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January 22, 1993

Ms. Diane D. Porter
Assistant Director for Legislation
and Policy Coordination
NIOSH
1600 Clifton Rd., NE
Atlanta, GA 30333

Dear Ms. Porter:

Enclosed is a copy of my review and comments on NIOSH's draft document entitled "A Performance Evaluation of DM and DFM Filter Respirators Certified for Protection Against Toxic Dusts, Fumes, and Mists". I appreciate having the opportunity to review the document and hope that you will find my comments useful in the preparation of a final product.

Sincerely,

Bill Kojola

Bill Kojola
Associate Director
Occupational Health

cc: John Moran
    Chuck Reese

Laborers'
**Health & Safety Fund of North America**

COMMENTS
ON
THE NIOSH WORKING DRAFT

# A Performace Evaluation of DM and DFM Filter Respirators Certified for Protection Against Toxic Dusts, Fumes, and Mists

William H. Kojola
Associate Director
Occupational Health

January 22, 1993

The National Institute for Occupational Safety and Health has circulated a working draft document entitled A Performance Evaluation of DM and DFM Filter Respirators Certified for Protection Against Toxic Dusts, Fumes, and Mists for review and comment. In this document, NIOSH has evaluated data obtained from several recent laboratory research studies that examined filter penetration characteristics of both dust/mist (DM) and dust/fume/mist (DFM) filters. Using the filter leakage data, NIOSH proceeded to incorporate the filter penetration findings into the calculations for determination of the assigned protection factors (APF) for DM/DFM filter masks. With its finding of substantial filter leakage from these research reports, NIOSH is proposing to significantly lower the APFs for current and future usage of DM/DFM filters masks in our nations workplaces. This will have broad implications for respirator usage among workers exposed to particulates and aerosols.

As framework for reviewing the working draft document, the definition of several respirator protection factors (PF) are useful and instructive, as taken from the NIOSH Respirator Decision Logic and Myers, et al (1,2). Those definitions, summarized in part, follow below (with emphasis added):

Assigned Protection Factor

" The assigned protection factor is a measure of the minimum anticipated workplace level of respiratory protection that would be provided, by a properly functioning respirator or class of respirators, to a large percentage of properly fitted and trained users. The assigned protection factor should be based on workplace protection factor measurements made in a representative number of workplace settings and for a representative number of wearers. In the absence of workplace protection factor measurements, it may be necessary to utilize measurements of laboratory protection factors. However, it is not appropriate to rely upon measurements of laboratory protection factors in this way, unless there is a demonstrated correlation between the laboratory protection factor and the workplace protection factor."

" It has been the practice, in the absence of workplace protection factor or laboratory protection factor data, to assign protection factors on measurements of respirator fit factors. That practice, however, is not considered to be appropriate unless a reliable correlation between the workplace protection factors and the fit factors can be demonstrated."

" Many of the assigned protection factors (APF's) that appear in this decision logic are based on laboratory studies and should be regarded as approximate."

" APF's based solely on laboratory fit testing should be viewed and applied with particular caution, even when the laboratory testing involves a simulated work regimen. To date, no relation has been demonstrated between laboratory fit factors and measured workplace performance."

" For the present, the APF's should be regarded as approximate if they are not based on WPF's."

" For the present, APF's should not be considered reliable predictors of performance levels that will be achieved during actual use, since APF's are not based on a sufficient amount of workplace testing."

Workplace Protection Factor

"The workplace protection factor (WPF) is a measure of the actual protection provided in the workplace under the conditions of that workplace by a properly functioning respirator when correctly worn and used. It is defined as the estimated contaminant concentration which the user would inhale if he were not wearing the respirator, $C_o$, divided by the estimated contaminant concentration inside the respirator facepiece, $C_I$. In practice, the workplace protection factor would be determined by measuring the concentration inside and outside the facepiece during the activities of a normal workday."

