



# **DPM Exposures in Metal and Nonmetal Mines in the United States 2002-2005 and the 2005 Final Rule on the Interim Limit**

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## **Diesel Particulate Matter Exposures**

- **Metal/Nonmetal DPM Rule issued Jan 19, 2001**
  - ◆ **DPM measured as Total Carbon**
  - ◆ **Interim exposure limit 400 $\mu$ g/m<sup>3</sup> July 19, 2002**
  - ◆ **Final exposure limit 160 $\mu$ g/m<sup>3</sup> July 19, 2006**

**All dieselized MNM mines sampled.**

**This paper covers:**

- **Inspector samples**
  - ◆ **July 19, 2002 through July 5, 2005**
- **June 6, 2005 Final Rule on the Interim Limit**

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## Sample Analysis

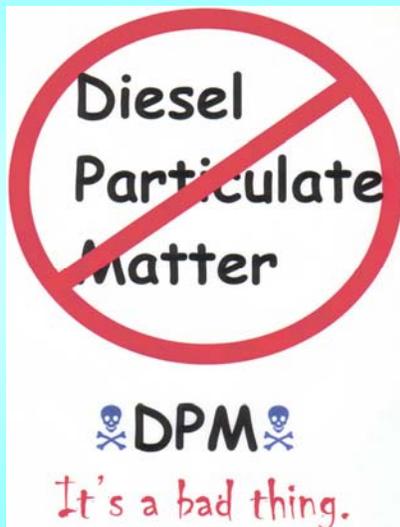
- TC (DPM surrogate)
  - ◆  $TC = EC + OC$
  - ◆  $TC = EC \times 1.3$
  - ◆ Compliance based on lower of  $[EC + OC]$  or  $[EC \times 1.3]$
- MSHA P-13/NIOSH 5040
- Sample - Top Filter
- Control - Tandem Filter



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## Compliance Experience



- Samples analyzed and reported 7/19/02 through 7/05/05
- Enforcement actions taken during same period

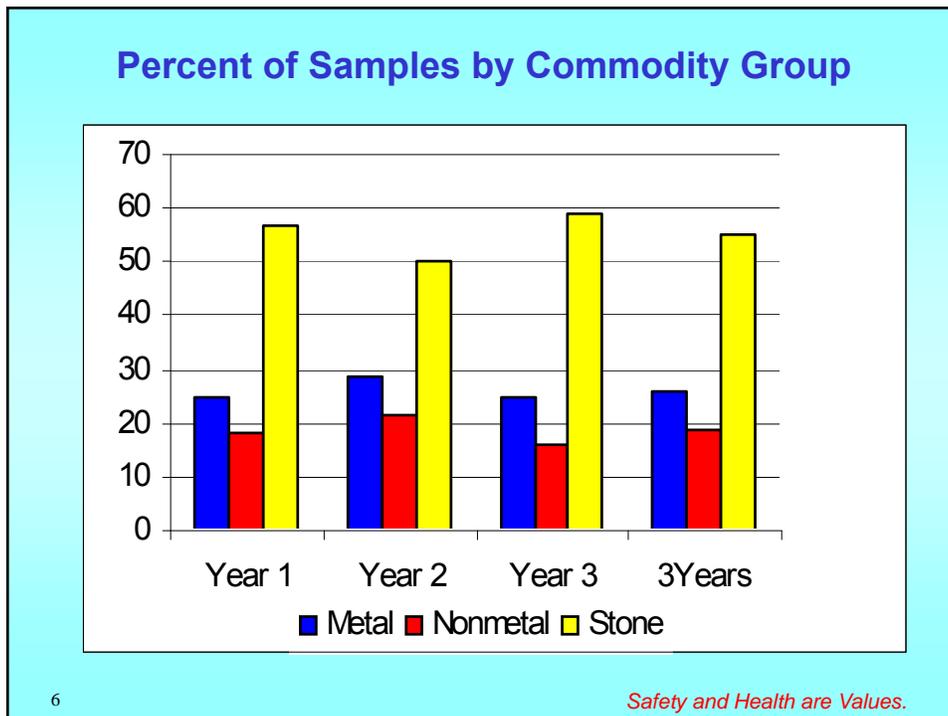
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### Number of Mines and Valid Samples by Commodity Group

