NATIONAL STONE, SAND & GRAVEL ASSOCIATION

Natural building blocks for quality of ***life***

November 25, 2002

By e-mail to comments@msha.gov;
regular mail submission to follow

Mr. Maivin W. Nichols
Director
Office of Standards, Regulations, and Variances
Mine Safety and Health Administration
1100 Wilson Blvd., Room 2352
Arlington, VA 22209-3939

Dear Marvin:

The National Stone, Sand & Gravel Association (NSSGA) is pleased to offer the attached comments to the Mine Safety and Health Administration (MSHA) on MSHA's Advanced Notice of Proposed Rulemaking (ANPRM) for Diesel Particulate Exposure of Underground Metal and Nonmetal Miners.

The NSSGA, based near the nation's capital, is the worlds largest construction material association by product volume, representing more than 850 member companies and approximately 120,000 working men and women in the aggregates industry. During 2001 a total of about 2.75 billion metric tons of crushed stone, sand and gravel, valued at $14.5 billion, were produced and sold in the United States.

NSSGA has always wholeheartedly supported efforts, regardless of their source, that promote miner health and safety, and has actively offered its own products and services to advance health and safety within the mining sector. We have also supported those features of the Diesel Particulate Matter (DPM) Rule that have already gone into effect. Our views are more fully elucidated in the attachment.

NSSGA appreciates the opportunity to comment afforded by MSHA's ANPRM. If you have any questions or comments, please do not hesitate to contact us.

Sincerely,

James Sharpe, CIH
Vice President, Safety & Health Services

CC: Dave D. Lauriski

Enclosures (8)

AB29-COMM-11

2101 WILSON BLVD. ■ SUITE 100 ■ ARLINGTON, VA 22201
703 525 8788 ■ 800 342 1415 ■ FAX 703 525 7782
WWW.NSSGA.ORG

Comments of the National Stone, Sand & Gravel Association on MSHA's Advance Notice of Proposed Rulemaking re Diesel Particulate Matter Exposure of Underground Metal And Non-Metal Miners

November 25, 2002

Having reviewed carefully MSHA's advance notice of proposed rulemaking (ANPRM), published in the Federal Register for September 25, 2002 (67 Fed. Reg. 60199), regarding amendments to MSHA's health standard for diesel particulate matter exposure of underground metal and non-metal miners (the DPM Rules), the National Stone, Sand & Gravel Association (NSSGA) offers the following comments.

Initially, we wish to note that of the approximately 200 underground mines covered by the DPM Rules, about 110 mines are aggregate operations and many of these are run by NSSGA member firms. The NSSGA is not a party to the litigation which led to the July 15, 2002 settlement agreement (see 67 Fed. Reg. 47297, Thurs. Jul. 18, 2002), which, among other things, called for this rulemaking to amend, on an expedited basis, key provisions of the DPM Rules. However, we followed the parties' settlement negotiations closely. Indeed, of the 31 mines studied in the "Report on Joint MSHA/Industry Study: Determination of DPM Levels in Underground Metal and Non-Metal Mines" (Draft Report), nine are operated by NSSGA members. Thus, the nation's underground stone mining industry, most of which is represented by the NSSGA, has an enormous stake in the outcome of the changes to the DPM Rules under consideration.

MSHA has set out 48 questions in the ANPRM to which it seeks information, data, and comments. NSSGA is considering each of these questions, and will continue to do so, but at this juncture, we are not prepared to respond to all of them. Importantly, fully half of the questions deal with the issue of whether or not it is technologically and economically feasible for operators to comply with the DPM Rules. We think the level of attention paid to that issue is wholly appropriate because, in our view, technological and economic feasibility is at the very heart of the DPM Rules, as well as the amendments contemplated by the July 15 settlement agreement and discussed in this ANPRM. Thus, in addition to responding to as many of MSHA's specific inquiries as we now can, the NSSGA first wishes to provide MSHA with our views on this central issue.

Technological and Economic Feasibility

Section 101(a)(6)(A) of the Federal Mine Safety and Health Act of 1977 (the Mine Act) requires, among other things, that when MSHA promulgates standards dealing with such issues as DPM, those standards must be feasible. See 30 U.S.C. §§ 801, 811(a)(6)(A). The issue has withstood legal scrutiny and hence is well settled.[1]

We think, however, that where a difference may exist between us and MSHA lies in our respective views as to whether or not the existing administrative record for the DPM Rules and the new augmenting administrative record which will be developed as a result of this current rulemaking will *adequately demonstrate* that it is technologically and economically feasible for industry to comply with the DPM Rules. Stated simply, NSSGA does not believe the existing administrative record for the DPM Rules, as published in the Federal Register for January 19, 2001 (66 Fed. Reg. 5706), supported the conclusion that it is technologically and economically feasible for operators of underground stone mines to comply with the DPM Rules. MSHA obviously disagreed, since the Agency finalized the DPM Rules. Furthermore, NSSGA has not seen any new information since January 19, 2001 which changes our view regarding feasibility. Fortunately, it appears that MSHA is now reconsidering that question. We say this because, in large part,

---

1 *See National Mining Ass'n. v. Sec. of Labor*, 153 F.3d 1264, 1269 (11th Cir. 1998)

the July 15 settlement agreement and this expedited rulemaking are based on the premise stated in the ANPRM that:

> New information on the technological and economic feasibility of current control technology was presented to MSHA following promulgation of the January 19, 2001 standard. MSHA intends to evaluate this new information in conjunction with compliance changes that would result from a proposed standard.

67 Fed. Reg. 60201.

The NSSGA is very pleased that MSHA is reconsidering this issue. Based on our understanding of the negotiations leading to the settlement agreement, however, the bulk of the "new information" noted above was that generated by the 31 mines studied in the Draft Report, including the nine mines operated by NSSGA members. Here we note, with grave concern, that, in its discussion of the 31-mine study, the ANPRM states that:

> . . . MSHA is in the process of developing the final report [of the study]. MSHA will include the final report in this [new] rulemaking record.

Id. 60200.

The NSSGA believes strongly that it is premature to finalize the Draft Report. Our letter of November 4, 2002 to Mr. Robert M. Friend, MSHA's Administrator for Metal and Non-Metal Mine Safety and Health (copy enclosed), sets out the reasons for our concerns in detail. To briefly reiterate its key point, however, we believe that a hasty finalization of the Draft Report will co-opt and prejudice MSHA's ability to fairly "evaluate this new information in conjunction with compliance changes that would result from a proposed standard." *Id*. 60201. In other words, MSHA cannot have it both ways. If the Agency is taking a fresh look at the new information to determine its effect on MSHA's determination of the technological and economic feasibility of current DPM control technology, then it is clearly erroneous and, at the very least, premature for MSHA to publish a final report of the 31-mine study concluding that it is technologically and economically feasible for underground metal and non-metal mine operators to comply with both the interim and final concentration limits set forth in the DPM Rules.[2] With regard to underground stone mines, in particular, such a conclusion is troublesome enough as it relates to the interim limit, but it is extraordinarily problematic and untrue in connection with the final concentration limit.

Furthermore, implementation of the settlement agreement itself will generate important new information regarding technological and economic feasibility which should undoubtedly become part of the administrative record in this expedited rulemaking. Thus, as part of its compliance assistance to underground metal/non-metal mine operators covered by the DPM Rules, to be carried out between July 20, 2002 and July 19, 2003, MSHA has committed to conduct DPM baseline sampling at all of the mines subject to the DPM Rules. 67 Fed. Reg. 47298. The NSSGA urges MSHA to compile and publish this baseline data as it becomes available so that both the Agency and all other interested parties can examine and comment on this information during this expedited rulemaking. We say this because, to the extent that the baseline sampling carried out during the 31-mine study may not be representative of

---

[2] The final Draft Report made available to us states in its executive summary that compliance *may* be feasible, but in numerous other portions of that Draft where feasibility is addressed, technological and economic feasibility is categorically concluded. Furthermore the Draft Report pays only lip service to industry comments on the earlier March 29, 2002 Draft Report. In order to make sure that these comments become part of the administrative record of this current expedited rulemaking, the NSSGA hereby incorporates by reference, as though fully set forth, our own comments of May 22, 2002, as well as the May 21, 2002 comments of John Head, P.E., for the Diesel Litigation Coalition, the May 22, 2002 comments of AngloGold (Jeritt Canyon) Corporation and Kennecott Minerals Company, and the May 24, 2002 comments of Getchell Gold Corporation. All of these comments present compelling information demonstrating that it is not now technologically or economically feasible for operators of underground stone mines to comply with the concentration limits specified in the DPM Rules.

DPM exposures throughout the industry, the compliance assistance DPM baseline sampling now being conducted by MSHA should provide an enormously valuable database, which will be fundamental to determinations of technological and economic feasibility.[3]

In addition, the settlement agreement specifies that:

> "MSHA will … work with NIOSH, … equipment manufacturers, mine operators, and representatives of miners to improve practical mine worthy filter technology, including the availability of after-treatment control technology for diesel powered engines, particularly for engines of less than 50 hp and 250 hp or greater." Id.

It is somewhat unclear to us as to how MSHA intends to accomplish this provision of the settlement agreement, but it would appear that one aspect of this commitment is the new Metal/Non-Metal Diesel Partnership (the Partnership) being developed under the leadership of the National Institute for Occupational Safety and Health (NIOSH). In addition to the NSSGA and NIOSH, other partners are the National Mining Association and the United Steelworkers of America. As we understand it, MSHA will be a non-partner observer of the Partnership's activities. The specific goal of the Partnership is to identify technologically and economically feasible DPM controls, using existing and available technology, that can be retrofitted onto existing diesel powered equipment used in underground metal/non-metal mines, to reduce DPM emissions to, or below, the concentration limits specified in MSHA's DPM Rules. Clearly, the work of the Partnership will generate important information

---

3 Indeed, the NSSGA remains astonished that MSHA could have promulgated the DPM Rules without ever having conducted any systematic baseline sampling of in-mine exposures of miners to DPM. The sampling carried out during the 31-mine study was a good start, but it is the industry-wide baseline DPM sampling now being carried out by MSHA which may show the first complete picture of DPM exposures of miners at all of the mines covered by the DPM Rules.

for MSHA to consider during the course of this expedited rulemaking. Enclosed please find the draft Partnership Agreement and a "Plan of Study for Evaluating Performance of Diesel Particulate Filters in Underground Mines" prepared by NIOSH.

Although we think that MSHA's commitment to work with NIOSH, equipment manufacturers, mine operators, and representatives of miners to improve practical mine-worthy filter technology is in no way fulfilled by MSHA's role in the Partnership as a non-partner participant, nevertheless, NSSGA is enthusiastic about the Partnership's goals and activities.[4] We say this particularly because we are aware of the activities of the Coal Diesel Partnership among NIOSH, the Bituminous Coal Operators' Association, and the United Mine Workers of America. As we understand it, the Coal Diesel Partnership was formed, in part, to deal with the substantial and ongoing implementation problems of MSHA's health standard for DPM exposure of underground coal miners (the Coal DPM Rules), also published in the Federal Register for January 19, 2001. See 66 Fed. Reg. 5526. The Coal DPM Rules were not subject to litigation. However, we have learned that their implementation has been extraordinarily vexing, both to MSHA and underground coal mine operators. Some problems have been solved, but a multitude remain. It is our understanding that the Coal Diesel Partnership has been a useful forum for discussion of those severe implementation issues.

For example, a June 17, 2002 NIOSH Report to the Coal Diesel Partnership, "Results of Filter Testing Conducted at Deer Creek Mine May 2002," identified, for the first time, serious problems resulting from NIOSH field tests of ceramic filters. The field tests demonstrated that diesel engines operating with such filters installed on them generated dangerous levels of NO_2

---

4 NSSGA is very interested to learn more about how MSHA intends to go about fulfilling its obligations pursuant to this requirement of the settlement agreement.

emissions. The Deer Creek Mine field testing, in turn, resulted in a May 31, 2002 MSHA Program Information Bulletin (PIB No. P02-4) alerting mine operators and miners of the potential health hazards that could be caused by currently available platinum-based catalyzed DPM exhaust filters.

Perhaps even more importantly, a subsequent August 7, 2002 Joint NIOSH-MSHA Report to the Coal Diesel Partnership, "Technical Issues Affecting Implementation of Diesel Filtration Technology on Permissible and Non-Permissible Vehicles in Underground Coal Mines," addressed further the NO_2 emissions problem resulting from the use of catalyzed DPM filters, and identified for the first time the potential underground mine fire hazard associated with the use of paper filters and the similar potential fire hazard associated with the use of ceramic filters.

Thus, the Coal Diesel Partnership identified crucial issues that apparently were unanticipated by MSHA prior to promulgation of the Coal DPM Rules. We fully expect that the new Metal/Non-Metal Diesel Partnership will likely identify (and hopefully resolve) both known, as well as currently unforeseen, problems with DPM control technology. Copies of the aforementioned June 17 NIOSH Report, the May 31 PIB, and the August 7 Joint NIOSH-MSHA Report are enclosed.

The NSSGA also wishes to comment favorably on the settlement agreement's recognition of the concept of "practical mine worthy filter technology." 67 Fed. Reg. 47298. We are disappointed and concerned, however, that despite the Agency's commitment to improving practical mine-worthy filter technology, the ANPRM never even uses the term in any of the 24 questions dealing with technological and economic feasibility. We hope this omission is not a signal MSHA is abandoning its commitment because we believe successful identification of practical mine-worthy filter technology is crucial to the success of this expedited rulemaking.

We say this because NSSGA is not aware of any actual in-mine results which would allow the assessment of the feasibility of aftertreatment systems, nor do we know of any such results published in the international literature.

Because of this dearth of data, NSSGA believes the amendments to the DPM Rules should clearly state that the standard for feasible aftertreatment systems is "practical mine- worthy filter technology," and that this term should be defined in the DPM Rules themselves. We propose the following definition for the term: *Practical mine- worthy filter technology means affordable, effective, and durable filters which will enable mine operators to comply with the DPM concentration limits specified in 30 CFR § 57.5060 by consistently reducing DPM emissions by no less than 80% in actual conditions of use, without causing engine damage or failure or otherwise creating safety or health hazards such as unhealthful or impermissible levels of any air contaminant*.

Successful development and use of practical mine-worthy filter technology is the critical underpinning to any valid determination that it is technologically and economically feasible for underground metal/non-metal mine operators to comply with the concentration limits of the DPM Rules. To highlight and reemphasize our concerns about this problem, we enclose a copy of a May 22, 2002 letter to MSHA from the Engine Manufacturers Association (EMA) cautioning MSHA about the feasibility of its DPM Rules. That letter states in part as follows:

> [I]t is EMA's position that filters are simply not add-on devices and cannot be unconditionally applied to all existing engines. . . .
>
> Because improper integration of particulate filters can harm the engine and deteriorate performance, any aftertreatment device must be verified to be compatible with engine exhaust characteristics, temperature profile, backpressure requirements, and engine protection. It is also necessary to verify that emission reductions claimed by equipment manufacturers will indeed occur after installation.

*   *   *

> Due to the current state of technology, EMA believes that MSHA should reconsider or delay implementation of the requirement that requires retrofitting mining equipment with filter technology. Additional time is needed to test and verify filter equipment that can be successfully applied to the wide range of engines and equipment operating in mines today. Failure to complete the necessary testing and verification may not only result in a lack of [DPM] reductions, but in equipment and engine damage or failure that could jeopardize safety.

Practical mine-worthy filter technology, when it is developed and suitable for use, by and large would appear to be the engineering control of choice in underground stone mines. Mine ventilation may play a role too, but, as has been demonstrated by industry commenters on the May 29, 2002 Draft Report (see footnote 2, *supra*), the costs of ventilation changes are likely to be enormous, if they can even be accomplished at all. Thus, for example, John Head's comments of May 21, 2002, point out as follows:

> MSHA's feasibility conclusion relying on no major ventilation additions in the industry is contradicted by the three trona mines in the [31-mine study] study which recorded compliance with the DPM limits using ventilation quantities averaging 1.29 million cubic feet per minute (cfm) (needed for methane gas control). These primary airflows in the trona mines can be contrasted against the eleven stone mines in the study which were out of compliance with the DPM limits and averaged main airflows of only 99,000 cfm (with nine of the fourteen readings estimated by MSHA sampling personnel as essentially zero flow. . . .

Head comments at 4.

Finally, as a general comment on the fundamental concept of technological and economic feasibility, NSSGA notes the recently issued executive order dealing with "Proper Consideration of Small Entities in Agency Rulemaking." Executive Order 13272 of August 13, 2002. 67 Fed. Reg. 53461. Many of NSSGA's affected member companies are covered by E.O. 13272, and MSHA must comply with that executive order (copy enclosed). Additionally, MSHA must comply with the new Office of Management and Budget (OMB) "Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies," published in the Federal Register for February 22, 2002. 67 Fed. Reg. 8452. The NSSGA believes that these Guidelines apply to the development of information by MSHA during this expedited rulemaking.

We now turn to our specific responses to the questions raised by MSHA in the ANPRM.

Responses to ANPRM Questions

As noted at the outset, NSSGA has under review each of the 48 questions raised by MSHA in the ANPRM; however, at this juncture we are not prepared to respond to all of them. Furthermore, we anticipate that during this expedited rulemaking, we will be able to furnish more detailed information at other appropriate times. For current purposes, and for ease of reference, we provide answers to questions based on the format of major categories noted in the ANPRM, as follows:

- *Sections 57.5060(a) and (b), Limit on concentration of diesel particulate matter.*

(a) What are the appropriate interim and final limits if EC is the surrogate?

Although we are not able to respond to this question at the moment, we do wish to state firmly that complying with the total carbon-based DPM interim and final concentration limits in the original DPM Rules is not technologically or economically feasible in underground stone mines. Our view is supported by data gathered from the nine mines operated by NSSGA members participating in the 31-mine study, and we believe that this conclusion will be buttressed by the compliance assistance baseline DPM sampling currently being conducted by MSHA as part of the settlement agreement. The NSSGA believes that elemental carbon-based concentration limits are the most appropriate of any surrogate for DPM at this time. We remain very concerned, however, that simply converting from total carbon-based concentration limits to *equivalent* elemental carbon-based limits fails to fully address our feasibility problems.

- *Section 57.5060(c) addresses application and approval requirements for an extension of time in which to reduce the concentration of DPM to the final limit.*

(a) What circumstances would necessitate an extension of time to come into compliance?

Generally speaking, although it is now uncertain as to what the final DPM elemental carbon-based concentration limit will be because of issues involving technological and economic feasibility, nevertheless it is quite likely that a number of mines will need extra time to comply. Operators should be granted an extension if they are acting in good faith to identify, obtain, or install practical mine-worthy filter technology or other engineering controls, and if they are utilizing, or in the process of utilizing, feasible administrative controls and personal protective equipment (PPE), if appropriate, and if they are otherwise in compliance with provisions of the DPM Rules aimed at minimizing the DPM exposure of miners.

(b) What should be the duration of the extension?

The extension should last up to one calendar year from the time of its approval by MSHA.

(c) Should MSHA allow more than one extension?

MSHA should allow more than one extension as long as the operator is working to identify, obtain, or install practical mine-worthy filter technology or other engineering controls, utilizing feasible administrative controls and PPE, if appropriate, and is otherwise in compliance with provisions of the DPM Rules aimed at minimizing the DPM exposure of miners.

(d) What actions should mine operators be required to take to minimize DPM exposures if they are operating under an extension?

Mine operators should be in compliance with other portions of the DPM Rules aimed at minimizing the DPM exposure of miners, and should also utilize feasible administrative control methods and PPE, as appropriate. These actions will help to lower the DPM exposures of miners while the operator determines what engineering controls are feasible.