" When WPF data existed, NIOSH utilized the point estimate equation proposed by Myers et al. to help establish the APF's recommended in this decision logic. When WPF data existed, NIOSH selected a confidence limit of $p=0.95$. Thus, for a given set of data and given class of respirators, NIOSH would expect that 95% of the WPF's would exceed the calculated point estimate value."

Simulated Workplace Protection Factor

" A surrogate measure of the workplace protection factor (WPF) of a respirator, a simulated workplace protection factor (SWPF) differs from the WPF only in that it is measured in a laboratory simulation of a workplace setting rather than in the actual workplace. For laboratory protection factor testing to reliably estimate WPF's, a relationship must be demonstrated between the two tests. Until such a relationship can be shown to exist, the laboratory protection factor is of questionable use in determining or predicting the WPF."

The "laboratory protection factor" definition in Myers et al. is equivalent to that of the SWPF definition in the respirator decision logic document.

Fit Factor

"The fit factor is a quantitative measure of the fit of a particular respirator facepiece to a particular individual. It is defined under the conditions of quantitative fit testing as the aerosol concentration in the test chamber $C_o$, divided by the penetration that occurs through the respirator face seal interface, $C_i$. For $C_i$ to reflect only face seal leakage, high efficiency filters are installed on the respirator. It is assumed that either no leakage or only a negligible amount of leakage into the facepiece occurs through the exhalation valve or any source other than the face seal. The fit factor is measured on a complete respirator worn by a test subject who follows a regimen of slow head movements, deep breathing, and talking; a polydispersed oil mist or sodium chloride aerosol is used that has an AMMD of approximately 0.6 ± 0.1 um (with a geometric standard deviation of approximately 2 to 2.4)."

NIOSH Working Draft Document

Principally on the basis of four research studies that were designed to measure filter penetration of challenge aerosols in laboratory settings using manikin-mounted respirators, including DM and DFM filters, NIOSH is now proposing to alter substantially the APF's of both powered and non-powered air purifying masks equipped with either DM or DFM filters. The findings of these studies indicated that for highest leakage contaminant size aerosols delivered to the filters at "medium work" flow rates, percent filter leakage was as high as 50 percent. With the incorporation of the leakage data into the calculation of APF's, assuming a 10 percent faceseal leakage, the APF's for DM and DFM masks are being proposed to be lowered significantly.

I believe that NIOSH's proposed lowering of the APF's of these classes of respirators is, at this time, premature for the following reasons:

1. The lowering of the APF's is based solely on the generation of laboratory filter penetration data of masks attached to manikins and does not rely on WPF measurements, SWPF's, nor fit factor data. Likewise, the new APF's for DM and DFM equipped masks are computed in the absence of any demonstrated relationship with laboratory protection factors or fit factors with APF data. This approach adopted by NIOSH calls into question the relevancy of the proposed APF's with the real world workplace protection afforded by DM and DFM masks.

2. NIOSH did evaluate and analyze nine WPF studies reporting data on non-powered air-purifying halfmasks and, for a variety of reasons, has chosen to discount these studies entirely (Table O). Despite their individual and collective shortcomings, these studies

do consist of WPF measurements upon which, ideally, the determination of APF's ought to be based. Rather, NIOSH has focused its attention on the filter penetration data for which a relationship with actual workplace protection has not been established.

3. I seriously question whether the flow rates of between 35 to 55 L/min/mask, defined as "medium" work rates from the filter penetration studies, are relevant and appropriate for what occurs in the workplace. If we use these medium work flow rates and extend them over an 8-hour workday, these rates would be equivalent to a worker inhaling 16.8 $m^3$ and 26.4 $m^3$ of air during a workshift, respectively. Clearly, this would not constitute real work performed that is anything close to that resembling "medium work" . Thus, there is no translation from the laboratory definition of medium work to that which is performed by workers. An example of relevancy, in the preamble to the Occupational Safety and Health Administration's proposed rule concerning occupational exposure to methylene chloride, the agency conducted its cancer risk assessment based on an inhalation rate of 9.8 $m^3$/8-hour workday, which is far less than that represented in this NIOSH evaluation (56 FR 57092). The filter penetration data also indicate that, as flow rates increase or decrease, the percent filter leakage also correspondingly increases or decreases. Thus, if flow rates of 35 to 55 L/min/mask does not represent "medium work" in the workplace, then lower flow rates would have to be used thus decreasing the percent leakage values that NIOSH utilized to calculate the proposed APF's.

