

periods (Johnson, 1976). Speech is impeded and if the respirator harness fits under the wearer's safety helmet it is necessary to remove the helmet when replacing the respirator.

Greenough's description illustrates how other styles of respirators are less compatible with the other safety requirements for miners, as well as miners' comfort, and their need to communicate. It would be more difficult for a miner to perform his/her job effectively and communicate with fellow workers, wearing a tight-fitting respirator their entire work shift. Voice transmission through a tight-fitting respirator can be difficult, annoying and fatiguing. In addition, movement of the jaw in speaking can cause leakage, thereby reducing the efficiency of the respirator and decreasing the protection afforded the wearer. While voice communication is somewhat easier with a PAPR than with other respirator styles, the face shield is generally raised to communicate. Also skin irritation can result from wearing a tight-fitting respirator in hot, humid conditions. Tight-fitting respirators have straps which go across the crown and back of a miner's head which is under a miner's helmet (*i.e.*, hard hat). Because miners are required to wear hard hats *at all times* while in the mine (30 CFR 75.1720(d)), each time a miner needs to break the seal of a tight-fitting respirator, to eat, or to speak, or to relieve the discomfort of the seal, he/she would have to remove the hard hat. Similarly, each time a miner would need to put a tight-fitting respirator back on he/she would have to remove their hard hat. It should be noted that both tight-fitting elastomeric respirators and disposable facepieces, if worn correctly, would require the wearer to be clean shaven. A large proportion of miners have a tendency to wear facial hair, especially during the fall and winter season.

The unique qualities of the PAPR identified within this proposed rule are such that it could fall into either the helmet or loose-fitting facepiece categories. ANSI defines a loose-fitting PAPR with a helmet to be "a hood that offers head protection against impact and penetration (ANSI, 1988)." ANSI defines a loose-fitting PAPR with a loose-fitting facepiece as "A respirator inlet covering that is designed to form a partial seal with the face, does not cover the neck and shoulders, and may offer head protection against impact and penetration (*Ibid.*)."

In this proposed rule, a powered air-purifying respirator (PAPR) is defined as an air-purifying respirator that uses a blower to force ambient air through the air-purifying

elements to the inlet covering, which provides a partial seal with the face. This respirator must be approved by NIOSH under 42 CFR part 84 and by MSHA under 30 CFR 18 and offer head and face protection in compliance with 30 CFR 75.1720(a) and (d).

A current list of equipment, including PAPRs, approved under 30 CFR 18 can be obtained from MSHA's Approval and Certification Center on the internet at <http://www.msha.gov/TECHSUPP/ACC/lists/18instrm.pdf>. A searchable index of approved respirators is available from NIOSH at http://www2.cdc.gov/drds/cel/cel_form.asp. As of 2002, the 3M Airstream Air-Purifying Helmet (MSHA Approval 2G-3143, originally issued to Racal 3/29/1979), was the only approved PAPR model suitable for use under this proposed rule.

b. PAPR Protection Program

In an underground coal mine, the degree of respiratory protection that a properly functioning PAPR will provide the wearer is a function of the type and condition of the air-purifying medium used to filter out the respirable dust particles from the mine air, the workplace environment (*i.e.*, nature and concentration of the respirable coal mine dust), the work activity of the wearer in that environment, how the wearer uses the device (*i.e.*, how often is the visor raised during the shift), and the care and maintenance of the PAPR's functional components and power source. These parameters are required to be addressed in the approved PAPR protection program (see example in Appendix B).

In 1998, to increase the efficiency of the filtering medium used in PAPRs, NIOSH began requiring PAPRs to be equipped with a high efficiency particulate air (HEPA) filter. This change introduced a denser medium to filter the air, providing an extra margin of safety at all levels of respirable coal mine and quartz dust exposure. However, as a result of this change, the PAPR's average airflow dropped from about 9 cubic feet per minute (cfm) to 7 (cfm). While the current airflow still exceeds the required minimum airflow of 6 cfm (42 CFR 84.1152(b)), the drop in airflow reduced the level of comfort the PAPR provides to the miner.

MSHA realizes that miners' comfort with a particular respirator is an important determinant to miners' proper use of it. Several previous commenters testified that PAPRs were not being used as approved.⁷ Many of these examples

related to reports that visors were fogging. These commenters attributed the fogging problem to NIOSH's recent (mid-1998) improvement in the filtering medium for PAPRs. One commenter testified:

I would have to answer honestly and say they [PAPRs] are being used in a modified condition. Miners some, you know, have typically removed the shroud * * * [miners] raise the face piece to communicate and so on * * *. We've had that [fogging of the visor] problem recently, * * * since we've been required [by NIOSH] to use the new version of the filter [the HEPA filter]. There has been what seems to be reduced flow in the unit and that has also resulted in more fogging. And we've worked real hard to try to—[work] with 3-M to try to resolve that.

MSHA's experience has shown that fogging of PAPRs has been an intermittent problem since the introduction of PAPRs in underground mines. This is due to the inclement conditions of underground mining such as: High humidity, fluctuation in temperature, and physical exertion by miners.

Some miners indicated that they had to replace the HEPA filters with socks to increase the PAPR airflow. Using socks in lieu of required filters is unacceptable. This one example of PAPRs being used outside the manufacturer's recommendations and the requirements of an approved respiratory protection program. Various approved remedies are available to control fogging of visors including: intermittent wiping down of the visor, "anti-fogging" visors, application of anti-fogging sprays, and the use of a new visor design with an anti-fog impregnate baked directly into the visor. A properly functioning respiratory protection program would address this issue, with respect to the appropriate selection and maintenance of a respirator.

MSHA recognizes that for a PAPR protection program to be effective, the miner must be properly trained to wear the respirator, to know why the respirator is needed, and to understand the limitations of the respirator. Appendix B contains a model PAPR protection program to assist an operator in developing a mine-specific program in accordance with the provisions of the American National Standards Institute's "Practices for Respiratory Protection ANSI Z88.2-1969" as required by 30 CFR 72.710. Additionally, mine management must regularly conduct reviews to ensure continued effectiveness of the PAPR protection

hoods, and helmets shall be designed and constructed to provide adequate vision which is not distorted by the eyepiece, NIOSH does not have requirements for a visor's predisposition to fogging.

⁷ NIOSH requirements for PAPR performance, including airflow are specified in 42 CFR subpart kk. Although § 84.1136 specifies that facepieces,