- *Section 57.5060(d) addresses certain exceptions to the concentration limit.*

(a) Would this provision be necessary if MSHA includes in the final rule its current hierarchy of controls for its other exposure-based health standards for metal and non-metals mines?

NSSGA believes that this provision would not be necessary if MSHA includes, in the amended DPM Rules, its current hierarchy of controls for other exposure-based health standards. The NSSGA strongly supports this approach. If the use of administrative controls and PPE is specifically permitted, then this exception to the concentration limits could be removed without significant impact. Allowing the application of the hierarchy of controls provides the mine operator with the flexibility to protect miners in an event of possible over-exposures to DPM, and therefore obviates the need for the exception.

- *Section 57.5060(e) prohibits use of personal protective equipment to comply with the concentration limits; and § 57.5060(f) prohibits use of administrative controls to comply with the concentration limits.*

(a) Currently, there is no approved respirator for use in protecting miners exposed to DPM atmospheres. If MSHA includes requirements for some

form of respiratory protection, what type of respirators would be protective of miners? What are their specifications?

At the MSHA DPM Outreach meeting of October 8, 2002 in Ebensburg, Pennsylvania, MSHA representatives stated that full and half-face respirators with R100 or P100-rated filters will be protective to miners. Such respirators are available from various vendors including 3M, North, and MSA. Both R100 and P100 filters are rated as 99.97% efficient, and are used for filtering out oil and non-oil aerosols. The NSSGA believes, however, that it would be prudent for NIOSH to test and approve respirators specifically for protection against DPM pursuant to the appropriate provisions of 42 C.F.R. Part 84. We intend to discuss this with NIOSH officials, and suggest that this work be an adjunct to the new Partnership's activities.

(b) Should MSHA propose to require mine operators to implement a written respiratory protection program when miners must wear respiratory protection?

Existing MSHA regulations on respirator use should apply. See 30 C.F.R. § 57.5005.

(c) Should MSHA require mine operators to apply to the secretary for approval to use respiratory protection? Should the application be in writing? What conditions should MSHA require mine operators to meet before approval is granted to use respirators?

MSHA's general standard for control of exposure to airborne contaminants (30 C.F.R. § 57.5005) contains no requirement for the operator to apply to the Secretary for approval to use respirators. That standard is the proper model here, too. Thus, operators should not be required to apply to the Secretary for approval to use respiratory protection. Ultimately, it is operators who have a statutory obligation for assuring a safe workplace. Therefore, it should be left to the operator how best to discharge that obligation.

(d) Should MSHA propose to require mine operators to implement a written administrative control plan when they use administrative controls to reduce miners' exposure to their required limit?

As in the above question, it should be left to the operator as to how best to reduce miners' exposures to the required limit. NSSGA does not support a provision requiring operators to implement a written administrative control plan.

- *Section 57.5061(b) addresses how MSHA will collect and analyze samples for compliance purposes.*

NSSGA supports the use of elemental carbon as the surrogate for DPM in the analysis of samples for compliance purposes.

- *Section 57.5061(c) provides for MSHA to conduct personal, area, and occupational sampling for compliance determinations.*

NSSGA supports MSHA's intent to amend this provision so that only personal samples are used for compliance determinations. MSHA has requested information regarding the cost for mine operators to conduct personal sampling of miners' DPM exposures for elemental carbon-based limits. NSSGA does not now have adequate information on this issue, but wishes to remind MSHA that many of the operators subject to the DPM Rules will need to hire consultants to perform this work. MSHA should be able to obtain consultants' costs. In any event, while not insubstantial, the costs of sampling pale by comparison to the costs of practical mine-worthy filter technology and feasible ventilation upgrades.

- *Section 57.5062 addresses the diesel particulate control plan.*

The NSSGA believes that the diesel particulate control plan provision of 30 C.F.R. § 57.5062 should be deleted in its entirety. Under the current provision, a plan must be established in the event of a violation of the DPM Rules' concentration limits. That plan, once adopted, must remain in effect for three years at a minimum, assuming no further violation of the concentration limits occurs. Each subsequent violation triggers a new three-year plan obligation.

This is disturbing because a violation of the concentration limits, as currently prescribed in the DPM Rules, would be based merely on a single sample, regardless of the potentially localized or unique precipitating conditions or the aberrant nature of that particular sample. Because a single sample exceedance in one location thus dictates a mine-wide plan which must be followed for at least three years, with any departure from any of the terms of the plan subjecting the operator to further enforcement action, it is apparent that this provision is unjustifiably onerous and an extremely disproportionate response to a single sample exceedance.

Moreover, it is particularly unreasonable to require plan modification and a demonstration of the effectiveness of the modified plan in the event of a subsequent single sample exceedance somewhere in the mine, for any reason. The mere occurrence of a single sample above the applicable concentration limit in no way demonstrates the existing plan is inadequate. Indeed, as likely as not, the single sample may not be reflective of the DPM levels normally achieved by the existing control measures. On the contrary, the exceedance may well have been the product of a unique or unusual set of circumstances, or may have been the result of a failure to follow fully one of the required control measures. Although a failure to comply with any of those control measures would itself be a punishable violation under the provision as now written, it is extraordinarily harsh and irrational also to require modification of the plan (which may well not need changing at all), and the attendant mandatory monitoring that is then required to prove the plan's effectiveness. In lieu of the diesel particulate control plan required currently by 30 C.F.R. § 57.5062, the NSSGA believes that the ventilation plan requirements of 30 C.F.R. § 57.8520 are more than adequate to deal with DPM.

- *Technological And Economic Feasibility.*

We believe that our discussion of the problems associated with technological and economic feasibility set forth above provide MSHA with our position on this fundamental issue. It may be useful to focus the attention of the Partnership on the 24 questions dealing with technological and economic feasibility specified in the ANPRM. The NSSGA intends to discuss that possibility with the Partnership.

- *Paperwork Burden Issues*

As noted above, the NSSGA does not believe it is necessary to develop a written program for the use of administrative controls, or a written program for the use of PPE other than what is currently required by 30 C.F.R. § 57.5005(b). The NSSGA also believes that the diesel particulate control plan provision of 30 C.F.R. § 57.5062 should be deleted in its entirety because the ventilation plan requirements of 30 C.F.R. § 57.8520 can more than adequately deal with DPM.

Conclusion

NSSGA appreciates the opportunity to review and comment upon this ANPRM. We will also look forward to reviewing and commenting on the notice of proposed rulemaking that will be published following MSHA's consideration of all the comments on the ANPRM. We are disappointed, however, that the Agency has apparently abandoned the process used during the discussions among the litigating parties leading to the settlement agreement. We think a revival of that sort of process, with the full involvement of the NSSGA, could well be more fruitful than the more traditional rulemaking road MSHA has now chosen to travel. The NSSGA would be interested in discussing this further with the Agency.

Finally, we are concerned that this expedited rulemaking may not be proceeding in a timely enough fashion to be completed by July 19, 2003, the date specified in the settlement agreement after which MSHA inspectors will begin issuing citations to operators for "failure to comply with the

400 micrograms per cubic meter of air interim limit." 67 Fed. Reg. 47298. We are not urging, however, that MSHA complete the expedited rulemaking through any pell-mell rush to judgment because the issues under consideration here are extraordinarily complex and of vital importance to the viability of the regulated industry. We simply point out that time is short. In this regard, as we have stated above, simply converting the current total carbon-based concentration limits to *equivalent* elemental carbon-based limits is not the answer to the severe technological and economic feasibility problems facing operators of underground stone mines. The final concentration limit is especially problematic. NSSGA believes that MSHA should reconsider the final limit with a view toward either delaying its effective date or withdrawing it altogether.

NSSGA stands ready in every way to work with MSHA to address and resolve the important issues at stake.

1961369

NATIONAL STONE. SAND & GRAVEL ASSOCIATION

Natural *building* **blocks** *for quality of life*

November 4,2002

Robert M. Friend
Administrator, Metal and Non-Metal
Mine Safety and Health
U.S. Department of Labor
Mine Safety and Health Administration
1100 Wilson Boulevard
Arlington, Virginia 22209-3939

Dear Bob:

The NSSGA, based near the nation's capital, is the world's largest construction materials association by product volume, representing more than 850 member companies and approximately 120,000 working men and women in the aggregates industry. During 2001, a total of about 2.75 billion metric tons of crushed stone, sand and gravel, valued at $14.5 billion, were produced and sold in the United States. Of this tonnage, a substantial portion came from the 109 underground aggregate mines operating in this country.

The purpose of this letter is to express to you the strongly held view of the National Stone, Sand & Gravel Association (NSSGA) that it is premature to finalize the draft "Report on Joint MSHA/Industry Study: Determination of DPM Levels in Underground Metal and Non-Metal Mines" (the Report). We also endorse the October 10,2002 letter concerning the Report sent to Assistant Secretary Lauriski from Bruce Watzman of the National Mining Association.

As you know, the data examined and analyzed in the Report is the result of a joint MSHA/Industry study involving 31 mines, some of which are operated by NSSGA member companies. The joint study examined, for the first time in any systematic fashion, real in-mine levels of diesel particulate matter (DPM) exposure of underground metal and nonmetal miners. While the study is not necessarily representative of the DPM exposures of miners throughout the underground metal and nonmetal mining industry, nevertheless it provided crucial new information which we believe served as the basis for the July 15,2002 settlement agreement among the litigating parties (see 67 Fed. Reg. 47297, Thurs. Jul. 18,2002). As part of the settlement, MSHA agreed to engage in expedited rulemaking to revise important portions of the Agency's standards for DPM exposure of underground metal and non-metal miners (the DPM Rules). *Id*. 47298. That expedited rulemaking has now begun through an advance notice of proposed rulemaking (ANPRM) published in the Federal Register for September 25,2002 (67 Fed. Reg. 60199).

We are troubled that premature finalization of the Report could well fundamentally undercut and compromise the settlement agreement, the ANPRM and other initiatives. Because we believe that outcome is not intended by MSHA, we ask that finalization of the Report be deferred, and that information gathered during the expedited rulemaking be given consideration by the Agency prior to any finalization of the Report.

AB29-COMM-11-A

2101 WILSON BLVD. SUITE 100 ARLINGTON. VA 22201
703 525 8788 800 342 1415 FAX 703 525 7782
WWW.NSSGA.ORG

At the outset, please know that, while the NSSGA is not a party to the litigation whch led to the July 15 Settlement agreement, we followed the settlement negotiations closely. Further that, since a significant portion of our membership is affected by the DPM Rules, the NSSGA will file comments both on the ANPRM, as well as on the proposed rules themselves once they are published. We also want you to know that we were impressed with the cooperation and diligence of all the litigating parties in the negotiations leading to the settlement agreement. Stakeholders have that process, as weII as the process used to create Part 46, as worthwhile models for hturecooperation.

Very specifically, although we have a number of problems with the draft final Report we have seen, our central concern is that we believe it is clearly erroneous and certainly premature for any final Report to conclude that it is technologically and economically feasible for underground metal and non-metal mines to comply with both the interim and final concentration limits set forth in the DPM Rules.[1] Such a conclusion makes a mockery of both the settlement agreement and the expedited rulemaking because the unresolved issue of technological and economic feasibility is at the very heart of both. Thus, the settlement agreement is prefaced with the following statement of the problem:

> The industry parties contend that the interim standard of 400 micrograms per cubic meter is not . . . feasible to achieve at the majority of mines with engineering controls alone, and will pose significant compliance problems. . . . They further contend that the final standard of 160 micrograms per cubic meter of air must be revoked because it is not feasible under any foreseeable circumstances. . . . The United Steelworkers of America contend that the interim standard is feasible and . . . also contend that achievement of the 160 micrograms per cubic meter of air standard is feasible. In light of these divergent positions, and *in Consideration of practical compliance questions raised during the joint industry/labor/government study,* the parties will take the steps set forth below.

67 Fed. Reg. **47297.** (Emphasis added.)
Among the steps next spelled out in the settlement is agreement on MSHA's part:

> . . . to work with equipment manufacturers, mine operators and representatives of miners to improve *practical mine worthy filter technology*, including the availability of after-treatment control technology for diesel powered engines, particularly for engines of less than 50 hp and 250 hp or greater.

Id. at 47298.

---

1 The draft final Report made available to us states in its executive summary that compliance *may* be feasible, but in numerous other portion of the Report where feasibility is addressed, technological and economic feasibility is categorically concluded.

As we understand it from our discussions with representatives of the industry parties to the settlement agreement (especially Ed Green), the goal of this provision is to resolve the substantia1 questions of technological and economic feasibility regarding DPM filter and other after-treatment DPM control technology. Here it is important to remember that the DPM filter efficiency information relied on by MSHA during the joint study only consisted of information from vendors or MSHA laboratory tests, which in turn were fed into MSHAs computer model "Estimator." The joint study did not analyze in-mine applications of DPM filters or other after-burner treatment technology to ascertain real DPM efficiency removaI data in the field. Indeed, such field work, yet to be done, will be the essential first task of the Metal and Nonmetal DPM Partnership now getting underway among NIOSH, NSSGA, the National Mining Association, and the United Steelworkers of America.

A further complication is those portions of the settlement agreement which commit MSHA to publish new proposed ruIes allowing mine operators to supplement feasible engineering controls with administrative control methods and personal protective equipment if engineering controls either do not reduce the concentration levels to required limits, are not feasible, or do not produce significant reductions in DPM exposures. Id. We fear that a premature finding of technological and economic feasibility in the Report will undercut that portion of the settlement.

Based on this review of the settlement agreement alone, we hope that you can readily see why we are so concerned about premature finalization of the Report. To compound the problem, however, we believe a premature Report could also taint the expeditd rulemaking. In this regard, we note that of the questions raised in the ANPRM, fully half deal with technological and economic feasibility. Furthermore, those 24 questions are predicated on the following statement in the ANPRM:

> New information on the technological and economic feasibility of current control technology was presented to MSHA following promulgation of the January 19,2001 standard. MSHA intends to evaluate this new information in conjunction with compliance changes that would result from a proposed standard."

67 Fed. Reg. 60201.

Based on our understanding of the negotiations leading to the settlement agreement, the bulk of the "new information" noted above was that generated by the joint study, including the detailed comments of the industry parties to the litigation.[2] For MSHA now to finalize the Report, even before the comment period for the ANPRM has been completed, runs the real risk of prejudicing the ability of MSHA to make changes to the DPM Rules consistent with the settlement agreement.

---

2 Disappointingly, the draft of the final Report we have seen pays short shrift to those industry comments.

We are also concerned that a premature Report could strike a severe blow to the development of the newly organized Metal and Non-Metal DPM Partnership. The specific goal of the Partnership is to identify, through in-mine testing, technologically and economically feasible engineering controls, using existing and available technology, that can be retrofitted onto the existing diesel-powered fleet in underground metal and non-metal mines to meet the DPM Rules' concentration levels. We think premature finalization of the Report could inadvertently compromise the Partnership's mission and usefulness.

Finally, while it is not the purpose of this letter to critique in any detail the most recent draft of the Report we have seen; nevertheless, we think that it utterly fails to take into account the real problems identified by industry with in-mine use of DPM filters and other after-burner treatment technology. Thus, for example, questions relating to retrofitting the existing diesel-powered fleet, problems associated with engine back pressures, and potentially hazardous gaseous emissions generated by the use of catalytic converters? just to name a few problems, are not even addressed by the most recent draft of the Report we have examined.

For all of the reasons discussed above, therefore, the NSSGA urges that any finalization of the Report be deferred until additional information about technological and economic feasibility becomes available to, and is considered by, MSHA as a result of the expedited rulemaking now underway. Simply put, for now, the joint study has done its job. It has generated very important "new information on the technological and economic feasibility of current control technology," as noted in the ANPRM. MSHA should defer finalization of the Report pending completion of the public comment period on the expedited rulemaking and further activities of the MetaI/Nonmetal DPM Partnership.

We hope you will agree with our concerns, and we are available to meet with you to discuss this letter further.

Sincerely,

James Sharpe, M.Ed., M.S., CIH
Vice President, Safety and Health Services

---

3 Just within the past few days, at the Mining Diesel Emissions Conference in Toronto, several presenters reaffirmed problems of excessive NO2 emissions from diesel-powered machines operated underground and equipped with passive platinum-based catalytic traps.

Chris Kolbash

From: Thimons, Edward D. [ebt7@cdc.gov]
Sent: Wednesday, October 16,2002 156 PM
To: Harry Tuggle (E-mail); Watzman, Bruce (E-mail); Deborah Green (E-mail); Mark Ellis (E-mail); Jim Sharpe; Chris Kolbash; 'Jones-Carole@MSHA.gov'
cc: Wade, Lewis; Kohler, Jeffery L.; Schnakenberg, George H.; Bugarski, Aleksandar D.; Welsh, Jeffrey H.; Chovanec, Marie I.
Subject: FW: Metal/ Nonmetal Diesel Partnership-Draft Language

Filter Efficiency Plan of the ... One page Criteria for Isozone.... Lew has provided the draft language below for the M/NM diesel partnership. It has been modified to reflect the rewrite of the specific goal by Bruce, and the other edits suggested during our 10/4 conference call. If you have any comments on the wording, please provide them to Lew (lowO@cdc.gov). Also attached are two documents. The first is the NIOSH scientific protocol for studying the efficiency of diesel filters in a M/NM mine environment. The second is a one page write-up describing the conditions that are needed in a mine to correctly carry out the NIOSH protocol. All of this will be discussed in the conference call scheduled for 11:00 a.m. tomorrow morning (Oct 17th). Jeff Kohler's secretary, Marie, will be contacting you by phone for the conference call at 11:00. Regards, Ed

<<Filter Efficiency Plan of the Study-I.doc>> <<One page Criteria for Ilsozone.doc>>
>
>
>
>
>
> MetallNonmetal Diesel Partnership-Draft Language
>
> The following parties (USWA, NIOSH, NMA, NSSGA,........) enter into a
> partnership agreement as defined by this document.
>
> The overall goal of this partnership is to safeguard the health and safety
> of mine workers with regard to the use of diesel powered equipment and the
> emissions (both gaseous and particulate) from such equipment.
>
> The specific goal of the partnership is to identify technically and
> economically feasible controls, using existing and available technology,
> that can be retrofitted onto existing diesel powered equipment in
> underground metal/nonmetal mines, to reduce diesel particulate matter
> emissions to, or below, MSHA's interim standards of 400 micrograms of
> total carbon (308 micrograms of elemental carbon) and the final standard
> of 160 micrograms total carbon (120 micrograms elemental carbon).
>
> Consistent with this goal, members of the partnership agree to:
> 1. Utilize the best available scientific methods and procedures in
> the accomplishment of the work of the partnership.
> 2. Within reason, make available the resources: people, equipment,
> instrumentation, and facilities (including mine sites) to accomplish the
> work of the partnership.
> 3. Work closely, openly and in a spirit of cooperation with staff
> from MSHA, in accomplishing the work of the partnership.
> 4. To the extent possible, involve diesel engine manufacturers and
> filter manufacturers in the work of the partnership.
> 5. Increase the number of partners (beyond the original membership)
> if such an increase is necessary to improve the probability that the

> partnership will be successful in realizing its goal.
> 6. Share all information derived from the work of the partnership
> with all members of the partnership.
>
> The partnership will conduct its business consistent with the following:
> 1. Each organization that **is** a member of the partnership will
> designate one individual (and one alternate) who will be empowered to
> represent that organization in the conduct of partnership business. No
> limitation is placed on the number of individuals from the Partnership
> organizations, who can attend and participate in any meeting.
> 2. Business will be conducted by the partnership at meetings that
> will be scheduled with as much lead time as possible.
> 3. Decisions can only be taken at a partnership meeting if a
> majority of partnership organizations are present (either member or
> alternate).
> 4. Partnership decisions will be made by consensus. If a consensus
> can not be reached on a particular issue, the partnership will not
> proceed, with work related to that issue.
> 5. Any member organization can unilaterally withdraw from the
> partnership at any time.
> 6. The partnership can be dissolved by a decision taken by a simple
> majority of member organizations. In that case, the remaining members,
> those that did not vote to dissolve, can modify the original partnership
> and continue, as long as there is at least one represenation from labor,
> industry and government involved in the modified partnership.