	Number of samples			
	Year 1	Year 2	Year 3	3 Years
	7/20/02 to 7/19/03	7/20/03 to 7/19/04	7/20/04 to 7/6/05	7/20/02 to 7/6/05
<b>Metal</b>	272	243	174	689
<b>Nonmetal</b>	202	181	111	494
<b>Stone</b>	620	427	410	1457
<b>Total</b>	1094	851	695	2640
<b>Total Mines Sampled</b>	178	142	133	196
<b>Samples / Mine</b>	6.1	6.0	5.2	13.5

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### Number of Valid Samples per Mine for Specific Commodities

Commodity	Number of mines	Number of Samples			
		Year 1	Year 2	Year 3	3 Years
Clay, Ceramic, Refractory Mnls.	1	5	8	6	19
Copper Ore NEC	4	13	4	3	20
Crushed, Broken Limestone NEC	100	525	368	368	1261
Crushed, Broken Marble	4	18	14	7	39
Crushed, Broken Sandstone	1	5	0	0	5
Crushed, Broken Stone NEC	3	12	10	4	26
Dimension Limestone	2	5	3	2	10
Dimension Marble	3	9	3	8	20
Gemstones	2	2	5	0	7
<b>Gold Ore</b>	<b>21</b>	<b>102</b>	<b>67</b>	<b>68</b>	<b>237</b>
Gypsum	5	29	35	20	84
Lead-Zinc Ore	10	91	32	55	178
Lime	6	37	19	19	75

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Commodity	Number of mines	Year 1	Year 2	Year 3	3 Years
Misc. Metal Ore NEC	1	9	3	0	12
<b>Molybdenum Ore</b>	<b>2</b>	<b>19</b>	<b>21</b>	<b>18</b>	<b>58</b>
<b>Platinum Group Ore</b>	<b>2</b>	<b>19</b>	<b>90</b>	<b>11</b>	<b>120</b>
Potash	3	30	15	3	48
<b>Salt</b>	<b>14</b>	<b>107</b>	<b>109</b>	<b>80</b>	<b>296</b>
Sand, Industrial NEC	2	9	10	2	21
Silver Ore	3	19	20	14	53
Talc	1	3	0	0	3
Trona	4	26	9	2	37
Uranium Ore	1	0	0	3	3
Uranium-Vanadium Ore	1	0	6	2	8
<b>Totals</b>	<b>196</b>	<b>1094</b>	<b>851</b>	<b>695</b>	<b>2640</b>

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**Valid Samples, by Occupation and Commodity Group, 3 Years**

