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FROM: KEVIN G. STRICKLIN 
Acting Administrator for
Coal Mine Safety and Health

MARK E. SKILES 
Director of Technical Support

SUBJECT: The Danger of Oxygen Deficiency in Underground Coal Mines

Who needs this information?

This Program Information Bulletin (PIB) applies to underground coal mine operators and Mine Safety and Health Administration (MSHA) personnel.

What is the purpose of this bulletin?

The purpose of this PIB is to increase awareness of the detrimental effects associated with low oxygen concentrations, emphasize the importance of testing for oxygen concentrations at certain locations, and identify some of these locations in underground coal mines.

Information

Methane liberation in the absence of effective ventilation can present serious hazards to miners. In addition to being an explosive gas, an accumulation of methane in high concentrations can result in a mine atmosphere that is deficient in oxygen. Atmospheres with oxygen concentrations below 19.5 percent can have adverse physiological effects, and atmospheres with less than 16 percent oxygen can become life threatening.

Methane may be released from a variety of sources in a mine, including strata in the roof or floor, as well as the coal seam itself. Since methane continues to be released after mining is completed, effective ventilation or sealing of mined-out areas is critical. Consequently, to verify that ventilation is effective and seals are maintained, weekly examinations by mine operators, as well as other examinations and surveys by MSHA personnel are required. To avoid exposing themselves to hazardous situations, each person making these examinations should have a thorough understanding of how the ventilation system is intended to function and how and where low levels of oxygen may exist; and they should be able to recognize situations conducive to accumulation of methane or other contaminant gases. Some of the more likely areas where oxygen-deficient atmospheres may be encountered are bleeder entries, worked-out areas, approaches to seals, low airflow areas, and areas ventilated by air currents with high levels of methane emanating from caved areas of a gob.

Methane is lighter than air and tends to migrate upwards. Methane may accumulate when the ventilation system is not moving air with sufficient velocity to mix with the methane, or the air is not reaching into cavities or other high locations, such as those created by roof falls. At times, methane accumulations may reach concentrations high enough to displace oxygen and create an irrespirable atmosphere that is immediately life threatening.

A fatal accident occurred when two foremen were making examinations in a bleeder system. As the two were traveling over fallen rock and into the roof fall cavity area, which had been supported after the fall, they encountered a methane-rich oxygen-deficient atmosphere. Both foremen immediately lost consciousness and collapsed. One foreman apparently fell to an area with a higher oxygen level near the mine floor where the ventilation air stream existed. He regained consciousness and traveled outby to seek help. The other died due to lack of oxygen.

Miners and MSHA personnel should understand the cause of this tragic accident and be aware that the harmful effects of entering an oxygen-deficient atmosphere can be so immediate that it is impossible to retreat to safety. Miners, and especially examiners, should exercise caution wherever high methane concentrations are suspected, particularly when entering or examining roof cavities. Miners and MSHA personnel should also fully understand the operation of multiple gas detection devices and the significance of their visual and audible alarms. Areas where alarms are activated should be approached slowly to permit adequate time for gas detection devices to react. High levels of methane or other contaminant gases should be a warning that the oxygen level may be lower than normal.

What is the background for this PIB?

Oxygen is depleted from the atmosphere by oxidation of coal, wood, or other organic materials. Oxygen deficiency can also occur as contaminant gases liberated from the coal strata displace the oxygen. Atmospheres with oxygen concentrations below 19.5 percent can have adverse physiological effects. The following are the likely effects of depressed oxygen levels in air:

<u>Percent Oxygen in Air</u>	<u>Effect</u>
17	Faster, deep breathing
15	Dizziness, buzzing in ears, rapid heartbeat
13	May lose consciousness with prolonged exposure
9	Fainting, unconsciousness
7	Life endangered
6	Convulsive movements, death

Historically, emphasis has been placed on testing for oxygen near mine floors and in low areas to detect gases that are heavier than air, such as carbon dioxide. However, gases that are lighter than air, such as methane, tend to migrate upward; and oxygen-deficient atmosphere may be found near the roof or other high spots. For example, methane seeping from feeders in cavities such as those created by roof falls will migrate upward, displace the air, and create an oxygen-deficient atmosphere if ventilation is ineffective. Similarly, methane that is layered near the roof or high areas can migrate upward for a considerable distance, even against air currents, and accumulate in these areas. These situations, however, can be prevented with ventilation that causes the air to move with a velocity sufficient to mix with the methane or other gases and render harmless atmosphere.

Typically, multiple gas detection devices give visual and audible warning signals when a predetermined gas concentration is encountered. Users of these devices should be familiar with their operation and should realize that there is a delay between the time the gas is encountered and the device responds. This delay period varies with the type, age, and condition of the device. It should be noted that when multiple gas concentrations are encountered, an alarm will sound when one of them reaches the predetermined concentration that activates the alarm. If a second gas reaches its predetermined level, the alarm may continue to sound and an additional visual warning signal will be activated. For example, a visual and audible signal may activate when methane concentration in excess of 2.0 percent is detected; then, if an oxygen concentration of less than 19.5 percent is detected simultaneously, another visual warning will activate and the audible alarm may remain unchanged.

What is MSHA's authority for this PIB?

The Federal Mine Safety and Health Act of 1977, as amended, 30 U.S.C. § 801 et seq.; 30 CFR §§ 75.321(a) and 323.

Is this PIB on the Internet?

This PIB may be viewed on the World Wide Web by accessing the MSHA home page (www.msha.gov) and choosing "Compliance Info" and "Program Information Bulletins."

Who are the MSHA contact persons for this PIB?

Coal Mine Safety and Health, Safety Division
Salwa El-Bassioni, (202) 693-9525
E-mail: El-Bassioni.Salwa@dol.gov

Technical Support, Ventilation Division
John Urosek, (412) 386-6851
E-mail: Urosek.John@dol.gov

Who will receive this PIB?

Program Policy Manual Holders
Underground Coal Mine Operators
MSHA Special Interest Groups