesel engines in other mines (63 percent) and gold mines (22 percent); they make up the smallest proportion in stone (5 percent).

Support equipment makes up a majority (56 percent) of all diesel powered equipment in underground M/NM mines. Support equipment is a smaller proportion (47 percent) of all diesel equipment in mines with fewer than 20 employees and a larger proportion (69 percent) in mines with over 500 employees. By commodity group, support equipment makes up the highest proportion of diesel equipment for evaporates (72 percent) and the smallest proportion for "other" (6 percent) and stone (46 percent).

Data from Comments

Comments on the proposed rule included results from a survey of M/NM mines.[16] The results include an extrapolated industry estimate of 6,666 pieces of diesel powered equipment? two thirds more machines than found in MSHA's census. MSHA has reviewed Head's survey instrument and results, MSHA has concluded that the apparent discrepancy stems from differences in the questions asked and thus in the extent of coverage in the equipment. In particular:

- MSHA asked explicitly about the number of pieces equipment actually in use.

- Head asked a broader question that encompassed all of the diesel powered equipment in a mine.

Mines do not use all the diesel powered equipment that they possess on any given day. The difference between the equipment actually used to operate a mine and the total amount of equipment in a mine is accounted for by two classes of back-up equipment:

[16] H. John Head, "Review of Economic and Technical Feasibility of Compliance Issues Related to: Department of Labor – MSHA 30 CFR Part 57 – Proposed Rule for Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners," report prepared under contract with the National Mining Association, July 21, 1999.

- Spare equipment represents a reserve that may be used if the front-line equipment breaks down or is out of service for planned major maintenance. Such equipment may be older and/or less productive than regularly used equipment, or it may be similar but simply not needed on any given production day. Spare equipment requires DPM emission controls only to the extent that it is actually used, and costs can be minimized by appropriate fleet management.

- Disused equipment is older equipment that will not be used in production. It may be used as collateral for loans, it may be a source of spare parts, or it may remain in a mine simply because nobody has bothered to remove it. Mine operators will not bother to put controls on disused equipment.

In order to estimate the proportion of spares that a mine is likely to need, MSHA reviewed and analyzed the ventilation plans of a sample of M/NM mines. This analysis suggested that a factor of about one third was a reasonable allowance for spares and that additional equipment was likely to be disused. Similar numbers are also obtained by a rough rule of thumb? splitting the difference between MSHA's count and Head's estimate. Thus MSHA's analysis of costs adopts the assumption that an additional 1,333 pieces of diesel equipment are operated as spares in underground M/NM mines, and this spare equipment needs to be appropriately equipped with DPM controls.

III. BENEFITS

INTRODUCTION

MSHA's DPM rule for M/NM mines will reduce a significant health risk to underground miners. The benefits of reducing this risk include a reduction in the incidence of illness and premature death, as well as a reduction in the attendant costs to the miners' employers, their families, and society at large.

MSHA estimates that approximately 18,700 miners who work in underground M/NM mines are exposed to diesel emissions[17] and thus are affected by this rule. Of these 18,700 miners, MSHA estimates that approximately 9,400 work in underground areas and that, among these, approximately 60 percent? or 5,611? work in production or development areas, including haulageways, like those for which MSHA has collected measurements of DPM concentration.

The risks that are addressed by this rule arise because underground miners who work with diesel powered equipment are exposed to extremely high concentrations of the very small particles produced by engines that burn diesel fuel. Diesel engines have the advantages of providing excellent mobility and a full range of power for all types of equipment, while avoiding the explosive hazards associated with gasoline. Underground mines are confined spaces, however. Despite ventilation requirements, they can accumulate significant concentrations of particles and gases? both those produced by the mine itself (e.g., methane gas and mine dust liberated by mining operations) and those produced by equipment used in the mine (i.e., DPM and exhaust gases).

It is widely recognized that respirable particles can create adverse health effects. Environmental regulations in effect for some years already restrict the exposure of the general public to particles less than 10 microns in diameter. Moreover, as discussed in part III of the preamble, evidence collected in recent years indicates that much of the health hazard is due to the smallest particles. Since airborne particles less than 2.5 microns in diameter have specifically been identified as posing significant health problems, further environmental restrictions have recently been established to limit public exposure to particles of this size range? a size range that includes DPM. These restrictions are in addition to a series of regulations issued over the years (and not yet entirely in effect) by the Environmental Protection Agency to directly limit the particulate output of new diesel engines.

Similarly, the need to control worker exposure to respirable dusts has long been recognized, and controls have been implemented. While exposure of working miners to certain other respirable dusts (e.g., silica) is controlled, there are no current restrictions specifically on occupational exposure to DPM. Moreover, EPA's rules limiting the particulate output of new diesel engines offer little prospect of immediate help, since the mining industry has a fleet of engines that largely predate these rules, and EPA's rules do not directly apply to engines used underground.

[17] See Table II-1 and Table II-3 in Chapter II of this REA.

In evaluating the health risks that underground miners currently face (and thus the potential benefits of controlling that risk), it is particularly significant to note that the exposures of underground miners constitute a special and exceptional class. Among all groups in the U.S. work force and population at large, underground miners are exposed to by far the highest levels of DPM. Based on MSHA field studies, which are discussed in part III of the preamble and summarized in Table III-1 of the preamble, median DPM concentrations observed for underground miners range up to 200 times as high as average environmental exposures in the most heavily polluted urban areas and up to 10 times as high as median exposures estimated for the most heavily exposed workers in other occupational groups.

SPECIFIC BENEFITS OF THE RULE

Overview

As described in detail in MSHA's risk analysis (part III of the preamble), the available scientific information indicates that miners exposed to the extremely high DPM concentrations found in underground mines are at significant excess risk of experiencing three kinds of material impairment to their health:

- Increased risk of lung cancer has been linked to chronic occupational DPM exposure. Although the scientific community has not established a definitive dose-response relationship for DPM and lung cancer, the existence of a relationship is being recognized:
    - NIOSH has concluded that miners are at an elevated risk of contracting lung cancer as a result of the very high exposures of this population to DPM.
    - NIOSH has also reaffirmed its 1988 recommendation that whole diesel exhaust be regarded as a "potential occupational carcinogen," and that reductions in workplace exposure be implemented to reduce cancer risks.
    - The International Agency for Research on Cancer declared that "diesel engine exhaust is probably carcinogenic to humans…"
    - In 1995, the American Conference of Governmental Industrial Hygienists (ACGIH) added diesel particulate matter to its "Notice of Intended Changes" for 1995-1996, recommending a threshold limit value (TLV^R) for a conventional 8 hour work day of 150 micrograms per cubic meter of air.
    - In 1999, ACGIH revised its notice to recommend a 50 micrograms/m^3 limit.
    - Germany already regulates exposure to diesel particulate, and Canada is looking closely at the problem.

- Increased acute risk of death from cardiovascular, cardiopulmonary, or respiratory causes has been linked to short or long term exposures to fine particulates, such as DPM.

- Sensory irritations and respiratory symptoms can result from even short term DPM exposures. These include:
    - Eye, nose, and throat irritations,

- Reduced lung function,
- Headaches, nausea, and/or vomiting, and
- Chest tightness and wheeze.

Besides being potentially debilitating, such effects can distract miners from their responsibilities in ways that could pose safety hazards for everyone in the mine.

Currently available scientific evidence may not be sufficient to generate definitive dose-response estimates for exposure to DPM. MSHA believes, however, that evidence of adverse health effects arising from such exposure is strong and that reducing miners' exposure to DPM will reduce the number of sensory irritations and respiratory symptoms; reduce the number of deaths due to cardiovascular, cardiopulmonary, or respiratory causes; and reduce the number of lung cancers.

Lung Cancer Risk Reduction

Estimation Models. Estimates of the exposure-response relationship have been made for lung cancer using both data on miner exposures and other data. The different estimates, however, entail considerable uncertainty, as they vary considerably with different model specifications. The best available data for estimation of the benefits of DPM controls in mines are studies by Johnston,[18] Säverin,[19] and Steenland.[20] All the estimates based on these studies are extrapolations well outside of the range of data on which the models are estimated. These studies, and the resulting estimates, are described in greater detail in part III of the preamble. The salient points of the studies for benefit estimation can be summarized as follows:

- Johnston's estimates are based on a cohort study of coal miners in mines that did and did not use diesel powered equipment. In the Johnston models, cumulative DPM exposure is lagged by 15 years to reflect the long latency period of lung cancer. Johnston estimated the exposure-response relationship using two model structures:
  - A "mine-unadjusted" model used only cumulative DPM exposure and miner characteristics as explanatory variables for lung cancer.
  - A "mine-adjusted" model also identified the specific mines as explanatory variables.

- Säverin's estimates are based on a cohort study of potash miners, with comparisons to lung cancer rates in the general population. Säverin used two data sets:
  - The full cohort of underground miners, and
  - A subcohort of miners who had worked underground, in relatively stable jobs, for at least 10 years.

- Säverin also used two statistical specifications for his models:

[18] Johnston, et al., 1997.

[19] Säverin, et al., 1999.

[20] Steenland, et al., 1998.

- A Poisson model specification, and
- A Cox model specification.

- Steenland's estimates are based on a study of exposures in the trucking industry. Steenland used two lag structures:
  - An unlagged model specification, and
  - A model specification with cumulative DPM exposure lagged by 5 years.

- Steenland also used two statistical specifications for his models:
  - A logistic model specification using a linear cumulative dose term, and
  - A logistic model specification using the logarithm of cumulative exposure.

The fact that Steenland's data involved DPM exposures very much lower than those found in mines raises considerable uncertainty about the applicability of the results to mines. To apply the model to underground mines requires extrapolation far outside the range of exposures on which the model was estimated, which is a problematic procedure. The fact that the linear and logarithmic specifications yield very different results highlights the uncertainties involved in such extrapolation. Nevertheless, the results do fall just outside the range of estimates from the other models, and the two specifications bracket most of the other estimates rather symmetrically. Thus, while Steenland's results probably should not be given much weight as estimates for underground mining environments under current conditions, they do generally corroborate the estimates of models based on underground mine data.

Risk Reduction Estimates. Table III-1 summarizes the exposure-response relationships from the various models estimated in these three studies. These results are presented in the form of an excess lifetime risk from a cumulative occupational exposure over a working life. That is, the occupational DPM exposure is assumed to be cumulative over 45 years (beginning at age 20), and the excess risk of dying from lung cancer (i.e., risk above that of an occupationally unexposed worker) is accumulated from age 20 through age 85? a span of 65 years. Table III-1 presents the excess risk per 1,000 occupationally exposed workers at two points along the exposure-response function estimated by each model:

- Lifetime exposure to DPM at a concentration of 808 micrograms/m^3 (the average current level measured by MSHA in underground production and development areas), and

- Lifetime exposure to DPM at a concentration of 200 micrograms/m^3 (the maximum level estimated by MSHA under the rule).

Table III-1 also shows the reduction in excess risk (as estimated by each model) that would result from lowering the lifetime DPM exposure rate from 808 micrograms/m^3 to 200 micrograms/m^3. The estimates of lifetime excess lung cancer rates shown in Table III-1 fall into several rather distinct groups:

- Säverin's full cohort Poisson model and both of Steenland's logarithmic models estimate:

- Relatively low[21] current excess lung cancer risks (83 to 103 per 1,000 affected[22] miners),
- Relatively low excess lung cancer risks with the rule (15 to 68 per 1,000), and
- Relatively small reductions in risk (34 to 68 per 1,000).

[21] These estimates are low relative to other estimates for underground M/NM mines. All of these risks are extremely large relative to any other occupational group than underground miners or any other rule on DPM.

[22] The affected miners are underground miners at mines using diesel equipment, who are occupationally exposed to DPM for 45 years at a mean concentration of 808 microegrams/m^3.

Table III-1: Estimates of Lifetime Excess Risk of Lung Cancer Death at Current and Controlled DPM Concentrations in Underground M/NM Mines

Study	Model		Estimate of Lifetime Excess Lung Cancer Deaths per 1,000 Occupationally Exposed Workers[a]		
	Data and Structure	Specification	Current[b]	With Rule[c]	Change
Johnston	Mine-unadjusted		830	513	317
	Mine-adjusted		800	313	487
Säverin	Full Cohort	Poisson	83	15	68
		Cox	577	71	506
	Subcohort	Poisson	693	94	599
		Cox	802	182	620
Steenland	Unlagged	Simple Cumulative Exposure	779	145	634
		Log of Cumulative Exposure	103	68	35
	5-Yr. Lag	Simple Cumulative Exposure	771	159	612
		Log of Cumulative Exposure	101	67	34
Averages	Median	All Studies	693	145	548
		Mines Only	693	182	511
	Mean	All Studies	554	162	392
		Mines Only	631	198	433

[a] Source: Preamble Table III-7. Assumes 45-year occupational exposure from age 20 to retirement at age 65. Lifetime risk of lung cancer adjusted for competing risk of death from other causes and calculated through age 85.

[b] Average measurement of 808 miligrams/m^3 DPM.

[c] Estimated at 200 miligrams/m^3 DPM.

- Säverin's full cohort Cox model estimates:
  - A medium (relative to other estimates) current excess lung cancer risk (577 per 1,000 affected miners),
  - A low excess lung cancer risk with the rule (71 per 1,000), and
  - A medium reduction in risk (506 per 1,000).

- Both of Johnston's models estimate:
  - High current excess lung cancer risks (800 to 830 per 1,000 affected miners),
  - High excess lung cancer risks with the rule (313 to 513 per 1,000), and
  - Medium reductions in risk (317 to 487 per 1,000).

- Both of Säverin's subcohort models and both of Steenland's linear models estimate:
  - High current excess lung cancer risks (693 to 802 per 1,000 affected miners),
  - Low to medium excess lung cancer risks with the rule (94 to 182 per 1,000), and
  - Large reductions in risk (599 to 634 per 1,000).

Several considerations appear to be germane for assessment of this range of estimates of excess risk and risk reduction:

- Since they are restricted to miners with relatively stable job histories, Säverin's subcohort data may provide a more accurate representation of long-term cumulative exposure to DPM than Säverin's full cohort. Therefore, the subcohort estimates should probably be credited more than the full cohort estimates.

- Because of the long latency period of cancer, the lagged specification used in Johnston's models appears preferable to an unlagged specification.

As previously noted, all of the estimates of the benefits of DPM controls in mines are based on extrapolations well outside of the range of data on miner exposures on which the various models were estimated. As a result, these estimates are subject to a high degree of uncertainty, which suggests that they be treated with caution. For that reason, we propose using the lower-range of the estimates, rather than the middle-range of the estimates, to represent the range in which the exposure-response relationship actually lies.

Benefit Estimates. Since exposure data were collected in production and development areas of M/NM mines, the number of M/NM miners in underground mines that work in such areas (5,611) appears to be a reasonably conservative number[23] on which to base an estimate of the benefits of the rule. The total number of miners who regularly work underground in these mines (9,400) is an upper-bound estimate. Table III-2 summarizes the benefits estimated over three different time frames:

[23] Using 5,611 as the number of miners who benefit from the rule assumes zero benefits related to lung cancer for the 3,789 other M/NM miners that work in underground areas of mines, as well as an additional 8,300 M/NM miners who have some exposure to DPM.

- Lifetime benefits for the population of miners currently working;

- One-year benefits for a population of miners working at any one time; and

- Average annual benefits over the long run, as the population of miners turns over because of new hires and retirement.

The estimated benefits of the rule in terms of lung cancers avoided over the lifetimes of these miners are as follows:

- Benefits probably fall within the range of 1,779 to 3,361[24] lifetime excess lung cancers avoided.

- A point estimate, based on mean values of the risk reduction estimates, is 2,200[25] lifetime excess lung cancers avoided.

- A possible lower bound, based on Säverin (full cohort, Poisson) is 382[26] lifetime excess lung cancers avoided.

- A possible upper bound, based on Säverin (subcohort, Cox) and all underground coal miners exposed to DPM is 5,828[27] lifetime excess lung cancers avoided.

[24] 1,779 lifetime cases = (317 cases/1,000 miners) x (5,611 miners); 3,361 lifetime cases = (599 cases/1,000 miners) x (5,611 miners)

[25] 2,200 lifetime cases = (392 cases/1,000 miners) x (5,611 miners)

[26] 382 lifetime cases = (68 cases/1,000 miners) x (5,611 miners)

[27] 5,828 lifetime cases = (620 cases/1,000 miners) x (9,400 miners)

Table III-2: Lung Cancer Reduction Benefits of Rule

Range	Study	Time Frame	Miners	Reduction per 1,000	Total Reduction
Upper Bound	Säverin, subcohort Cox	Lifetime[a]	9,400	620	5,828
		One-Year[b]			90
		Long-Run Annual[c]			130
Middle Range	Säverin, subcohort Poisson	Lifetime[a]	5,611	599	3,361
		One-Year[b]			52
		Long-Run Annual[c]			75
	Säverin, full cohort Cox	Lifetime[a]	5,611	506	2,839
		One-Year[b]			44
		Long-Run Annual[c]			63
	Johnston, mine-adjusted	Lifetime[a]	5,611	487	2,733
		One-Year[b]			42
		Long-Run Annual[c]			61
	Mean, all studies	Lifetime[a]	5,611	392	2,200
		One-Year[b]			34
		Long-Run Annual[c]			49
	Johnston, mine-unadjusted	Lifetime[a]	5,611	317	1,779
		One-Year[b]			27
		Long-Run Annual[c]			40
Lower Bound	Säverin, full cohort Poisson	Lifetime[a]	5,611	68	382
		One-Year[b]			5.9
		Long-Run Annual[c]			8.5

[a] Source: Table III-1

[b] Lifetime value divided by 65.

[c] Lifetime value divided by 45.

The lifetime risk is measured over 65 years (ages 20 through 85). The lifetime benefits summarized above can also be expressed as average one-year benefits over the lifetimes of a cohort of miners of all ages who worked in the mines at any one time. The estimated benefits of the rule in terms of lung cancers avoided in any one year for such a cohort of 5,611 miners are as follows:

- One-year benefits probably fall within the range of 27 to 52[28] excess lung cancers avoided.
- A point estimate of one-year risk, based on mean values of the risk reduction estimates, is 34[29] excess lung cancers avoided.
- A possible lower bound for one-year risk, based on Säverin (full cohort, Poisson) is 5.9[30] excess lung cancers avoided.
- A possible upper bound, based on Säverin (subcohort, Cox) and all underground M/NM miners exposed to DPM is 90[31] excess lung cancers avoided.

In the long run the average annual reduction becomes considerably larger, because each 45-year time span of exposure includes not only lung cancers experienced by miners who are currently working miners, but also lung cancers experienced by older generations of miners who retired over the previous 20 years. As the cumulative benefits to successive generations of miners build up, the estimates of annual benefits will approach (and in 65 years are estimated to reach) the following steady-state values:

- Long-run annual benefits probably fall in the range of 40 to 75[32] lung cancers avoided.
- A point estimate for long-run annual benefits is 49[33] lung cancers avoided.
- A possible lower bound for long-run annual benefits is 8.5[34] lung cancers avoided.
- A possible upper bound for long-run annual benefits is 130[35] lung cancers avoided.

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[28] 27 one-year cases = (317 lifetime cases/1,000 miners) x (5,611 miners) / (65 years); 52 one-year cases = (599 lifetime cases/1,000 miners) x (5,611 miners) / (65 years)

[29] 34 one-year cases = (392 lifetime cases/1,000 miners) x (5,611 miners) / (65 years)

[30] 5.9 one-year cases = (68 lifetime cases/1,000 miners) x (5,611 miners) / (65 years)

[31] 90 one-year cases = (620 lifetime cases/1,000 miners) x (9,400 miners) / (65 years)

[32] 40 cases = (317 lifetime cases/1,000 miners) x (5,611 miners) / (45 years); 75 cases = (599 lifetime cases/1,000 miners) x (5,611 miners) / (45 years)

[33] 49 cases = (392 lifetime cases/1,000 miners) x (5,611 miners) / (45 years)

[34] 8.5 cases = (68 lifetime cases/1,000 miners) x (5,611 miners) / (45 years)

[35] 130 cases = (620 lifetime cases/1,000 miners) x (9,400 miners) / (45 years)

Because lung cancer associated with DPM typically arises from cumulative exposure and after some latency period, the health benefits of reduced incidence of lung cancer will not materialize until some years after implementation of the rule. The yearly reduction in excess lung cancer deaths due to reduced exposure to DPM can be expected to build up gradually, depending on the historical cumulative exposure to DPM among the veteran workforce. Since the average latency period for lung cancer is about 20 years, the full level of even the initial benefit associated with a DPM concentration of 200 microgram/m^3 may not be seen before then.

Reduction of Acute Health Risks

Estimation Procedures. Unlike the case of lung cancer, acute health risks of DPM have not been isolated in studies of occupational exposure-response rates of DPM. Instead, the best available studies have examined exposure-response rates of these effects to ambient levels (i.e. 24-hour exposures) of fine (less than 2.5 micron) particulate matter? $PM_{2.5}$. Applying these results to risks from M/NM mine exposure to DPM, therefore, requires making several assumptions that are discussed below. These assumptions reveal the uncertainties involved in attempting to estimate benefits of the rule associated with reducing acute effects of DPM exposure.

- **An 8-hour exposure to an extra 3 micrograms/m^3 of $PM_{2.5}$ poses the same risks as a 24-hour exposure to an extra 1 microgram/m^3 of $PM_{2.5}$.** This assumption implies that a 24-hour time-weighted average (TWA_{24}) poses the same risk regardless of how the exposure is distributed over time. That is, a three-fold change in concentration is offset by a an opposite three-fold change in length of exposure. This assumption is probably conservative in the sense that miners are likely to inhale more than one third as much during an 8-hour shift, when they are actively working, as during a 24-hour day, which includes sleeping. However, there is considerable uncertainty about the relative risks of acute effects in the two exposure patterns. It is not well understood whether DPM exposures at higher concentrations for shorter periods of time (with respite periods) or exposures at lower concentrations for longer periods of time (possibly more than 24 hours) pose different risks of acute effects and? if so? which exposure pattern poses the greater risk.

- **Exposure to any level of DPM poses at least as great a risk as exposure to a comparable level of $PM_{2.5}$.** This assumption is plausible in the sense that almost all DPM is also $PM_{2.5}$, and the ambient dust studies found no acute risks associated with high concentrations of larger particulate matter. Nevertheless, the constituent elements of the $PM_{2.5}$ in the study are not known, and they could include some rather harmful pollutants. There are clearly substantial uncertainties in assuming that size of particulate matter alone is responsible for specific acute health risks.

- **The population of miners is at the same general level of risk as the population as a whole exposed to $PM_{2.5}$ in the studies.** This assumption is particularly problematic, since acute risks are likely to be exacerbated in populations that are already vulnerable because of health conditions. The population of miners has different demographic and health characteristics than the study populations. Miners who smoke tobacco and/or suffer from various respiratory ailments (which many miners do) fall into groups identified as likely to be especially sensitive to $PM_{2.5}$ and related acute mortality risks. Nevertheless, the general population almost certainly contains persons who are more vulnerable than any miner. The proportions of miners who are especially sensitive to the acute risks of DPM or $PM_{2.5,}$ as well as the degree of their sensitivity, are largely unknown. Thus there are substantial uncertainties in extrapolating from studies of the general population to risks of miners.

While these assumptions allow studies based on ambient $PM_{2.5}$ exposure to be used to estimate risks from occupational DPM exposure, the results are fraught with uncertainties. Moreover, the results of the studies are in the form of relative risk? excess risk as a percent of baseline risk? and they have not been converted to a form that measures numbers of cases avoided. To offset these uncertainties, MSHA has used the lower end of the 95-percent confidence interval as a lower-bound estimate of the risk reduction that may result from the rule.

The methodology used to estimate acute risks is similar to that used for lung cancer. It involves measuring the relative risk at measured DPM concentrations and at DPM concentrations projected under the rule. The reduction in relative risks is attributed to the rule. Because of the uncertainties in interpreting the relative risk functions that are implicit in the assumptions described above, however, MSHA does not consider the results to be reliable quantitative estimates of benefits of the rule to which any great confidence of precision can be ascribed.

Death from Cardiovascular, Cardiopulmonary, or Respiratory Causes. In an analysis of mortality rates associated with $PM_{2.5,}$ Schwartz[36] estimated associations between $PM_{2.5}$ and risks of death from ischemic heart disease[37] (IHD), chronic obstructive pulmonary disease[38] (COPD), and pneumonia.[39] Using the estimated mean reduction in DPM concentration[40] and a 3:1 adjustment factor for the difference in length of exposure[41] with the lower bound values of these relative risks produces estimates of risk reduction equivalent to:

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[36] Schwartz, et al.

[37] Schwartz found a 2.1 percent increase in mortality from IHD associated with each increment of 10 micrograms/m^3 in the daily concentration of $PM_{2.5}$. The lower 95 percent confidence interval bound of was 1.4 percent, yielding an incremental relative risk factor of 1.014.

[38] Schwartz found a 3.3 percent increase in mortality from CPHD associated with each increment of 10 micrograms/m^3 in the daily concentration of $PM_{2.5}$. The lower 95 percent confidence interval bound of was 1.0 percent, yielding an incremental relative risk factor of 1.01.

[39] Schwartz found a 4.0 percent increase in mortality from pneumonia associated with each increment of 10 micrograms/m^3 in the daily concentration of $PM_{2.5}$. The lower 95 percent confidence interval bound of was 1.8 percent, yielding an incremental relative risk factor of 1.018.

[40] A reduction of 608 micrograms/m^3 in the concentration of DPM. This full reduction in DPM concentration is applicable only to the 5,750 miners who work in mines that use permissible diesel face equipment.

- About one third of the baseline mortality rate[42] for IHD;
- About one fifth of the baseline mortality rate[43] for COPD; and
- Nearly half of the baseline mortality rate[44] for pneumonia.

Sensory Irritation and Respiratory Symptoms. The sensory irritation and respiratory symptoms caused by DPM at concentration levels found in underground are clear to casual observation. The estimated association between $PM_{2.5}$ and acute lower respiratory symptoms varies widely.[45] Using the estimated mean reduction in DPM concentration and a 3:1 adjustment factor for the difference in length of exposure with the lower bound values of these relative risks produces estimates of risk reduction equivalent to more than three times[46] the baseline rate.

Summary

Benefits of the rule include reductions in lung cancers. In the long run, as the mining population turns over, MSHA estimates that a minimum of 8.5 lung cancer deaths will be avoided per year.[47]

Benefits of the rule will also include reductions in the risk of death from cardiovascular, cardiopulmonary, or respiratory causes and reductions in the risk of sensory irritation and respiratory symptoms. However, MSHA has not included these health benefits in its estimates because the Agency cannot currently make reliable or precise quantitative estimates of them. Nevertheless, the expected reductions in the risk of death from cardiovascular, cardiopulmonary, or respiratory causes and the expected reductions in the risk of sensory irritation and respiratory symptoms are likely to be substantial.

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[41] By assumption (since they both result in the same reduction in TWA_{24}), a reduction in an 8-hour exposure of 30 micrograms/m^3 is equivalent to a reduction in a 24-hour exposure of 10 micrograms/m^3.

[42] $0.32 = (1.014)^{(608/30)} - 1$

[43] $0.22 = (1.01)^{(608/30)} - 1$

[44] $0.44 = (1.018)^{(608/30)} - 1$

[45] An increase of between 15 percent and 82 percent in acute lower respiratory symptoms was associated with each incremental increase of 20 micrograms/m^3 in 24-hour concentration of $PM_{2.5}$ in the ambient air (assumed equivalent to an increase of 60 micrograms/m^3 in 8-hour concentrations in mines). The lower bound of risk yields an incremental relative risk factor of 1.15.

[46] $3.12 = (1.15)^{(608/60)} - 1$

[47] This lower bound figure could significantly underestimate the magnitude of the health benefits. For example the estimate based on the mean value of all the studies examined is 49 lung cancer deaths avoided per year.

IV. COMPLIANCE COSTS

This chapter analyzes compliance costs for the underground metal/non-metal mining industry as a whole. Impacts for large and small underground metal/non-metal mines will be addressed in Chapter V.

