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STATE OF COLORADO  
BUREAU OF MINES  
State Capitol, Denver

HORACE F. LUNT, Commissioner of Mines

BULLETIN No. 9  
JUNE 1, 1920

# MINE SAFETY STANDARDS



Denver, Colorado  
EAMES BROTHERS, STATE PRINTERS  
1920

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**LETTER OF TRANSMITTAL**

To His Excellency,

THE HONORABLE OLIVER H. SHOUP,  
Governor of Colorado.

Sir: I have the honor to transmit herewith "Mine Safety Standards," designated as Bulletin No. 9 of the State Bureau of Mines.

Respectfully submitted,

HORACE F. LUNT,  
Commissioner of Mines.

State Capitol, Denver, Colorado,  
June 1, 1920.

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## INTRODUCTION

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These standards were originally suggested by standards submitted to the Industrial Commission by one of the insurance companies as a basis for a schedule to be used in merit rating. The original has been revised and rewritten to apply to Colorado metal mining conditions and to include Colorado statutes and mining regulations. Advantage has been taken of numerous valuable suggestions from the Mine Inspectors and others. It is believed that all the more important hazards incident to metal mining have been touched upon. Many of the standards are applicable to quarries, mills and smelters as well as to mines.

These standards contain nothing particularly new. The Commissioners of Mines and the Inspectors have been endeavoring to see that they were observed, so far as the conditions in each individual case required, for many years. None of the rules are the results of mere theories; men have been killed or injured to show the necessity of every one of them. Every point covered has been suggested by accidents which have occurred. The rules have been framed to prevent, so far as is humanly possible, repetition of the same sort of accident.

Carelessness, of one sort or another, is the one outstanding cause of nearly all accidents. No rules will eliminate it entirely, but by constant watchfulness, those in authority, by precept and example, can reduce it to a minimum.

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The Commissioner of Mines will welcome any suggestions or criticisms relating to the subject matter of this bulletin.

# MINE SAFETY STANDARDS

## GENERAL

The requirements of the state laws and previously published rules with respect to both surface and underground operations and equipment should be complied with, unless the Commissioner of Mines has granted exemption to certain of the said rules. Wherever the word "approved" is used, unless otherwise specified, it means approved by the Commissioner of Mines.

### ORGANIZATION.

The superintendent should be competent to conduct the operation of the mine with due regard to safety and efficiency. He should take an active interest in accident prevention; see that an accurate record is kept of all accidents and that reports are promptly sent to the Industrial Commission, and, in case of fatal accidents, that the Mine Inspector or Commissioner of Mines is immediately notified by telephone or telegraph; encourage his men to apply for first aid or medical treatment whenever injured, even when the injury is trifling; frequently inspect all working places; see that dangerous conditions are promptly made as safe as possible; prevent unsafe practices; carefully supervise the storage and handling of explosives, carbide, oils and other inflammable materials. He should have a sufficient number of assistants to adequately supervise all the operations under his control.

The foremen and shift bosses should be competent to assist the superintendent in their respective positions. They should inspect all working places, traveling ways and magazines under their jurisdiction at least daily and see that they are kept at all times in safe and sanitary condition.

Suggestions from all employees regarding improvements for greater safety should be encouraged.

Safety inspection committees of employees are desirable in large mines.

### SAFETY MEASURES.

All mines should have telephone connection with the nearest doctor.

First-aid cabinets, stretchers and blankets should be provided according to the U. S. Bureau of Mines standards. At least one man in every ten employed should be trained in first aid. In mines with extensive workings, first-aid supplies should be kept in convenient places underground as well as on the surface.

Change rooms with suitable lockers and washing facilities should be provided at all mines.

At all mines there should be provided on the surface one or more sanitary toilets as conditions may require. Precautions should be taken to keep all portions of the underground workings where men work or travel in a sanitary condition, and toilets should be provided at convenient places.