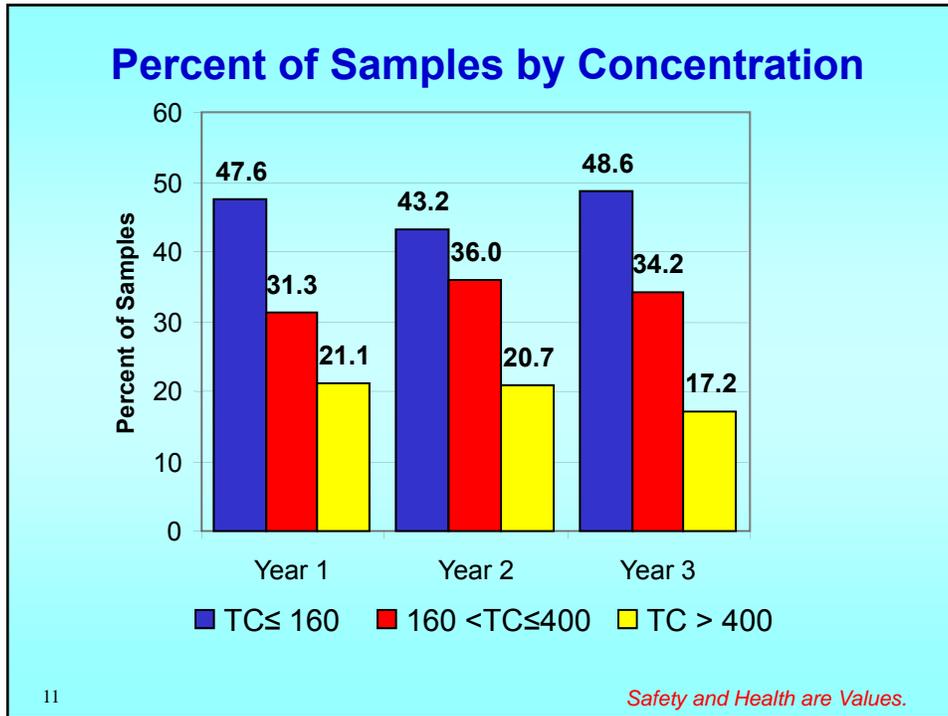
Job Description	Metal	Nonmetal	Stone	Total
Truck Driver	192	35	341	568
Front-end Loader Operator	108	70	304	482
Blaster, Powder Gang	16	58	187	261
Scaling (mechanical)	7	36	149	192
Drill Operator, Rotary	11	18	128	157
Drill Operator, Jumbo Perc.	26	19	68	113
Complete Load-Haul-Dump	33	44	6	83
Roof Bolter, Rock	23	12	32	67
Mucking Mach. Operator	59	5	2	66
Mechanic	14	22	22	58
Drill Operator, Rotary Air	1	5	43	49
Utility Man	12	25	7	44
Scaling (hand)	9	6	29	44
Miner, Drift	34	1	0	35
Crusher Oper/Worker	2	3	25	30
Supervisor, Co. Official	13	8	9	30
Scoop-Tram Operator	14	14	0	28
Roof Bolter, Mounted	6	6	13	25
All Others Combined	109	107	92	308

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**Comparison of Sample Results ( $\mu\text{g}/\text{m}^3$ ) with DPM Limits, TC=ECx1.3**

Concentration	Number of Samples			
	Year 1	Year 2	Year 3	3 Years
TC >400	228	179	120	527
160 < TC ≤ 400	338	311	238	887
TC ≤ 160	515	373	338	1226
<b>Total</b>	<b>1081</b>	<b>863</b>	<b>696</b>	<b>2640</b>

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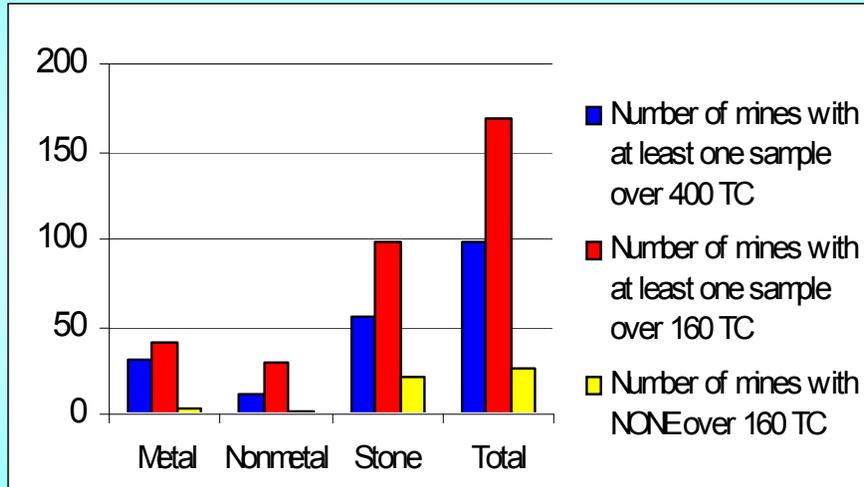
### Number of Mines Over Specified Level, 3 Years Combined