Report to the Coal Partnership

NIOSH – Pittsburgh

17 June 2002

Results of Filter Testing Conducted at Deer Creek Mine May 2002

Dr. George H. Schnakenberg, Jr.

Dr. Aleksandar Bugarski

AB29-COMM-11-C

Table of Contents

List of Figures

List of Tables

Background

Objectives

Recently, the Diesel Team at NIOSH-Pittsburgh has been conducting diesel exhaust measurements with the objective of providing to us, the Partners, and the mining industry, a greater knowledge of paper filter and ceramic filter systems available to the mining industry. In May 2002, NIOSH made measurements of DPM and gases downstream of diesel-powered vehicles with and without exhaust filters in the Isolated Zone (IsoZone) at Energy West's Deer Creek Mine. This report is a *summary* of the NIOSH findings.

Tests conducted

IsoZone Test Measurements

Over the course of Thursday through Monday, May 2 through May 6, NIOSH conducted tests in the isolated zone of the Deer Creek Mine. This zone had been prepared for similar testing performed by NIOSH in February. In essence a 1000-foot section of entry was isolated from the adjacent entries by sealing the crosscuts. Ventilation air to this zone only entered from the main air course and exited only downstream of the sampling location. Within this IsoZone, a diesel vehicle was operated consistently over a repetitious simulated work cycle while carrying a 30-ton shield. By maintaining control over the ventilation air quantity and vehicle operation, NIOSH could be reasonably assured that changes in mine air quality measured downstream of the vehicle could be attributed to the different vehicles and control systems or components. Within the IsoZone, NIOSH collected samples in three locations using SKC diesel impactors for OCEC analysis by NIOSH Method 5040: upstream of the vehicle operation, on the vehicle, and downstream of the vehicle operation. The downstream sampling basket also contained respirable samplers for OCEC analysis and held the ultrasonic airflow and air temperature sensor whose data was continually logged during the testing. About 3 meters downstream of the samplers were located a PAS 2000 real-time carbon particle sensor and ECOM-KL combustion gas analyzer whose data were logged throughout the tests. Exhaust backpressure and temperature(s) were logged on each test vehicle for some test runs.

Test Vehicles and Systems

Three vehicles were involved in the test. The first vehicle was the Energy West (EW) vehicle, a Caterpillar 3306 powered shield hauler equipped with a water scrubber, improved de-mister box, and a housing to hold the "standard" paper filter available from several manufacturers. The second vehicle, provided by RAG'S 20-mile mine (2O-mile), was equipped with an approved RAG-developed power package consisting of a Caterpillar 3306 PCTA engine and a Dry System Technology (DST) exhaust control system consisting of a catalytic converter, dry heat exchanger, and proprietary paper filter element. Energy West (Deer Creek Mine) was evaluating this power package for powering their shield hauling vehicles. The third vehicle and system tested was a shield hauler destined for Dugout Mine (DM). This heavy-duty outby vehicle had received a new Deutz BF6-1013 CP engine and a catalyzed ceramic soot filter from Nett Technologies.

The EW vehicle, since it accommodated "standard" filter elements, provided us a means to perform a qualitative (if not quite quantitative) estimate of the filtration efficiency of different paper filters. The filter elements differed by brand (manufacturer), media within s,atne manufacturer, and loading.

Filters Tested

Two brands of paper filter elements were tested using the EW vehicle, and the DST OEM filter element was tested in the 20-mile machine. Two of filter.elements were made by Donaldson: one was a "new" product we refer to as the "Blue" filter which Donaldson reports to be made from a finer fiber than its current products. The other Donaldson filter is cream colored and was the standard filter used by Deer Creek Mine, as was the filter element made by Baldwin. These filters were also tested in various stages of their useful life ranging from new to end of life. A NETT SF-1200 catalyzed ceramic soot filter was also tested.

The Donaldson "Blue" and DST OEM filters were run for extended periods to obtain OCEC data for comparison with the OCEC data obtained for a baseline run without the filter. PAS 2000 real-time carbon sensor was used to assess the relative performance of the other filters during short test runs. The NETT filter could not be run for an extended period of time owing to the unsafe NO_2 concentrations that resulted. Table 1, later in this report, provides the details of all of the tests performed.

Experirnental

Data Obtained and Analyzed

The type of data obtained is presented in the following list:

1. Average concentrations of organic and elemental carbon (OCEC) in the mine air from the SKC impactor filter samplers located upstream (air to the IsoZone), on the vehicles, and downstream of the vehicle activity (OCEC is a shorthand for NIOSH Method 5040 carbon analysis);
2. Average concentrations of OCEC in the mine air from respirable samplers located downstream;
3. Real time log of the "soot" particle concentration (approximating elemental carbon) readings from the PAS 2000 instrument with the instrument's current output to be calibrated later using EC concentrations simultaneously obtained from the filter samplers;
4. Real-time log of the concentrations of gases of O_2, CO_2, CO, NO, and NO_2 from the ECOM-KL combustion analyzer;
5. Real-time logs of air velocity and temperature at the downstream location from an ultrasonic air flow sensor;

6. Occasional traverses of the entry with anemometer and measurement of entry cross section;
7. Real-time logs of vehicle exhaust backpressure and temperature;
8. Tailpipe gases concentrations and Bacharach smoke number upstream of filters and downstream of the DST system on the 20-mile vehicle using the ECOM-KL while engine was operated at several steady-state engine modes. (The concentrations of the exhaust gases from the Dugout vehicle (DM) were not measured owing to the inability to load the engine without compromising the torque converter.)

The analysis of the data consists of the following elements:

1. Determining the net vehicle contribution to the concentrations of the OC and EC in the mine air by subtracting the upstream OCEC concentrations from the downstream OCEC concentrations obtained fkom OCEC analysis of the SKC diesel impactor samplers;
2. Determining the average volume flow of air during the downstream sampling periods and during the test runs of the different filter elements in the EW vehicle;
3. Using the net vehicle contributions of OCEC, correcting for air volume differences, to determine the filter efficiency (by comparing the baseline and filtered data);
4. Plotting PAS 2000 reading and their mean over the period that was sampled for OCEC by the downstream samplers;
5. Using the PAS mean reading in Pico amps pA) to determine the scale factor (μ/m^3 per pA) for PAS 2000 for instances where sufficient UCEC sampling was obtained (baseline and filter for EW and 20-mile, baseline only for the 20-mile vehicle);
6. Using the PAS 2000 scale factor to provide real-time EC concentration estimates based on PAS 2000 measurements;
7. Plotting the PAS 2000 readings for all filter testing;
8. Plotting the real time gas data and determining the mean for selected filter tests;
9. Plotting and determining the mean exhaust temperatures for selected filter tests;
10. Plotting the exhaust backpressures.

The following data was lost due to temporary equipment failure:

1. Downstream gas data for EW baseline test run (it was obtained from other runs with the EW vehicle) – ECOM-ICL inadvertently was on battery power and died until full battery charge was re-established;
2. Exhaust backpressure for the EWB and EWF runs – the drain cock on water drop out trap protecting the pressure transducer was left open.

Control Over Experimental Conditions

The IsoZone was ventilated from the main mine air course in which there was diesel traffic. This traffic could cause a high and fluctuating background and could compromise the accuracy of determining filter efficiencies owing to the low emissions with filters. To avoid this high background, NIOSH attempted to conduct the test runs involving the filters over the mine weekend days of Friday through Sunday when diesel activity was at a minimum. Therefore the EW baseline was run on Thursday, and the EW with the Blue filter test was run on Friday; the filter test for the 20-mile vehicle was attempted on Saturday, but equipment failure thwarted this attempt, but NIOSH serendipitously used the opportunity to conduct several short runs on a variety of paper filters using the EW vehicle. On Sunday the 20-mile vehicle with DST system was run successfully with and without filter. The Dugout Mine (Deutz + Nett ceramic trap) had to be run Monday.

Since changes in air flow among the test runs would change the dilution and affect the concentration measurements, the airflow was continuously monitored and logged throughout all of the testing activities using the ultrasonic anemometer. Several traverses were conducted with a hand held anemometer. The cross-sectional area of the entry at the point of airflow measurements was also obtained for computation of the volume flow of air. The ultrasonic anemometer was placed consistently in the center above midline of the entry. These measurements can be used to check on ventilation consistency, to compute air quantities and, when appropriate normalize concentration measurements to a consistent or “nameplate” air volume as required.

Out of our control was the inadvertent intrusion of two vehicles on Monday during the last filter tests. The result is an observable spike in the PAS 2000 readings during the test. Only qualitative testing was in progress so no critical data was lost.

Presentation of Results

This report will present the results of the May 2002 Deer Creek tests in summary form; details will be forthcoming in a more comprehensive summary report.

Paper Filters

Filter Life

The testing of filter life was not a NIOSH objective. However, NOSH believed that only systems that showed acceptable filter service life should be tested. Between the time of the NIOSH testing in February and the testing of May, mine personnel developed and experimented with various configurations (engine settingsheplacement, improved de-mister, etc.) with a result of a filter life of nominally 10 – 12 hours.

In routine use, the 20-mile vehicle had achieved a reported 40-hour life on its filter at the 20-mile mine and also during the vehicle evaluation tests at Deer Creek. Prior to the NIOSH testing of the 20-mile vehicle, the engine fuel setting was checked by mine personnel and found to be rather low (the rated power for that fuel setting was estimated to be about 120 hp). In the process of resetting the fuel rate, the injector pump was replaced and fuel setting *increased* to that of conditions under which the Caterpillar 3306 PCTA engine had been approved by MSHA (190 hp). Although this provided more power, it also increased engine DPM emissions, which would decrease filter lifetime from that historically achieved and explains the high back pressure observed after a few hours run time.

Filter DPM Efficiency Tests Actually Completed

NIOSH managed to complete full baseline and filter run tests on the EW+Donaldson Blue and the 20-mile DST systems. Owing to early termination of the DM + NETT soot filter run because of elevated NO_2 concentrations, filter efficiency was not attainable for the NETT ceramic filter. However, because of a blown tire on the 20-mile vehicle's first test, and the luxurious flexibility of mine personnel, NIOSH was able to conduct several short tests on at new and aged Donaldson Blue, Donaldson Cream, and Baldwin filters. The PAS 2000 provided an estimate of the effects of these filters on the "soot" levels downstream of the vehicles using these filters. Observations of the tests will be presented later on in this document.

Table 1. Vehicle and filter configurations tested.

Vehicle	Configuration	DPM measurements	Approx. Duration
Energy West	Baseline	PAS + 5040	2 hours
Energy West	Donaldson Blue P185027-REV	PAS + 5040	6 hours
20-mile	Paas DST	PAS + 5040	1 hour (aborted)
Energy West	Donaldson Blue used 10 hours	PAS	40 minutes 3 ½ " water BkPress[1]
Energy West	Donaldson Cream P142100 used 4 hrs.	PAS	40 minutes 1 - 2 " water BkPress
Energy West	Donaldson used Blue	PAS	20 minutes
Energy West	Donaldson Cream at end of life	PAS	1 hour
Energy West	Baseline	PAS	1 hour
20-mile	Paas DST with filter used *6* hours[2]	PAS + 5040; ECOM Smoke No. = **8**	5+ hours **3** 1·· water BP total
20-mile	Paas DST w/o filter	PAS + 5040	1+hour
Dugout Mine	Nett catalyzed ceramic soot filter SF-1200	PAS + 5040	30 min, terminated by high and rising NO_2
Dugout Mine	Baseline	PAS + 5040	1 hour

[1]Filter only ; water scrubber and demister back pressure must be added.

[2]Internal filter leak of unknown magnitude and time developed when tape covering of hole disintegrated.

Vehicle	Configuration	DPM measurements	Approx. Duration
20-mile	Paas DST new filter[3]	PAS; ECOM Smoke No. = 4	1 hour
Energy West	Donaldson Blue used 1/2 % hour (new)	PAS	1 hour
Energy West	New Baldwin PA2631	PAS	1 hour

Paper Filter Efficiency

Two filter systems were run with full baseline and full duration filter runs. (Running times for filtered systems had to be several hours to obtain sufficient material on the downstream samplers for OCEC analysis.) The filter efficiencies were obtained using the results of OCEC analysis of the impactor samples. The upstream concentrations were subtracted from the downstream concentrations of OC and EC then normalized to vehicle nameplate ventilation for both baseline and filter runs.

Table 2 Filter efficiencies (percent "soot" retained) for paper fiiters.

Identifier	Donaldson Blue	DST Fleetguard
5040 OC Impactor Net	86.91%	55.23%
5040 EC Impactor Net	100.20%	98.60%
5040 TC Impactor Net	95.27%	94.35%

The most relevant quantity for calculating filter efficiency is elemental carbon (EC) results. Since double filters were used and the OC on the second filter subtracted from that of the first, the OC values are somewhat reliable and yield a lower value for filter efficiency since semi-volatile organic material passes more easily through the filter. The EW vehicle with the Blue filter exhibits over 100% efficiency for EC; that is, the EC concentration the upstream air entering the IsoZone was more than the EC concentration downstream of the vehicle during the run with the filter installed. The PAS 2000 real time response confirms that the vehicle with a filter lowered the carbon particulate from that of the incoming air to the IsoZone. In Figure 1, the PAS trace before and after the zeroing at 10:48 represents a nominal background prior to start of the test. The start of the horizontal bar indicates the start of the test run and the precipitous decline of PAS EC reading demonstrates the process of decreasing EC from that of the incoming air. The ripples in the PAS trace represent fluctuations of the EC from the individual test cycles. The longer period undulations are possibly the result of diesel activity upstream of the IsoZone. Multiplying the EC in Figure 1 by 1.31 will give the EC concentration at nameplate air quantities.

[3]Hole in new filter was plugged compared to a smoke number of 7 with hole open.

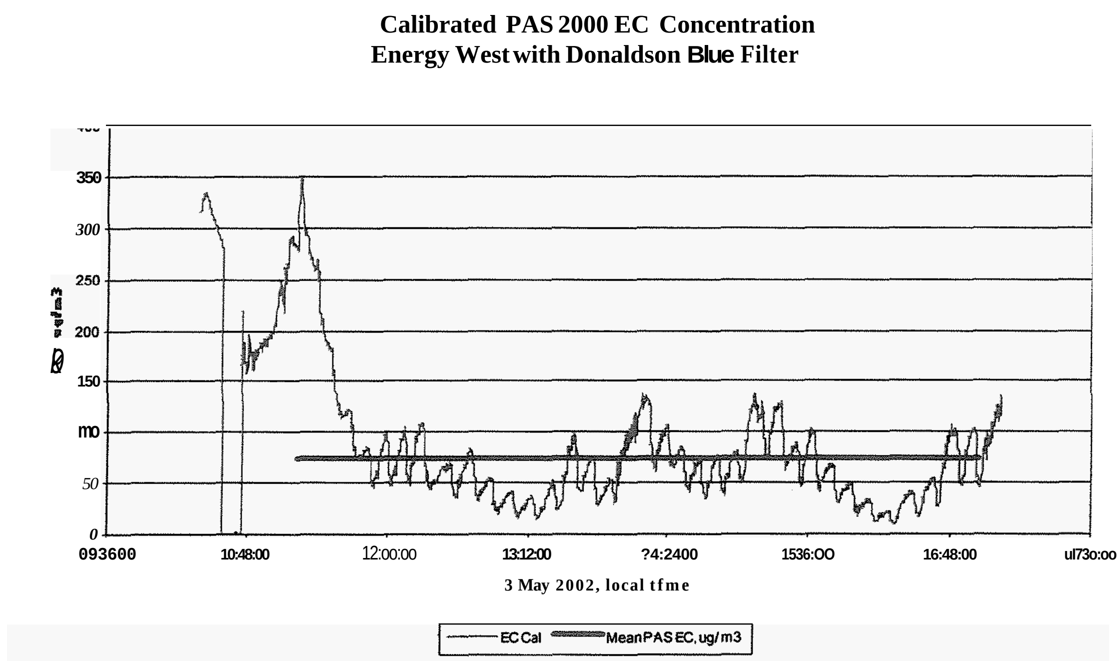


Figure 1 PAS 2000 response calibrated to EC concentrations during test run of Donaldson Blue filter.

Although the OCEC sampling was started after the completion of one cycle, it is clear that the downstream air had not attained an equilibrium concentration; thus it is quite possible that the efficiency estimates are conservative.

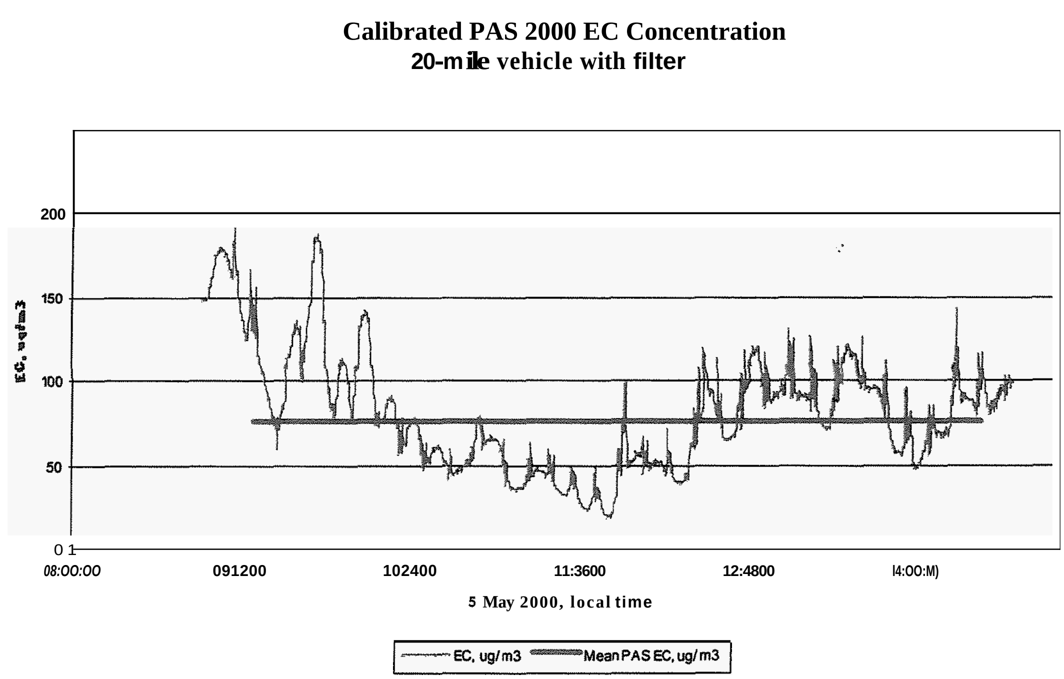


Figure 2 PAS 2000 (calibrated to EC) for the 20-mile DST filter system during filter run.