LIMITS ON CONCENTRATION OF DIESEL PARTICULATE MATTER

Compliance Strategy

Comments. Comments made in response to the PREA indicated that, for a variety of reasons, MSHA had substantially understated the costs of controlling DPM. The most comprehensive comments along these lines were by Head.[48] Among his comments, Head argued that:

- MSHA had understated the number of diesel units in underground M/NM mines by more than 50 percent;
- MSHA had understated the cost of replacement engines by up to one third and had omitted entirely additional installation costs that ran as high as three times MSHA's cost estimate for engines;
- MSHA had understated costs of filters on larger engines by 20 percent;
- MSHA had understated costs of vehicle cabs by about 60 percent; and
- MSHA had understated the number of ventilation upgrades by 20 percent to 40 percent and had entirely omitted major ventilation improvements needed by about one third of the mines.

Based on his own numbers, Head estimated compliance costs to be three times as high as MSHA's estimate in the PREA.

The issue of the number of diesel units was addressed in Chapter II. Other issues raised by Head will be addressed in specific situations below. A key factor associated with the much higher costs estimated by Head, however, was an issue on which Head meticulously conformed to MSHA's numbers but not MSHA's conceptual approach. MSHA's toolbox approach entails selecting the least-cost combination of measures to achieve compliance. If the relative prices of different measures change, the least-cost combination of control measures will change

[48] H. John Head, "Review of Economic and Technical Feasibility of Compliance Issues Related to: Department of Labor—MSHA, 30 CFR Part 57—Proposed Rule for Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners," Report prepared under contract with the National Mining Association, July 21, 1999.

correspondingly. Although Head's estimates of relative costs of various compliance measures differed sharply from MSHA's estimates, he nevertheless exactly replicated MSHA's assumptions about how many pieces of each kind of diesel equipment would be controlled, how they would be controlled, and the sequence in which controls would be used. By failing to use the toolbox strategy and adjust the combination of control measures to optimize their mix with respect to his different relative costs, therefore, Head based his total cost estimates on an inefficient and artificial high-cost mix of compliance measures. Consequently, Heads total costs were seriously overstated.

Concentration Limits and the Toolbox. This standard for underground M/NM mines is a performance standard, with an interim total carbon (TC) concentration limit of 400_{TC} micrograms/m^3, followed by a final concentration limit of 160_{TC} micrograms/m^3.[49] The rule encourages mine operators to use any combination of a "toolbox" of measures to meet these concentration limits. For cost estimation purposes, however, MSHA assumed a specific set and sequence of control measures. Specifically, MSHA assumed that:

- The interim standard would be met by replacing engines, installing oxidation catalytic converters, and improving ventilation; and

- The final standard would be met by adding cabs and filters.

Both the general strategy and the specific proportions of diesel powered equipment to be controlled by each measure were based on an optimizing approach, in which the most cost-effective additional measures were selected for additional DPM reductions at each stage.

MSHA agrees with the major thrust of Head's comments as they pertain to the relative costs of control measures. Substantially the most important of Head's changes is to make filters much cheaper relative to engine replacement. At the same time, data collected by MSHA since publication of the PREA indicate that filters are more effective than was previously understood. This finding has further enhanced the cost-effectiveness of filters relative to engine replacement.

These changes in information have caused MSHA to go back to the toolbox and rethink the optimized compliance strategy. The revised compliance strategy, upon which MSHA bases the revised estimates of compliance costs, reverses the two most widely used measures from the toolbox. MSHA now anticipates that:

- The interim standard of 400_{TC} micrograms/m^3 will be met with filters, cabs, and ventilation; and

- The final standard of 160_{TC} micrograms/m^3 will be met with more filters, ventilation, and such turnover in equipment and engines as will have occurred in the baseline.

[49] 400_{TC} micrograms/m^3 and 160_{TC} micrograms/m^3 are equivalent to 500 micrograms/m^3 DPM and 200 micrograms/m^3 DPM, respectively.

This new approach uses the same toolbox and optimization strategy that was used in the PREA. Since relative costs are different, however, the tools used and costs estimated are quite different than those in the PREA.

Ceramic Filters

Unit Cost of Ceramic Filters. MSHA's estimates of costs for controlling DPM emissions with ceramic filters[50] are based on the following data and assumptions:

- **Installation Cost of Ceramic Filters.** MSHA estimates, based on its current knowledge of prices manufacturers of aftertreatment devices have charged, that the initial cost of installing these devices? and the replacement cost? will be:
  - $5,000 for a ceramic filter for an engine of 150 hp or less,[51] and
  - $12,500 for a ceramic filter for an engine of more than 150 hp.[52]

- **Production Days and Shifts.** MSHA estimates that underground M/NM mines will operate an average of 300 production days per year. Table IV-1 shows the mean shifts and hours per shift, which were computed using data from MSHA's census. These data indicate that:
  - Large mines operate an average of 2.5 shifts per day for 24 hours per day;
  - Medium sized mines operate an average of 1.9 shifts per day for an average of 17.3 hours per day, and
  - Small mines operate an average of 1.2 shifts per day for an average of 10.7 hours per day.

[50] The term "ceramic" is used generally to indicate a filter capable of operating with high temperature exhaust regardless of the actual filter material utilized.

[51] This includes all support equipment as well as less powerful production equipment.

[52] The cost estimate in the PREA was $10,000. MSHA has increased this cost estimate following comments by Head that the very large engines found in M/NM mines would require more expensive filters.

Table IV-1: Parameters for Replacement and Regeneration of Ceramic Filters on Diesel Powered Equipment in Metal/Nonmetal Mines

		Mine Employment Size Class		
		Fewer Than 20	20 to 500	Over 500
Production Days/Year		300	300	300
Production Shifts and Hours	Average Shifts/Day	1.2	1.9	2.5
	Average Hours/Day	10.7	17.3	24.0
Useful Life of Filter Until Replacement[a]	Production Equipment	30 Months	18 Months	1 Year
	Support Equipment	5 Years	3 Years	2 Years
Filter Regenerations per Year[b]	Production Equipment	150	300	300
	Support Equipment	75	150	150

[a] Based on 7,200 hours prior to replacement for large mines; 7,785 hours prior to replacement for medium-sized mines; and 8,025 hours prior to replacement for small mines.

[b] Based on up to 25 hours of operation between regenerations.

- **Equipment Operation.** MSHA estimates that:
  - Production equipment operates for all of the production hours in each shift, and
  - Support equipment operates for half of the production hours in each shift.[53]

- **Frequency of Filter Replacement.** Based on MSHA's experience and information from filter manufacturers and other sources, MSHA estimates that a ceramic filter has a useful life of at least 8,000 hours of operation.[54] Based on the mean annual production hours shown in Table IV-1, MSHA estimates conservatively that:

[53] No one duty cycle characterizes support equipment. Some support equipment (e.g., personnel carriers) operates every day, but only briefly during a shift. Other support equipment (e.g., bulldozers and road graders) operates more hours per shift but not every day. Yet other support equipment (e.g., a crane) may operate only a few minutes at a time and perhaps only once or twice a week. Some support equipment (e.g., scalers and roof bolters) may operate daily for most of a shift, but with engines of much lower horsepower than production equipment.

[54] MSHA based its estimate of the life of a ceramic filter on three sources:

- Ceramic filters in large underground metal/non-metal mines will be replaced:
  - Annually for engines on production equipment, and
  - Every two years for engines on support equipment;
- Ceramic filters in medium sized mines will be replaced:
  - Every 18 months for engines on production equipment, and
  - Every three years for engines on support equipment; and
- Ceramic filters in small mines will be replaced
  - Every 30 months for engines on production equipment, and
  - Every five years for engines on support equipment;

- **Amortization.** MSHA amortizes costs using an annual discount rate of 7.0 percent.

- **Regeneration.** Ceramic filters will need to be maintained by being regenerated, so that they do not become clogged.[55] MSHA bases regeneration costs on the following assumptions:
  - The cost of the equipment used for regeneration is included in the costs of the installation package for the filter.
  - MSHA estimates that the process of dismounting the filter to regenerate and remounting the filter after regeneration? or alternatively, to attach power cables for on-board regeneration? will take no more than 15 minutes for a miner, whose hourly wage is $19.42.
  - Ceramic filters will need to be regenerated at least once every 25 hours of operation. For small and medium sized mines, this can be done while the equipment is not in use between shifts. Large mines all have spare equipment which is rotated; filters can be regenerated when the equipment is not in use. Based on the hours of operation shown in Table IV-1, MSHA estimates that ceramic filters will be regenerated:
    - Daily for engines on production equipment in large and medium sized mines (300 times per year),
    - Every other day for engines on support equipment in large and medium sized mines (150 times per year),

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1) An operation and maintenance guide prepared by DCL Incorporated (ca. 1994) for their MINE-X soot filters states that MINE-X soot filters are at work with over 11,000 hours of service and still counting.

2) A presentation of a technical paper by Bekaert/Typos included information showing that their filters have been at work for more than 10,000 hours (Willy Marrecau and Peter Klaus, "Diesel Wire Mesh Particulate Filter," Paper presented at the Mining Diesel Emission Conference, Toronto, Canada, November 3 & 4, 1999, TS3*6.4).

3) A presentation of a second technical paper found that most filters would (by time of the presentation) have been in use for 2,000 to 5,000 operating hours, and some are known to have been in use for more than 8,000 operating hours (Bernard Kahlert, "First Use of Additive-Regenerated Diesel Particulate Filter in German Mines," Paper presented at the Mining Diesel Emission Conference, Toronto, Canada, November 3 & 4, 1999, TS2*6.3).

[55] Ceramic filters on some hard-working equipment, such as LHDs and haulage trucks, will regenerate from the heat of the exhaust gas. No separate regeneration will be required for such equipment. In the interest of conservative cost analysis, however, MSHA is assuming that all equipment with hot gas filters will require regeneration that imposes costs on mine operators.

- Every other day for engines on production equipment in small mines (150 times per year), and
- Every four days for engines on support equipment in small mines (75 times per year).

For comparison with other costs and for purposes of estimating impacts of the regulation, the costs need to be annualized, or put on a yearly basis.[56] If costs are incurred annually to begin with, they need not be adjusted. If non-annual costs are incurred at the time of the publication of the rule, they need to be annualized.[57] If a cost is incurred after the publication date of the rule but not annually, it needs to be discounted to the publication date[58] and then annualized. Thus the yearly costs of filter installation are computed as follows:

- For active production equipment in large mines, the installation cost is annual and needs no adjustment.

- For active support equipment in large mines, filter replacement (in the first ten years) occurs after 2 years, 4 years, 6 years, and 8 years. Thus the appropriate annualization factor is 0.553091787.[59]

- For active production equipment in medium sized mines, filter replacement (in the first 10 years) occurs after 18 months, 3 years, 54 months, 6 years, 90 months, and 9 years). Thus the appropriate annualization factor is 0.750275254.[60]

- For active support equipment in medium sized mines, filter replacement (in the first 10 years) occurs after, 3 years, 6 years, and 9 years). Thus the appropriate annualization factor is 0.430916026.[61]

- For active production equipment in small mines, filter replacement (in the first 10 years) occurs after 30 months, 5 years, and 90 months. Thus the appropriate annualization factor is 0.44982836.[62]

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[56] For clarity, MSHA uses the term "annual" to refer to repeated costs that are incurred every year; MSHA uses the term "annualized" to refer to the annual equivalent of initial costs or other costs that are incurred less often than every year; and MSHA uses the term "yearly" to refer to the sum (or other combination) of annual and annualized costs.

[57] For example, the factor for annualizing over 10 years at an annual discount rate of 7.0 percent is:

$$0.142377503 = 0.07/(1-(1/1.07)^{10}).$$

[58] At a 7.0 percent annual discount rate, for example, the discount factor for a cost 5 years after the effective date is: $0.712986179 = 1/(1.07)^5$.

[59] $0.553091787 = [(1) + (1/(1.07)^2) + (1/(1.07)^4) + (1/(1.07)^6) + (1/(1.07)^8)] * [0.07/(1-(1/1.07)^{10})]$

[60] $0.750275254 =$

$$[(1)+(1/(1.07)^{1.5})+(1/(1.07)^3)+(1/(1.07)^{4.5})+(1/(1.07)^6)+(1/(1.07)^{7.5})+(1/(1.07)^9)] * [0.07/(1-(1/1.07)^{10})]$$

[61] $0.430916026 = [(1) + (1/(1.07)^3) + (1/(1.07)^6) + (1/(1.07)^9)] * [0.07/(1-(1/1.07)^{10})]$

[62] $0.44982836 = [(1) + (1/(1.07)^{2.5}) + (1/(1.07)^5) + (1/(1.07)^{7.5})] * [0.07/(1-(1/1.07)\text{^}10)]$

- For active support equipment in small mines, filter replacement (in the first 10 years) occurs after 5 years. Thus the appropriate annualization factor is 0.243890694.[63]

Table IV-2 summarizes MSHA's estimates of yearly compliance costs per filtered piece of diesel powered equipment, based on these parameters. The estimated yearly unit costs of ceramic filter installation will be as follows:

- The yearly cost for installation of a ceramic filter for an engine with over 150 hp in a piece of production equipment will be:
  - $12,500 in a large underground metal/non-metal mine,
  - $9,378 in a medium sized mine, and
  - $5,623 in a small mine.

- The yearly cost for installation of a ceramic filter for an engine with 150 hp or less in a piece of production equipment will be:
  - $5,000 in a large underground metal/non-metal mine,
  - $3,751 in a medium sized mine, and
  - $2,249 in a small mine.

- The yearly cost for installation of a ceramic filter for an engine in a piece of support equipment will be:
  - $2,765 in a large underground metal/non-metal mine,
  - $2,155 in a medium sized mine, and
  - $1,219 in a small mine.

[63] 0.243890694 = [(1) + (1/(1.07)^5)] * [0.07/(1-(1/1.07)^10)]

Table IV-2: Unit Costs of Ceramic Filters in M/NM Mines

		Mine Employment Size Class		
		Less Than 20	20 to 500	Over 500
Initial Filter Installation Cost	Production (> 150 hp)	$12,500	$12,500	$12,500
	Production (≤ 150 hp)	$ 5,000	$ 5,000	$ 5,000
	Support	$ 5,000	$ 5,000	$ 5,000
Yearly Cost of Ceramic Filter Installation[a]	Production (> 150 hp)	$ 5,623	$ 9,378	$12,500
	Production (≤ 150 hp)	$ 2,249	$ 3,751	$ 5,000
	Support	$ 1,219	$ 2,155	$ 2,765
	Spare >150hp	$ 1,780	$ 1,780	$ 1,780
	Spare ≤150hp	$ 712	$ 712	$ 712
Annual Regeneration (Maintenance) Cost of Ceramic Filters[b]	Production (> 150 hp)	$ 728	$ 1,456	$ 1,456
	Production (≤ 150 hp)	$ 728	$ 1,456	$ 1,456
	Support	$ 364	$ 728	$ 728
Total Yearly Unit Cost of Ceramic Filters[c]	Production (> 150 hp)	$ 6,351	$10,835	$13,956
	Production (≤ 150 hp)	$ 2,977	$ 5,208	$ 6,457
	Support	$ 1,583	$ 2,883	$ 3,494
	Spare >150hp	$ 1,780	$ 1,780	$ 1,780
	Spare ≤150hp	$ 712	$ 712	$ 712

[a] Includes costs of all replacements during the 10 years after publication of the rule, discounted at a discount rate of 7.0 percent.

[b] Based on labor costs of $4.85 per regeneration.

[c] May not precisely equal the sum of yearly cost of installation and annual regeneration cost due to rounding.

The cost of regenerating a filter will be the labor cost of $4.85.[64] Based on the estimates of frequency of regeneration stated above, the estimated annual costs of filter regeneration will be:

- $1,456 annually for each filtered piece of diesel production equipment in a large or medium sized mine;[65]

- $728 annually for each filtered piece of diesel support equipment in a large or medium sized mine and each filtered piece of diesel production equipment in a small mine;[66]

- $364 annually for each filtered piece of diesel support equipment in a small mine.[67]

Combining installation and regeneration costs, MSHA's estimates of the total yearly unit cost of ceramic filters are as follows:

- Total yearly cost of a ceramic filter on an engine with over 150 hp on a piece of production equipment will be:
  - $13,956 in a large underground M/NM mine,
  - $10,835 in a medium sized mine, and
  - $6,351 in a small mine.

- Total yearly cost of a ceramic filter on an engine with 150 hp or less on a piece of production equipment will be:
  - $6,457 in a large underground M/NM mine,
  - $5,208 in a medium sized mine, and
  - $2,977 in a small mine.

- Total yearly cost of a ceramic filter on an engine on a piece of support equipment will be
  - $3,494 in a large underground M/NM mine,
  - $2,883 in a medium sized mine, and
  - $1,583 in a small mine.

Purchase and Replacement of Ceramic Filters. The previous discussion assumed that the equipment being filtered is actively used equipment. The inventory profile (in Chapter II of this REA), however, identified three categories of diesel equipment, based on use patterns. Each category of equipment[68] has different implications for compliance costs:

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[64] $4.85 = (0.25 hours/regeneration) x ($19.42/hour).

[65] $1,456/year = (300 regenerations/year) x (0.25 hours/regeneration) x ($19.42/hour).

[66] $728/year = (150 regenerations/year) x (0.25 hours/regeneration) x ($19.42/hour).

[67] $364/year = (75 regenerations/year) x (0.25 hours/regeneration) x ($19.42/hour).

[68] In practice, there may be no way of telling whether a particular piece of equipment is active or spare, and a given machine may change from one of these categories to the other. It is a useful simplification (and equivalent

- Equipment that is used for production on any given day (active equipment) must have a ceramic filter installed. Because the equipment is used, the filter must be regenerated (maintained), and it must be replaced at the end of its useful life.

- Equipment that is not used for production on a given day but is held in reserve (spare equipment) must have the fittings for a ceramic filter and a filter must be on the equipment (or at least available), but unless the equipment is actually used, the filter need not be regenerated at the end of the shift(s) or replaced.[69]

- Equipment that is no longer used at all (disused equipment) does not need a filter or fittings.

Because of these differences, MSHA's cost estimates are based on the following assumptions about numbers of filters:

- Initial installation costs are based on the total number of active and spare pieces of diesel equipment. This assumption means that spare equipment will be fitted for a filter and that (at any given time) it will have a filter or there will be spare filters available.[70]

- Filter replacement costs and filter regeneration costs are based on the number of active pieces of equipment only, as well as on the number of hours of production in a working day.

Spare equipment, therefore, entails only the cost of initial installation of a filter, which is amortized over 10 years. Thus yearly costs of equipping spare equipment with filters are:

- $712[71] for equipment with engines of 150 hp or less, and

- $1,780[72] for production equipment with engines of over 150 hp.

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for cost estimation purposes), however, to think of one set of machines as "active" and another set of machines as only "spares." Disused equipment, of course, does consist of a distinct set of machines.

[69] In other words, the filters on all equipment (both front-line and spares) will have to be regenerated and eventually replaced *only* to the extent that that piece of equipment is actually used. Note that the actual number of filter regenerations and replacements is determined solely by the average number of pieces of equipment actually operated, regardless of the number of spares (equipped with filters) available or the frequency with which the spares are used. The number of available spares and the frequency with which they are used, however, does determine the proportions of filter regenerations and filter changes that occur on front-line equipment and on spare equipment.

[70] In practice, a mine operator could remove a filter from a piece of active equipment that goes out of service and put it on the piece of spare equipment that replaces it. It would be administratively simpler and is more conservative for cost estimation purposes, however, to assume that spare filters are already on the spare equipment. Whether the spare filters are on the spare equipment or stored elsewhere will not make a difference to the rate at which a mine operator replaces filters.

[71] $711.89 = $5,000 x 0.142377503

[72] $1,779.72 = $12,500 x 0.142377503

Cost estimates for filters on spare equipment are also shown in Table IV-2.

The patterns of purchase and replacement can be illustrated by a numerical example of a mine with 20 pieces of diesel powered production equipment? 15 active and 5 spare.[73] The initial installation, regeneration, and replacement for each size class of mine[74] will be as follows:

- For every 15 active and 5 spare pieces of diesel production equipment, a large mine will initially install filters on all 20 diesel powered machines. The mine will regenerate 15 filters each day (after 24 hours of use) and replace 15 filters each year (since filters have an expected life of one year).

- For every 15 active and 5 spare pieces of diesel production equipment, a medium sized mine will initially install filters on all 20 diesel powered machines. The mine will regenerate 15 filters each day (after 17 hours of use) and replace 10 filters each year (since filters have an expected life of 18 months).

- For every 15 active and 5 spare pieces of diesel production equipment, a small mine will initially install filters on all 20 diesel powered machines. The mine will regenerate 15 filters every two days (after 21 hours of use) and replace 6 filters each year (since filters have an expected useful life of 30 months).

This possibility of equipping spare machines at a relatively modest cost without incurring further costs if the machines are not used is a further cost advantage of ceramic filters relative to engine replacement or cabs.

Cabs

Comments. In the PREA, MSHA estimated the cost of installed cabs on diesel equipment to be $7,500. Head revised the cost estimate upward to $20,000. In response to Head's comment, MSHA called several manufacturers to confirm our cab cost estimate and concluded that the original estimate of $7,500 is appropriate. Costs of retrofitting cabs do vary a great deal, but Head's costs are seriously flawed because of his failure to take account of the optimizing process used in MSHA's cost estimate.

A great deal of diesel equipment that is sold without cabs is designed with a cab as an option. In such a case, the design of the equipment and the availability of equipment to make a cab makes retrofitting a relatively simple and inexpensive operation. Companies that make such equipment generally retain the ability to manufacture cabs until roughly eight years after the

[73] MSHA estimated one spare piece of diesel equipment for every three active pieces of diesel equipment. (See Chapter II of this REA.) Disused equipment does not involve costs and is therefore ignored for the remainder of the discussion.

[74] Obviously, larger mines will tend to have more pieces of diesel powered equipment. In this illustration, however, the same number of machines is used for each size class in order to clarify the differences in replacement and regeneration.

equipment model has gone out of production. MSHA has confirmed that its estimate is appropriate for equipment of this nature and age.

Where equipment was never designed to have a cab, or where equipment has been out of production for a decade or more, the cost of retrofitting a cab is much higher. The cost that Head cited is probably appropriate for such equipment. Indeed, it appears that Head assumed this situation in making his cost revisions.

In its optimizing procedure of the PREA, MSHA assumed that only 20 percent of diesel equipment would be retrofitted with a cab. Implicit in this estimate is the assumption that mine operators would chose to retrofit cabs on equipment for which this measure was cost-effective, rather than start with the equipment that was extremely expensive to retrofit. Moreover, since the 160_{TC} micrograms/m^3 concentration limit will not take effect until five years after publication of the rule, as much as 50 percent of the diesel powered equipment will consist of new machines that can be purchased with cabs, rather than retrofitted. MSHA believes, therefore, that it is reasonable to use an estimate of $7,500 for a cab, rather than Head's much higher cost.

Unit Cost of Cabs. MSHA's estimate of costs for controlling miner exposure to DPM emissions by retrofitting equipment with cabs is based on the following data and assumptions:

- **Initial Installation Cost.** MSHA estimates that the initial cost of retrofitting cabs on equipment with large or small engines will be $7,500.

- **Useful Life of Cabs.** MSHA estimates that the useful life of a cab is 10 years.

- **Maintenance.** MSHA estimates that maintenance of cabs will result in an annual cost equal to 10 percent of the initial cost of the cab, or $750 per year.

- **Amortization.** MSHA amortizes costs using an annual discount rate of 7.0 percent.

For comparison with other costs and for purposes of estimating impacts of the regulation, MSHA has annualized the cost of installing a cab. Using a ten-year annualization factor, MSHA estimates that the annualized cost of retrofitting a cab on diesel equipment is $1,068.[75] Including the annual maintenance cost ($750), the estimated yearly unit cost of a cab is $1,818.

Ventilation Upgrades

Comments. In the PREA, MSHA estimated that 41 underground metal/non-metal mines would need a new fan for ventilation and 117 mines would need a larger fan motor to increase ventilation capacity. In his comments, Head estimated that 77 mines would need a new fan and 98 mines would need a larger fan motor. Head also estimated that 63 mines would need major improvements related to ventilation, which he estimated would cost an average of $300,000 per mine.

[75] $1,068 = $7,500 x 0.142377503.

Head apparently failed to understand the basis on which MSHA's estimates were based. He made the point that "many mines cannot increase airflow simply by installing a new fan motor on an existing fan or by replacing the existing mine fan with a new one" and added that "to assume that all mines can substantially increase airflow by adding a new fan motor or by replacing an existing fan with a larger one demonstrates MSHA lack of understanding of the individual nature of mine's [sic] ventilation systems."[76] Yet MSHA never made such an assumption. Head apparently assumes that all mines that could increase airflow with fans would do so (which accounts for much of his higher costs). MSHA did not make that assumption either.

What MSHA actually did was to base its estimates on ventilation data for each individual underground M/NM mine. Based on these data, MSHA estimated that mines with no mechanical ventilation would install new fan systems. Similarly, MSHA's estimate of the number of mines that would install a larger fan motor was based on data for mines with fan systems that indicated airflow rates of less than 100 cfm/hp. MSHA continues to believe that both the methodology and the resulting estimates are valid.

Head's comments about the need for major ventilation improvements is far more persuasive. MSHA did not include such costs. Upon further consideration, MSHA agrees that larger mines, which have multiple diesel powered machines in the same air stream, are likely to need such upgrades. Accordingly, MSHA will add Head's estimated major system improvement costs to its own estimated fan costs.

Unit Costs of Ventilation Upgrades. MSHA's estimate of costs for ventilation improvements are based on the following data and assumptions:

- **Initial Installation Cost.** MSHA estimates that the initial unit cost of mine ventilation improvements will be:
  - $230,000 for installation of a new fan system,
  - $21,000 for installation of a new fan motor,[77] and
  - $300,000 for other major system improvements indicated by Head.

- **Electricity.** Mines that install either a new fan system or just a new fan motor will incur additional electricity costs to power the new motor. MSHA estimates that these costs will average $21,000 per mine annually.

- **Useful Life.** MSHA estimates that ventilation improvements' useful life is 10 years.

- **Amortization.** MSHA amortizes costs using an annual discount rate of 7.0 percent.

Based on these estimates, the annualized unit cost (i.e., cost per mine) of these ventilation improvements is:

[76] Head, pp. 25, 32-33.

[77] Head accepted MSHA's cost estimates for new fans and new fan motors.

- $32,747 for installation of a new fan system;
- $2,990 for installation of a new fan motor;
- $21,000 for purchase of electricity to power a new fan system or new fan motor; and
- $42,713 for other major system improvements indicated by Head.

Engines

MSHA anticipates that new engines will play a significant role in reducing DPM emissions. Under the revised strategy, however, MSHA does not expect engine replacement to have cost impacts on mine operators. The reason for the lack of impacts is that a great deal of equipment replacement and engine replacement will take place in the baseline? (i.e., would have taken place without the regulation). An impact, by contrast, is a cost that would not have been incurred except to comply with the regulation.

MSHA's assumption is that the useful life of diesel powered equipment is 10 years. Head has disputed this assumption, suggesting that 20 years is more reasonable for large, powerful, durable, and expensive production equipment. Even if Head is right about such machines, however, MSHA believes that it is reasonable to assume that the useful life of engines in those machines is 10 years (i.e., two engines over Head's 20-year life of those machines). Under this assumption, 10 percent of engines (on average) will be replaced each year. Since the 160_{TC} micrograms/m^3 exposure limit will not be in force until five years after the publication date, 50 percent of diesel engines would have been replaced as part of routine equipment replacement and engine replacement in existing machines. This degree of engine replacement, given significant improvements in engine technology (see below) and the shift in "toolbox" strategy to more heavy reliance on ceramic filters, will be sufficient to meet the 160_{TC} micrograms/m^3 exposure limit, which becomes effective five years after the publication date.

