SHAFT / SLOPE
FOREMAN STUDY GUIDE

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PRESENTED BY
BUREAU OF MINE SAFETY

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Preface

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Section I

Department of Environmental Protection
Bureau of Mine Safety

DOCUMENT NUMBER: 580-2200-011

TITLE: Sinking of Shafts and Slopes for Underground Mines

EFFECTIVE DATE: October 1, 2005

AUTHORITY: The Pennsylvania Anthracite and Bituminous Coal Mine Acts ("Acts") (52 P.S. §§ 70-101 *et. seq.* and §§ 701-101 *et. seq.)*; Section 2(f) of the General Safety Law (43 P.S. 25-2(f); The Coal and Non-Coal Surface Mining Conservation and Reclamation Acts ("SMCRA"), (52 P.S. §§ 1396.1 *et. seq.* and §§ 3301 *et. seq.*) Sections 1915-A and 1917-A of the Administrative Code of 1977 (§§ 510-15 and 17); and 25 Pa. Code Chapters 87, 88, 89 207 and 210.

POLICY: It is the policy of the Department to administer and enforce the mine safety laws in a manner that ensures the safety of persons working in or about the mine.

PURPOSE: The purpose of this technical guidance is to identify the safety requirements applicable to the development of shaft and slope entries to underground mines and to provide the operator the ability to implement MSHA's requirements for shaft and slope construction in lieu of those set forth in the Acts.

APPLICABILITY: This Technical Guidance is applicable to all employees of the Department's Bureau of Mine Safety responsible for inspecting underground mines and all underground mining operations.

DISCLAIMER: The policies and procedures outlined in this guidance document are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of the Department (DEP) to give these rules that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 2 pages
LOCATION: Volume 9 Tab 25

GUIDANCE:

1. <u>Underground Coal Mines</u>

The sinking of shafts and the driving of slope entries for underground coal mines, either in operation or under development, is subject to the requirements of the Pennsylvania Anthracite or Bituminous Coal Mine Acts ("Acts"). The safety standards for persons involved in the construction of anthracite mine shafts and slopes are contained in §§ 70-725 –70-731. The safety standards for persons involved in the construction of bituminous mine shafts are contained in § 701-290(l). The other provisions of the Acts are applicable to address issues not addressed by these sections, *e.g.* use of permissible explosives.

The Mine Safety and Health Administration's ("MSHA") regulations concerning the construction of entries from the surface to the coal seam are found in 30 CFR Part 77 Subpart T (Underground Coal Mines-Health and Safety Standards-Slope and Shaft Sinking). In the Department's opinion, these standards afford protections to workers that are substantially equivalent to or greater then those afforded by the requirements of the Acts. Therefore, pursuant to Section 1402 of the Anthracite Act and Section 702 of the Bituminous Act and to promote consistency, an operator may implement the MSHA standards in lieu of the requirements in the Acts. The operator must request, in writing, the Department's authorization to use the MSHA subpart T standards in lieu of the Acts Requirements. This authorization will be granted if the operator agrees to submit to the Department, all requests or plans that must be submitted and approved by MSHA under Subpart T.

2. <u>Underground Industrial Mineral Mines</u>

The Department's safety standards for the development and operation of underground industrial mineral mines is established by Section 2(f) of the General Safety Law and its implementing regulations, found at 25 Pa. Code Chapter 207. These regulations, *inter alia*, incorporate by reference the MSHA regulations found at 30 CFR Part 57 (relating to health and safety standards for underground metal and nonmetal mines). Therefore, the Department's regulations already require operators of underground industrial mineral mines to follow the MSHA regulations for the construction of entries to underground metal and nonmetal mines.

3. <u>Qualifications</u>

<u>**Shaft and Slope Construction Supervisor**</u> -The person immediately responsible for supervising persons engaged in the sinking of a shaft or slope entry is responsible for ensuring compliance with applicable safety requirements and the safety of persons engaged in this activity. At a minimum, the Department expects this supervisor to be the person who: ensures the adequacy of the entry's ventilation, performs all required checks for methane and oxygen, checks the walls of the entry for loose rock after a blast, and ensures the adequacy of the entry's ground control. In general the Department will

consider a person competent, by issuing a certificate of competency, to supervise persons engaged in the sinking of shafts or slopes if that person:

(a) Is at least 21 years of age.

(b) Has at least 2 years of practical experience in the sinking of slopes and shafts or has 1 year of practical experience in the sinking of slopes and shafts and either possess:

(i) A Bachelor of Science Degree in mining engineering.

(ii) A certificate of qualification to be a coal mine foreman or assistant coal mine foreman issued pursuant to the Acts.

(iii) A certificate of qualification to be an industrial mineral underground mine foreman.

(iv) An acceptable certificate of qualification issued by another state.

(c) Has been trained in the detection of oxygen and explosive gases, as well as, the use and mechanics of all gas detection devices.

(d) Has demonstrated the ability to ensure the safety of persons engaged in the sinking of slopes and shafts by successfully answering at least 80 percent of the questions in an examination administered by the Department.

Blaster – The Department will continue to require persons performing blasting activity in connection with the construction of an entry from the surface to the coal seam or mineral deposit to be mined to possess a license issued pursuant to Chapter 210. For Industrial Mineral Mines the authority for this requirement comes from § 207.217 (relating to blasting activity) and 210.12 (relating to scope)). For coal mines the authority for this requirement flows from the fact that the development of an entry from the surface to the seam to be mined is also surface mining activity subject to the requirements of the SMCRA and its implementing regulations found at §§ 87.124(d) (relating to use of explosives: general requirements) and 88.134(c) (relating to blasting: general requirements).

Note: The construction of a mine opening from the surface to the coal seem or mineral strata to be mined is also surface mining activity subject to the SMCRA or the NCSMCRA and their implementing regulations. The regulations concerning the use of explosives are found at § 77.453 and § 77.561-565 (relating to use of explosives) for noncoal mines; § 87.64 (relating to blasting plan), and §§ 87.124–129 (relating to the use of explosives) for bituminous mines, and § 88.45(relating to blasting) and §§88.134-137 (relating to blasting) for anthracite coalmines. These regulations are for the protection of persons and property outside the permit area as well as persons at the mine site. They address issues such as peak particle velocity, air blasts, preblast surveys, scheduling of blasts, and measures to be taken to protect traffic on nearby highways. The Department is developing a proposed rulemaking package which will, among other things, clarify that these regulations apply to the use of explosives in connection with the development of a mine opening, as well as, increased flexibility in the scheduling of the blasts so that the construction of a mine opening can occur round the clock.

Section II

CHAPTER 207. NONCOAL UNDERGROUND MINES

Authority

The provisions of this Chapter 207 issued under sections 2(f) and 12 of the act of May 18, 1937 (P. L. 654, No. 174)(43 P. S. § § 25-2(f) and 25-12); and sections 1917-A and 1920-A of the Administrative Code of 1929 (71 P. S. § § 510-17, and 510-20, unless otherwise noted.

Source

The provisions of this Chapter 207 adopted December 1, 1972,2 Pa.B. 2262, unless otherwise noted.

Subchapter A. GENERAL

§ 207.1. [Reserved].

Source

The provisions of this § 207.1 adopted December 1, 1972, 2 Pa.B. 2262; reserved April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041. Immediately preceeding text appears at serial page (234646).

§ 207.2. [Reserved].

Source

The provisions of this § 207.2 adopted December 1, 1972, 2 Pa.B. 2262; amended December 1, 1972, 2 Pa.B. 2262; reserved April 9, 2004, April 10, 2004, 34 Pa.B. 2041. Immediately preceding text appears at serial page (234646).

§ § 207.11—207.22. [Reserved].

Source

The provisions of these § § 207.11—207.22 adopted December 1, 1972, 2 Pa.B. 2262; reserved April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041. Immediately preceeding text appears at serial pages (234647) to (234650).

§ § 207.31—207.46. [Reserved].

Source

The provisions of these § § 207.31—207.46 adopted December 1, 1972, 2 Pa.B. 2262; reserved April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041. Immediately preceeding text appears at serial pages (234650) to (234655).

§ 207.101. Scope.

This chapter applies to underground noncoal mines and mined-out underground noncoal mines used to house other businesses in this Commonwealth. The purpose of this chapter is for the protection of life, the promotion of health and safety and the prevention of accidents.

Source

The provisions of this § 207.101 adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041.

§ 207.102. Definitions.

The following words and terms, when used in this chapter, have the following meanings, unless the context clearly indicates otherwise:

Developed facility—The portion of a mined-out underground noncoal mine developed or being developed for storage, manufacturing or other activities requiring a person to enter the mined-out area. The term includes all roads and means of entering and leaving the mined-out area of the underground noncoal mine.

Mined-out—A portion of the noncoal underground mine where no further mining is planned.

Noncoal underground mine—

(i) Lands, excavations, underground passageways, shafts, slopes, tunnels and workings, structures, facilities, equipment, machines, tools or other property including impoundments, retention dams and tailings ponds, on the surface or underground, used in, or to be used in, or resulting from, the work of extracting metals or minerals other than coal from their natural deposits in nonliquid form, or if in liquid form, with workers underground, or used in, or to be used in, the milling of the metals or minerals, or the work of preparing metals or minerals other than coal, and includes custom preparation facilities.

(ii) Private ways and roads appurtenant to the areas set forth in subparagraph (i).

Person—A natural person, partnership, association or corporation or any agency, instrumentality or entity of Federal or State government. When used in any clause prescribing and imposing a penalty, or imposing a fine or imprisonment, or both, the term ''person'' does not exclude the members of an association and the directors, officers or agents of a corporation.

Source

The provisions of this § 207.102 adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041.

§ 207.103. Responsible party.

The person who is the owner or operator of a noncoal underground mine or developed facility shall ensure that the noncoal underground mine or developed facility is constructed and operated in accordance with this chapter. A subcontractor who conducts all or part of the operation shall be jointly and severally responsible with the owner or operator.

Source

The provisions of this § 207.103 adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041.

§ 207.104. Enforcement.

(a) The Department has the authority to issue orders necessary to ensure compliance with section 2(f) of the act of May 18, 1937 (P. L. 654, No. 174) (43 P. S. § 25-2(f)), known as the General Safety Law, and this chapter. This authority includes orders:

(1) Revoking or suspending a certificate of qualification to be a foreman.

(2) Ceasing or suspending the operation of a noncoal underground mine or developed facility.

(3) Requiring the abatement of an unsafe condition or practice.

(b) Except for orders abating a condition that is an imminent hazard or ceasing, in whole or in part, the operation of a noncoal underground mine or developed facility due to the existence of an imminent hazard, the Department will not issue an order abating a condition or correcting a violation of this chapter until the owner or operator has had an opportunity to meet with the Department to discuss the matter and the owner or operator has had a reasonable opportunity to abate the condition or correct the violation.

Source

The provisions of this § 207.104 adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041.

Subchapter B. NONCOAL UNDERGROUND MINES

GENERAL

Sec.

PERFORMANCE STANDARDS

Source

The provisions of this Subchapter B adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041, unless otherwise noted.

GENERAL

§ 207.201. Applicability.

This subchapter applies to the development, construction and operation of noncoal underground mines in this Commonwealth.

§ 207.202. Definitions.

The following words and terms, when used in this subchapter, have the following meanings, unless the context clearly indicates otherwise:

MSHA—The United States Department of Labor, Mine Safety and Health Administration, its employees and its officers.

Magazine—A structure used for the storage of explosives.

PERFORMANCE STANDARDS

§ 207.211. Safety requirements.

(a) The provisions of 30 CFR Part 57 (relating to safety and health standards—underground metal and nonmetal mines) are incorporated herein by reference.

(b) Alternative safety and health standards for underground metal and nonmetal mines, established by MSHA under section 101(c) of the Federal Mine Safety and Health Act of 1977 (30 U.S.C.A. § 811(c)) and 30 CFR Part 44 (relating to rules of practice for petitions for modification of mandatory safety standards), are incorporated herein by reference.

(c) The provisions of 30 CFR Part 57 requiring the submission of a map, plan, notification, report, program description or other materials to MSHA are amended to require the same submission to the Department. A copy of the documents required by 30 CFR Part 57 to be submitted to MSHA and any other material requested by MSHA under 30 CFR Part 57 shall also be submitted to the Department's Anthracite and Industrial Mineral Mine Safety Division at 5 West Laurel Blvd., Pottsville, Pennsylvania 17901.

(d) An owner or operator of a noncoal underground mine maintaining a magazine located on the surface shall comply with the magazine licensing requirements of Chapter 211 (relating to storage, handling and use of explosives).

§ 207.212. Employment of foreman.

The owner or operator of an underground noncoal mine shall employ a foreman who possesses the Department's certificate of qualification to be a foreman.

§ 207.213. Duties of foreman.

The foreman shall have full charge of the inside portions of the noncoal underground mine and the persons employed therein. The foreman's duty shall be to ensure compliance with the Commonwealth's mine safety laws and the regulations promulgated thereunder, as well as to secure and promote the health and safety of persons employed in the noncoal underground mine.

§ 207.214. Certificate of qualification application requirements.

To be eligible to apply for a certificate of qualification, the individual shall:

(1) Be at least 21 years of age.

(2) Have at least 2 years of practical experience as a noncoal underground miner or have 1 year of practical experience as a noncoal underground miner and either possess a Bachelor of Science Degree in mining engineering, possess a certificate of qualification under section 205 of the Pennsylvania Anthracite Coal Mine Act (52 P. S. § 70-205) or section 206 of the Pennsylvania Bituminous Coal Mine Act (52 P. S. § 701-206) or possess an acceptable certificate of qualification issued by another state.

§ 207.215. Standards for issuing certificates of qualification.

(a) The Department will only issue certificates of qualification to be a foreman to applicants who have demonstrated the ability to ensure the safety of persons and the inside portions of a noncoal underground mine under their supervision. Applicants make this demonstration by correctly answering at least 80% of the Department's written examination covering applicable mine safety laws and regulations of the Commonwealth.

(b) The Department may refuse to issue to an applicant a certificate of qualification when the applicant has demonstrated an inability or unwillingness to comply with the mine safety laws and regulations of the Commonwealth or the mine safety laws or regulations administered by MSHA.

§ 207.216. Examining committee.

(a) The Department will appoint a committee consisting of a noncoal underground mine foreman and a representative of the Department to prepare the initial draft of the examination to be given to applicants for the mine foreman's certificate of qualification. A bank of questions shall be developed by the committee. The Department will assemble the examination from this bank of questions.

(b) This committee shall review and score the results of the examinations given to applicants for the foreman's certificate of qualification. These results shall be transmitted to the Department for issuance of the certificate.

§ 207.217. Blasting activity.

The storage, handling and use of explosives at a noncoal underground mine shall be under the supervision and control of a person licensed as a blaster under Chapter 210 (relating to blasters' licenses).

Subchapter C. MINED-OUT AREAS

GENERAL PROVISIONS

Sec.

SPECIFICATIONS

Source

The provisions of this Subchapter C adopted April 9, 2004, effective April 10, 2004, 34 Pa.B. 2041, unless otherwise noted.

GENERAL PROVISIONS

§ 207.301. Applicability.

This subchapter applies to the use of mined-out underground noncoal mines in this Commonwealth. The activities covered by this subchapter include storage, manufacturing or other activities requiring a person to enter the mined-out area.

§ 207.302. Definitions.

The following words and terms, when used in this subchapter, have the following meanings, unless the context clearly indicates otherwise:

Outside air—Air moving through the mined-out passageways after entering them through the main or accessory portals by mechanical or natural forces.

Pure air—Air containing not less than 19.5% oxygen, not more than 0.5% carbon dioxide and no harmful quantities of other noxious or poisonous gases, dust, soot or particulates.

Safety container—A container not over 5 gallons capacity, having a spring closing lid and spout cover.

§ 207.303. Approvals.

(a) A person may not operate a business in a mined-out area unless that mined-out area is part of a developed facility, which has been approved by the Department in writing and is constructed and operated in accordance with this subchapter.

(b) The owner or operator of the developed facility shall submit to the Department a written request which:

(1) Identifies the owner of the developed facility.

(2) Identifies the location of the developed facility.

(3) Describes the purpose of the developed facility.

(4) Identifies a responsible person at the developed facility.

(5) Contains a map or drawings depicting the developed facility, including the following:

(i) The information required by § 207.314(b) (relating to ventilation) if the developed facility will be using mechanical ventilation.

(ii) The information required by § 207.318(b) (relating to storage of flammable liquids) if more than 5 gallons of flammable liquid are to be stored in the developed facility.

(c) One or more inspections of the developed facility may be part of the Department's review of the operator's request.

(d) The Department's approval may include conditions necessary to ensure compliance with section 2(f) of the act of May 18, 1937 (P. L. 654, No. 174) (43 P. S. § 25-2(f)), known as the General Safety Law, the requirements of this subchapter and protect the public health, safety and welfare.

SPECIFICATIONS

§ 207.311. Roof areas.

The owner or operator of a developed facility shall ensure that the developed facility's roof shall be scaled, bolted or otherwise supported.

§ 207.312. Lighting.

(a) *Permanent.* The owner or operator of a developed facility shall ensure that a permanent lighting system is installed in the developed facility to provide adequate lighting for the activities to be conducted in the developed facility. An adequate permanent lighting system is one constructed in accordance with a Nationally recognized safety code such as the *National Electric Code* established by the United States of America Standards Institute.

(b) *Emergency.* The owner or operator of a developed facility shall ensure that a person is not allowed to work in a developed facility unless either an emergency lighting system meeting the requirements of the

Department has been installed in that area or each worker is provided with an approved personal lamp.

(1) The emergency lighting system shall be powered by an emergency generator. The emergency lighting system shall also be constructed in accordance with a Nationally recognized safety code such as the *National Electric Code* established by the United States of America Standards Institute.

(2) Cap lamps constructed and maintained in accordance with 30 CFR 19.5 (relating to general requirements for approval) are approved as personal lamps. The Department may approve the use of other types of personal lamps provided the other lamps are as safe as a personal cap lamp constructed and operated in accordance with 30 CFR 19.5.

§ 207.313. Entrances and exits.

The owner or operator of a developed facility shall ensure that two separate passages, connecting each area of the developed facility to the surface, shall be provided for personnel use and shall be maintained in a safe, passable condition at all times.

§ 207.314. Ventilation.

(a) *General requirement.* The owner or operator of a developed facility shall ensure that an adequate supply of pure air is provided and maintained in the developed facility as provided in subsection (c). If the Department or the operator determines it is necessary to install mechanical means of ventilation, these mechanical means for providing pure air shall be approved by the Department in writing before the mechanical ventilation system is operated.

(b) *Ventilation system requirements.* The owner or operator of the developed facility shall submit to the Department drawings depicting the proposed ventilation system. One or more inspections of the developed facility may be part of the Department's review of the proposed mechanical ventilation system. Any Department approval may include conditions necessary to ensure the ventilation system is providing pure air to all portions of the developed facility.

(c) *Quantity of air.* A minimum of 20 cubic feet of outside air shall be supplied to every occupied or enclosed space in a developed area, per minute, per person present in that area.

Cross References

This section cited in 25 Pa. Code § 207.303 (relating to approvals).

§ 207.315. Closing underground sections.

If it becomes necessary to permanently close or enclose a section or portion of the developed facility, the owner or operator of the developed facility shall ensure that noncombustible material is used to permanently close or enclose that section or portion of the developed facility.

§ 207.316. Inspections.

The owner or operator of a developed facility shall ensure that inspections are made at the following times, and defective conditions that are discovered shall be corrected:

(1) *Monthly.* The ceiling, pier and walls shall be inspected monthly for new cracks. The entrances, shafts, slopes, drifts and roadways leading to them, and the doors or gates shall be inspected monthly to insure they are in safe, usable condition.

(2) *Biweekly.* Emergency lighting systems and approved personal lamps shall be tested biweekly to assure they are in operating condition. Charge, fluid, terminals and visual conditions of batteries shall be checked.

(3) *Weekly.* The ventilating system shall be inspected weekly to ensure that motors and controls are in operating condition.

§ 207.317. Record of inspection.

The owner or operator of the developed facility shall ensure that daily logs containing the findings of inspections and the repairs and corrective action taken are maintained and kept on file at the developed facility's office. These logs shall be available for inspection by the Department at any time during working hours. Each day's log shall be dated and signed by a person designated by the owner or operator to be responsible for the day-to-day operation of the developed facility. Corrections or orders required by the Department representative shall be in writing and shall become a part of the log.

§ 207.318. Storage of flammable liquids.

(a) The owner or operator of the developed facility shall ensure that flammable liquids are stored in a safety container unless otherwise approved in writing by the Department. To request the Department's approval, the owner or operator shall submit to the Department a photograph, drawing or sketch of the container and an explanation as to why this alternative container is safe for storing flammable liquids. Department approvals may include conditions necessary to ensure that the container will safely store flammable liquids.

(b) The owner or operator of a developed facility shall ensure that flammable liquids in excess of 5 gallons are not stored in the developed facility unless otherwise approved in writing by the Department.

(c) The request for storing more than 5 gallons of flammable liquid shall include a drawing depicting the location, size and nature of storage. The request shall also state the reason it is necessary to store more than 5 gallons of flammable liquids and describe the materials which will be used to construct the container, as well as measures to be taken to detect, prevent or respond to a fire or a spill.

Cross References

This section cited in 25 Pa. Code § 207.303 (relating to approvals).

§ 207.319. Check in/check-out system.

The owner or operator of the developed facility shall ensure that there is a check-in/check-out system, which will inform personnel on the surface of the mine as to who is currently in the developed facility.

Section III

CHAPTER 210. BLASTERS' LICENSES

Sec.

Authority

The provisions of this Chapter 210 issued under sections 3 and 7 of the act of July 1, 1937 (P. L. 2681, No. 537) (73 P. S. § § 157 and 161); section 3 of the act of July 10, 1957 (P. L. 685, No. 362) (73 P. S. § § 157, 161 and 166); Reorganization Plan No. 8 of 1981 (71 P. S. § 751-35); section 2(f) of the act of May 18, 1937 (43 P. S. § 25-2(f)); Reorganization Plan No. 2 of 1975 (71 P. S. § 751-22); section 4(b) of the Surface Mining Conservation and Reclamation Act (52 P. S. § 1396.4(b)); section 11(e) of the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. § 3311(e)); and sections 1917-A and 1920-A(b) of The Administrative Code of 1929 (71 P. S. § § 510-17 and 510-20(b)), unless otherwise noted.

Source

The provisions of this Chapter 210 adopted January 26, 1973, effective January 27, 1973, 3 Pa. 183, unless otherwise noted.

Cross References

This chapter cited in 25 Pa. Code § 77.561 (relating to general requirements); 25 Pa. Code § 87.64 (relating to blasting plan); 25 Pa. Code § 87.124 (relating to use of explosives: general requirements); 25 Pa. Code § 88.134 (relating to blasting: general requirements); 25 Pa.

Code § 207.17 (relating to blasting activity); and 25 Pa. Code § 211.101 (relating to definitions).

§ § 210.1—210.3. [Reserved].

Source

The provisions of these § § 210.1—210.3 adopted January 26, 1973, effective January 27, 1973, 3 Pa.B. 183; amended November 7, 1980, effective November 8, 1980, 10 Pa.B. 4294; reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243459) to (243462).

§ § 210.4—210.6. [Reserved].

Source

The provisions of this § 210.4 adopted January 26, 1973, effective January 27, 1973, 3 Pa.B. 183; reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243462) to (243463).

§ 210.11. Definitions.

The following words and terms, when used in this chapter, have the following meanings, unless the context clearly indicates otherwise:

Blaster—A person who is licensed by the Department under this chapter to detonate explosives and supervise blasting activities.

Blaster learner—An individual who is learning to be a blaster and who participates in blasting activities under the direct supervision of a blaster.

Blaster's license—A license to detonate explosives and supervise blasting activities issued by the Department under this chapter.

Demolition and demolition blasting—The act of wrecking or demolishing a structure with explosives.

Person—A natural person.

Source

The provisions of this § 210.11 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

§ 210.12. Scope.

This chapter applies to persons engaging in the detonation of explosives within this Commonwealth. This chapter does not apply to persons authorized to detonate explosives or to supervise blasting activities under:

(1) The Pennsylvania Anthracite Coal Mine Act (52 P. S. § § 70.101—70.1405).

(2) The Pennsylvania Bituminous Coal Mine Act (52 P. S. § § 701-101—701-706).

Source

The provisions of this § 210.12 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

§ 210.13. General.

(a) A person may not detonate explosives or supervise blasting activities unless the person has obtained a blaster's license.