Figure 2 shows the real-time log of the PAS 2000 carbon concentrations for the DST system on the 20-mile vehicle. After about 11:36 the concentration of EC rises and the cause is uncertain. There is some speculation that the tape used to seal a port on the filter had burned through and allowed some bypassing of the raw exhaust around the filter element. Supporting this conjecture is the fact that the Bacharach smoke number obtained in the tailpipe measurement (using the ECOM-KL smoke test) for this filter was a **7** whereas for a new filter with the port properly plugged yielded a 4. Thus the reported efficiency of the DST system is probably on the low side even though it was a respectable *95+%.* Spreadsheet *PAS 5404 compar..xls* DPM efficiencies tab contains the efficiency table; *EWF consolidated.xls* and *20mile consolidated.xls* contains the two figures shown above. The EC concentrations in Figure 2 can be multiplied by 1.11 to provide EC concentration at nameplate air quantities.

Performance of Other Paper Filters

The striking performance of the Donaldson Blue filter plus the opportunity to test other configurations offered by the mechanical problems of the 20-mile vehicle on Saturday, caused us to decide to conduct additional test runs on other filters. These runs did not incorporate SKC impactor sampling, but we relied on the PAS 2000 instrument to provide real-time traces of estimated elemental carbon (soot) levels. The calibration of the PAS to EC is presented later in this report; it is nominally 100 $\mu g/m^3$ per pA indicated by the PAS 2000 instrument.

Presented below is the PAS log of several runs with various filters installed in the EW vehicle.

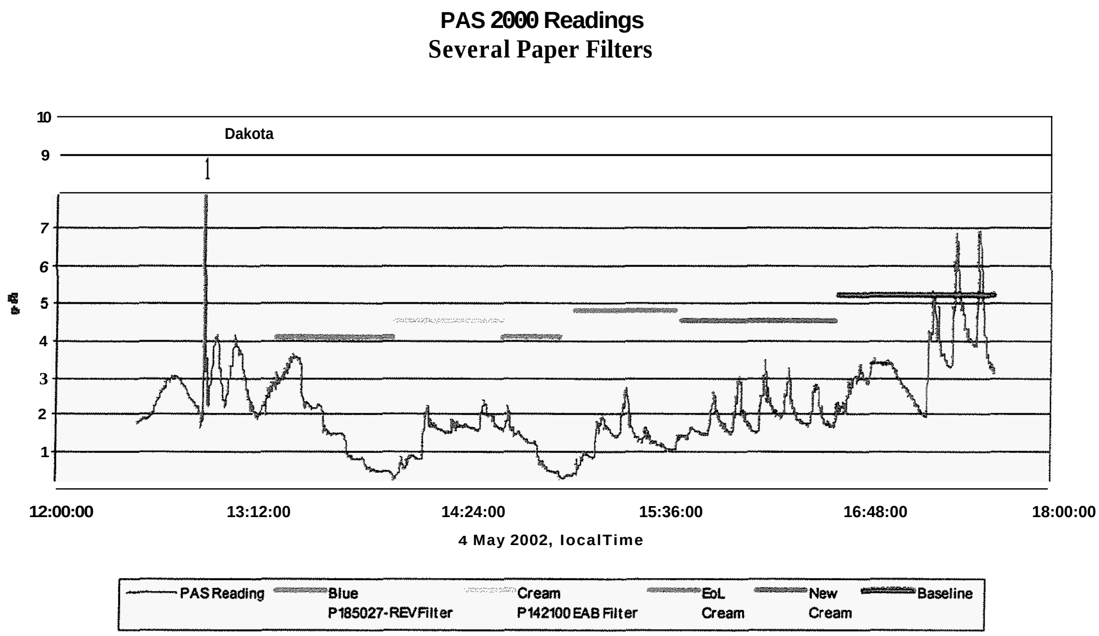


Figure 3 A series of runs using Donaldson Blue and Cream filters (new and used). The height of the bars identifying the filters has no meaning. Multiply PAS readings by about 100 to estimate EC in µg/m^3.

Figure **3** shows in order from left to right the tests using the EW vehicle with the Donaldson Blue filter used during the efficiency run, a Donaldson Cream filter used 4 hours, a repeat of the Blue filter, a Donaldson Cream filter that had been removed at the End of Life and a new Cream filter. Of the lot, the new cream filter seemed to be the least efficient. The final run was the EW vehicle without a filter (baseline). The bars signify the times of the run and their height have no meaning.

Two features are evident in this chart: The first is the value of the PAS trace near the end of a filter run, and the second is the amplitude of the ripples in the trace. The ripples signify the variation in concentration as the vehicle goes through the cycle and builds up concentration in a plug of air as it proceeds towards the downstream'sampling station. It is evident that at 14:24 local time, the Donaldson cream filter with 4 hours use did not result in nearly as low a PAS reading as the partially used Donaldson blue filter run prior to it and after it. Also note that the ripples during the blue filter runs are almost indiscernible indicating very little contribution of DPM to the air plug. In contrast, the average PAS level for the new cream. filter (indicated by the PAS trace below the fifth bar to the right between 15:36 and 16:48) is around 2 pA with strong ripples of about 1.3 pA amplitude. Even higher average and ripples are evident for the unfiltered (baseline) run.

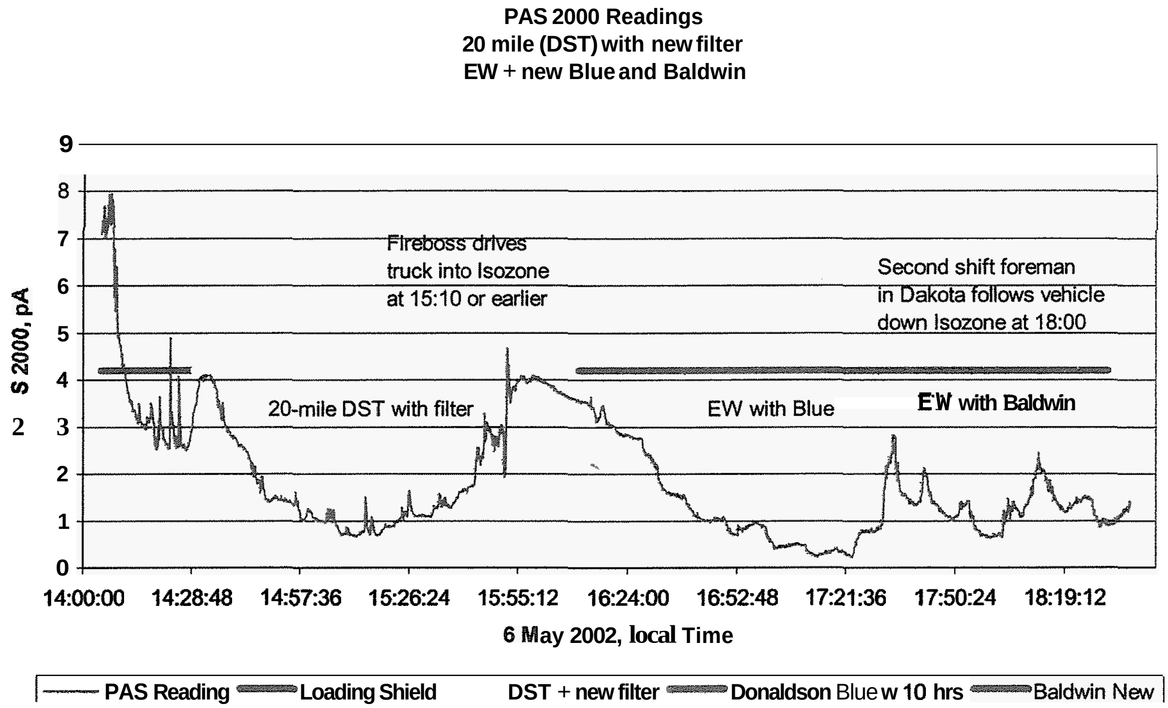


Figure 4 Another series of paper filters. Multiply PAS readings by about 100 to estimate EC in µg/m³.

Figure 4 shows the downstream PAS readings with a new filter installed in the 20-mile vehicle's DST system (14:28 to 15:55). The rise in the PAS readings starting at about 15:10 is the rise in the background owing to the fire boss's truck parked/idling upstream of the IsoZone rather than a reduction in the efficiency of the filter since the ripples are almost indiscernible. At about 15:50, the 20-mile vehicle unloaded the shield and left the Isozone. Then the EW vehicle picked up the shield. The EW vehicle was then run with a new Donaldson Blue filter at (approximately 16:40 to 17:21) and a new Baldwin filter (1521 to 18:30 approximately). The run of the Baldwin was compromised by a pickup truck entering the IsoZone. Note that both the DST and Donaldson Blue filter traces show only small ripples whereas the PAS trace from the Baldwin filter exhibit larger and distinct ripples indicating less filter efficiency.

Expanded charts are contained in the Excel files, which are available from NIOSH.

Summary

Wet scrubber systems

Three filters were run on the Energy West vehicle equipped with a Wagner water scrubber, custom designed de-mister and paper filter canister:

1. Donaldson ''blue" filter – a new product – P185027-REV characterized by a finer fiber used in making the filter paper; designed for air flow from inside out;
2. Donaldson "cream" filter – a standard over highway engine intake filter, chemically treated, part number P142100 EBA13 inside to out flow direction;
3. Baldwin PA2631 (supplied for the Jeffrey system to Deer Creek in Feb. 2002)

Both new and partially loaded filters were tested as can be observed from the testing schedule, Table 1. The results below are qualitative based upon the response of the PAS 2000 carbon particle concentration instrument.

1. Donaldson "Blue" – P185027-REV
   a. In two tests, the Donaldson Blue filter appears *to* provide superior filtration **as** evidenced by the low PAS 2000 readings and low amplitude of the cyclic concentrations (ripples) caused by a repetitious test cycle, see Figure 1.
   b. **After** the extended filter efficiency test run, the filter had accumulated about 10 hours of use time. The backpressure of the filter only was 3½ inches of water.
   c. The "blue" filter did not exhibit a "new filter inefficiency" as is commonly thought to occur. See Figure **3.**
   d. **A** new filter emits an odor for the first half hour of use but this odor is rather pleasant and inoffensive (it was coined "zesty Italian.")
2. Donaldson "cream" – P 142100 EBAl3
   a. PAS 2000 readings rose, partly because of emissions that escaped during filter changing (we didn't shut off the engine), but the amplitude of the cycles was noticeably greater than the "blue" filter. But reinserting the "blue" filter caused immediate drop in **PAS** 2000 readings supporting a conclusion that there is a significant difference in filter efficiency between the "blue" and "cream" filters. The "cream" filter had 4 *hrs on* **it.**
   b. PAS 2000 readings for the end of life "cream" filter (removed from service 8 April at the end of its life determined by exhaust backpressure limits) were higher than the partially used "cream" filter.
   c. PAS 2000 carbon particle readings for a new "cream" filter showed higher cyclic amplitudes and evidence of a higher equilibrium concentration supporting the common statement that the filtration efficiency of a new filter is inferior to that of a partially loaded filter. We did not run this filter longer to verify this. Note that an eyeball estimate of the **PAS** 2000 for the new cream filter was about 2 pA compared to about **4** pA for the baseline (no filter). These values suggest a filter efficiency of only 50%.
3. Baldwin filter

a. PAS 2000 readings for a new Baldwin filter resulted in a graph similar to the new cream Donaldson. The test was compromised by the foreman for the second shift driving part way down the entry in a Dakota Truck (Isuzu-powered) causing a noticeable rise in the PAS readings at the midpoint of the test. However, the amplitude of the cycles was much greater than for the Donaldson blue leading to the conclusion that the Baldwin was not nearly as efficient a filter as the Donaldson blue filter.

b. For the first half hour of running the Baldwin filter emitted an unpleasant fishy odor.

Dry Exhaust Cooling Systems

The 20-mile vehicle was equipped with a Paas DST system in a permissible package with a Caterpillar 3306 PCTA (turbo charged prechamber engine). The filter is of a proprietary manufacture. The element consists of two concentric pleated filter elements configured so that the exhaust flows radially outward through one element and radially inward through the other. The input end of the filter contains a plate capping the inner filter to constrain the exhaust flow to between the filters. But this plate contains a hole that is to be plugged to prevent leakage of raw exhaust around the flat sealing surface when this filter is used with this system.

1. PAS 2000 data on the initial run which lasted a little more than an hour showed a dramatic reduction to approximately 0.06 pA with a cyclic amplitude peaking at 0.15 pA before settling to a low amplitude ripple at about 0.11 pA (–10 $\mu g/m^3$ EC). Then the tire failed and test was terminated. See Figure 5, below.
2. The vehicle with filter was driven out of the mine for repair. This activity put several hours on the filter.
3. A retest of the filter did not repeat the dramatic reductions seen on the first test as shown in Figure 2. Upon examination and removal of the filter, NIOSH discovered the hole in the metal cap of the filter, and that the tape that had been used to cover the hole had burned through. This was the first that NIOSH had learned of the hole and the standard procedure of using tapes to seal it. As a result, the long term testing of this filter is not representative of its capabilities.
4. The results of a retest (Figure 4) of a new filter with the hole capped by bolted washer sandwich, did not exhibit the reductions we expected based upon the results obtained earlier, but again, this may be the result of the clean filter phenomena. Also this test was run on a workday, and background DPM may have contributed to the PAS readings which had a minimum of about 0.73 pA, or about 67 $\mu g/m^3$ EC.
5. The filter system exhibited a backpressure of 31". (max allowed is 34"?) after only about 10 hours of operation. The reported life of a filter life for this vehicle was 40 hours. "'his filter life was achieved at engine settings of 120 hp as noted earlier. Prior to NIOSH testing, the engine was set by mine personnel to the MSHA certification power of 190hp. This increased fueling rate coupled with turbo lag would increase PM emissions and shorten filter life.
6. CO emissions during turbo catch up were peaking at 2400 ppm; PM emissions would be expected to follow suit.

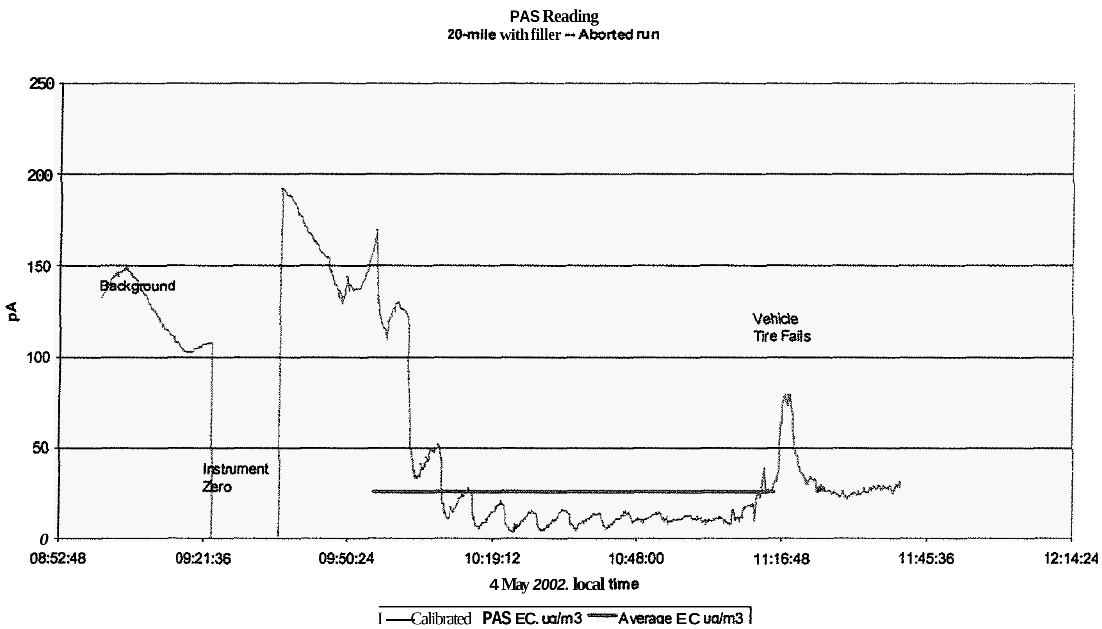


Figure 5 First test with **20-mile DST system** with **new filter. The calibration factor for PAS** is 91 **µg/m^3 per pA. The** attai**ned concentration** prior to tir**e failure was about 10 µg/m^3 EC.**

Downstream Gases

Engine exhaust gases were logged at the downstream sampling site of the IsoZone. The concentrations of CO, NO, and NO_2 were considered the important gases to track.

Table 3 Downstream gas concentrations normalized to nameplate air quantities.

Gas / Vehicle config.	EWB	EWF	20-mile Baseline	20-mile DST w Filter	DM Baseline	DM Filter
CO(ppm)	NA	7.7	3.1	1.9	10.3	2.1
NO(ppm)	NA	11.2	11.4	11.9	8.2	6.4
NO2(ppm)	NA	1.3	1.0	1.1	1.6	4.1

Owing to equipment failure, the gas values for the Energy West vehicle without filter (EWB)were not attained.

The effect of paper filter alone on any of the gases is not evident from the data, no effect is expected. The 20-mile (DST) system contains a catalyst that reduces CO an hydrocarbons. Because of the great difference in the CO emissions between the Caterpillar 3306 PCNA engine of the EW vehicle that was tuned to minimize CO and the Caterpillar 3306 PCTA of the 20-mile vehicle that was tuned to MSHA certification and is turbocharged, it is not possible to observe the effect of the catalyst in the DST system although we expect that the CO would be substantially higher if the catalyst were not present.

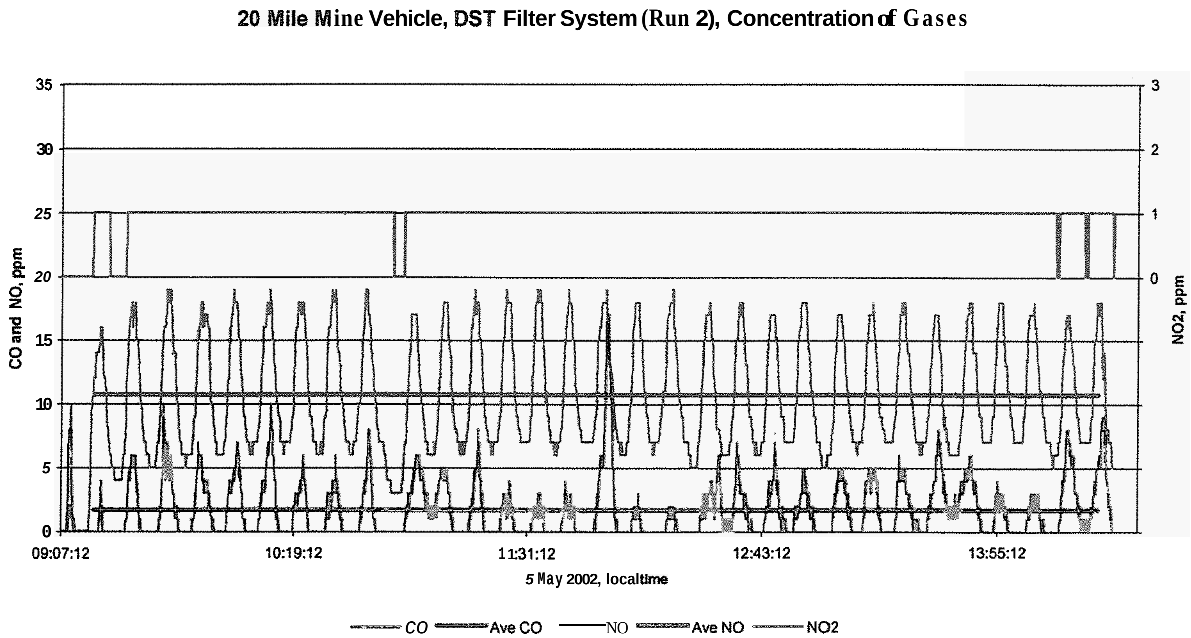


Figure 6 Downstream gases from DST system not normalized to nameplate ventilation. The average NO is above 10 ppm; the action level is 12.5 ppm. The scale for the NO_2 on the right is offset for clarity.