Because of advances in engine technology, mine operators have major economic incentives to replace old engines with state-of-the art engines. This is particularly true of very large engines in the heaviest production equipment, since this is where advanced engine technology is concentrated. Because older high-horsepower engines are among the heaviest emitters of DPM, the percent of engines replaced will probably understate the impact on DPM emission reduction. Moreover, the fact that mine operators have strong economic incentives to replace engines, even in the absence of this regulation, underscores the fact that this engine replacement does not entail regulatory impacts.

Industry Costs of the 400_{TC} Micrograms/m^3 Concentration Limit (57.5060(a))

Ceramic Filters. MSHA estimates that M/NM mines will need to put ceramic filters on the following diesel powered equipment to meet the 400_{TC} micrograms/m^3 concentration limit:[78]

[78] These estimates reflect the earlier assumption that 10 percent of engines will be replaced each year. Therefore, at the time the 400_{TC} micrograms/m^3 concentration limit takes effect, 18 months after the publication

- Of production equipment with engines of over 150 hp, ceramic filters will be used on:
  - 75 percent of machines (73 machines) in mines with over 500 employees,
  - 75 percent of machines (653 machines) in mines with 20 to 500 employees, and
  - 50 percent of machines (132 machines) in mines with fewer than 20 employees.

- Of production equipment with engines of 150 hp or less, ceramic filters will be used on:
  - 75 percent of machines (93 machines) in mines with over 500 employees,
  - 75 percent of machines (263 machines) in mines with 20 to 500 employees, and
  - 50 percent of machines (25 machines) in mines with fewer than 20 employees.

- Of support equipment, ceramic filters will be used on:
  - 50 percent of machines (241 machines) in mines with over 500 employees,
  - 50 percent of machines (746 machines) in mines with 20 to 500 employees, and
  - 25 percent of machines (68 machines) in mines with fewer than 20 employees.

Table IV-3 shows the computations of estimated yearly costs for these ceramic filters. As of the effective date of Section 57.5060(a)? 18 months after publication of the rule? MSHA estimates that the total yearly costs will be:

- $2,582,996 for underground M/NM mines with over 500 employees;

- $11,222,652 for underground M/NM mines with 20 to 500 employees;

- $1,120,840 for underground M/NM mines with fewer than 20 employees; and

- $14,926,488 for all underground M/NM mines.

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date, 15 percent of the engines would already have been replaced. Note that ceramic filters will need to be placed on additional diesel powered equipment to meet the 160_{TC} micrograms/m^3 concentration limit.

Table IV-3: Yearly Industry Costs of Ceramic Filters to Comply With Section 57.5060(a)

Mine Employment Size Class	Category of Equipment	Number	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	Production (> 150 hp)	73	$13,956	$ 1,018,825
	Production (≤ 150 hp)	93	$ 6,457	$ 600,455
	Support	241	$ 3,494	$ 841,984
	Spare (> 150 hp)	24	$ 1,780	$ 42,713
	Spare (≤ 150 hp)	111	$ 712	$ 79,020
	TOTAL YEARLY COST			$ 2,582,996
20 to 500 Employees	Production (> 150 hp)	653	$10,835	$ 7,075,216
	Production (≤ 150 hp)	263	$ 5,208	$ 1,369,671
	Support	746	$ 2,883	$ 2,150,591
	Spare (> 150 hp)	218	$ 1,780	$ 387,979
	Spare (≤ 150 hp)	336	$ 712	$ 239,194
	TOTAL YEARLY COST			$11,222,652
Under 20 Employees	Production (> 150 hp)	132	$ 6,351	$ 838,346
	Production (≤ 150 hp)	25	$ 2,977	$ 74,435
	Support	68	$ 1,583	$ 107,683
	Spare (> 150 hp)	44	$ 1,780	$ 78,308
	Spare (≤ 150 hp)	31	$ 712	$ 22,069
	TOTAL YEARLY COST			$ 1,120,840
M/NM INDUSTRY TOTAL YEARLY COST				$14,926,488

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Cabs. In order to meet the 400_{TC} micrograms/m^3 concentration limit, MSHA estimates that M/NM mine operators will add cabs to 15 percent of diesel powered equipment, or 600 machines. Of these machines:

- 105 machines are in underground M/NM mines with over 500 employees;
- 407 machines are in underground M/NM mines with 20 to 500 employees; and
- 88 machines are in underground M/NM mines with fewer than 20 employees.

Table IV-4 shows the computations of estimated yearly costs for these cabs. As of the effective date of Section 57.5060(a)? 18 months after publication of the rule? MSHA estimates that the total yearly costs will be:

- $190,872 for underground M/NM mines with over 500 employees;
- $739,857 for underground M/NM mines with 20 to 500 employees;
- $159,969 for underground M/NM mines with fewer than 20 employees; and
- $1,090,699 for all underground M/NM mines.

Table IV-4: Yearly Industry Costs of Cabs to Comply with Section 57.5060(a)

Mine Employment Size Class	Category of Equipment	Number	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	Cabs	105	$ 1,818	$ 190,872
20 to 500 Employees	Cabs	407	$ 1,818	$ 739,857
Fewer Than 20 Employees	Cabs	88	$ 1,818	$ 159,969
M/NM INDUSTRY TOTAL YEARLY COST				$1,090,699

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Ventilation Improvements. In addition to these measures, MSHA assumes that half of the ventilation upgrades will be done in time to help meet the 400_{TC} micrograms/m^3 concentration limit, even though MSHA expects that most of these ventilation upgrades will not really be necessary until the 160_{TC} micrograms/m^3 concentration limit is in force. To avoid occasional feasibility issues with the 400_{TC} micrograms/m^3 concentration limit, MSHA assumes that half of these upgrades will be made 18 months after publication of the rule, rather than 5 years after publication. Thus MSHA assumes for costing purposes that at the time the 400_{TC} micrograms/m^3 concentration limit becomes effective, the following ventilation upgrades will have been made:

- Half of the 45 mines requiring a new fan system (22 mines) will install it, including:
  - 7 mines with 20 to 500 employees, and
  - 15 mines with fewer than 20 employees.

- Half of the 79 additional mines[79] requiring a new fan motor (39 mines) will install it, including:
  - 1 mine with over 500 employees,
  - 24 mines with 20 to 500 employees, and
  - 14 mines with fewer than 20 employees.

- Half of the 63 mines[80] requiring major ventilation upgrades (31 mines) will make them, including:

[79] The numbers of mines requiring new fan systems and new fan motors differs slightly from the estimates in the PREA because the population of underground M/NM mines has changed slightly. The new fan system required by 45 mines, of course, includes a new fan motor.

[80] The number 63 is taken from Head. MSHA assumes that mines with fewer than 20 employees will not need major ventilation upgrades because of their small physical size and the relatively small number of diesel powered machines in series in the same air stream. MSHA assumes that the mines with over 500 employees and the

- 2 mines with over 500 employees, and
- 29 mines with 20 to 500 employees.

Table IV-5 shows the computations of estimated yearly costs for these ventilation improvements. As of the effective date of Section 57.5060(a)? 18 months after publication of the rule? MSHA estimates that the total yearly costs will be:

- $109,416 for underground M/NM mines with over 500 employees;
- $2,190,670 for underground M/NM mines with 20 to 500 employees;
- $1,142,061 for underground M/NM mines with fewer than 20 employees; and
- $3,442,148 for all underground M/NM mines.

mines with 20 to 500 employees will need these upgrades in proportion to the total number of mines in these size classes (i.e., 4 mines with over 500 employees and 59 mines with 20 to 500 employees).

Table IV-5: Yearly Industry Costs of Ventilation System Upgrades for Section 57.5060(a)

Mine Employment Size Class	Category of Ventilation System Change	Number of Mines	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	New Fan Motor	1	$ 2,990	$ 2,990
	Electricity	1	$21,000	$ 21,000
	Major Upgrade	2	$42,713	$ 85,426
	TOTAL YEARLY COST			$ 109,416
20 to 500 Employees	New Fan System	7	$32,747	$ 229,228
	New Fan Motor	24	$ 2,990	$ 71,758
	Electricity	31	$21,000	$ 651,000
	Major Upgrade	29	$42,713	$ 1,238,684
	TOTAL YEARLY COST			$ 2,190,670
Fewer Than 20 Employees	New Fan System	15	$32,747	$ 491,202
	New Fan Motor	14	$ 2,990	$ 41,859
	Electricity	29	$21,000	$ 609,000
	TOTAL YEARLY COST			$ 1,142,061
M/NM INDUSTRY TOTAL YEARLY COST				$ 3,442,148

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Total Yearly Industry Costs. Table IV-6 shows total estimated yearly industry costs for these DPM controls. As of the effective date of Section 57.5060(a)? 18 months after publication of the rule? MSHA estimates that the total yearly costs will be:

- $2,883,284 for underground M/NM mines with over 500 employees;
- $14,153,179 for underground M/NM mines with 20 to 500 employees;
- $2,422,870 for underground M/NM mines with fewer than 20 employees; and
- $19,459,335 for all underground M/NM mines.

Table IV-6: Total Yearly M/NM Industry Cost of Section 57.5060(a)

Mine Size	Cost Element			All Costs[a]
	Filters	Cabs	Ventilation	
COST AS OF EFFECTIVE DATE OF SECTION 57.5060(a)				
Over 500 Employees	$ 2,582,996	$ 190,872	$ 109,416	$ 2,883,284
20 to 500 Employees	$11,222,652	$ 739,857	$ 2,190,670	$14,153,179
Under 20 Employees	$ 1,120,840	$ 159,969	$ 1,142,061	$ 2,422,870
ALL MINES[a]	$14,926,488	$1,090,699	$ 3,442,148	$19,459,335
COST AS OF PUBLICATION DATE				
ALL MINES[b]	$13,485,963	$ 985,438	$ 3,109,953	$17,581,354

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

[b] Discount factor of 0.903492.

For comparability with other costs, these yearly cost streams must be discounted to a common point in time. The appropriate discount factor for discounting the 18 months from the effective date of Section 57.5060(a) back to the publication date of the rule is 0.903492.[81] As of the publication date of the rule, the total yearly costs of Section 57.5060(a) will be:

- $13,485,963 for ceramic filters;
- $985,438 for cabs;
- $3,109,953 for ventilation improvements; and
- $17,581,354 for all controls in underground M/NM mines.

[81] $0.903492 = 1/(1.07)^{1.5}$

Industry Costs of the 160_{TC} Micrograms/m^3 Concentration Limit (57.5060(b))

Ceramic Filters. MSHA estimates that, to meet the 160_{TC} microgram/m^3 concentration limit, M/NM mines will need to put ceramic filters on additional diesel powered equipment (in addition to the ceramic filters placed on diesel powered equipment to meet the 400_{TC} microgram/m^3 concentration limit):

- Of production equipment with engines over 150 hp, ceramic filters will be used on:
  - An additional 25 percent of machines (24 machines) in mines with over 500 employees,
  - An additional 25 percent of machines (217 machines) in mines with 20 to 500 employees, and
  - An additional 50 percent of machines (131 machines) in mines with fewer than 20 employees.

- Of production equipment with smaller engines, ceramic filters will be used on:
  - An additional 25 percent of machines (31 machines) in mines with over 500 employees,
  - An additional 25 percent of machines (87 machines) in mines with 20 to 500 employees, and
  - An additional 50 percent of machines (24 machines) in mines with fewer than 20 employees.

- Of support equipment,[82] ceramic filters will be used on an additional 25 percent of machines (68 machines) in mines with fewer than 20 employees.

Table IV-7 shows the computations of estimated yearly costs for these additional ceramic filters. As of the effective date of Section 57.5060(b)? 5 years after publication of the rule? MSHA estimates that the total yearly costs will be:

- $556,454 for underground M/NM mines with over 500 employees;

- $2,953,052 for underground M/NM mines with 20 to 500 employees;

- $1,111,512 for underground M/NM mines with fewer than 20 employees; and

- $4, 621,028 for all underground M/NM mines.

[82] MSHA estimates that 50 percent of support equipment has engines that are clean enough not to need filters.

Table IV-7: Yearly Industry Costs of Ceramic Filters to Comply With Section 57.5060(b)

Mine Employment Size Class	Category of Equipment	Number	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	Production (> 150 hp)	24	$13,956	$ 334,956
	Production (≤ 150 hp)	31	$ 6,457	$ 200,152
	Spare (> 150 hp)	8	$ 1,780	$ 14,238
	Spare (≤ 150 hp)	10	$ 712	$ 7,119
	TOTAL YEARLY COST			$ 556,454
20 to 500 Employees	Production (> 150 hp)	217	$10,835	$ 2,351,182
	Production (≤ 150 hp)	87	$ 5,208	$ 453,085
	Spare (> 150 hp)	72	$ 1,780	$ 128,140
	Spare (≤ 150 hp)	29	$ 712	$ 20,645
	TOTAL YEARLY COST			$ 2,953,052
Less Than 20 Employees	Production (> 150 hp)	131	$ 6,351	$ 831,995
	Production (≤ 150 hp)	24	$ 2,977	$ 71,457
	Support	68	$ 1,583	$ 107,683
	Spare (> 150 hp)	44	$ 1,780	$ 78,308
	Spare (≤ 150 hp)	31	$ 712	$ 22,069
	TOTAL YEARLY COST			$ 1,111,512
UNDERGROUND M/NM INDUSTRY TOTAL YEARLY COST				$ 4,621,028

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Cabs. In order to meet the 160_{TC} micrograms/m^3 concentration limit, MSHA estimates that M/NM mine operators will add cabs to an additional 15 percent of diesel powered equipment (an additional 600 machines). Table IV-8 shows the computations of estimated yearly costs for these cabs. As of the effective date of Section 57.5060(b)? 5 years after publication of the rule? MSHA estimates that the total yearly costs will be:

- $190,872 for underground M/NM mines with over 500 employees;
- $739,857 for underground M/NM mines with 20 to 500 employees;
- $159,969 for underground M/NM mines with fewer than 20 employees; and
- $1,090,699 for all underground M/NM mines.

Table IV-8: Yearly Industry Costs of Cabs to Comply With Section 57.5060(b)

Mine Employment Size Class	Category of Equipment	Number	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	Cabs	105	$ 1,818	$ 190,872
20 to 500 Employees	Cabs	407	$ 1,818	$ 739,857
Fewer Than 20 Employees	Cabs	88	$ 1,818	$ 159,969
M/NM INDUSTRY TOTAL YEARLY COST				$1,090,699

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Ventilation Improvements. The remainder of the ventilation improvements that MSHA estimates will be needed to meet the 160_{TC} micrograms/m^3 concentration level include:

- New fan systems in:
  - 8 mines with 20 to 500 employees, and
  - 15 mines with fewer than 20 employees;
- New fan motors in:
  - 1 mine with over 500 employees,
  - 25 mines with 20 to 500 employees, and
  - 14 mines with fewer than 20 employees; and
- Major ventilation upgrades in:
  - 2 mines with over 500 employees, and
  - 30 mines with 20 to 500 employees.

Table IV-9 shows the computations of estimated yearly costs for these ventilation improvements. As of the effective date of Section 57.5060(b)? 5 years after publication of the rule? MSHA estimates that the total yearly costs will be:

- $109,416 for underground M/NM mines with over 500 employees;
- $2,311,120 for underground M/NM mines with 20 to 500 employees;
- $1,142,061 for underground M/NM mines with fewer than 20 employees; and
- $3,562,598 for all underground M/NM mines.

Table IV-9: Yearly Industry Costs of Ventilation System Upgrades for Section 57.5060(b)

Mine Employment Size Class	Category of Ventilation System Change	Number of Mines	Total Yearly Unit Cost	Industry Yearly Total Cost[a]
Over 500 Employees	New Fan Motor	1	$ 2,990	$ 2,990
	Electricity	1	$21,000	$ 21,000
	Major Upgrade	2	$42,713	$ 85,426
	TOTAL YEARLY COST			$ 109,416
20 to 500 Employees	New Fan System	8	$32,747	$ 261,975
	New Fan Motor	25	$ 2,990	$ 74,748
	Electricity	33	$21,000	$ 693,000
	Major Upgrade	30	$42,713	$ 1,281,398
	TOTAL YEARLY COST			$ 2,311,120
Fewer Than 20 Employees	New Fan System	15	$32,747	$ 491,202
	New Fan Motor	14	$ 2,990	$ 41,859
	Electricity	29	$21,000	$ 609,000
	TOTAL YEARLY COST			$ 1,142,061
M/NM INDUSTRY TOTAL YEARLY COST				$ 3,562,598

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

Total Yearly Industry Costs. Table IV-10 shows total estimated yearly industry costs for these DPM controls. As of the effective date of Section 57.5060(b)? 5 years after publication of the rule? MSHA estimates that the total yearly costs will be:

- $856,742 for underground M/NM mines with over 500 employees;

- $6,004,029 for underground M/NM mines with 20 to 500 employees;
- $2,413,542 for underground M/NM mines with fewer than 20 employees; and
- $9,274,325 for all underground M/NM mines.

For comparability with other costs, these yearly cost streams must be discounted to a common point in time. The appropriate discount factor for discounting the 5 years from the effective date of Section 57.5060(a) back to the publication date of the rule is 0.712986.[83] As of the publication date of the rule, the total yearly costs of Section 57.5060(b) will be:

- $3,294,729 for ceramic filters;
- $777,653 for cabs;
- $2,540,082 for ventilation improvements; and
- $6,612,464 for all controls in underground M/NM mines.

[83] $0.712986 = 1/(1.07)^5$

Table IV-10: Total Yearly M/NM Industry Cost of Section 57.5060(b)

Mine Size	Cost Element			All Costs[a]
	Filters	Cabs	Ventilation	
COST AS OF EFFECTIVE DATE OF SECTION 57.5060(b)				
Over 500 Employees	$ 556,454	$ 190,872	$ 109,416	$ 856,742
20 to 500 Employees	$ 2,953,052	$ 739,857	$ 2,311,120	$ 6,004,029
Under 20 Employees	$ 1,111,512	$ 159,969	$ 1,142,061	$ 2,413,542
ALL MINES[a]	$ 4,621,028	$1,090,699	$ 3,562,598	$ 9,274,325
COST AS OF PUBLICATION DATE				
ALL MINES[b]	$ 3,294,729	$ 777,653	$ 2,540,082	$ 6,612,464

[a] Numbers may not add or multiply precisely because costs were rounded to the nearest dollar in the table.

[b] Discount factor of 0.712986.

Total Yearly Costs of DPM Controls

Total costs to achieve the 160_{TC} micrograms/m^3 concentration limit are the sum of the costs of controls used to achieve a 400_{TC} micrograms/m^3 concentration limit (Table IV-6) plus the additional costs of controls to reduce concentrations from 400_{TC} micrograms/m^3 to 160_{TC} micrograms/m^3 (Table IV-10). MSHA estimates these costs to be:

- $16,780,691 for ceramic filters;
- $1,763,091 for cabs;
- $5,650,035 for ventilation improvements; and
- $24,193,818 for all controls in underground M/NM mines.

NEWLY INTRODUCED ENGINES (57.5067)

Section 57.5067 requires any diesel engine[84] that is introduced into an underground M/NM mine more than 60 days after publication of the rule to meet one of two requirements:

- It must be approved by MSHA pursuant to 30 CFR part 7, subpart E, or 30 CFR part 36; or

- It must meet or exceed the applicable EPA particulate emission requirements listed in the rule.[85]

Factors Limiting Costs

The final rule represents a major change from the proposed rule. The addition of a second option for complying with Section 57.5067 that was not in the proposed rule? meeting EPA standards listed in the rule? provides an important element of flexibility. Machines used in underground M/NM mines that are not specifically designed for mining are generally off-road machines designed for industries such as construction, or they are functional modifications of on-road vehicles. Thus virtually all new non-mine-specific diesel powered equipment and engines used in underground M/NM mines must already meet the listed EPA standards.

In addition, engine manufacturers are voluntarily seeking MSHA approval on an ongoing basis for engines used in M/NM mine equipment. They do so because an MSHA approved engine is perceived to have a competitive advantage in multiple markets. Coal mines and foreign sales are two examples where MSHA approval is required. Indeed, the mining equipment market is small enough that manufacturers that specialize in it have strong incentives to be able to sell to both coal and M/NM mines. To the extent that these MSHA approvals are voluntarily sought by engine manufacturers even without this rule, the costs are in the baseline? not impacts? of this rule.

The rule provides 60 days between publication and the effective date of the requirements of Section 57.5067. MSHA believes that this is sufficient time for mine operators to reallocate existing diesel powered equipment among mines if they choose to do so. Furthermore, since the listed EPA standards have been in effect since at least 1996, mine operators will be able to move most equipment with engines less than five years old from mine to mine without incurring regulatory costs. Accordingly, MSHA is not attributing any cost to engines in existing

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[84] Following the precedent of MSHA's diesel equipment rule for coal mines, this rule excepts engines in ambulances and fire fighting equipment.

[85] These listed EPA standards include:

- Requirements of 40 CFR 86.094-8(a)(1)(i)(A)(2) for light duty on highway engines,
- Requirements of 40 CFR 86.094-11(a)(1)(iv)(B) for heavy duty on highway engines,
- Tier 1 requirements of 40 CFR 89.112(a) for nonroad engines, and
- Tier 2 requirements in horsepower ranges where Tier 1 requirements are lacking.

equipment that are "introduced" into an underground M/NM mine by being moved from another mine.

There is one temporary gap in the options available for meeting the requirements of Section 57.5067. The EPA Tier 2 standards for diesel engines in the 50 hp to 175 hp range will not be in effect until the year 2003. Thus for the first two years that Section 57.5067 is in effect, engines in new equipment will not be required to meet that standard. MSHA believes that most major engine manufacturers have already redesigned their engines to comply with the Tier 2 standard, as it has been known for several years. Although it is possible that there are some small manufacturers that have not already re-engineered for the EPA standards and have not had some of these engines approved by MSHA, any such manufacturers will be under enormous competitive pressure to bring their engines into compliance with at least one of these options.

MSHA reviewed the engines used in a sample of mine ventilation plans to assess the potential extent of costs. This review indicated that virtually all equipment had engines that were approved by MSHA, would have engines that met the listed EPA standards when a new version of the existing model was purchased, or were sufficiently generic that different equipment with engines that met one (or both) of these tests would be very good substitutes for the existing equipment. Only a very small handful of scalers and (possibly) drills might have engines that did not meet either test, MSHA concluded, and this situation would not continue past the effective date of the Tier 2 standards.

Unit Cost

There are two likely ways that equipment manufacturers could deal with engines in the horsepower range that does not have Tier 1 standards and for which Tier 2 standards are not yet in effect. They could get the engines approved by MSHA, or they could re-engineer the equipment to accommodate engines that are already MSHA approved. In the PREA for this rule, MSHA assumed that manufacturers would obtain MSHA approval and pass the costs through to mine operators in the form of higher prices. MSHA estimated the cost for an MSHA approval to be $16,625, [86] and MSHA estimated the resulting price premium for a newly approved engine to be $2,500 per engine. In the REA for the Coal DPM rule, MSHA estimated a cost of $4,000[87] to reconfigure an equipment model to accommodate a different engine.

MSHA believes that the only plausible scenario under which a new scaler or drill would not have an engine that was MSHA approved or met the listed EPA standards would be a case where an individual mine operator? based on the circumstances of his mine? had a very strong preference for a new piece of equipment of the same model as existing equipment that did not have a compliant engine. Under such circumstances, it would be less expensive to modify the equipment than to obtain MSHA approval for the engine. If the re-engineering cost of $4,000

[86] This estimate for approval of a nonpermissible diesel engine was based on $14,000 for an independent testing laboratory to conduce a maximum fuel/air ratio test (required by existing Section 7.87), a gaseous ventilation test (required by existing Section 7.88), and a particulate index test (required by existing Section 7.89) plus 35 hours of engineer's time @ $75 per hour to prepare the application.

[87] This estimate was based on 80 hours of engineer's time @ $50 per hour for reconfiguration of the design.

were spread over two machines, the cost to the mine operator would be similar to the $2,500 per machine estimate used in the PREA for this rule. Accordingly, MSHA retains this per machine cost estimate.

Industry Costs

Because the circumstances where there would be any Section 57.5067 compliance costs to the mine operator are so unlikely and limited? although conceivable? MSHA estimates that not more than 5 equipment models would be reconfigured and the costs would be spread over 10 new engines/machines. Thus the total cost to mine operators of Section 57.5067 is estimated to be $25,000, all of which would occur as an initial cost. On an annualized basis (using a 7.0 percent annual discount rate over an infinite horizon), the estimated industry cost of Section 57.5067 is $1,750.[88]

EXTENSION APPLICATION (57.5060(C))

If, as a result of technological constraints, a mine operator requires additional time to come into full compliance with the final concentration limit (160_{TC} micrograms/m^3), the mine operator may file an application for a special extension. In addition to sending the application to MSHA for approval, a mine operator must provide the miners' representative with a copy of the application and must post both the original application and the approved application in the mine. The proposed rule provides for no more than one extension, which may last for no more than two years.

Unit Cost Estimate

MSHA's estimate of the unit cost of applying for an extension is based on the following estimates and assumptions:

- To prepare and submit an application to MSHA will take a supervisor:
  - 16 hours in a mine with 20 or more employees, and
  - 8 hours in a mine with fewer than 20 employees.

- The application will not exceed 10 pages in length.

- Copying and distribution of the application will require 20 minutes of a clerical worker's time, and will involve:
  - Making 3 copies of the original application:
    - One mailed to MSHA,
    - One distributed to the miners' representative, and
    - One posted in the mine, and
  - Making and posting one copy of the approved application.

[88] $1,750 = $25,000 x 0.07

- Wage rates are:
  - $44.79/hour for a supervisor, and
  - $17.57/hour for a clerical worker.

- Other direct costs include:
  - $ .15 per page ($1.50 per copy) for copying costs, and
  - $ .55 for postage.

Table IV-11 shows the estimated cost per mine, at the time the application is prepared. MSHA's estimated average cost is:

- $729 for an underground M/NM mine with 20 or more employees; and

- $371 for an underground M/NM mine with fewer than 20 employees.

Table IV-11: Costs of Extension Application

Mine Size	Activity	Cost Element	Unit Cost	Units	Cost
20 and Over	Prepare	Supervisor	$44.49	16 hours	$ 717
	Copy & Distribute	Clerical Worker	$17.57	0.33 hours	$ 6
	Direct Costs	Copying	$ 1.50	4 copies	$ 6
		Postage	$ .55	1 copy	$ 1
	Total Cost per Mine				$ 729
	Mines Making Application				12
	Total Cost for Mine Size Class				$8,748
Less Than 20	Prepare	Supervisor	$44.49	8 hours	$ 358
	Copy & Distribute	Clerical Worker	$17.57	0.33 hours	$ 6
	Direct Costs	Copying	$ 1.50	4 copies	$ 6
		Postage	$ .55	1 copy	$ 1
	Total Cost per Mine				$ 371
	Mines Making Application				8
	Total Cost for Mine Size Class				$2,966
TOTAL INDUSTRY COST	Cost at Time of Application				$11,714
	Annualized Cost				$ 820[a]
	Yearly Cost as of Publication of the Rule				$ 585[b]

[a] The annualization factor is 0.07, which is equal to the annual discount rate.

[b] Discounted for 5 years at an annual discount rate of 7.0 percent.

Industry Cost

MSHA estimates that 10 percent of underground M/NM mines will need to file an application for an extension. Ten percent includes 12 mines with 20 or more employees and 8 mines with fewer than 20 employees. As indicated in Table IV-11, the total industry cost of extension applications? at the time the applications are filed? is estimated to be $11,714.