(b) The Department may exempt certain individuals from needing a blaster's license if the person is detonating extremely small amounts of explosives for industrial or research purposes. The Department will consider a written request for an exemption from the person seeking the exemption.

(c) Upon request, a blaster shall exhibit a blaster's license to the following:

(1) An authorized representative of the Department.

(2) The blaster's employer or an authorized representative of the employer.

(3) A police officer acting in the line of duty.

(d) A blaster's license is not transferable.

Source

The provisions of this § 210.13 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

§ 210.14. Eligibility requirements.

(a) To be eligible for a blaster's license, a person shall:

(1) Be 21 years of age or older.

(2) Have at least 1 year of experience as a blaster learner in preparing blasts in the classification for which a license is being sought.

(3) Have taken the Department's class on explosives. It is not necessary for a blaster to retake the class when adding an additional classification to a license.

(4) Have successfully passed the Department's examination for a blaster's license.

(b) The Department will not issue or renew a license if the applicant, as indicated by past or continuing violations, has demonstrated a lack of ability or intention to comply with the Department's regulations concerning blasting activities.

Source

The provisions of this § 210.14 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Cross References

This section cited in 25 Pa. Code § 210.17 (relating to issuance and renewal of licenses).

§ 210.15. License application.

(a) The license application shall be on forms provided by the Department and be accompanied by a check for $50 payable to the Commonwealth of Pennsylvania. The complete application shall be submitted to the Department at least 2 weeks prior to the examination.

(b) The license application shall include a signed notarized statement from a person who has direct knowledge of the applicant's expertise, such as the blaster who supervised the applicant, or the applicant's employer. The statement shall:

(1) Describe the applicant's experience in blasting. In particular, the statement shall describe in detail how the applicant assisted in the preparation of the blasts and for how long.

(2) State whether the applicant is competent to prepare and detonate blasts in the classification for which the license is being sought.

Source

The provisions of this § 210.15 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Cross References

This section cited in 25 Pa. Code § 210.17 (relating to issuance and renewal of licenses).

§ 210.16. Examinations.

(a) The Department will conduct examinations for specific types of blasting, as specified in § 210.17(a) (relating to issuance and renewal of licenses).

(b) The Department will schedule and conduct examinations as needed.

(c) An applicant failing to appear for a scheduled examination forfeits the application fee unless the applicant provides written notice to the Department prior to the examination date or submits a valid medical excuse in writing.

(d) Refund of the fee or admittance to a subsequent examination without a reapplication fee will be at the discretion of the Department.

Source

The provisions of this § 210.16 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Cross References

This section cited in 25 Pa. Code § 210.17 (relating to issuance and renewal of licenses).

§ 210.17. Issuance and renewal of licenses.

(a) A blaster's license is issued for a specific classification of blasting activities. The classifications will be determined by the Department and may include general blasting (which includes all classifications except demolition and underground noncoal mining), trenching and construction, seismic and pole line work, well perforation, surface mining, underground noncoal mining, industrial, limited and demolition.

(b) A person may apply to amend the blaster's license for other classifications by meeting the requirements of § 210.14 (relating to eligibility requirements) and by submitting a complete application.

(c) A blaster's license will be issued for 3 years.

(d) A blaster's license is renewable if the blaster can demonstrate that he has had 8 hours of continuing education in Department-approved courses related to blasting and safety within the 3 year period.

(e) The blaster's license may be renewed for a 3-year term by submitting a renewal application to the Department and a check for $30, payable to the Commonwealth of Pennsylvania.

(f) A person who intends to be a blaster and whose blaster's license was not renewed within 1 year of its expiration date shall apply for a new license under § § 210.14—210.16 (relating to eligibility requirements; license application; and examinations).

(g) A person who conducted demolition blasting under a general blaster's license may conduct demolition blasting after July 14, 2001, by applying for and receiving a demolition blaster's license. The Department may waive the examination required by § 210.14 and the application fee if the blaster demonstrates at least 3 years of experience in demolition blasting. The demonstration shall be in the form of a notarized statement from the blaster's employer that describes the blaster's experience.

Source

The provisions of this § 210.17 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Cross References

This section cited in 25 Pa. Code § 210.14 (relating to eligibility requirements).

§ 210.18. Recognition of out-of-State blaster's license.

(a) The Department may license a person who holds a blaster's license or its equivalent in another state. The Department may issue the license if, in the opinion of the Department, that state's licensing program provides training on the storage, handling and use of explosives and an examination that is equivalent to the requirements of this chapter.

(b) A request for a license under this section shall be made in writing. Copies of the other state's explosives training and examination material and proof that the applicant holds a license in the other state shall be provided to the Department in order to make a proper evaluation.

Source

The provisions of this § 210.18 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

§ 210.19. Suspension, modification and revocation.

The Department may issue orders suspending, modifying or revoking a blaster's license. Before an order is issued, the Department will give the blaster an opportunity for an informal meeting to discuss the facts and issues that form the basis of the Department's determination to suspend, modify or revoke the license. The Department may suspend, modify or revoke a blaster's license for violations of this chapter and Chapter 211 (relating to storage, handling and use of explosives in surface applications).

Source

The provisions of this § 210.19 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Section IV

CHAPTER 211. STORAGE, HANDLING AND USE OF EXPLOSIVES

Authority

The provisions of this Chapter 211 issued under sections 1901-A and 1920-A of The Administrative Code of 1929 (71 P. S. § § 510-1 and 510-20); amended under sections 3 and 7 of the act of July 1, 1937 (P. L. 2681, No. 537) (73 P. S. § § 157 and 161); section 3 of the act of July 10, 1957 (P. L. 685, No. 362) (73 P. S. § § 157, 161 and 166); Reorganization Plan No. 8 of 1981 (71 P. S. § 751-35); section 2(f) of the act of May 18, 1937 (43 P. S. § 25-2(f)); Reorganization Plan No. 2 of 1975 (71 P. S. § 751-22); section 4(b) of the Surface Mining Conservation and Reclamation Act (52 P. S. § 1396.4(b)); section 11(e) of the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. § 3311(e)); and sections 1917-A and 1920-A(b) of The Administrative Code of 1929 (71 P. S. § § 510-17 and 510-20(b)), unless otherwise noted.

Source

The provisions of this Chapter 211 adopted June 14, 1972, effective June 15, 1972, 2 Pa.B. 1067, unless otherwise noted.

Cross References

This chapter cited in 25 Pa. Code § 77.561 (relating to general requirements); 25 Pa. Code § 87.124 (relating to use of explosives: general requirements); 25 Pa. Code § 88.134 (relating to blasting: general requirements); 25 Pa. Code § 207.211 (relating to safety requirements); and 25 Pa. Code § 210.19 (relating to suspension, modification and revocation).

Subchapter A. GENERAL PROVISIONS

Sec.

§ § 211.1 and 211.2. [Reserved].

Source

The provisions of these § § 211.1 and 211.2 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243466) to (243469).

§ 211.31. [Reserved].

Source

The provisions of this § 211.31 amended November 7, 1980, effective November 8, 1980, 10 Pa.B. 4294; reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial page (243469).

§ § 211.32—211.44. [Reserved].

Source

The provisions of these § § 211.32—211.44 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243469) to (243482).

§ § 211.51—211.56. [Reserved].

Source

The provisions of these § § 211.51—211.56 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243481) to (243490).

§ § 211.61 and 211.62. [Reserved].

Source

The provisions of these § § 211.61 and 211.62 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243490) to (243495).

§ 211.71. [Reserved].

Source

The provisions of this § 211.71 reserved October 15, 1982, effective October 16, 1982, 12 Pa.B. 3736. Immediately preceding text appears at serial page (11436).

§ 211.72. [Reserved].

Source

The provisions of this § 211.72 amended October 15, 1982, effective October 16, 1982, 12 Pa.B. 3736; reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243495) to (243496).

§ § 211.73—211.76. [Reserved].

Source

The provisions of these § § 211.73—211.76 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243496) to (243497).

§ § 211.81—211.87. [Reserved].

Source

The provisions of these § § 211.81—211.87 reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial text pages (243497) to (243499).

§ 211.88. [Reserved].

Source

The provisions of this § 211.88 amended July 28, 1972, 2 Pa.B. 1439; reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial page (243499).

§ 211.101. Definitions.

The following words and terms, when used in this chapter, have the following meanings, unless the context clearly indicates otherwise:

Access point—A point in the outer perimeter security and a point in the inner perimeter security that allows entry to or exit from the magazine or the magazine site.

Airblast—An airborne shock wave resulting from an explosion, also known as air overpressure, which may or may not be audible.

Blast area—The area around the blast site that should be cleared to prevent injury to persons and damage to property.

Blast site—The specific location where the explosives charges are loaded into the blast holes.

Blaster—An individual who is licensed by the Department under Chapter 210 (relating to blasters' licenses) to detonate explosives and supervise blasting activities.

Blaster-in-charge—The blaster designated to have supervision and control over all blasting activities related to a blast.

Blasting activity—The actions associated with the use of explosives from the time of delivery of explosives to a worksite until all postblast measures are taken, including priming, loading, stemming, wiring or connecting, detonating, and all necessary safety, notification and monitoring measures.

Building—A structure that is designed for human habitation, employment or assembly.

Charge weight—The weight in pounds of an explosive charge.

Concertina razor wire—Razor wire that is extended in a spiral for use as a barrier, such as along or on a fence and having a minimum of 101 coils of wire to 50 linear feet.

Delay interval—The designed time interval, usually in milliseconds, between successive detonations.

Detonator—

(i) A device containing an initiating or primary explosive that is used for initiating detonation of explosives.

(ii) The term includes electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord, delay connectors and nonelectric instantaneous and delay blasting caps.

Display fireworks— (i) Large fireworks designed primarily to produce visible or audible effects by combustion, deflagration or detonation.

(ii) The term includes, but is not limited to, salutes containing more than 2 grains (130 mg) of explosive materials, aerial shells containing more than 40 grams of pyrotechnic compositions, and other display pieces which exceed the limits of explosive materials for classification as consumer fireworks. Display fireworks are classified as fireworks UN0333, UN0334 or UN0335 by the United States Department of Transportation at 49 CFR 172.101 (relating to purpose and use of hazardous materials table).

(iii) The term also includes fused setpieces containing components which together exceed 50 mg of salute powder.

Explosive—A chemical compound, mixture or device that contains oxidizing and combustible materials or other ingredients in such proportions or quantities that an ignition by fire, friction, concussion, percussion or detonation may result in an explosion.

(i) The term includes safety fuse, squibs, detonating cord and igniters.

(ii) The term does not include the following:

(A) Commercially manufactured black powder, percussion caps, safety and pyrotechnic fuses, matches and friction primers, intended to be used solely for sporting, recreational or cultural purposes in antique firearms or antique devices, as defined in 18 U.S.C.A. § 921 (relating to definitions).

(B) Smokeless powder, primers used for reloading rifle or pistol cartridges, shot shells, percussion caps and smokeless propellants intended for personal use.

Flyrock—Overburden, stone, clay or other material ejected from the blast area by the force of a blast.

Indoor magazine—A magazine located entirely within a secure intrusion-resistant and theft-resistant building which is primarily used for commercial or industrial purposes.

Inner perimeter security—Measures taken to increase the intrusion resistance and theft resistance of a magazine that encircles an individual or a group of magazines. These measures lie within the outer perimeter security measures.

Magazine—A structure used for the storage of explosives.

Misfire—Incomplete detonation of explosives.

Outdoor magazine site—The contiguous area of land upon which the following are located: a magazine or group of magazines; the outer perimeter security, and the inner perimeter security, if any.

Outer perimeter security—Measures taken to increase the intrusion resistance of magazines that encircle the area where the magazines are situated.

Particle velocity—A measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.

Peak particle velocity—The maximum intensity of particle velocity.

Person—A natural person, partnership, association, or corporation or an agency, instrumentality or entity of state government.

Primer—A cartridge or package of high explosives into which a detonator has been inserted or attached.

Purchase—To obtain ownership of explosives from another person.

Sale or sell—To transfer ownership of explosives to another person.

Scaled distance (Ds)—A value calculated by using the actual distance (D) in feet, measured in a horizontal line from the blast site to the nearest building or structure, neither owned nor leased by the blasting activity permittee or its customer, divided by the square root of the maximum weight of explosives (W) in pounds, that is detonated per delay period of less than 8 milliseconds.

Ds = D/(square root) W

Stemming—Inert material placed in a blast hole after an explosive charge for the purpose of confining the explosion gases to the blast hole, and inert material used to separate explosive charges in decked holes.

Structure—

(i) A combination of materials or pieces of work built or composed of parts joined together in some definite manner for occupancy, use or ornamentation.

(ii) The term includes everything that is built or constructed, including bridges, offices, water towers, silos and dwellings.

Utility line—An electric cable, fiber optic line, pipeline or other type of conduit used to transport or transmit electricity, gases, liquids and other media including information.

Wheeled vehicle—A vehicle that moves about on three or more wheels and has a gross vehicle weight of less than 11,000 pounds.

Source

The provisions of this § 211.101 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751; amended June 17, 2005, effective June 18, 2005, 35 Pa.B. 3406. Immediately preceding text appears at serial pages (281299) to (281300).

§ 211.102. Scope.

(a) This chapter applies to persons using, storing, purchasing and selling explosives and engaging in blasting activities within this Commonwealth. Persons using and storing explosives at underground mines are exempt from this chapter. The storage of explosives in magazines on the surface at an underground noncoal mine is subject to the applicable requirements of this chapter. The provisions of this chapter that are more stringent than the blasting provisions in Chapters 77, 87 and 88 (relating to noncoal mining; surface mining of coal; and anthracite coal) apply to blasting activities at coal or noncoal surface mines.

(b) Compliance with this chapter does not relieve a person who is engaged in the purchase or sale of explosives, or blasting activities, from compliance with other applicable laws or regulations of the Commonwealth.

Source

The provisions of this § 211.102 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

§ 211.103. Enforcement.

(a) The Department may issue orders necessary to implement this chapter including an order to suspend, modify or revoke a license or permit authorized by this chapter.

(b) Before issuing an order modifying peak particle velocity or airblast limits in a blasting activity permit, the Department will first provide the permittee with an opportunity to meet and discuss modifications.

Source

The provisions of this § 211.103 adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751.

Subchapter B. STORAGE AND CLASSIFICATION OF EXPLOSIVES

Sec.

Source

The provisions of this Subchapter B adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

Cross References

This subchapter cited in 25 Pa. Code § 211.141 (relating to requirements).

§ 211.111. Scope.

(a) This subchapter applies to the classification and storage of explosives. It establishes the requirements, procedures and standards for licensing, constructing, and siting and maintaining magazines.

(b) Persons storing explosives underground in permitted underground mines are exempt from this subchapter.

Source

The provisions of this § 211.111 amended June 17, 2005, effective June 18, 2005, 35 Pa.B. 3409. Immediately preceding text appears at serial page (281302).

§ 211.112. Magazine license and fees.

(a) A person storing explosives shall do so in a magazine licensed by the Department. A person may not construct, install or modify a magazine until the Department has issued or amended the license in writing. The licensee shall store explosives in accordance with the approved application, the license and this chapter.

(b) The license specifies the types and quantities of explosives to be stored in the magazine and any other condition necessary to ensure that the proposed activity complies with applicable statutes and this chapter.

(c) Licenses expire annually on December 31 of each year. If the Department receives a complete renewal application by December 31, the licensee may continue to operate under the current license until the Department acts on the renewal application.

(d) License fees are as follows:

(1) License:

(i) Application—$50

(ii) Site inspection—$50

(2) License modifications—$50

(3) License renewals—$50

(4) License transfers—no fee

§ 211.113. Application contents.

(a) An application to obtain, renew, modify or transfer a magazine license shall be on forms approved by the Department. Before the Department issues, renews, transfers or modifies a license, the application must demonstrate that the applicant has complied with the applicable requirements of this chapter.

(b) A completed license application shall include:

(1) The applicant's name, address and telephone number.

(2) A contact person, including name, title and telephone number.

(3) The types and quantities of explosives to be stored within the magazine.

(4) A map, plan or a sketch of the site location showing the nearest buildings, nearest railways, nearest highways, and existing barricades, if any, and proposed barricades.

(5) A plan showing the design and specifications of the magazine to be licensed.

(6) A plan showing the design, specifications, dimensions and locations of all security measures to be installed under § 211.115(d) (relating to standards for classifying and storing explosives and constructing, maintaining and siting magazines).

(7) The latitude and longitude of outdoor magazines except for Type 3 magazines as defined in 27 CFR 555.203(c) (relating to types of magazines).

(8) The latitude and longitude of indoor magazines containing high explosives.

(c) A license renewal application shall include:

(1) The applicant's name, address and telephone number.

(2) A contact person, including name, title and telephone number.

(3) The maximum amount and type of explosives for which the magazine is currently licensed.

Source

The provisions of this § 211.113 amended June 17, 2005, effective June 18, 2005, 35 Pa.B. 3409. Immediately preceding text appears at serial pages (281302) to (281303).

Cross References

This section cited in 25 Pa. Code § 211.115 (relating to standards for classifying and storing explosives and constructing, maintaining and siting magazines).

§ 211.114. Displaying the license.

The magazine license, or a legible copy of the license, shall be conspicuously displayed. If possible, the license shall be displayed inside the magazine. In all other cases, the license shall be displayed at the site and adjacent to the magazine to which it applies.

§ 211.115. Standards for classifying and storing explosives and constructing, maintaining and siting magazines.

(a) The provisions of 27 CFR Part 555, Subpart K (relating to storage), are incorporated herein by reference. If any provision of 27 CFR Part 555, Subpart K addresses an issue addressed in this section, the more stringent provision applies. These provisions shall be used to:

(1) Classify explosives.

(2) Determine which class of explosives may be stored in each type of magazine.

(3) Determine the quantity of explosives that may be stored.

(4) Determine the applicable construction standards for each type of magazine.

(5) Site the magazine.

(6) Specify maintenance and housekeeping standards for a magazine.

(7) Grant variances.

(b) For purposes of incorporation by reference of 27 CFR Part 555, Subpart K, the term ''Department'' is substituted for the term ''director'' and the term ''representatives of the Department'' is substituted for the term ''ATF Official.''

(c) Indoor magazines shall be located in buildings which are in compliance with all applicable building codes and other applicable regulations

(d) Persons storing only display fireworks in Type 4 magazines as defined in 27 CFR 555.203(d) (relating to types of magazines) are exempt from this subsection except for paragraphs (8) and (9). Type 3 magazines as defined in 27 CFR 555.203(c), are exempt from this subsection. The following security measures apply to outdoor magazines and to indoor magazines located in buildings that are not intrusion-resistant and theft-resistant:

(1) Each magazine site shall be inspected by the licensee or his agent at least daily at approximately 24-hour intervals. If all magazines and outer perimeter security gates at the site are equipped with electronic intrusion detection devices conforming with paragraphs (3)(ii) or (iii), and (4)(ii) or (iii), or otherwise approved, in writing, by the Department, the inspection

shall be conducted at least every 7 days. Individual magazines or entire magazine sites which do not contain explosives are not required to be inspected provided the inspection records reflect the date the last explosives were removed from the magazine. Each inspection shall include the magazine itself, the access points and perimeter security. The inspection can be performed by a person or electronically by remote cameras. A record of the inspections shall be kept and made available to the Department. Records shall be maintained for at least 3 years. The record of each inspection shall include:

(i) The names of the persons who inspected the site.

(ii) The date and time each inspection began and ended.

(iii) Any information related to the integrity of the magazine site.

(iv) Actions taken on problems discovered.

(v) The dates on which no inspections were conducted because no explosives were contained in the magazine.

(2) There may be no more than one access point to each magazine site. The Department may approve, in writing, more than one access point to a magazine site if the Department determines that the security of the site will be maintained.

(3) Each magazine must have outer perimeter security that obstructs, to the greatest extent possible, unauthorized access to the magazine by wheeled vehicles. The outer perimeter security must surround the entire magazine site and be located at least 25 feet away from the exterior of any magazine within the site or at least 25 feet away from the inner perimeter security measures, whichever is applicable. The Department may approve, in writing, a lesser distance upon request when the Department determines a lesser distance is appropriate and will not compromise the security of the magazine site. The outer perimeter security requirements can be met by measures approved by the Department as provided for in subsection (g) or by one or a combination of the following:

(i) A sufficient number of personnel assigned to physically inspect each magazine containing explosives or detonators at least once every hour. All persons acting in this capacity shall at all times be equipped with a communications device capable of providing direct verbal communications with either the police department having jurisdiction or another person who has the ability to contact the police department having jurisdiction.

(ii) Closed Circuit Television (CCTV) continuously monitoring the entire outer perimeter, or any portion of the outer perimeter that is not protected by another measure.

(A) The images shall be recorded and maintained at least until magazine integrity is confirmed during the next required site inspection.

(B) The latest output images of all CCTV cameras shall be viewed at least once every hour by a person having direct verbal communications with the police department having jurisdiction.

(iii) Electronic intrusion detection devices including, but not limited to: microwave sensors, seismic detectors, vehicle detectors, alarms or infrared motion detectors.

(A) If microwave sensors, seismic sensors, vehicle detectors or similar devices are used, the zone of detection of the devices shall encompass the entire outer perimeter, or any portion of the outer perimeter that is not protected by another measure.

(B) All systems shall have the capability of providing initial notification of an alert within 15 minutes of an event and an onsite presence in response to an alert within 1 hour.

(C) All systems shall have a backup power supply, and provide an alert in the event of a power loss or a compromise of the system integrity.

(iv) An earthen barrier, a minimum of 7 feet in height. Earthen barriers shall be constructed to obstruct, to the greatest extent possible, unauthorized access by wheeled vehicles. If made of loose soils the earthen barrier shall be compacted and vegetated to the greatest extent possible.

(v) A barrier constructed of boulders. The boulders shall be of a size and weight sufficient to deter, to the greatest extent possible, defeat of the barrier by wheeled vehicles.

(vi) A highwall that is a minimum of 7 feet in height and whose face or slopes are sufficient to obstruct, to the greatest extent possible, unauthorized access to the magazine site by wheeled vehicles.

(vii) Barriers composed of natural terrain features which are impassable, to the greatest extent possible, to wheeled vehicles.

(viii) A fencing system constructed of members that are of sufficient size, strength and anchorage to deter, to the greatest extent possible, the fencing system from being bent over, broken through or uprooted by a wheeled vehicle.

(ix) Other equivalent barriers approved by the Department, in writing.

(4) In addition to the requirements contained in paragraph (3), a magazine or group of magazines within a site that contains high explosives or detonators shall be enclosed by inner perimeter security designed to obstruct, to the greatest extent possible, access by unauthorized persons. The additional inner perimeter security shall be located at least 6 feet away from the exterior of any magazine within the site and at least 25 feet inside and away from the outer perimeter security. The inner perimeter security requirement can be met by measures approved by the Department as provided for in subsection (g) or by one or a combination of the following:

(i) A sufficient number of personnel assigned to physically inspect each magazine containing high explosives or detonators at least once every hour. All persons acting in this capacity shall at all times be equipped with a communications device capable of providing direct verbal communications with either the police department having jurisdiction or another person who has the ability to contact the police department having jurisdiction.

(ii) CCTV continuously monitoring the magazine interior or the exterior of the doors of each magazine containing high explosives or detonators.

(A) The images shall be recorded and maintained at least until magazine integrity is confirmed during the next required site inspection.

(B) The latest output images of all CCTV cameras shall be viewed at least once every hour by a person having direct verbal communications with the police department having jurisdiction.

(iii) Electronic intrusion detection devices including, but not limited to: microwave sensors, seismic detectors, alarms or infrared motion detectors.

(A) If alarms, infrared motion detectors or other similar devices are used, they shall be installed on each magazine containing high explosives or detonators. Alarms shall be installed on all magazine doors. Infrared motion detectors and other similar devices shall be installed on the interior of each magazine.

(B) If microwave sensors, seismic sensors or similar devices are used, the zone of detection of the devices shall encompass the entire inner perimeter, or any portion of the inner perimeter that is not protected by another measure.

(C) All systems shall have the capability of providing initial notification of an alert within 15 minutes of an event and an onsite presence in response to an alert within 1 hour.

(D) All systems shall have a backup power supply, and shall provide an alert in the event of a power loss or a compromise of the system integrity.

(iv) A highwall that is a minimum of 20 feet in height and whose face or slopes are sufficient to obstruct, to the greatest extent possible, access by unauthorized persons.

(v) A fence constructed of a minimum of 9 gauge chain link fencing with a maximum 2-inch mesh that is kept in a condition which maintains its original functionality. The fence shall:

(A) Be buried at least 1 foot at the base or be equipped with a minimum 1.66 inch outside diameter bottom rail.