4. NIOSH has criticized the WPF studies presented in Table O as not being a representative sample of all non-powered halfmask facepieces certified under 30 CFR Part 11, with the results reported for a "very limited number of the scores of halfmask makes and models certified by NIOSH" and that these studies were also not likely to be representative of the range of smaller and larger facial sizes of workers. This criticism of the lack of representativeness of the samples is also just as applicable and appropriate to the samples of DM and DFM filters used in the penetration studies. And yet, in spite of the lack of representativesness of filters chosen for use in the penetration studies, NIOSH is proceeding to lower the APF's for these classes of respirators. NIOSH can't have it both ways. If the WPF studies can be, at least in part, ignored because they are unrepresentative, so to for the filter leakage data.

5. NIOSH has chosen to perform its APF calculations, utilizing the filter penetration data, based upon the highest leakage particle size. This approach constitutes a "worst case" scenario. However, adopting this approach has questionable relevancy as it relates to the size and distribution of particulates to which workers are, in fact, exposed to in the workplace. Workers are not likely to be exposed to a monodisperse particle size and, as a class of wearers of DM and DFM masks, more unlikely still to have exposures

exclusively to particle sizes that result in the highest leakage. While I can appreciate designing laboratory studies that present monodisperse size aerosols to test filter materials, the relationship to workplace exposure experiences and the laboratory data are not necessarily related to one another. In contrast, WPF measurements would be more appropriate in this regard.

6. The filter penetration studies used new and clean DM and DFM filters for evaluating leakage characteristics and penetration measurements (efficiency) were performed within a matter of minutes after the aerosol was presented to the filter material. Thus, the results of these studies relative to particle capture efficiencies relate only to the initial filtering characteristics of new filters. The data say nothing about filter loading over time, in which capture efficiencies would increase. However, NIOSH has, in my view, inappropriately used the instantaneous filter penetration that can occur upon the initial use of a new filter and applied the data to calculating APF's for DM and DFM masks as though these penetration characteristics remain constant over the time in which the masks are worn by workers in the field. Workers using these masks would likely have their particulate capture efficiencies increase with time as the filter loading increases with use. Instantaneous initial penetration of clean filters does not describe the protection that workers will be afforded when using the masks and by doing so, distorts the protection that may be achieved when properly worn. As an alternative, WPF measurements would more adequately address this issue in the absence of any known relationship between capture efficiencies over time in filters attached to manikins with that present in the workplace.

7. The NIOSH calculations of the new APF's assumes a faceseal leakage of 10%, in addition to the filter leakage figures. It's not clear as to what relevance this assumption has to workplace settings in which workers that have been properly fit tested and assigned a respirator must have a fit that is, at a minimum, 10 times that of the APF of that class of respirator. When NIOSH uses a faceseal leakage figure of 10%in its calculation of the APF's, no filter penetration whatsoever can occur for respirators to maintain an APF of 10. When penetration values representing only the instantaneous initial penetration of clean filters are used, this procedure distorts the actual protection these filters may provide and does not address the practice that quantitative fit must be 10 times that of the APF.

8. The draft document assumes that workers assigned DM and DFM masks will be working constantly at the maximum use concentrations. This is not likely to be the case in the workplace. While the concept of a maximum use concentration is important to establish a ceiling for assigning respirators, it is not predictive of the actual exposures

that workers will experience.