The illumination furnished by miners' lights should be sufficient to enable the miner to see dangerous places and conditions. It will not be considered that this requirement is met if candles are used. It can be best fulfilled by the use of carbide or electric lamps.

In large mines there should be some adequate method of checking the men in and out.

Sign boards should be maintained at all places in and around the mine where their presence will reduce hazards. Danger signs should not be used promiscuously. A danger sign should mean, "stop"; a caution sign, "proceed with caution."

Electric lights should be provided underground at shaft stations, magazines, pump stations, and other places where needed. If there is no electric power available other adequate fixed lights should be provided.

## **SURFACE HAZARDS**

### **POWER PLANT.**

There should be a semi-annual inspection of all boilers, and of all compressed air tanks, by an insurance company, the state boiler inspection department, or a competent boiler maker. The records of these inspections should be posted or so kept that they will be available for inspection. Each boiler should be equipped with an efficient water gauge column, properly placed, well lighted and kept clean for easy observation of water level. Each water gauge column glass should be provided with an approved guard which will protect against flying pieces of glass and so arranged as not to obstruct clear observation of water level. Each blow-off valve or pipe within seven feet of the floor or platform should have its outlet so located or protected that anyone passing may not be scalded. There should be two safe means of exit from all parts of the boiler room. Runways and stairways should be provided so that there may be easy access to top of boiler. Adequate protection and warning signs should be furnished for men working inside the boilers or on steam lines.

Boilers, if not in detached boiler houses at least 60 feet from the engine room and other inflammable buildings, should be enclosed by fire-proof wall. Boilers should be located not less than 100 feet from any mine opening, unless there is an additional mine opening at least 200 feet from the opening affected by such boiler house.

Boilers should be in charge of employes skilled in their operation.

In addition to the usual automatic blow-off valve, air compressor systems should be equipped with a fusible plug or plugs, located in discharge line as close to compressor as practicable, which will open at temperatures in excess of the flash point of the lubricating oil in use (450° to 500° F., is the flash point of ordinary cylinder oil and 550° to 650° F., of high test lubricating oil).

Air receivers should be built according to the standard specifications for steam boiler shells. Each receiver should be equipped with a pressure gauge, a blow-off at its lowest point, and a man-hole through which it can be entered and cleaned; if the receiver is too small to be entered, hole should be large enough to permit easy inspection and cleaning.

Engines should have fly wheel and all other moving parts adequately guarded. Fly wheels over four feet in diameter should be inspected periodically. Each engine should be provided with an effective governor to control its speed under varying loads.

Electrical apparatus, such as generators, motors, switchboards, transformers and controlling and operating apparatus, should have all moving parts guarded; also be so protected as to remove the liability of dangerous contact or approach by persons or objects.

All steam lines should be adequately supported and protected from falling objects. All exhaust steam should be so conducted away that it will present no hazard.

### **AERIAL TRAMWAYS.**

Wire rope tramways should be substantially constructed. Two independent brakes, each capable of easily controlling the load, should be provided. Long tramways should have some approved form of speed control. Men should not be permitted to ride aerial trams if it can possibly be avoided. When they are permitted to ride, the latch of the bucket should be fastened so that it cannot be dumped. Buckets should leave both terminals on an up grade so that they cannot get away ungripped.

### **MACHINERY.**

All moving parts of machinery about the surface plant, such as gears and pinion wheels, sprockets, belts, pulleys, clutches, chains, wheels, shafts, the arbor end of shafts, spindles, couplings, counter-weights, revolving and reciprocating parts, circular and rip saws, emery wheels, and all other dangerous points, parts or projections, should be guarded in accordance with approved standards. Whenever possible, machinery should be oiled while it is at rest; adequate runways and stairways should be provided for oiling line shafts and the like. In machine shops adequate clearance should be provided around all machines.

### **CLEANLINESS.**

Roads and paths in yards, walks in buildings, and other places where men must work or travel, should be free from loose or fallen materials or other obstructions over which men may stumble. All material should be stored or piled in workmanlike manner. Especial care should be taken not to leave boards with projecting nails where they may be stepped on.