It is notable, however, that the average NO concentration is close to the MSHA action level (1/2 TLV) of 12.5 ppm. This is not unexpected given the ventilation rate.

The Dugout Mine (DM) vehicle used a catalyzed ceramic soot filter, model SF-1200 from NETT, as is appropriate for the Deutz engine. Although it is not evident from the average data presented in the table above for the DM + Filter, NO_2 levels rose to over 6 ppm (10ppm on a hand-held Industrial Scientific multigas detector). Since this level is greater than the MSHA ceiling, we terminated the test immediately. The graph of the three gases for the NETT filter test is presented in Figure 7. The step appearance of the graph, especially noticeable in NO_2 concentrations, is a result of the 1 ppm resolution of the ECOM-KL. The ECOM was calibrated prior to the test using 11.3 ppm NO_2.

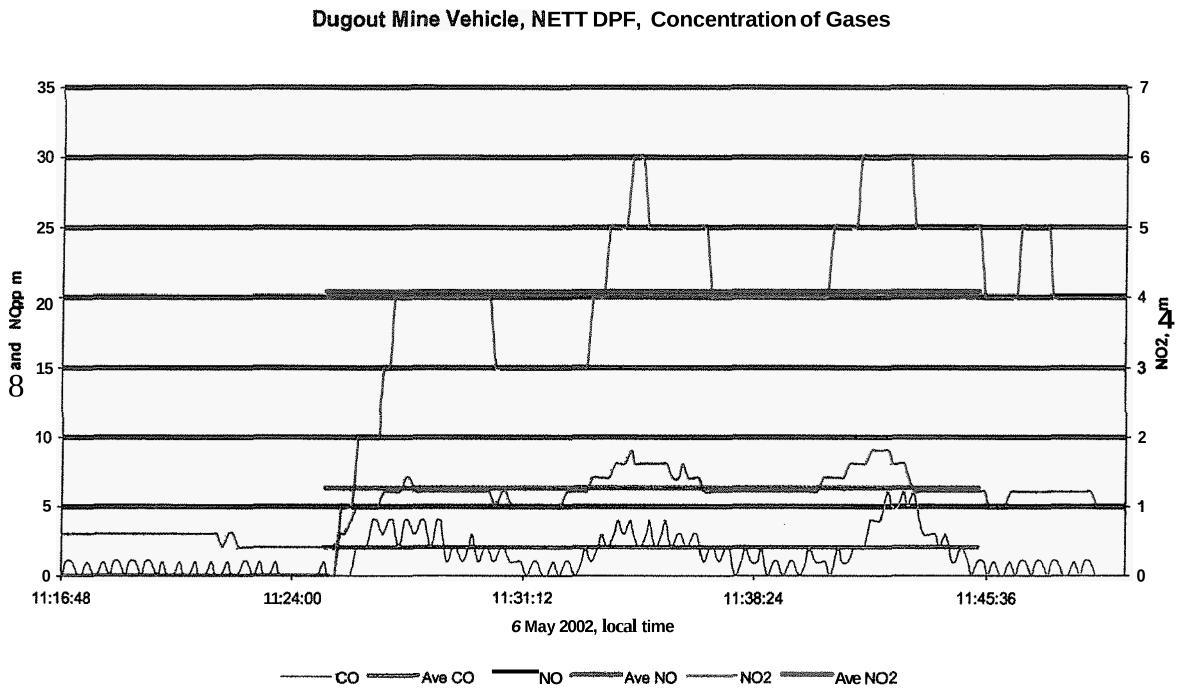


Figure 7 Downstream gases during test with NETT SF-1 200 soot filter with the Deutz BF6 1013 CP engine.

Tailpipe Emissions

The tailpipe concentrations of selected gases were measured using ECOM-KL while vehicles were operated over two steady state vehicle/engine operating conditions: Torque converter stall, Figure 8, and high idle, Figure 9. The gaseous emissions were measured upstream and downstream of the DST filtration system and upstream of the water scrubber and paper filter system installed on Energy West vehicle. The downstream concentrations in the exhaust of this filtration system were not measured due to high water content of the exhaust downstream of the water scrubber. Dug to the inability of the torque converter used in the Dugout vehicle equipped with Nett catalyzed soot filter, it was not possible to load vehicle/engine in the repeatable manner without damaging torque converter. Therefore the effects of NETT filter on concentrations of the measured gases were not determined.

DST system was tested with brand new filter element and with filter element with 10 hours in operation. The significant differences in performance of the new and used filter were not observed. Significant reductions of CO were observed between upstream and downstream of the Paas DST system at both high idle and torque converter stall conditions owing to the presence of a catalytic converter. The effects of the filter on relatively high concentrations of NO were relatively minor for the both engine operating conditions. However, the NO_2 concentrations after the DST system are significantly lower than the concentrations prior to the DST system, especially at high idle.

Gaseous Emissions, Torque Converter Stall

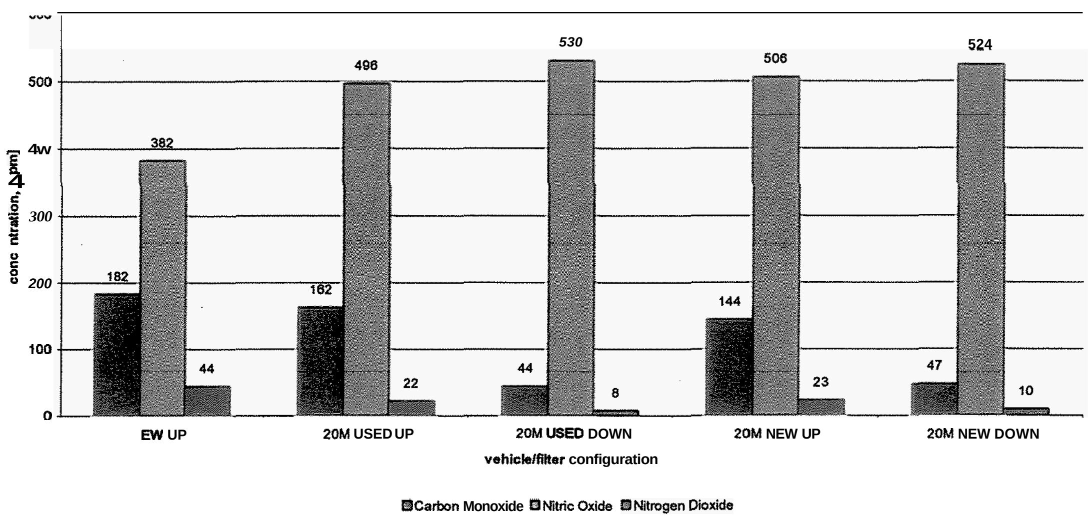


Figure 8 Tailpipe emissions under torque converter stall load.

Gaseous Emissions, High Idle

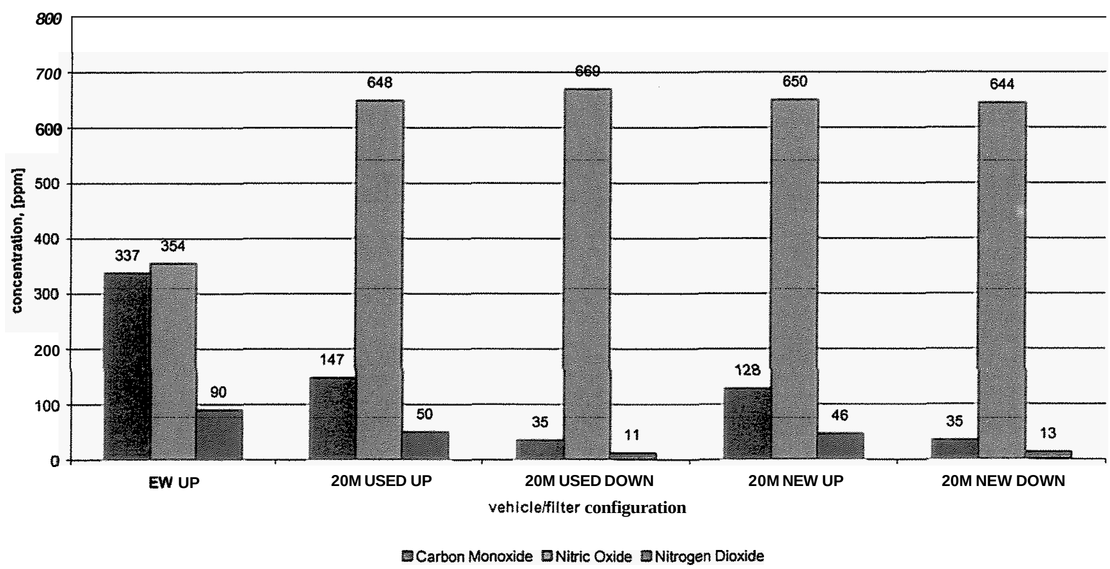


Figure 9 Tailpipe emissions at high idle.

Additional Results

calibration factors.

Identifier	**EWB**	**EWF**	**20Fa**	**20 Baseline**	**20 Filter**	**DM Baseline**	**DM Filter**
Date	2-May-02	3-May-02	4-May-02	5-May-02	5-May-02	6-May-02	6-May-02
Downwind sampling ON	16:10	11:14	09:55	14:57:30	09:17:30	12:48:20	11:25
Downwind sampling OFF	19:00	17:01:30	1[redacted]15	15:56	14:26	13:32:30	11:45:20
Elapsed clock time, min	170	348		61	309	44	20
Indicated pump time, min	171	351, 352					
OCEC Concentrations μg/m³							
5040 OC Impactor Ave	182.8	45.7		181.5	83.7	336.0	
5040 EC Impactor Ave	339.7	72.6		1568.1	75.6	2049.3	
5040 TC Impactor Ave	522.6	118.3		1749.6	159.3	2385.3	
5040 OC Respirable	167.5	69.6		206.2	80.8	407.8	
5040 EC Respirable	326.7	75.3		1724.7	88.1	2495.2	
5040 TC Respirable	494.1	144.9		1931.1	169.0	2087.4	
PAS Statistics							
Mean **PAS** reading over sampling period in pA	3.23	0.59	0.282	16.987	0.830	16.57	0.22
PAS Calibrations μg/m³ per pA							
5040 EC Impactor	**105.2**	**123.9**		**92.3**	**91.1**	**123.7**	
5040 TC Impactor	**161.8**	**202.0**		**103.0**	**192.0**	**144.0**	
5040 EC Respirable	**101.1**	**128.6**		**101.5**	**106.2**	**150.6**	
5040 TC Respirable	**153.0**	**247.3**		**113.7**	**203.6**	**126.0**	

Two overnight runs were made with the **PAS** 2000 and OCEC sampling, but these results have not yet been examined.

Exhaust Temperatures and Backpressure

Exhaust gas temperatures were logged for all three baseline runs for the three vehicles and for the EW+ Donaldson Blue and the 20-mile DST filter runs. The run for the vehicle identified as 20Fa is the aborted run owing to tire failure on the 20-mile vehicle.

Table 5 Average exhaust temperature over test run.

Exhaust temp Statistics							
Vehicle	**EWB**	**EWF**	**20Fa**	**20-mile Baseline**	**20-mile Filter**	**DM Baseline**	**DM Filter**
Average Temp deg C	408.19	388.60	367.10	313.56	322.47	329.58	359.36

The exhaust temperatures are nearly all in the mid-300 deg C range. This temperature range is critically important for the DM vehicle as it afTects the operation of a catalyst soot filter. At these temperatures, a catalyst is required to promote regeneration (removal of soot by spontaneous burning), but at the same time and at these temperatures, this catalyst causes NO to convert to NO_2 at significant rates. Soot filters, such as the one here, the NETT SF-1200, have a catalytic wash of platinum to promote lower temperature regeneration (removal of accumulated soot by thermal oxidation) and to reduce CO and Hydrocarbons (odors). However, platinum also readily converts NO to NO_2 in the temperature range of 300 to 400 °C. This conversion can cause problems because most engines produce a great deal of NO (see the tailpipe emissions). At higher temperatures, above 400 °C, NO_2 reverts to NO.

Backpressures were logged for the 20-mile DST equipped vehicle, and for the Dugout Mine NETT Filter; we lost the logged data for the Energy West efficiency runs. The backpressure of the NETT filter was in the neighborhood of 25 to 30 inches of water gage. A graph of the backpressure of the 20-mile vehicle of the filter test is shown in Figure 10, below.

Air Flows

Airflow was recorded at the downstream sampling site. The cross sectional area was 141.49 square feet. Below is a table of the air volume flows throughout the test runs:

Volume flow / Vehicle	**EWB**	**EWF**	**20Fa**	**20-mile Baseline**	**20-mile Filter**	**DM Baseline**	**DM Filter**
MSHA Nameplate cfm	9500	9500	14500	14500	14500	12000	12000
Mean (Volume) cfm	11581	12410	16311	16258	16147	11401	12176
Normalization Factor	1.22	1.31	1.12	1.12	1.11	0.95	1.01

The normalization factor is the factor by which the prevailing ventilation during concentration measurement exceeds the nameplate ventilation. Multiplying the measured concentrations by the factor results in the concentration at the nameplate air quantities.

Figure 11 provides an example of airflow data with the filter testing times superposed over the data at the mean airflow during the test run for the filter. As shown, the airflows during this series of runs are nearly identical; thus the PAS 2000 readings truly reflect the filter reductions of carbon particles.

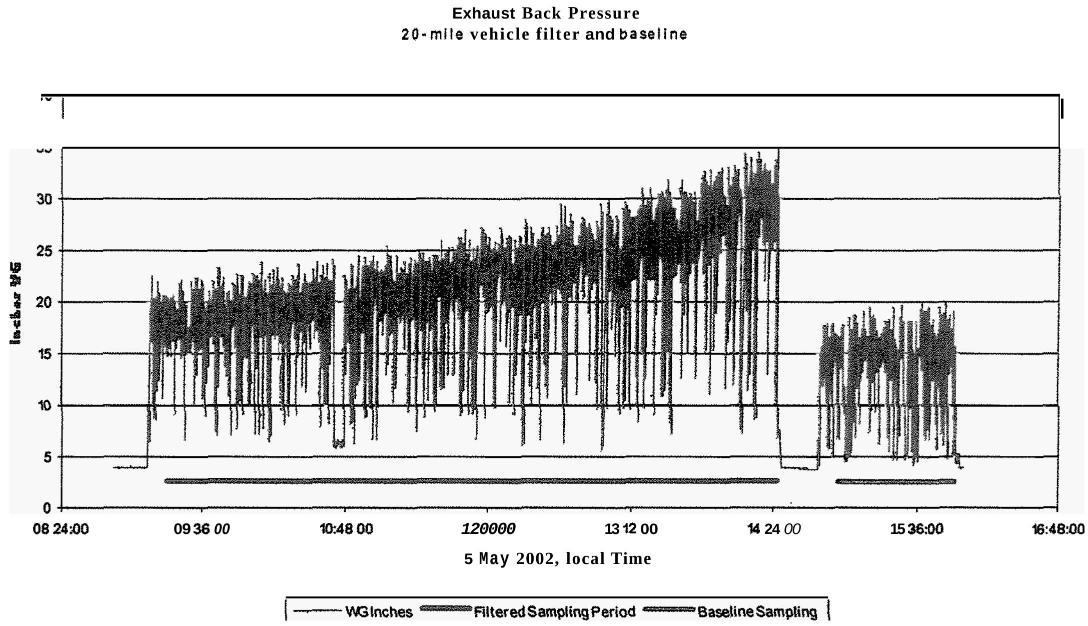


Figure 10 Exhaust backpressure for the DST system.

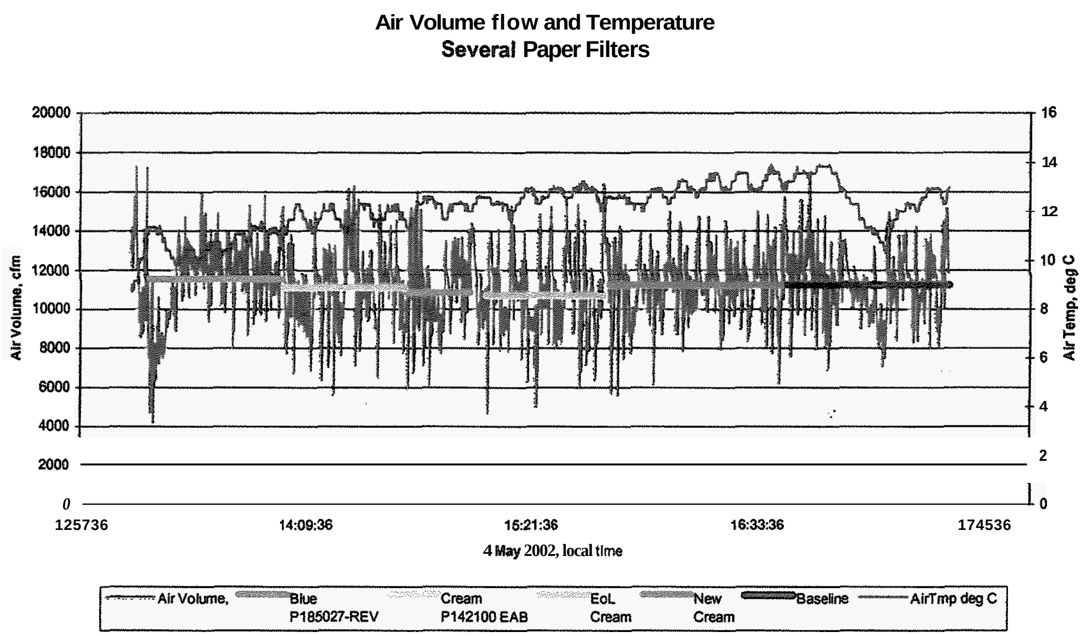


Figure 11 Air volume during filter testing on May 4, 2002.

Concluding Remarks

The data presented for the most part speaks for itself. Paper filters are effective in reducing diesel particulate matter emissions. The readings of the PAS 2000 during the two series of short runs with the paper filters, indicates that there is a difference in filtration efficiencies among the filter media. We know that different particle make-up affects the PAS 2000 sensitivity, and thus different filters may produce slightly different calibration factor for the PAS instrument for the same mass, but this effect would not account for the differences observed. Further testing in a more controlled setting (less background DPM) with longer runs and the collection of samples for QCEC analysis would be required to fully resolve and quantify these differences in filter efficiency.

A catalyzed ceramic soot filter was demonstrated to praduc NO:! in excess of the health limit, substantiating this claim by industry and recent bench test evidence by MSHA/ NIOSH has subsequently performed tailpipe emission testing on two catalyzed soot filters (Engelhard) at INCO and at Buchanan Mine. We found no conversion under torque converter stall loads on the filter installed on the INCO vehicle, but a **5** to 6 fold increase in the NO2 on the fiiter installed at buchanan. We do not have a temperature record of the filter at INCO but duty cycle logs indicate that it is over 400 °C. The filter at Buchanan was runnig at about 350 ºC during the test. an ideal temperature for NO_2 production. Owing to the prevailing ventilation rate over the path af the locomotive at Buchanan. Nine, the NO_2 does not result in a health hazard. At ventilation rates closer to nameplate this 'level of NO_2 would possibly create a health hazard.

