Mine Foreman Training
Ventilation
Unit 7 – Part 1

Power Point Program and Training
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2005

The purpose of mine ventilation is to provide a safe and productive working environment for men and equipment in underground mines.

Ventilation is one of the most important aspects of mining because of its direct effect on the health and safety of miners.

The ventilation of a mine deals with the supplying, conducting, and distributing of a required amount of fresh air through underground openings and returning the used air to the outside atmosphere.

KRS 352.020 Methods of ventilation -- Amount of air required.

(1) The ventilation of all underground coal mines shall be produced by means of mechanically operated fans located outside the mine in fireproof housing and offset at least fifteen (15) feet to one (1) side or above the opening, protected by explosion doors or weak walls and arranged so that ventilating current may be reversed if necessary.

KRS 352.020 - continued

The fan shall be installed so as to prevent recirculation of mine air. The main fan shall be operated from a power circuit independent from the mine circuit. If inside auxiliary fans are required to ventilate working places the commissioner must first approve the installation.

352.020 - continued

(2) The licensee, superintendent, or foreman of every coal mine worked by shaft, slope, or drift shall provide and maintain for every mine two (2) separate and distinct escapeways, one (1) of which is vented by the intake air. However, if a mine was originally licensed prior to January 1, 1990, the commissioner may approve an alternate ventilation plan.

352.020 - continued

Each active working section shall be ventilated by a separate split of intake air. In all mines the quantity of air passing through the last open crosscut between the intake and return in any pair or sets of entries shall be not less than nine thousand (9,000) cubic feet of air per minute and as much more as is necessary to dilute and render harmless and carry away flammable and harmful gases.

352.020 - continued

All working faces from which coal is being cut, mined, or loaded in a working section between the intake and return airway entries shall be ventilated with a minimum quantity of three thousand (3,000) cubic feet of air per minute and as much more as is necessary to dilute and render harmless and carry away flammable and harmful gases.

352.020 - continued

The quantity of air reaching the last crosscut in pillar sections may be less than nine thousand (9,000) cubic feet of air per minute if at least nine thousand (9,000) cubic feet of air per minute is being delivered to the intake of the pillar line.

352.020 - continued

The air current shall under any conditions have a sufficient volume and velocity to reduce and carry away smoke from blasting and any flammable or harmful gases. All active underground working places in a mine shall be ventilated by a current of air containing not less than nineteen and one-half percent (19.5%) of oxygen, and no harmful quantities of other noxious or poisonous gases.

352.020 - continued

(3) The commissioner shall have the authority to require additional air in any mine when he deems it necessary for the safety of the employees.

352.020 - continued

(4) When the air from a split has passed through and has ventilated all the working places in an air split of a mine it shall then be designated as return air.

352.020 - continued

(5) As working places advance, breakthroughs for air shall be made not more than ninety (90) feet apart, except that where longwall or modern systems of mining are used the commissioner or his authorized representative may approve a greater distance between breakthroughs or the method of ventilating such longwall or modern systems of mining.

352.020 - continued

If any breakthroughs between intake and return airways are not required for the passage of air, they shall be closed with stoppings. All permanent stoppings shall be substantially built with suitable incombustible or fire resistant material subject to the approval of the mine inspector so as to keep the working places well ventilated. All brattice cloth and ventilation tubing shall be flame resistant.

352.020 - continued

Doors on the main haulways shall be avoided where practicable, and overcasts, built of concrete or other suitable material and of ample strength, shall be adopted. Where doors are used they shall be built in a substantial manner, and shall be hung so as to close automatically when unobstructed.

352.020 - continued

(6) In a mine where methane can be found to an extent of one percent (1%) or more on the return of any one (1) split, the inspector, with the approval of the commissioner may require the mine to be ventilated by the exhaust system, requiring the haulage roads and all trolley and feed wires to be located on the intake air and the electrical system to be so arranged that no wires carrying electrical current shall be on return air. A period of not more than ninety (90) days from date of notification shall be allowed to make the changes required.