### **CHUTES AND BINS.**

Bins should be strongly built so that there is no danger of their collapsing when fully loaded. The chutes used for discharging them

should be of approved design and so arranged as to be conveniently and safely operated. Tops of bins should be covered or guarded so that it is impossible to stumble into them. When men are working inside bins warning notices or other suitable precautions should be taken to protect them. When electric lights are used around bins they should be protected with wire cages. Electric wires should not be placed where they can be damaged by flying rock.

### **ILLUMINATION OF BUILDINGS.**

All reasonable efforts should be made to provide adequate illumination in all places where men must work or travel.

### **SURFACE HAULAGE.**

On all surface haulage there should be adequate clearance provided.

All jumping of moving trains at speeds exceeding four miles per hour should be prohibited. Men should not ride cars on surface planes or inclines unless there are adequate safety devices for their protection.

### **RAILWAYS.**

Adequate warning signs must be displayed at all crossings. At least 20 inches clearance should be provided alongside of railroad tracks and this space must be kept clear of all material. Condition of track and road-bed should be such that cars cannot jump rails at any probable speed; frogs and switches should be blocked; on grades the cars should be kept under control by a brake, a suitable car retarder, or other mechanical device.

### **FLOORS AND STAIRWAYS.**

Openings in floors should be protected by guard-rails conforming to approved standards, or be covered by a hinged trap door of substantial construction capable of being blocked open when necessary and guarded or kept closed when the opening is not in use. Stairways should be set at an angle of not more than 45 degrees. They should be kept in good condition at all times. All of the treads in any one flight should be of the same width, and all of the risers should be of the same height. Adequate hand-rails, toe boards and illumination should be provided for all stairways. Ladders should have non-slip shoes, or if over 15 feet in length or over 60 degrees pitch should be securely fastened. The rungs should be securely fastened, equally spaced, and not over 12 inches apart. Ladders over 75 degrees pitch and over 50 feet in height should be caged in.

### **FIRE PROTECTION.**

Where there appears to be the possibility of the loss of life from fire, there should be sufficient fire protection on the surface, including water supply with adequate pressure, fire plugs and accessible hose, nozzles, chemical or automatic extinguishers, properly located to provide for the



safety of workmen. Adequate fire exits should be provided in all buildings. No wood or oil should be allowed within one foot of any steam pipe. Fire hose should be tested at least once a month. Chemical apparatus should be carefully inspected once a month to see that it is in working order. A record of such inspections should be kept on a tag attached to the apparatus.

### **FALLING OBJECTS.**

Timber and store room supplies should be handled and stored in a safe manner. Materials and tools of all kinds should be kept in their proper places. Adequate screens or bulkheads should be placed at all points where rocks are likely to fall.

### **MISCELLANEOUS.**

Openings or dangerous places in the ground surface should be fenced. Plank runways in buildings should be protected. All public or private railway or other surface haulage crossings over which employees must pass should have suitable danger signs posted. Teaming and construction work should be safely conducted. In the winter the danger of slipping should be guarded against by keeping paths cleaned, or, where this is not feasible, by sprinkling them with sawdust, ashes or dirt.

## **SHAFT HAZARDS**

### **HEADFRAME.**

The material and construction of the headframe or other device used for supporting the cage, skip, or bucket should be sufficiently strong and durable to assure its withstanding any strain put upon it. It should be so designed that it will withstand a greater load than the calculated breaking strain of the hoisting attachments. Where headframe is constructed of inflammable material, adequate fire protection should be provided. The headframe should be so constructed as to secure the maximum protection for men working on or around it. The sheaves should be adequately strong, properly mounted, and frequently inspected.