(B) Have a minimum height of 8 feet above the ground.

(C) Have a top rail with a minimum 1.66 inch outside diameter.

(D) Have firmly anchored posts 10 feet or less on center. End, corner and pull posts shall have a minimum outside diameter of 2.875 inches if round or 2.5-inch square. Intermediate posts shall have a minimum outside diameter of 2.375 inches if round or 2.25-inch C-Section. Posts shall be set in concrete at a minimum depth of 33 inches. The post holes shall be a minimum of 12 inches in diameter and be completely filled with concrete.

(E) Have outriggers at the top with concertina razor wire attached.

(F) Have concertina razor wire attached on the inside at the bottom.

(G) Have as many gates as the licensee demonstrates are necessary to provide for the safe exit of employees in the event of an emergency.

(H) All inner perimeter security emergency exit gates shall meet the requirements specified in paragraph (6).

(I) Vegetation shall be kept trimmed or suppressed to a distance of 6 feet from each side of the fence.

(vi) The Department may approve, in writing, the use of other security fence systems or other barriers that provide at least equivalent security.

(5) In addition to outer perimeter security, all portable magazines being used as stationary magazines and magazines having an a volume of less than 3 cubic yards shall be immobilized by fastening the magazine securely to the earth or a terrain feature in a manner sufficient to prevent displacement of the magazine by a wheeled vehicle.

(6) Any single layer of perimeter security measures that obstructs, to the greatest extent possible, unauthorized access to the magazine by wheeled vehicles and deters, to the greatest extent possible, access by unauthorized persons, and is located at least 25 feet away from the exterior of any magazine within the site may be employed to satisfy the requirements of both paragraphs (3) and (4).

(7) Inner perimeter security gates shall be constructed at all access points. Gates shall have firmly anchored posts and shall be kept in a condition which maintains their original functionality. Each gate shall be securely padlocked whenever the site is unoccupied.

(i) Gates shall be constructed of a minimum of 9 gauge chain link fencing with a maximum 2-inch mesh. Gate frame members shall be a minimum outside diameter of 1.9 inches if round or 2.0-inch if square.

(ii) Gates shall have firmly anchored gate posts with a minimum 6.625-inch outside diameter. Posts shall be set in concrete at a minimum depth of 42 inches. The postholes shall be a minimum of 16 inches in diameter and shall be completely filled with concrete.

(iii) Gates shall have outriggers at the top with concertina razor wire attached.

(iv) The construction of the gates shall be contiguous with the surrounding fence.

(v) All gates shall have 2 locks. The locks shall have separate hasps and staples.

(vi) Each lock shall have a hood of at least 1/4-inch thick steel. The hoods must prevent sawing or lever-cutting action on the locks, hasps, and staples.

(vii) Each lock shall have at least five tumblers and a case-hardened shackle of at least 3/8 inches in diameter.

(viii) When a lock and chain are used to secure a gate, the minimum specification of the chain shall be 3/8 inch Grade 70, Transport.

(ix) The Department may approve, in writing, the use of other security gate systems that provide at least equivalent security.

(8) Outer perimeter security gates shall be constructed at all access points. Gates shall be designed and constructed to deter, to the greatest extent possible, defeat of the gate by wheeled vehicles. Gates shall have firmly anchored posts and be kept in a condition which maintains their original functionality. Gateposts shall be a minimum 6.625-inch outside diameter. Posts shall be set in concrete at a minimum depth of 42 inches. The postholes shall be a minimum of 16 inches in diameter and be completely filled with concrete. The Department may approve, in writing, the use of gateposts having smaller diameters or other shapes or alternate gatepost anchoring methods, or both, that provide at least equivalent security.

(9) Outer perimeter security gates shall be padlocked whenever the site is unoccupied. All gates shall have 2 locks which meet the specifications of paragraph (7)(vi)—(viii).

(10) "No Trespassing" signs shall be placed around the outer perimeter of the site. Warning signs shall be placed at all access points. Signs shall be well maintained.

(i) "No Trespassing" signs shall be spaced so that, except for corners, adjacent signs are visible.

(ii) Signs shall be placed so that a bullet passing directly through the sign will not impact a magazine.

(iii) Warning signs at all access points shall provide notice of private property and no trespassing, in addition to providing a notice substantially conforming to the following: ''Danger, never fight explosives fires, explosives are stored on this site'' to warn first responders and the public of the hazards contained within.

(iv) Warning signs at all access points shall provide an emergency contact phone number.

(v) Signs may not be obscured by vegetation or other obstructions.

(vi) Signs shall be constructed of a durable, weather-resistant material. Letters and numbers shall be of a minimum height of 2 inches that can be easily seen and read.

(11) Magazines shall be constructed to the standards contained in this paragraph. Magazines shall be constructed according to the construction standards found in 27 CFR Part 555, Subpart K (relating to storage) with the following additions:

(i) Mobile type 5 magazines being used as stationary magazines for more than 1 year must be located within the outer perimeter security, shall be immobilized in accordance with 27 CFR 555.211 (relating to construction of type 5 magazines) and be fastened securely to the earth or a terrain feature in a manner sufficient to prevent movement of the magazine by a motor vehicle. Motor vehicles used to transport bulk blasting agents that are left unattended at a magazine site must have two Department approved methods of disabling the vehicles to render them effectively immobilized and the vehicles must be kept within the outer perimeter security. Disabling methods may include:

(A) Steering locking devices

(B) Pedal locking devices

(C) Fuel or electrical system disablers.

(D) Other equivalent disabling measures approved by the Department.

(ii) Systems of pumps or tanks, or both, used to store, mix or dispense bulk blasting agents at magazine sites shall be equipped with locks or shall otherwise be constructed to prevent the unauthorized removal of blasting agents from the system.

(12) A person who stores explosive materials shall notify both the local police having jurisdiction in the area where the explosives are being stored and the Pennsylvania State Police of the storage. This notification must be made in the manner of and in addition to the notification requirements in 27 CFR 555.201(f) (relating to general).

(13) A person who stores explosive materials shall immediately notify the Department, the Pennsylvania State Police and the local police jurisdiction, if any, when any of the following occur:

(i) Evidence is discovered of a break-in or theft at the magazine, or an attempted theft or break-in has occurred.

(ii) The security measures required by this section have been breached or disabled or partially breached or disabled. Short-term partial breaches of security of less than 48-hour duration need not be reported under this subsection if all of the following apply:

(A) The partial breach was due to equipment failure or accidental or natural causes.

(B) An account of the partial breach was recorded under paragraph (1).

(C) Immediate measures are being taken to repair or replace the partial breach.

(iii) Unauthorized persons exhibiting suspicious behavior are observed in the vicinity of the magazine.

(iv) Inventory records indicate that explosive material is missing and unaccounted for.

(14) The notifications to State and local agencies required in paragraphs (12) and (13) are in addition to any notification required by agencies of the United States.

(e) Licensees of magazines licensed prior to June 18, 2005, shall comply with this section according to the following schedule except as approved by the Department under subsections (f) and (g):

(1) Immediately upon June 18, 2005, the inspection and notification requirements shall be implemented.

(2) Within 180 days of approval of the plan required by subsections (f) or (g), implement either the outer or inner perimeter security measure requirements.

(3) Within 360 days of approval of the plan required by subsections (f) or (g), implement the remaining perimeter security measure requirements.

(4) The Department, at its sole discretion, may approve, in writing, a time extension to the requirements of either paragraph (2) or (3) if the licensee has demonstrated a good faith effort to comply with the perimeter security measure requirements imposed under this chapter.

(f) By August 17, 2005, licensees of magazines licensed prior to June 18, 2005, shall submit to the Department on forms provided by the Department:

(1) The plan required by § 211.113(b)(6) (relating to application contents).

(2) A schedule for the implementation of the plan required by § 211.113(b)(6).

(3) If the security enhancements required by subsection (d) cannot be implemented in the time frames required by subsection (e), the plan must include a request for a time extension. The request for a time extension must include a schedule and a justification for the extension. The Department will act upon time extension requests within 30 days of the receipt of the request.

(g) After consultation with the Pennsylvania State Police and the Pennsylvania Office of Homeland Security, the Department may approve, in writing, alternatives to specific requirements of this section which are based upon advanced technology or other alternatives and which, either alone or in combination with other measures, provide at least equivalent security at magazines or magazine sites. The Department will act upon requests for approval of alternative security measures or, upon the written request of the licensee, for approval of plans submitted pursuant to subsection (f) within 30 days of the receipt of the request. The Department may extend this review period for up to an additional 30 days if additional time is necessary to properly review the request.

(h) Requests for Department approval of plans submitted under subsection (f) or alternate requirements, including alternative security measures and time extensions under this section, shall be on forms provided by the Department.

(i) A licensee will be deemed to be in compliance with this section as to having deterred or obstructed, to the greatest extent possible, unauthorized intrusion upon a magazine site if the licensee constructs, installs, implements and maintains the security measures specified in subsection (d), which meet the requirements of this section and which are specified by the licensee in one of the following:

(1) A plan submitted to the Department under subsection (f).

(2) A plan submitted to and approved by the Department under subsection (g).

(3) A plan submitted to the Department under § 211.113(b)(6) (relating to application contents).

Source

The provisions of this § 211.115 amended June 17, 2005, effective June 18, 2005, 35 Pa.B. 3409. Immediately preceding text appears at serial page (281303).

Cross References

This section cited in 25 Pa. Code § 211.113 (relating to application contents).

Subchapter C. PERMITS

Sec.

Source

The provisions of this Subchapter C adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

§ 211.121. General requirements.

(a) Except as otherwise provided in this subchapter, a person may not engage in blasting activities, or sell or purchase explosives in this Commonwealth without first obtaining the appropriate permit from the Department issued under this chapter.

(b) Permits under this chapter are not required for the sale, purchase or use of fireworks governed by the act of May 15, 1939 (35 P. S. § § 1271—1277).

(c) A permit issued under the Surface Mining Conservation and Reclamation Act (52 P. S. § § 1396.1—1396.19a), or the Noncoal Surface Mining and Conservation and Reclamation Act (52 P. S. § § 3301—3326), and the regulations promulgated thereunder, authorizing blasting activity shall act as a blasting activity permit issued under this chapter.

(d) An application for a permit for the sale or purchase of explosives or to conduct blasting activities shall be on a form provided by the Department. A permit will not be issued unless the application is complete and demonstrates that the proposed activities comply with the applicable requirements of this chapter. The Department will notify applicants of an incomplete application and identify the items necessary to complete the application. The permittee shall comply with the approved application, the permit and this chapter.

(e) The Department will not issue a permit to any person who has either:

(1) Failed and continues to fail to comply with this chapter or a condition of a permit issued under this chapter or an order issued to enforce this chapter.

(2) Demonstrated an inability or lack of intention to comply with this chapter as indicated by past or continuing violations.

§ 211.122. Permits to sell explosives.

(a) An application for a permit to sell explosives shall:

(1) Identify the applicant's name, address, telephone number and type of business.

(2) Identify a contact person, including name, title and telephone number.

(3) Specify the type of explosives to be sold.

(4) State whether the applicant will purchase or manufacture the explosives to be sold.

(5) For in-State sellers, include the applicant's magazine license number, if applicable.

(b) Permits to sell explosives are not transferable.

(c) Permits to sell explosives expire on April 30 of each year. If the Department receives a complete renewal application by April 30, the permittee may continue to operate under the current permit until the Department acts on the renewal application.

(d) A permit to sell explosives shall:

(1) Identify the permittee.

(2) Specify the type of explosives that the permittee may sell.

(3) Contain conditions, as necessary, to ensure that the proposed activity complies with applicable statutes and this chapter.

§ 211.123. Permits to purchase explosives.

(a) An application for a permit to purchase explosives shall:

(1) Identify the applicant's name, address, telephone number and type of business.

(2) Identify a contact person, including name, title and telephone number.

(3) Identify the location and license number of the magazine to be used for storing the explosives, if applicable.

(4) Specify the type of explosives that will be purchased.

(5) Specify whether the explosives are being purchased for sale or use by the permittee.

(b) Permits to purchase explosives are not transferable.

(c) Permits to purchase explosives expire on April 30 of each year. If the Department receives a complete renewal application by April 30, the permittee may continue to operate under the current permit until the Department acts on the renewal.

§ 211.124. Blasting activity permits.

(a) An application for a blasting activity permit shall be prepared by a blaster and shall include:

(1) The applicant's name, address, telephone number and type of business.

(2) A contact person's name, title and telephone number.

(3) The identity of independent subcontractors who will be performing the blasting activities.

(4) The type of explosives to be used.

(5) The maximum amount of explosives that will be detonated per delay interval of less than 8 milliseconds.

(6) The maximum amount of explosives that will be detonated in any one blast.

(7) A map indicating the location where the explosives will be used.

(8) The purpose for which the explosives will be used.

(9) The location and license number of the magazine that will be used to store the explosives, if applicable.

(10) A description of how the monitoring requirements of Subchapter G (relating to requirements for monitoring) will be satisfied.

(11) Proof of third party general liability insurance in the amount of $300,000 or greater per occurrence. This requirement is not applicable if the permittee is a noncoal surface mine operator who produces no more than 2,000 tons (1,814 metric tons) of marketable minerals per year from all its noncoal surface mining operations.

(12) The anticipated duration of the blasting activity for which the permit is needed.

(13) The anticipated days of the week and times when blasting may occur.

(14) The distance and direction to the closest building not owned by the permittee or its customer.

(15) Other information needed by the Department to determine compliance with applicable laws and regulations.

(16) The printed name, signature and license number of the blaster who prepared the application.

(17) Proof that residents within 200 feet (65.61 meters) of the blast site were informed of the proposed blasting operation. This notification could be a personal notification, written material left at each residence, or first class mail. The notification will provide general information about the blasting operation including the duration of the operation.

(b) Blasting activity permits are not transferable.

(c) The blasting activity permit shall specify:

(1) The blasting activity permittee.

(2) Any independent subcontractors performing work under this permit.

(3) Limits on particle velocity and airblast.

(4) The types of explosives that may be used.

(5) The duration of the permit.

(6) Other conditions necessary to ensure that the proposed blasting activity complies with the applicable statutes and this chapter.

(d) The permittee may request extensions and modifications by submitting an amended application.

§ 211.125. Blasting activity permit-by-rule.

(a) A person shall be deemed to have a permit for a blasting activity if:

(1) The blasts are designed and performed for a scaled distance of 90 or greater.

(2) No more than 15 pounds (6.81 kilograms) of explosives are detonated per delay interval of less than 8 milliseconds.

(3) The total charge weight per blast does not exceed 150 pounds (68.18 kilograms).

(4) The person notifies the Department either verbally, in writing, or by other means approved by the Department prior to the initial blast. If the person gives verbal notification, a written notice shall be received by the Department within 5 working days. The notification shall indicate the following information for all blasts that will occur under this permit:

(i) The identity of the person.

(ii) The location where the blasting will occur.

(iii) The purpose of the blasting.

(iv) The distance to the nearest building not owned or leased by the person or its customer.

(v) The days of the week and times when blasting may occur.

(vi) The duration of blasting activities under this permit by rule.

(vii) The minimum scaled distance.

(viii) The maximum weight of explosives detonated per delay period of less than 8 milliseconds.

(ix) The maximum total weight of explosives per blast.

(x) A contact person and telephone number.

(5) Blast reports are completed in accordance with § 211.133 (relating to blast report).

(6) The other monitoring and performance standards of this chapter are met.

(b) The Department may revoke a blasting activity permit by rule under one of the following:

(1) The permittee has demonstrated an unwillingness or inability to comply with the applicable regulations.

(2) The blasting activity possesses a sufficient risk of harm to the public or the environment to warrant an individual blasting activity permit.

Subchapter D. RECORDS OF DISPOSITION OF EXPLOSIVES

Sec.

Source

The provisions of this Subchapter D adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

§ 211.131. Sales records.

The seller shall keep an accurate record of every sale of explosives for 3 years. The record shall identify the purchaser's name and address, the Department purchase permit number, the date of the sale and the amount and types of explosives.

§ 211.132. Purchase records.

The purchaser shall keep a record of all purchases of explosives for 3 years. The record shall identify the date, types and amounts of explosives purchased and the name and address of the seller.

§ 211.133. Blast reports.

(a) The blaster-in-charge shall prepare a report of each blast to provide the Department with sufficient information to reconstruct the conditions and events surrounding a blast. The Department may develop and require a blast report form to be used. The blasting activity permittee shall retain the blast report for at least 3 years and shall make the blast report available to the Department upon request. Blast reports shall contain, at a minimum, the following:

(1) The locations of the blast and monitoring readings.

(2) The name of the blasting activity permittee.

(3) The blasting activity permit or appropriate mining permit number.

(4) The date and time of the blast.

(5) The printed name, signature and license number of the blaster-in-charge.

(6) The type of material blasted.

(7) A sketch showing the number of blast holes, burden, spacing, pattern dimensions and point of initiation.

(8) The diameter and depth of blast holes.

(9) The height or length of stemming and deck separation for each hole.

(10) The types of explosives used and arrangement in blast holes.

(11) The total weight in pounds of explosives and primer cartridges used.

(12) The maximum weight in pounds of explosives detonated per delay period of less than 8 milliseconds.

(13) The type of circuit, if electric detonation was used.

(14) The direction and distance in feet from the blast site to the nearest building not owned by the blasting activity permittee or its customer.

(15) A description of the nearest building location not owned or leased by the blasting activity permittee or its customer based upon local landmarks.

(16) The scaled distance.

(17) The weather conditions.

(18) The direction from which the wind was coming.

(19) The measures taken to control flyrock, including whether or not mats were used.

(20) The total quantity and type of detonators used and delays used.

(21) The number of individuals in the blasting crew.

(22) The maximum number of blast holes or portions of blast holes detonated per delay period less than 8 milliseconds.

(23) The monitoring records required by § 211.173 (relating to monitoring records). Monitoring records shall be made part of the blast report within 30 days of the blast. Beginning July 14, 2004, monitoring records shall be made part of the blast report within 14 days of the blast. The Department may grant a waiver to allow monitoring records to be made part of the blasting record within 30 days of the blast if all blasts, regardless of scaled distance, are monitored and monthly summaries of these reports, including the information required in subsection (b), are provided. Monitoring records shall be made part of the blast report within 7 days, if requested by the Department.

(24) If a misfire occurred, the actions taken to make the site safe as specified in § 211.157 (relating to postblast measures).

(b) The Department may require monthly summaries of these reports. The summaries shall include the date and time of the blasts, scaled distance, peak particle velocity, airblast, monitoring location, amount and types of explosives used and other information the Department deems necessary to ensure compliance with this chapter.

Cross References

This section cited in 25 Pa. Code § 211.135 (relating to blasting activity permit-by-rule); 25 Pa. Code § 211.154 (relating to preparing the blast); and 25 Pa. Code § 211.157 (relating to postblast measures).

Subchapter E. TRANSPORTATION OF EXPLOSIVES

Sec.

Source

The provisions of this Subchapter E adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

§ 211.141. General requirements.

The blasting activity, purchase or sale permittee shall:

(1) Immediately unload a vehicle carrying explosives upon reaching a magazine location. The unloaded vehicle shall be removed from the site. The only exception to this requirement is if the vehicle is a licensed magazine under Subchapter B (relating to the storage and classification of explosives).

(2) Load or unload explosives from a vehicle only after the engine is turned off, unless power is needed for the loading or unloading operation. The permittee shall take all precautions necessary, such as blocking the wheels, to prevent the movement of the vehicle while it is being loaded or unloaded.

(3) Load explosives only into a vehicle that is marked in accordance with the Department of Transportation standards for placarding vehicles transporting explosives.

(4) Prohibit smoking within 100 feet of a vehicle used for transporting explosives. ''NO SMOKING'' signs shall be posted when a vehicle containing explosives is parked at a blast site or magazine.

(5) Load no more than 2,000 pounds (908 kilograms) of explosives into an open body vehicle for transporting. The ends and sides shall be high enough to prevent explosives from falling off, and the load shall be covered with a fire-resistant tarpaulin, unless the explosives are transported in a magazine securely attached to the vehicle.

(6) Load explosives into a closed body vehicle if the load is more than 2,000 pounds (908 kilograms) of explosives.

(7) Only load explosives into a vehicle with a bed made of wood or other nonsparking material.

(8) Load explosives into a vehicle which is also transporting metal, metal tools, blasting machines or other articles or materials likely to damage the explosives, only if these items are separated from the explosives by substantial nonsparking bulkheads constructed to prevent damage to the explosives.

(9) Load detonators and other explosives into the same vehicle only if the detonators are in containers that conform to the current version of the *Institute of Makers of Explosives Safety Library Publication # 22* available from the Institute of Makers of Explosives, 1120 Nineteenth Street, N. W., Suite 310, Washington, DC 20036-3605.

(10) Not load explosives into the same vehicle with materials such as matches, firearms, electric storage batteries, corrosive compounds, flammable substances, acids, oxidizing agents and ammonium nitrate not in the original containers.

(11) Only load explosives into vehicles equipped with a fire extinguisher having a National Board of Underwriters Laboratories rating of 10 B:C or more. The fire extinguisher shall be easily accessible and ready for immediate use.

(12) Load explosives into a vehicle so that explosives containers are not exposed to sparks or hot gases from the exhaust tailpipe. Exhaust systems that discharge upwards are recommended to avoid possible exposure of sparks or hot gases to explosives.

(13) Only load explosives into vehicles that have passed the State safety inspection or certification.

Subchapter F. BLASTING ACTIVITIES

Sec.

Source

The provisions of this Subchapter F adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

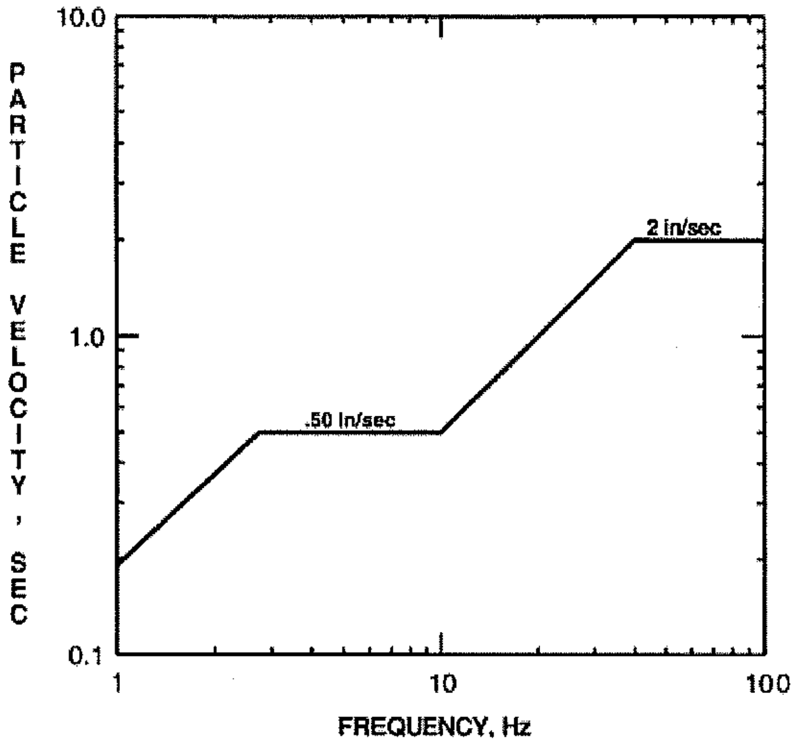
§ 211.151. Prevention of damage.

(a) Blasting may not damage real property except for real property under the control of the permittee. If damage occurs, the blaster-in-charge shall notify the Department within 4 hours of learning of the damage.

(b) Blasting may not cause flyrock. If flyrock occurs, the blaster-in-charge shall notify the Department within 4 hours of learning of the flyrock.

(c) Blasts shall be designed and conducted in a manner that achieves either a scaled distance of 90 or meets the maximum allowable peak particle velocity as indicated by Figure 1 at the closest building or other structure designated by the Department. However, blasting activities authorized prior to July 14, 2001, may continue as authorized unless the authorization is modified, suspended or revoked by the Department. The scaled distance and maximum allowable peak particle velocity does not apply at a building or other structure owned or leased by the permittee or its customer.

Figure 1.



(d) Blasts shall be designed and conducted to control airblast so that it does not exceed the noise levels specified in Table 1 at a building or other structure designated by the Department unless the building is owned or leased by the permittee or its customer.