KRS 352.030 Number of persons permitted to work in same air current or split

(1) As many as sixty (60) persons may work in the same air current or split, and with the approval of the mine inspector and the commissioner, as many as eighty (80) persons may work in the same air current. Each active section in a mine shall be ventilated by a separate split of intake air.

KRS 352.030 - continued

Every mine, and all portions thereof, shall be ventilated by one (1) or more currents of air, which shall contain not less than nineteen and one-half percent (19.5%) of oxygen, nor any dangerous quantities of flammable gas, nor any harmful amount of poisonous gases or dust, when the current of air enters into each split.

352.030 - continued

The ventilation shall be sufficient to prevent methane accumulations, so far as practicable, and to keep the methane percentage in the return of any split to not more than two percent (2%).

352.030 - continued

(2) The ventilating current shall be circulated through the haulageways, travelways, and airways to reach all portions of the mine, except sealed sections; and it shall be circulated through the entries and rooms around the ends of line brattice and along pillar lines.

352.030 - continued

It shall be conducted to the last breakthrough, or to the working faces if required, by means of stoppings, check doors, curtains, and brattice that may be necessary or required, in order to dilute, render harmless, and carry away the noxious and dangerous gases, smoke, and dust liberated therein, and to supply a sufficient quantity of ventilation for all emergencies.

352.030 - continued

The ventilating current in the area of a mine's belt entries shall be directed to an air return before the ventilating current reaches the face area, unless the department, under certain conditions issues a permit for belt air to be used at the coal face. The department shall render a final written decision within sixty (60) calendar days of receipt of the permit application.

352.030 - continued

(3) When mine ventilation, formerly satisfactory and adequate, becomes deficient in quality or quantity, the department shall have authority to order improvement of the ventilation.

352.030 - continued

(4) No licensee, superintendent, or mine foreman shall permit any person to work at a place where sufficient ventilation cannot be maintained, except persons employed to make the places of employment safe in compliance with the requirements of this chapter,

352.030 - continued

and while repair work necessary to comply with the requirements is in progress no person shall be permitted to enter that part of the mine affected except those actually employed in doing the repair work. The repair work shall be done under the constant supervision of a certified official designated by the mine foreman.

352.030 - continued

(5) Each licensee shall adopt a plan which shall provide that when any mine fan stops, immediate action shall be taken by the licensee or his agent:

(a) To withdraw all persons from the working sections;

(b) To cut off the power in the mine in a timely manner;

352.030 - continued

(c) To provide for restoration of power and resumption of work if ventilation is restored within a reasonable period, of not more than fifteen (15) minutes, as set forth in the plan after the working places and other active workings where methane is likely to accumulate are reexamined by a certified person to determine if methane in amounts of one percent (1%) or more exists therein; and

352.030 - continued

(d) To provide for withdrawal of all persons from the mine if ventilation cannot be restored within a reasonable time, of not more than fifteen (15) minutes.

The plan and revisions thereof approved by the commissioner or his authorized representative shall be set out in printed form and a copy shall be furnished to the commissioner or his authorized representative.

Oral Review

What is the purpose of mine ventilation?

To provide sufficient air to employees and to dilute, render harmless, and carry away all the dangerous and noxious gases and

To provide a safe and productive working environment for men and equipment in underground mines.

What is the minimum amount of oxygen in air permitted in working places?

19.5%

To which areas should the ventilation in a mine be directed?

To the faces and active areas where miners work or travel.

What path should ventilating air follow in a mine?

The air should course through the intake airways to the working faces and return to the outside through the return airways.

What are the main requirements of an intake opening?

It should be unobstructed, fireproof, and located away from possible sources of contamination to the air.

What are the main requirements of airways?

They should be of sufficient area and kept free of obstructions, such as roof falls and accumulations of water.

How is the ventilating air current controlled?

