United States Department of Labor

MSHA

Mine Safety and Health Adminstration

DPM:

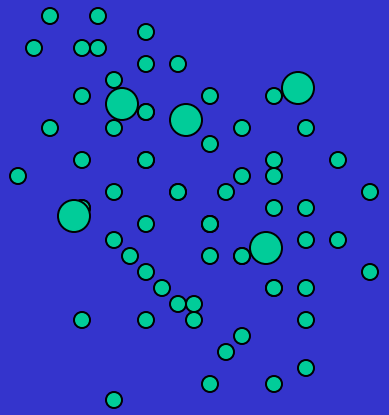
What is it?
What are the health risks?
How does MSHA regulate it?

Diesel Particulate Matter (DPM) Consists of:

- Solids, liquids and vapors;
- Burned and unburned hydrocarbons;
- Oxides of sulfur and nitrogen;
- Metal fragments, metal oxides and other substances

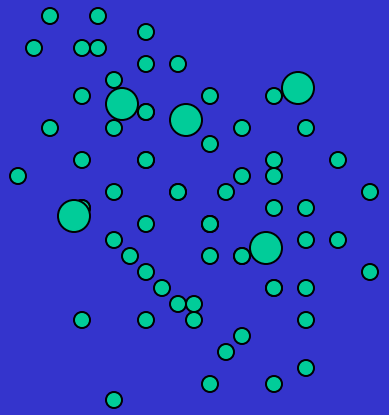
- "Raw" DPM mixture difficult to measure
- ***Carbon components*** are 80% to 85% of DPM and can be accurately measured at very low concentrations

DPM Carbon Components



Vapor Phase Organic Hydrocarbons (OC)