Table 1

Lower frequency limits of measuring System in Hz(+3dB)	Maximum allowable levels in dBL
0.1 Hz or lower — flat response*	134 peak
2.0 Hz or lower — flat response	133 peak
6.0 Hz or lower — flat response	129 peak
C - weighted — slow response*	105 peak

*only when approved by the Department

(e) The Department may establish an alternative peak particle velocity or airblast level if it determines that an alternative standard is appropriate because of density of population, land use, age or type of structure, geology or hydrology of the area, frequency of blasts or other factors.

Cross References

This section cited in 25 Pa. Code § 211.173 (relating to monitoring records).

§ 211.152. Control of noxious gases.

A blast shall be conducted so that the gases generated by the blast do not affect the health and safety of individuals. Effects from gases may be prevented by taking measures such as venting the gases to the atmosphere, interrupting the path along which gases may flow, and evacuating people from areas that may contain gases.

§ 211.153. General requirements for handling explosives.

(a) Only a nonferrous, nonsparking tool shall be used to open containers of explosives.

(b) Matches, lighters and smoking are prohibited within 100 feet (30.48 meters) of the blast site and areas where explosives are used or stored.

(c) If it becomes necessary to destroy damaged or deteriorated explosives, the permittee shall immediately contact the manufacturer for technical advice and assistance.

(d) Detonators may not be forced into cartridges of explosive or cast boosters. Detonators shall be completely inserted into a hole in an explosive cartridge made with an approved powder punch or into the detonator well of a cast booster.

(e) Explosives may not be left unattended. They are to be stored in a licensed magazine or kept under the permittee's supervision and control.

(f) A loaded blast shall always be under the continuous observation of the blaster-in-charge or a designee.

(g) Shooting or carrying ammunition or firearms on a blast site and in areas where explosives are used or stored is prohibited, except for material needed to initiate the blast.

(h) If blasting activities are conducted in the vicinity of electric lines such as transmission lines or electrified railways, a test shall be made for presence of stray electric currents. Electric blasting caps may not be used if stray electric currents in excess of 50 milliamperes are present.

(i) A package of explosives may not be thrown, slid along floors or over other packages of explosives, or handled roughly.

(j) If an electrical storm approaches an area where there is an activity involving explosives, the area shall be cleared by the permittee or licensee, who shall post guards at all approaches to prevent trespass of unauthorized persons.

(k) Explosives and equipment that are obviously damaged or deteriorated may not be used.

(l) Explosives may not be abandoned.

§ 211.154. Preparing the blast.

(a) The blasting activity permittee shall designate a blaster-in-charge for each blast. The blaster-in-charge shall control and supervise the blasting activity. The blaster-in-charge is responsible for all effects of the blast.

(b) Only equipment necessary for loading blast holes may be allowed to operate within 50 feet (15.24 meters) of the blast site. The Department may establish, in writing, a different distance limitation.

(c) A blaster-in-charge may not prepare or detonate a blast unless another person is present, able and ready to render assistance in the event of accident or injury.

(d) The blaster-in-charge shall make every effort to determine the condition of the material to be blasted from the individual who drilled the blast holes or from the drill log.

(e) Only the blaster-in-charge, other blasters, and up to six assistants per blaster may be at a blast site once loading of blast holes begins.

(f) While loading a blast hole, the following measures shall be followed:

(1) Ferrous material may not be used in the blast hole unless the use is approved by the Department in writing. This includes the use of steel casings, ferrous tools and retrieving equipment.

(2) Only nonferrous, nonsparking tamping sticks may be used in loading a blast hole. Sectional poles connected by brass fittings are permitted, if only the nonferrous, nonsparking end of the pole is used for

tamping. Retrieving hooks shall be made from nonsparking metal such as brass or bronze.

(3) When using a pneumatic loading device, every precaution shall be taken to prevent an accumulation of static electricity. A loading operation shall be stopped immediately if static electricity or stray electrical currents are detected. The condition shall be remedied before loading may be resumed.

(4) The blast hole shall be carefully checked for obstructions with a nonferrous, nonsparking tamping pole, a tape, a light or a mirror before it is loaded. The use of magnifying mirrors is prohibited. Explosives may not be forced past an obstruction in a blast hole.

(5) Each blast hole shall be logged throughout the leading process to measure the amount and location of explosives placed in the blast hole. The information is to be recorded on the blast report required by § 211.133 (relating to blast report).

(6) A blast hole containing loose dynamite shall be stemmed but not tamped.

(7) The Department may specify the type and amount of stemming.

(g) Before connecting one loaded blast hole to another, all activity within the blast area shall cease, and all nonessential persons shall retreat to a safe place. The blaster-in-charge shall determine the blast area.

(h) Primers shall be prepared only at the hole to be loaded, immediately prior to loading. The components of the primer are to be kept separated at the collar of the blast hole. The primer may not be slit, dropped, deformed or carelessly handled and may not be tamped or forced into the blast hole.

(i) Immediately upon completing the loading of a blast hole, any wood, paper or other materials used to pack explosives shall be inspected for the presence of explosives and removed to an isolated area. These materials may be burned after the blast has been fired. Persons may not be within 100 feet (30.48 meters) of these burning materials.

(j) Measures shall be taken to reduce the chance of flyrock including:

(1) The use of blasting mats or other protective devices, if, in the opinion of the blaster-in-charge, the measures are necessary to prevent injuries to persons or damage to property.

(2) When blasting to an open, vertical face, checking the face for loose, hanging material or other faults prior to loading the blast holes.

(k) Explosives may not be brought to a blast site in greater quantities than are expected to be needed for that blast. Surplus explosives may not be stored in the blast area.

(l) Before a blast hole is loaded, it shall be checked to ensure that it is cool and does not contain any hot metal or smoldering material remaining from drilling the hole.

(m) The use of abrasive or sharp-edged constituents in stemming material shall be avoided if tamping is necessary and the tamping may sever blasting cap leg wires, shock tubes or detonating cords.

(n) Blasting activities may not be conducted within 800 feet (243.84 meters) of a public roadway unless precautionary measures are taken to safeguard the public. Precautionary measures include stopping or slowing of traffic and posting signs.

§ 211.155. Preblast measures.

Prior to detonating a blast, the blaster-in-charge shall:

(1) Ensure that all excess explosives have been removed from the blast area and are located in a safe area.

(2) Inspect the blast site to ensure that connections are proper and adequate.

(3) Ensure that the blast area is cleared and safeguarded.

(4) In addition to the warning signal, notify all persons who may be in danger.

(5) Ensure that the necessary precautions are in place to protect the public on public roads.

(6) At least 1 minute but no more than 2 minutes prior to detonation, sound a warning signal of three blasts, each lasting approximately 5 seconds. The warning signal shall be of sufficient power to be heard 1,000 feet (304.80 meters) from the blast site.

§ 211.156. Detonating the blast.

(a) A blast may be detonated only between sunrise and sunset unless the Department authorizes a blast at another time of day.

(b) Only the blaster-in-charge may detonate a blast.

§ 211.157. Postblast measures.

(a) After a blast has been detonated, no one may return to the blast area until all smoke and fumes have dissipated.

(b) After the smoke and fumes have cleared, the blaster-in-charge shall return to the blast site and closely inspect the blast site to ensure that it is safe with respect to the blasting activity.

(c) After the blaster-in-charge has determined the blast area is safe, the blaster-in-charge shall sound an all-clear signal, consisting of one long blast, lasting approximately 10 seconds. This all-clear signal shall be of sufficient power to be heard 1,000 feet (304.80 meters) from the blast site.

(d) The blaster-in-charge shall determine if a misfire occurred and shall take all actions necessary to render the blast site safe. The blast site shall be made safe before drilling or muck removal begins.

(e) If the blaster-in-charge suspects that undetonated ammonium nitrate/fuel mixture remains in the muck pile, the muck pile shall be thoroughly wetted down with water before any digging is attempted. Special attention shall be given to determine if primers, other explosives or detonators are present in the muck pile.

(f) The blaster-in-charge shall immediately complete the blast report as required by § 211.133 (relating to blast report).

(g) The blaster-in-charge shall notify the Department within 24 hours of the occurrence of a misfire. A copy of the blast report shall be forwarded to the Department.

Cross References

This section cited in 25 Pa. Code § 211.133 (relating to blast reports).

§ 211.158. Mudcapping.

Mudcapping in blasting activities is allowed only if the blaster-in-charge determines that drilling the material to be blasted would endanger the safety of the workers. If mudcapping is necessary, no more than 10 pounds (4.53 kilograms) of explosives shall be used for a blast.

§ 211.159. Electric detonation.

(a) Electric blasting caps shall be tested for continuity with a blaster's galvanometer or blaster's multimeter specifically designed for testing blasting circuits. Testing shall be done:

(1) Before the primers are made up.

(2) After the blast hole has been loaded but prior to stemming.

(3) As the final connecting of the circuit progresses.

(b) When a shunt is removed from electric blasting cap leg wires, the exposed wires shall be reshunted.

(c) Electric blasting caps may not be employed in a blast if there is any possibility of wires from the circuit being thrown against overhead or nearby electric lines.

(d) An effort may not be made to reclaim or reuse electric blasting caps if the leg wires have been broken off near the top of the cap.

(e) Leg wires on electric blasting caps shall extend above the top of the blast hole. Wire connections and splices are not allowed in the blast hole.

(f) Only solid wire shall be used in a blasting circuit. The use of stranded wire is prohibited.

(g) When electric detonation is used near public roads, signs shall be erected at least 500 feet (152.40 meters) from the blast areas reading: ''BLAST AREA - SHUT OFF ALL TWO-WAY RADIOS.''

(h) A blasting machine is the only permissible source of electrical power for a detonation.

(i) The blasting circuit shall remain shunted until the time for detonation unless the circuit is being tested or connections are being made.

(j) A sticker shall be displayed on blasting machines that shows they have been tested within the last 30 days by procedures recommended by the manufacturer or supplier to ensure performance at rated capacity. If blasting caps are used in the test, they shall be covered with earth or sand.

(k) When electronic detonation is used, the blaster-in-charge shall determine that adequate current, as specified by the manufacturer of the detonators, is available to properly energize the detonators in the circuit.

§ 211.160. Nonelectric detonation.

Nonelectric initiation systems shall be checked and tested for secure connections in accordance with recommendations of the manufacturer of the system in use.

§ 211.161. Detonating cords.

(a) Detonating cord shall be cut from the supply roll immediately after placement in the blast hole. A sufficient length of downlines shall be left at the top of the blast hole for connections to trunk lines. The supply roll shall be immediately removed from the site. Scrap pieces of detonating cord shall be destroyed after connections are made.

(b) A trunk line shall be covered with at least 12 inches (0.30 meter) of earth or sand, unless otherwise authorized by the Department.

(c) Detonating cord may not be spliced if the resulting splice will fall within a blast hole.

§ 211.162. Safety fuse.

(a) When safety fuse is used in blasting, it shall be long enough to provide a burn time of 120 seconds or longer.

(b) Prior to using safety fuse, the blaster-in-charge shall conduct a test burn. The test burn will utilize at least a 12-inch (0.30-meter) section of fuse which is lit, then timed to determine actual burn time.

(c) A blasting cap shall only be crimped to a safety fuse with a proper crimping tool. A blasting cap may not be attached to a safety fuse in or within 10 feet (3.05 meters) of a magazine.

Subchapter G. REQUIREMENTS FOR MONITORING

Sec.

Source

The provisions of this Subchapter G adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

§ 211.171. General provisions for monitoring.

(a) If the scaled distance of a blast is 90 or numerically less at the closest building not owned or leased by the blasting activity permittee or its customer, ground vibration and airblast monitoring shall be conducted. The Department may require the permittee to conduct ground vibration and airblast monitoring at other buildings or structures even if the scaled distance is greater than 90.

(b) Blasting activities without monitoring may be considered in compliance with this chapter if at a specified location, on at least five blasts, monitoring has demonstrated that the maximum peak particle velocity at the specified location represents more than a 50% reduction from the limit in the permit and this chapter. Future blasts shall maintain a scaled distance equal to or greater than the scaled distance for the monitored blasts.

(c) If monitoring is required, a ground vibration and airblast record of each blast shall be made part of the blast report.

(d) If monitoring is performed with instruments that have variable ''trigger levels,'' the trigger for ground vibration shall be set at a particle velocity of no more than .25 inches per second unless otherwise directed by the Department.

(e) If the peak particle velocity and airblast from a blast are below the set trigger level of the instrument, a printout from the instrument shall be attached to the blast report. This printout shall provide the date and time when the instrument was turned on and off, the set trigger levels and information concerning the status of the instrument during the activation period. When an instrument is used that does not provide this information, the Department will allow the permittee to supply on/off times on a signed statement.

§ 211.172. Monitoring instruments.

If monitoring is required, the monitoring instrument shall provide a permanent record of each blast.

(1) A monitoring instrument for recording ground vibration, at a minimum, shall have:

(i) A frequency range of 2 Hz to 100 Hz.

(ii) Particle velocity range of .02 to 4.0 inches (5.08×10^{-4} to 0.10 meters) per second or greater.

(iii) An internal dynamic calibration system.

(2) A monitoring instrument used to record airblast shall have:

(i) A lower frequency limit of 0.1, 2.0 or 6.0 Hz.

(ii) An upper end flat-frequency response of at least 200 Hz.

(iii) A dynamic range that, at a minimum, extends from 106 to 142 dBL.

(3) A monitoring instrument shall be calibrated annually and when an instrument is repaired and the repair may effect the response of the instrument. Calibration shall be done by the manufacturer of the equipment, or by an organization approved by the manufacturer, or by an organization having verifiable knowledge of the calibration procedures developed by the manufacturer. The calibration procedure shall include testing the response of the entire system to externally-generated dynamic inputs. These inputs shall test the entire monitoring system at a sufficient number of discrete frequency intervals to assure flat response throughout the frequency ranges specified by this chapter. Dynamic reference standards used for calibration shall be traceable to the National Institute of Standards and Technology (NIST). Calibration procedures and documentation of calibration shall be made available for review by the Department.

(4) A nonalterable sticker that is clearly visible shall be firmly affixed to the instrument. The sticker shall indicate the name of the calibration facility, the calibration technician, the date of calibration and frequency range of the airblast monitor.

§ 211.173. Monitoring records.

(a) Anyone using a monitoring instrument shall be trained on the proper use of that instrument by a representative of the manufacturer or distributor, or other competent individual. A record of that training is to be maintained and available for review by the Department.

(b) Monitoring records, at a minimum, shall contain:

(1) A calibration pulse on each of the mutually-perpendicular ground vibration traces. These pulses shall represent the dynamic response of the entire recording system to an internally-generated calibration signal, and shall allow the Department to verify that the seismograph is recording ground vibration to its specific accuracy.

(2) The time history of particle velocities for three mutually perpendicular ground vibration traces and one air-overpressure trace, including time base, amplitude scales and peak values for all traces.

(3) The results of a field calibration test for each channel.

(4) The frequency content of all vibration signals using either single degree of freedom (SDF) response spectrum or half-cycle zero-crossing analysis methods.

(5) Frequency versus particle velocity plots as indicated in § 211.151(c), Figure 1 (relating to prevention of damage).

(6) The name and signature of the individual taking the recording.

(7) The location of the monitoring instrument, date and time of the recording.

(8) The last calibration date of the monitoring instrument.

(c) If the Department questions the validity of a ground vibration or airblast record, or the interpretation of the record, the Department may require a ground vibration or airblast recording to be analyzed or certified by an independent, qualified consultant who is not related to the blasting activity permittee or its customer. When the Department requires that a recording be analyzed or certified, it shall be performed and included with the blast report within 30 days.

Cross References

This section cited in 25 Pa. Code § 211.133 (relating to blast reports).

Subchapter H. BLASTING ACTIVITIES NEAR UTILITY LINES

Sec.

Source

The provisions of this Subchapter H adopted July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751, unless otherwise noted.

§ 211.181. Scope.

This subchapter applies to buried or underground utility lines and utility lines making contact with the surface of the ground.

§ 211.182. General provisions.

(a) Blasts shall be designed and conducted so that they provide the greatest relief possible in a direction away from the utility line and to keep the resulting vibration and actual ground movement to the lowest possible level.

(b) Blasting shall use a type of explosive specifically designed to minimize the likelihood of propagation between explosive charges.

(c) When blasting within 200 feet (60.96 meters) of a utility line, blast holes may not exceed 3 inches (7.62×10^{-2} meters) in diameter.

(d) Blasting in the vicinity of a utility line shall be conducted as follows:

(1) Excavation from the ground surface to a depth corresponding to the elevation of the top of the buried utility line may proceed at the discretion of the blaster-in-charge, using safe, accepted techniques.

(2) Once the excavation has attained a depth equal to the elevation of the top of the buried utility line or if the line is exposed, or makes solid contact with the surface, the vertical depth of subsequent blast holes shall be restricted to one half the horizontal distance from the closest portion of the utility line.

(e) If one or more of the requirements listed in this section are not feasible or creates a potential safety problem, the permittee may apply to the Department for a waiver of the provision or provisions in question. This waiver will be granted if, in the judgment of the Department and the utility owning the lines, the alternate procedure does not endanger the utility line.

APPENDIX A. [Reserved]

Source

The provisions of this Appendix A reserved July 13, 2001, effective July 14, 2001, 31 Pa.B. 3751. Immediately preceding text appears at serial pages (243499) to (243502).

Section V
ATF Background Checks

Department of the Treasury
Bureau of Alcohol, Tobacco and Firearms
Washington, DC 20226

SAFE EXPLOSIVES ACT FACT SHEET

12/12/02

The Safe Explosives Act (the Act) was signed into law by the President on November 25, 2002. The legislation takes effect in two parts. The first two provisions outlined below are effective 60 days after enactment. The last three provisions outlined below are effective 180 days after enactment.

Effective January 24, 2003:

1. New Prohibited Persons Categories: The Act adds three new categories of persons prohibited from receiving or possessing explosives: (1) aliens (with limited exceptions); (2) persons who have been dishonorably discharged from the military; and (3) citizens of the United States who have renounced their citizenship. These categories have been added to the pre-existing list of prohibited persons, which includes felons; fugitives; users of, and persons addicted to, controlled substances; and persons who have been adjudicated mental defectives or committed to mental institutions. All prohibited persons are permitted to apply to the Bureau of Alcohol, Tobacco and Firearms (ATF) for relief from Federal explosives disabilities.

2. Samples: When requested by ATF, manufacturers and importers of explosive materials, including Ammonium Nitrate, must submit samples of these materials to ATF, as well as information on their chemical composition or other information. This will assist ATF in the identification of explosives found at crime scenes.

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Effective May 24, 2003:

1. Intrastate Permit: Intrastate users of explosives must first obtain an ATF "limited permit" prior to receiving explosive materials. Intrastate users may include, for example, farmers or construction companies that acquire and use explosives infrequently and within their own State of residence. The limited permit will allow the purchaser to receive explosive materials from an in-State explosives licensee or permittee on no more than six (6) occasions during the period of the permit. The limited permit will be valid for one year. Currently, intrastate users are exempt from most provisions of Federal explosives law. By contrast, *interstate* users of explosives must obtain ATF user permits; importers, manufacturers, and dealers in explosive materials must obtain ATF licenses. The limited permit will not authorize the permittee to transport or use explosives interstate. This provision is significant, as ultimately all persons possessing explosive materials in either interstate or intrastate commerce must first obtain a Federal license or permit issued by ATF.

2. New Required Industry Information for More Thorough ATF Background Checks: ATF must approve an explosives license or permit application if, among other things, the applicant is not prohibited from possessing explosives. Responsible persons (e.g., facility site managers, corporate officers) will now be required to submit to ATF identifying information, fingerprints, and photographs. Employees of licensees and permittees who will be possessing explosive materials must submit only identifying information. ATF must issue "letters of clearance" for those responsible persons and possessor employees who are not prohibited from possessing explosives. If ATF determines that a responsible person or employee is subject to an explosives prohibition, ATF must provide specific information to the employer and to the prohibited person (e.g., advise of appeal procedures). This new provision is significant, as all persons possessing explosive materials in either interstate or intrastate commerce will have to undergo a background check conducted by ATF.

3. Inspections: Generally, ATF will have to physically inspect all ATF licensees and permittees at least once every three calendar years for compliance with Federal explosives storage regulations.

□ In the case of user permits and licenses, ATF must verify by visual inspection that new applicants and renewal applicants have places of storage for explosive materials that meet the standards of safety and security set forth in the regulations.

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□ In the case of new applicants for limited permits, ATF is not required to conduct a visual inspection of places of storage. Instead, ATF may verify by inspection or by "such other means as the Secretary determines appropriate" that there is acceptable storage. For the first and second renewal of limited permits, ATF may continue to verify storage by "such other means." However, if a field inspection has not been conducted during the previous three years, ATF must, for the third renewal and at least once every three years after that renewal, verify by a field inspection that the limited permittee has acceptable places of storage.

Section VI

ATF -- Subpart K—Storage

§555.201 General.

(a) Section 842(j) of the Act and §555.29 of this part require that the storage of explosive materials by any person must be in accordance with the regulations in this part. Further, section 846 of this Act authorizes regulations to prevent the recurrence of accidental explosions in which explosive materials were involved. The storage standards prescribed by this subpart confer no right or privileges to store explosive materials in a manner contrary to State or local law.

(b) The Director may authorize alternate construction for explosives storage magazines when it is shown that the alternate magazine construction is substantially equivalent to the standards of safety and security contained in this subpart. Any alternate explosive magazine construction approved by the Director prior to August 9, 1982, will continue as approved unless notified in writing by the Director. Any person intending to use alternate magazine construction shall submit a letter application to the regional director (compliance) for transmittal to the Director, specifically describing the proposed magazine. Explosive materials may not be stored in alternate magazines before the applicant has been notified that the application has been approved.

(c) A licensee or permittee who intends to make changes in his magazines, or who intends to construct or acquire additional magazines, shall comply with §555.63.

(d) The regulations set forth in §§555.221 through 555.224 pertain to the storage of display fireworks, pyrotechnic compositions, and explosive materials used in assembling fireworks and articles pyrotechnic.

(e) The provisions of §555.202(a) classifying flash powder and bulk salutes as high explosives are mandatory after March 7, 1990: *Provided,* that those persons who hold licenses or permits under this part on that date shall, with respect to the premises covered by such licenses or permits, comply with the high explosives storage requirements for flash powder and bulk salutes by March 7, 1991.

(f) Any person who stores explosive materials shall notify the authority having jurisdiction for fire safety in the locality in which the explosive materials are being stored of the type, magazine capacity, and location of each site where such explosive materials are stored. Such notification shall be made orally before the end of the day on which storage of the explosive materials commenced and in writing within 48 hours from the time such storage commenced.

(Paragraph (f) approved by the Office of Management and Budget under control number 1512–0536)

[T.D. ATF–87, 46 FR 40384, Aug. 7, 1981, as amended by T.D. ATF–293, 55 FR 3722, Feb. 5, 1990; T.D. ATF–400, 63 FR 45003, Aug. 24, 1998]

§555.202 Classes of explosive materials.

For purposes of this part, there are three classes of explosive materials. These classes, together with the description of explosive materials comprising each class, are as follows:

(a) *High explosives.* Explosive materials which can be caused to detonate by means of a blasting cap when unconfined, (for example, dynamite, flash powders, and bulk salutes). See also §555.201(e).

(b) *Low explosives.* Explosive materials which can be caused to deflagrate when confined (for example, black powder, safety fuses, igniters, igniter cords, fuse lighters, and "display fireworks" classified as UN0333, UN0334, or UN0335 by the U.S. Department of Transportation regulations at 49 CFR 172.101, except for bulk salutes).

(c) *Blasting agents.* (For example, ammonium nitrate-fuel oil and certain water-gels (see also §555.11).

[T.D. ATF–87, 46 FR 40384, Aug. 7, 1981, as amended by T.D. ATF–293, 55 FR 3722, Feb. 5, 1990; T.D. ATF–400, 63 FR 45003, Aug. 24, 1998]

§555.203 Types of magazines.

For purposes of this part, there are five types of magazines. These types, together with the classes of explosive materials, as defined in §555.202, which will be stored in them, are as follows:

(a) *Type 1 magazines.* Permanent magazines for the storage of high explosives, subject to the limitations prescribed by §§555.206 and 555.213. Other classes of explosive materials may also be stored in type 1 magazines.

(b) *Type 2 magazines.* Mobile and portable indoor and outdoor magazines for the storage of high explosives, subject to the limitations prescribed by §§555.206, 555.208(b), and 555.213. Other classes of explosive materials may also be stored in type 2 magazines.

(c) *Type 3 magazines.* Portable outdoor magazines for the temporary storage of high explosives while attended (for example, a "day-box"), subject to the limitations prescribed by §§555.206 and 555.213. Other classes of explosives materials may also be stored in type 3 magazines.