	Metal	Nonmetal	Stone	Total
Number of mines with at least one sample over 400 TC µg/m <sup>3</sup>	31	12	55	98
Number of mines with at least one sample over 160 TC µg/m <sup>3</sup>	41	29	99	169
Number of mines with NO samples over 160 TC µg/m <sup>3</sup>	4	1	22	27

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### Number of Mines Over Specified Level, 3 Years Combined



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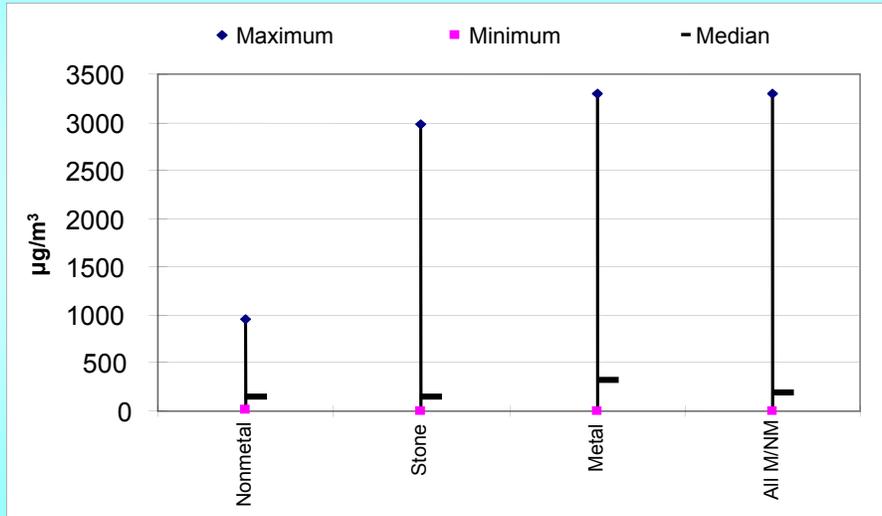
### TC Concentration by Commodity Group All Samples (TC=EC x 1.3)

	Maximum	Minimum	Median
<b>Nonmetal</b>	<b>960.01</b>	<b>7.44</b>	<b>144.24</b>
<b>Stone</b>	<b>2978.95</b>	<b>0.26</b>	<b>150.95</b>
<b>Metal</b>	<b>3299.75</b>	<b>3.46</b>	<b>324.57</b>
<b>All M/NM</b>	<b>3299.75</b>	<b>0.26</b>	<b>181.37</b>

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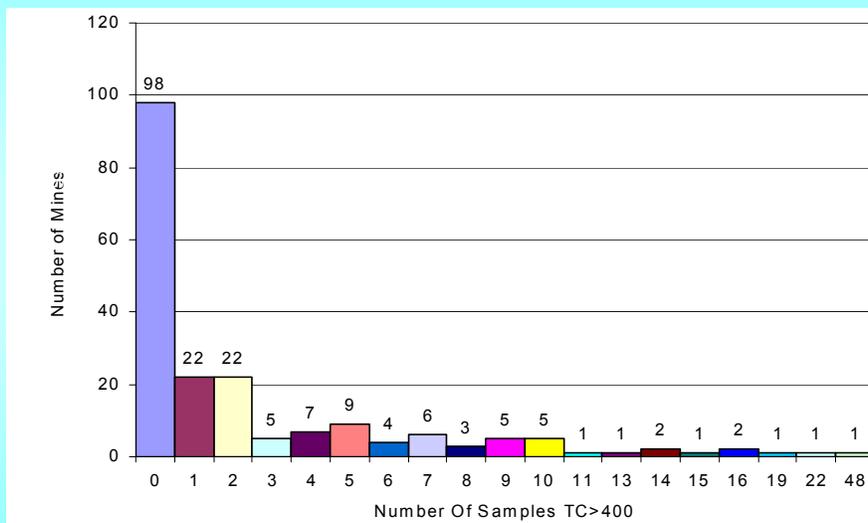
### TC Concentration by Commodity Group Samples (TC=EC x 1.3)