For comparability with other costs, two adjustments need to be made. First, total industry costs must be annualized over a 10 year period, using a 7.0 percent annual discount rate.[89] Then this annual cost stream must be discounted five years (also at a 7.0 percent annual discount rate) to the time of publication of the rule. The resulting total industry yearly cost estimate is $1,189.[90]

RESPIRATOR PROTECTION (57.5060(d))

Section 57.5060(d) conditionally allows mine employees to conduct inspection, maintenance, or repair activities in certain areas of a mine where the DPM concentration limit is exceeded. The conditions involve adequate safeguards for the miners, which may include a respiratory protection program (RPP). The conditions include the following compliance activities:

- Mine operators must prepare an Exemption Plan (EP), which includes at least the following information:
  - The types, frequency, location, and duration of inspection, maintenance, and repair activities involved where engineering controls cannot achieve the DPM concentration limit,
  - The reasons why engineering controls to achieve the DPM concentration limit are not feasible,
  - The number of miners involved in the activities, and
  - The measures for limiting miner exposure to DPM (Section 57.5060(d)(3)).

- The plan must be made available to the miners in the following manner:
  - Upon submission of the application to MSHA, the proposed EP must be posted at the mine site, and a copy must be provided to the authorized representative of miners, and
  - The approved EP must be posted at the mine site (Section 57.5060(d)(4)).

- The EP must be revised (as necessary) and resubmitted annually, since the advance approval for an exemption is valid for no more than one year (Section 57.5060(d)(4)).

- The RPP covered by the EP must meet the minimum requirements for respirators of Section 57.5005 (a) and (b) with respect to:
  - Selection,

[89] $1,668 = $11,714 x $(0.07/(1-(1/1.07)^{10}))$

[90] $1,189 = $1,668 x $(1/1.07)^5$

- Maintenance,
- Training,
- Fitting,
- Supervision,
- Cleaning, and
- Use (Section 57.5060(d)(4)).

Unit Cost Estimate

MSHA bases its estimates of the unit costs of preparing the EP and RPP and of implementing the RPP on the following estimates and assumptions.

- **Initial EP/RPP Preparation.** Initial preparation of the EP and RPP will require an average of 13 hours of a supervisor's time (including 8 hours for the EP and 5 hours for the RPP).

- **Revision and Resubmission.** Annual revision and resubmission to MSHA of the EP and RPP will require an average of one hour of a supervisor's time.

- **Distribution.** Distribution of the EP and RPP (which includes sending the proposed EP and RPP to MSHA for approval, providing a copy to the miners' representative, and posting the proposed and approved EPs at the mine site) will require (annually):
  - A total of 0.5 hours of a clerical worker's time,
  - Making 4 copies of 10-page documents at $0.15 per page ($6.00), and
  - Postage costs of $0.77 to mail the application to MSHA.

- **Respirator Equipment Costs.** MSHA estimates that respirators, which have a useful life of one year, cost $30. Cartridges, which will need to be changed weekly, cost $2. Thus the total annual unit cost of respirators will be $134.[91]

- **Respirator Use.** MSHA estimates that respirators will be required for an average of:
  - 12 miners in mines with 20 or more employees,[92] and
  - 4 miners in mines with fewer than 20 employees.[93]

- **Training.** MSHA assumes that training in respirator use will be performed by a supervisor and that a training session will last 45 minutes.

- **Initial Training.** Initially, all miners using respirators (4 miners in small mines; 12 miners in larger mines) will need to be trained. MSHA assumes that one initial training session will be held in each mine.

[91] $134 = $30 + (52 x $2)

[92] Three two-person work crews for each of two shifts.

[93] Two two-person work crews for one shift.

- **Annual Training.** New miners (or miners newly assigned to repair crews) will need to be trained in respirator use each year. Previously trained miners will not require retraining. Based on an assumed labor turnover rate of 7.0 percent MSHA estimates that:
    - Mines with 20 or more employees are expected to train at least one miner in respirator use each year,[94] so that all such mines will hold a follow-up training session annually, and
    - Mines with fewer than 20 employees are expected to train one miner in respirator use about every three years,[95] so that in any given year only one third of small mines will hold a follow-up training session.

- **Fit Testing.** Fit testing will take 15 minutes. Since fit testing is done by a supervisor working one-on-one with a miner, the total time required is 15 minutes of a supervisor's as well as 15 minutes of a miner's time for each miner using a respirator. Initially all miners using respirators will be fit tested. Thereafter, the number of miners to be fit tested each year will be the same as the number of miners to be trained in respirator use. MSHA assumes that training and fit testing will be done as nearly at the same time as is practicable.

- **Recordkeeping for Training and Fit Testing.** MSHA estimates the cost of recordkeeping for respirator training and fit testing based on the following process:
    - The supervisor providing the training will brief a clerical worker, which will require an estimated five minutes of both persons' time. This activity will occur only for the initial training session and fit testing.
    - Each year that training and fit testing occurs, the clerical worker will prepare a registration sheet with the trainees' names on a clipboard and will subsequently record the attendees in a computer file, which will require an estimated 10 minutes plus one minute for each trainee.
    - Attendees will sign the registration sheet. This will require an estimated 20 seconds each, which will occur during training rather than in addition to it.[96]

- **Routine Respirator Care.** Miners will routinely visually inspect their respirators prior to each use and then clean and store them after the shift is over. MSHA assumes that:
    - The process will take 1.5 minutes for each miner on a shift when the respirator is used.
    - Respirators will be used? and thus inspections required an average of:
        - 20 times per month? 240 times per year? in mines with fewer than 20 employees,[97] and

[94] 0.84 = 12 x 0.07

[95] 0.28 = 4 x 0.07

[96] Because this cost is included in the training time, it is not explicitly estimated in this section. For purposes of estimating paperwork burden, however, the time is a distinct burden that is estimated separately.

[97] Based on the assumption that inspection, maintenance, or repair activities will be performed on 5 shifts per month by 4 miners (two 2-person crews) on each of these shifts.

- 90 times per month? 1,080 times per year? in larger mines.[98]

- **Random Inspection.** Supervisors will randomly check, during a shift, to ensure that respirators are properly worn. The supervisor will then log the random checks. MSHA assumes that:
  - Random inspection will take the supervisor and the miner 1.5 minutes for each miner inspected.
  - The supervisor will require an additional 1.5 minutes to log the date.
  - Mine operators will conduct an average of:
    - 2 random inspections per month? 24 inspections per year? in mines with fewer than 20 employees, and
    - 7 random inspections per month? 84 per year? in larger mines.

- **Wage Rates.** MSHA estimates that the loaded hourly wage rates applicable to these activities are:
  - $44.79 for a supervisor,
  - $19.42 for a miner, and
  - $17.57 for a clerical worker.

- **Amortization.** All one-time costs are amortized over a 10-year period. MSHA uses an annual discount rate of 7.0 percent.

Industry Costs

MSHA estimates that all underground M/NM mines that use diesel powered equipment will require an RPP. As noted above in the industry profile, Chapter II, there are an estimated 196 such mines. These include 7 mines with over 500 employees, 112 mines with 20 to 500 employees, and 77 mines with fewer than 20 employees.

EP and RPP. Table IV-12 shows the costs of the EP and RPP. These costs include initial preparation, annual revision and resubmission, and distribution each time the plan is prepared or revised. In order to make these costs comparable, they have been put on a yearly basis. Each of the three cost elements requires different treatment:

- **Initial EP/RPP Preparation.** Initial preparation of the EP and RPP is a one-time cost. To convert it to a yearly cost, it is amortized over an infinite horizon at an annual discount rate of 7.0 percent. For infinite horizon investments, the annualization factor is equal to the discount rate.

- **Revision and Resubmission.** Revision and resubmission to MSHA of the EP and RPP is an annual cost, but it does not begin until a year after the effective date of the project.

[98] Based on the assumption that inspection, maintenance, or repair activities will be performed on 15 shifts per month by 6 miners (three 2-person crews) on each of these shifts.

- **Distribution.** Distribution of the EP and RPP occurs annually, including the first year. Thus this cost needs no adjustment.

Table IV-12: Costs of Respirator Protection Plan and Exemption Plan

Activity	Cost Element	Unit Cost	Units	Cost[a]
Initial Preparation	Supervisor	$44.79	12 hours[b]	$ 537
	Annualized Cost[c]			$ 38
Annual Revision and Resubmission	Supervisor	$44.79	1 hour	$ 45
Copy and Distribute	Clerical worker	$17.57	0.5 hours	$ 9
	Copying	$ 1.50	4 copies	$ 6
	Postage	$ .77	1 copy	$ 1
	Annual Cost			$ 16
Total Yearly Cost per Mine				$ 98
Total Yearly Industry Cost	Mines With Fewer Than 20 Employees		77	$ 7,544
	Mines With 20 to 500 Employees		112	$10,972
	Mines With Over 500 Employees		7	$ 686
	All M/NM Mines		196	$19,202

[a] Costs may not sum exactly because of rounding.

[b] One time initial costs minus recurring annual costs.

[c] The annualization factor is 0.07, which is equal to the annual discount rate.

As Table IV-12 shows, the estimated yearly cost per mine of EP/RPP preparation and revision is $98. The estimated yearly cost for the industry is $19,202.

Equipment, Training, and Fit Testing. Table IV-13a and Table IV-13b show the costs associated with the purchase of respirators and cartridges, training in respirator use, fit testing, and related recordkeeping. Estimated costs for all mines are as follows:

- Annual equipment costs are $232,624;
- Yearly costs for initial respirator training, fit testing, and recordkeeping are $3,403; and

- Yearly costs for follow-up respirator training, fit testing, and recordkeeping are $13,217.

Total estimated yearly industry costs of respirators, training, fit testing, and related recordkeeping are $249,244.

Table IV-13a: Costs of Respirator Equipment, Training, and Recordkeeping for Mines With 20 or More Employees

Activity	Cost Element	Unit Cost	Units or Units x Miners	Cost[a]
ANNUAL COSTS				
Respirator	Respirator	$30.00	1 x 119 x 12	$ 42,840
	Cartridge	$ 2.00	52 x 119 x 12	$148,512
	Annual Cost			$191,352
INITIAL COSTS				
Training	Supervisor	$44.79	0.75 x 119	$ 3,998
	Miner	$19.42	0.75 x 119 x 12	$ 20,799
Fit Testing	Supervisor	$44.79	0.25 x 119 x 12	$ 15,990
	Miner	$19.42	0.25 x 119 x 12	$ 6,933
Recordkeeping	Supervisor	$44.79	0.0833 x 119	$ 444
	Clerical Worker	$17.57	0.25 x 119	$ 523
	Clerical Worker	$17.57	1/60 x 119 x 12	$ 418
TOTAL	Sum of Initial Costs			$ 49,104
	Annualized Initial Costs[b]			$ 2,876
FOLLOW-UP COSTS				
Training	Supervisor	$44.79	0.75 x 119	$ 3,998
	Miner	$19.42	0.75 x 119	$ 1,733
Fit Testing	Supervisor	$44.79	0.25 x 119	$ 1,333
	Miner	$19.42	0.25 x 119	$ 578
Recordkeeping	Clerical Worker	$17.57	0.1667 x 119	$ 348
	Clerical Worker	$17.57	0.01667 x 119	$ 35
TOTAL	Sum of Annual Follow-up Costs			$ 8,024
TOTAL INDUSTRY YEARLY COSTS				$202,252

[a] Costs may not sum exactly because of rounding.

[b] One-time initial costs minus recurring annual follow-up costs. The annualization factor is 0.07, which is equal to the annual discount rate.

Table IV-13b: Costs of Respirator Equipment, Training, and Recordkeeping for Mines With Fewer Than 20 Employees

Activity	Cost Element	Unit Cost	Units or Units x Miners	Cost[a]
ANNUAL COSTS				
Respirator	Respirator	$30.00	1 x 77 x 4	$ 9,240
	Cartridge	$ 2.00	52 x 77 x 4	$ 32,032
	Annual Cost			$ 41,272
INITIAL COSTS				
Training	Supervisor	$44.79	0.75 x 77	$ 2,587
	Miner	$19.42	0.75 x 77 x 4	$ 4,486
Fit Testing	Supervisor	$44.79	0.25 x 77 x 4	$ 3,449
	Miner	$19.42	0.25 x 77 x 4	$ 1,495
Recordkeeping	Supervisor	$44.79	0.0833 x 77	$ 287
	Clerical Worker	$17.57	0.25 x 77	$ 338
	Clerical Worker	$17.57	1/60 x 77 x 12	$ 90
TOTAL	Sum of Initial Costs			$ 12,733
	Annualized Initial Costs[b]			$ 528
FOLLOW-UP COSTS				
Training	Supervisor	$44.79	0.75 x 77	$ 2,587
	Miner	$19.42	0.75 x 77	$ 1,122
Fit Testing	Supervisor	$44.79	0.25 x 77	$ 862
	Miner	$19.42	0.25 x 77	$ 374
Recordkeeping	Clerical Worker	$17.57	0.1667 x 77	$ 225
	Clerical Worker	$17.57	0.01667 x 77	$ 23
TOTAL	Sum of Annual Follow-up Costs			$ 5,192
TOTAL INDUSTRY YEARLY COSTS				$ 46,992

[a] Costs may not sum exactly because of rounding.

[b] One-time initial costs minus recurring annual follow-up costs. The annualization factor is 0.07, which is equal to the annual discount rate.

Inspection. Table IV-14a and Table IV-14b show the estimated costs of inspection related to respirator use. These costs are annual costs.

- Annual costs for routine inspection and care of respirators are $71,368; and
- Annual costs for random inspection of respirator use are $32,275.

Total estimated yearly industry costs for respiratory protection are $103,643.

Table IV-14a: Unit Costs of Respirator Inspections

Activity	Cost Element	Cost/Hour	Hours	Cost
Routine Inspection	Miner	$19.42	0.025	$ 0.49
Random Inspection	Supervisor	$44.79	0.025	$ 1.12
	Miner	$19.42	0.025	$ 0.49
	Total			$ 1.61
Recordkeeping	Supervisor	$44.79	0.025	$ 1.12

Table IV-14b: Industry Costs of Respirator Inspections

Mine Size	Type of Inspection	Inspections per Year	Cost per Inspection	Total Cost
Over 500 Employees	Routine	7,560	$ 0.49	$ 3,670
	Random with Recordkeeping	588	$ 2.73	$ 1,602
	Total			$ 5,272
20 to 500 Employees	Routine	120,960	$ 0.49	$ 58,726
	Random with Recordkeeping	9,408	$ 2.73	$ 25,637
	Total			$ 84,363
Under 20 Employees	Routine	18,480	$ 0.49	$ 8,972
	Random with Recordkeeping	1,848	$ 2.73	$ 5,036
				$ 14,008
All Underground M/NM Mines				$103,643

Total Costs of Respiratory Protection. Table IV-15 shows the total costs of respiratory protection, by mine size class and by type of compliance activity. The total estimated yearly costs of all elements of a respiratory protection program for the underground M/NM mining industry are $372,089.

Table IV-15: Total Industry Costs of Respirator Protection

Activity	Mine Size			All Mines
	Under 20	20 to 500	Over 500	
RPP and EP[a]	$ 7,544	$ 10,972	$ 686	$ 19,202
Equipment, Training, and Recordkeeping[b]	$ 46,992	$190,355	$ 11,897	$249,244
Inspection[c]	$ 14,008	$ 84,363	$ 5,272	$103,643
TOTAL	$ 68,544	$285,690	$ 17,855	$372,089

[a] Source: Table IV-12.

[b] Source: Table IV-3a and Table IV-3b.

[c] Source: Table IV-14.

DIESEL PARTICULATE MATTER CONTROL PLAN (57.5062)

In the event of a violation of Section 57.5060(a) (the 400_{TC} micrograms/m^3 concentration limit) or Section 57.5060(b) (the 160_{TC} micrograms/m^3 concentration limit), an underground coal mine operator must take the following steps:

- Section 57.5062(a) and Section 57.5060(b) require a mine operator to establish a diesel particulate control plan for the mine (or modify the plan if one already exists) that includes a description of the controls the mine operator will utilize to keep the DPM concentrations below the limits;

- Section 57.5062(c) requires the mine operator to demonstrate the effectiveness of the particulate control plan by monitoring;

- Section 57.5062(d) requires the mine operator to:
  - Make the diesel particulate control plan and sampling records available to representatives of DOL, DHHS, and the miners, and
  - Supply the particulate control plan to the District Manager (upon request);

- Section 57.5062(e) requires the mine operator to modify the particulate control plan to reflect changes in mining equipment or circumstances.

Unit Cost Estimate

MSHA uses the following estimates and assumptions[99] to estimate Section 57.5062 costs:

- Preparation of a particulate control plan (or modification in the event of a violation) will require an average of 4 hours of a M/NM mine supervisor's time.

- Demonstration of the effectiveness of a particulate control plan will entail (for each violation) taking one verification sample per day for three days in one production area of the mine where the violation occurred.

- A M/NM mine with a DPM control plan in place will need to revise it annually, due to changes in equipment or circumstances.

- Modification of a particulate control plan after changes in equipment or circumstances will require an average of half an hour of a M/NM mine supervisor's time.

- The particulate control plan will not exceed 10 pages in length.

- Each mine will need to make a total of:
  - Four copies for Section 57.5060(d) and
  - Two copies for Section 72.370(e)

- Production and distribution (i.e., providing to a miners' representative and mailing to MSHA upon request) will require an average of:
  - Fifteen minutes per mine of a clerical worker's time for an original plan under Section 57.5060(d), and.
  - Ten minutes per mine of a clerical worker's time for modification of a plan under Section 57.5060(e).

- Labor wage rates are:
  - $44.79/hour for a mine supervisor, and
  - $17.57/hour for a clerical worker.

- Direct costs of producing and distributing reports will include:
  - Copying costs of $ .15 per page (equivalent to $1.50 per plan copy), and
  - Postage (for submission to MSHA) at $ .55 per plan.

Table IV-16 shows the calculation of estimated unit costs, based on these assumptions. MSHA estimates that preparation of a plan will cost:

[99] These assumptions differ slightly from assumptions made in the PREA.

- $514.10 for preparation of an original particulate control plan (or modification of an existing plan) after a violation, and

- $28.87 for modification of a plan after a change in equipment or circumstances.

The combined unit cost of a DPM control plan has two elements: A one-time cost of the initial plan and a cost stream of annual revisions. Table IV-16 also summarizes this calculation. To make them comparable to the cost of the initial plan the annual costs of plan revisions (over a ten-year time horizon) are discounted to the year of the initial plan. This present value is $189.53.[100] Thus the present value of the total yearly unit cost of a DPM plan? as of the year the initial plan is written? is $703.63.

[100] $189.53 = $28.87/{0.07[(1/(1.07))-(1/(1.07)^{11})]}

Table IV-16: Unit Costs of Diesel Particulate Master Control Plan

Type of Plan	Cost Element	Cost or Rate/Hour	Hours or Units	Cost
Initial	Supervisor	$44.79	4	$ 179
	Clerical Worker	$17.57	0.25	$ 4
	Copies	$ 1.50	4	$ 6
	Postage	$ .55	1	$ 1
	Sampling	$75.00	3	$ 225
	Analysis	$33.00	3	$ 99
	Total Unit Cost			$ 514
Plan Revision	Supervisor	$44.79	0.5	$ 22
	Clerical Worker	$17.57	0.166667	$ 3
	Copies	$ 1.50	2	$ 3
	Postage	$ .55	1	$ 1
	Total Unit Cost			$ 29
	Present Value at the Time of the Initial Plan[a]			$ 190
Total Cost at the Time of the Initial Plan				$ 704

[a] Discounted at an annual discount rate of 7.0 percent.

Industry Costs

MSHA estimates that approximately 12 underground M/NM mines annually will receive a violation citation that generates a DPM control plan. This will include an estimated ten mines with 20 or more employees[101] (about 8 percent of these mines) and two mines with fewer than 20 employees (about 2 percent of these mines). This estimate allows for an individual mine to have a second violation and have to do a major revision of the DPM control plan in another part of the mine.

Every year, according to MSHA's estimate, 12 mines each incur costs that are equivalent to $703.63 in that year. Thus the total yearly industry costs of Section 57.5062 are estimated to be $8,444.

FUELING PRACTICES (57.5065)

[101] One of these mines will have over 500 employees; the other 9 between 20 and 500 employees.

Section 57.5065 requires that underground M/NM mine operators that use diesel powered equipment must:

- Use diesel fuel having a sulfur content of no greater than 0.05 percent;
- Retain purchase records for fuel; and
- Use only diesel fuel additives that have been registered by the EPA.

Of the provisions in this section, the requirement to use low-sulfur diesel fuel has the greatest potential for imposing compliance costs. At the time the PREA was prepared, MSHA contacted two oil company refineries, both of which noted that low-sulfur fuel cost about 1.75 cents per gallon more than high-sulfur fuel. This refinery cost differential, however, does not readily translate into a differential in prices at the supplier or pump level. High-sulfur fuel is commonly used for heating, and in regions where oil heat is not widely used, high-sulfur fuel may be difficult to obtain and higher priced than low-sulfur fuel. Moreover, high-sulfur fuel damages catalytic converters and can cause engines to perform less well. Thus a mine operator is likely to prefer low-sulfur fuel for at least some vehicles, and mine operators are unlikely to store both high-sulfur and low-sulfur fuel. Finally, an increasing percentage of new engines require low-sulfur fuel, and proposed EPA regulations (which would apply to all diesel powered equipment covered by this final MSHA rule) would limit the sulfur content of diesel fuel to no greater than 0.015 percent—which is even stricter than the limits on sulfur content imposed by this final rule. All things considered, MSHA does not believe that there is a significant or measurable compliance cost for the mining industry as a whole to switch from high-sulfur fuel to low-sulfur fuel.

Costs of the other requirements of Section 57.5065 are likely to be zero or negligible. Mine operators already retain fuel purchase orders for tax purposes. The EPA has registered fuel additives that are currently used or substitutes that are equivalent in price to those used, and EPA will provide a list of registered additives at no cost.

For these reasons, MSHA has estimated no compliance costs for Section 57.5065.

MAINTENANCE TRAINING (57.5066(C))

Section 57.5066(c) requires that any persons maintaining diesel powered equipment in underground M/NM mines must be qualified, by virtue of training or experience, to ensure that engines are maintained in approved condition and that emission related components are maintained to manufacturer specifications and are in effective operating condition.[102]

Unit Cost Estimates

MSHA's estimate of mechanic training costs derived from Section 75.503(d) is based on the following assumptions:

- Mine operators will contract out the training, which will entail either a manufacturer's seminar (on the purchase of new equipment) or classroom training in a vocational or lecture type of setting. Instructional costs are estimated to be $75 per hour for each person trained.

- The number of trainees for each mine will be determined by the number of pieces of diesel powered equipment, as follows:
  - One person will be trained in diesel engine and control maintenance in mines with 1 to 6 pieces of diesel powered equipment.
  - An additional person will be trained in maintenance for every 12 pieces of diesel powered equipment (rounded up to the next higher dozen) above the initial six pieces.

- The training course will take one hour of the mechanic's time.

- The training will be recorded by having each trainee sign a sign-in sheet, which was prepared by a clerical worker, and the clerical worker will then enter the names into a computer. MSHA estimates that this process will entail the following actions:[103]
  - A supervisor will brief the clerical worker, which will require an estimated five minutes of both persons' time.
  - The clerical worker will prepare a registration sheet with the trainees' names on a clipboard and will subsequently record the attendees in a computer file, which will require an estimated 10 minutes plus one minute for each trainee.
  - Attendees will sign the registration sheet. This will require an estimated 20 seconds each.

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[102] Costs of filter maintenance itself were included under Section 57.5060(a) and Section 57.5060(b), above.

[103] This process replaces the PREA assumption that recording of attendance would require five minutes of a supervisor's time.

- **Wage Rates.** Estimated hourly wage rates are:
  - $44.79 for a supervisor,
  - $25.00 for a mechanic, and
  - $17.57 for a clerical worker.

These assumptions lead to the following estimates of unit costs of training mechanics and recording the training:

- Training costs will be $100 per mechanic, including:
  - $75.00 tuition, and
  - $25.00 for one hour of the mechanic's time.
- Recording costs will include the following costs:
  - $8.13 per mine for time of a supervisor and clerical worker to set up recordkeeping, and
  - Costs per mechanic, including:
    - $ .14 for each mechanic to sign his name, and
    - $ .29 per mechanic for the clerical worker to record the names.

Industry Costs

Table IV-17 shows the distribution of pieces of diesel powered equipment in underground M/NM mines of each size class (under 20 employees, 20 to 500 employees, and over 500 employees). The number of mechanics to be trained is derived from the number of pieces of diesel powered equipment in each mine, according to the assumptions stated above. MSHA estimates that the underground M/NM mine industry will need to train 517 mechanics as a result of Section 57.5066(c). Of these, 121 will be in mines that have fewer than 20 employees; 330 in mines that have 20 to 500 employees; and 66 in mines with over 500 employees.

Table IV-17: Numbers of Diesel Maintenance Trainees in M/NM Mines

Diesel Machines in Mine	Diesel Mechanics to Train per Mine	Under 20 Employees		20 to 500 Employees		Over 500 Employees	
		Mines	Mech.	Mines	Mech.	Mines	Mech.
1-6	1	34	34	6	6	-	-
7-18	2	42	84	51	102	-	-
19-30	3	1	3	28	84	-	-
31-42	4	-	-	14	56	2	8
43-54	5	-	-	4	20	-	-
55-66	6	-	-	3	18	-	-
67-78	7	-	-	5	35	-	-
91-102	9	-	-	1	9	2	18
127-138	12	-	-	-	-	2	24
175-186	16	-	-	-	-	1	16
TOTAL		77	121	112	330	7	66

Table IV-18 shows the estimated costs of training these mechanics and recording the training. At the time of the training, these estimated costs are:

- $6,685 for 7 mines with over 500 employees to train 66 mechanics;
- $34,052 for 112 mines with 20 to 500 employees to train 330 mechanics; and
- $12,778 for 77 mines with fewer than 20 employees to train 121 mechanics.

MSHA estimates that the formal training on maintaining emission control components will need to be done only once? when the controls are introduced[104]? as the presumption is that mechanics are not currently trained in these skills. Thereafter, MSHA assumes, new mechanics will be hired with the skill or can be trained individually with minimal cost as part of orientation or on the job. Thus the training is a one-time cost that needs to be annualized for comparability with other costs. The annualized cost for the total industry for Section 57.5066(c) training and recordkeeping is $3,746.

[104] MSHA's cost estimation assumes (for simplicity) that all training will take place when the rule becomes effective. In practice, some M/NM mines may not introduce controls until the second phase, so that training may be deferred several years. In such a case, the training costs should be discounted further and will be lower.

Table IV-18: Industry Costs for Maintenance Training

Mine Size	Activity	Cost Element	Unit Cost	Hours	Number	Cost
Over 500	Training Cost	Tuition	$75.00	1	66	$ 4,950
		Mechanic	$25.00	1	66	$ 1,650
	Record-Keeping Cost	Supervisor	$44.79	0.083	7	$ 26
		Clerical Worker	$17.57	0.25	7	$ 31
		Mechanic	$25.00	0.006	66	$ 9
		Clerical Worker	$17.57	0.017	66	$ 19
	Total Cost	At the Time of Training				$ 6,685
		Annualized Cost[a]				$ 468
20 to 500	Training Cost	Tuition	$75.00	1	330	$ 24,750
		Mechanic	$25.00	1	330	$ 8,250
	Record-Keeping Cost	Supervisor	$44.79	0.083	112	$ 418
		Clerical Worker	$17.57	0.25	112	$ 492
		Mechanic	$25.00	0.006	330	$ 46
		Clerical Worker	$17.57	0.017	330	$ 97
	Total Cost	At the Time of Training				$ 34,052
		Annualized Cost[a]				$ 2,384
Less Than 20	Training Cost	Tuition	$75.00	1	121	$ 9,075
		Mechanic	$25.00	1	121	$ 3,025
	Record-Keeping Cost	Supervisor	$44.79	0.083	77	$ 287
		Clerical Worker	$17.57	0.25	77	$ 338
		Mechanic	$25.00	0.006	121	$ 17
		Clerical Worker	$17.57	0.017	121	$ 36
	Total Cost	At the Time of Training				$ 12,778
		Annualized Cost[a]				$ 894
Total Annualized Industry Cost						$ 3,746

[a] The annualization factor is 0.07, which is equal to the annual discount rate for investments with an infinite life.