By the use of stoppings, doors, overcasts, regulators, check curtains, and line brattices.

Through what portions of the mine should the ventilating air not be permitted to pass before reaching working places?

Through abandoned workings that are not regularly inspected or past seals of abandoned areas.

What methods should be used to ensure ventilation at faces where unusual quantities of gas or smoke exist?

Line brattices or other approved methods of ventilation should be used.

Why should idle, dead-end working places not be permitted?

It is difficult to ventilate these areas.

When miners are found working in places in advance of air currents, what action should be taken?

The miners should be withdrawn immediately.

Where should the ventilating air current be measured?

In the main returns, in the last open crosscuts in active sections, and at the intake air side of pillar lines.

What attention should be given ventilating equipment, controls, airways, and travelways?

They should be inspected regularly and written records should be kept of these inspections.

In the event of a ventilating system failure, what action should be taken?

The approved ventilation interruption plan should be followed.

What action should be taken before miners are permitted to re-enter a mine following ventilating system failure?

Mine ventilation should be restored and the mine carefully examined and reported safe by a qualified person.

While ventilation is being restored, who is permitted to enter the affected part of the mine?

No one, except those miners doing the necessary repair work or inspections.

When should changes in ventilation be made?

When the mine is idle.

What is the disadvantage of permitting intake air to pass by seals before ventilating active parts of a mine?

Any failure of the seals may permit dangerous gases to be carried to the active workings; therefore, seals should be installed on return air or on separate splits.

How should underground substations, transformer stations, and battery-charging stations be ventilated?

By a separate air current vented directly to the return.

What is the speed of a ventilating air current called?

The velocity.

Why should excessively high velocities in a mine be avoided?

High velocities increase the necessary ventilating pressure and power consumption, keep coal dust in suspension, and may cause discomfort to the workers.

Why should extremely low velocities be avoided?

Low velocities will not properly sweep out the gases.

What is the greatest single factor negatively influencing air velocity, pressure and resistance?

Irregular, congested airways.

How may high velocities be avoided?

By the use of airways with adequate cross-sectional area and by splitting the air current.

For efficient ventilation, what should be the maximum velocity in airways?

500 feet per minute (fpm).

What is the danger of not having sufficient air velocity on haulage and travelways in a gassy mine?

Insufficient air velocity may not sweep gas out of pockets in the roof or other places such as refuge holes.

What must be overcome to pass a ventilating current through a mine?

The mine resistance.

What is mine resistance?

The resistance to the passage of air on the surfaces, bends, and obstructions in the airways.

What factors determine mine resistance?

The area, perimeter, length, and condition of airways, as well as velocity of the ventilating air current.

How can mine resistance be decreased without decreasing the volume of air or changing its course?

By enlarging and cleaning the airways.

What effect do constricted airways have upon mine resistance?

Constricted airways increase resistance by offering a greater proportion of rubbing surface for the effective area, thereby requiring increased velocity for a given quantity of air.

What is ventilating pressure?

Ventilating pressure is the pressure which must be exerted upon an air current to overcome the mine resistance.

How is ventilating pressure measured?

With a water gage or continuous reading pressure recorders.

How is ventilating pressure produced by fans?

The speed at which the fan is operating (depending on the characteristics of the fan) determines the ventilating pressure.

What effect do obstructions in airways have upon the quantity of air circulated, if the fan speed remains constant?

100

The quantity of air is decreased.

What effect does a short circuit have on the quantity of air circulated, if the fan speed remains constant?

The quantity is increased outby the point of the short circuit, since there is less resistance.

What is meant by splitting a ventilating current?

Dividing the main current into separate individual currents.

What is an air split?

An air split is a portion of the main ventilating current forming a continuous current through a definite part of the mine.

What effect does splitting an air current have on mine resistance?

The overall mine resistance is decreased. However, splitting a given volume of air too many times will result in insufficient ventilation.

What effect does a decrease in mine resistance have on the performance of a fan?