DPM Carbon Components



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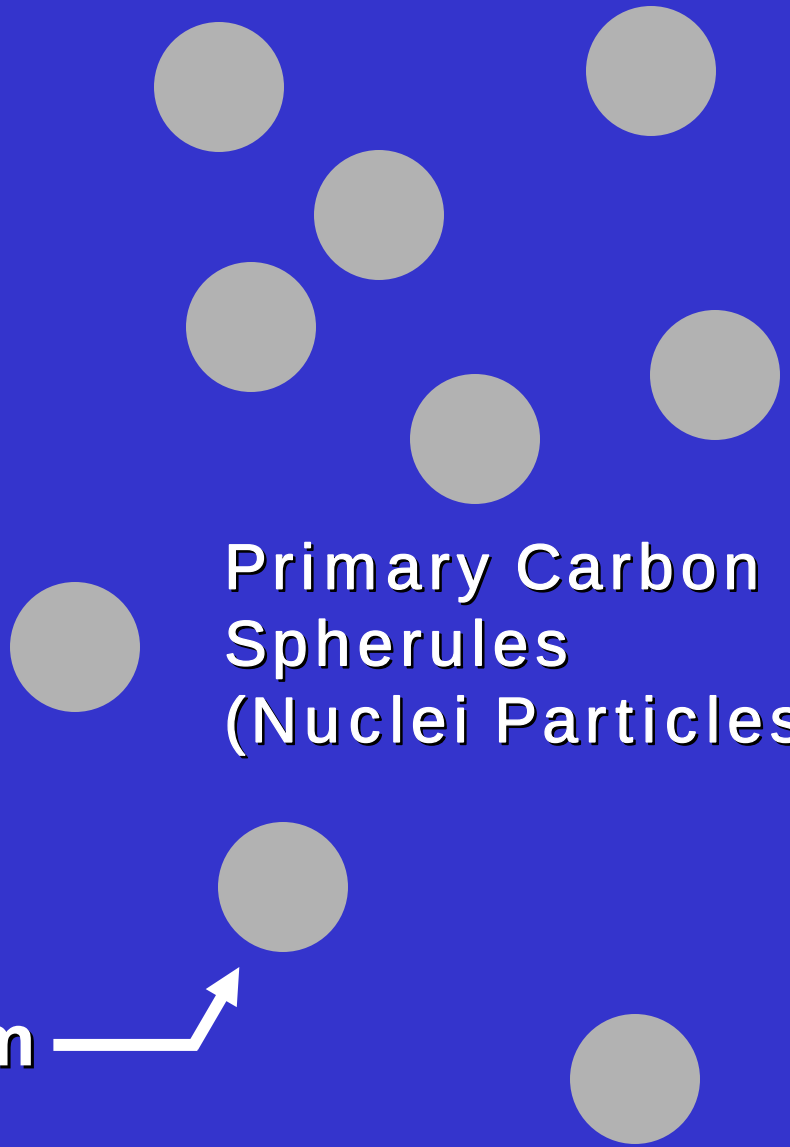
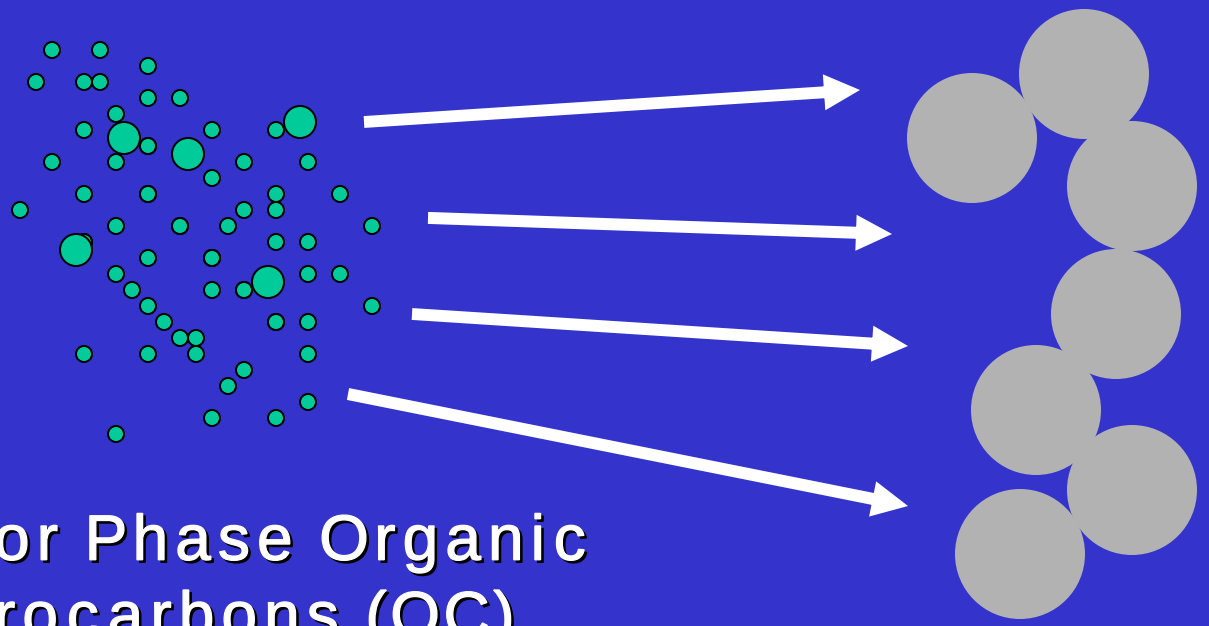


Primary Carbon Spherules (Nuclei Particles)

0.01 to 0.08 µm

DPM Carbon Components

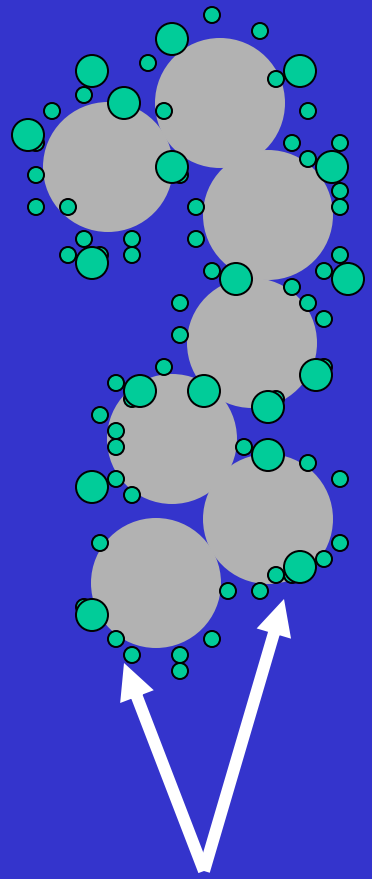


Vapor Phase Organic Hydrocarbons (OC)