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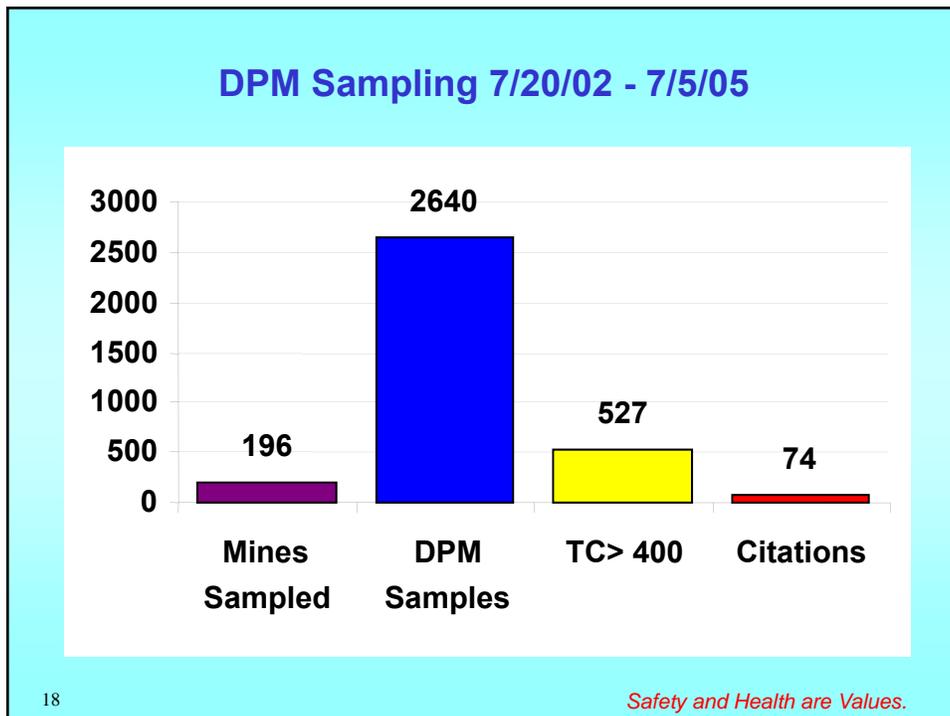
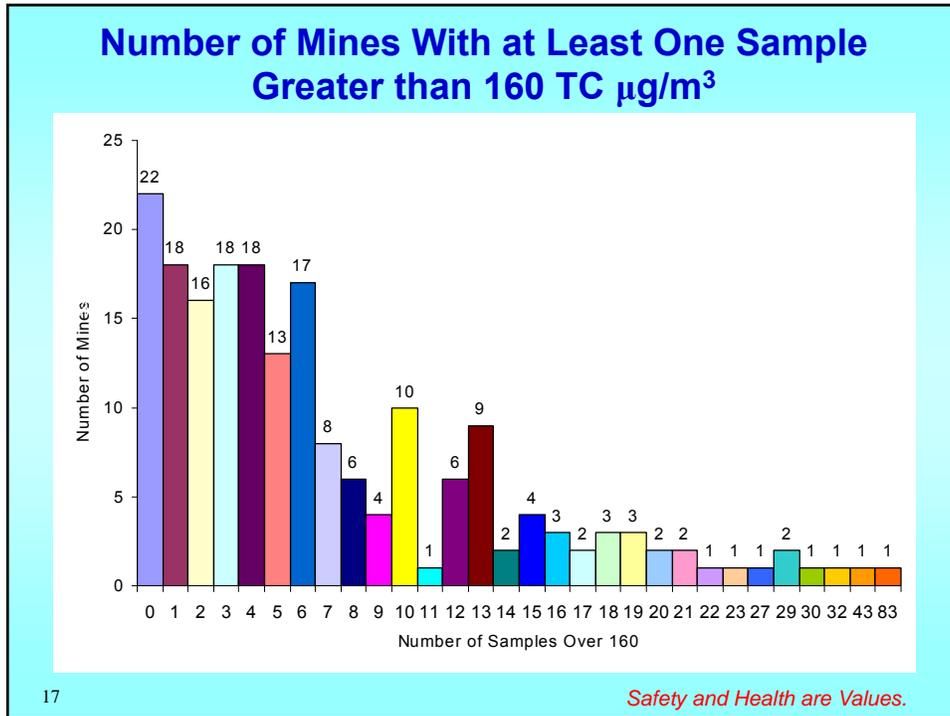
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### Number of Mines with at Least One Sample Greater than 400TC µg/m³