TAGGING AND EXAMINATION (57.5066(b))

Section 57.5066(b) requires that operators of diesel powered equipment in underground M/NM mines affix a visible tag to the equipment at any time the miner notes any apparent emission-related defect in the equipment. The rule requires that a mechanic make a prompt examination of tagged equipment. Both the tagging and the subsequent examination must be recorded in a log. The miner must record the equipment tagged and the date it was tagged. The mechanic must record the date the tagged equipment was examined, by whom, and what actions were taken. Although not explicitly required by the rule, MSHA assumes for costing purposes that diesel powered equipment operators will be trained in identifying apparent emission-related defects in their equipment and in tagging and logging procedures.

Unit Cost Estimates

MSHA's estimate of costs of tagging of equipment, examination of equipment, and related operator training is based on the following assumptions:

- **Training.** Concerning training equipment operators for tagging:
  - Each mine will train one operator per machine per shift.[105]
  - Supervisors will conduct the operator training on location in the mine, utilizing a piece of diesel powered equipment for demonstration purposes.
  - MSHA assumes that (due to the hands-on nature of the training) no more than 12 operators will be trained in one session.
  - The training will take fifteen minutes.

- **Tagging of Equipment.** MSHA estimates that, for each incident of tagging a piece of diesel powered equipment, it will take the miner who operates the equipment:
  - Two minutes to tag the equipment, and
  - Two additional minutes to record the tagging.

- **Examination of Equipment.** MSHA estimates that, for each incident of tagging, it will take a mechanic:
  - Ten minutes to examine the equipment, and
  - Two additional minutes to record the examination.

- **Wage Rates.** Estimated hourly wage rates are:
  - $44.79 for a supervisor,
  - $19.42 for a miner, and
  - $25.00 for a mechanic.

[105] Based on the production hours per day cited above:

- Mines with fewer than 20 employees will train one operator per piece of diesel equipment;
- Mines with 20 to 500 employees will train two operators per piece of diesel equipment; and
- Mines with over 500 employees will train three operators per piece of diesel equipment.

These assumptions lead to the following estimates of unit costs of tagging diesel powered equipment:

- Costs of training operators on tagging will be:
  - $11.20 for a supervisor to conduct each training session, and
  - $4.86 for each miner/operator to take the training.

- Costs of tagging equipment, examining it, and recording it will be $6.29 per episode of tagging, consisting of:
  - $1.29 for the operator to tag the equipment and record the tagging, and
  - $5.00 for a mechanic to examine the equipment and record the examination.

Total Industry Costs

Training. Table IV-19 shows the distribution of underground M/NM mines of each size class (fewer than 20 employees, 20 to 500 employees, and over 500 employees) by the number of training sessions they will hold. Table IV-19 also shows the estimated number of miners operating diesel powered equipment to be trained. These estimates are derived from the distributions of pieces of diesel powered equipment in each mine and the number of shifts operated by the different sizes of mines. MSHA estimates that the underground M/NM mine industry will need to train 8,108 miners about tagging diesel powered equipment, and that this training will take 757 training sessions. Of these, 577 miners and 87 training sessions will be in mines that have fewer than 20 employees; 5,422 miners and 502 training sessions in mines that have 20 to 500 employees; and 2,109 miners and 168 training sessions in mines with over 500 employees.

Table IV-19 Numbers of Diesel Equipment Operator Trainees in M/NM Mines

Number of Training Sessions per Mine	Fewer Than 20 Employees		20 to 500 Employees		Over 500 Employees	
	Mines	Miners	Mines	Miners	Mines	Miners
1	67	420	6	50	-	-
2	10	157	18	382	-	-
3	-	-	31	936	-	-
4	-	-	19	784	-	-
5	-	-	11	584	-	-
6	-	-	6	414	-	-
7	-	-	8	626	-	-
8	-	-	3	272	-	-
9	-	-	1	98	-	-
10	-	-	1	112	2	240
11	-	-	2	254	-	-
12	-	-	3	410	-	-
13	-	-	2	292	-	-
17	-	-	1	198	-	-
23	-	-	-	-	1	276
24	-	-	-	-	1	282
32	-	-	-	-	1	381
34	-	-	-	-	1	399
45	-	-	-	-	1	531
TOTAL	77	577	112	5,422	7	2,109

Table IV-20 shows the estimated costs of training these miners. At the time of the training, these estimated costs are:

- $15,062 for 7 mines with over 500 employees;
- $39,509 for 112 mines with 20 to 500 employees; and

- $4,580 for 77 mines with fewer than 20 employees.

MSHA estimates that the formal training on tagging will need to be done only once. Thus the training is a one-time cost that needs to be annualized for comparability with other costs. The estimated yearly cost for the total industry for training about tagging is $4,142.

Table IV-20: Industry Costs of Equipment Tagging and Related Actions

Mine Size	Activity	Cost Element	Wage Rate	Hours	Number	Cost
Over 500	Training	Supervisor	$44.97	0.25	168	$ 1,881
		Miner	$19.42	0.25	2,109	$13,181
		Total	At Time of Training			$15,062
			Annualized Cost[a]			$ 1,054
	Tagging	Miner	$19.42	0.067	142	$ 184
		Mechanic	$25.00	0.2	142	$ 710
		Total				$ 894
	Total Yearly Cost					$ 1,948
20 to 500	Training	Supervisor	$44.97	0.25	502	$ 5,621
		Miner	$19.42	0.25	5,422	$33,888
		Total Cost	At Time of Training			$39,509
			Annualized Cost[a]			$ 2,766
	Tagging	Miner	$19.42	0.067	542	$ 702
		Mechanic	$25.00	0.2	542	$ 2,710
		Total				$ 3,412
	Total Yearly Cost					$ 6,178
Under 20	Training	Supervisor	$44.97	0.25	87	$ 974
		Miner	$19.42	0.25	577	$ 3,606
		Total Cost	At Time of Training			$ 4,580
			Annualized Cost[a]			$ 321
	Tagging	Miner	$19.42	0.067	230	$ 298
		Mechanic	$25.00	0.2	230	$ 1,150
		Total				$ 1,448
	Total Yearly Cost					$ 1,769
Total Industry Yearly Cost						$ 9,895

[a] The annualization factor is 0.07, which is equal to the annual discount rate.

Tagging. MSHA estimates that, on average, the annual number of taggings in underground M/NM mines with fewer than 20 employees will be the equivalent of 40 percent of diesel powered equipment in those mines. For larger mines, which generally have more extensive preventive maintenance programs, MSHA estimates that the average annual number of taggings will be the equivalent of 20 percent of diesel powered equipment in those mines. Thus the estimated annual number of taggings is 914, including:

- 142 in mines with over 500 employees;
- 542 in mines with 20 to 500 employees; and
- 230 in mines with fewer than 20 employees.

Table IV-20 also shows the estimated annual cost of tagging, which is estimated to be $5,754, including:

- $894 for tagging in mines with over 500 employees;
- $3,412 for tagging in mines with 20 to 500 employees; and
- $1,448 for tagging in mines with fewer than 20 employees.

Combining the annualized cost of training miners for tagging and the annual cost of tagging and examining equipment and recording these activities, MSHA's estimated total yearly industry cost of Section 57.5066(b) is $9,895.

MINER HEALTH TRAINING (57.5070)

Section 57.5070(a) requires that coal miners covered by the rule who can reasonably be expected to be exposed to DPM be trained in DPM health risks, DPM control methods, personnel responsible for controls, and actions required by miners to ensure that controls operate as intended. In addition, the mine operator is required to maintain records of the training for one year.

Unit Cost Estimates

MSHA's estimate of miner training and recording costs under Section 57.5070 is based on the following assumptions:

- Training will be performed by a mine supervisor.
- Up to 34 miners will be trained at each session.[106]

[106] In effect, a mine will schedule 3 sessions for every 100 miners to be trained. Thus, for example, a mine with 120 miners to be trained would hold four training sessions, while a mine with 40 miners to be trained would

- Hourly wage rates of the personnel involved are:
  - $44.79 for a supervisor,
  - $19.42 for a miner, and
  - $17.57 for a clerical worker.

- All training sessions will be of two durations:
  - Underground M/NM mines with 20 or more employees will hold training sessions that last for 30 minutes, and
  - Underground M/NM mines with fewer than 20 employees will hold training sessions that last for 15 minutes.

- **Recording.** The training will be recorded by having each trainee sign a sign-in sheet, which was prepared by a clerical worker and will be entered into a computer. MSHA estimates that this process will entail the following actions:[107]
  - The supervisor will brief the clerical worker, which will require an estimated five minutes of both persons' time. This will occur once at each mine for each annual round of training, regardless of the number of training sessions held.
  - For each training session, the clerical worker will prepare a registration sheet with the trainees' names on a clipboard and will subsequently record the attendees in a computer file, where it can be stored essentially without cost. These activities will require an estimated 10 minutes for set-up plus one minute for each trainee.
  - Attendees will sign the registration sheet. This will require an estimated 20 seconds each, which will occur during training rather than in addition to it.[108]

These assumptions lead to the following estimates of unit costs of training miners and recording the training:

- Training costs per session will be $11.20, for every 15 minutes of supervisor's time spent as trainer;

- Training costs per miner will be $4.86 for every 15 minutes of miner's time spent in training; and

- Recording costs will include two types of costs:
  - $8.13 per mine for time of a supervisor and clerical worker to set up recordkeeping, and
  - $ .29 per miner for the clerical worker to record the names.

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hold two training sessions. This assumption replaces the PREA assumption that all mines with 20 or more employees would hold an average of 3 training sessions and all smaller mines would hold one training session.

[107] This process replaces the PREA assumption that recording would consist only of each miner taking 30 seconds to sign a list.

[108] Because this cost is included in the training time, it is not explicitly estimated in this section. For purposes of estimating paperwork burden, however, the time is a distinct burden that is estimated separately.

Total Industry Cost

Table IV-21 and Table IV-22 summarize the computation of industry costs of miner training. Table IV-21 is based on a classification of underground M/NM mines by size? under 20 employees (in which case they require 15-minute training sessions) or 20 or more employees (in which case they require 30-minute training sessions). Table IV-21 also groups mines by how many training sessions each mine will hold, based on the number of miners to be trained. The result of these computations is that 77 underground M/NM mines will hold 77 15-minute training sessions, and 119 mines will hold 382 30-minute training sessions.

Table IV-21 Numbers of Miner Health Training Sessions in Underground M/NM Mines

Number of Training Sessions per Mine	Under 20 Employees (15 Minutes)		20 to 500 Employees (30 Minutes)		Over 500 Employees (30 Minutes)	
	Mines	Sess.	Mines	Sess.	Mines	Sess.
1	77	77	46	46	-	-
2	-	-	29	58	-	-
3	-	-	13	39	-	-
4	-	-	10	40	-	-
5	-	-	9	45	-	-
6	-	-	1	6	-	-
7	-	-	-	-	-	-
8	-	-	2	16	-	-
9	-	-	2	18	-	-
10	-	-	-	-	1	10
11	-	-	-	-	2	22
15	-	-	-	-	1	15
16	-	-	-	-	1	16
20	-	-	-	-	1	20
37	-	-	-	-	1	37
TOTAL	77	77	112	262	7	120

Published MSHA data reported by M/NM mine operators[109] indicate that underground M/NM mines have 12,073 employees. MSHA estimates that 5 percent of these are office workers, who do not need miner health training, and the other 95 percent (11,469) are miners who do need to be trained. MSHA estimates that underground M/NM mines with fewer than 20 employees have 770 miners to be trained; mines with 20 to 500 employees have 6,772 miners to be trained; and mines with over 500 employees have 3,972 miners to be trained.[110]

For each mine size class, Table IV-22 multiplies the number of training sessions by the cost of supervisors' time and the number of miners by the cost of their time to produce an estimate of industry costs. Total annual industry miner training costs are estimated to be $117,043.

Table IV-22 also shows the computations of recordkeeping costs. The five-minute briefing of a clerical worker by a supervisor occurs once for each mine. Thus this unit cost is computed and then multiplied by the number of mines. The time it takes for the clerical worker to produce a sign-up sheet depends both on the number of sessions and on the number of miners. Each of these unit cost elements is computed separately, multiplied by the number of units (sessions and miners, respectively), and then added together. Since MSHA anticipates that the miners will pass around and sign the registration sheet during the training session, that cost was already included in the estimated time of the sessions themselves. The total estimated cost of recording miner health training is $4,377.

[109] Mine Safety and Health Administration, "Mine Injury and Worktime, Quarterly."

[110] This allocation by mine size is based on data from MSHA's survey of M/NM mines. The survey data include surface operations and are thus not directly comparable to the data from MSHA's 1977 "Mine Injury and Worktime, Quarterly." MSHA accepted the survey count for mines with fewer than 20 employees, assuming that mines this small were unlikely to have both underground and surface operations. Having subtracted these employees from both counts, MSHA then allocated employees in the "Mine Injury and Worktime, Quarterly" data between mines with 20 to 500 employees and mines with over 500 employees in the same proportions as were found in the survey data.

Table IV-22: Industry Costs of Miner Health Training Actions

Mine Size	Activity	Cost Element	Wage Rate	Hours	Number	Cost
Over 500	Training Cost	Supervisor	$44.79	0.5	120	$ 2,688
		Miner	$19.42	0.5	3,972	$ 38,131
		Total				$ 40,819
	Record-Keeping Cost	Supervisor	$44.79	0.083	7	$ 26
		Clerical Worker	$17.57	0.083	7	$ 10
		Clerical Worker	$17.57	0.017	3,972	$ 1,150
		Total				$ 1,186
	Total Annual Cost					$ 42,005
20 to 500	Training Cost	Supervisor	$44.79	0.5	112	$ 5,868
		Miner	$19.42	0.5	6,772	$ 65,756
		Total Cost				$ 71,624
	Record-Keeping Cost	Supervisor	$44.79	0.083	112	$ 418
		Clerical Worker	$17.57	0.083	112	$ 164
		Clerical Worker	$17.57	0.017	6,772	$ 1,983
		Total				$ 2,565
	Total Annual Cost					$ 74,189
Less Than 20	Training Cost	Supervisor	$44.79	0.25	77	$ 862
		Miner	$19.42	0.25	770	$ 3,738
		Total Cost				$ 4,600
	Record-Keeping Cost	Supervisor	$44.79	0.083	77	$ 287
		Clerical Worker	$17.57	0.083	77	$ 113
		Clerical Worker	$17.57	0.2	770	$ 226
		Total				$ 626
	Total Yearly Cost					$ 5,226
Total Industry Yearly Cost						$121,420

Total estimated annual industry costs for Section 57.570, including training and recordkeeping, are $121,420.

ENVIRONMENTAL MONITORING (57.5071)

The rule requires that mine operators sample the air to determine DPM concentrations. MSHA makes the following assumptions about the scope of sampling:

- All underground M/NM mines will conduct sampling 4 times per year.

- Mine operators will sample:
  - Two working areas in mines with 20 or more employees, and
  - One working area in mines with fewer than 20 employees.

- When conducting sampling, mine operators will take 3 samples in each working area sampled.

Estimated Sampling Cost per Mine per Year

MSHA makes the following assumptions for purposes of estimating costs of environmental monitoring:

- Half of underground M/NM mines with 20 or more employees and all underground M/NM mines with fewer than 20 employees will contract out their sampling.

- The other half of the underground M/NM mines with 20 or more employees will conduct their own in-house sampling and contract out analysis of the samples.

Cost of Contracted Sampling. For mines that contract out their sampling, MSHA estimates that the cost per sample will be:

- $75.00 for a contractor to perform the sample; and

- $33.00 per sample for a lab to analyze the sample.

Computations are summarized in Table IV-23. At this unit cost, MSHA estimates that the total yearly cost for a mine operator to contract out sampling will be:

- $1,296 for a mine with fewer than 20 employees, which requires 12 samples[111] per year; and

- $2,592 for a mine with 20 or more employees, which requires 24 samples[112] per year.

[111] 12 samples/year = (3 samples/working area) * (1 working areas/sampling) * (4 samplings/year)

[112] 24 samples/year = (3 samples/working area) * (2 working areas/sampling) * (4 samplings/year)

Table IV-23: Cost Per Mine of Environmental Monitoring Sampling

Mode of Sampling	Mine Size	Type of Cost	Cost Element	Unit Cost	Units	Cost
Contract Sampling	Less Than 20	Sampling Cost	Sample	$75.00	12	$ 900
			Analysis	$33.00	12	$ 396
			Total Annual Cost			$1,296
	20 or More	Sampling Cost	Sample	$75.00	24	$1,800
			Analysis	$33.00	24	$ 792
			Total Annual Cost			$2,592
In-House Sampling	20 or More	Initial Cost	Miner	$19.42	4	$ 78
			Calibrator	$1,000	1	$1,000
			Cassettes	$ 650	3	$1,950
			Total Cost	Initial		$3,028
				Annualized[a]		$ 431
		Sampling Cost	Cassettes	$20.00	24	$ 480
			Labor	$19.42	8	$ 155
			Analysis	$33.00	24	$ 792
			Total Annual Cost			$1,427
		Total Yearly Cost				$1,858

[a] Annualized over 10 years using an annual discount rate of 7.0 percent.

Cost of In-House Sampling. MSHA's estimate of the costs of a large mine doing its own sampling is based on the following assumptions and estimates:

- MSHA estimates that it will take 4 hours of a miner's time (at $19.42/hour) to become familiar with the method of sampling and equipment used by reading materials and asking MSHA inspectors questions about sampling.

- For costing purposes, MSHA assumes that mine operators will use the sampling and analytical method developed by the National Institute of Occupational Safety and Health, known as NIOSH Method 5040, although MSHA recognizes that mine operators may use a different sampling and analytical method to perform sampling.

- MSHA estimates that each mine operation doing its own sampling will initially need to purchase equipment, which MSHA estimates will have a useful life of 10 years. This equipment consists of:
    - Three sampling systems, which include a pump, a submicron impactor, and charger, which—based on conversations with pump manufacturers—sell for $650 each, and
    - A calibration device to calibrate the sampling instruments, costing about $1,000.

- MSHA estimates that a disposable filter cassette, which costs $20, is attached to the sampling instrument each time the sample is taken.

- MSHA estimates that it will take a miner 20 minutes for sampling activities, including:
    - Hooking up the pumps to charge,
    - Assembling the pump components before sampling,
    - Washing the pump after sampling is conducted, and
    - Filling out information regarding the sample.

- MSHA estimates that analysis of samples at a laboratory will cost $33 per sample.

Table IV-23 shows the computation of the yearly cost of a mine's conducting its own sampling. Table IV-23 indicates that initial costs will total $3,028, but that the annual equivalent of this cost, amortized over 10 years using an annual discount rate of 7.0 percent, is $431. Table IV-23 also shows that the time and materials cost of a sample is $26.47. For 24 samples[113] this cost is $635.28 per year. Analysis of samples is an additional $33.00 per samples, or $792 for 24 samples. Thus the annual cost for sampling is estimated to be $1,427.28. The total yearly cost for a mine operator to do his own sampling is $1,858.35.

[113] 24 samples/year = (3 samples/working area) * (2 working areas/sampling) * (4 samplings/year)

Unit Cost of Related Activities

In addition to sampling itself, Section 57.5071 requires underground M/NM mine operators to take a number of related actions:

- Mine operators must provide affected miners and their representatives with a reasonable opportunity to observe the diesel particulate monitoring required by Section 57.5071 and to inform them of the dates and times that they intend to conduct monitoring (Section 57.5071(b)).

- If the DPM concentration limit is exceeded, mine operators must take corrective action and must post corrective actions that were taken (Section 57.5071(c)).

- Mine operators must also post sample results on the mine bulletin board within 15 days of receipt (Section 57.5071(d)).

Notification. MSHA assumes that mine operators will notify miners and their representatives orally, by giving miners written notices, or by posting a written notice. Specific assumptions and estimates concerning the costs of notification are as follows:

- Oral notification will be made at the beginning of each shift at an occasion such as a daily safety meeting. MSHA estimates that notification will require two minutes time of a supervisor who makes the announcement and of all of the miners.

- Written notice to the miners will require the following actions:
  - A supervisor will spend five minutes briefing a clerical worker.
  - The clerical worker will prepare, copy, and deliver a one-page notice to each miner, which will require 5 minutes of the clerical worker's time per miner.

- Posting a notice will require the following actions:
  - A supervisor will spend five minutes briefing a clerical worker.
  - The clerical worker will prepare, copy, and post a one-page notice, which will require a total of 10 minutes of the clerical worker's time.

Table IV-24 provides estimates of the cost of each mode of notification for each of the three size classes of mine. These costs would be incurred each time a mine does sampling for environmental monitoring. As noted above, MSHA estimates that this would occur four times each year.

Table IV-24: Unit Cost of Notification of Environmental Monitoring

Type of Notice	Mine Size	Cost Element	Unit Cost	Hours Units	Times	Cost
Oral Notice	Less Than 20	Supervisor	$44.79	0.033	1[a]	$ 1.49
		Miner	$19.42	0.033	10[b]	$ 6.47
		Total				$ 7.97
	20 to 500	Supervisor	$44.79	0.033	2[a]	$ 2.99
		Miner	$19.42	0.033	60[b]	$ 38.84
		Total				$ 41.83
	Over 500	Supervisor	$44.79	0.033	3[a]	$ 4.48
		Miner	$19.42	0.033	561[b]	$363.15
		Total				$367.63
Written Notice	Less Than 20	Supervisor	$44.79	0.083	1	$ 3.73
		Clerical Worker	$17.57	0.083	10[b]	$ 14.64
		Copying	$ .15	1	10[b]	$ 1.50
		Total				$ 19.87
	20 to 500	Supervisor	$44.79	0.083	1	$ 3.73
		Clerical Worker	$17.57	0.083	60[b]	$ 87.85
		Copying	$ .15	1	60[b]	$ 9.00
		Total				$100.58
	Over 500	Supervisor	$44.79	0.083	1	$ 3.73
		Clerical Worker	$17.57	0.083	561[b]	$821.40
		Copying	$ .15	1	561[b]	$ 84.15
		Total				$909.28
Posted Notice	All	Supervisor	$44.79	0.083	1	$ 3.73
		Clerical Worker	$17.57	0.167	1	$ 2.93
		Copying	$ .15	1	1	$ .15
		Total				$ 6.81

[a] Number of shifts operated, by mine size class.

[b] Average Number of miners per mine for mine size class.

Other Compliance Activities. Table IV-25 summarizes estimates of the unit costs of other actions related to sampling. These costs are based on the following assumptions:

- A miner or miner's representative who observes the sampling will put in the same time as the miner who conducts the sampling (20 minutes). The estimated unit cost is $6.47 for each observation of sampling.

- If a mine environment is above the DPM concentration limits, MSHA believes that this would occur because the mine operator was not correctly implementing activities already required by Section 57.5060. In such a case, corrective action would entail a relatively straightforward activity such as checking and/or adjusting ventilation or performing basic maintenance. MSHA estimates that such corrective action would take a miner about one hour to perform. Thus the estimated unit cost of a corrective action is $19.42.

- MSHA estimates that it would take a supervisor about 15 minutes to write up and post a notice on corrective action taken. The estimated unit cost of posting a corrective action is $11.20.

- Once sampling results are received, MSHA estimates that it would take a clerical worker 10 minutes to make two copies of a one-page notice and to post one and deliver the other to the miners' representative. The estimated unit cost of posting and delivering the results of each round of sampling is $3.23.

Table IV-25: Unit Cost of Other Activities Related to Environmental Monitoring

Action	Cost Element	Unit Cost	Hours (Units)	Cost
Observe Sampling	Miner	$19.42	0.33333	$ 6.47
Post and Take Corrective Action	Supervisor	$44.79	0.25	$ 11.20
	Miner	$19.42	1	$ 19.42
	Total			$ 30.62
Post Sampling Results and Notify Miners' Representative	Clerical Worker	$17.57	0.16667	$ 2.93
	Copying	$ .15	2	$ .30
	Total			$ 3.23

Industry Costs

Sampling. Table IV-26 summarizes the computation of total industry yearly costs of Section 57.5071. The total estimated yearly cost of environmental monitoring sampling $364,226, of which $99,792 falls on underground M/NM mines with fewer than 20 employees; $249,224 on mines with 20 to 500 employees, and $15,210 on mines with over 500 employees.

Table IV-26: Total Industry Cost of Environmental Monitoring Sampling and Related Activities

Mine Size	Activity	Mode	Unit Cost	Mines	Times	Cost
Less Than 20	Sampling	Contract	$1,296	77	1	$ 99,792
	Notifying	Oral	$ 7.97	35	4	$ 1,116
		Written	$ 19.87	27	4	$ 2,146
		Posted	$ 6.81	15	4	$ 409
	Observation		$ 6.47	77	3	$ 1,495
	Corrective Action		$ 30.62	77	0.2	$ 472
	Sampling Results		$ 3.23	77	4	$ 995
	Total Yearly Cost					$106,425
20 to 500	Sampling	Contract	$2,592	56	1	$145,152
		In-House	$1,858	56	1	$104,072
	Notifying	Oral	$ 41.83	51	4	$ 6,533
		Written	$100.58	39	4	$ 15,690
		Posted	$ 6.81	22	4	$ 599
	Observation		$ 6.47	112	6	$ 4,348
	Corrective Action		$ 30.62	112	0.4	$ 1,372
	Sampling Results		$ 3.23	112	4	$ 1,447
	Total Yearly Cost					$297,213
Over 500	Sampling	Contact	$2,592	3	1	$ 7,776
		In-House	$1,858	4	1	$ 7,434
	Notifying	Oral	$367.63	3	4	$ 4,412
		Written	$909.28	3	4	$ 10,911
		Posted	$ 6.81	1	4	$ 27
	Observation		$ 6.47	7	6	$ 272
	Corrective Action		$ 30.62	7	0.4	$ 86
	Sampling Results		$ 3.23	7	4	$ 90
	Total Yearly Cost					$ 31,008
Total Industry Yearly Cost						$434,646

Notification. Notification to miners of sampling will take place each time a set of samples is taken? four times a year. MSHA makes the following assumptions with respect to the mode of notification used by underground M/NM mines:

- Oral notification will be used by 45 percent of mines, including:
  - 35 mines with fewer than 20 employees,
  - 51 mines with 20 to 500 employees, and
  - 3 mines with over 500 employees.

- Written notification will be used by 35 percent of mines, including:
  - 27 mines with fewer than 20 employees,
  - 39 mines with 20 to 500 employees, and
  - 3 mines with over 500 employees.

- Posted notification will be used by 20 percent of mines, including:
  - 15 mines with fewer than 20 employees,
  - 22 mines with 20 to 500 employees, and
  - 1 mine with over 500 employees.

Based on these assumptions, the total estimated yearly cost of sampling notification is $41,843, of which $3,671 falls on underground M/NM mines with fewer than 20 employees; $22,822 on mines with 20 to 500 employees, and $15,350 on mines with over 500 employees. Table IV-26 summarizes the computations of these costs.

Observation. MSHA anticipates that approximately 25 percent of the environmental monitoring samples taken by underground M/NM mine operators will be observed by a miner or miners' representative who is on duty. This averages 3 samples per year for mines with fewer than 20 employees and 6 samples per year for larger mines. In other cases, MSHA expects that either the miners would forgo their observation rights or an off-duty miner or miners' representative would observe the sampling, in which case the mine operator would not incur costs. Based on these assumptions, the total estimated yearly cost of observation is $6,115, of which $1,495 falls on underground M/NM mines with fewer than 20 employees; $4,348 on mines with 20 to 500 employees, and $272 on mines with over 500 employees. Table IV-26 summarizes the computations of these costs.

Corrective Action. If an underground M/NM mine is in compliance with other requirements of the rule, MSHA expects that it will be a rare anomaly for environmental monitoring to show that a DPM concentration limit has been exceeded. MSHA estimates that, on average, each time sampling is done 5 percent of the production areas sampled will be found to be over the DPM concentration limit. Thus the probability is 0.2[114] that a mine with fewer than 20 employees will need to take corrective action in any given year and 0.4[115] that a larger mine will have to take corrective action in any given year. Based on these assumptions, the total

[114] 0.2 = 0.05 x (1 production area per round of sampling) x (4 rounds of sampling per year)

[115] 0.4 = 0.05 x (2 production areas per round of sampling) x (4 rounds of sampling per year)

estimated yearly cost of corrective actions is $1,930, of which $472 falls on underground M/NM mines with fewer than 20 employees; $1,372 on mines with 20 to 500 employees, and $86 on mines with over 500 employees. Table IV-26 summarizes the computations of these costs.