9. While NIOSH is proposing to reduce the APF's for the various DM and DFM respirators, both powered and non-powered, it has overlooked APF's of DM or DFM respirators than may be used in combination with sorbet cartridges/canisters for gas/vapor exposure.

10. Currently there exists confusion and conflicting advice as to the protection factors afforded by various classes of respirators. Protection factor recommendations or requirements have been established by several entities, including NIOSH, OSHA, ANSI, and the NRC. For any given class of respirators, the protection factors developed by these individual entities can vary substantially from one another. The attached article from Deleading magazine regarding the wide variance in recommended protection factors for workers engaged in lead abatement activities adequately highlights this problem. Clearly this variation in APF's poses major problems for professionals who are responsible for decision making as it applies to respiratory protection. Unfortunately, the NIOSH draft document will only add to the confusion.

11. A correction on page 111 of the working draft is necessary. Under the second bullet near the bottom of the page concerning labels for NIOSH-certified DM and DFM filters, it should read:

> ...having a time-weighted average of not less than...

Point Estimates and Tolerance Limits

The working document discusses the use of point estimates from WPF studies as described by Myers, et al and indicates that were multiple WPF performance studies to be conducted, the study-to-study 5th percentile WPF point estimates would have a certain amount of variability due to sampling errors. It then discusses the computation of a "tolerance limit" to create an "interval estimate" for the range of values around the point estimate within which, at a specified confidence level, there is confidence that the actual 5th percentile WPF lies. This interval estimate would then define the error band for the actual 5th percentile WPF.

The working draft then goes on to advocate the use of a 1-sided lower tolerance limit, computed at the 95% confidence level, for the 5th percentile WPF as the criteria for establishing the APF's for respirators where WPF studies are available.

In my view, this approach is not appropriate and, in fact, misrepresents the meaning of a "tolerance limit". Of course, with multiple WPF studies, variation will occur due to sampling errors and the calculation of tolerance limits around the point estimate is appropriate. However, to focus on the 1-sided lower tolerance limit to establish the APF's is not. The tolerance limits define the "error band" or "margin of error" around which the point estimates lies, at some level of confidence. It will only provide a range of values with the calculation of an upper tolerance limit as well. Calculating both the upper and a lower tolerance limit around the point estimate gives a full picture of the " margin of error " that could occur. To ignore the upper tolerance limit distorts the full range of point estimate values. In other words, the respirator also has as much likelihood of performing better than the point estimate (upper tolerance limit) as would the likehood of performing worse(lower tolerance limit). You can't just merely ignore the upper tolerance limit and expect that you have adequately described, in a statistical sense, the performance of a respirator. The calculation of tolerance limits, both lower and upper, should be computed and be made available to the respirator user community to give it a sense of the variability of performance of a given class of respirators. Focusing exclusively on lower tolerance limits does not accomplish this.

Filter Leakage

The filter leakage data reported and analyzed in the document provides, at least for simultaneous initial penetration through clean filters, a strong argument for advocating procedures to address an apparent problem. Leakage in these studies could be substantial, approaching 74% through DM filters and 24% through DFM filters tested at "heavy work" rates. It is also noteworthy that the leakage variability within manufacturers filters or even with the same lot of filters was substantial, approaching a range of up to five-fold differences in leakage characteristics. Within this range of variability however, it is clear that some respirator manufacturers have designed DM and DFM filters that have lower leakages that will afford workers the potential for more protection. NIOSH also acknowledged that for more than 15 years, respirator manufacturers have had the capability to produce DM filters that have less than 5% leakage.

To address this wide range of variability in filter leakage filters characteristics for DM and DFM filters, I would recommend that NIOSH establish a set of minimum criteria for certifying DM and DFM filters for leakage. Such criteria would be similar in nature to that of HEPA filters which must have a 99.97% capture efficiency at an established particle size. Establishment of a minimum capture efficiency criteria for certification of DM and DFM filters would compel the manufacturers to construct their filters in such a manner to meet a protective minimum which they have had the capability of doing for quite some time.