All the data and analysis spreadsheets for the tests at Deer Creek Mine are available upon request.

Acknowledgements

NIOSH is exceedingly grateful to the mining industry and the individual mining companies and especially to the individuals involved directly with this project at Deer Creek Mine. Without their cooperation and active support this effort could not have been accomplished.

Appendix – OCEC DATA

2-May	EW	Baseline														
	Concentrations							OCEC net on filter			OCEC top			OCEC Bottom		
	OC	EC	TC	Sample	Sample	Pump	EC/TC	OC	EC	TC	OC	EC	TC	OC	EC	TC
	ug/m3	ug/m3	ug/m3	Volume, l/m	Time, min	Flow, l/m		ug	ug	ug	ug	ug	ug	ug	ug	ug
Upstream																
EWB1	17.8	55.2	73.1	379.3	189	**2.007**	76%	6.8	20.9	27.7	19.8	22.7	42.5	13.1	1.7	14.8
EWB2	9.1	50.5	59.6	379.1	189	**2.006**	85%	3.4	19.1	22.6	16.9	21.9	38.8	13.5	2.7	16.2
EWB3	11.3	50.1	61.4	377.1	189	**1.995**	82%	4.3	18.9	23.2	16.5	21.4	37.9	12.2	2.5	14.7
Mean	12.8	51.9	64.7													
RelStDev	0.4	0.1	0.1													
Downstream																
EWB4	190.4	340.3	530.7	340.1	171	**1.989**	64%	64.8	115.7	180.5	98.2	117.3	215.5	33.4	1.5	35.0
EWB5	169.1	343.0	512.1	341.8	171	**1.999**	67%	57.8	117.3	175.0	95.6	118.9	214.5	37.8	1.7	39.5
EWB6	189.0	335.9	524.9	342.5	171	**2.003**	64%	64.7	115.1	179.8	94.7	116.4	211.1	30.0	1.3	31.3
Mean	182.8	339.7	522.6													
RelStDev	0.1	0.0	0.0													
Net Contribution	170.1	287.8	457.9													
Stdev	0.4	0.1	0.1													
Vehicle																
EWB7	173.4	362.3	535.7	373.1	187	**1.995**	68%	64.7	135.2	199.8	118.5	137.9	256.4	53.8	2.7	56.
EWB8	179.0	399.2	578.2	374.2	186	**2.012**	69%	67.0	149.4	216.4	122.4	151.1	273.5	55.4	1.7	57.
EWB9	207.7	402.9	610.6	370.9	186	**1.994**	66%	**77.0**	149.4	226.5	132.0	151.4	283.4	55.0	2.0	57.
Mean	186.7	388.1	574.8													
RelStDev	0.1	0.1	0.1													
Respirable																
EWBRIO	183.3	335.7	519.1	344.4	171	**2.014**	65%	63.1	115.6	178.8	123.9	116.6	240.5	60.8	0.9	61.
EWBR11	156.3	327.1	483.4	344.1	171	**2.012**	68%	53.8	112.5	166.3	122.6	113.5	236.1	68.8	1.0	69.8
EWBR12	162.7	317.2	480.0	342.2	171	**2.001**	66%	55.7	108.5	164.2	121.6	108.6	230.2	65.9	0.1	66.1
Mean	167.5	**326.7**	494.1													
RelStDev	0.1	0.0	0.0													

3-May	EW	Blue Donaldson Filter														
	Concentrations							OCEC net on filter			OCEC top			OCEC Bottom		
	OC	EC	TC	Sample	Sample	Pump	EC/TC	OC	EC	TC	OC	EC	TC	OC	EC	TC
	ug/m3	ug/m3	ug/m3	Volume, l/m	Time, min	Flow, l/m		ug	ug	ug	ug	ug	ug	ug	ug	ug
Upstream																
EWF01	23.9	69.5	93.4	763.0	380	**2.008**	74%	18.2	53.0	71.3	35.3	54.9	90.1	17.0	1.8	18.9
EWF02	27.1	71.7	98.8	760.8	380	**2.002**	73%	20.6	54.5	75.2	32.6	56.1	88.7	11.9	1.5	13.5
EWF03	23.8	78.3	102.1	755.4	380	**1.988**	77%	18.0	59.1	77.1	35.0	61.0	96.1	17.0	1.9	19.0
Mean	24.9	73.2	98.1													
RelStDev	0.1	0.1	0.0													
Downstream																
EWF04	48.0	75.8	123.8	697.0	352	**1.98**	61%	33.4	52.9	86.3	79.5	53.4	132.9	46.1	0.6	46.6
EWF05	43.1	66.0	109.2	698.7	352	**1.985**	60%	30.1	46.1	76.3	78.8	48.2	127.0	48.6	2.1	50.7
EWF06	46.1	75.9	122.0	706.5	352	**2.007**	62%	32.5	53.6	86.2	78.9	55.3	134.3	46.4	1.7	48.1
Mean	45.7	72.6	118.3													
RelStDev	0.1	0.1	0.1													
Net Contribution	20.8	-0.5	20.2													
Stdev	0.1	0.1	0.1													
Vehicle																
EWF07	43.3	66.8	110.2	726.1	372	**1.952**	61%	31.4	48.5	80.0	91.2	48.5	139.8	59.8	0.0	59.8
EWF08	36.8	81.4	118.2	729.6	370	**1.972**	69%	26.9	59.4	86.3	88.5	60.1	148.6	61.6	0.7	62.4
EWF09	37.6	63.7	101.3	720.8	370	**1.948**	63%	27.1	45.9	73.0	91.3	49.5	140.8	64.3	3.6	67.8
Mean	39.2	70.7	109.9													
RelStDev	0.1	0.1	0.1													
Respirable																
EWFR10	78.4	67.1	145.4	718.8	351	**2.048**	46%	56.3	48.2	104.6	224.4	50.3	174.7	68.0	**2.1**	70.1
EWFR11	65.6	75.8	141.5	696.4	351	**1.984**	54%	45.7	52.8	98.5	122.9	54.9	177.8	77.2	2.1	79.3
EWFR12	64.8	83.1	147.8	701.3	351	**1.998**	56%	45.4	58.3	103.7	121.8	59.2	180.9	76.3	0.9	77.3
Mean	69.6	75.3	144.9													
RelStDev	0.1	0.1	**0.0**													

5-May	20-mile DST filter															
	Concentrations							OCEC net on filter			OCEC top			OCEC Bottom		
	OC	EC	TC	Sample	Sample	Pump	EC/TC	OC	EC	TC	OC	EC	TC	OC	EC	TC
	ug/m3	ug/m3	ug/m3	Volume, l/m	Time, min	Flow, l/m		ug	ug	ug	ug	ug	ug	ug	ug	ug
Upstream																
202F1	10.7	43.2	53.9	707.9	347	**2.04**	80%	7.6	30.6	38.2	18.6	32.2	50.7	11.0	1.6	12.6
202F2	10.1	58.0	68.1	705.1	347	**2.032**	85%	7.1	40.9	48.0	15.7	41.0	56.7	8.6	0.1	8.7
202F3	11.5	62.2	73.7	694.3	347	**2.001**	84%	8.0	43.2	51.2	16.2	43.2	59.4	8.2	0.0	8.3
Mean	10.8	54.5	65.3													
RelStDev	0.1	0.2	0.2													
Downstream																
202F4	89.8	69.8	159.6	618.7	312	**1.983**	44%	55.6	43.2	98.7	87.0	45.3	132.3	31.5	2.1	33.6
202F5	77.6	72.4	150.1	618.7	312	**1.983**	48%	48.0	44.8	92.8	80.9	45.8	126.7	32.9	1.0	33.9
202F6	83.7	84.6	168.3	619.3	312	**1.985**	50%	51.8	52.4	104.2	87.1	52.9	140.1	35.3	0.6	35.9
Mean	83.7	75.6	159.3													
RelStDev	0.1	0.1	0.1													
Net Contribution	72.9	21.1	94.0													
Stdev	0.1	0.2	0.2													
Vehicle																
202F7	52.6	75.8	128.4	674.2	340	1.983	69%	35.5	51.1	86.5	62.9	51.7	**114.6**	27.4	0.6	28.0
202F8	63.2	76.3	139.6	669.6	339	1.975	55%	42.3	51.1	93.4	73.9	**53.0**	126.9	31.5	1.9	33.5
202F9	56.2	76.5	132.7	666.1	339	1.965	68%	37.4	61.0	88.4	66.7	52.2	118.9	29.3	1.2	30.5
Mean	57.3	76.2	133.5													
RelStDev	0.1	0.0	0.0													
Respirable																
202FR10	**73.3**	87.8	161.1	627.9	311	2.019	55%	46.0	55.1	101.2	95.5	57.2	**152.6**	49.4	2.0	61.5
202FR11	90.9	92.3	183.2	614.2	311	1.975	50%	55.8	56.7	112.5	100.8	58.7	169.6	44.9	2.0	47.0
202FR12	78.3	84.3	162.7	609.2	311	**1.989**	52%	47.7	51.4	99.1	95.3	56.9	**152.1**	47.5	5.5	53.0
Mean	80.8	88.1	169.0													
RelStDev	0.1	0.0	0.0													

5-May	20-Mile Baseline																
	Concentrations							OCEC net on filter			OCEC top			OCEC Bottom		
	OC	EC	TC	Sample	Sample	Pump	EC/TC	OC	EC	TC	OC	EC	TC	OC	EC	TC
	ug/m3	ug/m3	ug/m3	Volume, l/m	Time, min	Flow, l/m		ug	ug	ug	ug	ug	ug	ug	ug	ug
Upstream																
20MB01	26.6	75.6	102.2	173.4	85	**2.04**	74%	4.6	13.1	17.7	16.8	13.7	30.5	12.2	0.6	12.8
20MB02	21.9	72.6	94.6	172.7	85	**2.032**	77%	3.8	12.5	16.3	18.3	14.7	33.0	14.5	2.2	16.7
20MB03	10.6	79.5	90.1	170.1	85	**2.001**	88%	1.8	13.5	15.3	16.0	14.1	30.1	14.2	0.5	14.8
Mean	19.7	75.9	95.6													
RelStDev	0.4	0.0	0.1													
Downstream																
20MB04	186.4	1594.8	1781.2	117.0	59	**1.983**	90%	21.8	186.6	208.4	38.5	187.8	226.3	16.7	1.2	17.9
20MB05	143.4	1445.1	1588.4	115.0	58	**1.983**	91%	16.5	166.2	182.7	33.4	168.5	201.9	17.0	2.3	19.[illegible]
20MB6	214.9	1664.3	1879.2	115.1	58	**1.985**	89%	24.7	191.6	216.3,	37.3	192.3	229.6	12.5	0.7	13.2
Mean	181.5	1568.1	1749.6													
RelStDev	0.2	0.1	0.1													
Net Contribution	161.8	1492.1	1654.0													
Stdev	0.5	0.1	0.1													
Vehicle																
20MB07	126.9	929.1	1055.9	150.7	76	**1.983**	88%	19.1	140.0	159.1	37.1	141.5	178.6	18.0	1.5	19.5
20MB08	122.2	963.6	1085.7	150.1	76	**1.975**	89%	18.3	144.6	163.0	34.3	145.9	180.3	16.0	1.3	17.3
20MB09	155.6	901.9	1057.5	149.3	76	**1.965**	85%	23.2	134.7	157.9	39.3	135.8	175.1	16.0	1.1	17.1
Mean	134.9	931.5	1066.4													
RelStDev	0.1	0.0	0.0													
Respirable																
20MBR10	224.3	1734.8	1959.1	117.1	58	**2.019**	89%	26.3	203.2	229.4	44.6	203.2	247.8	18.4	0.0	18.4
20MBR11	178.8	1708.2	1887.0	114.6	58	**1.975**	91%	20.5	195.7	216.2	41.1	195.7	236.8	20.7	0.0	20.7
20MBR12	215.5	1731.1	1947.3	113.6	58	**1.959**	89%	24.5	196.7	221.3	41.7	196.8	238.5	17.2	0.[illegible]	17.3
Mean	206.2	1724.7	1931.1													
RelStDev	0.1	0.0	0.0													

6-May	DM (Deutz)	Baseline														
	Concentrations							OCEC net on filter			OCEC top			OCEC Bottom		
	OC	EC	TC	Sample	Sample	Pump	EC/TC	OC	EC	TC	OC	EC	TC	OC	EC	TC
	ug/m3	ug/m3	ug/m3	Volume, l/m	Time, min	Flow, l/m		ug	ug	ug	ug	ug	ug	ug	ug	ug
DMB02	-3.5	29.7	26.2	140.3	69	**2.034**	113%	-0.5	4.2	3.7	15.2	5.9	21.1	15.6	1.8	17.4
DMB03	8.3	19.8	28.1	134.5	68	**1.978**	70%	1.1	2.7	3.8	15.5	4.4	19.9	14.4	1.7	16.2
Mean	9.4	27.9	37.3													
RelStDev	1.4	0.3	0.5													
Downstream																
DMB04	310.5	2035.2	2345.7	85.9	44	**1.953**	87%	26.7	174.9	201.6	52.8	177.2	230.0	26.1	2.3	28.4
DMB05	349.1	2101.5	2450.6	88.3	44	**2.007**	86%	30.8	185.6	216.4	52.2	186.8	239.0	21.4	1.2	22.6
DMB06	348.5	2011.2	2359.7	87.8	44	**1.996**	85%	30.6	176.6	207.2	54.8	179.7	234.5	24.2	3.1	27.3
Mean	336.0	2049.3	2385.3													
RelStDev	0.1	0.0	0.0													
Net Contribution	326.6	2021.4	2348.1													
Stdev	1.4	0.3	0.5													
Vehicle																
DMB07	230.2	1115.0	1345.2	110.9	56	**1.981**	83%	25.5	123.7	149.2	52.9	125.6	178.6	27.4	2.0	29.3
DMB08	199.8	1155.2	1355.0	107.7	55	**1.959**	85%	21.5	124.5	146.0	50.0	125.8	175.8	28.4	1.3	29.8
DMB09	224.7	1069.5	1294.2	107.4	55	**1.953**	83%	24.1	114.9	139.0	48.4	116.7	165.2	24.3	1.9	26.1
Mean	218.2	1113.3	1331.5													
RelStDev	0.1	0.0	0.0													
Respirable																
DMBR10	378.7	2044.5	2423.1	89.9	44	**2.043**	84%	34.0	183.8	217.8	57.5	186.0	243.5	23.5	2.2	25.7
DMBR11	427.6	2091.7	2519.4	87.6	44	**1.99**	83%	37.4	183.2	220.6	57.3	184.1	241.4	19.8	0.9	20.3
DMBR12	417.0	2126.1	2543.1	87.1	44	**1.979**	84%	36.3	185.1	221.4	59.0	186.9	246.0	22.7	1.8	24.5
Mean	407.8	2087.4	2495.2													
RelStDev	0.1	0.0	0.0													

Plan of Study for Evaluating Performance of Diesel Particulate Filters in Underground Mines

Aleksandar Bugarski
and George Schnakenberg
NIOSH-PRL
October 11,2002

Introduction

Establishing the confidence in the performance of diesel particulate filters (DPFs) plays an important role in fulfillingthe MNM partnerships goal to identify technically and economically feasible controls to curtail particulate matter emissions from existing diesel powered vehicles in underground metal and nonmetal mines. The majority of current knowledge on the performance of the DPF systems is based on studies done under laboratory conditions and deploying those on on-highway vehicles. According **to** the best knowledge of NIOSH, only two studies conducted at Normanda's BM&S mine and INCO's Stobie mine under sponsorship of Diesel Emissions Evaluation Program offered somewhat more insight into the problems associated to deployment of DPFs on U/G mining vehicle. The U.S. mining industry expressed concern that this rather limited knowledge base is not sufficient to help them to comply with rule on diesel particulate matter exposure of underground metal and nonmetal miners [30 CFR Part **571.** The need for long term field evaluation of DPFs with emphasis on in-use efficiency of DPFs in several U/G mines emerged.

This generic plan of study, developed by NIOSH-PRL, set forth below, provides the methods and criteria for field testing of in-use DPF systems. This plan focuses on the details of determining in-use efficiencies of DPF systems on a basis of elemental carbon (EC), organic carbon (OC), nitrogen dioxide (NO_2), nitric oxide (NO), and carbon monoxide (CO) measurements. In this study, the efficiencies will be assessed by comparing concentrations of aforementioned gases and particulate matter in the airborne samples obtained for cases where diesel powered vehicles are operated under controlled conditions with DPFs installed and without DPFs installed (baseline).

Test Procedures

Determining the efficiency of DPFs, which are assumed to be over 90 percent efficient in removal of elemental carbon, in the underground mine conditions, is a non-trivial task. In such an undertaking, designing and executing proper sampling strategy is of great importance. The primary concerns are high and uncontrolled concentrations of diesel particulate matter in the air used to ventilate the test zone and an ill-defined ventilation scheme that makes differentiating the DPM contribution of the vehicle with a DPF from the background DPM difficult.

Two different approaches to conducting study with objective of establishing DPF efficiencies on a basis of in-mine measurements are described below.

Criteria for Determining the Field Performance of Diesel Particulate Filters
Mine Test Site Requirements

NIOSH has determined that in order to obtain measurements that are able to quantify the efficiency of DPFs, tests must be conducted on individual vehicles operated under conditions which limit the quantity of DPM in the ventilation air, which limit and control the ventilation air quantity, and which isolate the vehicle operation and the air passing over the test vehicle to the test course except for **a** well-defined inlet and outlet. NISOH calls this isolated test area an "Isozone" and for all intents and purposes it is a full scale diesel emission dilution tunnel.