### **HOISTING ENGINE.**

This should be of such kind and in such condition as to assure certainty of operation and ease of control. There should be hand or other brakes adequate to stop the cage, skip, or bucket in ten feet under all conditions of operation. There should be drum guides or horns of sufficient height to keep the rope from slipping off the drum. Large hoists should be fitted with an approved speed controller. The cable fastenings must be absolutely secure against the maximum emergency strain. The hoisting engineer should be a person skilled in such duties and with no physical disabilities that might suddenly incapacitate him.

Hoisting engines should be so placed that the noise of air compressor or other machinery will not prevent hearing the signals, and will not distract the attention of the engineer. Notices should be posted forbidding loitering around or conversing with the engineer when operating the hoist. Indicators showing the position of the cage, skip, or bucket must always be provided.

## **CABLE.**

The hoisting rope or cable should have an ultimate breaking strength of ten times the maximum load, but in any case must have an ultimate strength of seven times the maximum load it will ever be called upon to carry. There should be a thorough inspection of the rope, its attachments, the cage or skip, sheave and hoisting engine once a week, and a record should be kept of this inspection. The rope should make at least two full laps on the drum and be securely fastened to the drum in accordance with approved methods. The rope should be kept well lubricated with a proper lubricant and should be discarded as soon as inspection reveals any defects in it. Approved detaching hooks and safety chairs or catches should be used in vertical shafts. The rope should be fastened to its load either by means of a socket, or by clamps and thimble, either style of fastening to be made in an approved manner.

With either style of fastening the rope should be resocketed or re-clamped at intervals not to exceed three months of actual use, at which time all fractured or worn parts of the rope must be cut off and inspected for corrosion and internal wear.

Open hooks must not be used for attaching buckets to cable. Some approved form of safety hook or chain should be used for this purpose.

## **CAGES, SKIPS AND BUCKETS.**

In either vertical or inclined shafts, skips or cages must not be overloaded. Boards must not be placed across the top of skips and men permitted to ride thereon, unless side casing is provided as a protection. Guides or back runners should be installed in all hoisting shafts when the inclination is more than 20 degrees from the horizontal. Safety catches should be used on man cages or skips. These safety catches should be inspected daily and tested once a month. When hoisting or lowering men at the beginning or end of each shift, special man cages or skips should be used in all shafts where the angle of inclination from the horizontal exceeds 20 degrees and when the angle of inclination exceeds 30 degrees, such cages or skips should be equipped with bonnets to protect men from falling rock. Safety gates should be used on cages for hoisting men.

Men should never be hoisted or lowered faster than 800 feet per minute. Conditions may require slower speed for safety.

Where buckets are used in vertical shafts over 100 feet deep, crossheads should be used. Where men ride on the buckets a suitable bonnet and safety catches should be used on the crosshead. Crossheads should be securely fastened to the cable.

The guides of vertical shafts and the tracks and back-runners of inclined shafts should be inspected daily.

Where inspection shows that guides or tracks have been shifted by moving ground, repairs must be made immediately.

Wall plates must be kept clear of accumulations of broken rock.

Men should not be allowed to crowd around the shaft collar or the station, previous to lowering or hoisting. If conditions permit, chains should be provided at shaft stations so that only a cage or skip load of men can approach the shaft at one time. Men must not ride in a car on a cage.

### **LADDERWAY.**

The provisions of the state law in regard to ladderways must be fully complied with.

### **STATIONS.**

At all shaft stations and skip pockets electric or other approved lights should be so placed that efficient illumination is given in addition to the light from the men's lamps. Ample runways should be provided and securely railed off from the shaft so as to make it unnecessary and inconvenient for men to cross the shaft. Suitable gates or bars should be provided and used to close the entrance to the shaft when not in use; they should be placed at least two feet from the shaft opening.

### **HOISTING SIGNALS.**

Adequate hoisting signals and signal devices must be installed. Where the shaft is more than 500 feet deep electrical signalling devices should be used. The State Code of Hoisting Signals must be used and posted at all stations and at the hoist. At all shaft stations and skip pockets the means of signalling must be conveniently located and must work easily so that a man, while standing on the cage or skip, can signal the engineer without difficulty. Telephones should be installed and kept in good working order at all working levels at and deeper than 500 feet.