Agglomerated Elemental Carbon Cores (EC)

DPM Carbon Components

Hydrocarbons Adsorbed Onto Agglomerated Elemental Carbon Cores (OC + EC)

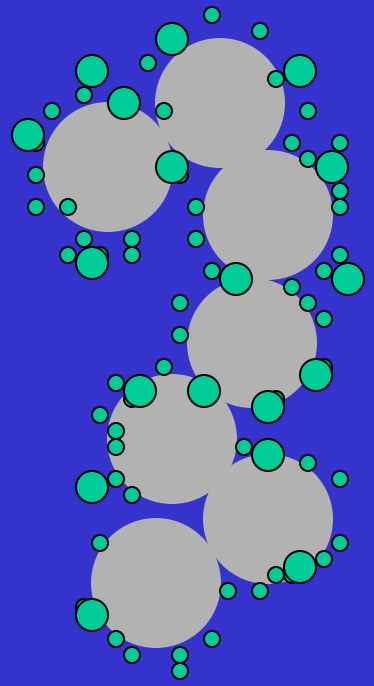


0.08 µm to 1.0 µm

Adsorbed Hydrocarbons (Soluble Organic Fraction)

DPM Carbon Components

Hydrocarbons
Adsorbed Onto
Agglomerated
Elemental Carbon
Cores (OC + EC)



Organic Carbon + Elemental Carbon = Total Carbon

OC + EC = TC

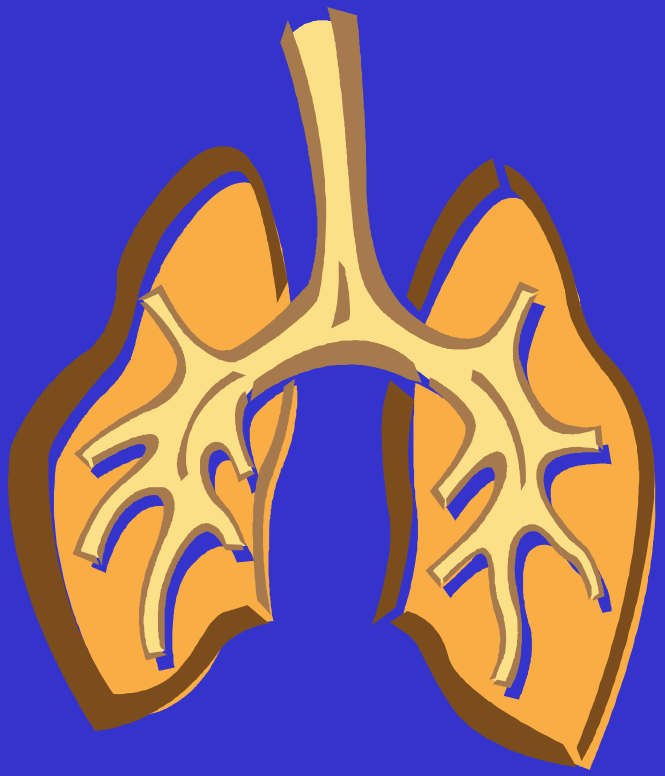
MSHA uses TC as the Surrogate for DPM

Total Carbon (TC)

- MSHA's MNM DPM rule uses ***TC*** as the surrogate for controlling exposure to ***DPM***
- MSHA's Permissible Exposure Limit (PEL) for TC is 160 $\mu g/m^3$
- MSHA is not using EC as a surrogate because there is insufficient evidence for an appropriate conversion factor
- MSHA has developed an enforcement strategy to ensure that a miner's exposure to TC is not the result of interferences from non-diesel exhaust sources such as tobacco smoke, drill oil mist and ANFO vapors