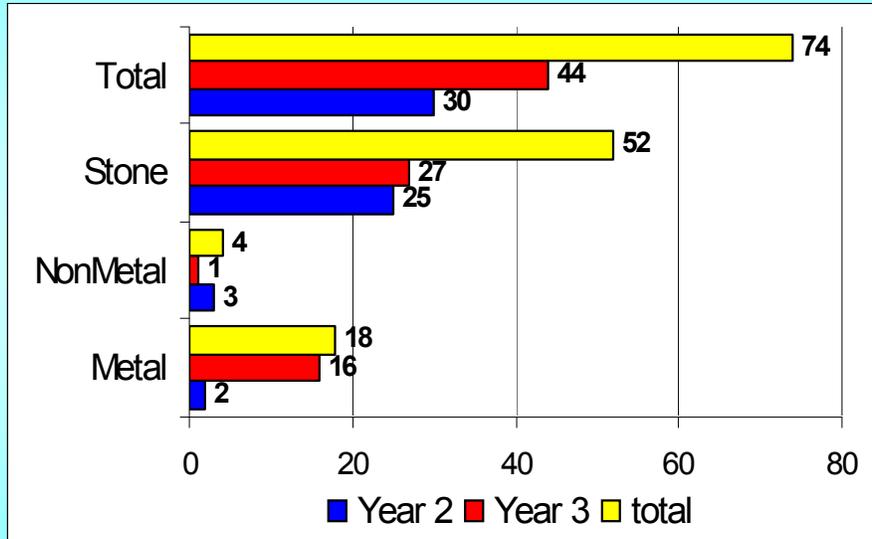


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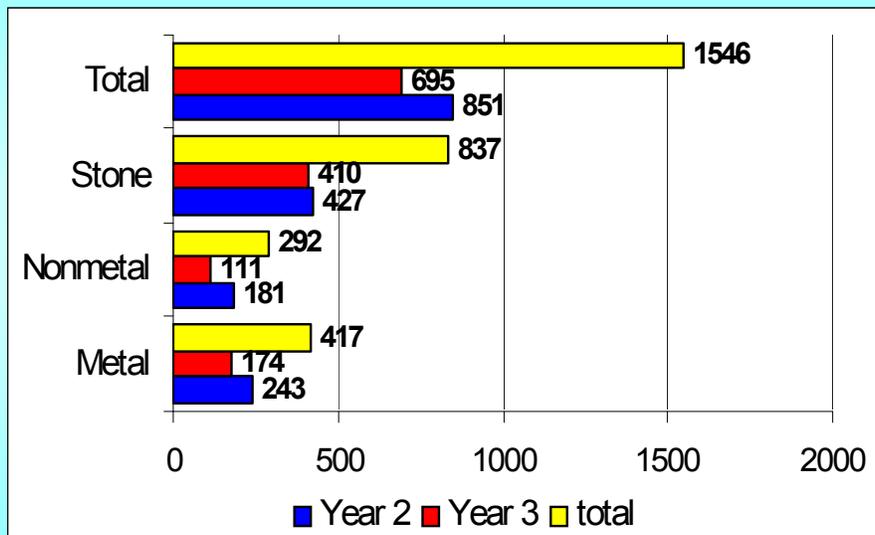
### Citations by Year and Commodity Group