(d) *Type 4 magazines.* Magazines for the storage of low explosives, subject to the limitations prescribed by §§555.206(b), 555.210(b), and 555.213. Blasting agents may be stored in type 4 magazines, subject to the limitations prescribed by §§555.206(c), 555.211(b), and 555.213. Detonators that will not mass detonate may also be stored in type 4 magazines, subject to the limitations prescribed by §§555.206(a), 555.210(b), and 555.213.

(e) *Type 5 magazines.* Magazines for the storage of blasting agents, subject to the limitations prescribed by §§555.206(c), 555.211(b), and 555.213.

§555.204 Inspection of magazines.

Any person storing explosive materials shall inspect his magazines at least every seven days. This inspection need not be an inventory, but must be sufficient to determine whether there has been unauthorized entry or attempted entry into the magazines, or unauthorized removal of the contents of the magazines.

§555.205 Movement of explosive materials.

All explosive materials must be kept in locked magazines meeting the standards in this subpart unless they are:

(a) In the process of manufacture;

(b) Being physically handled in the operating process of a licensee or user;

(c) Being used; or

(d) Being transported to a place of storage or use by a licensee or permittee or by a person who has lawfully acquired explosive materials under §555.106.

§555.206 Location of magazines.

(a) Outdoor magazines in which high explosives are stored must be located no closer to inhabited buildings, passenger railways, public highways, or other magazines in which high explosives are stored, than the minimum distances specified in the table of distances for storage of explosive materials in §555.218.

(b) Outdoor magazines in which low explosives are stored must be located no closer to inhibited buildings, passenger railways, public highways, or other magazines in which explosive materials are stored, than the minimum distances specified in the table of distances for storage of low explosives in §555.219, except that the table of distances in §555.224 shall apply to the storage of display fireworks. The distances shown in §555.219 may not be reduced by the presence of barricades.

(c)(1) Outdoor magazines in which blasting agents in quantities of more than 50 pounds are stored must be located no closer to inhabited buildings, passenger railways, or public highways than the minimum distances specified in the table of distances for storage of explosive materials in §555.218.

(2) Ammonium nitrate and magazines in which blasting agents are stored must be located no closer to magazines in which high explosives or other blasting agents are stored than the minimum distances specified in the table of distances for the separation of ammonium nitrate and blasting agents in §555.220. However, the minimum distances for magazines in which explosives and blasting agents are stored from inhabited buildings, etc., may not be less than the distances specified in the table of distances for storage of explosives materials in §555.218.

[T.D. ATF–87, 46 FR 40384, Aug. 7, 1981, as amended by T.D. ATF–293, 55 FR 3722, Feb. 5, 1990; T.D. ATF–400, 63 FR 45003, Aug. 24, 1998]

§555.207 Construction of type 1 magazines.

A type 1 magazine is a permanent structure: a building, an igloo or "Army-type structure", a tunnel, or a dugout. It is to be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and ventilated.

(a) *Buildings.* All building type magazines are to be constructed of masonry, wood, metal, or a combination of these materials, and have no openings except for entrances and ventilation. The ground around building magazines must slope away for drainage or other adequate drainage provided.

(1) *Masonry wall construction.* Masonry wall construction is to consist of brick, concrete, tile, cement block, or cinder block and be not less than 6 inches in thickness. Hollow masonry units used in construction must have all hollow spaces filled with well-tamped, coarse, dry sand or weak concrete (at least a mixture of one part cement and eight parts of sand with enough water to dampen the mixture while tamping in place). Interior walls are to be constructed of, or covered with, a nonsparking material.

(2) *Fabricated metal wall construction.* Metal wall construction is to consist of sectional sheets of steel or aluminum not less than number 14-gauge, securely fastened to a metal framework. Metal wall construction is either lined inside with brick, solid cement blocks, hardwood not less than four inches thick, or will have at least a six inch sand fill between interior and exterior walls. Interior walls are to be constructed of, or covered with, a nonsparking material.

(3) *Wood frame wall construction.* The exterior of outer wood walls is to be covered with iron or aluminum not less than number 26-gauge. An inner wall of, or covered with nonsparking material will be constructed so as to provide a space of not less than six inches between the outer and inner walls. The space is to be filled with coarse, dry sand or weak concrete.

(4) *Floors.* Floors are to be constructed of, or covered with, a nonsparking material and shall be strong enough to bear the weight of the maximum quantity to be stored. Use of pallets covered with a nonsparking material is considered equivalent to a floor constructed of or covered with a nonsparking material.

(5) *Foundations.* Foundations are to be constructed of brick, concrete, cement block, stone, or wood posts. If piers or posts are used, in lieu of a continuous foundation, the space under the buildings is to be enclosed with metal.

(6) *Roof.* Except for buildings with fabricated metal roofs, the outer roof is to be covered with no less than number 26-guage iron or aluminum, fastened to at least 7/8 inch sheathing.

(7) *Bullet-resistant ceilings or roofs.* Where it is possible for a bullet to be fired directly through the roof and into the magazine at such an angle that the bullet would strike the explosives within, the magazine is to be protected by one of the following methods:

(i) A sand tray lined with a layer of building paper, plastic, or other nonporous material, and filled with not less than four inches of coarse, dry sand, and located at the tops of inner walls covering the entire ceiling area, except that portion necessary for ventilation.

(ii) A fabricated metal roof constructed of 3/16-inch plate steel lined with four inches of hardwood. (For each additional 1/16 inch of plate steel, the hardwood lining may be decreased one inch.)

(8) *Doors.* All doors are to be constructed of not less than 1/4 inch plate steel and lined with at least two inches of hardwood. Hinges and hasps are to be attached to the doors by welding, riveting or bolting (nuts on inside of door). They are to be installed in such a manner that the hinges and hasps cannot be removed when the doors are closed and locked.

(9) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlock fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a casehardened shackle of at least 3/8 inch diameter. Padlocks must be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(10) *Ventilation.* Ventilation is to be provided to prevent dampness and heating of stored explosive materials. Ventilation openings must be screened to prevent the entrance of sparks. Ventilation openings in side walls and foundations must be offset or shielded for bullet-resistant purposes. Magazines having foundation and roof ventilators with the air circulating between the side walls and the floors and between the side walls and the ceiling must have a wooden lattice lining or equivalent to prevent the packages of explosive materials from being stacked against the side walls and blocking the air circulation.

(11) *Exposed metal.* No sparking material is to be exposed to contact with the stored explosive materials. All ferrous metal nails in the floor and side walls, which might be

exposed to contact with explosive materials, must be blind nailed, countersunk, or covered with a nonsparking lattice work or other nonsparking material.

(b) *Igloos, "Army-type structures", tunnels, and dugouts.* Igloo, "Army-type structure", tunnel, and dugout magazines are to be constructed of reinforced concrete, masonry, metal, or a combination of these materials. They must have an earthmound covering of not less than 24 inches on the top, sides and rear unless the magazine meets the requirements of paragraph (a)(7) of this section. Interior walls and floors must be constructed of, or covered with, a nonsparking material. Magazines of this type are also to be constructed in conformity with the requirements of paragraph (a)(4) and paragraphs (a)(8) through (11) of this section.

§555.208 Construction of type 2 magazines.

A type 2 magazine is a box, trailer, semitrailer, or other mobile facility.

(a) *Outdoor magazines*—(1) *General.* Outdoor magazines are to be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and ventilated. They are to be supported to prevent direct contact with the ground and, if less than one cubic yard in size, must be securely fastened to a fixed object. The ground around outdoor magazines must slope away for drainage or other adequate drainage provided. When unattended, vehicular magazines must have wheels removed or otherwise effectively immobiliized by kingpin locking devices or other methods approved by the Director.

(2) *Exterior construction.* The exterior and doors are to be constructed of not less than 1/4-inch steel and lined with at least two inches of hardwood. Magazines with top openings will have lids with water-resistant seals or which overlap the sides by at least one inch when in a closed position.

(3) *Hinges and hasps.* Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks must be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(b) *Indoor magazines*—(1) *General.* Indoor magazines are to be fire-resistant and theft-resistant. They need not be bullet-resistant and weather-resistant if the buildings in which they are stored provide protection from the weather and from bullet penetration. No indoor magazine is to be located in a residence or dwelling. The indoor storage of high explosives must not exceed a quantity of 50 pounds. More than one indoor magazine may be located in the same building if the total quantity of explosive materials stored does not exceed 50 pounds. Detonators must be stored in a separate magazine (except as provided in §555.213) and the total quantity of detonators must not exceed 5,000.

(2) *Exterior construction.* Indoor magazines are to be constructed of wood or metal according to one of the following specifications:

(i) Wood indoor magazines are to have sides, bottoms and doors constructed of at least two inches of hardwood and are to be well braced at the corners. They are to be covered with sheet metal of not less than number 26-gauge (.0179 inches). Nails exposed to the interior of magazines must be countersunk.

(ii) Metal indoor magazines are to have sides, bottoms and doors constructed of not less than number 12-gauge (.1046 inches) metal and be lined inside with a nonsparking material. Edges of metal covers must overlap sides at least one inch.

(3) *Hinges and hasps.* Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter. Padlocks must be protected with not less than 1/4-inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. Indoor magazines located in secure rooms that are locked as provided in this subparagraph may have each door locked with one steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter, if the door hinges and lock hasp are securely fastened to the magazine. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(c) *Detonator boxes.* Magazines for detonators in quantities of 100 or less are to have sides, bottoms and doors constructed of not less than number 12-gauge (.1046 inches) metal and lined with a nonsparking material. Hinges and hasps must be attached so they cannot be removed from the outside. One steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter is sufficient for locking purposes.

§555.209 Construction of type 3 magazines.

A type 3 magazine is a "day-box" or other portable magazine. It must be fire-resistant, weather-resistant, and theft-resistant. A type 3 magazine is to be constructed of not less than number 12-gauge (.1046 inches) steel, lined with at least either 1/2-inch plywood or

1/2-inch Masonite-type hardboard. Doors must overlap sides by at least one inch. Hinges and hasps are to be attached by welding, riveting or bolting (nuts on inside). One steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8-inch diameter is sufficient for locking purposes. Explosive materials are not to be left unattended in type 3 magazines and must be removed to type 1 or 2 magazines for unattended storage.

§555.210 Construction of type 4 magazines.

A type 4 magazine is a building, igloo or "Army-type structure", tunnel, dugout, box, trailer, or a semitrailer or other mobile magazine.

(a) *Outdoor magazines*—(1) *General.* Outdoor magazines are to be fire-resistant, weather-resistant, and theft-resistant. The ground around outdoor magazines must slope away for drainage or other adequate drainage be provided. When unattended, vehicular magazines must have wheels removed or otherwise be effectively immobilized by kingpin locking devices or other methods approved by the Director.

(2) *Construction.* Outdoor magazines are to be constructed of masonry, metal-covered wood, fabricated metal, or a combination of these materials. Foundations are to be constructed of brick, concrete, cement block, stone, or metal or wood posts. If piers or posts are used, in lieu of a continuous foundation, the space under the building is to be enclosed with fire-resistant material. The walls and floors are to be constructed of, or covered with, a nonsparking material or lattice work. The doors must be metal or solid wood covered with metal.

(3) *Hinges and hasps.* Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and case-hardened shackle of at least 3/8 inch diameter. Padlocks must be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(b) *Indoor magazine*—(1) *General.* Indoor magazines are to be fire-resistant and theft-resistant. They need not be weather-resistant if the buildings in which they are stored provide protection from the weather. No indoor magazine is to be located in a residence or dwelling. The indoor storage of low explosives must not exceed a quantity of 50 pounds. More than one indoor magazine may be located in the same building if the total quantity of explosive materials stored does not exceed 50 pounds. Detonators that will not mass detonate must be stored in a separate magazine and the total number of electric detonators must not exceed 5,000.

(2) *Construction.* Indoor magazines are to be constructed of masonry, metal-covered wood, fabricated metal, or a combination of these materials. The walls and floors are to be constructed of, or covered with, a nonsparking material. The doors must be metal or solid wood covered with metal.

(3) *Hinges and hasps.* Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8 inch diameter. Padlocks must be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. Indoor magazines located in secure rooms that are locked as provided in this subparagraph may have each door locked with one steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8 inch diameter, if the door hinges and lock hasp are securely fastened to the magazine. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

§555.211 Construction of type 5 magazines.

A type 5 magazine is a building, igloo or "Army-type structure", tunnel, dugout, bin, box, trailer, or a semitrailer or other mobile facility.

(a) *Outdoor magazines*—(1) *General.* Outdoor magazines are to be weather-resistant and theft-resistant. The ground around magazines must slope away for drainage or other adequate drainage be provided. When unattended, vehicular magazines must have wheels removed or otherwise be effectively immobilized by kingpin locking devices or other methods approved by the Director.

(2) *Construction.* The doors are to be constructed of solid wood or metal.

(3) *Hinges and hasps.* Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside of door). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks.* Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8 inch

diameter. Padlocks must be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. Trailers, semitrailers, and similar vehicular magazines may, for each door, be locked with one steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8 inch diameter, if the door hinges and lock hasp are securely fastened to the magazine and to the door frame. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(5) *Placards*. The placards required by Department of Transportation regulations at 49 CFR part 172, subpart F, for the transportation of blasting agents shall be displayed on all magazines.

(b) *Indoor magazines*—(1) *General*. Indoor magazines are to be theft-resistant. They need not be weather-resistant if the buildings in which they are stored provide protection from the weather. No indoor magazine is to be located in a residence or dwelling. Indoor magazines containing quantities of blasting agents in excess of 50 pounds are subject to the requirements of §555.206 of this subpart.

(2) *Construction*. The doors are to be constructed of wood or metal.

(3) *Hinges and hasps*. Hinges and hasps are to be attached to doors by welding, riveting, or bolting (nuts on inside). Hinges and hasps must be installed so that they cannot be removed when the doors are closed and locked.

(4) *Locks*. Each door is to be equipped with (i) two mortise locks; (ii) two padlocks fastened in separate hasps and staples; (iii) a combination of a mortise lock and a padlock; (iv) a mortise lock that requires two keys to open; or (v) a three-point lock. Padlocks must have at least five tumblers and a case-hardened shackle of at least 3/8 inch diameter. Padlocks must be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples. Indoor magazines located in secure rooms that are locked as provided in this subparagraph may have each door locked with one steel padlock (which need not be protected by a steel hood) having at least five tumblers and a case-hardened shackle of at least 3/8 inch diameter, if the door hinges and lock hasps are securely fastened to the magazine and to the door frame. These requirements do not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

[T.D. ATF–87, 46 FR 40384, Aug. 7, 1981, as amended by T.D. ATF–298, 55 FR 21863, May 30, 1990]

§555.212 Smoking and open flames.

Smoking, matches, open flames, and spark producing devices are not permitted:

(a) In any magazine;

(b) Within 50 feet of any outdoor magazine; or

(c) Within any room containing an indoor magazine.

§555.213 Quantity and storage restrictions.

(a) Explosive materials in excess of 300,000 pounds or detonators in excess of 20 million are not to be stored in one magazine unless approved by the Director.

(b) Detonators are not to be stored in the same magazine with other explosive materials, except under the following circumstances:

(1) In a type 4 magazine, detonators that will not mass detonate may be stored with electric squibs, safety fuse, igniters, and igniter cord.

(2) In a type 1 or type 2 magazine, detonators may be stored with delay devices and any of the items listed in paragraph (b)(1) of this section.

§555.214 Storage within types 1, 2, 3, and 4 magazines.

(a) Explosive materials within a magazine are not to be placed directly against interior walls and must be stored so as not to interfere with ventilation. To prevent contact of stored explosive materials with walls, a nonsparking lattice work or other nonsparking material may be used.

(b) Containers of explosive materials are to be stored so that marks are visible. Stocks of explosive materials are to be stored so they can be easily counted and checked upon inspection.

(c) Except with respect to fiberboard or other nonmetal containers, containers of explosive materials are not to be unpacked or repacked inside a magazine or within 50 feet of a magazine, and must not be unpacked or repacked close to other explosive materials. Containers of explosive materials must be closed while being stored.

(d) Tools used for opening or closing containers of explosive materials are to be of nonsparking materials, except that metal slitters may be used for opening fiberboard containers. A wood wedge and a fiber, rubber, or wooden mallet are to be used for opening or closing wood containers of explosive materials. Metal tools other than nonsparking transfer conveyors are not to be stored in any magazine containing high explosives.

§555.215 Housekeeping.

Magazines are to be kept clean, dry, and free of grit, paper, empty packages and containers, and rubbish. Floors are to be regularly swept. Brooms and other utensils used in the cleaning and maintenance of magazines must have no spark-producing metal parts, and may be kept in magazines. Floors stained by leakage from explosive materials are to be cleaned according to instructions of the explosives manufacturer. When any explosive material has deteriorated it is to be destroyed in accordance with the advice or instructions of the manufacturer. The area surrounding magazines is to be kept clear of rubbish, brush, dry grass, or trees (except live trees more than 10 feet tall), for not less than 25 feet in all directions. Volatile materials are to be kept a distance of not less than 50 feet from outdoor magazines. Living foliage which is used to stabilize the earthen covering of a magazine need not be removed.

§555.216 Repair of magazines.

Before repairing the interior of magazines, all explosive materials are to be removed and the interior cleaned. Before repairing the exterior of magazines, all explosive materials must be removed if there exists any possibility that repairs may produce sparks or flame. Explosive materials removed from magazines under repair must be (a) placed in other magazines appropriate for the storage of those explosive materials under this subpart, or (b) placed a safe distance from the magazines under repair where they are to be properly guarded and protected until the repairs have been completed.

§555.217 Lighting.

(a) Battery-activated safety lights or battery-activated safety lanterns may be used in explosives storage magazines.

(b) Electric lighting used in any explosives storage magazine must meet the standards prescribed by the "National Electrical Code," (National Fire Protection Association, NFPA 70–81), for the conditions present in the magazine at any time. All electrical switches are to be located outside of the magazine and also meet the standards prescribed by the National Electrical Code.

(c) Copies of invoices, work orders or similar documents which indicate the lighting complies with the National Electrical Code must be available for inspection by ATF officers.

§555.218 Table of distances for storage of explosive materials.

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 Quantity of explosives
Distances in feet
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                                Inhabited buildings        Public
highways with traffic      Passenger railways_public        Separation
of magazines
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				highways with traffic volume of 3000 or fewer vehicles/day		highways with traffic volume of more than 3,000 vehicles/day			
Pounds over	Pounds not over	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
0	5	70	140	30	60	51	102	6	12
5	10	90	180	35	70	64	128	8	16
10	20	110	220	45	90	81	162	10	20
20	30	125	250	50	100	93	186	11	22
30	40	140	280	55	110	103	206	12	24
40	50	150	300	60	120	110	220	14	28
50	75	170	340	70	140	127	254	15	30
75	100	190	380	75	150	139	278	16	32
100	125	200	400	80	160	150	300	18	36
125	150	215	430	85	170	159	318	19	38
150	200	235	470	95	190	175	350	21	42
200	250	255	510	105	210	189	378	23	46
250	300	270	540	110	220	201	402	24	48
300	400	295	590	120	240	221	442	27	54
400	500	320	640	130	260	238	476	29	58
500	600	340	680	135	270	253	506	31	62
600	700	355	710	145	290	266	532	32	64
700	800	375	750	150	300	278	556	33	66
800	900	390	780	155	310	289	578	35	70
900	1,000	400	800	160	320	300	600	36	72
1,000	1,200	425	850	165	330	318	636	39	78

1,200	1,400	450	900	170
340	336	672	41	82
1,400	1,600	470	940	175
350	351	702	43	86
1,600	1,800	490	980	180
360	366	732	44	88
1,800	2,000	505	1,010	185
370	378	756	45	90
2,000	2,500	545	1,090	190
380	408	816	49	98
2,500	3,000	580	1,160	195
390	432	864	52	104
3,000	4,000	635	1,270	210
420	474	948	58	116
4,000	5,000	685	1,370	225
450	513	1,026	61	122
5,000	6,000	730	1,460	235
470	546	1,092	65	130
6,000	7,000	770	1,540	245
490	573	1,146	68	136
7,000	8,000	800	1,600	250
500	600	1,200	72	144
8,000	9,000	835	1,670	255
510	624	1,248	75	150
9,000	10,000	865	1,730	260
520	645	1,290	78	156
10,000	12,000	875	1,750	270
540	687	1,374	82	164
12,000	14,000	885	1,770	275
550	723	1,446	87	174
14,000	16,000	900	1,800	280
560	756	1,512	90	180
16,000	18,000	940	1,880	285
570	786	1,572	94	188
18,000	20,000	975	1,950	290
580	813	1,626	98	196
20,000	25,000	1,055	2,000	315
630	876	1,752	105	210
25,000	30,000	1,130	2,000	340
680	933	1,866	112	224
30,000	35,000	1,205	2,000	360
720	981	1,962	119	238
35,000	40,000	1,275	2,000	380
760	1,026	2,000	124	248
40,000	45,000	1,340	2,000	400
800	1,068	2,000	129	258
45,000	50,000	1,400	2,000	420
840	1,104	2,000	135	270
50,000	55,000	1,460	2,000	440
880	1,140	2,000	140	280
55,000	60,000	1,515	2,000	455
910	1,173	2,000	145	290
60,000	65,000	1,565	2,000	470
940	1,206	2,000	150	300
65,000	70,000	1,610	2,000	485
970	1,236	2,000	155	310

70,000	75,000	1,655	2,000	500
1,000	1,263	2,000	160	320
75,000	80,000	1,695	2,000	510
1,020	1,293	2,000	165	330
80,000	85,000	1,730	2,000	520
1,040	1,317	2,000	170	340
85,000	90,000	1,760	2,000	530
1,060	1,344	2,000	175	350
90,000	95,000	1,790	2,000	540
1,080	1,368	2,000	180	360
95,000	100,000	1,815	2,000	545
1,090	1,392	2,000	185	370
100,000	110,000	1,835	2,000	550
1,100	1,437	2,000	195	390
110,000	120,000	1,855	2,000	555
1,110	1,479	2,000	205	410
120,000	130,000	1,875	2,000	560
1,120	1,521	2,000	215	430
130,000	140,000	1,890	2,000	565
1,130	1,557	2,000	225	450
140,000	150,000	1,900	2,000	570
1,140	1,593	2,000	235	470
150,000	160,000	1,935	2,000	580
1,160	1,629	2,000	245	490
160,000	170,000	1,965	2,000	590
1,180	1,662	2,000	255	510
170,000	180,000	1,990	2,000	600
1,200	1,695	2,000	265	530
180,000	190,000	2,010	2,010	605
1,210	1,725	2,000	275	550
190,000	200,000	2,030	2,030	610
1,220	1,755	2,000	285	570
200,000	210,000	2,055	2,055	620
1,240	1,782	2,000	295	590
210,000	230,000	2,100	2,100	635
1,270	1,836	2,000	315	630
230,000	250,000	2,155	2,155	650
1,300	1,890	2,000	335	670
250,000	275,000	2,215	2,215	670
1,340	1,950	2,000	360	720
275,000	300,000	2,275	2,275	690
1,380	2,000	2,000	385	770

TABLE: AMERICAN TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES (DECEMBER 1910), AS REVISED AND APPROVED BY THE INSTITUTE OF MAKERS OF EXPLOSIVES&MDASH;JULY, 1991.

NOTES TO THE TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES

(1) Terms found in the table of distances for storage of explosive materials are defined in §555.11.

(2) When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways, and highways.

(3) All types of blasting caps in strengths through No. 8 cap should be rated at 1 1/2 lbs. (1.5 lbs.) of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

(4) For quantity and distance purposes, detonating cord of 50 or 60 grains per foot should be calculated as equivalent to 9 lbs. of high explosives per 1,000 feet. Heavier or lighter core loads should be rated proportionately.

[T.D. ATF–87, 46 FR 40384, Aug. 7, 1981, as amended by T.D. ATF–400, 63 FR 45003, Aug. 24, 1998; T.D. ATF–446, 66 FR 16602, Mar. 27, 2001; T.D. ATF–446a, 66 FR 19089, Apr. 13, 2001]

§555.219 Table of distances for storage of low explosives.

Pounds		From inhabited building distance (feet)	From public railroad and highway distance (feet)	From above ground magazine (feet)
Over	Not over			
0	1,000	75	75	50
1,000	5,000	115	115	75
5,000	10,000	150	150	100
10,000	20,000	190	190	125
20,000	30,000	215	215	145
30,000	40,000	235	235	155
40,000	50,000	250	250	165
50,000	60,000	260	260	175
60,000	70,000	270	270	185
70,000	80,000	280	280	190
80,000	90,000	295	295	195

90,000	100,000	300	300	200
100,000	200,000	375	375	250
200,000	300,000	450	450	300

§555.220 Table of separation distances of ammonium nitrate and blasting agents from explosives or blasting agents.