Health Risks of DPM

- Almost all DPM particles are respirable in size and can reach deep into the lungs



Primary Health Effects of DPM

- Sensory irritations and respiratory symptoms
- Immunologic effects (allergenic responses and asthma-like symptoms)
- Premature death from cardiovascular, cardiopulmonary, or respiratory causes
- Lung cancer

Many Organizations Regard DPM as Hazardous to Human Health

Year	Organization	Conclusion
2002	US EPA	Likely human carcinogen
2001	ACGIH (proposal)	Suspected human carcinogen
2001	US Dept of HHS	Reasonably anticipated to be a human carcinogen
2000	NTP	Reasonably anticipated to be a human carcinogen
1998	CARB	Toxic air contaminant
1996	World Health Org	Probable human carcinogen
1989	IARC	Probable human carcinogen
1988	NIOSH	Potential occupational carcinogen

How does MSHA MNM regulate DPM?

§57.5060 (b)	DPM final limits
§57.5060 (c)	Special extensions
§57.5060 (d)	Controls, RPP, medical evaluation & transfer
§57.5060 (e)	Rotation of miners
§57.5061	Compliance determinations
§57.5065	Fueling
§57.5066	Maintenance
§57.5067	Engines
§57.5070	Training
§57.5071	Exposure monitoring
§57.5075	Recordkeeping

§57.5060(b)(3) Final DPM PEL

- Effective May 20, 2008, a miner's personal exposure to diesel particulate matter (DPM) in an underground mine must not exceed an average eight-hour equivalent full shift airborne concentration of ***160 micrograms of total carbon (TC)*** per cubic meter of air ***(160_{TC} $\mu g/m^3$)***

§57.5060(c) Special Extensions

- Apply to District Manager
- Technological or economic constraints
- Post application at mine (30 days)
- Provide copy to miner's representative
- Limited to 1 year (renewable)
- ***Application must be justified***
  - *Must show that exposures exceed PEL despite implementation of all feasible engr/admin controls*
- Include sampling results
- Include plan for minimizing exposures during period of Special Extension

§57.5060(d) DPM Controls

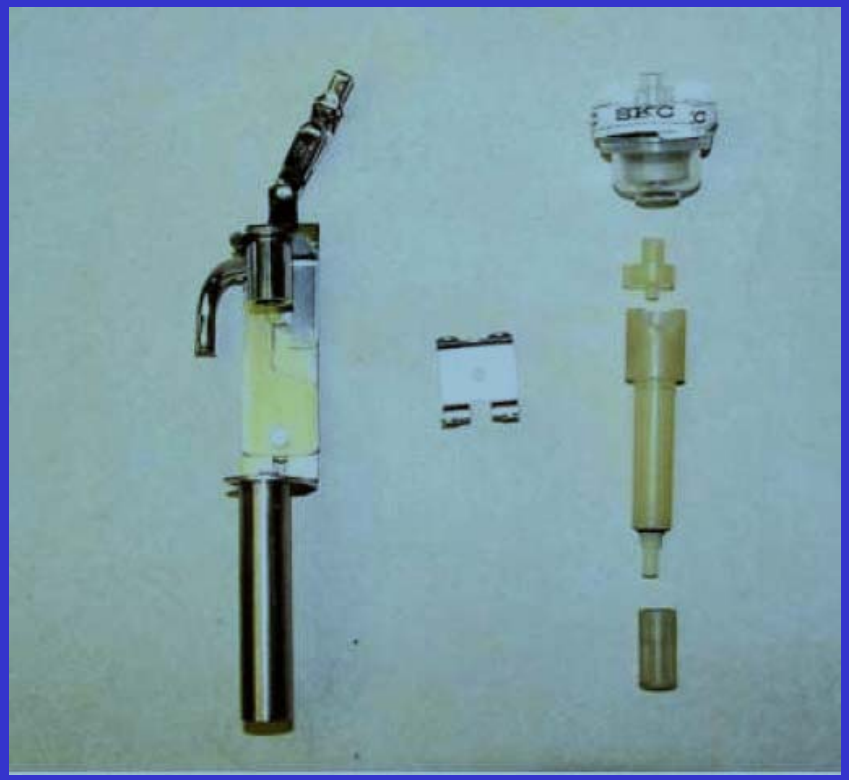
- The mine operator must install, use, and maintain feasible engr/admin controls to reduce a miner's exposures to/below the PEL.
- When controls do not reduce exposure to/below PEL, controls are infeasible, or controls do not produce significant reductions in DPM exposures, controls must be used to reduce exposure to as low a level as feasible, and must be supplemented with respiratory protection.
- Miners required to wear respirators due to DPM exposure must be medically evaluated. Miner who is medically unable to wear respirator must be transferred to another job where respirator not required.