Posting. Posting and distribution of sampling results will occur for every round of sampling? four times a year for all mines. Based on this assumption, the total estimated yearly cost of posting and distributing sampling results is $2,532, of which $995 falls on underground M/NM mines with fewer than 20 employees; $1,447 on mines with 20 to 500 employees, and $90 on mines with over 500 employees. Table IV-26 summarizes the computations of these costs.

Total Costs. The total estimated yearly cost to underground M/NM mines of Section 57.5071, as shown in Table IV-26, is $434,646. Of this total, $106,425 falls on underground M/NM mines with fewer than 20 employees; $297,213 on mines with 20 to 500 employees, and $31,008 on mines with over 500 employees.

DIESEL PARTICULATE RECORDS (57.5075)

The rule has two requirements for production of records designated as "health" records related to DPM:

- Upon request from an authorized representative of the U.S. Department of Health and Human Services (DHHD), underground M/NM mine operators shall provide access to any health record (Section 57.5075(b)(3)).

- Upon request by a miner, former miner, or personal representative of a miner, underground M/NM mine operators shall provide copies of health records, with the first copy of each record provided without charge (Section 57.5075(b)(4)).

Unit Costs

MSHA assumes that some miners leaving their job at the mine or retired miners would request a copy of the health records. The health records generated by requirements of this rule that a miner could request would consist of copies of the exposure measurements (sampling results), which this rule requires underground M/NM mine operators to maintain. MSHA bases its estimate of unit costs on the following assumptions:

- The sampling results provided will consist of four one-page reports.

- It will take a clerical worker 5 minutes to respond to each request.

- Direct costs include:
  - Copying costs of $0.15 per page $0.60 per request, and
  - Postage of $0.33 for each request.

Thus the estimated cost of responding to each request for health records is $2.40.[116]

Industry Total Costs

MSHA bases its estimate of total industry costs on the following assumptions about the number of requests for health records:

- On average, a copy of sampling results would be requested annually by 10 percent of miners, or:
  - One miner for each of the 77 mines with fewer than 20 employees (or a total of 77 requests per year),
  - Six miners for each of the 112 mines with 20 to 500 employees (or a total of 672 requests per year), and
  - Fifty-six miners for each of the 7 mines with over 500 employees (or a total of 392 requests per year).

- On average, DHHS will request a copy of sampling results from 10 percent of the mines each year, or:
  - A total of 8 requests per year to mines with fewer than 20 employees,
  - A total of 11 requests per year to mines with 20 to 500 employees, and
  - A total of 1 request per year to mines with over 500 employees.

Based on these assumptions, the total estimated yearly cost to underground M/NM mines of Section 57.5075 is $2,786. Of this total, $204 falls on underground M/NM mines with fewer than 20 employees; $1,639 on mines with 20 to 500 employees, and $943 on mines with over 500 employees. Table IV-27 summarizes the computations of these costs.

[116] $2.40 = ($17.57/12) + $0.60 + $0.33

Table IV-27: Total Costs of Requests for Health Records

Mine Size	Number of Requests		Unit Cost per Request	Cost
	Miners	DHHS		
Fewer Than 20 Employees	77	8	$2.40	$ 204
20 to 500 Employees	672	11	$2.40	$1,639
Over 500 Employees	392	1	$2.40	$ 943
All Mines	1,141	20	$2.40	$2,786

TOTAL COSTS OF THE RULE

Table IV-28 shows the total estimated yearly compliance costs for M/NM mine operators. Costs are disaggregated by size of mine in Chapter V. MSHA estimates that this rule will have a yearly cost for the M/NM mine industry of $25.2 million.

TABLE IV-28: Total Yearly Compliance Costs for Mine Operators

Requirement	Total Yearly Industry Cost
Section 57.5060(a) (DPM Concentration Limits)[a] Section 57.5060(b)	$ 24,193,818
Section 57.5067 (Newly Introduced Engines)[b]	$ 1,750
Section 57.5060(c) (Extension Application)[c]	$ 585
Section 57.5060(d) (Respirator Protection)[d]	$ 372,089
Section 57.5062 (DPM Control Plans)[e]	$ 8,444
Section 57.5066(c) (Maintenance Training)[f]	$ 3,746
Section 57.5066(b) (Tagging and Examination)[g]	$ 9,895
Section 57.5070 (Miner Health Training)[h]	$ 121,420
Section 57.5071 (Environmental Monitoring)[I]	$ 434,646
Section 57.5075 (Diesel Particulate Records)[j]	$ 2,786
TOTAL	$ 25,149,179

[a] Source: Table IV-6 and Table IV-10.

[b] Source: Footnote 85.

[c] Source: Table IV-11.

[d] Source: Table IV-15.

[e] Source: Table IV-16.

[f] Source: Table IV-18.

[g] Source: Table IV-20.

[h] Source: Table IV-22.

[i] Source: Table IV-26.

[j] Source: Table IV-27.

FEASIBILITY

The Agency has considered the technological and economic feasibility of the rule for the segment of underground metal/nonmetal mines that use diesel-powered equipment. As discussed in more detail in Part V of the preamble, MSHA has concluded that the requirements of the final rule are technologically and economically feasible for underground metal/nonmetal mines that use diesel-powered equipment.

In evaluating whether a lower concentration limit is technologically feasible for this mining sector, MSHA considered several examples of real-world situations. These examples, and a detailed description of the methodology by which they were developed, were published in the preamble to the proposed rule (65 FR 58198 et seq.). The examples were based on data about equipment and ventilation from several actual underground metal and nonmetal mines: a salt mine; an underground limestone mine that operates two completely different shifts, one for production, and one for support; and a multi-level gold mine. The data were placed into a computer model to estimate the ambient dpm that would remain in a mine section after the application of a particular combination of control technologies. The details of this computer model, referred to as "The Estimator," have subsequently been published in the literature (Haney and Saseen, Mining Engineering, April 2000). The results for the salt and limestone mines were written up in detail and placed into the rulemaking record, with actual mine identifiers removed; the study of the underground gold mine is based on information supplied by inspectors, and all available data were presented in the preamble to the proposed rule.

MSHA had picked these mines because the Agency originally thought the conditions there were such that these mines would have great difficulty in controlling dpm concentrations. As the results indicated, however, even in these apparently difficult situations, the concentration of dpm could be lowered to well below 200_{DPM} mg/m^3 with readily available control techniques.[117]

In addition, sufficient time is provided for mine operators to comply with the rule's requirements. Even though emission controls are readily available to meet the rule's requirements, underground metal/nonmetal mines have 18 months after the date of promulgation to comply with the interim concentration limit of 400_{TC} mg/m^3, while implementation of the final concentration limit of 160_{TC} mg/m^3 does not begin until 5 years after the date of promulgation. The delay in the rule's promulgation allows operators adequate time to familiarize themselves with the compliance technology and to train mine personnel in the maintenance and use of such technology.

With respect to economic feasibility, as previously estimated in this chapter, the affected underground coal mines will incur costs of approximately $25.2 million yearly to comply with the final rule. Data on underground M/NM mines are published by the U.S. Geological Survey.[118] These data include both tonnage[119] and value.[120] The commodities are grouped into

[117] Moreover, as noted in Part V of the preamble, MSHA can adopt a rule which is not feasible for every mine; the standard is that the rule be feasible for the industry as a whole.

[118] U. S. Geological Survey, "Mineral Industry Surveys: Mining and Quarrying Trends, 1998 Annual Review, April 2000.

metals and industrial minerals. For underground metal/nonmetal mines as a whole, MSHA has computed revenues by multiply tonnage by value per ton for underground metals mines[121] and for underground industrial minerals mines[122] and then added the two figures together to obtain a measure of total revenues. Total underground M/NM mine revenues for 1998 were $3.726 billion.[123] Therefore, the estimated yearly costs of the rule to underground M/NM mines, $25.2 million, are 0.677 percent of 1998 revenues.[124] This is about two thirds of the level—1.0 percent of revenues—that is typically used as a threshold value for significant impacts. Therefore, MSHA concludes that the final rule is economically feasible. [125]

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[119] U.S.G.S., Table 2: Material Handled at Surface and Underground Mines in the United States in 1998, by Commodity and State.

[120] U.S.G.S., Table 3: Value of Principal Mineral Products and Byproducts of Surface and Underground Mines in the United States in 1998.

[121] $1,677,828,000 = (53,400,000 metric tons) x ($31.40/metric ton).

[122] $2,048,110,000 = (109,000,000 metric tons) x ($18.79/metric ton).

[123] $3,725,938,000 = $1,677,828,000 + $2,048,110,000

[124] 0.0067544621 = $25,166,707 / $3,725,938,000

[125] For the metal/nonmetal mining industry as a whole, the economic impact is even smaller, with compliance costs equal to only 0.06 percent of yearly industry revenues of about $40.0 billion. Therefore, the Agency concludes that the final rule is economically feasible for the metal/nonmetal mining industry as a whole.

V. REGULATORY FLEXIBILITY CERTIFICATION AND FINAL REGULATORY FLEXIBILITY ANALYSIS

INTRODUCTION

In accordance with § 605 of the Regulatory Flexibility Act of 1980 as amended, MSHA has analyzed the impact of the final rule on small businesses. Further, MSHA has made a determination with respect to whether or not it can certify that this final rule will not have a significant economic impact on a substantial number of small entities that are affected by this rulemaking. Under the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the Regulatory Flexibility Act (RFA), MSHA must include a factual basis for this certification. If the final rule does have a significant economic impact on a substantial number of small entities, then the Agency must develop a final regulatory flexibility analysis.

The Agency has, as required by law (5 U.S.C. § 605), developed a final regulatory flexibility analysis which is set forth in this chapter of the REA. In addition to a succinct statement of the objectives of the final rule and other information required by the Regulatory Flexibility Act, the analysis reviews alternatives considered by the Agency with an eye toward minimizing the economic impact on small business entities.

A copy of the final regulatory flexibility analysis has been included in the preamble to the final rule, which MSHA will mail to every underground M/NM mine operator.

DEFINITION OF A SMALL MINE

Under the RFA, in analyzing the impact of a rule on small entities, MSHA must use the Small Business Administration (SBA) definition for a small entity or, after consultation with the SBA Office of Advocacy, establish an alternative definition for the mining industry by publishing that definition in the Federal Register for notice and comment. MSHA has not taken such an action, and hence is required to use the SBA definition.

The SBA defines a small entity in the mining industry as an establishment with 500 or fewer employees (13 CFR 121.201). Of the 196 underground M/NM mines that use diesel powered equipment and are therefore affected by this rulemaking, 189 (or all but 7) fall into this category and hence can be viewed as sharing the special regulatory concerns that the RFA was designed to address.

Traditionally, the Agency has also looked at the impacts of its rules on a subset of mines with 500 or fewer employees—those with fewer than 20 employees, which the mining community refers to as "small mines." The way these small mines perform mining operations is generally recognized as being different from the way larger mines operate. These small mines differ from larger mines not only in the number of employees, but also, among other things, in economies of scale in material produced, in the type and amount of production equipment, and in supply inventory. Therefore, their costs of complying with MSHA rules and the impact of

MSHA rules on them will also tend to be different. It is for this reason that “small mines,” as traditionally defined by the mining community, are of special concern to MSHA.

This analysis complies with the legal requirements of the RFA for an analysis of the impacts on "small entities" while continuing MSHA's traditional look at "small mines." MSHA concludes that the final rule would not have a significant economic impact on small entities, as defined by SBA, when considered as a group. However, MSHA has determined that the final rule arguably would have a significant economic impact on a subset of small entities that are covered by this rulemaking. That subset is small underground M/NM mines as traditionally defined by MSHA, those mines with fewer than 20 employees. This subset of affected mines constitutes a substantial number of small entities.

SCREENING ANALYSIS

General Approach

The Agency’s analysis of impacts on “small entities” begins with a "screening" analysis. The screening compares the estimated compliance costs of a rule for small entities in the sector affected by the rule to the estimated revenues for those small entities. When estimated compliance costs are less than 1 percent of the estimated revenues (for the size categories considered), the Agency believes it is generally appropriate to conclude that there is no significant economic impact on a substantial number of small entities. When estimated compliance costs exceed 1 percent of revenues, it tends to indicate that further analysis may be warranted.

Derivation of Costs and Revenues

The compliance costs presented in this chapter were previously introduced in Chapter IV of this REA along with an explanation of how they were derived. Table V-1 summarizes the total yearly cost of the final rule by mine size.

TABLE V-1: Total Yearly Compliance Costs for M/NM Mine Operators by Mine Size Class

Requirement	Total Yearly Industry Cost By Mine Size Class		
	Under 20 Employees	20 to 500 Employees	Over 500 Employees
Section 57.5060(a)&(b) DPM Concentration Limits	$3,909,865	$17,068,073	$3,215,869
Section 57.5067 Newly Introduced Engines	$ -	$ 2,848	$ 712
Section 57.5060(c) Extension Application	$ 148	$ 401	$ 36
Section 57.5060(d) Respirator Protection	$ 67,247	$ 285,690	$ 17,855
Section 57.5062 DPM Control Plans	$ 1,408	$ 6,336	$ 704
Section 57.5066(c) Maintenance Training	$ 894	$ 2,384	$ 468
Section 57.5066(b) Tagging and Examination	$ 1,769	$ 6,178	$ 1,948
Section 57.5070 Miner Health Training	$ 5,226	$ 74,189	$ 42,005
Section 57.5071 Environmental Monitoring	$ 106,425	$ 297,213	$ 31,008
Section 57.5075 Diesel Particulate Records	$ 204	$ 1,639	$ 943
TOTAL COST	$4,093,186	$17,744,951	$3,311,548
AVERAGE COST PER MINE	$ 53,158	$ 158,437	$ 473,078

Data on underground M/NM mines published by the U.S. Geological Survey[126] were used for tonnage and value of underground M/NM mines. These data, however, are not disaggregated by mine size class. MSHA collects data, by mine size, on both average employees and employee hours.[127] MSHA has used these data to apportion estimated revenues by mine size class.

MSHA has assumed that tonnage is proportional to employee hours. This assumption (rather than proportionality with employees) implicitly adjusts for different shift lengths associated with different sizes of mines. MSHA has also assumed that all underground M/NM mines use diesel powered equipment.[128] Using these assumptions, MSHA has computed the percentages of employee hours of all underground M/NM mines that are accounted for by each size class. MSHA estimates that these percentages of total revenues are accounted for by the different mine size classes.

Results of the Screening Analysis

The final rule applies to underground M/NM mines that use diesel-powered equipment. Table V-1 shows that the estimated yearly cost of the final rule as a percentage of yearly revenues is about 0.8 percent for the affected underground M/NM mines with 500 or fewer employees.

However, for a subset of affected underground M/NM mines, those with fewer than 20 employees, estimated yearly costs are equal to about 2.16 percent of yearly revenues for this subset of mines. The economic impact on these small mines, which constitute a substantial number of small entities affected by the final rule, is larger than one percent of their revenues. MSHA therefore cannot certify that the final rule would not have a significant impact on a substantial number of small entities.

The Agency has prepared a final regulatory flexibility analysis, as required by law, which explains the steps MSHA has taken to minimize the burden on these small entities and justifies the costs placed on them.

[126] U. S. Geological Survey, "Mineral Industry Surveys: Mining and Quarrying Trends, 1998 Annual Review, April 2000.

[127] U.S. Department of Labor, MSHA, 1998 Final MIS data CM441 cycle 1998/198.

[128] This assumption ignores the fact that some very small mines do not use diesel powered equipment. MSHA believes, however, that these mines are generally very small (even among the mines with fewer than 20 employees) and that many of them operate only intermittently. Thus they account for employee hours proportionately far less than their numbers. Accordingly, MSHA believes that the most accurate way to interpret the data is to disregard the fact that these mines do not use diesel powered equipment.

Table V-2
Estimated Yearly Costs of Final Rule Relative to Yearly Revenues
For Underground M/NM Mines That Use Diesel-Powered Equipment

Mine Size	Final Rule Yearly Costs (in thousands)	Revenues[a] (in thousands)	Costs as Percentage Of Revenues
< 20 emp.	$4,093	$189,305	2.16%
≤ 500 emp.	$21,837	$2,745,137	0.80%

[a] Source: U.S. Geological Survey, "Mineral Industry Surveys: Mining and Quarrying Trends, 1998 Annual Review, April 2000 and U.S. Dept. of Labor, Mine Safety and Health Administration , Office of Standards, Regulations, and Variances based on 1998 MIS data, CM441 cycle 1998/198.

FINAL REGULATORY FLEXIBILITY ANALYSIS

As indicated above, the estimated yearly cost of the final rule on a subset of small entities, those with fewer than 20 employees, is 2.16 percent of yearly revenue. This percentage is just over twice the value (1.0 percent) below which MSHA could say with reasonable confidence that the final rule does not have a significant economic impact on a substantial number of small entities. Accordingly, MSHA has prepared a final regulatory flexibility analysis.

Need for, and Objective of, the Rule

Need. The rule is needed because underground miners in mines that use diesel powered equipment are currently exposed to extremely high concentrations of diesel particulate matter (DPM). Based on MSHA field studies, median DPM concentrations to which underground miners are exposed range up to 200 times as high as average environmental exposures in the most heavily polluted urban areas and up to 10 times as high as median exposures estimated for the most heavily exposed workers in any occupational group other than underground miners.

The available scientific information indicates that miners exposed to the extremely high DPM concentrations found in underground mines are at significant excess risk of experiencing three kinds of material impairment to their health:

- Increased risk of lung cancer has been linked to chronic occupational DPM exposure.
- Increased acute risk of death from cardiovascular, cardiopulmonary, or respiratory causes has been linked to short or long term DPM exposures.

- Sensory irritations and respiratory symptoms can result from even short term DPM exposures. Besides being potentially debilitating, such effects can distract miners from their responsibilities in ways that could pose safety hazards for everyone in the mine.

Although definitive dose-response relationships have not yet been established (especially for the acute effects), the best available evidence indicates that the risks are substantial.

Objective. The objective of the rule is to lower DPM exposures in underground M/NM mines to concentrations similar to the worst levels to which other occupational groups are exposed. By doing so, the rule is designed substantially to lower the health risks associated with DPM. Expected benefits include a minimum of 8.5 cases of lung cancer avoided per year.[129]

Significant Issues Raised in Response to the Initial RFA

Comments. The principal issue raised in comments on the PREA was that, for a variety of reasons, MSHA had substantially understated the costs of controlling DPM. The implication of these comments was that the rule was economically infeasible. The most comprehensive comments along these lines were by Head,[130] who argued (among other things) that MSHA had made the following errors and omissions in its analysis:

- MSHA had (according to Head) understated the numbers of machines and mines affected, including:
  - Understatement of the number of diesel units in underground M/NM mines by more than 50 percent, and
  - Understatement of the number of ventilation upgrades needed by 20 percent to 40 percent

- MSHA had understated a number of costs, including:
  - Understatement of the cost of replacement engines by up to one third,
  - Understatement of the costs of filters on larger engines by 20 percent, and
  - Understatement of the costs of vehicle cabs by about 60 percent.

- MSHA had omitted some costs entirely, including:
  - Installation costs of retrofitting new engines in old equipment, which ran as high as three times the costs of the engines themselves, and
  - Major ventilation improvements needed by about one third of the mines.

[129] As noted in Chapter III of this REA, this lower bound figure could significantly underestimate the magnitude of the health benefits. For example the estimate based on the mean value of all the studies examined is 49 lung cancer deaths avoided per year.

[130] H. John Head, "Review of Economic and Technical Feasibility of Compliance Issues Related to: Department of Labor – MSHA, 30 CFR Part 57 – Proposed Rule for Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners," Report prepared under contract with the National Mining Association, July 21, 1999.

Based on his own numbers, Head estimated yearly compliance costs to be three times as high as MSHA's estimate of the cost of the proposed rule of $19.2 million.

Analytical Assessment of Issues. MSHA considered the comments and reviewed its assessment of costs very carefully. The assessment focused on Head's comments, since his exposition was detailed enough for analysis of the basis of his estimates. MSHA responded in a variety of ways, which are summarized below.

The key to the issue of the number of diesel units affected by the rule was how one interpreted the number. MSHA resolved this issue by recognizing that not all diesel powered equipment would be affected in the same manner. In fact, the machines in Head's total count should be grouped into three categories: active, spares, and disused. Active diesel powered equipment (essentially MSHA's original count) needs to be fitted for everyday use. Spare equipment needs to be controlled for occasional use as back-up. Disused equipment is essentially not affected by the rule. A shift in the principal control strategy from engine replacement to ceramic filters (discussed further below) made these distinctions operational. With ceramic filters, both active and spare equipment can be fitted with filters (a relatively inexpensive operation), but filters need to be regenerated and changed (which encompasses most of the costs) only to the extent that the equipment is actually used.

MSHA believes that Head was simply wrong about the number of mines needing upgrades to their ventilation systems. Head appeared to believe that MSHA's count was arbitrary, and the basis for his proposed number was obscure. In fact, MSHA has based its count on mine-specific data on the existence and rate of air flow of ventilation systems. Thus, MSHA retained its original count.

MSHA's review of comments on costs produced different conclusions for different specific costs:

- MSHA accepted and used Head's estimate of costs of ceramic filters.

- MSHA does not entirely agree with Head's estimates of costs of new engines. Moreover, expensive new engines are technologically advanced and tend to produce substantial gains in productivity and savings in operating costs, which Head did not consider. The issue of engine costs became irrelevant, however, under a strategy of filters as the first-used control device.

- MSHA's re-examination of the costs of cabs indicated that MSHA's cost estimate is appropriate for equipment for which equipment manufacturers can provide off-the-shelf kits for retrofitting equipment, and Head's cost estimate is appropriate for equipment for which cabs have to be custom designed and retrofitted. Since the rule does not mandate cabs and MSHA expects cabs to be used on a relatively small proportion of equipment, however, MSHA believes that mine operators will not retrofit equipment for which cabs would need to be custom designed. Accordingly, MSHA has retained its original cost estimate.

- Head concurred with MSHA on the costs of ventilation improvements. While these costs appear to be an appropriate average estimate for M/NM mines as a whole, there is a distinct possibility that they may be too high for very small M/NM mines.[131] In the context of regulatory flexibility analysis, MSHA considers these cost estimates to be fairly conservative.

MSHA agrees that certain costs were omitted, but the conclusions of MSHA's reconsideration of these costs also vary with the cost:

- MSHA has accepted Head's estimates for major ventilation improvements and has included them in the analysis of costs.

- Head's comment that MSHA had omitted the costs of retrofitting new engines in old equipment is correct, although MSHA does not agree with the size of Head's cost estimates. The key issue, however, is that the strategy of relying primarily on filters does not entail retrofitting engines. Thus Head's comment is not germane.

Concentration Limits and the Toolbox. This standard for underground M/NM mines is a performance standard, with an interim DPM concentration limit of 500 micrograms/m^3, followed by a final DPM concentration limit of 200 micrograms/m^3. The rule encourages mine operators to use any combination of a "toolbox" of measures to meet these concentration limits. For cost estimation purposes, however, it is necessary to assume a specific set and sequence of control measures. Specifically, in the PREA MSHA assumed that:

- The interim standard would be met by replacing engines, installing oxidation catalytic converters, and improving ventilation; and

- The final standard would be met by adding cabs and filters.

Both the general strategy and the specific proportions of diesel powered equipment to be controlled by each measure were based on an optimizing approach, in which the most cost-effective additional measures were selected for additional DPM reductions at each stage.

In his comments, Head exactly replicated MSHA's assumptions about how many pieces of each kind of diesel equipment would be controlled, how they would be controlled, and the sequence in which controls would be used. Although his cost estimates differed substantially from MSHA's, Head made no attempt to optimize the use of DPM control "tools" from the toolbox.

[131] The issue is further complicated by the fact that mines that are "small" in terms of employment vary considerably among commodities and mining techniques in their physical size and ventilation requirements. Accordingly, MSHA has not attempted to make a separate cost estimate of ventilation improvement costs for "small" M/NM mines as a group.

Substantially the most important of Head's changes is to make filters much cheaper, relative to engine replacement. At the same time, data collected by MSHA since publication of the PREA indicate that filters are more effective than was previously understood. This finding has further enhanced the cost-effectiveness of filters, relative to engine replacement. These changes in information have caused MSHA to go back to the toolbox and rethink the optimized compliance strategy. The revised compliance strategy, upon which MSHA bases the revised estimates of compliance costs, reverses the two most widely used measures from the toolbox. MSHA now anticipates that:

- The interim DPM standard of 500 micrograms/m^3 will be met with filters, cabs, and ventilation; and

- The final DPM standard of 200 micrograms/m^3 will be met with more filters, ventilation, and such turnover in equipment and engines as will have occurred in the baseline.

This new approach uses the same toolbox and optimization strategy that was used in the PREA. Since relative costs are different, however, the tools used and costs estimated are quite different. The effect on costs is substantial. Most of the difference between Head's cost estimate and the cost estimate in the REA is attributable to this change in strategy.

Cost of Low Sulfur Fuel

On average, MSHA estimates that the costs of low sulfur fuel are negligible. When they are measurable, it is because the mine is located in an area where heating fuel has relatively large market share compared to diesel fuel used for vehicles. This circumstance is unrelated to mine size. Most mines are not located in these regions and there is no evidence that small mines are disproportionately concentrated in these regions.

Changes in the Rule. Because the design of the rule was already flexible, there was not a great deal of opportunity for changes in the rule (as opposed to changes in the choice of tools) that would produce substantial reductions in cost without substantial loss of protection. MSHA did make one significant change, however, by allowing compliance with listed EPA standards as a substitute for MSHA approval of new engines. This change resulted in eliminating a cost of approval that was estimated in the PREA to average $2,500 per new engine.

Small Entities to Which the Rule Will Apply

For the purposes of this regulatory flexibility analysis, the working definition of "small" is MSHA's definition of fewer than 20 employees. (Although SBREFA requires use of the SBA's definition, the impacts on mines with 500 or fewer employees as a whole are not economically significant.)

There are 77 M/NM mines that are "small" by this definition. Collectively, these 77 mines have estimated revenues of $189.3 million, or an average of $2.46 million per mine. The

estimated total costs of the rule for these 77 mines are $4.1 million, or an average of $53,160 per mine. Estimated costs of the rule are 2.16 percent of estimated revenues for these 77 mines.

Alternatives Considered

The Mine Act requires that in promulgating a standard, the Secretary shall attain the highest degree of health and safety protection for the miner with feasibility a consideration. For a discussion of the pertinent legal requirements, see Part V of the preamble to the final rule.

In order to ensure that the maximum feasible protection for the underground mining industry as a whole would be provided, the Agency considered four alternatives. These alternatives are: (1) a lower concentration limit; (2) a significantly shorter implementation period; (3) requiring certain categories of diesel powered equipment to be filtered in addition to observing a concentration limit; and (4) in lieu of a concentration limit, require various categories of equipment to meet specific tailpipe limits (as required in the underground coal dpm rulemaking). Based on the discussion below, the Agency has concluded that compliance with these alternatives would either provide less protection than the feasible approach being adopted or not be technically or economically feasible for the underground M/NM industry as a whole at this time. In addition to the alternatives discussed below, Part IV of the preamble to the final rule describes, and comments upon, specific alternatives and approaches suggested by commenters.

MSHA also considered the possibility of adding less stringent alternatives for small M/NM underground mines. Any such alternatives, however, would diminish miner safety and health protection and violate the Agency's statutory obligation, under the Mine Act, to provide the highest degree of protection to all miners, subject to feasibility considerations. We note, however, that many of the provisions of this final rule—such as a longer and phased-in implementation period and the use of a performance standard (the concentration limit)--were selected, in part, so as to minimize any adverse economic impact on small M/NM underground mines and to provide them maximum flexibility in achieving compliance.