### **SINKING.**

In shaft sinking the men in the bottom should be protected from falling rock by a bulkhead over all of the shaft except the hoisting compartment. If a bucket without a crosshead is used there should be a trap door in the bulkhead to cover the hoisting compartment; the door to be kept closed when bucket is above it. The timbering should be carried near enough to the bottom to prevent danger of falls of rock from the sides. After blasting, the timbers below the bulkhead should be cleared of all loose rocks. A chain ladder should be provided and should always be in place before blasting.

## **UNDERGROUND HAULAGE**

The haulage system as a whole, including motive power, rolling stock, haulage ways, track system and roadbed should be kept in safe operating condition.

## **CARS.**

Cars operated by hand should have a convenient handle so that it is unnecessary for the trammer to place his fingers inside or outside the car body. Depending upon the system used, the capacity of a car should not be too great, nor should too many cars be hauled in one train. The body and running gears of cars should be kept in good condition. Where necessary cars should be provided with adequate brakes so that the hazard offered by the grade of the tracks will be reasonably overcome. Grades should not be so steep that they offer danger from derailment of cars.

## **LOCOMOTIVES.**

Locomotives should be of an approved type with all necessary appliances for their safe operation. They should be provided with headlights and gongs. Gasoline locomotives should only be used by special written permission of the Commissioner of Mines. Locomotives should be kept in good condition.

## **CLEARANCE.**

Between top of cars and back, two feet; between sides of car and timber or rock sides of haulage way, six inches; between top of car and trolley, eighteen inches. Larger clearances are desirable.

## **ILLUMINATION.**

Where electric haulage is used, shaft stations must be electrically lighted and haulage ways should have electric light bulbs at least every 200 feet. For animal tramping a light must be carried on the first car of the trip or by the driver. For hand tramping a light must be carried by the trammer or on front of car.

## **CONDITION OF TRACK.**

Rails should be of such weight as to safely carry the maximum load that may be imposed at maximum speed. They should be firmly spiked, have suitable joint fastenings, and rest on a sufficient number of ties of adequate dimensions. Frogs and switches should be properly blocked on motor haulage roads. The track should be properly aligned and free from high joints, broken rails, defective switches and frogs.

## **CONDITION OF ROADBED.**

The roadbed should be kept in good condition, free from rocks, timbers, or other obstructions, well drained and properly surfaced.

## **CLEARANCE OF CHUTES.**

Chute lips should not project more than three inches over the nearest side of the cars.

## **JUMPING MOVING CARS.**

Jumping moving cars and uncoupling cars moving at a speed exceeding four miles per hour should be prohibited. Cars without brakes should not be ridden on grades.

Speed of trains should not be greater than conditions of track make safe—in no case over 15 miles per hour.

## **SMELTER HOLES.**

Where mechanical haulage is used and there is not room to pass at all points, refuge or shelter places, affording space of at least two and one-half feet at each side between the widest portion of cars or train and walls, should be provided not more than 50 feet apart. These places must be kept open and clear at all times. Where hand tramming is used refuge places should be provided at least every 150 feet.

# **FALLS OF ROCK**

Every reasonable precaution should be taken to prevent falls of ground in all parts of the mine which are in use. Shaft stations and traveling ways should be adequately timbered where necessary to prevent falls of ground. Foremen and shift bosses must inspect the backs and sides of shaft stations and traveling ways frequently and carefully and have any loose pieces of rock picked down or timbered up. Timbering must be reinforced or replaced when it shows signs of giving way.

## **STOPES AND OTHER WORKING PLACES.**

Inspection should be made at least twice daily by the shift boss and at frequent intervals by men working in the place. After shots have been fired careful inspection should be made and all loose ground picked down or timbered up before men go to work.