§57.5061 Compliance Determinations

- Single sample is basis for non-compliance determination
- Sub-micron sampling using 10 mm Dorr Oliver nylon cyclone and SKC DPM cassette with integral sub-micron impactor
- Full shift personal sampling
- NIOSH Method 5040 analysis

DPM Sampling Equipment

SKC DPM Sampling Cassette with Jeweled Sub-micron Impactor

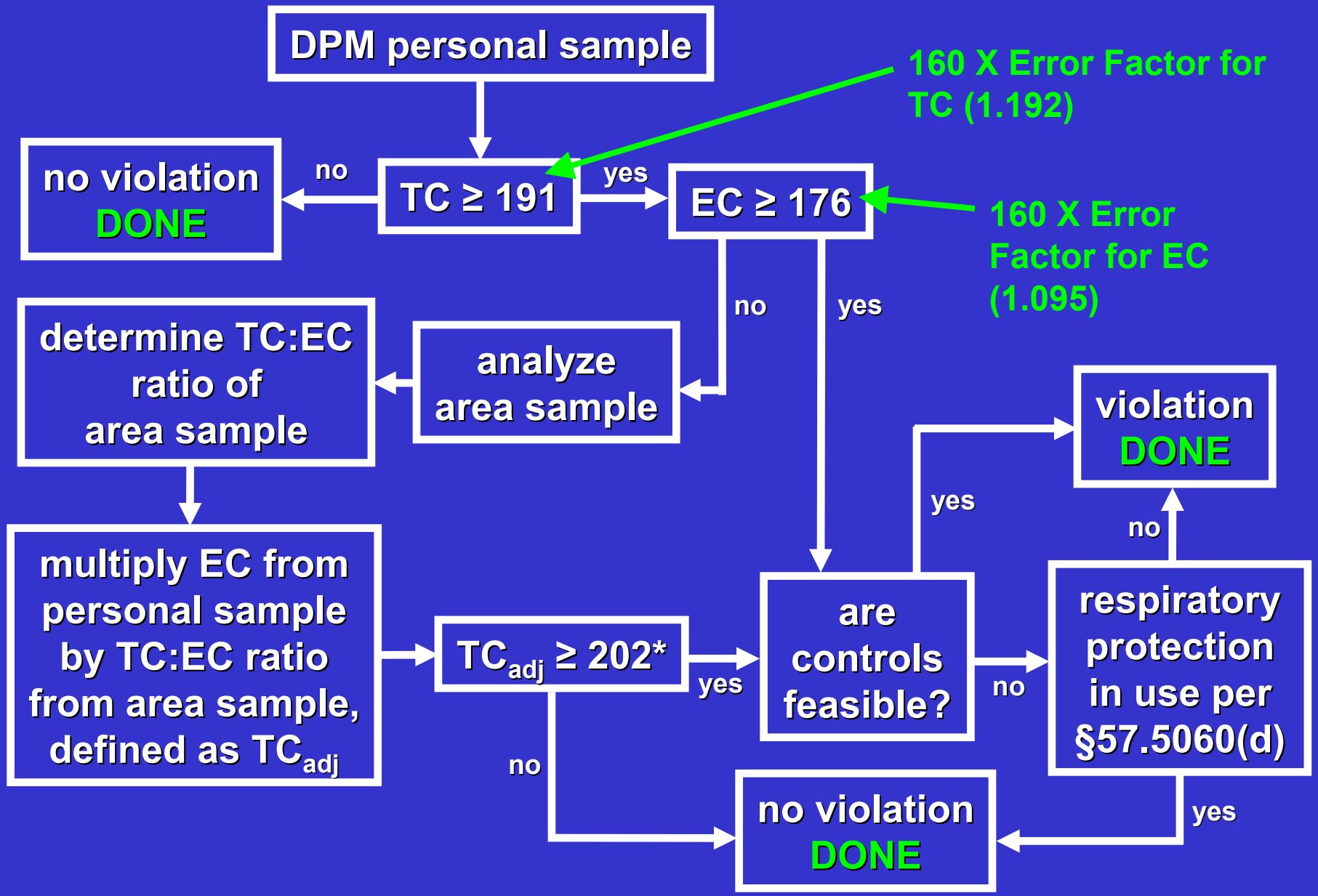


Dorr-Oliver Nylon Cyclone with Metal Cassette Holder

Cassette/Cyclone Assembly with SKC Sampling Pump

Sampling Policy

- MSHA has developed a practical sampling strategy to account for interferences from non-diesel exhaust sources
- MSHA will adjust a miner's TC exposure based on the ratio of TC to EC obtained from an area sample taken at a location within the mine without OC interferences
- Area sample placed at least 25-feet from area where miners smoke and at least 500-feet from any area that has drill oil mist



* Enforceable limit (PEL x EF) for TC_{adj} depends on number of area samples taken. Above example for 1 area sample. For more than 1 area sample, see table.

§57.5065 Fueling Practices

- Must use low sulfur fuel (.05% = 500 ppm)
  - Ultralow sulfur diesel fuel (ULSD) (.0015% = 15 ppm) now available (EPA requires for on-road use)
  - EPA will require ULSD for off-road in 2010
  - ULSD reduces DPM slightly (reason for requiring ULSD is that sulfur can poison certain catalyzed emission control devices)
  - B100 is less than 15 ppm sulfur (usually about 5-7 ppm)
- Fuel additives must be EPA registered

§57.5066 Maintenance Standards

- MSHA Approved engines maintained in approved condition
- Emission-related components of non-approved engines maintained to manufacturer specifications