## Conclusion

In summary, I believe the NIOSH proposal to lower the APF's for DM and DFM masks, based upon the filter leakage studies, is premature and inappropriate. The filtering efficiency demonstrated within a few minutes using a highest penetration size aerosol on clean filters does not adequately describe the capture efficiencies these filters might provide to workers in the workplace. However, the wide variability in filter leakage for DM and DFM filter materials is indicative of a problem that needs to be addressed. Establishing some minimum criteria for DM and DFM filter capture efficiencies, akin to that of HEPA filters, is recommended to obtain certification from NIOSH.

## References


1. NIOSH Respirator Decision Logic. DHHS (NIOSH) Publication No. 87-108, Cincinnati, OH (May, 1987).

2. Myers, W.R., Lenhart, S.W., Campbell, D., and Provost, G. Letter. Am. Ind. Hyg. Assoc. J. 44:B25-B26, 1983

# The Deleading Industry's Respirator Protection Factor Controversy

*By John F. Quinn, Abatement Industry Specialist*
*Mine Safety Appliances Company*

Selecting an appropriate respirator for use in the deleading industry would appear on the surface to be a fairly straightforward proposition. Respirator selection is supposed to be as easy as applying respirators' assigned protection factors, numerical representations of protection levels, to the anticipated lead concentration, a simple process.

Unfortunately, there is wide disparity among assigned protection factors found in existing and proposed respirator and substance specific standards and guidelines. Deleading professionals can find themselves at the beginning of a virtual maze with several avenues from which to choose, hoping the route selected provides the necessary worker protection for the work environment involved.

Depending on the respirator, an assigned protection factor may range from as low as 10 to as high as 10,000. The assigned protection factor represents the potential for a contaminant to leak into a respirator and actually be inhaled. Therefore, the higher the assigned protection factor, the better the expected protection.

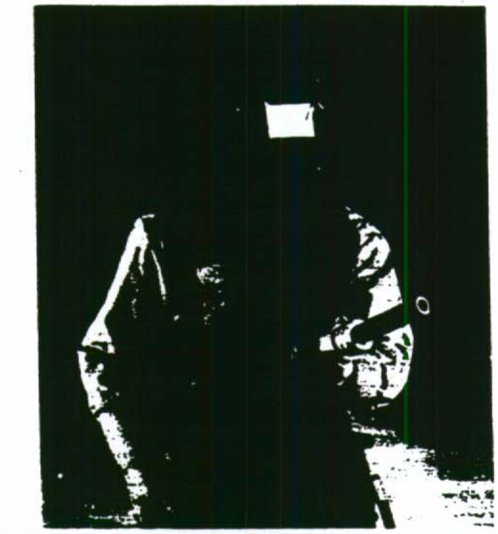
While there are about 20 different generic types of respirators from which the deleading industry can choose, there are also numerous regulations or guidelines relating to assigned protection factors, and it seems that no two completely agree *(see table on the following page)*.

So how are deleading contractors to know which assigned protection factor fits their situation when there is disagreement over assigned protection factors even among government agencies, such as NIOSH and OSHA, and independent industry groups, like the American National Standards Institute (ANSI)?

Lead abatement contractors generally don't have the necessary equipment to conduct precise respirator fit checks, called *quantitative* fit tests, for each of their employees. And even if they did, regulations would preclude the use of fit factors derived from quantitative tests. Thus, using assigned protection factors would seem to be the natural starting point. In fact, OSHA indirectly requires the use of assigned protection factors in respirator selection in its latest substance specific standards (e.g., asbestos, formaldehyde).