A summary of the criteria for Isolated Zone tests is in the table below:

Working length	300 meters / 1000 feet minimum
Maximum cross section*	**6** x 5 meters / 20 x 15 feet
Target ventilation rate	Vehicle Nameplate, controlled and maintained constant
Maximum Intake EC concentration**	Fresh air (< 10 µg/m³)
Configuration	a) single entry may contain curves **or** ramps with *minimum of dead* space; b) dead-ended entry with incoming air brought to dead-end by leak-free ventilation tubing

Requirements for a test vehicle

Vehicle	Any production vehicle(s) agreed to by the partners, e.g., a truck and/or LHD
Diesel Particulate Filter	Any DPF(s) for the engine agreed to by the partners; presumably ceramic DPF
Engine Condition	Engines must be well maintained

Sampling and measurements

Upstream OCEC samples (NIOSH 5040)	About **10** entry width/height from change in entry geometry (ventilation entrance) and 5 to 10 entry widthsheights from extreme of path of travel of the test vehicle.
Downstream OCEC samples (NIOSH 5040)	About 5 entry width/height from change in entry geometry (ventilation exit) and **5** to 10 entry widths/heights from extreme of path of travel of the test vehicle
Tailpipe emissions	CO_2, CO, NO, NO_2 and Bacharach smoke number; upstream and downstream of DPF
Exhaust system inspection	Exhaust system and DPF will be inspected for integritv and leaks repaired
Exhaust back pressure and temperature	
Misc	Fuel consumption, and tentatively CO_2; activity logs. Realtime measurements of carbon particles and air velocities

Isolated zone study

The evaluation of DPFs and obtaining relatively accurate results on the efficiency of the tested DPFs require setting test zone isolated from the other parts of the mine. The requirements for this zone, so called Aisozone@, a listed bellow:

1. The zone should be at least 1000 ft (330 meters) long drift; longer is better.
2. The drift should be physically isolated from the other parts of the mine. The cross cuts should be sealed using permanent or temporary stoppings. The zone should have a well defined inlet and outlet.
3. The drift opening should not have cross section area larger than approximately 300 ft^2 (20'X15'). The rationale behind establishing this requirement is following:
    1. The vehicle(s) tested in the zone will be powered by DDEC Series 60 engines (12.7 liter, 475 hp) which will be operated at name plate ventilation (NPV) of 28000 cfm, and
    2. The minimum air velocity in the drift is100 ft/min. This velocity is necessary for accurate realtime measurements of air velocities and ventilation rates.
4. The isozone should be ventilated with fi-esh uncontaminated air. The target value for ventilation rate is name plate ventilation rate for the engine(s) which power the tested vehicle(s). For example, in the case of DDEC Series 60 engines (12.7 liter, 475 hp) that should be 28000 cfm. The ventilation rate at the zone should be controllable and maintained relatively constant during each of the tests.
5. The ventilation air should be free of diesel PM and gases and other known interferants. The ventilation air that has traveled through drifts where diesel powered vehicles, particularly those which are not equipped with DPFs, are operated is not acceptable as ventilation air for the isozone. Samples collected in such an environment would not allow discerning contribution of the vehicles equipped with DPFs from the diesel contaminants present in the incoming air. The maximum concentrations of the elemental carbon in the ventilation air should not exceed 10 $\mu g/m^3$. The rationale behind such a requirement is the following:
    1. The test vehicle is powered by DDEC Series 60 engines (12.7 liter, 475 hp) which has NPV of 28000 ft^3/min and 8500 ft^3/min for particulate index (PI).
    2. When such a vehicle/engine is operated at NPV the resulting concentrations of DPM should be approximately 300 $\mu g/m^3$ of DPM and 200 $\mu g/m^3$ of elemental carbon.
    3. Such a vehicle/engine when equipped with 90 percent efficient DPF should contribute approximately 20 $\mu g/m^3$ to concentrations of elemental carbon in the zone.

    Therefore, the accuracy of the measurement can be jeopardized if elemental carbon concentrations in the fresh air are higher than 10 $\mu g/m^3$. Any higher levels compromise the precision with which an efficiency can be determined.
6. The smoking should be strictly prohibited in the zone and upstream in the ventilation course.

7. The sampling stations at the both ends of the isozone should be located at least ten cross-section characteristic diameters (app 200 ft)from any potential obstruction or change in drift cross-section geometry, such as crosscut, underpass or similar.
8. The activity of the test vehicle during sample collection shall occur entirely within the test zone.

The examples of a successfully executed isozone tests are the one set by CANMET and NIOSH at Noranda's Brunswick Mining and Smelting, New Brunswick, Canada [McGinn 2001, Bugarski 20011 and the one set by NIOSHat Deer Creek mine, Huntington Utah.

Isolated stope study

The alternative to the open-ended drift isolated zone described previously is **an** isolated stope, termed here as the Aisostope.@ The isostope is essentially a typical dead-end drift, closed at its furthest end and open to a main air course at the other. The isostope would be **an** entire stope which is physically isolated from other parts of the mine. The iso stope should fulfill all the requirements listed in the section on the isozone. In addition, following requirements are specific for isostope:

1. The fresh air to ventilate the isostope should be obtained by an auxilliary fan ducted (ventilation bag) to a discharge point deep within the stope.
2. The fan (intake) should placed as far upstream in the fresh air course as necessary to prevent mixing of the contaminated outflow of the stope with the fresh air (recirculation).
3. The background or fi-esh air samples would be collected upstream of the intake to the duct. The downstream samples would be collected in the contaminated (return) airstream approximately ten entry diameters upstream of the point that it exits into the main air course.
4. This downstream collection point should also be ten entry diameters downstream of the furthest extent of travel of the test vehicle.
5. In order to collect representative samples, it is crucial to have leak-tight duct and prevent mixing of fresh and contaminated air at the entrance of the dead end drift.
6. The activity of the test vehicle during sample collection shall occur entirely within the test zone.

Vehicles

The vehicles selected for these studies should be representative of the host mine's production fleet or those which are agreed upon by the partners. Only well maintained vehicles should be used in this study. The vehicles which consume engine oil should not be considered for DPF performance evaluation tests. The gaseous and PM emissions will be checked prior to and after the testes using ECOM KL portable combustion gas analyzer (ECOM America, GA) following the procedure described in the section on raw exhaust gas emissions measurements.

The following specifications for each of the test vehicles/engines should be provided by the mine at the time of writing the protocol for mine specific study:

Testing at *XYZ* mine - **VEHICLE** #	
Vehicle number	
Vehicle type	
Vehicle age, [year]	
Engine make and model	
Engine serial number	
Engine age (since last rebuilt), [hours]	
Engine displacement, [liters]	
Engine rated output, [kW]	
Transmission type	
Torque converter type	

If electronically controlled engine is used in the study, additional information about engine parameters such as fuel consumed can be obtained from engine management system.

If possible the test engines should be equipped with crankcase filters. Those should reduce the concentrations of the unfiltered particulate matter and gases leaving the engine.

Diesel particulate filter(s) (DPFs)

The DPF systems should be selected and acquired by mine or by partnership. The DPF system(s) will be installed by mine personnel following manufacturer's instructions and recommendation. This installation should include exhaust back pressure and temperature monitoring an logging. The DPFs should accumulate at least 50 hours use in a production and should have several regeneration cycles performed prior to the testing. The DPF(s) should be regenerated just prior to the testing. The engine backpressure imposed by DPF(s) should not exceed or even be close to the limit recommended by the engine manufacture.

The performance of the filter should be examined prior to the test using the procedure described in the section on raw exhaust emission measurements. The analysis of the raw exhaust emissions data should indicate whether DPFs are performing according to the expectations, and whether they are fit to be evaluated in the isolated zone or the isolated stope. Visual inspections should be conducted of the exhaust system upstream of the DPF. Any leaks found shall be corrected prior to tests with the DPF installed.

The following specifications for each of the test vehicles/engines should be provided by the mine at the time of writing the protocol for a mine-specific study:

Testing at XYZ mine B **Filter** #	
Vehicle number	
Filter manufacturer	
Filter model	
Filter serial number	
Filter size	
Number of the filters	
Filter Volume [liter]	

Duty cycle

Performance of the each of the tested DPF systems should be examined individually. That requires that only one of the test vehicles is operated inside the test zone at the time. The DPF efficiency should be determined on a basis of the samples collected while the same vehicle was operated with the DPF system and without DPF system (baseline) in the zone. The direct comparison of the particulate emissions from similar vehicles powered with identical engine models is not acceptable practice. In order to protect the hearing of the operator and scientists during the test involving vehicle with unfiltered exhaust the DPF should be replaced with an adequate muffler and no other exhaust aftertreatment device such as a diesel oxidation catalyst. In the open-entry isozone, the vehicle should be operated between two turning points: the Aloading@point should be located at least 10 diameters (–200 ft) downstream of the upstream sampling location and the Adumping@point should be located at least 10 diameters (– 200 ft) upstream of the downstream sampling location. For the isostope configuration, the vehicle should operate between the furthest point in the dead-end drift to within 10 entry diameters of the downstream sampling point. The vehicle should not leave the zone during the test. If tests of a DPF-equipped vehicle and a baseline vehicle are run during the same shift in the same isozone, it is desirable that the test on DPF-equipped vehicle is performed first. Preferably all DPF tests on all vehicles would be completed prior to conducting tests on the baseline configured vehcles. This practice is to ensure that the isolated zone or stope is as free of DPM as possible.

The duty cycle to be executed within the isozone/isostope should be representative of the duty cycle performed by the same type of the vehicle while in the production. The cycle should be well defined and simple so that it is relatively easy to repeat. Consistency in executing duty cycle over extended period of time, both within the test and among the different tests, is crucial. Therefore, in order to minimize human factor variables, the vehicles should be operated by single, experienced and conscientious operator for all of the tests. The loader should be operated with bucket full of an ore and perform tasks that simulate the loading, hauling and dumping an ore. For example, the vehicle could be parked and engine loaded using torque converter and hydraulics. The truck(s) should be loaded with ore and operated within the zone and stopped to exercise the loading of the engine. The cycles for both loader(s) and truck(s) should be repeated over the entire sampling period. The specific cycle will be developed and then agreed upon by the partners to be representative. Exhaust pressures and temperatures and engine control module data could be used to evaluate the intensity of any duty cycle.

The results obtained for the vehicles operating individually in the zone can be used to estimate the contributions of several vehicles to miners exposures to elemental and total carbon.

DPM Sampling

OCEC samples will be collected for determining the DPF efficiency for elemental, organic, and total carbon. SKC diesel samplers with double quartz fiber filters will be used in triplicate at all

sampling locations. The samples will be collected at rate of 1.7 liter per minute using personal dust pumps. The samples will be collected for a period time that is long enough to collect sufficient material for the analysis. The samples will be analyzed for elemental and organic carbon using NIOSH Method 5040.
The efficiency of the DPF is the ratio of the net contribution of contaminant from a DPF-equipped vehicle to the net contribution obtained when run with only a muffler, normalized for any differences in ventilation rates of the two tests. The contaminants sampled in this case are elemental carbon, organic carbon and their sum, total carbon, that is OCEC sampling. In addition, personal samples collected on the operator or potentially other miners can be used for establishing levels of their exposure to DPM.

The DPM area samples will be collected at the upstream and downstream end of the zone, and at the vehicle, next to the operator. Multiple samplers will be spaced on a wire grid across the entry at the two sampling locations to average the spatial distribution of the contaminants across the downstream and upstream sampling locations. The results at each location will be averaged. The samplers at the vehicle will be conveniently located close to the operator in his breathing zone. The personal sample of the vehicle operator will be collected simultaneously with the area sample on the vehicle.

If one of the objectives in this study is to determine the performance of filtration system installed on the operators cabin the area and personal sample should be collected and compared for the baseline (no DPF) configuration of the vehicle.

Measurements of nitrogen dioxide, nitric oxide and carbon dioxide concentrations

The effects of the filters on concentrations of NO_2, NO and CO will be determined on a basis of measurements performed **a)** upstream and downstream locations using ECOM KL or **AC** gas analyzer.

Real time measurements of elemental carbon concentrations

Real time measurements of elemental carbon using **PAS** 2000 will be incorporated in protocol. The instrument will be conveniently located at the downstream sampling station. These measurements should provide information valuable for evaluating the effects of the DPFs on particulate matter emissions. The **PAS** 2000 is also necessary for estimating the elemental concentrations for determining the sampling time required to obtain a sufficient quantity for reliable OCEC analysis samples by **NIOSH** Method 5040.

Ventilation

The good control and knowledge of the ventilation rate is crucial for the final analysis on the collected samples. The ventilation rates will be continuous monitored by real-time measurements of air velocity in the zone. The effects of vehicle movements will be closely monitored for effect on ventilation rate.

Special CO_2 Measurements

NIOSH will attempt to collect very accurate downstream CO_2 measurements. CO_2 provides unique information that combines the effect of fuel burned (engine loading) and ventilation. When EC measurements are normalized to CO_2 concentrations, the effect of varying ventilation and engine loading between baseline and DPF tests are almost fully accounted for.

Exhaust temperature and backpressure

The exhaust temperature and backpressure of each of the tested vehicles will be recorded using data loggers. The thermocouple and pressure transducer will be mounted on the exhaust pipe using the 1/4" port conveniently located upstream of the tested DPFs. The data will be used to identify average exhaust temperatures during the duty cycle and to identify occurrences of the DPF regeneration.

Raw exhaust emissions measurements

At the initial stage of the study, the performance of DPFs will be evaluated on the basis of raw exhaust gas measurements of particulate matter and gaseous emissions upstream and downstream of the DPFs. This testing can take place in the underground maintenance shop or similar location where power supply (1 10 V) is available. The test area must be properly ventilated to allow removal of the engine exhaust from the test area.

The vehicles should have sampling ports (2" or 3/8" NPT male nipples) welded on the relatively straight sections of exhaust pipes upstream and downstream of the DPFs. If exhaust pipe downstream of the filter is not long enough to position the sampling port for access, the sampling will be performed directly from the outlet of the exhaust from the machine.

The emissions would be measured while vehicles/engines are exercised over the following steady state conditions: (1) torque converter stall (parking brake is applied, engine is in the highest gear, fill1 throttle), (2) high idle (full throttle, no load), and (3) low idle. All the samples and measurements will be done in triplicates.

The efficiency of the DPFs in curtailing elemental carbon emissions would be determined on a basis of PAS 2000 (Matter Engineering, Switzerland) measurements. The instrument will be calibrated using two diesel particulate matter (DPM) samples collected during or immediately following the PAS 2000 measurements. In the order to make measurement at high concentrations present in the tailpipe upstream of the filter the portable dilution system MD 19E (Matter Engineering, Switzerland) will be used to dilute exhaust. The effects of the DPFs on exhaust opacity could be determined using AVL DiSmoke 4000 opacity meter (AVL, Gratz, Austria) using the standard free snap acceleration test procedure. The filter efficiency will be also examined using smoke number samples collected using ECOM KL (ECOM America, Norcross, Georgia). These measurements not only provide some estimate of PM filtration efficiency of the installed DPF but also provides an assurance that the DPF filter media is not leaking.

The emissions of NO_2, NO, and CO will be measured upstream and downstream of the DPFs using ECOM KL portable gas analyzer (ECOM America, Norcross, Georgia). These measurements provide an indication of engine condition (upstream CO) and the effects of a catalyzed DPF on these gases.

Analysis of the data

Raw emissions data

For each vehicle/DPF system, a table of results of the measurements will be presented. When replicate measurements are made, they will be averaged. DPF performance will be computed as a ratio of the measurement downstream to the upstream measurement and subtracted from 1 and presented as **a** percent reduction. The results will be presented for each engine operating mode and not averaged across modes.

Isozone measurements

OCEC samples from a single location will be averaged and analyzed with and without outliers removed. Descriptive statistics (mean, coefficient of variance, etc.) will be computed on each set. Ventilation rates, diesel activities, fuel burned, and other variables will be examined for the tests run with DPF and without DPF (baseline). **As** needed, the variables may be used to normalize the concentration data. The field efficiency of a DPF for OCEC will be computed from upstream and downstream OCEC measurements normalized for observed variables. Spot tests of upstream and downstream CO, NO, and NO_2 will be obtained and estimates of DPF effects computed.
Unusual events will be noted.

U.S. Department of Labor

Mine Safety and Health Administration
4015 Wilson Boulevard
Arlington, Virginia 22203-1984

ISSUE DATE: May 31,2002

PROGRAM INFORMATION BULLETIN NO. **P02-04**

FROM: CARL E. BOONE, II
Acting Administrator for
Coal Mine Safety and Health

IRVIN T. HOOKER
Acting Administrator for
Metal and Nonmetal Mine Safety and Health

MARK E. SKILES
Director of Technical Support

SUBJECT: Potential Health Hazard Caused by Platinum-Based Catalyzed Diesel Particulate Matter Exhaust Filters

Scope

This Program Information Bulletin affects underground coal and metal and nonmetal mine operators using diesel-powered equipment, manufacturers of diesel-powered underground mining equipment, including exhaust after-treatment devices and systems, and Mine Safety and Health Administration (MSHA) enforcement personnel.

Purpose

The purpose of this bulletin is to inform mine operators of a potential health hazard caused by currently available platinum-based catalyzed diesel particulate matter (DPM) exhaust filters for diesel-powered equipment. Use of these type filters may result in increased production of nitrogen dioxide (NO_2) gas, as compared to NO, emissions produced by engines operating without these type filters, causing miners to be exposed to increased concentrations of NO,. Symptoms of overexposure to NO, include irritation to the eyes, nose and throat, cough, decreased pulmonary function, chronic bronchitis, breathing difficulty, chest pain, pulmonary edema, and rapid heartbeat.

Background

The MSHA standard at Title 30, Code of Federal Regulations, Section 72.501 (30 CFR § 72.501) establishes a schedule requiring that coal mine operators meet certain emission specifications for nonpermissible heavy-duty diesel-powered equipment in underground coal mines. At 30 CFR § 57.5060, MSHA requires operators of metal and nonmetal underground mines to limit DPM concentration where miners normally work or travel. Mine operators most likely have to use DPM filters to meet these MSHA requirements.

A common type of DPM filter is the ceramic (Cordierite® or silicon carbide) wall-flow monolith. These filters are either catalyzed (containing precious or base metal) or non-catalyzed. Catalyzed filters offer the advantage of low-temperature on-board regeneration (removal of trapped soot from the filter) accomplished through the utilization of exhaust gas heat. Noncatalyzed or base metal catalyzed filters may require removal from the machine for cleaning, but may, in some cases, be regenerated on board.

In addition to DPM standards, the concentration of NO_2 in underground mining environments may not exceed a ceiling value of 5 parts per million (ppm) as established in MSHA standards at 30 CFR § 57.5001 (Metal/Nonmetal) and 30 CFR § 75.322 (Coal).

Information

Thus far, MSHA has tested six precious metal (platinum) catalyzed filters at its diesel laboratory and has determined that each of them increases the amount of NO_2 emitted by one MSHA-approved diesel engine, as compared to the same engine operating under identical test conditions, but without the catalyzed filter. The increase is attributed to the oxidation of nitric oxide (NO) due to the presence of the platinum catalyst. The concentrations of NO_2 obtained through the installed platinum catalyzed filters reached levels that could not be diluted to or below 5 ppm using the engine's approved gaseous name plate air quantity. The gaseous name plate air quantity is the amount of ventilation air necessary to reduce the engine emission gaseous concentrations to or below these specified levels: NO to 25 ppm, NO_2 to 5 ppm, CO (carbon monoxide) to 50 pprn and CO_2 (carbon dioxide) to 5000 ppm based on a laboratory test cycle. This air quantity is listed on the engine's approval plate which is attached to the engine.

Metal and Nonmetal Mine Safety and Health, Health Division
Doris A. Cash (703) 235-8307
E-mail: cash-doris@msha.gov

Technical Support, Approval and Certification Center
George Saseen (304) 547-2072
E-mail: saseen-george@msha.gov

Internet Availability
This information bulletin may be viewed on the Internet by accessing MSHAs home page at **http://wvwmsha.gov** by choosing Statutory and Regulatory Infomation,. CompIiance Assistance Information, then Program Information Bulletins.

Distribution
A1l Program Policy Manual Holders
Mine Operators
Independent Contractors
Special Interest Groups

22201+3062 02

JIM SHARPE NA164
NATIONAL STONE & SAND & GRAVEL
ASSOCIATION
2101 WILSON BLVD STE 100
ARLINGTON VA 22201-3062

U.S. Department of Labor
National Mine Health and Safety Academy
1301 Airport Road
Beaver, WV 25813-9426

Technical Issues Affecting Implementation of Diesel Filtration Technology on Permissible and Non-Permissible Vehicles in Underground Coal Mines

A Joint NIOSH-MSHA Report to the Coal Diesel Partnership
August 7,2002

On July 22nd and 23rd 2002, representatives of MSHA and NIOSH met at Arlington, Virginia to discuss the technical issues affecting implementation of diesel particulate matter rule [30 CFR Part 72, Diesel Particulate Matter Exposure of Underground Coal Miners; Final Rule]. The meeting was arranged as a follow-up to the Diesel Partnership meeting held at Arlington, Virginia on **July** 12nd, 2002 at which time the underground coal mining industry expressed concerns about their ability to meet the requirements of the rule which became effective on July 20th, 2002.