- Emission control devices maintained in effective operating condition
- DPM maintenance tagging
- Qualifications of miners authorized to maintain diesel equipment

§57.5067 Engines

- Engines introduced after Sept. 30, 2002 must be either:
  - MSHA Approved
  - Have DPM emissions that meet the requirements of table 57.5067-1
- Introduced means
  - Engine in new or used equipment brought into the mine (unless same mine operator)
  - Rebuilt engine *if different serial number*

§ 57.5067(a)(2) Engines - Table 57.5067-1 EPA Emission Requirements

EPA Category		PM Limit
Light Duty Vehicle/Truck		0.1 g/mile
Heavy Duty Highway Engine		0.1 g/bhp-hr
Non-road Engines		
Tier 1	Less Than 11 hp	0.75 g/bhp-hr
Tier 1	11 hp To < 50 hp	0.60 g/bhp-hr
Tier 2	50 hp To < 100 hp	0.30 g/bhp-hr
Tier 2	100 hp To < 175 hp	0.22 g/bhp-hr
Tier 1	175 hp To 750 hp	0.40 g/bhp-hr

§57.5070 Miner Training

- Annual DPM training required (if reasonably expected to be exposed to DPM underground)
- Training must cover
  - Health risks
  - Methods used to control DPM
  - Personnel responsible for maintaining controls
  - Actions miners must take to insure controls work properly

§57.5071 Exposure Monitoring

- Operator must monitor as often as necessary to determine whether exposures exceed PEL
- If exposures exceed PEL
  - Post notice of corrective action
  - Promptly initiate corrective action
- Must post all monitoring results
- Copy of monitoring results provided to miner's representative

§57.5075 DPM Recordkeeping

- Lists records that must be maintained and retention time

Thank You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