The fan is able to circulate an increased quantity of air.

What effect does a cold intake current of air have upon the dampness of a mine?

As the temperature of the air rises, moisture is absorbed by the air and the mine surfaces become dry.

What are the two systems of ventilation?

Blowing (forced air) and exhausting.

On what air current is it generally recommended that haulage roads be placed?

Usually on intake air.

How can the main haulway of a mine be placed on fresh air when the mine is ventilated by a forced-air system?

By the use of air locks or by placing the main haulway on a separate split of air.

What is the advantage of having the main haulway on the intake in the event of an explosion or fire?

Usually, entrance to the mine is more easily attained.

What is the proper method of producing ventilation in a mine?

A mechanically operated fan.

What types of fans are in common use?

Centrifugal, propeller, and disk.

Where are the main ventilating fans located?

On the outside of the mine.

How should fan buildings be constructed?

With incombustible material.

Where should main fans be installed with respect to the mine openings?

They should be placed at least 15 feet to one side or above the openings and the exhaust duct should be directed away from the openings to prevent recirculation.

Why should fans not be located in a mine opening?

Because of the possibility of their destruction in the event of a mine explosion.

How can a mine fan installation be protected from an explosion?

By installing explosion doors with the fan placed to one side of the outlet.

True or False – the mine fan can be operated from the same power source used for all the other mine equipment.

False, the main fan must be operated from a separate power source.

What is the purpose of explosion doors?

To relieve the pressure of an explosion and prevent it from reaching the fan.

Why should mine fans not be located inside the mine?

Locating fans inside the mine creates the possibility of recirculation of air, introduces a fire hazard, and provides no means of protection against explosions.

What is a booster fan?

A booster fan is one which is placed in the mine to handle the total volume of air of one or more splits. It boosts the air current delivered by the outside fan.

Why are booster fans objectionable?

They may recirculate air and constitute a fire hazard; their intermittent use may permit accumulations of gas.

How should man doors at fans be installed?

In pairs to form an air lock.

Why should mine fans be reversible?

So that the air current can be reversed in case of fire or explosions, if necessary.

What is atmospheric pressure?

150

The pressure exerted by the column of air above a given point.

What is the normal pressure of air on the earth's surface at sea level?

About 14.7 pounds per square inch (psi).

What is a barometer?

An instrument for determining atmospheric pressure or elevation.

What is the barometer reading for normal air pressure at sea level?

Thirty inches.

How many pounds of atmospheric pressure per square inch are denoted by one inch of mercury column?

0.491 pounds.

Of what value is a barometer relative to underground mine ventilation?

A falling barometer indicates decreased atmospheric air pressure, which permits air in the mine to expand. This is important where there are seals and large pillar lines.

How may a sudden marked reduction in atmospheric pressure affect the atmosphere of an underground mine?

By permitting gases in sealed or large abandoned areas to expand into active workings.

What is a water gage?

An instrument which detects differences in air pressure.

Of what does a water gage consist?

The water gage consists of a glass U-tube that is partially filled with water and open at both ends.

How is a water gage used to determine differences in air pressure?

The ends of the tube are connected to the points between which the difference is to be measured.

Where can the total mine resistance be determined?

At the fan.

What are stoppings?

Partitions erected across openings.

What is the purpose of a stopping?

To prevent short-circuiting of an air current or to seal off portions of the mine.

What is short-circuiting of the air?

When air enters the return through an unintended path before reaching the faces.

What material is used to construct permanent stoppings?

Durable and incombustible materials such as concrete, brick, tile, rock, metals, and other materials.

Why should temporary materials be used only for short-life stoppings?

They generally permit excess leakages of the ventilating current.

What are the principal requirements for permanent stoppings?

They should be airtight and substantially built.

As a mine deepens, what effect will this have on leaky stoppings?

The increased ventilating pressure will cause the stoppings to permit more air to pass through them.

In what way do leaky stoppings decrease the efficiency of ventilation?