TABLE: DEPARTMENT OF DEFENSE AMMUNITION AND EXPLOSIVES STANDARDS, TABLE 5&NDASH;4.1 EXTRACT; 4145.27 M, MARCH 1969

Donor weight (pounds)		Minimum separation distance of acceptor from donor when barricaded (ft.)		Minimum thickness of artificial barricades (in.)
Over	Not over	Ammonium nitrate	Blasting agent	
	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1,000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20

12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	34	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60
275,000	300,000	64	230	60

TABLE: NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) OFFICIAL STANDARD NO. 492, 1968

NOTES OF TABLE OF SEPARATION DISTANCES OF AMMONIUM NITRATE AND BLASTING AGENTS FROM EXPLOSIVES OR BLASTING AGENTS

(1) This table specifies separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the table as the "donor." Ammonium nitrate, by itself, is not considered to be a donor when applying this table. Ammonium nitrate, ammonium nitrate-fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the ammonium nitrate is to be included in the mass of the donor.

(2) When the ammonium nitrate and/or blasting agent is not barricaded, the distances shown in the table must be multiplied by six. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers, and the like which may enclose the "donor." Where explosives storage is in bullet-resistant magazines or where the storage is protected by a bullet-resistant wall, distances and barricade thicknesses in excess of those prescribed in the table in §555.218 are not required.

(3) These distances apply to ammonium nitrate that passes the insensitivity test prescribed in the definition of ammonium nitrate fertilizer issued by the Fertilizer Institute. [1] Ammonium nitrate failing to pass the test must be stored at separation distances in accordance with the table in §555.218.

[1]Definition and Test Procedures for Ammonium Nitrate Fertilizer, Fertilizer Institute 1015–18th St. N.W. Washington, DC 20036.

(4) These distances apply to blasting agents which pass the insensitivity test prescribed in regulations of the U.S. Department of Transportation (49 CFR part 173).

(5) Earth or sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.

(6) For determining the distances to be maintained from inhabited buildings, passenger railways, and public highways, use the table in §555.218.

§555.221 Requirements for display fireworks, pyrotechnic compositions, and explosive materials used in assembling fireworks or articles pyrotechnic.

(a) Display fireworks, pyrotechnic compositions, and explosive materials used to assemble fireworks and articles pyrotechnic shall be stored at all times as required by this Subpart unless they are in the process of manufacture, assembly, packaging, or are being transported.

(b) No more than 500 pounds (227 kg) of pyrotechnic compositions or explosive materials are permitted at one time in any fireworks mixing building, any building or area in which the pyrotechnic compositions or explosive materials are pressed or otherwise prepared for finishing or assembly, or any finishing or assembly building. All pyrotechnic compositions or explosive materials not in immediate use will be stored in covered, non-ferrous containers.

(c) The maximum quantity of flash powder permitted in any fireworks process building is 10 pounds (4.5 kg).

(d) All dry explosive powders and mixtures, partially assembled display fireworks, and finished display fireworks shall be removed from fireworks process buildings at the conclusion of a day's operations and placed in approved magazines.

[T.D. ATF–293, 55 FR 3722, Feb. 5, 1990, as amended by T.D. ATF–400, 63 FR 45004, Aug. 24, 1998]

§555.222 Table of distances between fireworks process buildings and between fireworks process and fireworks nonprocess buildings.

Net weight of fireworks \1\ (pounds)	Display fireworks \2\ (feet)	Consumer fireworks \3\ (feet)
0-100	57	37
101-200	69	37
201-300	77	37
301-400	85	37
401-500	91	37
Above 500	Not permitted \4\ \5\.	Not permitted \4\ \5\

\1\ Net weight is the weight of all pyrotechnic compositions, and explosive materials and fuse only.

\2\ The distances in this column apply only with natural or artificial barricades. If such barricades are not used, the distances must be doubled.

\3\ While consumer fireworks or articles pyrotechnic in a finished state are not subject to regulation, explosive materials used to manufacture or assemble such fireworks or articles are subject to regulation. Thus, fireworks process buildings where consumer fireworks or articles pyrotechnic are being processed shall meet these requirements.

\4\ A maximum of 500 pounds of in-process pyrotechnic compositions, either loose or in partially-assembled fireworks, is permitted in any fireworks process building. Finished display fireworks may not be stored in a fireworks process building.

\5\ A maximum of 10 pounds of flash powder, either in loose form or in assembled units, is permitted in any fireworks process building. Quantities in excess of 10 pounds must be kept in an approved magazine.

[T.D. ATF–293, 55 FR 3723, Feb. 5, 1990, as amended by T.D. ATF–400, 63 FR 45004, Aug. 24, 1998]

§555.223 Table of distances between fireworks process buildings and other specified areas.

Distance from Passenger Railways, Public Highways, Fireworks Plant Buildings used to Store Consumer Fireworks and Articles Pyrotechnic, Magazines and Fireworks Shipping Buildings, and Inhabited Buildings. \3\ \4\ \5\

Net weight of fireworks \1\ (pounds)	Display fireworks \1\ (feet)	Consumer fireworks \2\ (feet)
0-100	200	25
101-200	200	50
201-300	200	50
301-400	200	50
401-500	200	50
Above 500	Not permitted	Not permitted.

\1\ Net weight is the weight of all pyrotechnic compositions, and exposive materials and fuse only.

\2\ While consumer fireworks or articles pyrotechnic in a finished state are not subject to regulation, explosive materials used to manufacture or assemble such fireworks or articles are subject to regulation. Thus, fireworks process buildings where consumer fireworks or articles pyrotechnic are being processed shall meet these requirements.

\3\ This table does not apply to the separation distances between fireworks process buildings (see § 555.222) and between magazines (see §§ 555.218 and 555.224).

\4\ The distances in this table apply with or without artificial or natural barricades or screen barricades. However, the use of barricades is highly recommended.

\5\ No work of any kind, except to place or move items other than explosive materials from storage, shall be conducted in any building designated as a warehouse. A fireworks plant warehouse is not subject to § 555.222 or this section, tables of distances.

[T.D. ATF–293, 55 FR 3723, Feb. 5, 1990, as amended by T.D. ATF–400, 63 FR 45004, Aug. 24, 1998]

§555.224 Table of distances for the storage of display fireworks (except bulk salutes).

Net weight of firework \1\ (pounds)	Distance between magazine and inhabited building, passenger railway, or public highway \3\ \4\ (feet)	Distance between magazines \2\ \3\ (feet)
0-1000	150	100
1001-5000	230	150
5001-10000	300	200
Above 10000	Use table § 555.218	....

\1\ Net weight is the weight of all pyrotechnic compositions, and exposive materials and fuse only.

\2\ For the purposes of applying this table, the term ``magazine'' also includes fireworks shipping buildings for display fireworks.

\3\ For fireworks storage magazines in use prior to (30 days from the date of publication of the final rule in the Federal Register), the distances in this table may be halved if properly barricaded between the magazine and potential receptor sites.

\4\ This table does not apply to the storage of bulk salutes. Use table at § 555.218.

[T.D. ATF–293, 55 FR 3723, Feb. 5, 1990, as amended by T.D. ATF–400, 63 FR 45004, Aug. 24, 1998]

Section VII

PART 77--MANDATORY SAFETY STANDARDS, SURFACE COAL MINES AND SURFACE WORK AREAS OF UNDERGROUND COAL MINES

Subpart A--General

30 CFR § 77.1

Scope.

This Part 77 sets forth mandatory safety standards for bituminous, anthracite, and lignite surface coal mines, including open pit and auger mines, and to the surface work areas of underground coal mines, pursuant to section 101(i) of the Federal Mine Safety and Health Act of 1977.

30 CFR § 77.2

Definitions.

For the purpose of this part 77, the term:

(a) *Active workings* means any place in a coal mine where miners are normally required to work or travel;

(b) *American Table of Distances* means the current edition of "The American Table of Distances for Storage of Explosives" published by the Institute of Makers of Explosives;

(c) *Barricaded* means to obstruct passage of persons, vehicles, or flying materials;

(d) *Berm* means a pile or mound of material capable of restraining a vehicle;

(e) *Blasting agent* means any material consisting of a mixture of a fuel and oxidizer which--
(1) Is used or intended for use in blasting;
(2) Is not classed as an explosive by the Department of Transportation;
(3) Contains no ingredient classed as an explosive by the Department of Transportation; and,
(4) Cannot be detonated by a No. 8 blasting cap when tested as recommended in Bureau of Mines Information Circular 8179.

(f) *Blasting area* means the area near blasting operations in which concussion or flying material can reasonably be expected to cause injury.

(g) *Blasting cap* means a detonator containing a charge of detonating compound, which is ignited by electric current, or the spark of a fuse. Used for detonating explosives.

(h) *Blasting circuit* means electric circuits used to fire electric detonators or to ignite an igniter cord by means of an electric starter.

(i) *Blasting switch* means a switch used to connect a power source to a blasting circuit.

(j) *Box-type magazine* means a small, portable magazine used to store limited quantities of explosives or detonators for short periods of time in locations at the mine which are convenient to the blasting sites at which they will be used.

(k) *Capped fuse* means a length of safety fuse to which a detonator has been attached.

(l) *Capped primer* means a package or cartridge of explosives which is specifically designed to transmit detonation to other explosives and which contains a detonator.

(m) *Certified or registered*, as applied to any person means a person certified or registered by the State in which the coal mine is located to perform duties prescribed by this Part 77, except that, in a State where no program of certification or registration is provided or where the program does not meet at least minimum Federal standards established by the Secretary, such certification or registration shall be by the Secretary.

(n) *Detonating cord or detonating fuse* means a flexible cord containing a core of high explosive.

(o) *Detonator* means a device containing a small detonating charge that is used for detonating an explosive, including, but not limited to blasting caps, exploders, electric detonators, and delay electric blasting caps.

(p) *Electrical grounding* means to connect with the ground to make the earth part of the circuit.

(q) *Explosive* means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. Explosives include, but are not limited to black powder, dynamite, nitroglycerin, fulminate, ammonium nitrate when mixed with a hydrocarbon, and other blasting agents.

(r) *Flash point* means the minimum temperature at which sufficient vapor is released by a liquid or solid to form a flammable vapor-air mixture at atmospheric pressure.

(s) *Low voltage* means up to and including 660 volts, medium voltage means voltages from 661 to 1,000 volts, and high voltage means more than 1,000 volts.

(t) *Misfire* means the complete or partial failure of a blasting charge to explode as planned.

(u) *Primer or Booster* means a package or cartridge of explosive which is designed specifically to transmit detonation to other explosives and which does not contain a detonator.

(v) *Qualified person* means, as the context requires,

(1) An individual deemed qualified by the Secretary and designated by the operator to make tests and examinations required by this Part 77; and,
(2) An individual deemed, in accordance with the minimum requirements to be established by the Secretary, qualified by training, education, and experience, to perform electrical work, to maintain electrical equipment, and to conduct examinations and make tests of all electrical equipment.

(w) *Roll protection* means a framework, safety canopy, or similar protection for the operator when equipment overturns.

(x) *Safety can* means an approved container, of not over 5 gallons capacity, having a spring-closing lid and spout cover.

(y) *Safety fuse* means a train of powder enclosed in cotton, jute yarn, and waterproofing compounds, which burns at a uniform rate; used for firing a cap containing the detonating compound which in turn sets off the explosive charge.

(z) *Safety switch* means a sectionalizing switch that also provides shunt protection in blasting circuits between the blasting switch and the shot area.

(aa) *Secretary* means the Secretary of Labor or his delegate.

Subpart B--Qualified and Certified Persons

30 CFR § 77.100

Certified person.

(a)(1) The provisions of this Part 77 require that certain examinations and tests be made by a certified person. A certified person within the meaning of these provisions is a person who has been certified in accordance with the provisions of paragraph (b) of this §77.100 to perform the duties, and make the examinations and tests which are required by this Part 77 to be performed by a certified person.

(2) A person who has been so certified shall also be considered to be a qualified person within the meaning of those provisions of this Part 77 which require that certain examinations, tests and duties be performed by a qualified person, except those provisions in Subparts F, G, H, I, and J of this part relating to performance of electrical work.

(b) Pending issuance of Federal standards, a person will be considered, to the extent of the certification, a certified person to make examinations, tests and perform duties which are required by this Part 77 to be performed by a certified person:

(1) If he has been certified for such purpose by the State in which the coal mine is located; or

(2) If this person has been certified for such purpose by the Secretary. A person's initial certification is valid for as long as the person continues to satisfy the requirements necessary to obtain the certification and is employed at the same coal mine or by the same independent contractor. The mine operator or independent contractor shall make an application which satisfactorily shows that each such person has had at least 2 years experience at a coal mine or equivalent experience, and that each such person demonstrates to the satisfaction of an authorized representative of the Secretary that such person is able and competent to test for oxygen deficiency with a permissible flame safety lamp, or any other device approved by the Secretary and to test for methane with a portable methane detector approved by the Bureau of Mines, MESA, or MSHA, under Part 22 of this Chapter (Bureau of Mines Schedule 8C), and to perform such other duties for which application for certification is made. Applications for certification by the Secretary should be submitted in writing to the Mine Safety and Health Administration, Certification and Qualification Center, P.O. Box 25367, Denver Federal Center, Denver, Colorado 80225.

30 CFR § 77.101

Tests for methane and for oxygen deficiency; qualified person.

(a) The provisions of Subparts C, P, R, and T of this Part 77 require that tests for methane and for oxygen deficiency be made by a qualified person. A person is a qualified person for these purposes if he is a certified person for such purposes under §77.100.

(b) Pending issuance of Federal standards, a person will be considered a qualified person for testing for methane and oxygen deficiency:

(1) If he has been qualified for this purpose by the State in which the coal mine is located; or

(2) If he has been qualified by the Secretary for these purposes upon a satisfactory showing by the operator of the coal mine that each such person has been trained and designated by the operator to test for methane and oxygen deficiency. Applications for Secretarial qualification should be submitted in writing to the Mine Safety and Health Administration, Certification and Qualification Center, P.O. Box 25367, Denver Federal Center, Denver, Colo. 80225

30 CFR § 77.102

Tests for methane; oxygen deficiency; qualified person, additional requirement.

Notwithstanding the provisions of §77.101, on and after December 30, 1971, no person shall be a qualified person for testing for methane and oxygen deficiency unless he has demonstrated to the satisfaction of an authorized representative of the Secretary that he is able and competent to make such tests and the Mine Safety and Health Administration has issued him a current card which qualifies him to make such tests.

30 CFR § 77.103

Electrical work; qualified person.

(a) Except as provided in paragraph (f) of this section, an individual is a qualified person within the meaning of Subparts F, G, H, I, and J of this Part 77 to perform electrical work (other than work on energized surface high-voltage lines) if:

(1) He has been qualified as a coal mine electrician by a State that has a coal mine electrical qualification program approved by the Secretary; or,

(2) He has at least 1 year of experience in performing electrical work underground in a coal mine, in the surface work areas of an underground coal mine, in a surface coal mine, in a noncoal mine, in the mine equipment manufacturing industry, or in any other industry using or manufacturing similar equipment, and has satisfactorily completed a coal mine electrical training program approved by the Secretary; or,

(3) He has at least 1 year of experience, prior to the date of the application required by paragraph (c) of this section, in performing electrical work underground in a coal mine, in the surface work areas of an underground coal mine, in a surface coal mine, in a noncoal mine, in the mine equipment manufacturing industry, or in any other industry using or manufacturing similar equipment, and he attains a satisfactory grade on each of the series of five written tests approved by the Secretary as prescribed in paragraph (b) of this section.

(b) The series of five written tests approved by the Secretary shall include the following categories:

(1) Direct current theory and application;

(2) Alternating current theory and application;

(3) Electric equipment and circuits;

(4) Permissibility of electric equipment; and,

(5) Requirements of Subparts F through J and S of this Part 77.

(c) In order to take the series of five written tests approved by the Secretary, an individual shall apply to the District Manager and shall certify that he meets the requirements of paragraph (a)(3) of this section. The tests will be administered in the Coal Mine Safety and Health Districts at regular intervals, or as demand requires.

(d) A score of at least 80 percent on each of the five written tests will be deemed to be a satisfactory grade. Recognition shall be given to practical experience in that 1 percentage point shall be added to an individual's score in each test for each additional year of experience beyond the 1 year requirement specified in paragraph (a)(3) of this section; however, in no case shall an individual be given more than 5 percentage points for such practical experience.

(e) An individual may, within 30 days from the date on which he received notification from the Administration of his test scores, repeat those on which he received an unsatisfactory score. If further retesting is necessary after his initial repetition, a minimum of 30 days from the date of receipt of notification of the initial retest scores shall elapse prior to such further retesting.

(f) An individual who has, prior to November 1, 1972, been qualified to perform electrical work specified in Subparts F, G, H, I, and J of this Part 77 (other than work on energized surface high-voltage lines) shall continue to be qualified until June 30, 1973. To remain qualified after June 30, 1973, such individual shall meet the requirements of either paragraph (a)(1), (2), or (3) of this section.

(g) An individual qualified in accordance with this section shall, in order to retain qualification, certify annually to the District Manager, that he has satisfactorily completed a coal mine electrical retraining program approved by the Secretary.

30 CFR § 77.104

Repair of energized surface high-voltage lines; qualified person.

An individual is a qualified person within the meaning of §77.704 of this part for the purpose of repairing energized surface high-voltage lines only if he has had at least 2 years experience in electrical maintenance, and at least 2 years experience in the repair of energized high-voltage lines located on poles or structures.

30 CFR § 77.105

Qualified hoistman; slope or shaft sinking operation; qualifications.

(a)(1) A person is a qualified hoistman within the provisions of Subpart T of this part, for the purpose of operating a hoist at a slope or shaft sinking operation if he has at least 1 year experience operating a hoist plant or maintaining hoist equipment and is qualified by any State as a hoistman or its equivalency, or

(2) If a State has no program for qualifying persons as hoistmen, the Secretary may qualify persons if the operator of the slope or shaft-sinking operation makes an application and a satisfactory showing that the person has had 1 year of experience operating hoists. A person's qualification is valid for as long as the person continues to satisfy the requirements for qualification and is employed at the same coal mine or by the same independent contractor.

(b) Applications for Secretarial qualification should be submitted to the Mine Safety and Health Administration, Certification and Qualification Center, P.O. Box 25367, Denver Federal Center, Denver, Colo. 80225.

30 CFR § 77.106
Records of certified and qualified persons.

The operator of each coal mine shall maintain a list of all certified and qualified persons designated to perform duties under this Part 77.

30 CFR § 77.107
Training programs.

Every operator of a coal mine shall provide a program, approved by the Secretary, of training and retraining both qualified and certified persons needed to carry out functions prescribed in the Act.

30 CFR § 77.107-1
Plans for training programs.

Each operator must submit to the district manager, of the Coal Mine Safety and Health District in which the mine is located, a program or plan setting forth what, when, how, and where the operator will train and retrain persons whose work assignments require that they be certified or qualified. The program must provide--
(a) For certified persons, annual training courses in the tasks and duties which they perform as certified persons, first aid, and the provisions of this part 77; and
(b) For qualified persons, annual courses in performance of the tasks which they perform as qualified persons.

Subpart C--Surface Installations

30 CFR § 77.200
Surface installations; general.

All mine structures, enclosures, or other facilities (including custom coal preparation) shall be maintained in good repair to prevent accidents and injuries to employees.

30 CFR § 77.201
Methane content in surface installations.

The methane content in the air of any structure, enclosure or other facility shall be less than 1.0 volume per centum.

30 CFR § 77.201-1
Tests for methane; qualified person; use of approved device.

Tests for methane in structures, enclosures, or other facilities, in which coal is handled or stored shall be conducted by a qualified person with a device approved by the Secretary at least once during each operating shift, and immediately prior to any repair work in which welding or an open flame is used, or a spark may be produced.

30 CFR § 77.201-2
Methane accumulations; change in ventilation.

If, at any time, the air in any structure, enclosure or other facility contains 1.0 volume per centum or more of methane changes or adjustments in the ventilation of such installation shall be made at once so that the air shall contain less than 1.0 volume per centum of methane.

30 CFR § 77.202
Dust accumulations in surface installations.

Coal dust in the air of, or in, or on the surfaces of, structures, enclosures, or other facilities shall not be allowed to exist or accumulate in dangerous amounts.

30 CFR § 77.203
Use of material or equipment overhead; safeguards.

Where overhead repairs are being made at surface installations and equipment or material is taken into such overhead work areas, adequate protection shall be provided for all persons working or passing below the overhead work areas in which such equipment or material is being used.

30 CFR § 77.204
Openings in surface installations; safeguards.

Openings in surface installations through which men or material may fall shall be protected by railings, barriers, covers or other protective devices.

30 CFR § 77.205
Travelways at surface installations.

(a) Safe means of access shall be provided and maintained to all working places.

(b) Travelways and platforms or other means of access to areas where persons are required to travel or work, shall be kept clear of all extraneous material and other stumbling or slipping hazards.

(c) Inclined travelways shall be constructed of nonskid material or equipped with cleats.

(d) Regularly used travelways shall be sanded, salted, or cleared of snow and ice as soon as practicable.

(e) Crossovers, elevated walkways, elevated ramps, and stairways shall be of substantial construction, provided with handrails, and maintained in good condition. Where necessary toeboards shall be provided.

(f) Crossovers shall be provided where it is necessary to cross conveyors.

(g) Moving conveyors shall be crossed only at designated crossover points.

30 CFR § 77.206
Ladders; construction; installation and maintenance.

(a) Ladders shall be of substantial construction and maintained in good condition.

(b) Wooden members of ladders shall not be painted.

(c) Steep or vertical ladders which are used regularly at fixed locations shall be anchored securely and provided with backguards extending from a point not more than 7 feet from the bottom of the ladder to the top of the ladder.

(d) Fixed ladders shall not incline backwards at any point unless provided with backguards.

(e) Fixed ladders shall be anchored securely and installed to provide at least 3 inches of toe clearance.

(f) Fixed ladders shall project at least 3 feet above landings, or substantial handholds shall be provided above the landings.

30 CFR § 77.207
Illumination.

Illumination sufficient to provide safe working conditions shall be provided in and on all surface structures, paths, walkways, stairways, switch panels, loading and dumping sites, and working areas.

30 CFR § 77.208
Storage of materials.

(a) Materials shall be stored and stacked in a manner which minimizes stumbling or fall-of-material hazards.

(b) Materials that can create hazards if accidentally liberated from their containers shall be stored in a manner that minimizes the dangers.

(c) Containers holding hazardous materials must be of a type approved for such use by recognized agencies.
(d) Compressed and liquid gas cylinders shall be secured in a safe manner.

(e) Valves on compressed gas cylinders shall be protected by covers when being transported or stored, and by a safe location when the cylinders are in use.

30 CFR § 77.209
Surge and storage piles.

No person shall be permitted to walk or stand immediately above a reclaiming area or in any other area at or near a surge or storage pile where the reclaiming operation may expose him to a hazard.

30 CFR § 77.210
Hoisting of materials.

(a) Hitches and slings used to hoist materials shall be suitable for handling the type of materials being hoisted.

(b) Men shall stay clear of hoisted loads.

(c) Taglines shall be attached to hoisted materials that require steadying or guidance.

30 CFR § 77.211
Draw-off tunnels; stockpiling and reclaiming operations; general.

(a) Tunnels located below stockpiles, surge piles, and coal storage silos shall be ventilated so as to maintain concentrations of methane below 1.0 volume per centum.

(b) In addition to the tests for methane required by §77.201 such tests shall also be made before any electric equipment is energized or repaired, unless equipped with a continuous methane monitoring device installed and operated in accordance with the provisions of §77.211-1. Electric equipment shall not be energized, operated, or repaired until the air contains less than 1.0 volume per centum of methane.

30 CFR § 77.211-1
Continuous methane monitoring device; installation and operation; automatic deenergization of electric equipment.

Continuous methane monitoring devices shall be set to deenergize automatically electric equipment when such monitor is not operating properly and to give a warning automatically when the concentration of methane reaches a maximum percentage determined by an authorized representative of the Secretary which shall not be more than 1.0 volume per centum of methane. An authorized representative of the Secretary shall require such monitor to deenergize automatically electric equipment when the concentration of methane reaches a maximum percentage determined by such representative which shall not be more than 2.0 volume per centum of methane.