The back or roof should be kept clear of small pieces of loose rock.

The back or roof should be kept clear of loose slabs or masses of rock, or such slabs or masses should be securely held in place by timber.

The method of timbering and size of timbers should be such as to render the working place safe. Timbers should be carried sufficiently close to the working face to insure the safety of the men.

If filling is used, it should be carried sufficiently close to the roof or back to prevent the movement of walls and to permit easy inspection of the roof.

Where raises are so situated that anything falling from them can strike persons passing in the level below, the level should be guarded by a bulkhead.

# FALLS OF PERSON

## CHUTES AND BINS.

Openings to chutes or bins should be protected by heavy chains, iron bars, gratings or railings so that men cannot fall into them. In cases where cars dump from the edge of the opening, substitutes for the chains or bars may be used in the form of railings of wood or metal.

## RAISES AND WINZES.

Raises and winzes used for manways must have ladderways in good repair and constructed according to state laws. Collars of winzes, raises or manways must be protected by means of doors, railings or bars. Bottoms of raises should not be so placed that rock or falling objects can strike persons passing in drift below. Raises and winzes should be started in offset from the drifts wherever possible. Chutes or winzes in the middle of tracks are always dangerous.

All open places must be securely railed off so as to prevent anyone walking into them.

# EXPLOSIVES

## SURFACE MAGAZINES.

Magazines should be so arranged that rough handling of explosives will not be necessary and so that the boxes of dynamite may be securely piled without crowding. They should be constructed of fire-proof material with a bullet-proof door. There should be suitable vents for ventilation.

Magazines should be in protected places, rather than on or near a hill top. All brush and other inflammable material should be cleared away from the sides. The American Table of Distances from roads and other buildings should be followed unless circumstances make it impossible and the approval of the Commissioner of Mines is secured for the location of the magazine.

Dynamite and black powder should not be stored in the same magazine. No other material of any kind should be stored in a magazine with dynamite or black powder.

No other explosive should be stored in a detonator (cap) magazine.

Magazine should be kept clean—no old boxes, papers, etc., left around.

Boxes of dynamite or cans of black powder should never be opened in a magazine.

## TRANSFER OF EXPLOSIVES TO MINE.

Only sufficient powder for one day's supply underground should be transferred from the surface magazine unless special permission is given by the Commissioner of Mines or the Mine Inspector.

Explosives should not be loaded on trucks, skips, or cages with men, supplies or machinery, except such men as are required to handle them.

Except in special cases, explosives should not be delivered to underground magazines unless intended for immediate use at the working face.

## **UNDERGROUND STORAGE OF EXPLOSIVES.**

There should be an underground magazine for each working level. Underground magazines should consist of a separate drive or chamber, the walls of which must be of fire-proof material or of wood covered with sheet iron. Small amounts of powder (100 pounds) may be kept in stout, tight boxes, with hinged lids and locks.

Underground magazines should be as far as possible from shafts, pump stations and main traveled ways.

Underground magazines should be dry and well ventilated. If there is no natural ventilation a compressed air jet, or other suitable means of inducing an air current, should be used.

Caps and fuse should be stored at least 50 feet away from the powder magazine.

Powder magazines should not be directly connected with dry timbering. There should be a space of at least 10 feet between the magazine and the last inflammable timber set.

Magazines should be kept locked at all times, except when explosives are being put in or taken out. Key or keys should be in the possession only of the man or men who deliver the powder to the miners.

Magazines should be lighted from the outside if possible. Open lights should never be taken into a magazine. Electric lights are permissible if installed in an approved manner. Electric lights in magazines should never be hung from roof or ceiling by wires or lamp cord but should be firmly fastened in such a position that they are not likely to be broken. They should be provided with vapor-proof globes and if necessary further guarded by wire cages. The wires leading to them should be enclosed in metal conduits. The light should be turned off when not in use. The light switch and a pilot light should be placed outside the magazine. If electric current is not available electric battery lanterns or flash lights should be used.