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### Enforcement Samples by Year and Commodity Group



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<b>Samples by Commodity</b>					
<b>Commodity</b>	<b>Number of Mines</b>	<b>Number of Samples</b>	<b>Minimum</b>	<b>Median</b>	<b>Maximum</b>
Clay, Ceramic, Refractory Mnls.	1	19	28.6	67.0	419.5
Copper Ore NEC	4	20	4.92	292.6	647.2
Crushed, Broken Limestone NEC	100	1261	0.3	155.2	2978.9
Crushed, Broken Marble	4	39	1.2	103.5	530.7
Crushed, Broken Sandstone	1	5	3.5	8.0	12.7
Crushed, Broken Stone NEC	3	26	13.6	107.3	447.5
Dimension Limestone	2	10	17.8	76.0	333.5
Dimension Marble	3	20	16.6	140.3	306.0
Gemstones	2	7	102.8	171.8	372.1
<b>Gold Ore</b>	<b>21</b>	<b>237</b>	<b>3.5</b>	<b>376.1</b>	<b>3299.7</b>
Gypsum	5	84	7.7	252.9	960.0
Lead-Zinc Ore	10	178	9.1	320.8	2025.6
Lime	6	75	26.2	150.5	668.4

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<b>Samples by Commodity</b>					
<b>Commodity</b>	<b>Number of Mines</b>	<b>Number of Samples</b>	<b>Minimum</b>	<b>Median</b>	<b>Maximum</b>
Misc. Metal Ore NEC	1	12	20.3	105.8	333.9
Molybdenum Ore	2	58	20.9	144.4	1333.4
<b>Platinum Group Ore</b>	<b>2</b>	<b>120</b>	<b>21.5</b>	<b>425.9</b>	<b>1794.9</b>
Potash	3	48	7.4	90.2	579.2
Salt	14	296	16.4	137.8	824.1
Sand, Industrial NEC	2	21	36.7	304.9	868.4
Silver Ore	3	53	61.1	233.6	735.1
Talc	1	3	242.7	245.7	328.8
Trona	4	37	17.5	81.8	407.3
Uranium Ore	1	3	48.3	95.7	271.3
Uranium-Vanadium Ore	1	8	119.5	295.0	885.3
<b>Grand Total</b>	<b>196</b>	<b>2640</b>	<b>0.26</b>	<b>181.4</b>	<b>3299.7</b>

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### Occupations With at Least One Sample $\geq 400_{TC} \mu\text{g}/\text{m}^3$

Job	Number of Samples, 3 Years	Minimum	Median	Maximum
Motorman	15	36.4	165.7	418.9
Shuttle Car Operator (diesel)	3	95.2	201.6	419.5
Mechanic	58	5.9	93.8	420.0
<b>Engineer</b>	<b>1</b>	<b>437.7</b>	<b>437.7</b>	<b>437.7</b>
Cont. Miner Operator	7	20.5	75.5	446.1
Laborer, Bullgang	24	2.1	140.0	454.0
Cleanup Man	7	66.4	325.7	499.0
Belt Crew	9	25.8	178.8	501.6
Cement/Concrete Man	2	144.4	332.6	518.8
Scoop-Tram Operator	28	13.5	308.4	583.3
Drill Oper., Jackleg/Stoper	19	13.7	303.9	609.2
Washer Operator	5	296.5	399.7	807.6
Drill Helper	21	21.8	217.7	834.0
Supervisor, Co. Official	30	1.2	133.1	855.8
Miner, Drift	35	15.8	301.4	925.2