30 CFR § 77.212
Draw-off tunnel ventilation fans; installation.

When fans are used to ventilate draw-off tunnels the fans shall be:

(a) Installed on the surface;

(b) Installed in fireproof housings and connected to the tunnel openings with fireproof air ducts; and,

(c) Offset from the tunnel opening.

30 CFR § 77.213
Draw-off tunnel escapeways.

When it is necessary for a tunnel to be closed at one end, an escapeway not less than 30 inches in diameter (or of the equivalent, if the escapeway does not have a circular cross section) shall be installed which extends from the closed end of the tunnel to a safe location on the surface; and, if the escapeway is inclined more than 30 degrees from the horizontal it shall be equipped with a ladder which runs the full length of the inclined portion of the escapeway.

30 CFR § 77.214
Refuse piles; general.

(a) Refuse piles constructed on or after July 1, 1971, shall be located in areas which are a safe distance from all underground mine airshafts, preparation plants, tipples, or other surface installations and such piles shall not be located over abandoned openings or steamlines.

(b) Where new refuse piles are constructed over exposed coal beds the exposed coal shall be covered with clay or other inert material as the piles are constructed.

(c) A fireproof barrier of clay or inert material shall be constructed between old and new refuse piles.

(d) Roadways to refuse piles shall be fenced or otherwise guarded to restrict the entrance of unauthorized persons.

30 CFR § 77.215
Refuse piles; construction requirements.

(a) Refuse deposited on a pile shall be spread in layers and compacted in such a manner so as to minimize the flow of air through the pile.

(b) Refuse shall not be deposited on a burning pile except for the purpose of controlling or extinguishing a fire.

(c) Clay or other sealants shall be used to seal the surface of any refuse pile in which a spontaneous ignition has occurred.

(d) Surface seals shall be kept intact and protected from erosion by drainage facilities.

(e) Refuse piles shall not be constructed so as to impede drainage or impound water.

(f) Refuse piles shall be constructed in such a manner as to prevent accidental sliding and shifting of materials.

(g) No extraneous combustible material shall be deposited on refuse piles.

(h) After October 31, 1975 new refuse piles and additions to existing refuse piles, shall be constructed in compacted layers not exceeding 2 feet in thickness and shall not have any slope exceeding 2 horizontal to 1 vertical (approximately 27°) except that the District Manager may approve construction of a refuse pile in compacted layers exceeding 2 feet in thickness and with slopes exceeding 27° where engineering data substantiates that a minimum safety factor of 1.5 for the refuse pile will be attained.

(i) Foundations for new refuse piles and additions to existing refuse piles shall be cleared of all vegetation and undesirable material that according to current, prudent engineering practices would adversely affect the stability of the refuse pile.

(j) All fires in refuse piles shall be extinguished, and the method used shall be in accordance with a plan approved by the District Manager. The plan shall contain as a minimum, provisions to ensure that only those persons authorized by the operator, and who have an understanding of the procedure to be used, shall be involved in the extinguishing operation.

30 CFR § 77.215-1
Refuse piles; identification.

A permanent identification marker, at least six feet high and showing the refuse pile identification number as assigned by the District Manager, the name associated with the refuse pile and the name of the person owning, operating or controlling the refuse pile, shall be located on or immediately adjacent to each refuse pile within the time specified in paragraphs (a) or (b) of this section as applicable.

(a) For existing refuse piles, markers shall be placed before May 1, 1976.

(b) For new or proposed refuse piles, markers shall be placed within 30 days from acknowledgment of the proposed location of a new refuse pile.

30 CFR § 77.215-2
Refuse piles; reporting requirements.

(a) The proposed location of a new refuse pile shall be reported to and acknowledged in writing by the District Manager prior to the beginning of any work associated with the construction of the refuse pile.

(b) Before May 1, 1976, for existing refuse piles, or within 180 days from the date of acknowledgment of the proposed location of a new refuse pile, the person owning, operating or controlling a refuse pile shall submit to the District Manager a report in triplicate which contains the following:

(1) The name and address of the person owning, operating or controlling the refuse pile; the name associated with the refuse pile; the identification number of the refuse pile as assigned by the District Manager; and the identification number of the mine or preparation plant as assigned by MSHA.

(2) The location of the refuse pile indicated on the most recent USGS 7 1/2 minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.

(3) A statement of the construction history of the refuse pile, and a statement indicating whether the refuse pile has been abandoned in accordance with a plan approved by the District Manager.

(4) A topographic map showing at a scale not to exceed 1 inch=400 feet, the present and proposed maximum extent of the refuse pile and the area 500 feet around the proposed maximum perimeter.

(5) A statement of whether or not the refuse pile is burning.

(6) A description of measures taken to prevent water from being impounded by the refuse pile or contained within the refuse pile.

(7) At a scale not to exceed 1 inch=100 feet, cross sections of the length and width of the refuse pile at sufficient intervals to show the approximate original ground surface, the present configuration and the proposed maximum extent of the refuse pile, and mean sea level elevations at significant points.

(8) Any other information pertaining to the stability of the pile which may be required by the District Manager.

(c) The information required by paragraphs (b)(4) through (b)(8) of this section shall be reported every twelfth month from the date of original submission for those refuse piles which the District Manager has determined can present a hazard until the District Manager notifies the operator that the hazard has been eliminated.

30 CFR § 77.215-3
Refuse piles: certification.

(a) Within 180 days following written notification by the District Manager that a refuse pile can present a hazard, the person owning, operating, or controlling the refuse pile shall submit to the District Manager a certification by a registered engineer that the refuse pile is being constructed or has been modified in accordance with current, prudent engineering practices to minimize the probability of impounding water and failure of such magnitude as to endanger the lives of miners.

(b) After the initial certification required by this section and until the District Manager notifies the operator that the hazard has been eliminated, certification shall be submitted every twelfth month from the date of the initial certification.

(c) Certifications required by paragraphs (a) and (b) of this section shall include all information considered in making the certification.

30 CFR § 77.215-4
Refuse piles; abandonment.

When a refuse pile is to be abandoned, the District Manager shall be notified in writing, and if he determines it can present a hazard, the refuse pile shall be abandoned in accordance with a plan submitted by the operator and approved by the District Manager. The plan shall include a schedule for its implementation and describe provisions to prevent burning and future impoundment of water, and provide for major slope stability.

30 CFR § 77.216
Water, sediment, or slurry impoundments and impounding structures; general.

(a) Plans for the design, construction, and maintenance of structures which impound water, sediment, or slurry shall be required if such an existing or proposed impounding structure can:

(1) Impound water, sediment, or slurry to an elevation of five feet or more above the upstream toe of the structure and can have a storage volume of 20 acre-feet or more; or

(2) Impound water, sediment, or slurry to an elevation of 20 feet or more above the upstream toe of the structure; or

(3) As determined by the District Manager, present a hazard to coal miners.

(b) Plans for the design and construction of all new water, sediment, or slurry impoundments and impounding structures which meet the requirements of paragraph (a) of this section shall be submitted in triplicate to and be approved by the District Manager prior to the beginning of any work associated with construction of the impounding structure.

(c) Before May 1, 1976, a plan for the continued use of an existing water, sediment, or slurry impoundment and impounding structure which meets the requirements of paragraph (a) of this section shall be submitted in triplicate to the District Manager for approval.

(d) The design, construction, and maintenance of all water, sediment, or slurry impoundments and impounding structures which meet the requirements of paragraph (a) of this section shall be implemented in accordance with the plan approved by the District Manager.

(e) All fires in impounding structures shall be extinguished, and the method used shall be in accordance with a plan approved by the District Manager. The plan shall contain as a minimum, provisions to ensure that only those persons authorized by the operator, and who have an understanding of the procedures to be used, shall be involved in the extinguishing operation.

30 CFR § 77.216-1
Water, sediment or slurry impoundments and impounding structures; identification.

A permanent identification marker, at least six feet high and showing the identification number of the impounding structure as assigned by the District Manager, the name associated with the impounding structure and name of the person owning, operating, or controlling the structure, shall be located on or immediately adjacent to each water, sediment or slurry impounding structure within the time specified in paragraph (a) or (b) of this section as applicable.

(a) For existing water, sediment or slurry impounding structures, markers shall be placed before May 1, 1976.

(b) For new or proposed water, sediment, or slurry impounding structures, markers shall be placed within 30 days from the start of construction.

30 CFR § 77.216-2
Water, sediment, or slurry impoundments and impounding structures; minimum plan requirements; changes or modifications; certification.

(a) The plan specified in §77.216, shall contain as a minimum the following information:

(1) The name and address of the persons owning, operating or controlling the impoundment or impounding structure; the name associated with the impoundment or impounding structure; the identification number of the impounding structure as assigned by the District Manager; and the identification number of the mine or preparation plant as assigned by MSHA.

(2) The location of the structure indicated on the most recent USGS 7 1/2 minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.

(3) A statement of the purpose for which the structure is or will be used.

(4) The name and size in acres of the watershed affecting the impoundment.

(5) A description of the physical and engineering properties of the foundation materials on which the structure is or will be constructed.

(6) A statement of the type, size, range, and physical and engineering properties of the materials used, or to be used, in constructing each zone or stage of the impounding structure; the method of site preparation and construction of each zone; the approximate dates of construction of the structure and each successive stage; and for existing structures, such history of construction as may be available, and any record or knowledge of structural instability.

(7) At a scale not to exceed 1 inch=100 feet, detailed dimensional drawings of the impounding structure including a plan view and cross sections of the length and width of the impounding structure, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the measurement of the minimum vertical distance between the crest of the impounding structure and the reservoir surface at present and under design storm conditions, sediment or slurry level, water level and other information pertinent to the impoundment itself, including any identifiable natural or manmade features which could affect operation of the impoundment.

(8) A description of the type and purpose of existing or proposed instrumentation.

(9) Graphs showing area-capacity curves.

(10) A statement of the runoff attributable to the probable maximum precipitation of 6-hour duration and the calculations used in determining such runoff.

(11) A statement of the runoff attributable to the storm for which the structure is designed and the calculations used in determining such runoff.

(12) A description of the spillway and diversion design features and capacities and calculations used in their determination.

(13) The computed minimum factor of safety range for the slope stability of the impounding structure including methods and calculations used to determine each factor of safety.

(14) The locations of surface and underground coal mine workings including the depth and extent of such workings within the area 500 feet around the perimeter, shown at a scale not to exceed one inch=500 feet.

(15) Provisions for construction surveillance, maintenance, and repair of the impounding structure.

(16) General provisions for abandonment.

(17) A certification by a registered engineer that the design of the impounding structure is in accordance with current, prudent engineering practices for the maximum volume of water, sediment, or slurry which can be impounded therein and for the passage of runoff from the designed storm which exceeds the capacity of the impoundment; or, in lieu of the certification, a report indicating what additional investigations, analyses, or improvement work are necessary before such a certification can be made, including what provisions have been made to carry out such work in addition to a schedule for completion of such work.

(18) Such other information pertaining to the stability of the impoundment and impounding structure which may be required by the District Manager.

(b) Any changes or modifications to plans for water, sediment, or slurry impoundments or impounding structures shall be approved by the District Manager prior to the initiation of such changes or modifications.

30 CFR § 77.216-3
Water, sediment, or slurry impoundments and impounding structures; inspection requirements; correction of hazards; program requirements.

(a) All water, sediment, or slurry impoundments that meet the requirements of §77.216(a) shall be examined as follows:

(1) At intervals not exceeding 7 days, or as otherwise approved by the District Manager, for appearances of structural weakness and other hazardous conditions.

(2) All instruments shall be monitored at intervals not exceeding 7 days, or as otherwise approved by the District Manager.

(3) Longer inspection or monitoring intervals approved under this paragraph (a) shall be justified by the operator based on the hazard potential and performance of the impounding structure, and shall include a requirement for inspection immediately after a specified rain event approved by the District Manager.

(4) All inspections required by this paragraph (a) shall be performed by a qualified person designated by the person owning, operating, or controlling the impounding structure.

(b) When a potentially hazardous condition develops, the person owning, operating or controlling the impounding structure shall immediately:

(1) Take action to eliminate the potentially hazardous condition;

(2) Notify the District Manager;

(3) Notify and prepare to evacuate, if necessary, all coal miners from coal mine property which may be affected by the potentially hazardous conditions; and

(4) Direct a qualified person to monitor all instruments and examine the structure at least once every eight hours, or more often as required by an authorized representative of the Secretary.

(c) After each examination and instrumentation monitoring referred to in paragraphs (a) and (b) of this section, each qualified person who conducted all or any part of the examination or instrumentation monitoring shall promptly record the results of such examination or instrumentation monitoring in a book which shall be available at the mine for inspection by an authorized representative of the Secretary, and such qualified person shall also promptly report the results of the examination or monitoring to one of the persons specified in paragraph (d) of this section.

(d) All examination and instrumentation monitoring reports recorded in accordance with paragraph (c) of this section shall include a report of the action taken to abate hazardous conditions and shall be promptly signed or countersigned by at least one of the following persons:

(1) The mine foreman;

(2) The assistant superintendent of the mine;

(3) The superintendent of the mine;

(4) The person designated by the operator as responsible for health and safety at the mine.

(e) Before May 1, 1976, the person owning, operating, or controlling a water, sediment, or slurry impoundment which meets the requirements of §77.216(a) shall adopt a program for carrying out the requirements of paragraphs (a) and (b) of this section. The program shall be submitted for approval to the District Manager. The program shall include as a minimum:

(1) A schedule and procedures for examining the impoundment and impounding structure by a designated qualified person;

(2) A schedule and procedures for monitoring any required or approved instrumentation by a designated qualified person;

(3) Procedures for evaluating hazardous conditions;

(4) Procedures for eliminating hazardous conditions;

(5) Procedures for notifying the District Manager;

(6) Procedures for evacuating coal miners from coal mine property which may be affected by the hazardous condition.

(f) Before making any changes or modifications in the program approved in accordance with paragraph (e) of this section, the person owning, operating, or controlling the impoundment shall obtain approval of such changes or modifications from the District Manager.

(g) The qualified person or persons referred to in paragraphs (a), (b)(4), (c), (e)(1), and (e)(2) of this section shall be trained to recognize specific signs of structural instability and other hazardous conditions by visual observation and, if applicable, to monitor instrumentation.

30 CFR § 77.216-4
Water, sediment or slurry impoundments and impounding structures; reporting requirements; certification.

(a) Except as provided in paragraph (b) of this section, every twelfth month following the date of the initial plan approval, the person owning, operating, or controlling a water, sediment, or slurry impoundment and impounding structure that has not been abandoned in accordance with an approved plan shall submit to the District Manager a report containing the following information:

(1) Changes in the geometry of the impounding structure for the reporting period.

(2) Location and type of installed instruments and the maximum and minimum recorded readings of each instrument for the reporting period.

(3) The minimum, maximum, and present depth and elevation of the impounded water, sediment, or slurry for the reporting period.

(4) Storage capacity of the impounding structure.

(5) The volume of the impounded water, sediment, or slurry at the end of the reporting period.

(6) Any other change which may have affected the stability or operation of the impounding structure that has occurred during the reporting period.

(7) A certification by a registered professional engineer that all construction, operation, and maintenance was in accordance with the approved plan.

(b) A report is not required under this section when the operator provides the District Manager with a certification by a registered professional engineer that there have been no changes under paragraphs (1) through (6) of this section to the impoundment or impounding structure. However, a report containing the information set out in paragraph of this section shall be submitted to the District Manager at least every 5 years.

30 CFR § 77.216-5
Water, sediment or slurry impoundments and impounding structures; abandonment.

(a) Prior to abandonment of any water, sediment, or slurry impoundment and impounding structure which meets the requirements of 30 CFR 77.216(a), the person owning, operating, or controlling such an impoundment and impounding structure shall submit to and obtain approval from the District Manager, a plan for abandonment based on current, prudent engineering practices. This plan shall provide for major slope stability, include a schedule for the plan's implementation and, except as provided in paragraph (b) of this section, contain provisions to preclude the probability of future impoundment of water, sediment, or slurry.

(b) An abandonment plan does not have to contain a provision to preclude the future impoundment of water if the plan is approved by the District Manager and documentation is included in the abandonment plan to ensure that the following requirements are met:

(1) A registered professional engineer, knowledgeable in the principles of dam design and in the design and construction of the structure, shall certify that it substantially conforms to the approved design plan and specifications and that there are no apparent defects.

(2) The current owner or prospective owner shall certify a willingness and ability to assume responsibility for operation and maintenance of the structure.

(3) A permit or approval for the continued existence of the impoundment or impounding structure shall be obtained from the Federal or State agency responsible for dam safety.

30 CFR § 77.217
Definitions.

For the purpose of §§77.214 through 77.216-5, the term:

(a) *Abandoned* as applied to any refuse pile or impoundment and impounding structure means that work on such pile or structure has been completed in accordance with a plan for abandonment approved by the District Manager.

(b) *Area-capacity curves* means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations.

(c) *Impounding structure* means a structure which is used to impound water, sediment, or slurry, or any combination of such materials.

(d) *Probable maximum precipitation* means the value for a particular area which represents an envelopment of depth-duration-area rainfall relations for all storm types affecting that area adjusted meteorologically to maximum conditions.

(e) *Refuse pile* means a deposit of coal mine waste which may contain a mixture of coal, shale, claystone, siltstone, sandstone, limestone, and related materials that are excavated during mining operations or separated from mined coal and disposed of on the surface as waste byproducts of either coal mining or preparation operations. *Refuse pile* does not mean temporary spoil piles of removed overburden material associated with surface mining operations.

(f) *Safety factor* means the ratio of the forces tending to resist the failure of a structure to the forces tending to cause such failure as determined by accepted engineering practice.

Subpart D--Thermal Dryers

30 CFR § 77.300
Thermal dryers; general.

On and after July 1, 1971 dryer systems used for drying coal at high temperatures, hereinafter referred to as thermal dryers, including rotary dryers, continuous carrier dyes, vertical tray, and cascade dryers, multilouver dryers, suspension or flash dryers, and fluidized bed dryers, shall be maintained and operated in accordance with the provision of §77.301 to §77.306.

30 CFR § 77.301
Dryer heating units; operation.

(a) Dryer heating units shall be operated to provide reasonably complete combustion before heated gases are allowed to enter hot gas inlets.

(b) Dryer heating units which are fired by pulverized coal, shall be operated and maintained in accordance with the recommended standards set forth in the National Fire Protection Association Handbook, 12th Edition, Section 9, "Installation of Pulverized Fuel Systems," 1962.

30 CFR § 77.302
Bypass stacks.

Thermal dryer systems shall include a bypass stack, relief stack or individual discharge stack provided with automatic venting which will permit gases from the dryer heating unit to bypass the heating chamber and vent to the outside atmosphere during any shutdown operation.

30 CFR § 77.303
Hot gas inlet chamber dropout doors.

Thermal dryer systems which employ a hot gas inlet chamber shall be equipped with drop-out doors at the bottom of the inlet chamber or with other effective means which permit coal, fly-ash, or other heated material to fall from the chamber.

30 CFR § 77.304
Explosion release vents.

Drying chambers, dry-dust collectors, ductwork connecting dryers to dust collectors, and ductwork between dust collectors and discharge stacks shall be protected with explosion release vents which open directly to the outside atmosphere, and all such vents shall be:

(a) Hinged to prevent dislodgment;

(b) Designed and constructed to permit checking and testing by manual operation; and

(c) Equal in size to the cross-sectional area of the collector vortex finder when used to vent dry dust collectors.

30 CFR § 77.305
Access to drying chambers, hot gas inlet chambers and ductwork; installation and maintenance.

Drying chambers, hot gas inlet chambers and all ductwork in which coal dust may accumulate shall be equipped with tight sealing access doors which shall remain latched during dryer operation to prevent the emission of coal dust and the loss of fluidizing air.

30 CFR § 77.306
Fire protection.

Based on the need for fire protection measures in connection with the particular design of the thermal dryer, an authorized representative of the Secretary may require any of the following measures to be employed:

(a) Water sprays automatically actuated by rises in temperature to prevent fire, installed inside the thermal dryer systems, and such sprays shall be designed to provide for manual operation in the event of power failure.

(b) Fog nozzles, or other no less effective means, installed inside the thermal dryer systems to provide additional moisture or an artificial drying load within the drying system when the system is being started or shutdown.

(c) The water system of each thermal dryer shall be interconnected to a supply of compressed air which permits constant or frequent purging of all water sprays and fog nozzles or other no less effective means of purging shall be provided.

30 CFR § 77.307
Thermal dryers; location and installation; general.

(a) Thermal dryer systems erected or installed at any coal mine after June 30, 1971 shall be located at least 100 feet from any underground coal mine opening, and 100 feet from any surface installation where the heat, sparks, flames, or coal dust from the system might cause a fire or explosion.

(b) Thermal dryer systems erected or installed after June 30, 1971 may be covered by roofs, however, such systems shall not be otherwise enclosed unless necessary to protect the health and safety of persons employed at the mine. Where such systems are enclosed, they shall be located in separate fireproof structures of heavy construction with explosion pressure release devices (such as hinged wall panels, window sashes, or louvers); which provide at least 1 square foot of area for each 80 cubic feet of space volume and which are distributed as uniformly as possible throughout the structure.

30 CFR § 77.308
Structures housing other facilities; use of partitions.

Thermal dryer systems installed after June 30, 1971 in any structure which also houses a tipple, cleaning plant, or other operating facility shall be separated from all other working areas of such structure by a substantial partition capable of providing greater resistance to explosion pressures than the exterior wall or walls of the structure. The partition shall also include substantial, self-closing fire doors at all entrances to the areas adjoining the dryer system.

30 CFR § 77.309
Visual check of system equipment.

Frequent visual checks shall be made by the operator of the thermal dryer system control station, or by some other competent person, of the bypass dampers, air-tempering louvers, discharge mechanism, and other dryer system equipment.

30 CFR § 77.309-1
Control stations; location.

Thermal dryer system control stations constructed after June 30, 1971, shall be installed at a location which will give to the operator of the control station the widest field of visibility of the system and equipment.

30 CFR § 77.310
Control panels.

(a) All thermal dryer system control panels constructed after June 30, 1971 shall be located in an area which is relatively free of moisture and dust and shall be installed in such a manner as to minimize vibration.

(b) A schematic diagram containing legends which show the location of each thermocouple, pressure tap, or other control or gaging instrument in the drying system shall be posted on or near the control panel of each thermal drying system.

(c) Each instrument on the control panel shall be identified by a nameplate or equivalent marking.

(d) A plan to control the operation of each thermal dryer system shall be posted at or near the control panel showing a sequence of startup, normal shutdown, and emergency shutdown procedures.

30 CFR § 77.311
Alarm devices.

Thermal dryer systems shall be equipped with both audible and visual alarm devices which are set to operate when safe dryer temperatures are exceeded.

30 CFR § 77.312
Fail safe monitoring systems.

Thermal dryer systems and controls shall be protected by a fail safe monitoring system which will safely shut down the system and any related equipment upon failure of any component in the dryer system.

30 CFR § 77.313
Wet-coal feedbins; low-level indicators.

Wet-coal bins feeding thermal drying systems shall be equipped with both audible and visual low-coal-level indicators.

30 CFR § 77.314
Automatic temperature control instruments.

(a) Automatic temperature control instruments for thermal dryer system shall be of the recording type.

(b) Automatic temperature control instruments shall be locked or sealed to prevent tampering or unauthorized adjustment. These instruments shall not be set above the maximum allowable operating temperature.

(c) All dryer control instruments shall be inspected and calibrated at least once every 3 months and a record or certificate of accuracy, signed by a trained employee or by a servicing agent, shall be kept at the plant.

30 CFR § 77.315
Thermal dryers; examination and inspection.

Thermal dryer systems shall be examined for fires and coal-dust accumulations if the dryers are not restarted promptly after a shutdown.

Subpart E--Safeguards for Mechanical Equipment

30 CFR § 77.400
Mechanical equipment guards.

(a) Gears; sprockets; chains; drive, head, tail, and takeup pulleys; flywheels; couplings; shafts; sawblades; fan inlets; and similar exposed moving machine parts which may be contacted by persons, and which may cause injury to persons shall be guarded.

(b) Overhead belts shall be guarded if the whipping action from a broken line would be hazardous to persons below.

(c) Guards at conveyor-drive, conveyor-head, and conveyor-tail pulleys shall extend a distance sufficient to prevent a person from reaching behind the guard and becoming caught between the belt and the pulley.

(d) Except when testing the machinery, guards shall be securely in place while machinery is being operated.

30 CFR § 77.401
Stationary grinding machines; protective devices.

(a) Stationary grinding machines other than special bit grinders shall be equipped with:

(1) Peripheral hoods (less than 90° throat openings) capable of withstanding the force of a bursting wheel.