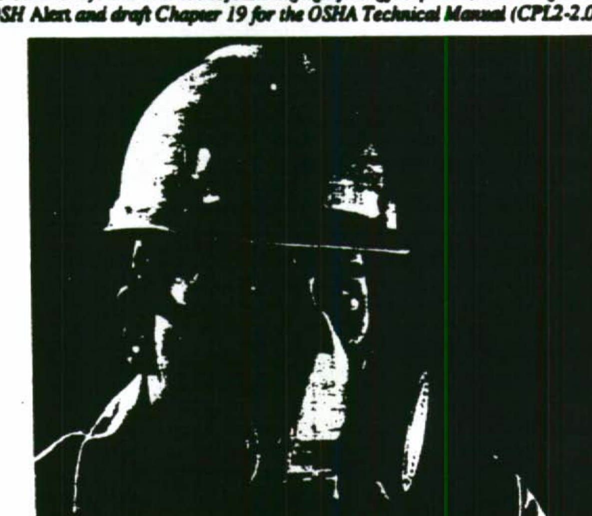
**What's the Problem?**

The confusion and controversy surrounding assigned protection factors becomes clear when lead abatement contractors try to select an appropriate respirator. Using the assigned protection factor (APF) for a half-mask respirator of 10 and the OSHA General Industry Lead Standard's Permissible Exposure Limit (PEL) of 50 micrograms/cubic meter (μg/m³), the maximum use concentration (MUC) for a half-mask respirator for protection against lead is 500 μg/m³: APF X PEL = MUC. Thus, a half-mask respirator should not be used if the airborne concentration of lead is above 500



*Blasting hoods, such as this Abrasi-Blast™ Supplied-Air Respirator, have a tight-fitting full-facepiece design and high flow rate for achieving higher assigned protection factors.*

*Traditional air-supplied blasting hoods, such as this unit, have lower assigned protection factors than are found with hoods featuring tight fitting facepieces, according to the latest NIOSH Alert and draft Chapter 19 for the OSHA Technical Manual (CPL2-2.0C).*



*Maintenance-free half-mask air-purifying respirator is an example of a respirator suitable for some residential lead abatement applications.*

But because assigned protection factor standards vary, and would result in differing maximum use concentrations, it's a better rule of thumb to start with the maximum concentration of lead involved in a particular work environment and work backwards by dividing by the PEL for lead, a constant 50 μg/m³. Actually, even the PEL is a matter of controversy; the OSHA Construction Standard references a PEL of 200 μg/m³, and some industrial hygienists would argue than an even more conservative PEL, such as 25 μg/m³, should be used! But as long as you can measure the amount of lead in the surrounding atmosphere, you should be able to determine the assigned protection factor, and hence respirator, needed for the job. While that may seem relatively easy, the differing standards and guidelines can complicate the process.

According to some OSHA standards, the typical sand-blasting hood has an assigned protection factor of 2000, which would result in an MUC of 100,000 μg/m³ and allow work in environments with very high concentrations of lead without concern for exceeding the PEL.

But that may not necessarily be the case. Recently, a NIOSH *Alert* and a draft OSHA guideline for inorganic lead give the same respirator a protection factor of only 25.

That state of affairs begs the question: What are the "true" assigned protection factors for respirators? To gather insight into the matter, we need to compare some existing OSHA standards and other guidelines and standards.

The only respirator class where there is universal agreement between the various standards and guidelines regarding assigned protection factors is the half-mask, negative-pressure, air-purifying respirator, which has an assigned protection factor of 10.

For the full-facepiece version there is presently consensus amongst OSHA and NIOSH on an assigned protection factor of 50, but the proposed new ANSI Z88.2 Respirator Standard gives it an assigned protection factor of 100.

And when it comes to powered air-purifying respirators (PAPRs) with a helmet or hood, the disparity in assigned protection factor standards becomes readily apparent. The assigned protection factor for a PAPR with a helmet or hood and a minimum flow rate of 6 cubic feet/minute (cfm) is all over the board, ranging from 25 to 1,000.