They require the fan to move a greater quantity of air than otherwise necessary to properly ventilate the working faces.

When should brattice cloth stoppings be used?

Only as temporary stoppings.

How can the ventilating of large abandoned areas be avoided?

By sealing them.

What should be done when conveyors are extended through stoppings?

They should be boxed to prevent excessive air leakage.

What is a seal?

A seal is a specially constructed stopping, based on engineering plans and drawings, that is designed to effectively prevent the mixing of air from the sealed area with air circulated by the mine ventilating system.

When should seals be constructed?

When abandoned mine workings can no longer be adequately ventilated and examined, a sealing plan should be submitted for approval before construction begins.

Why should seals not be used?

Seals must be regularly inspected. Therefore, if seals cannot be safely inspected, they should not be built.

What is required before seals can be constructed?

200

Approval from the OMSL and MSHA of a sealing plan and associated engineering specifications.

How often should a certified person examine seals?

If intake air passes by seals, those seals must be examined as part of each preshift examination. If seals are adjacent to a return airway, they must be inspected weekly.

What is an overcast?

It is an enclosed airway which provides a means for one air current to cross another.

How should overcasts be constructed?

They should be airtight and substantially constructed of incombustible material.

What conditions should overcasts satisfy?

They should provide sufficient area for the volume of the air current and permit a smooth, uninterrupted flow of air.

What are some of the common errors made in constructing overcasts?

They are of insufficient area and offer rough and abrupt interruptions to the ventilating current.

How do overcasts aid haulage?

They eliminate the necessity for doors on the haulage road.

How do overcasts aid ventilation?

They permit splitting of the air and allow uninterrupted ventilation to the various work areas in the mine.

Can an undercast be used for the same purpose as an overcast?

Yes.

What is a regulator?

An adjustable, partial obstruction in an airway.

What is the purpose of a regulator?

To control the distribution of the air in the mine by regulating the resistance of an air split.

How is a regulator usually constructed?

It usually is a stopping provided with an opening which has a sliding door.

What is the effect of a regulator on the amount of air entering a split?

The regulator serves as a valve to increase or decrease the amount of air.

Why are regulators essential to the ventilation of a mine?

They proportion the air to meet the requirements of each individual split.

Who determines where regulators are placed?

Mine management.

What types of regulators are used?

Slides, door types, and other approved methods.

Where are regulators usually placed in a mine?

At the return ends of the splits.

What is the purpose of ventilating doors?

To permit traffic in haulageways without interrupting ventilation.

Why are doors in a mine objectionable?

If damaged or left open, they permit leakage or short-circuiting of the air and, unless built of incombustible material, they constitute a fire hazard.

How should a door be hung?

So that it will close automatically and tightly.

What provision should be made to prevent short-circuiting of a main ventilating current controlled by doors?

Doors should be hung in pairs to form an air lock.

How far apart should the doors of an air lock be placed?

At sufficient distance to accommodate the haulage equipment.

When are doors advisable?

When it is impractical to use overcasts.

If a serious explosion of methane occurred in a mine which was normally well ventilated, what would be the probable cause?

Interrupted ventilation.

Should haulage equipment be parked in doors or curtains?

No.

Is the use of automatic doors preferable to ordinary doors?

250

Yes, but they should be inspected regularly and kept in operating condition.

In which direction should doors swing to close?

In the direction of the air current so the pressure will keep the door closed.

Why should latches on doors be prohibited?

Because doors should not be provided with any device to interfere with their closing.

What should be provided for the passage of miners through doors when the ventilating pressure prevents their easy opening?

Man doors on the clearance side.

What should be the minimum dimensions of man doors in permanent stopping or overcasts?

Thirty inches or the height of the coal seam.

What are the requirements relative to the construction of doors placed on main haulageways?

They should be substantially built and hung so that they close automatically.

Should air which has passed through a belt conveyor entry be used for face ventilation?

No, unless a special permit has been granted.