Lower Concentration Limit

Based on the Agency's risk assessment (see Part III of the preamble to the final rule), a lower concentration limit would provide more miner protection. Although technologically feasible, the Agency has determined that it would not be economically feasible for the underground M/NM sector to reach a lower concentration limit at this time. In evaluating whether a lower concentration limit is technologically feasible for the M/NM mining sector MSHA considered several examples of real-world situations, which are discussed in the preamble to the proposed rule (65 FR 58198 et seq.) and in the feasibility section of Chapter IV of this document. In addition, further discussion concerning technical feasibility is contained in the preamble to the final rule.

With respect to economic feasibility, MSHA estimates that the final rule will cost the underground M/NM industry about $25.2 million a year to comply with a concentration limit of 160_{TC} $\mu g/m^3$ (200_{DPM} $\mu g/m^3$). For an average underground M/NM dieselized mine that uses

diesel powered equipment, this amounts to about $128,400 per year. In general, MSHA has concluded that:

- the interim standard of 400_{TC} µg/m^3 (500_{DPM} µg/m^3) will be met primarily through the use of filters, but with cabs and ventilation in certain instances; and

- the final standard of 160_{TC} µg/m^3 (200_{DPM} µg/m^3) will be met through the use of more filters, ventilation changes, and the turnover in equipment and engines to less polluting models that will have occurred by the time the final standard goes into effect.

Based on MSHA's cost estimates, the incremental cost of additional controls would rise sharply if the industry were required to reach a substantially lower concentration level (e.g., 120_{TC} µg/m^3). It would begin to be necessary to retrofit cabs on equipment that was not designed with cabs and/or did not have off-the-shelf parts — at a cost per unit nearly three times as large as the cost for more limited retrofitting of suitably-designed equipment. Additional ventilation improvements (e.g., new shafts) could easily run into the millions of dollars — compared with the $300,000 estimate for more limited "major system improvements" used in the cost analysis. Additional replacement of engines beyond the natural turnover included in the baseline could run as high as $27,500 for the engine itself, with additional costs possibly as high as $65,000 for equipment modifications and installation. A lower concentration limit could more than double the current cost of the rule.

Shorten Phase-in Period

Under the rule, operators will have 18 months to reduce dpm concentrations in areas of the mine where miners work or travel to 400_{TC} µg/m^3 (500_{DPM} µg/m^3), and up to 60 months in all to reduce dpm concentrations in those areas to 160_{TC} µg/m^3 (200_{DPM} µg/m^3).

MSHA has established this phase-in period because it has concluded that it is economically infeasible for the underground M/NM mining industry as a whole to implement the requirements sooner. The costs of the rule would increase significantly were the final concentration limit to become effective significantly sooner. For example, the turnover of the fleet to less polluting engines would not be as complete by the time the final limit goes into effect; hence, operators would be required to purchase new engines ahead of schedule.

Technological feasibility problems might also be more frequent with a quicker implementation schedule. The rule includes a provision for a special time extension to deal with unique situations; shortening the normal time frame available to this sector would tend to increase the frequency upon which operators would have to apply for such extensions.

Filters on Equipment

In addition to a concentration limit, MSHA could require certain types of equipment to utilize an 80 percent efficiency filter. This approach would help reduce dpm concentrations in localized areas of a mine and ensure that problems with ventilation controls will have less of an impact on miner exposures. Most filters can meet the 80 percent requirement. The requirement could be applied: (a) just to loading and hauling equipment (e.g., trucks and loaders); (b) to the equipment in (a) plus equipment used in the production process (e.g., drills and powered trucks); (c) to the equipment in (a) and (b) and also direct support equipment (e.g., scalers, lube trucks, generators, compressors, and pumps); or (d) to all equipment except personnel carriers and supply trucks.

However, such an approach will limit operator flexibility on controls — the broader the requirement, the less the flexibility. And it will increase expense, since the most efficient way to achieve compliance with the concentration limit might well be another type of control (e.g., new engine, cab, ventilation, etc.).

Tailpipe Limits

In lieu of a concentration limit, in the underground coal sector, MSHA is requiring various categories of equipment to meet specific tailpipe limits. Compliance with these limits would be determined through laboratory tests of engines and control devices. This approach avoids questions about MSHA in-mine compliance sampling, which has been the focus of much discussion in coal mining. Accordingly, MSHA considered requiring a similar approach in underground M/NM mines. However, the Agency has determined that this approach would not be practical, because the engines in the current fleet are not approved; hence, the Agency lacks information on their emission rates, a key piece of information needed to implement a tailpipe standard. Moreover, in many cases, a cab or ventilation change might be a more effective solution to a localized dpm concentration in an underground M/NM mine than a change in the engine or emission control device — and perhaps less expensive for equipment of this size. One of the advantages of a concentration limit is the flexibility of controls that the operator can apply to meet the limit.

Based on the alternatives discussed above and in Part V of the preamble, the discussion of comments on the proposed rule detailed in Part IV of the preamble, and the best evidence available at this time, the Agency has concluded that the final rule for the M/NM sector meets the statutory requirements that the Secretary attain the highest degree of health and safety protection for the miners affected by this rule.

Projected Reporting, Recordkeeping, and Other Requirements of the Rule

The rule requires several types of records and reports. Plans are required in conjunction with respirator use and DPM control if the concentration levels are violated, and these must be posted and provided to various parties. An extension may be applied for. Maintenance training, miner health training, and respirator training must be logged. Environmental monitoring results must be recorded and provided to miners upon request. While there are a number of reporting

and recordkeeping requirements, however, each one is straightforward, and most are no more than the simplest form of documentation. Thus the total cost of recordkeeping is only about 0.35 percent of the compliance costs for small mines.

The principal source of costs of the rule is controls to reduce the DPM concentrations in underground mines. MSHA has adopted a flexible "toolbox" approach that allows mine operators to select the controls that will be most cost-effective for their mines. MSHA has based its cost estimates on extensive use of ceramic filters, less widespread use of cabs on equipment, and ventilation upgrades. MSHA also assumes that new diesel engines introduced into the mines as part of the baseline turnover of the fleet and its engines will be relatively clean and will contribute to reduced DPM levels. These control costs account for an estimated 95.6 percent of the yearly compliance costs of small mines. Of these costs, ventilation costs (47.1 percent) and filter costs (46.3 percent) account for nearly half each, while the cost of cabs (6.6 percent) is relatively minor.

Only two other requirements impose costs of any size. Environmental monitoring accounts for about 2.6 percent of the estimated compliance costs of small mines. Occasional use of respirators (equipment, training, inspection, etc.) accounts for about 1.6 percent of estimated compliance costs. Maintenance training and miner health training account for less than 0.2 percent of compliance costs. The non-control requirements of the rule are quite modest.

Steps Taken to Minimize Impacts on Small Entities

Constraints of the Mine Safety and Health Act. The Federal Mine Safety and Health Act of 1977 was enacted to protect miners. MSHA has always read the Act to prohibit discriminating among miners by providing different degrees of protection that varied systematically with the size of the mine in which they worked. Accordingly, the Mine Safety and Health Act rules out certain classes of regulatory flexibility alternatives, particularly exemption of small mines, but also any alternative that would result in systematically higher allowable DPM concentration levels in small mines. Because over 95 percent of the yearly costs to be incurred by small mines are directly related to protection, there is little scope for distinct provisions for small mines.

Built-In Flexibility. To minimize impacts on small entities, MSHA has taken steps to build as much flexibility into the rule itself as possible. The rule itself is a performance standard that allows mine operators to meet the DPM concentration limits with their own choice of "tools." While MSHA has selected a specific set of tools for the cost analysis, MSHA expects that operators of specific mines probably will often be able to come into compliance at lower costs by using a mix of techniques tailored to that specific mine.

Other parts of the rule provide similar flexibility. Training and recordkeeping requirements indicate the information to be imparted or retained, for example, but they do not spell out how this is to be done. Much of the reporting is required only upon request, rather than routinely. Where a requirement (e.g., MSHA approval of new engines) appeared to be relatively expensive, MSHA added an alternative (compliance with listed EPA standards).

Phasing in over five years is another element that MSHA has incorporated to minimize impacts (albeit for all mines, not just for small ones). This not only defers costs, it allows impacts to be reduced in a number of ways. Mine operators can spread major expenses out to avoid a capital crunch. To a great degree, mine operators will be able to take advantage of the natural turnover of their fleets, rather than doing extensive (and more expensive) retrofitting. In extreme cases, if a mine is quite marginal and/or is likely to shut down in a few years anyway, the five-year phase-in allows an orderly closure that minimizes impacts.

Low Risk of Short-Term Closures

Ultimately, the issue of concern related to impacts is whether mines may be forced to close. When compliance costs are a significant but relatively small fraction of revenues (or profits), however, it is especially difficult to determine whether closure is an impact resulting from the rule or a baseline event that would have happened anyway. Given the fact that profits fluctuate widely over time, even the presence of losses is not necessarily a good indicator of whether businesses will recover or fail. In many cases where a business does fail, the true impact of a regulation is not causing its failure but rather hastening its failure. Because of the phasing of this rule, it affords an opportunity to consider the potential for hastening the failure of a small mine.

If a mine is likely to close within five years without the regulation, the impacts of the rule are different from the above analysis. First of all, any mines likely to close within 18 months would not be impacted by the regulation. Those mines likely to close during the period from 18 months to five years following publication of the regulation would be affected to varying degrees. For example, in order to stay open for five years, a mine need only comply with the interim DPM concentration level. To this end, it needs to incur the costs of:

- Control costs necessary for Section 57.5060(a);[132]
- Respirator protection costs of Section 57.5060(d);[133]
- DPM control plan costs of Section 57.5062;[134]
- Maintenance training, tagging, and examination costs of Section 57.5066(b) and Section 57.5066(c);[135]
- Miner Health Training costs of Section 57.5071;[136]

[132] These controls include ceramic filters and cabs, but not ventilation (which MSHA did not estimate to be necessary for the interim DPM level. These costs, amortized over 5 years at an annual discount rate of 7.0 percent, are $1,119,860 for filters and $150,437 for cabs.

[133] These costs, amortized over 5 years at an annual discount rate of 7.0 percent, are $164,845.

[134] Annual costs are $1,408.

[135] These costs, amortized over 5 years at an annual discount rate of 7.0 percent, are $5,681.

[136] Annual costs are $5,226.

- Environmental monitoring costs of Section 57.5071;[137] and

- DPM record costs of Section 57.5075.[138]

Thus the yearly costs for small mines, amortized over 5 years at an annual discount rate of 7.0 percent, would be $1,554,086, or an average of $20,183 per mine. This is 0.82 percent of annual revenue, which is below the threshold for a significant economic impact. This is not the type of impact that would force a mine to close sooner rather than later. However, those mines likely to close in 2, 3, or 4 years would not be able to amortize costs over the full five year period and might make the decision to close rather than install the new equipment. Likewise, a few small mines on the economic margin or with significantly below-average revenues might be induced to close prematurely in response to this rule. However, MSHA expects that, overall, these closure impacts would be mild and would occur foreseeably over time, rather than abruptly.

Compliance Assistance

The Agency plans to provide extensive compliance assistance to the mining community. MSHA intends to focus these efforts on smaller metal and nonmetal operators, including training them to measure DPM concentrations, providing technical assistance on available controls, and establishing a system for addressing compliance inquiries from small businesses. The Agency will also issue a compliance guide, continue its current efforts to disseminate educational materials and software, and hold workshops to inform the mining community.

In conclusion, MSHA believes that it has taken all of the steps consistent with the Mine Safety and Health Act that could substantially reduce the impacts of this rule on small entities.

[137] Annual costs are $106,425.

[138] Annual costs are $204.

VI. OTHER REGULATORY CONSIDERATIONS

THE UNFUNDED MANDATES REFORM ACT

For purposes of the Unfunded Mandates Reform Act of 1995, the final rule does not include any Federal mandate that may result in increased expenditures by State, local, or tribal governments, or increased expenditures by the private sector of more than $100 million.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) of 1969 requires each Federal agency to consider the environmental effects of proposed actions and to prepare an Environmental Impact Statement on major actions significantly affecting the quality of the environment. MSHA has reviewed the final rule in accordance with NEPA requirements (42 U.S.C. 4321 *et. seq.*), the regulations of the Council of Environmental Quality (40 CFR Part 1500), and the Department of Labor's NEPA procedures (29 CFR Part 11). As a result of this review, MSHA has determined that this rule will have no significant environmental impact.

EXECUTIVE ORDER 12630: GOVERNMENT ACTIONS AND INTERFERENCE WITH CONSTITUTIONALLY PROTECTED PROPERTY RIGHTS

This rule is not subject to Executive Order 12630, Government Actions and Interference with Constitutionally Protected Property Rights, because it does not involve implementation of a policy with takings implications.

EXECUTIVE ORDER 12988: CIVIL JUSTICE REFORM

The Agency has reviewed Executive Order 12988, Civil Justice Reform, and determined that the final rule will not unduly burden the Federal court system. The rule has been written so as to provide a clear legal standard for affected conduct, and has been reviewed carefully to eliminate drafting errors and ambiguities.

EXECUTIVE ORDER 13045: PROTECTION OF CHILDREN FROM ENVIRONMENTAL HEALTH RISKS AND SAFETY RISKS

In accordance with Executive Order 13045, MSHA has evaluated the environmental health and safety effects of the final rule on children. The Agency has determined that the rule will not have an adverse impact on children.

EXECUTIVE ORDER 13084: CONSULTATION AND COORDINATION WITH INDIAN TRIBAL GOVERNMENTS

MSHA certifies that the final rule will not impose substantial direct compliance costs on Indian tribal governments.

EXECUTIVE ORDER 13132: FEDERALISM

MSHA has reviewed the final rule in accordance with Executive Order 13132 regarding federalism and has determined that it does not have "federalism implications." The final rule does not "have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

VII. PAPERWORK REDUCTION ACT OF 1995

INTRODUCTION

The purposed of this chapter is to show the burden hours and related costs of the final rule that is borne by affected underground M/NM mine operators that use diesel powered equipment. The compliance costs derived in Chapter IV included paperwork and non-paperwork costs. However, this chapter shows only costs which relate to burden hours that are a result of the final rule.

DETAILS CONCERNING PAPERWORK BURDEN HOURS AND RELATED COSTS

For M/NM mine operators that use diesel powered equipment, most paperwork provisions concerns two types of burden hours. There are burden hours that will occur only in the first year the rule is in effect (hereafter known as, first year burden hours). There are burden hours that will occur every year that the rule is in effect, starting with the first year, (hereafter known as, annual burden hours).

There are a few cases were the paperwork provisions need further explanation. For section 57.5060(c) the burden hours and costs occur only in the fifth year after the rule takes effect.

There are a few paperwork provisions in section 57.5060(d) were burden hours and costs will be the same each year starting with the second year the rule is in effect, but whose first year burden hours and costs are different. MSHA transformed these first year burden hours and costs and annual burden hours and costs starting in Year 2 into adjusted first year burden hours and costs (first year burden hours and costs minus an amount equal to annual burden hours and costs starting with Year 2 after the rule takes effect) and true annual burden hours and costs starting in Year 1 after the rule takes effect.[139]

Throughout this chapter the following hourly wage rates are used:

$44.79 for a mine supervisor;
$19.42 for a miner;
$17.57 for a clerical worker and;
$25 for a mine mechanic.

[139] A hypothetical example might help to explain this procedure. Suppose that burden costs are $2,000 the first year and $400 each year thereafter. The adjustment procedure simply splits first year burden costs into two parts: (1) $400, for the first year of annual burden costs; and (2) the residual $1,600. Consequently, adjusted first year burden costs would be $1,600 and annual burden costs (starting in Year 1) would be $400.

SUMMARY OF PAPERWORK BURDEN HOURS AND RELATED COSTS

Table VII-1 shows that in the first year that the rule takes effect, M/NM mine operators will incur 5,567 burden hours, which is composed of 3,118 first year burden hours (from Table VII-2) and 2,449 annual burden hours (from Table VII-3). The related burden costs, in the first year, to mine operators will be $214,661 (from Table VII-1), which is composed of $136,413 of first year burden costs (from Table VII-2) and $78,247 of annual burden costs (from Table VII-3).

For every year after the first year, with the exception of the fifth year, Table VII-1 shows that mine operators will incur 2,449 burden hours and related burden costs of $78,247 (from Table VII-3). Only in the fifth year in which the rule takes effect, will there be an increase in burden hours and cost above the fourth year. This is because there are burden hours and costs that only occur in the fifth year. Therefore, in the fifth year, Table VII-1 shows that M/NM mine operators will incur burden hours of 2,711, which is composed of 2,449 annual burden hours (from Table VII-3) and 263 fifth year burden hours (from Table VII-4). The related burden costs, in the fifth year, are $89,831, of which $78,247 is related to annual burden costs (from Table VII-3) and $11,583 is related to fifth year burden costs (from Table VII-4).

Table 1: Summary of Burden Hours and Costs

	<20		20 to 500		>500		Total	
	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs
1st Only [a]	1,668	$65,206	3,450	$134,245	455	$15,210	5,567	$214,661
2nd thru 4th [b]	560	$17,198	1,582	$52,503	306	$8,551	2,449	$78,247
5th Only [c]	627	$20,107	1,762	$60,450	323	$9,274	2,711	$89,831
6th [d]	560	$17,198	1,582	$52,503	306	$8,551	2,449	$78,247

[a] The 1st year = First Year burden hours and costs + Annual burden hours and costs.

[b] The 2nd through 4th year = Annual burden hours.

[c] The 5th year = Annual burden hours and costs + burden hours and costs that occur only in the 5th year.

[d] Beginning in the 6th Year burden hours and costs are the same in each following year.

Table VII-2: Summary of Only First Year Burden Hours and Costs*

	<20		20 to 500		>500		Total	
	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs
57.5060(d)	1,048	$46,361	1,698	$75,069	106	$4,692	2,852	$126,121
57.5066(c)	28	$678	45	$1,052	4	$85	77	$1,816
57.5066(b)	22	$974	126	$5,621	42	$1,881	189	$8,477
Total	1,098	$48,013	1,868	$81,742	152	$6,658	3,118	$136,413

*** Some of the first year costs in 57.5060(d) are adjusted first year costs.**

Table VII-3: Summary of Annual Burden Hours and Costs That Begin in the First Year and Continue Every Year Thereafter

	<20		20 to 500		>500		Total	
	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs
57.5060(d)	251	$10,074	772	$32,458	48	$2,029	1,071	$44,561
57.5066(b)	61	$1,446	145	$3,412	38	$894	244	$5,753
57.5070	62	$1,796	344	$9,930	169	$4,667	575	$16,394
57.5071	179	$3,751	265	$5,702	18	$386	462	$9,839
57.5075	7	$124	57	$1,000	33	$575	97	$1,700
Total	560	$17,193	1,582	$52,503	306	$8,551	2,449	$78,247

Table VII-4: One-Time Burden Hours and Costs That Occur Only in the 5th Year

	<20		20 to 500		>500		Total	
	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs	Hrs.	Costs
57.5060(c)	67	$2,913	180	$7,947	16	$722	263	$11,583

Section 57.5060(c)
Supervisor Prepare Extension Application
One-Time Burden Hours and costs Occurring in the Fifth Year

Five years after publication of the rule mine operators must limit the concentration of diesel particulate matter (dpm) to which miners are exposed in underground areas of a mine, where miners normally work or travel, to 160_{TC} ($\mu g/m^3$. If a mine has technological constraints in meeting this time requirement, then the mine can file a special extension application. MSHA estimates that the following mines will file for an extension application: 8 mines employing fewer than 20 workers; 11 mines employing 20 to 500 workers; and 1 mine employing more than 500 workers.

MSHA estimates that a supervisor will take 8 hours to write the application and a clerical worker will take 20 minutes (0.3333 hours) to prepare the applications, post the applications, and provide a copy to the miners' representative. Table VII-5 shows one-time burden hours and costs for the mine supervisor to write the extension application. Table VII-6 shows one-time burden hours and costs for the clerical worker's time that is associated with preparing the extension application.

Since the one-time costs occur only in the fifth year after publication of the rule, they are multiplied by a discount factor of 0.71294 and an annualization factor of 0.07.

Table VII-5
Section 57.5060(c)-Supervisor Prepare Extension Application
One-Time Burden Hours and Costs Occurring in the Fifth Year

Mine Size (Emp.)	Number of Mines	Prepare Application per Mine (hrs.)	One Time Burden Hours	Superv. Wage (per hr.)	One Time Burden Cost	Discounted Annualized Burden Cost[a]
<20	8	8	64	$44.79	$28.67	$20.44
20 to 500	11	16	176	$44.79	$78.83	$56.20
>500	1	16	16	$44.79	$7.17	$5.11
Total	20		256		$114.66	$81.75

[a] Total Burden Costs x 0.71294 x 0.07, where 0.71294 is the discount factor and 0.07 is the annualization factor.

Table VII-6
Section 57.5060(c) - Clerical Worker Preparation for Extension Application
One-Time Burden Hours and Costs Occurring in the Fifth Year

Mine Size Emp.	Number of Mines	Prepare Application per Mine (hrs.)	One Time Burden Hours	Clerical Worker Wage (per hr.)	One Time Burden Costs	Discounted Annualized Burden Costs[a]
< 20	8	0.333	2.667	$17.57	$47	$33
20 to 500	11	0.333	3.667	$17.57	$64	$46
> 500	1	0.333	0.333	$17.57	$6	$4
Total	20		7		$117	$84

[a] Total Burden Costs x 0.71294 x 0.07, where 0.71294 is the discount factor and 0.07 is the annualization factor.

Section 57.5060(d)
Supervisor Preparation for Initial Exemption Plan (EP) and Initial Respiratory Protection Plan (RPP)
First Year and Annual Burden Hours and Costs

The supervisor will need to write an EP and a RPP plan, in order to allow miners to conduct inspection, maintenance, or repair activities in certain areas of the mine where the DPM concentration limit is exceeded. The mines affected by this provision will be: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mine employing more than 500 workers. In the first year, a supervisor will take 12 hours to prepare the EP and RPP plan. Annually, after the first year, it will take a supervisor 1 hour to revise such plans.

Table VII-7 shows first year burden hours and costs to write the EP and RPP plan, where 0.07 is used to annualized first year costs. Table VII-8 shows annual burden hours and costs to revise the EP and RPP plan.

Table VII-7
Section 57.5060(d) - Supervisor Preparation for Initial Exemption Plan (EP) and Initial Respiratory Protection Plan (RPP)
First Year Burden Hours and Costs

Mine Size Emp.	Number of Mines	Prepare EP/RPP Plan per Mine (hrs.)	First Year Burden Hours	Supev. Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[a]
<20	77	12	924	$44.79	$41,386	$2,897
20 to 500	112	12	1,344	$44.79	$60,198	$4,214
>500	7	12	84	$44.79	$3,762	$263
Total	196		2,352		$105,346	$7,374

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Table VII-8
Section 57.5060(d) - Supervisor Revision of EP/RPP and Initial Respiratory Protection Plan (RPP) Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Revise EP/RPP Plan per Mine (hrs.)	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
< 20	77	1	77	$44.79	$3,449
20 to 500	112	1	112	$44.79	$5,016
> 500	7	1	7	$44.79	$314
Total	196		196		$8,779

Section 57.5060(d)
Clerical Workers Distribution of EP and RPP Plan
Annual Burden Hours and Costs

With respect to the initial EP and RPP plan, and annual revisions to such plans, MSHA estimates that a clerical worker will take 30 minutes (0.5 hours) to distribute the EP and RPP plan. This distribution includes copying and distributing the plan to miners' representative and copying and mailing the plan to MSHA. The affected mines are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers.

Table VII-9, shows annual burden hours and costs to distribute the EP and RPP plan.

Table VII-9
Section 57.5060(d)-Clerical Workers Distribution of EP-RPP Plan
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Distribute EP-RPP Plan per Mine (hrs.)	Annual Burden Hours	Clerical Wage (per hr.)	Annual Burden Cost
<20	77	0.5	39	$17.57	$676
20 to 500	112	0.5	56	$17.57	$984
>500	7	0.5	4	$17.57	$61
Total	196		98		$1,722

Section 57.5060(d)
Miner Respirator Initial Training and Briefing by Mine Supervisor
Adjusted First Year and Annual Burden Hours and Costs

In the first year of the rule, MSHA estimates that a mine supervisor will take 45 minutes (0.75 hours) to provide initial training to certain miners in the use of respirators. A supervisor will need one training session, per mine, to provide respirator initial training. In addition, the first time respirator training is provided the supervisor will spend 5 minutes (0.0833 hours) of his time briefing a clerical worker concerning such training. The affected mines that will need to provide the one session training will be: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers, and 7 mines employing more than 500 workers.

For every year after the first year, as a result of employment turnover, a supervisor will need to provide one training session to train miners to use respirators. The training session is estimated to take 45 minutes (0.75 hours). No briefing of the clerical worker is necessary after the first year. In addition, annually, after the first year, the number of affected mines are the same with the exception that there will be only 26 mines employing fewer than 20 workers.[140]

Table VII-10 shows adjusted first year burden hours and costs concerning the supervisor's activities for initial respirator training. A discount factor of 0.07 is used to annualize the adjusted first year costs.

Table VII-10
Section 57.5060(d) - Miner Respirator Initial Training and Briefing by Mine Supervisors
Adjusted First Year Burden Hours and Costs

Mine Size Employment	No. of Mines	Training and Record Keeping Hours[a]	First Year Burden Hours	Annual Burden Hours[b]	Adjusted First Year Burden Hours	Superv. Wage (per hr.)	Adjusted First Year Burden Cost	Adjusted First Year Burden Cost Annualized[c]
X < 20	77	0.833	64	19	45	$44.79	$2,012	$141
20 ≤ X ≤ 500	112	0.833	93	84	9	$44.79	$418	$29
X > 500	7	0.833	6	5	1	$44.79	$26	$2
Total	196		163	109	55		$2,456	$172

[a] 0.833 = 0.75 hours for training + 0.0833 for briefing clerical worker.
[b] An equivalent amount of annual burden hours from Table VII-11.
[c] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

[140] Every year after the first year only 26 mines employing fewer than 20 workers are affected because the provision affects such mines every three years (77 mines divided by 3 years).

Table VII-11 shows annual burden hours and costs concerning the supervisor's respirator training.

Table VII-11
Section 57.5060(d) - Miner Respirator Training
by Mine Supervisors
Annual Burden Hours and Costs

Mine Size Employment	Number of Mines	Training and Recordkeeping Hours	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
X<20	26	0.75	19	$44.79	$862
20<X<500	112	0.75	84	$44.79	$3762
X>500	7	0.75	5	$44.79	$236
Total	145		109		$4860

Section 57.5060(d)
Clerical Workers Briefing by Mine Supervisor Regarding Respirator Training
First Year Burden Hours

During the first year of the rule, for each affected mine, a clerical worker will need to spend 5 minutes (0.083 hours) being briefed by a supervisor concerning respirator training. The mines affected by this provision are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers.

Table VII-12 shows first year burden hours and costs associated with the clerical workers' time associated with being briefed by a supervisor concerning respirator training.

Table VII-12
Section 57.5060(d) - Clerical Workers Briefing by Mine Supervisors Regarding Training
First Year Hours and Costs

Mine Size Emp.	Number of Mines	Briefing (hours)	First Year Burden Hours	Clerical Wage (per hr.)	Burden Cost
< 20	77	0.083	6	$17.57	$113
20 to 500	112	0.083	9	$17.57	$164
> 500	7	0.083	1	$17.57	$10
Total	196		16		$287

Section 57.5060(d)
Miner Respirator Initial Fit Testing by Mine Supervisor
First Year and Annual Burden Hours and Costs

During the first year of the rule, a supervisor will provide fit testing to each miner that will use a respirator. The mines were fit testing will be provided will be: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers. In the first year of the rule, 3 miners will be tested in mines employing fewer than 20 workers, while 11 miners will be tested in mines employing 20 or more workers. It is estimated to take 15 minutes (0.25 hours) to fit test each affected miner.