Furthermore, a draft of the OSHA Technical Manual Chapter 19 entitled "Construction Worker Protection: Lead Exposure" (Draft OSHA Instruction CPL2-2.20C) allows higher assigned protection factors for PAPRs that have minimum flow rates of 6 cfm with tight-fitting facepieces. Yet full-face PAPRs with a minimum flow of 4 cfm have the same assigned protection factor as negative-pressure, full-facepiece respirators. And if a PAPR has a flow rate higher than 6 cfm, it could be used in atmospheres draft document. While this draft will undoubtedly have some changes before publication, it does signal a shift in OSHA's thinking.

With constant-flow air-line respirators, the difference of opinion between standards and guidelines becomes even greater. The NIOSH *Alert* Guideline and the 1978 OSHA Lead Standard generally allow high assigned protection factors (1000-2000 depending on flow rates). But the draft OSHA Technical Manual Chapter 19 lists assigned protection factors that are more conservative (50-250 depending on flow rates).

However, the key area of concern for lead abatement contractors who are doing blasting work is the assigned protection factor for the constant-flow hood or helmet, more commonly known as an abrasive blasting or sand-blast hood. The assigned protection factor of 25 that is found in both of the newest documents, the NIOSH *Alert* and OSHA Chapter 19 draft, effectively eliminates the traditional style of blasting hood from being used in the enclosures now being erected around bridges, tanks, etc., because of the excessively high airborne lead dust concentrations.

Fortunately, alternative style blasting hoods can achieve a higher assigned protection factor (from 500 to 2000 for lead applications) because they are designed with a tight-fitting full-facepiece and high-flow rate.

Variance in assigned protection factors also exists in the categories of pressure-demand air-line respirators and pressure-demand self-contained breathing apparatuses (SCBA). From a practical standpoint, SCBA are not likely to be used in lead paint abatement work because of their limitations of weight, size and duration. However, since both the NIOSH *Alert* and OSHA Chapter 19 draft assign relatively high protection factors to full-facepiece pressure-demand air-line respirators, as did the OSHA Lead Standard, the use of these type of devices for lead paint abatement involving high dust concentrations will likely increase over time.

### The Right Respirator for the Job

While the preceding provides an overall assessment of the confusion surrounding assigned protection factors and the respirator selection process, lead abatement contractors are still left to wonder what to do when selecting respirators and what assigned protection factor should come into play.

Because of the wide variance of opinion on assigned protection factors, it may be prudent to be conservative in your selection of the appropriate assigned protection factor until the confusion and controversy surrounding this issue are cleared up.

A conservative approach and the history of the assigned protection factor controversy can point lead abatement contractors to some basic conclusions for selecting the right respirator for the job.

For most residential lead abatement work, the airborne lead concentrations are quite low. A half-mask or full-facepiece negative-pressure respirator, providing assigned protection factors of 10 and 50 respectively, should work fine for many

But where higher levels of protection are needed to, for example, reduce a worker's blood lead level, or because of higher airborne dust concentrations, PAPRs with tight-fitting full facepieces and flow rates *in excess of 6 cfm* are recommended.

And for work on industrial steel structures and/or bridges, lead abatement contractors should investigate the newer sand-blasting hoods with pressure-demand regulators that are equipped with tight-fitting full facepieces. A typical respirator of this type has a tough waist-length protective hood. The respirator facepiece lens is protected from scratches by a special cover lens adapter with replaceable lenses. Air is supplied via an air-line of up to 300 feet, which is connected to an approved compressed air source with a pressure of between 65 and 85 psig.

It is important for lead abatement contractors to remember that regardless of the assigned protection factor of a particular respirator, wearers are well advised to perform standard *qualitative* fit testing on tight-fitting-facepiece-type respirators. Qualitative fit-testing is a GO/NO GO type of test. It is performed by using a test agent to determine a proper respirator fit, which is achieved when the wearer cannot detect the test agent.

By following the aforementioned recommendations, approaching assigned protection factors conservatively, and keeping apprised of pending changes in standards involving assigned protection factors, lead abatement contractors can select the appropriate respirator for a particular task and provide adequate protection for themselves and their employees.