How should belt conveyors be ventilated?

By placing them on a separate split of air with the air passing into the return entry after passing through the belt entry.

How much air is required to ventilate a belt conveyor entry?

Enough to keep the entry free of explosive gases and provide a safe atmosphere.

What is the minimum number of entries required where belt conveyors are used?

Three.

Why must there be a least three entries when belt conveyors are used?

One entry is for intake air, one for return air, and the third should be a neutral split of air used for ventilating the belt entry.

What is an anemometer?

An instrument resembling a small disk fan used to measure air velocities.

For what period of time are underground mine air velocities measured?

Usually for one minute.

How is an anemometer used to obtain velocities?

It is held in an air current for a given period of time to measure linear feet of air travel.

In which direction should the air current pass through the anemometer?

The air current should enter the back of the anemometer.

Why should the anemometer be moved across the airway when taking the reading?

So that the average reading may be obtained.

What is the purpose of mine ventilation?

To provide sufficient air to the employees and to dilute, render harmless, and carry away all the dangerous and noxious gases.

What is the minimum amount of oxygen in air permitted in working places?

19.5%.

To which areas should the ventilation in a mine be directed?

To the faces and active areas where miners work or travel.

What path should ventilating air follow in a mine?

The air should course through the intake airways to the working faces and return to the outside through the return airways.

What are the main requirements of an intake opening?

It should be unobstructed, fireproof, and located away from possible sources of contamination to the air.

What are the main requirements of airways?

They should be of sufficient area and kept free of obstructions, such as roof falls and accumulations of water.

How much air is required to pass through the last open crosscut at each active section on the intake and return side?

9000 cubic feet per minute

What is the minimum quantity of air required at each working face where coal is being cut, mined, or loaded in a working section?

3000 cubic feet per minute

What is the minimum quantity of air that must be delivered to the intake side of the pillar line?

9000 cubic feet per minute

Who shall have the authority to require additional air in any mine when he deems it necessary for the safety of the employees?

300

The Commissioner

True or False

Air that has passed through and ventilated all the working places in an air split of a mine is still considered to be intake air.

False, it is return air.

When working places advance, what is the maximum distance permitted between breakthroughs or crosscuts, unless permission is granted from the commissioner?

90 feet

True or False

All permanent stoppings shall be substantially built with suitable combustible material that does not have to be fire resistant.

False, it must be incombustible and fire resistant.

When doors are required on the main haulways, they shall be built in a substantial manner and shall be hung so as to close _____ when unobstructed.

Automatically

In a mine where methane can be found to an extent of one percent (1%) or more on the return of any one (1) split, what may the inspector, with the approval of the commissioner require?

The inspector may require the mine be ventilated with the exhaust system and that no electrical wires or haulage roads be located on the return.

The ventilation in a mine shall be sufficient to prevent methane accumulations, so far as practicable, and to keep the methane percentage in the return to not more than _____ percent.

Answer: Two (2) percent

The ventilating current from the belt entries must be directed to the return before reaching the face areas. But is it ever possible to use belt air in the face areas?

Yes, belt air can be used at the face area if a permit has been granted from the OMSL.

Who is allowed to work at a place where sufficient ventilation cannot be maintained?

Only those persons employed to make the places safe and in compliance with the ventilation requirements.

Who is required to supervise the workers employed for making the place safe and in compliance with the ventilation requirements?

The repair work shall be done under the constant supervision of a certified official designated by the mine foreman.

When the fan stops or for whatever reason the ventilation at a mine is interrupted for 15 minutes or more, what action must be taken be the licensee?

All persons must be withdrawn from the working sections and the power must be cut off in a timely manner.

After repairs have been completed to the interrupted ventilation system at a mine, what must be done before the workers are allowed to reenter the mine?

The mine must be reexamined by a certified official to make sure the air is traveling its proper course and that methane has not accumulated in the amount of one (1) percent or more.

End of Part 1 of Unit 7