The following representatives of MSHA and NIOSH attended meeting:

1. Mark Ellis, MSHA, Special Assistant to the Assistant Secretary for Mine Safety and Health
2. Allyn Davis, MSHA, Acting Deputy Administrator, Coal
3. Linda Zeiler, MSHA, Deputy Director, Tech Support
4. William Pomroy, MSHA, Industrial Hygienist
5. George Saseen, MSHA, Physical Scientist, Tech Support, A&CC
6. Steven Luzik, MSHA, Center Chief, Tech Support, A&CC
7. Deborah Green, DOL-MSHA Solicitor's Office
8. Jack Powasnik, DOL-MSHA Solicitor's Office
9. Lewis Wade, NIOSH, Associate Director for Mining
10. Edward Thimons, NIOSH PRL, Branch Chief, Health Branch
11. George Schnakenberg, NIOSH PRL, Senior Physical Scientist
12. Aleksandar Bugarski, NIOSH PRL, Senior Research Fellow

Meeting Objectives

The objectives of the meeting were: 1) to identify major technical issues affecting the Implementation of the filtration technology *on* the permissible ***and*** non-permissible vehicles in underground coal mines, 2) to prioritize those issues, and 3) to propose compliance assistance activities and the responsible parties to initiate them.

Prioritized Issues

Through open discussion the issues were identified, overlaps consolidated, and prioritized as follows:

AB29-COMM-11-F

High Priority/Primary Issues

The group identified the following issues as high priority:

1. Life expectancy of paper filters;
2. Potential fire hazard associated with the use of paper filters;
3. The effects of a water level limit hole in the water scrubbers on particulate emissions;
4. Defining criteria for selection of filtration systems for non-permissible heavy-duty vehicles;
5. The effects of catalyzed diesel particulate filters on nitrogen dioxide (NO_2) emissions;
6. Potential fire hazard associated with the use of ceramic filters.

Lower Priority Issues

In addition, the group found that it is also important to address the following issues:

1. Use of alternative fuels, in particular biodiesel and ultra-low sulfur fuels in underground coal mines;
2. Performance of fuel treatment devices such as Diesel Product's Fuel Preparator®;
3. The effects of mine altitude on performance of the naturally aspirated; turboelarged and supercharged engines;
4. The effects of a supercharger on engine emissions and exhaust aftertreatment system performance;
5. The release of the gaseous and PM emissions data obtained through MSHA certification process.

High Priority Tasks

As a result of the group's discussions, the following tasks were identified as essential for resolving the above-mentioned high priority issues:

1. **Life expectancy of paper filters**

   There is both uncertainty and concern with the service life of a paper filter. At the very least, the life of a filter element should be one working shift. There is evidence that in several cases the service life is much less.

   a. The group decided that the execution of an industry-wide survey on mine operator experiences with paper filters is essential for defining the problem and devising a strategy for establishing industry-wide standards. The data on the use and average life of the paper filters will be collected as the joint effort of industry and MSHA Coal Mine Safety & Health [CMS&H] representatives.

   b. The filtration efficiency of paper filters currently available on the market needs to be verified. The MSHA Approval and Certification Center (A&CC)

representatives present indicated that they have formulated plans to conduct comparative testing of the filters in their operational configuration in the laboratory at the MSHA AC&C in Triadelphia, West Virginia as part of a more comprehensive initiative of investigations and compliance assistance to the industry.

c. Filter end-of-life is reached when the system back pressure increases to the maximum limit allowed for the engine. In addition to the filter itself, which increases the backpressure as it loads, the major contributing factors to exhaust back pressure at the engine are 1) the back pressures from exhaust conditioning system components upstream of the filter found in the existing exhaust treatment systems, and 2) the relatively low engine backpressure limits imposed by engine manufacturers.

1. Some water scrubber systems in current use exhibit very high water scrubber back pressures (without a paper filter present). The potential for redesigning the water scrubber and other components of the exhaust system upstream of the filter to reduce pressure losses needs to be investigated. This effort should be coordinated among the equipment manufacturers and the industry. MSHA [A&CC] is willing to test modifications to scrubber systems supplied by a third party.

ii. Since increasing the limit on engine back pressure could extend filter service life, the effects of increased engine backpressure on the gaseous and particulate emissions will be investigated.. The effects of the higher engine backpressure on the engine performance and durability will be investigated in cooperation with engine manufacturers. The issue of the engine warranties will be discussed with engine manufacturers. All of these investigations will be performed by MSHA [A&CC].

d. NIOSH will investigate the potential of reducing engine backpressure and extending filter life by using a scavenging fan installed at the downstream end of the exhaust system.

2. Potential fire hazard associated with the use of paper filters

Paper filters operating in a properly functioning exhaust cooling system (water scrubber or dry heat exchanger) should not be exposed to temperatures that will cause them to ignite. Exhaust temperatures at the filter can rise when a malfunction in the exhaust temperature and/or water level engine shut off safety system occurs. Antidotal evidence indicates the incidence rate of these malfunctions is quite frequent. There is a lack of factual information on the number and causes of filter fires.

a. The industry should report to the partnership and MSHA [CMS&H] all known instances in which the paper filter has caught fire. The report should include a detailed description of the filtration system and the conditions under which the fire occurred. MSHA [A&CC] will verify the data.

b. MSHA [A&CC] will assist industry in modifying safety systems and in developing protocols for preventing a fire in the filtration system.

c. The reliability of low water and high exhaust temperature sensors and alarms will be reassessed by MSHA [A&CC] and the industry, and, if needed, new designs and products will be acquired and tested.

d. MSHA proposes to include tests for the safety sensors (high temperature & loss of water in scrubber), alarms, and valves in the weekly permissibility check on the vehicle.

e. NIOSH will interview filter manufacturers and search the literature and the web to find alternative filtration media which can tolerate higher exhaust temperatures. The filtration efficiency of any potential candidates will be evaluated prior to flammability testing.

f. NIOSH will investigate secondary emissions from high exhaust temperatures and flame on any alternative filter media that is found.

3. **The effects of a water level overflow hole in the water scrubbers on particulate emissions**

a. MSHA [CMS&H], industry, and NIOSH will conduct a survey with the objective to identify the extent of the problem. NIOSH will design a survey sheet which will allow MSHA inspectors to gather information pertinent to the problem.

b. MSHA [A&CC], industry and NIOSH will consult the manufacturer(s) of the water scrubber about potential engineering solutions. If necessary, MSHA and NIOSH will assist the manufacturer(s) in solving the problem.

c. In the interim period, MSHA [A&CC] will investigate the ramifications of using the filtration system with the overflow hole open to the ambient.

4. Defining criteria for selection of filtration systems for non-permissible vehicles

There is no question that Corderite and Silicon Carbide matrix ceramic diesel particulate matter filters (DPF) work, and are long lived when treated and maintained in accordance with known practices. However, successful application of this device requires knowledge

\

of the vehicle, vehicle function, logistics, and filter system configurations and regeneration options beyond that possessed by most mine technicians and some filter suppliers.

a. MSHA [A&CC] has formulated a team to develop a "Trouble shooting Guide" to address the application of filters for complying to the Coal Rule. NIOSH also offered that it had given some thought to a decision tree approach for selecting the proper ceramic filter system. MSHA [A&CC] and NIOSH agreed to work together to design a decision tree, available through the web, which will help mine operators in the selection of the proper filtration system for their application. The decision tree should provide an operator with a tool to accurately and efficiently select the best filtration configuration for his applications. The solutions will be based on proven filtration technologies and concepts currently on the market.

5. **The effects of catalyzed diesel particulate filters on nitrogen dioxide (NO,) emissions:**

a. The Partnership and MSHA [A&CC] will meet with representatives of the MECA (Manufacturers of Emission Controls Association) and the individual filter manufacturers to discuss the NO, issue and motivate them to conduct additional research with the objective shedding more light on the problem.

b. The effects of the chemical composition and the quantity of catalyst in the filter wash coat on nitrogen dioxide (NO,) emissions should be investigated. This research should address noble and base metal catalysts. The investigation should be conducted by the filter manufacturers with monitoring by NIOSH and MSHA [A&CC].

c. NIOSH proposes to study the effects on NO, emissions of fuel-born catalysts in the exhaust filtration systems.

d. NIOSH proposes to study the effects of the pending reduction of fuel sulfur content (from 350 ppm to 15 ppm) on NO, emissions from catalyzed filters.

6. **Potential fire hazard associated with use of ceramic filters**

There has been a report of a fire (melt-down) of a ceramic DPF in use in a coal mine. A fire such as this is usually caused by the spontaneous ignition of an unusually large quantity of soot accumulated in the ceramic filter and is triggered by a period of high engine load (high exhaust temperature) followed by low engine load or idle (oxygen level in exhaust rises) . Proper monitoring and limiting of filter back pressure is the common practice used to prevent excessive soot loadings of DPF.

a. The industry should document the cases of fire associated with the use of ceramic diesel particulate filters. Of critical interest is whether a back pressure monitor and alarm was installed and functioning. MSHA [A&CC] should verify the data.

b. MSHA [A&CC] and NIOSH should assist operators in the selection of adequate filtration systems and accompanying equipment for their application. The system should be based on proper configuration, proper sizing, and equipped with sensors and alarms for backpressure monitoring.

Lower Priority Tasks

The following tasks are identified as essential for resolving the above mentioned lower priority issues:

1. **Use of alternative fuels in underground coal mines:**

   a. The partnership should investigate potential of using biodiesel and ultra-low sulfur fuels in underground coal mines. NIOSH can offer advice on the advantages and disadvantages of various fuels and will support mine operators in conducting field trials including emissions measurements.

      1. NIOSH (at Penn State) will conduct additional research on the effects of those fuels on gaseous and particulate matter emissions (also see item 5.c on page 5 regarding effects on fuel sulfur and NO to NO_2 conversion by noble metal catalyzed filters).

2. **Performance of fuel treatment devices such as Diesel Products Fuel Preparator®:**

   a. At the request of the Coal Partnership, NIOSH has funded a laboratory evaluation of the Fuel Preparator® at West Virginia Engine and Emissions Research Laboratory. The study was recently completed and a report will be available soon. The conclusion is that the device is effective in restoring engine power lost as a result of air and fuel vapor bubbles in the fuel delivered to the injection pump and would work in instances when such bubbles are the cause for reduced power in a mine vehicle.

3. **The effects of mine altitude on performance of the naturally aspirated, turbocharged and supercharged engines:**

   a. MSHA [A&CC] is willing to conduct certification tests (establish a ventilation rate and particulate index) on modified power packages provided by a third party.

This includes power packages in which the engines are derated for use at high altitudes.

4. **The effects of supercharger on engine and exhaust aftertreatment system performance:**

Engine supercharging is a means by which the horsepower lost **by** limiting the maximum **fuel** rate to an engine (derating) operating at a high altitude can be regained by compressing the engine intake air to restore its density **to** that of sea level and thus making derating unnecessary. The expected effect is to also restore engine particulate matter emissions to those at sea level and to increase exhaust gas volume.

a. MSHA [A&CC] will investigate the effects of engine supercharging on filter performance and life. The tests will be run at simulated high altitude conditions.

b. In addition, MSHA [A&CC] will investigate the effects of a supercharger on performance of the water scrubber since exhaust gas volumes will increase above the design limit of the scrubber.

5. **Release of the gaseous and PM emissions data obtained through the MSHA certification process:**

a. MSHA [A&CC] will investigate the possibility of making public the gaseous and particulate matter emissions numbers obtained through the MSHA mandatory engine certification process. That data base should be of immense help to mine operators and ceramic filter suppliers and manufacturers in the process of selection of adequate engines and aftertreatment devices.

Aleksandar Bugarski
George Schnakenberg, Jr.
Pittsburgh, July 29,2002
Includes minor MSHA rev. August 6,2002

Engine Manufacturers Association
www.enginemanufacturers.org

Two North LaSalle Street
Suite 2200
Chicago, Illinois 60602
Tel: 312/827-8700
Fax: 312/827-8737

May 22,2002

Honorable David Lauriski
Assistant Secretary of Labor
Mine Safety and Health Administration
4015 Wilson Blvd,
Arlington, VA 22203

RE: Feasibility Of MSHA Diesel Engine Particulate Controls

Dear Mr. Lauriski:

The Mine Safety Health Administration has developed requirements to reduce the concentration of diesel particulate matter *in* underground mines. In 1998, EMA commented on the proposed rule and advised against mandating a single technology solution. Instead, we recommended a perEonnance standard that allows mine operators flexibility to develop the most effective control measures possible.

Engine manufacturers have made great strides to reduce emissions fiom diesel engines over the past years, and we are currently working to ensure further reductions. Increasing evidence showsthat, when properly fitted and used with ultra-low sulfur (1 5 ppm) fuel, catalyzed particulate filters can provide the 90% reduction efficiencies needed to *virtually* eliminate PM and hydrocarbon emissions from today's new on-road diesel engines.

EMA is also a proponent of using particulate filters to retrofit diesel engines already in service, but only when appropriate conditions are met. Caution must be taken to ensure that any proposed engine retrofit actually results in emissions reductions and that dmage to the engine or a decrease in needed performance does not occur. Consequently, it is EMA's position that filters are simply not add-on devices and cannot be unconditionally applied to all existing engines. In fact, there is recognition that some existing engines cannot successfullybe retrofitted with catdyzed particulate filters. Specifically, such particulate filters may not be appropriate for older engines with relatively high PM emissions rates.

Because improper integration ofparticulate filters can harm the engine and deteriorate performance, any afiertreatment device must be verified to be compatible with engine exbaust characteristics, temperature profile, backpressure requirements, and engine protection. It is also necessary to verify that emissions reductions claimed by equipment manufacturers will indeed occur after installation,

Passive and automatic regenerating filter affertreatment technology to reduce PM is very promising and is currently being verified for many on-road **applications,** To date, there has not been as much progress or testing of these devices for non-road applications, such as engines used

AB29-COMM-11-G

in mining equipment. For this reason, it is unlikely that automatio regenerating filters are currently available for all the types of diesel equipment used in mining operations. Indeed, due to the age and emissions cliaracteristics of some of this equipment, it may not be technically feasible to retrofit this equipment witb such filters.

Due to the current state of technology, EMA believes that MSHA should reconsider or delay implementation of the requirement that requires retrofitting mining equipment with filter technology. Additional time is needed to test and verify filter equipment that can be successfufly applied to the wide range of engines and equipment operating in rnines today. Failure to complete the necessary testing and verification may not only result in a lack of diesel PM emissions reductions, but in equipment and engine damage or failure that could jeopardize safety.

EMA recommends that MSHA delay implementation of the rule until filter manufacturers and suppliers have been able to complete the extensive studies needed to ensure that the aftertreatrnent systems for a particular class/year of equipment can successfully be completed. Programs, such as the Canadian Diesel Exhaust Emissions Project, that we studying the feasibility **and** effectiveness of retrofit technology for all quipment will provide such information and should be supported. Rapid completion of such studies will allow equipment operators to safely phase-in diesel PM reduction equipment as appropriate equipment **is** certified.

Sincerely,

Joseph L. Suchecki
Director, Public Affairs

Federal Register
Vol. 67, No. 159
Friday, August 16, 2002

Presidential Documents

Title 3—

The President

Executive Order 13272 of August 13, 2002

Proper Consideration of Small Entities in Agency Rulemaking

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section **1.** *General Requirements.* Each agency shall establish procedures and policies to promote compliance with the Regulatory Flexibility Act, as amended (5 U.S.C. 601 *et seq.)* (the “Act”). Agencies shall thoroughly review draft rules to assess and take appropriate account of the potential impact on small businesses, small governmental jurisdictions, and small organizations, as provided by the Act. The Chief Counsel for Advocacy of the Small Business Administration (Advocacy) shall remain available to advise agencies in performing that review consistent with the provisions of the Act.

Sec. 2. *Responsibilities of Advocacy.* Consistent with the requirements of the Act, other applicable law, and Executive Order 12866 of September 30,1993, as amended, Advocacy:

(a) shall notify agency heads from time to time of the requirements of the Act, including by issuing notifications with respect to the basic requirements of the Act within 90 days of the date of this order;

(b) shall provide training to agencies on compliance with the Act; and

(c) may provide comment on draft rules to the agency that has proposed or intends to propose the rules and to the Office of Information and Regulatory Affairs of the Office of Management and Budget (OIRA).

Sec. 3. *Responsibilities of Federal Agencies.* Consistent with the requirements of the Act and applicable law, agencies shall:

(a) Within 180 days of the date of this order, issue written procedures and policies, consistent with the Act, to ensure that the potential impacts of agencies' draft rules on small businesses, small governmental jurisdictions, and small organizations are properly considered during the rulemaking process. Agency heads shall submit, no later than 90 days from the date of this order, their written procedures and policies to Advocacy for comment. Prior to issuing final procedures and policies, agencies shall consider any such comments received within 60 days from the date of the submission of the agencies' procedures and policies to Advocacy. Except to the extent otherwise specifically provided by statute or Executive Order, agencies shall make the final procedures and policies available to the public through the Internet or other easily accessible means;

(b) Notify Advocacy of any draft rules that may have a significant economic impact on a substantial number of small entities under the Act. Such notifications shall be made (i) when the agency submits a draft rule to OIRA under Executive Order 12866 if that order requires such submission, or (ii) if no submission to OIRA is so required, at a reasonable time prior to publication of the rule by the agency; and

(c) Give every appropriate consideration to any comments provided by Advocacy regarding a draft rule. Consistent with applicable law and appropriate protection of executive deliberations and legal privileges, an agency shall include, in any explanation or discussion accompanying publication in the Federal Register of a final rule, the agency's response to any written comments submitted by Advocacy on the proposed rule that preceded the final rule; provided, however, that such inclusion is not required if the head of the agency certifies that the public interest is not served thereby. Agencies and Advocacy may, to the extent permitted by law, engage in an exchange of data and research, as appropriate, to foster the purposes of the Act.

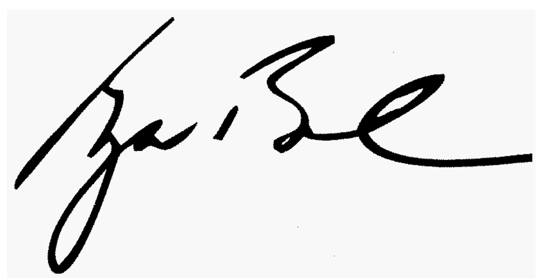
Sec. 4. *Definitions.* Terms defined in section 601 of title 5, United States Code, including the term "agency," shall have the same meaning in this order.

Sec. 5. *Preservation of Authority.* Nothing in this order shall be construed to impair or affect the authority of the Administrator of the Small Business Administration to supervise the Small Business Administration as provided in the first sentence of section 2(b)(1) of Public Law 85–09536 (15 U.S.C. 633(b)(1)).

Sec. 6. *Reporting.* For the purpose of promoting compliance with this order, Advocacy shall submit a report not less than annually to the Director of the Office of Management and Budget on the extent of compliance with this order by agencies.

Sec. 7. *Confidentiality.* Consistent with existing law, Advocacy may publicly disclose information that it receives from the agencies in the course of carrying out this order only to the extent that such information already has been lawfully and publicly disclosed by OIRA or the relevant rulemaking agency.

Sec. 8. *Judicial Review.* This order is intended only to improve the internal management of the Federal Government. This order is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or equity, against the United States, its departments, agencies, or other entities, its officers or employees, or any other person.



THE WHITE HOUSE,
August 13, 2002.

[FR Doc. 02-21056 Filed 08-15-02; 8:45 am]
Billing code 3195-01-P

AB29-COMM-11-H