Fortunately, the assigned protection factor controversy may soon be resolved. The Housing and Community Development Act of 1992, just recently signed into law, includes a provision which mandates that OSHA establish an interim lead standard for the construction industry as least as stringent as the general industry standard and develop a conclusive lead standard for the construction industry within 180 days.

*This article was written by John F. Quinn, Abatement Industry Specialist, Mine Safety Appliances Company, P.O. Box 426, Pittsburgh, PA 15230-0426; (412) 967-3142*

MSA

THE PROTECTION FACTOR CONTROVERSY

| RESPIRATOR | NIOSH ALERT FOR INORGANIC LEAD (4/92) | 1991 OSHA CHAP. 19 CONSTR. GUIDE (DRAFT) | PROPOSED ANSI Z88.2 1992 | 1986 OSHA ASBESTOS STANDARD | 1978 OSHA LEAD STANDARD | 1991 10CFR20 NUCLEAR REG. COMMIS. |
|---|---|---|---|---|---|---|
| 1/2 Mask w/HEPA*** | 10 | 10 | 10 | 10 | 10 | 10 |
| Full Facepiece w/HEPA | 50 | 50 | 100 | 50 | 50 | 50 |
| PAPR w/Helmet or Hood (Min 6 CFM) | 25 | N/A | 1,000 | 100 | 50 | 1,000 |
| PAPR w/Loose Fitting Fcpc (Min 6 CFM) | 25 | N/A | 25 | 100 | 50 | 1,000 |
| PAPR w/Half Mask (Min 4 CFM) | 25 | 50 | 50 | 100 | 50 | 1,000 |
| PAPR w/Half Mask (Min 6 CFM) | 25 | 250 | 50 | 100 | 50 | 1,000 |
| PAPR w/Full Facepiece (Min 4 CFM) | 50 | 50 | 1,000 | 100 | 50 | 1,000 |
| PAPR w/Full Facepiece (Min 6 CFM) | 50 | 500 | 1,000 | 100 | 50 | 1,000 |
| Constant Flow w/Half Mask (Min 4 CFM) | 1,000 | 50 | 50 | 100 | 1,000 | 1,000 |
| Constant Flow w/Half Mask (Min 6 CFM) | 1,000 | 250 | 50 | 100 | 1,000 | 1,000 |
| Constant Flow w/Full Fcpc (Min 4 CFM) | 2,000 | 50 | 1,000 | 100 | 2,000 | 2,000 |
| Constant Flow w/Full Fcpc (Min 6 CFM) | 2,000 | 500 | 1,000 | 100 | 2,000 | 2,000 |
| Constant Flow w/Hood or Helmet (Min 6 CFM) | 25 | 25 | 1,000 | 100 | 2,000 | 1,000 |
| Constant Flow w/Hood or Helmet (at manufacturer's maximum flow rate) | 25 | 25 | 1,000 | 100 | 2,000 | 2,000 |
| Constant Flow w/Loose Fitting Facepiece | 25 | 25 | 25 | 100 | 2,000 | N/A |
| Pressure Demand w/Half Mask | 1,000 | N/A | 50 | 1,000 | 2,000 | N/A |
| Pressure Demand w/Full Fcpc | 2,000 | 1,000* | 1,000 | 1,000 | 2,000 | 2,000 |
| Pressure Demand w/Full Fcpc w/Escape Bottle | 2,000+ | N/A | 10,000** | 1,000+ | N/A | 2,000+ |
| Pressure Demand SCBA | 2,000+ | N/A | 10,000** | 1,000+ | 2,000+ | 10,000 |

*Peak air flow must be at least 230 l/min (8 CFM).
**For planning purposes; not all SCBA in all situations.
***Organic vapor cartridge instead of HEPA for Benzene Standard.

*The above table displays the wide variance in protection factor guidelines and standards.* *Table courtesy of MSA.*