As a result of miner turnover, every year after the first year, 1 miner will be tested in each mine size category. The number of mines and the time to perform fit testing is the same as in the first year.

Table VII-13 shows first year burden hours and costs related to fit testing. Table VII-14 shows annual burden hours and costs related to fit testing.

Table VII-13
Section 57.5060(d) - Miner Respirator Initial Fit Testing by Mine Supervisors
First Year Burden Hours and Costs

Mine Size Employment	No. of Mines	Number of Fit Tests per Mine	Time to Fit Test Hours	First Year Burden Hours	Superv. Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[a]
X < 20	77	3	0.25	58	$44.79	$2,587	$181
20 < X < 500	112	11	0.25	308	$44.79	$13,795	$966
X > 500	7	11	0.25	19	$44.79	$862	$60
Total	196			385		$17,244	$1,207

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Table VII-14
Section 57.5060(d) - Miner Respirator Fit Testing by Mine Supervisors
Annual Burden Hours and Costs

Mine Size Employment	Number of Mines	Number of Fit Tests per Mine	Time to Fit Test Hours	Annual Burden Hours	Supev. Wage (per hr)	Annual Burden Cost
X < 20	77	1	0.25	19	$44.79	$862
20 < X < 500	112	1	0.25	28	$44.79	$1,254
X > 500	7	1	0.25	2	$44.79	$78
Total	196			49		$2,195

Section 57.5060(d)
Clerical Workers Preparation of Registration Sheet for Trainees
Adjusted First Year Burden Hours and Costs

The clerical worker will need to register miners who are going to take respirator training. In the first year of the rule, the mines affected mines are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers. For each mine, the clerical person will need 10 minutes (0.167 hours) to prepare a registration sheet for the miners receiving respirator training. In addition, 1 minute (0.0167 hours) will be needed to log in each trainee's name. In the first year of the rule the miners that will need to be registered are 4 miners in mines employing fewer than 20 workers, and 12 miners in mines employing 20 or more workers.

Annually, after the first year, only 1 miner will need to be registered in each mine size category. It will still take the clerical worker 10 minutes (0.167 hours) to prepare a registration sheet. In addition, annually, after the first year, the number of affected mines are the same with the exception that there will be only 26 mines employing fewer than 20 workers.[141]

Table VII-15 shows adjusted first year burden hours and costs for the clerical worker to prepare for respirator training. Table VII-16 shows annual burden hours and costs for the clerical worker to prepare for respirator training.

Table VII-15
Section 57.5060(d) - Clerical Workers Preparation of Registration Sheet for Trainees
Adjusted First Year Burden Hours and Costs

Mine Size Employment	No. of Mines	Prepare Reg. Sheet (hours)[a]	First Year Burden Hours	Annual Burden Hours[b]	Adjusted First Year Burden Hours	Clerical Wage (per hr)	Adjusted First Year Burden Cost	Adjusted First Year Burden Cost Annualized[c]
X≤20	77	0233	18	5	13	$1757	$233	$16
20≤X≤500	112	0367	41	21	21	$1757	$361	$25
X>500	7	0367	3	1	1	$1757	$23	$2
Total	196		62	27	35		$616	$43

[a] = 0.167 (to prepare registration sheet per mine) + 0.0167 (to enter each trainee's name). Training involves 4 miners in mines employing fewer than 20 workers and 12 miners in larger mines.
[b] An equivalent amount of annual burden hours from Table VII-16.
[c] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

[141] Every year after the first year only 26 mines employing fewer than 20 workers are affected because the provision affects such mines every three years (77 mines divided by 3 years).

Table VII-16
Section 57.5060(d) - Clerical Workers Preparation of Registration Sheet for Trainees
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Trainees	Prepare Registration Sheet (hours)[a]	Annual Burden Hours	Clerical Wage (per hr.)	Annual Burden Cost
< 20	26	1	0.183	5	$17.57	$83
20 to 500	112	1	0.183	21	$17.57	$361
> 500	7	1	0.183	1	$17.57	$23
Total	145			27		$466

[a] 0.813 = 0.167 (to prepare registration sheet per mine)
+ 0.0167 (to enter each trainee's name)

Section 57.5060(d)
Miners Sign Registration Sheet
Adjusted First Year and Annual Burden Hours and Costs

The miners must sign a registration sheet proving that they have taken the respirator training. In the first year, the number of mines affected are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers, and 7 mines employing more than 500 workers. MSHA estimates that it will take 20 seconds (0.006 hours) to sign the registration sheet. In the first year, the number of miners to sign will be 4 miners in mines employing fewer than 20 workers; and 12 miners in mines employing 20 or more workers.

Annually, every year after the first year, the number of miners to sign will be 1 miner in each mine size category. In addition, annually, after the first year, the number of affected mines are the same with the exception that there will be only 26 mines employing fewer than 20 workers.[142]

Table VII-17 shows adjusted first year burden hours and costs for miners to sign the training registration sheet. Table VII-18 shows annual burden hours and costs for miners to sign the training registration sheet.

Table VII-17
Section 57.5060(d) - Miners Sign Registration Sheet
Adjusted First Year Burden Hours and Costs

Mine Size Emp.	No. of Mines	No. of Miners	Sign Reg. Sheet (hrs.)	First Year Burden Hours	Annual Burden Hours[a]	Adjusted First Year Burden Hours	Miner Wage per Hour	Adjusted First Year Burden Cost	Adjusted First Year Burden Cost Annualized[b]
< 20	77	4	0.006	2	0	2	$19.42	$30	2
20 to 500	112	12	0.006	7	1	7	$19.42	$133	9
> 500	7	12	0.006	0	0	0	$19.42	$8	1
Total	196			10	1	9		$172	12

[a] An equivalent amount of annual burden hours from Table VII-18.
[b] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

[142] Every year after the first year only 26 mines employing fewer than 20 workers are affected because the provision affects such mines every three years (77 mines divided by 3 years).

Table VII-18
Section 57.5060(d) - Miners Sign Registration Sheet
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Miners	Sign Registration Sheet (hours)[a]	Annual Burden Hours	Clerical Wage (per hr.)	Annual Burden Cost
< 20	26	1	0.006	0	$19.42	$3
20 to 500	112	1	0.006	1	$19.42	$12
> 500	7	1	0.006	0	$19.42	$1
Total	145			1		$16

Section 57.5060(d)
Supervisor Random Inspection of Respirators and Recordkeeping
Annual Burden Hours

Annually, supervisors will make random checks, during a shift, to ensure that respirators are properly worn. The supervisor will then record the random checks. The number of mines affected are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers, and 7 mines employing more than 500 workers. For each random inspection, MSHA estimates that the supervisor will spend 1.5 minutes making the inspection and another 1.5 minutes to record the inspection, for a total of 3 minutes (0.05 hours). In addition, for each mine, it is estimated that 2 random inspections per month (24 per year) will occur in mines employing fewer than 20 workers, and 7 random inspections per month (84 per year) will occur in mines employing 20 or more workers.

Table VII-19 shows annual burden hours and costs to make random inspections of respirators.

Table VII-19
Section 57.5060(d) Supervisor Random Inspection of Respirators and Recordkeeping Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Inspections per Mine per Year	Inspection and Record Keeping (hours)[a]	Annual Burden Hours	Clerical Wage ($ per hr.)	Annual Burden Cost
<20	77	24	0.050	92	$44.79	$4,139
20 to 500	112	84	0.050	470	$44.79	$21,069
>500	7	84	0.050	29	$44.79	$1,317
Total	196			592		$26,525

[a] 0.50 = 0.25 (to inspect respirators) + 0.25 (to log date of inspection)

Section 57.5066(c)
Supervisor Brief Clerical Workers Regarding Maintenance Training
First Year Burden Hours and Costs

A supervisor will need to brief a clerical worker concerning the preparation of the maintenance training. The mines affected will be: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers. It will take the supervisor 5 minutes (0.083 hours) to brief the clerical worker.

Table VII-20 shows first year burden hours and costs for the supervisor to brief the clerical worker concerning maintenance training.

Table VII-20
57.5066 (c) Mine Supervisors Brief Clerical Workers Regarding Maintenance Training
First Year Burden Hours and Costs

Mine Size	Number of Mines	Briefing (hours)	First Year Burden Hours	Superv. Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[a]
X < 20	77	0.083	6	$44.79	$287	$20
20 < X < 500	112	0.083	9	$44.79	$418	$29
X > 500	7	0.083	1	$44.79	$26	$2
Total	196		16		$732	$51

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Section 57.5066(c)
Clerical Worker Briefing and Preparing Registration Sheet
First Year Burden Hours and Costs

After being briefed by the supervisor the clerical worker will need to prepare the registration sheet. The number of mines affected are: 77 mines employing fewer than 20 workers; 112 mines employing 20 to 500 workers; and 7 mines employing more than 500 workers. MSHA estimates that the clerical worker will spend 5 minutes being briefed by the supervisor and another 10 minutes preparing the registration sheet, for a total of 15 minutes (0.25 hours).

Table VII-21 shows first year burden hours and costs for the clerical worker to be briefed and prepare registration sheet for maintenance training.

Table VII-21
57.5066 (c) Clerical Workers Briefing and Preparing Registration Sheet
First Year Burden Hours and Costs

Mine Size	Number of Mines	Briefing and Preparing (hours)[a]	First Year Burden Hours	Clerical Worker Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[b]
X<20	77	0.25	19	$17.57	$338	$24
20≤X≤500	112	0.25	28	$17.57	$492	$34
X>500	7	0.25	2	$17.57	$31	$2
Total	196		49		$861	$60

[a] 0.25 = 0.083 (for briefing) + 0.167 (to prepare registration sheet)
[b] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Section 57.5066(c)
Clerical Workers Entering Names of Trainees in Computer
First Year Burden Hours and Costs

It will take a clerical work 1 minute (0.017 hours) to enter the name of each trainee in the computer. The number of miners to receive maintenance training in each mine size category are: 121 miners in mines employing fewer than 20 workers, 330 miners in mines employing 20 to 500 workers, and 66 miners in mines employing more than 500 workers.

Table VII-22 shows first year burden hours and costs for the clerical worker to enter names of trainees in the computer.

Table VII-22
57.5066 (c) Clerical Workers Entering Names of Trainees in Computer
First Year Burden Hours and Costs

Mine Size	Number of Trainees	Entering Name (hours)	First Year Burden Hours	Clerical Worker Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[a]
X < 20	121	0.017	2	$17.57	$35	$2
20 < X < 500	330	0.017	6	$17.57	$97	$7
X > 500	66	0.017	1	$17.57	$19	$1
Total	517		9		$151	$11

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Section 57.5066(c)
Miner Sign Registration Sheet
First Year Burden Hours and Costs

The miner who is receiving training must sign a registration sheet which can be used as proof that the miner has taken the training concerning maintenance of diesel powered equipment. The number of miners to receive maintenance training in each mine size category are: 121 miners in mines employing fewer than 20 workers, 330 miners in mines employing 20 to 500 workers, and 66 miners in mines employing more than 500 workers. For each miner, MSHA estimates that it will take 20 seconds (0.006 hours) to sign the registration sheet.

Table VII-23 shows first year burden hours and costs for miners to sign the registration sheet concerning maintenance training of diesel powered equipment.

Table VII-23
57.5066(c) Miners Sign Registration Sheet
First Year Burden Hours and Costs

Mine Size	Number of Trainees	Signing Registration Sheet (hours)	First Year Burden Hours	Mechanic Wage (per hr)	First Year Burden Cost	First Year Burden Cost Annualized[a]
X<20	121	0.006	1	$25.00	$17	$1
20<X<500	330	0.006	2	$25.00	$46	$3
X>500	66	0.006	0	$25.00	$9	$1
Total	517		3		$72	$5

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Section 57.5066(b)
Training of Miners by Mine Supervisor Regarding Tagging Procedures
First Year Burden Hours and Costs

Section 57.5066(b) requires that operators must tag diesel powered equipment at any time there is any apparent emission related defect in the equipment. In order for machine operator to be able to tag the equipment they will first need to receive training as to what problems will result in tagging the equipment. A mine supervisor will provide the training. It is estimated to take the mine supervisor 15 minutes (0.25 hours) for each training session. The number of estimated training sessions are: 87 in mines employing fewer than 20 workers, 502 in mines employing 20 to 500 workers, and 168 in mines employing more than 500 workers.

Table VII-24 shows first year burden hours and costs for the supervisor to hold training sessions related to tagging defected diesel powered equipment.

Table VII-24
57.5066 (b) Training of Miners by Mine Supervisor Regarding Tagging Procedure
First Year Burden Hours and Costs

Mine Size	Number of Training Sessions	Training (hours)	First Year Burden Hours	Supev. Wage (per hr.)	First Year Burden Cost	First Year Burden Cost Annualized[a]
X<20	87	0.25	22	$44.79	$974	$68
20<X<500	502	0.25	126	$44.79	$5621	$393
X>500	168	0.25	42	$44.79	$1881	$132
Total	756		189		$8477	$593

[a] First Year Burden Cost x 0.07, where 0.07 is the annualization rate.

Section 57.5066(b)
Miner Tag Diesel Equipment and Record Tag
Annual Burden Hours and Costs

Each time there is an emission related problem on a diesel powered machine the equipment must be tagged, and a record is made of the tag. Annually, MSHA estimates that, on average, in mines with fewer than 20 workers 40 percent of diesel powered equipment (230 machines) will be tagged. For larger mines, which generally have more extensive preventive maintenance programs, MSHA estimates that annually, on average, 20 percent of the diesel powered equipment will be tagged. Therefore, the number of diesel machines to be tagged annually will be 542 machines in mines employing 20 to 500 workers, and 142 machines in mines employing more than 500 workers. It is estimated to take 2 minutes to tag the machine and another 2 minutes to record the tagging, for a total of 4 minutes (0.067 hours).

Table VII-25 shows annual burden hours to tag diesel powered equipment concerning emission related problems.

Table VII-25
Section 57.5066 (b) Miners Tag Diesel Equipment and Record Tag
Annual Burden Hours and Costs

Mine Size Emp.	Number of Tags	Tag and Record (hrs.)[a]	Annual Burden Hours	Miner Wage (per hr.)	Annual Burden Cost
< 20	230	0.067	15	$19.42	$298
20 to 500	542	0.067	36	$19.42	$702
> 500	142	0.067	9	$19.42	$184
Total	914		61		$1,183

[a] 0.067 = 0.0333 (to tag the equipment) + 0.0333 (to record the tag)

Section 57.5066(b)
Examine Tagged Diesel Equipment and Record Examination
Annual Burden Hours and Costs

For each diesel machine that has been tagged an examination must be conducted concerning the tagged equipment and a record must be made of the examination. As noted earlier, the number of machines to be tagged annually will be: 230 machines in mines employing fewer than 20 workers, 542 machines in mines employing 20 to 500 workers, and 142 machines in mines employing more than 500 workers. For each piece of equipment tagged, MSHA estimates that it will take 10 minutes to examine the machine and another 2 minutes to record the examination, for a total of 12 minutes (0.2 hours).

Table VII-26 shows annual burden hours and costs to examine tagged equipment and record the examination.

Table VII-26
Section 57.5066(b) Examine Tagged Diesel Equipment and Record Examination
Annual Burden Hours and Costs

Mine Size Emp.	Number of Tags	Examine and Record (hrs)[a]	Annual Burden Hours	Mechanic Wage (per hr)	Annual Burden Cost
<20	230	020	46	$2500	$1,150
20 to 500	542	020	108	$2500	$2,710
>500	142	020	28	$2500	$710
Total	914		183		$4,570

[a] 020 = 0167 (to examine the equipment) + 0033 (to record the examination)

Section 57.5070
Mine Supervisor Briefing Clerical Worker Regarding Health Training
Annual Burden Hours and Costs

All miners at a mine who can reasonably be expected to be exposed to diesel emission on mine property must receive health training in accordance with section 57.5070(a)(1) through (a)(4). For each mine, MSHA estimates that it will take a mine supervisor 5 minutes (0.083 hours) to brief a clerical worker concerning such training. The number of mines affected by this provision will be: 77 mines employing fewer than 20 workers, 112 mines employing 20 to 500 workers, and 7 mines employing more than 500 workers.

Table VII-27 shows annual burden hours and costs for a supervisor to brief a clerical worker concerning miner health training.

Table VII-27
Section 57.5070 Mine Supervisors Brief Clerical Workers Regarding Health Training
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Briefing (hrs.)	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
<20	77	0.083	6	$44.79	$287
20 to 500	112	0.083	9	$44.79	$418
>500	7	0.083	1	$44.79	$26
Total	196		16		$732

Section 57.5070
Clerical Worker Briefed by Mine Supervisor Regarding Health Training
Annual Burden Hours and Costs

As noted earlier, all miners at a mine who can reasonably be expected to be exposed to diesel emission on mine property must receive health training in accordance with section 57.5070(a)(1) through (a)(4). For each mine, MSHA estimates that it will take a clerical worker 5 minutes (0.083 hours) to be briefed by a supervisor concerning such training. The number of mines affected by this provision will be: 77 mines employing fewer than 20 workers, 112 mines employing 20 to 500 workers, and 7 mines employing more than 500 workers.

Table VII-28 shows annual burden hours and costs for a clerical worker to be briefed by a supervisor concerning miner health training.

Table VII-28
Section 57.5070 Clerical Workers are Briefed by Mine Supervisors Regarding Health Training
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Briefing (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	77	0.083	6	$17.57	$113
20 to 500	112	0.083	9	$17.57	$164
>500	7	0.083	1	$17.57	$10
Total	196		16		$287

Section 57.5070
Mine Supervisor Perform Health Training Sessions
Annual Burden Hours

Concerning miner health training, the supervisor will hold a 15 minute (0.25 hours) training sessions in mines employing fewer than 20 workers, and a 30 minute (0.5 hours) training session in mines employing 20 or more workers . The average number of training sessions to be held by a mine, in each mine size category, will be: 77 sessions in mines employing fewer than 20 workers, 262 sessions in mines employing 20 to 500 workers, and 120 sessions in mines employing more than 500 workers.

Table VII-29 shows annual burden hours and costs for supervisors to give miner health training.

Table VII-29
Section 57.5070 Mine Supervisors Perform Health Training Sessions
Annual Burden Hours and Costs

Mine Size Emp.	Number of Training Sessions	Health Training (hrs.)	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
< 20	77	0.25	19	$44.79	$862
20 to 500	262	0.50	131	$44.79	$5,867
> 500	120	0.50	60	$44.79	$2,687
Total	459		210		$9,417

Section 57.5070
Clerical Worker Prepare Registration Sheet for Health Training Sessions
Annual Burden Hours and Costs

For each mine, the clerical worker will need 10 minutes (0.167 hours) to prepare the Registration sheet for the health training attendees to sign at each training session. As noted earlier the average number of training sessions to be held by a mine, in each mine size category, will be: 77 sessions in mines employing fewer than 20 workers, 262 sessions in mines employing 20 to 500 workers, and 120 sessions in mines employing more than 500 workers.

Table VII-30 shows annual burden hours and costs for clerical workers to prepare registration sheets for health training sessions.

Table VII-30
Section 57.5070 Clerical Workers Prepare Registration Sheet for Health Training Sessions
Annual Burden Hours and Costs

Mine Size Emp.	Number of Training Sessions	Prepare Registration Sheet (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	77	0.167	13	$17.57	$225
20 to 500	262	0.167	44	$17.57	$767
>500	120	0.167	20	$17.57	$351
Total	459		77		$1,344

Section 57.5070
Clerical Workers Record Names of Health Training Attendees in Computer File
Annual Burden Hours and Costs

For each person trained the clerical worker will record their name in a computer file. It is estimated to take the clerical work 1 minute (0.017 hours) to record each name. The number of trainees are estimated to be: 770 trainees in mines employing fewer than 20 workers, 6,772 trainees in mines employing 20 to 500 workers, and 3,972 in mines employing more than 500 workers.

Table VII-31 shows annual burden hours and costs for clerical workers to record names of trainees.

Table VII-31
Section 57.5070 Clerical Workers Record Names of Health Training Attendees in Computer File Annual Burden Hours and Costs

Mine Size Emp.	Number of Attendees	Entering Name (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	770	0.017	13	$17.57	$225
20 to 500	6772	0.017	113	$17.57	$1,983
>500	3972	0.017	66	$17.57	$1,163
Total	11,514		192		$3,372

Section 57.5070
Miners Sign Health Training Attendance Sheet
Annual Burden Hours and Costs

Each miner attending a health training session will be required to sign the registration sheet prepared by the clerical worker. Each signature will require 20 seconds of a miner's time. Table VII-32 presents the annual burden hours and costs, by mine size, resulting from this provision.

Table VII-32
Section 57.5070 Miners Sign Health Training Attendance Sheet
Annual Burden Hours and Costs

Mine Size Emp.	Number of Miners	Sign Name (hrs.)	Annual Burden Hours	Miner Wage (per hr.)	Annual Burden Cost
<20	770	0.005	4	$19.42	$83
20 to 500	6,772	0.005	33	$19.42	$731
>500	3,972	0.005	22	$19.42	$429
Total	11,514		64		$1,243

Section 57.5071
Mine Supervisor Oral Notification of Sampling
Annual Burden Hours and Costs

Section 57.5071 requires that mine operators sample the air four times a year to determine DPM concentrations. Additionally mine operators must notify miners and their representatives of the dates and times the sampling will take place. MSHA assumes that 45 percent of mines will notify miners orally. This action will require 2 minutes of a mine supervisor's time. The annual burden hours and costs of oral notification appear in Table VII-33.

Table VII-33
Section 57.5071 Mine Supervisor Oral Notification of Sampling
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Oral Notifications per Mine	Oral Notification (hrs.)	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
< 20	35	4	0.033	5	$44.79	$209
20 to 500	51	4	0.033	7	$44.79	$305
> 500	3	4	0.033	0	$44.79	$18
Total	89			12		$532

Section 57.5071
Written Notification of Sampling
Annual Burden Hours and Costs

MSHA assumes that another 35 percent of mines will notify miners and their representatives in writing. This will require five minutes of a mine supervisor's time to brief a clerical worker. These annual burden hours and costs appear in Table VII-34. The clerical worker will prepare, copy and deliver the written notice to each miner. This activity will take five minutes for each miner. The annual burden hours and costs associate with these actions are shown in Table VII-35.

Table VII-34
Section 57.5071 Mine Supervisor Writes Notification of Sampling
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Written Notifications per Mine	Written Notification (hrs.)	Annual Burden Hours	Supev. Wage (per hr.)	Annual Burden Cost
<20	27	4	0.083	9	$44.79	$403
20 to 500	39	4	0.083	13	$44.79	$582
>500	3	4	0.083	1	$44.79	$45
Total	69			23		$1,030

Table VII-35
Section 57.5071 Clerical Worker Prepares
Written Notification of Sampling
Annual Burden Hours and Costs

Mine Size Emp.	Number of Miners	Number of Written Notifications per Mine	Written Notification (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	270	4	0.083	90	$17.57	$1,581
20 to 500	390	4	0.083	130	$17.57	$2,284
>500	30	4	0.083	10	$17.57	$176
Total	690			230		$4,041

Section 57.5071
Posted Notification of Sampling
Annual Burden Hours and Costs

MSHA assumes that the remaining 20 percent of mines will use a posted notice to inform miners of the dates and times that they intend to conduct sampling. This will require five minutes of a supervisor's time to brief a clerical worker. These annual burden hours and costs are exhibited in Table VII-36. It will take the clerical worker ten minutes to prepare and post the notice and five minutes to be briefed by the supervisor. Table VII-37 presents these annual burden hours and costs.

Table VII-36
Section 57.5071 Mine Supervisor Briefs Clerical Worker Regarding Posted Notification of Sampling
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Posted Notifications per Mine	Briefing Clerical Worker (hrs.)	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
<20	15	4	0.083	5	$44.79	$224
20 to 500	22	4	0.083	7	$44.79	$328
>500	1	4	0.083	0	$44.79	$15
Total	38			13		$567

Section 57.5071 Mine Supervisor Prepares and Posts Notice of Corrective Action Annual Burden Hours and Costs

Table VII-37
Section 57.5071 Clerical Workers Receive Briefing and Prepare and Post Notification of Sampling
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Posted Notifications per Mine	Briefing Clerical Worker (hrs.)[a]	Annual Burden Hours	Superv. Wage (per hr.)	Annual Burden Cost
<20	15	4	0.25	15	$17.57	$264
20 to 500	22	4	0.25	22	$17.57	$387
>500	1	4	0.25	1	$17.57	$18
Total	38			38		$668

[a] 0.25 = 0.083 (to be briefed) + 0.167 (to prepare and post)

If a mine environment is above the DPM concentration limits mine operators will have to take corrective actions. This section requires the mine supervisor to write up and post a notice of the corrective action taken. This will take 15 minutes of the mine supervisor's time. These annual burden hours and costs are displayed in Table VII-38. MSHA assumes that 20 percent of mines with fewer than 20 workers and 40 percent of larger mines will require corrective action.

Table VII-38

Section 57.5071 Mine Supervisor Prepares and Posts Notice of Corrective Action

Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Prepare and Post Notice (hrs.)	Annual Burden Hours	Supev. Wage (per hr.)	Annual Burden Cost
<20	15	0.250	4	$44.79	$168
20 to 500	45	0.250	11	$44.79	$504
>500	3	0.250	1	$44.79	$34
Total	63		16		$705

Section 57.5071 Posting Sampling Results
Annual Burden Hours and Costs

Once sampling results are received, MSHA estimates that it will take a clerical worker 10 minutes to make two copies of a one-page notice and to post one and deliver the other to the miner's representative. These annual burden hours and costs appear in Table VII-39.

Table VII-39
Section 57.5071 Clerical Worker Copies and Distributes Sampling Results
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Samplings per Mine	Copy and Distribute (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	77	4	0.167	51	$17.57	$902
20 to 500	112	4	0.167	75	$17.57	$1,312
>500	7	4	0.167	5	$17.57	$82
Total	196			131		$2,296

Section 57.5075
Clerical Workers Respond to Requests for Health Records by Miners
Annual Burden Hours and Costs

MSHA assumes that some miners leaving their jobs at the mine or retired miners would request a copy of the health records generated by the requirements of this rule. These records would consist of copies of the exposure measurements that M/NM mine operators are required to maintain. MSHA estimates that 10 percent of miners will request health records each year. It will take a clerical worker five minutes to respond to each request. The annual burden hours and costs resulting from requests for health records appear in Table VII-40.

Table VII-41
57.5075 Clerical Workers Respond to Requests for Health Records by Miners
Annual Burden Hours and Costs

Mine Size Emp.	Number of Mines	Number of Requests per Mine	Respond to Request (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
< 20	77	1	0.083	6	$17.57	$113
20 to 500	112	6	0.083	56	$17.57	$984
> 500	7	56	0.083	33	$17.57	$574
Total	196			95		$1,671

Section 57.5075
Clerical Workers Respond to Requests for Health Records by Dept. of Health and Human Services (DHHS)
Annual Burden Hours and Costs

Upon request from an authorized representative of the U.S. Department of Health and Human Services (DHHS), underground M/NM mine operators must provide access to any health records. Annually, MSHA estimates that DHHS will request a copy of sampling results from 10 percent of the mines. Therefore, the number of requests each year will be: 8 requests in mines employing fewer than 20 miners, 11 requests in mines employing 20 to 500 workers; and 1 request in a mine employing more than 500 workers. It is estimated to take a clerical worker 5 minutes (0.083 hours) to respond to each request.

Table VII-41 shows annual burden hours and costs for clerical workers to respond to requests from DHHS.

Table VII-42
57.5075 Clerical Workers Respond to Requests for Health Records by DHHS
Annual Burden Hours and Costs

Mine Size Emp.	Number of Requests per Year	Respond to Request (hrs.)	Annual Burden Hours	Clerical Worker Wage (per hr.)	Annual Burden Cost
<20	8	0.083	1	$17.57	$12
20 to 500	11	0.083	1	$17.57	$16
>500	1	0.083	0	$17.57	$1
Total			2		$29

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