## **TRANSPORTING OF EXPLOSIVES TO WORKING PLACES.**

Explosives should be delivered to miners at their working places by a man or men especially designated for this duty.

The oldest explosives in stock should be used first.

Caps and fuses should not be carried in the same receptacle with dynamite or black powder, unless made into primers with same.

## **THAWING.**

Where thawing is necessary it should be carried out under supervision of some one experienced in this work and approved methods used.

## **MAKING PRIMERS.**

A suitable place, at least 100 feet and preferably farther from the magazine, should be provided for making primers. Paper, saw-dust, empty boxes, and other rubbish should be removed at frequent intervals. No open lights should be allowed in the place.

Only an approved crimper should be used in crimping caps. No method of making the primer that bends the fuse more than 35 degrees should be used.

For waterproofing use only some standard compound sold by powder manufacturers, or roofing paint; where holes are not very wet, tallow or soap may be used—no grease of any kind should be used.

## **LOADING AND SHOOTING.**

Drill holes should be thoroughly cleaned with a spoon or by means of compressed air.

Drill holes should be loaded only by men experienced in this work; the primer should be placed near the outer end of the charge; a wooden bar should be used for tamping.

There should be a regular hours for blasting, preferably only at the end of shift.

Where blasting is done while men are in the mine all entrances to the place where the shooting is to be done should be guarded and the usual cry of "fire" given.

In drifts and crosscuts not more than ten holes should be "spit" by one man; in shafts and raises not more than eight holes should be "spit" by one man.

In raises and shafts the electric system of firing is to be preferred.

## **MISFIRES.**

Misfires should be reported by the miner to his shift boss. The shift boss, in turn, should make a written report either on a blank provided for the purpose or on a blackboard so that such report will be received by the shift boss on the next on-coming shift.

Misfires should be sought for and handled only by experienced men. An attempt should be made to blast the hole by using another primer. If this fails a new hole should be drilled not nearer than two feet from the old hole.

## **CARBIDE.**

Carbide must be stored in a perfectly dry place. Large cans when open, should never be approached with an open light. When cans are emptied they should be filled with water or thoroughly washed out immediately. Carbide should be carried into the mine only in quantities sufficient for one man for one shift.

Spent carbide should be dumped into boxes provided for that purpose and not thrown around indiscriminately.



# ELECTRICITY

## CHARACTER OF ELECTRICAL INSTALLATION.

Efficient guard rails, insulating mats, etc., should be installed wherever necessary; all electrical equipment should be so constructed, installed and maintained as to reduce the accident hazard as far as is reasonably possible. All work on electrical equipment should be performed by properly qualified persons.

Lightning arresters should be installed and maintained in good condition.

Efficient equipment for fighting electrical fires should be kept near all electrical stations. Fire drills should be held once each month and the men in charge of, or working near, electrical equipment should be instructed in the use of the fire-fighting devices.

All equipment should be so installed as to be readily and safely accessible to authorized persons.

## TROLLEY WIRE.

Voltage should be less than 300. Trolley wires should be installed at least seven feet above rail and six inches outside of the track and guarded where necessary to reduce danger of accident. The hangers should be close enough together to prevent a sag of more than three inches; on curves the loosening of one hanger should not expose the motorman to danger of contact.

Underground trolley lines should be sectionalized every 1,000 feet by placing in the line a switch by which the line can be entirely disconnected from the power supply. All branch trolley lines should be provided with a frog and switch, at the point where they leave the main line, by which the branch can be disconnected. The tracks of all main haulage systems that use a rail return should be bonded at every rail joint, and cross bonding should be placed at intervals not exceeding 200 feet. Special provision should be made for bonding around all switches, frogs or openings in the track, so as to insure a continuous return. Drawbars and axles of cars used in electric trains should be bonded.

## STATIONARY MOTORS, PUMPS, HOISTS, FANS, ETC.

Effective illumination should be provided in the vicinity of all moving machinery in or about the mine, and should be so installed that moving parts are well illuminated.