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Job	Number of Samples, 3 Years	Minimum	Median	Maximum
Utility Man	44	23.2	99.8	990.5
Miner, Stope	17	99.9	305.0	991.8
<b>Bulldozer Operator</b>	<b>2</b>	<b>151.7</b>	<b>582.6</b>	<b>1011.5</b>
Roof Bolter, Mounted	25	43.8	276.3	1062.9
Drill Operator, Jumbo Perc.	113	5.0	183.3	1098.2
Drill Operator, Rotary	157	3.1	174.8	1108.7
Ground Control/Timberman	10	80.7	336.1	1135.3
<b>Mucking Mach. Operator</b>	<b>66</b>	<b>15.5</b>	<b>460.3</b>	<b>1196.0</b>
Scaling (mechanical)	192	0.3	149.7	1245.5
Blaster, Powder Gang	261	6.2	212.7	1340.3
Drill Operator, Rotary Air	49	31.6	288.6	1352.7
Roof Bolter, Rock	67	17.8	277.9	1397.3
Truck Driver	568	3.5	196.3	1580.8
Scaling (hand)	44	18.4	170.5	2012.7
Diamond Drill Operator	8	15.4	236.6	2034.0
Front-end Loader Operator	482	1.5	169.3	2979.0
Complete Load-Haul-Dump	83	16.1	249.7	3299.8

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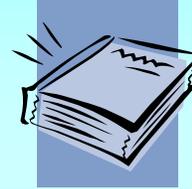
<b>Occupations With No Samples <math>\geq 400_{TC} \mu\text{g}/\text{m}^3</math> at least one sample per year</b>				
<b>Job</b>	<b>Number of Samples, 3 years</b>	<b>Minimum</b>	<b>Median</b>	<b>Maximum</b>
Crusher Oper/Worker	30	1.2	86.1	270.8
Cutting Mach Operator	17	17.6	136.6	275.5
Stone Polisher/Cutter	11	17.8	139.7	333.5
Road Grader Operator	11	19.6	184.1	389.0
Oiler, Greaser	10	31.8	128.9	351.2
Forklift Operator	8	13.6	91.6	204.8
Backhoe Operator	7	17.4	58.3	195.6
Tractor Operator	7	11.3	95.4	256.2
Nipper, Supply Man	7	61.2	121.7	342.6
Chute Blaster	5	20.9	28.3	61.3
Skip tender	5	30.6	83.8	139.0
Bobcat Operator	5	47.5	183.3	274.0
Surveyor	5	45.0	172.9	374.8
Electrician	4	63.5	69.8	85.1
Ram Car Operator	4	70.7	240.0	355.2

### Conclusions from 3 Years Sampling

- Three years does not a trend make.  
Nonetheless, consider slides 10 and 11, *Number and the Percent of Samples by Concentration.*
- Most mines with levels over the interim limit made efforts to decrease exposures.
- More citations issued the second year.
  - ◆ Fewer samples taken. Sampling smarter?
- Mine operators implementing controls
  - ◆ Continual upgrading to low-emission engines
  - ◆ Ventilation improvements
  - ◆ Alternative fuel blends used at some mines

## June 6, 2005 Final Rule on Interim Limit

- changed surrogate to EC
- PEL is  $308_{EC} \mu\text{g}/\text{m}^3$
- requires hierarchy of controls
- requires MSHA to consider economic as well as technological feasibility
- deletes requirement for a control plan



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## Extension of Time to Reduce the Concentration of DPM

- ◆ for compliance with the final DPM limit and for one year intervals.
- ◆ No maximum limit on number of times an operator can apply for an extension.
- ◆ File with district manager rather than Secretary
- ◆ Document controls are technologically or economically infeasible to meet the DPM final limit.
- ◆ state that diesel-powered equipment was used in the mine prior to October 29, 1998.

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## Control Requirements that Mine Operators Must Employ

- may choose from a combination of feasible engineering and administrative controls.
  - ◆ **supplement controls with respiratory protection if infeasible or fail to reach PEL**
- Rotation of miners shall not be used for compliance.

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## Compliance Guide Updated

- ◆ **environmental → exposure monitoring**
- ◆ **determining an overexposure**
- ◆ **feasibility of controls**
- ◆ **deleted extraneous text**
  - **140 → 134 Q&As**



- EPA approved Ethanol as a fuel additive

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