Exposed live controller contacts, unprotected motor terminals and unprotected switches should be adequately guarded.

## TRANSMISSION LINES AND CABLES.

No exposed wires of 300 or more volts should be permitted underground. Where it is necessary to take higher voltage underground the wires should be enclosed in lead cables or other approved conduits.

Unless the workings are perfectly dry, lead cables should be used for carrying current underground.

Cutouts and circuit breaking devices should comply with approved standards.

Switches must be kept in good condition and must not be so placed that they can close by gravity. Covered or enclosed switches should be used on all lines carrying heavy currents.

Circuit breakers or fuses should be used which will adequately protect the equipment against overheating due to excessive current.

Cases of all motors, transformers, starting boxes, etc., must be effectively grounded.

Illuminating circuits should be kept in first-class condition and all burnt-out globes should be promptly replaced. Wherever possible lights should be firmly fastened and not permitted to swing on wires or lamp cord. Where lights are near anything inflammable they should be guarded with vapor-proof globes.

Where insulation is worn deeper than the outer braid the conductors should be replaced.

Sections of cable armor, if broken or sufficiently deformed to impair the value of insulation underneath, should be replaced.

Where sag is caused by stretching the conductor, the conductor should be replaced, and where produced by lossening of supports, the supports should be substantially fastened.

All joints of conductors should be made mechanically close and should be thoroughly soldered.

## MISCELLANEOUS

### TRANSPORTING AND HANDLING.

Care should be exercised in transporting timbers, ties, rails, rock, etc., in the mine, and in handling, setting or placing same. No material should be transported on top of haulage motors, but should be carried only in cars or trucks adapted to the material to be hauled.

### CHUTE POCKETS.

Approved types of doors must be used on all chutes leading from raises, bins or pockets from which ore or rock is drawn. It should not be necessary for the operator to stand in front of the chute to open and close the door. Nails should not be permitted on the outer edges of the chute.

### DRILLING.

Drilling should be practiced so as to present a minimum hazard in setting up and running machine drills. Water attachments or sprays should be used to prevent dust.

## **MACHINERY AND MISCELLANEOUS TOOLS.**

Safe methods must be used in handling and installing all machinery.

Hand tools should be kept in good condition—wooden handles on hammers, picks, shovels, etc., free from splinters and solidly attached to heads. Ends of moils, hand drills, etc., kept dressed down—not mushroomed.

## **MINE FIRES.**

There should be adequate fire protection at the collar of all shafts, or portals of main adits. Such equipment should include fire doors, fire hydrants and hose, or fire extinguishers, or both. At all dry shaft stations there should be a hydrant and hose with a dependable water supply, or a barrel of water with buckets nearby. If chemical fire extinguishers are provided men should be instructed in their use. In dry, timbered crosscuts, drifts and working places, water under adequate pressure should be available, either from water barrels, from a special water line or from the air line. If water is not available adequate chemical extinguishers must be provided.

## **GASES.**

If natural noxious gases exist in the mine precaution should be observed to prevent their injuring the men, either by means of proper ventilation or by ready means of escape. Men should not be allowed to return to "dead ends" after blasting until powder gases have been blown out or otherwise removed. All working places should be adequately ventilated.

## **INRUSH OF WATER.**

A barrier of at least fifty feet should be maintained between a working face and any abandoned workings containing a dangerous accumulation of water, until same has been drained off. When approaching abandoned workings, advance bore holes should be driven. When working under ditch, river, lake or body of water, special precautions must be taken to prevent flood. The opening to every mine should be protected from any possible inrush of water due to cloudburst or flood.

## **MINING METHODS.**

If it is necessary for men to work alone, out of hearing of others, the shift boss or someone designated by him, should visit the working place at frequent intervals. Wherever possible at least two men should work together. In general every precaution should be taken to conduct the work with the least possible hazard.