(2) Adjustable tool rests set as close as practical to the wheel.

(3) Safety washers.

(b) Grinding wheels shall be operated within the specifications of the manufacturer of the wheel.

(c) Face shields or goggles, in good condition, shall be worn when operating a grinding wheel.

30 CFR § 77.402
Hand-held power tools; safety devices.

Hand-held power tools shall be equipped with controls requiring constant hand or finger pressure to operate the tools or shall be equipped with friction or other equivalent safety devices.

30 CFR § 77.403
Mobile equipment; falling object protective structures (FOPS).

(a) When necessary to protect the operator of the equipment, all rubber-tired or crawler-mounted self-propelled scrapers, front-end loaders, dozers, graders, loaders, and tractors, with or without attachments, that are used in surface coal mines or the surface work areas of underground coal mines shall be provided with substantial falling object protective structures (FOPS). FOPS which meet the requirements of the Society of Automotive Engineers (SAE) Standard J 231 shall be considered to be a "substantial" FOPS. An authorized representative of the Secretary may approve a FOPS which provides protection equivalent to SAE J 231.

(b) When necessary to protect the operator of the equipment, forklift or powered industrial trucks shall be provided with substantial FOPS. Such FOPS shall meet the requirements of the State of California, Division of Industrial Safety, General Safety Orders, Register 72, Number 6, February 8, 1972, Article 25, Section 3655--"Overhead Guards for High-Lift Rider Trucks."

30 CFR § 77.403a
Mobile equipment; rollover protective structures (ROPS).

(a) All rubber-tired or crawler-mounted self-propelled scrapers, front-end loaders, dozers, graders, loaders, and tractors, with or without attachments, that are used in surface coal mines or the surface work areas of underground coal mines shall be provided with rollover protective structures (hereinafter referred to as ROPS) in accordance with the requirements of paragraphs (b) through (f) of this section, as applicable.

(b) *Mobile equipment manufactured on and after September 1, 1974.* All mobile equipment described in paragraph (a) of this section manufactured on and after September 1, 1974 shall be equipped with ROPS meeting the requirements of the Department of Labor specified in §§1926.1001 and 1926.1002 of Part 1926, Title 29, Code of Federal Regulations--Safety and Health Regulations for Construction.

(c) *Mobile equipment manufactured prior to September 1, 1974.* All mobile equipment described in paragraph (a) of this section manufactured prior to September 1, 1974 shall be equipped with ROPS meeting the requirements of paragraphs (d) through (f) of this section, as appropriate, no later than the dates specified in paragraphs (1), (2), and (3) of this paragraph (c), unless an earlier date is required by an authorized representative of the Secretary under paragraph (c)(4) of this section:

(1) Mobile equipment manufactured between July 1, 1971, and September 1, 1974, shall be equipped with ROPS no later than March 1, 1975.

(2) Mobile equipment manufactured between July 1, 1970, and June 30, 1971, shall be equipped with ROPS no later than July 1, 1975.

(3) Mobile equipment manufactured between July 1, 1969, and June 30, 1970, shall be equipped with ROPS no later than January 1, 1976.

(4) Irrespective of the time periods specified in paragraph (c) (1) through (3) of this section an authorized representative of the Secretary may require such mobile equipment to be equipped with ROPS at an earlier date when necessary to protect the operator of the equipment under the conditions in which the mobile equipment is, or will be operated. The authorized representative of the Secretary shall in writing advise the operator that the equipment shall be equipped with a ROPS and shall fix a time within which the operator shall provide and install the ROPS. If such ROPS is not provided and installed within the time fixed a notice shall be issued to the operator pursuant to section 104 of the Act.

(5) Nothing in this §77.403a shall preclude the issuance of a withdrawal order because of imminent danger.

(d) Except as provided in paragraph (e) of this section, mobile equipment described in paragraph (a) of this section, manufactured prior to September 1, 1974, shall be deemed in compliance with this section if the ROPS is installed in accordance with the recommendations of the ROPS manufacturer or designer. The coal mine operator shall exhibit certification from the ROPS manufacturer or designer in the form of a label attached to the equipment, indicating the manufacturer's or fabricator's name and address, the ROPS model number, if any, the machine make, model or series number that the structure is designed to fit, and compliance with the applicable specification listed in paragraph (c)(1) or (2) of this section, or he shall, upon request of the authorized representative of the Secretary, furnish certification from a registered professional engineer that:

(1) The ROPS complies with the Society of Automotive Engineers (SAE) Standard J 397, "Critical Zone--Characteristics and Dimensions for Operators of Construction and Industrial Machinery" or SAE J 397a, "Deflection Limiting Volume for Laboratory Evaluation of Rollover Protective Structures (ROPS) and Falling Object Protective Structures (FOPS) of Construction and Industrial Vehicles" and the following applicable SAE Standards:

(d)(1)(i) J 320a, "Minimum Performance Criteria for Rollover Protective Structure for Rubber-Tired Self-Propelled Scrapers" or J 320b, "Minimum Performance Criteria for Rollover Protective Structures for Prime Movers"; or

(d)(1)(ii) J 394, "Minimum Performance Criteria for Rollover Protective Structure for Rubber-Tired Front-End Loaders and Rubber-Tired Dozers" or J 394a, "Minimum Performance Criteria for Rollover Protective Structures for Wheeled Front-End Loaders and Wheeled Dozers"; or

(d)(1)(iii) J 395, "Minimum Performance Criteria for Rollover Protective Structure for Crawler Tractors and Crawler-Type Loaders" or J 395a, "Minimum Performance Criteria for Rollover Protective Structures for Track-Type Tractors and Track-Type Front-End Loaders"; or

(d)(1)(iv) J 396 or J 396a, "Minimum Performance Criteria for Rollover Protective Structures for Motor Graders"; or

(d)(1)(v) J 167, "Protective Frame with Overhead Protection--Test Procedures and Performance Requirements"; or

(d)(1)(vi) J 334a, "Protective Frame Test Procedures and Performance Requirements"; or

(2) The ROPS and supporting attachments will:

(d)(2)(i) Show satisfactory performance by actual test of a prototype involving a roll of 720° or more; or

(d)(2)(ii) Support not less than the weight of the vehicle applied as a uniformly distributed horizontal load at the top of the structure and perpendicular to a vertical plane through the longitudinal axis of the prime mover, and support two times the weight of the vehicle applied as a uniformly distributed vertical load to the top of the structure;[1] or

[1] Paragraph (d) or §77.403a is based on the ROPS criteria of the U.S. Army Corps of Engineers, Safety General Safety--Requirements EM 385-1-1, Change 1, No. 21, Para. 18.A.20 (March 27, 1972), except that subparagraph (2)(ii) of this paragraph (d) is substituted for Para. 18.A.20e(2) of the Corps requirements.

(d)(2)(iii) Support the following separately applied minimum loads:

(d)(2)(iii)(A) 125 percent of the weight of the vehicle applied as a uniformly distributed horizontal load at the top of the ROPS and perpendicular to a critical plane through the longitudinal axis of the prime mover; and

(d)(2)(iii)(B) A load of twice the weight of the vehicle applied as a uniformly distributed vertical load to the top of the ROPS after complying with paragraph (d)(1)(iii)(A) of this section. Stresses shall not exceed the ultimate strength. Steel used in the ROPS must have capability to perform at 0° F., or exhibit Charpy V-notch impact strength at 8 ft.-lb. at -20° F. with a standard Charpy V-notch Type A specimen and provide 20 percent elongation over two inches in a standard two inch gauge length on a 0.505 inch diameter tensile specimen. Bolts and nuts shall be SAE grade 8 (reference SAE J 429d, J 429e, J 429f or J 429g and J 995, J 995a or J 995b).

(e) *Mobile equipment manufactured prior to September 1, 1974 meeting certain existing governmental requirements for ROPS.* Mobile equipment described in paragraph (a) of this section, manufactured prior to September 1, 1974 and already equipped with ROPS, shall be deemed in compliance with this section if it meets the ROPS requirements of the State of California, the U.S. Army Corps of Engineers, the Bureau of Reclamation of the

U.S. Department of the Interior in effect on April 5, 1972, or the Occupational Safety and Health Administration, U.S. Department of Labor. The requirements in effect are:

(1) State of California: Construction Safety Orders 1591(i), 1596, and Logging and Sawmill Safety Order 5243, issued by the Department of Industrial Relations pursuant to Division 5, Labor Code §6312, State of California;

(2) U.S. Army Corps of Engineers: Safety--General Safety Requirements, EM-385-1-1 (March 1967);

(3) Bureau of Reclamation, U.S. Department of the Interior: Safety and Health Regulations for Construction, Part II (September 1971); and

(4) Occupational Safety and Health Administration, U.S. Department of Labor: Safety and Health Regulations for Construction, 29 CFR 1926.1001 and 1926.1002.

(f) Field welding on ROPS shall be performed by welders who are certified by the coal mine operator or equipment distributor as being qualified in accordance with the American Welding Society Structural Welding Code AWS D1.1-73, or Military Standard MIL-STD 248, or the equivalent thereof.

(g) Seat belts required by §77.1710(i) shall be worn by the operator of mobile equipment required to be equipped with ROPS by §77.403a.

30 CFR § 77.400b
Incorporation by reference.

In accordance with 5 U.S.C. 552(a), the publications to which references are made in §§77.403 and 77.403a and which have been prepared by organizations other than the Mine Safety and Health Administration (MSHA), are hereby incorporated by reference and made a part hereof. The incorporated publications are available at each Coal Mine Health and Safety District and Subdistrict Office of MSHA. The U.S. Army Corps of Engineers, Safety--General Safety Requirements and the Occupational Safety and Health Administration regulations are also available from the U.S. Government Printing Office, Washington, DC 20402. Bureau of Reclamation Safety and Health Regulations for Construction are available from the Bureau of Reclamation, Division of Safety, Engineering and Research Center, Denver, Colorado. SAE documents are available from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096. American Welding Society Structural Welding Code D1-1-73 is available from the American Welding Society, Inc., 550 N.W. LeJeune Road, Miami, FL 33126. Military Standard MIL-STD 248 is available from the U.S. Government Printing Office, Washington, DC 20202.

30 CFR § 77.404
Machinery and equipment; operation and maintenance.

(a) Mobile and stationary machinery and equipment shall be maintained in safe operating condition and machinery or equipment in unsafe condition shall be removed from service immediately.

(b) Machinery and equipment shall be operated only by persons trained in the use of and authorized to operate such machinery or equipment.

(c) Repairs or maintenance shall not be performed on machinery until the power is off and the machinery is blocked against motion, except where machinery motion is necessary to make adjustments.

(d) Machinery shall not be lubricated while in motion where a hazard exists, unless equipped with extended fittings or cups.

30 CFR § 77.405
Performing work from a raised position; safeguards.

(a) Men shall not work on or from a piece of mobile equipment in a raised position until it has been blocked in place securely. This does not preclude the use of equipment specifically designed as elevated mobile work platforms.

(b) No work shall be performed under machinery or equipment that has been raised until such machinery or equipment has been securely blocked in position.

30 CFR § 77.406
Drive belts.

(a) Drive belts shall not be shifted while in motion unless the machines are provided with mechanical shifters.

(b) Belt dressing shall not be applied while belts are in motion except where it can be applied without endangering a person.

30 CFR § 77.407
Power-driven pulleys.

(a) Belts, chains, and ropes shall not be guided onto power-driven moving pulleys, sprockets, or drums with the hands except on slow moving equipment especially designed for hand feeding.

(b) Pulleys of conveyors shall not be cleaned manually while the conveyor is in motion.

30 CFR § 77.408
Welding operations.

Welding operations shall be shielded and the area shall be well-ventilated.

30 CFR § 77.409
Shovels, draglines, and tractors.

(a) Shovels, draglines, and tractors shall not be operated in the presence of any person exposed to a hazard from its operation and all such equipment shall be provided with an adequate warning device which shall be sounded by the operator prior to starting operation.

(b) Shovels and draglines shall be equipped with handrails along and around all walkways and platforms.

30 CFR § 77.410
Mobile equipment; automatic warning devices.

(a) Mobile equipment such as front-end loaders, forklifts, tractors, graders, and trucks, except pickup trucks with an unobstructed rear view, shall be equipped with a warning device that--

(1) Gives an audible alarm when the equipment is put in reverse; or

(2) Uses infrared light, ultrasonic waves, radar, or other effective devices to detect objects or persons at the rear of the equipment, and sounds an audible alarm when a person or object is detected. This type of discriminating warning device shall--

(a)(2)(i) Have a sensing area of a sufficient size that would allow endangered persons adequate time to get out of the danger zone.

(a)(2)(ii) Give audible and visual alarms inside the operator's compartment and a audible alarm outside of the operator's compartment when a person or object is detected in the sensing area; and

(a)(2)(iii) When the equipment is put in reverse, activate and give a one-time audible and visual alarm inside the operator's compartment and a one-time audible alarm outside the operator's compartment.

(b) Alarms shall be audible above the surrounding noise levels.

(c) Warning devices shall be maintained in functional condition.

(d) An automatic reverse-activated strobe light may be substituted for an audible alarm when mobile equipment is operated at night.

30 CFR § 77.411
Compressed air and boilers; general.

All boilers and pressure vessels shall be constructed, installed, and maintained in accordance with the standards and specifications of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

30 CFR § 77.412
Compressed air systems.

(a) Compressors and compressed-air receivers shall be equipped with automatic pressure-relief valves, pressure gages, and drain valves.

(b) Repairs involving the pressure system of compressors, receivers, or compressed-air-powered equipment shall not be attempted until the pressure has been relieved from that part of the system to be repaired.

(c) At no time shall compressed air be directed toward a person. When compressed air is used, all necessary precautions shall be taken to protect persons from injury.

(d) Safety chains or suitable locking devices shall be used at connections to machines of high-pressure hose lines of 1-inch inside diameter or larger, and between high-pressure hose lines of 1-inch inside diameter or larger, where a connection failure would create a hazard.

Boilers.

(a) Boilers shall be equipped with guarded, well-maintained water gages and pressure gages placed so that they can be observed easily. Water gages and pipe passages to the gages shall be kept clean and free of scale and rust.

(b) Boilers shall be equipped with automatic pressure-relief valves; valves shall be opened manually at least once a week to determine that they will function properly.

(c) Blowoff valves shall be piped outside the building and shall have outlets so located or protected that persons passing by, near, or under them will not be scalded.

(d) Boiler installations shall be provided with safety devices, acceptable to the Mine Safety and Health Administration, to protect against hazards of flameouts, fuel interruptions, and low-water level.

(e) Boilers shall be inspected internally at least once a year by a licensed inspector and a certificate of inspection signed by the inspector shall be displayed in the vicinity of the boiler.

Subpart F--Electrical Equipment—General

30 CFR § 77.500
Electric power circuits and electric equipment; deenergization.

Power circuits and electric equipment shall be deenergized before work is done on such circuits and equipment, except when necessary for troubleshooting or testing.

30 CFR § 77.501
Electric distribution circuits and equipment; repair.

No electrical work shall be performed on electric distribution circuits or equipment, except by a qualified person or by a person trained to perform electrical work and to maintain electrical equipment under the direct supervision of a qualified person. Disconnecting devices shall be locked out and suitably tagged by the persons who perform such work, except that in cases where locking out is not possible, such devices shall be opened and suitably tagged by such persons. Locks or tags shall be removed only by the persons who installed them or, if such persons are unavailable, by persons authorized by the operator or his agent.

30 CFR § 77.501-1
Qualified person.

A qualified person within the meaning of §77.501 is an individual who meets the requirements of §77.103.

30 CFR § 77.502
Electric equipment; examination, testing, and maintenance.

Electric equipment shall be frequently examined, tested, and properly maintained by a qualified person to assure safe operating conditions. When a potentially dangerous condition is found on electric equipment, such equipment shall be removed from service until such condition is corrected. A record of such examinations shall be kept.

30 CFR § 77.502-1
Qualified person.

A qualified person within the meaning of §77.502 is an individual who meets the requirements of §77.103

30 CFR § 77.502-2
Electric equipment; frequency of examination and testing.

The examinations and tests required under the provision of this §77.502 shall be conducted at least monthly.

30 CFR § 77.512
Inspection and cover plates.

Inspection and cover plates on electrical equipment shall be kept in place at all times except during testing or repairs.

30 CFR § 77.513
Insulating mats at power switches.

Dry wooden platforms, insulating mats, or other electrically nonconductive material shall be kept in place at all switchboards and power-control switches where shock hazards exist. However, metal plates on which a person normally would stand and which are kept at the same potential as the grounded, metal, non-current-carrying parts of the power switches to be operated may be used.

30 CFR § 77.514
Switchboards; passageways and clearance.

Switchboards shall be installed to provide passageways or lanes of travel which permit access to the back of the switchboard from both ends for inspection, adjustment or repair. Openings permitting access to the rear of any switchboard shall be guarded, except where they are located in buildings which are kept locked.

30 CFR § 77.515
Bare signal or control wires; voltage.

The voltage on bare signal or control wires accessible to personal contact shall not exceed 40 volts.

30 CFR § 77.516
Electric wiring and equipment; installation and maintenance.

In addition to the requirements of §§77.503 and 77.506, all wiring and electrical equipment installed after June 30, 1971, shall meet the requirements of the National Electric Code in effect at the time of installation.

Subpart G--Trailing Cables

30 CFR § 77.600
Trailing cables; short-circuit protection; disconnecting devices.

Short-circuit protection for trailing cables shall be provided by an automatic circuit breaker or other no less effective device, approved by the Secretary, of adequate current-interrupting capacity in each ungrounded conductor. Disconnecting devices used to disconnect power from trailing cables shall be plainly marked and identified and such devices shall be equipped or designed in such a manner that it can be determined by visual observation that the power is disconnected.

30 CFR § 77.601
Trailing cables or portable cables; temporary splices.

Temporary splices in trailing cables or portable cables shall be made in a workmanlike manner and shall be mechanically strong and well insulated. Trailing cables or portable cables with exposed wires or splices that heat or spark under load shall not be used.

30 CFR § 77.602
Permanent splicing of trailing cables.

When permanent splices in trailing cables are made, they shall be:

(a) Mechanically strong with adequate electrical conductivity;

(b) Effectively insulated and sealed so as to exclude moisture; and,

(c) Vulcanized or otherwise made with suitable materials to provide good bonding to the outer jacket.

30 CFR § 77.603
Clamping of trailing cables to equipment.

Trailing cables shall be clamped to machines in a manner to protect the cables from damage and to prevent strain on the electrical connections.

30 CFR § 77.604
Protection of trailing cables.

Trailing cables shall be adequately protected to prevent damage by mobile equipment.

30 CFR § 77.605
Breaking trailing cable and power cable connections.

Trailing cable and power cable connections between cables and to power sources shall not be made or broken under load.

30 CFR § 77.606
Energized trailing cables; handling.

Energized medium- and high-voltage trailing cables shall be handled only by persons wearing protective rubber gloves (see §77.606-1) and, with such other protective devices as may be necessary and appropriate under the circumstances.

30 CFR § 77.606-1
Rubber gloves; minimum requirements.

(a) Rubber gloves (lineman's gloves) worn while handling high-voltage trailing cables shall be rated at least 20,000 volts and shall be used and tested in accordance with the provisions of §§77.704-6 through 77.704-8.

(b) Rubber gloves (wireman's gloves) worn while handling trailing cables energized by 660 to 1,000 volts shall be rated at least 1,000 volts and shall not be worn inside out or without protective leather gloves.

(c) Rubber gloves shall be inspected for defects before use on each shift and at least once thereafter during the shift when such rubber gloves are used for extended periods. All protective rubber gloves which contain defects shall be discarded and replaced prior to handling energized cables.

Subpart H—Grounding

30 CFR § 77.700
Grounding metallic sheaths, armors, and conduits enclosing power conductors.

Metallic sheaths, armors, and conduits enclosing power conductors shall be electrically continuous throughout and shall be grounded by methods approved by an authorized representative of the Secretary.

30 CFR § 77.700-1
Approved methods of grounding.

Metallic sheaths, armors, and conduits in resistance grounded systems, where the enclosed conductors are a part of the system, will be approved if a solid connection is made to the neutral conductor; in all other systems, the following methods of grounding will be approved:

(a) A solid connection to metal waterlines having low resistance to earth;

(b) A solid connection to a grounding conductor, other than the neutral conductor of a resistance grounded system, extending to a low-resistance ground field;

(c) Any other method of grounding, approved by an authorized representative of the Secretary, which ensures that there is no difference in potential between such metallic enclosures and the earth.

30 CFR § 77.701
Grounding metallic frames, casings, and other enclosures of electric equipment.

Metallic frames, casings, and other enclosures of electric equipment that can become "alive" through failure of insulation or by contact with energized parts shall be grounded by methods approved by an authorized representative of the Secretary.

30 CFR § 77.701-1
Approved methods of grounding of equipment receiving power from ungrounded alternating current power systems.

For purposes of grounding metallic frames, casings and other enclosures of equipment receiving power from ungrounded alternating current power systems, the following methods of grounding will be approved:

(a) A solid connection between the metallic frame; casing, or other metal enclosure and the grounded metallic sheath, armor, or conduit enclosing the power conductor feeding the electric equipment enclosed;

(b) A solid connection to metal waterlines having low resistance to earth;

(c) A solid connection to a grounding conductor extending to a low-resistance ground field; and,

(d) Any other method of grounding, approved by an authorized representative of the Secretary, which insures that there is no difference in potential between such metal enclosures and the earth.

30 CFR § 77.701-2
Approved methods of grounding metallic frames, casings, and other enclosures of electric equipment receiving power from a direct-current power system.

(a) The following methods of grounding metallic frames, casings, and other enclosures of electric equipment receiving power from a direct-current power system with one polarity grounded will be approved:

(1) A solid connection to the grounded power conductor of the system; and,

(2) Any other method, approved by an authorized representative of the Secretary, which insures that there is no difference in potential between such metal enclosures and the earth.

(b) A method of grounding of metallic frames, casings, and other enclosures of electric equipment receiving power from a direct-current power system other than a system with one polarity grounded, will be approved by an authorized representative of the Secretary if the method insures that there is no difference in potential between such frames, casings, and other enclosures, and the earth.

30 CFR § 77.701-3
Grounding wires; capacity.

Where grounding wires are used to ground metallic sheaths, armors, conduits, frames, casings, and other metallic enclosures, such grounding wires will be approved if:

(a) Where the power conductor used is No. 6 A.W.G., or larger, the cross-sectional area of the grounding wire is at least one-half the cross-sectional area of the power conductor.

(b) Where the power conductor used is less than No. 6 A.W.G., the cross-sectional area of the grounding wire is equal to the cross-sectional area of the power conductor.

30 CFR § 77.701-4
Use of grounding connectors.

If ground wires are attached to grounded power conductors, separate clamps, suitable for such purpose, shall be used and installed to provide a solid connection.

30 CFR § 77.702
Protection other than grounding.

Methods other than grounding which provide no less effective protection may be permitted by the Secretary or his authorized representative. Such methods may not be used unless so approved.

30 CFR § 77.703
Grounding frames of stationary high-voltage equipment receiving power from ungrounded delta systems.

The frames of all stationary high-voltage equipment receiving power from ungrounded delta systems shall be grounded by methods approved by an authorized representative of the Secretary.

30 CFR § 77.703-1
Approved methods of grounding.

The methods of grounding stated in §77.701-1 will be approved with respect to the grounding of frames of high-voltage equipment referred to in §77.703.

30 CFR § 77.704
Work on high-voltage lines; deenergizing and grounding.

High-voltage lines shall be deenergized and grounded before work is performed on them, except that repairs may be permitted on energized high-voltage lines if (a) such repairs are made by a qualified person in accordance with procedures and safeguards set forth in §§77.704-1 through 77.704-11 of this Subpart H as applicable, and (b) the operator has tested and properly maintained the protective devices necessary in making such repairs.

30 CFR § 77.704-1
Work on high-voltage lines.

(a) No high-voltage line shall be regarded as deenergized for the purpose of performing work on it, until it has been determined by a qualified person (as provided in §77.103) that such high-voltage line has been deenergized and grounded. Such qualified person shall by visual observation (1) determine that the disconnecting devices on the high-voltage circuit are in open position, and (2) insure that each ungrounded conductor of the high-voltage circuit upon which work is to be done is properly connected to the system grounding medium. In the case of resistance grounded or solid wye-connected systems, the neutral wire is the system grounding medium. In the case of an ungrounded power system, either the steel armor or conduit enclosing the system or a surface grounding field is a system grounding medium;

(b) No work shall be performed on any high-voltage line which is supported by any pole or structure which also supports other high-voltage lines until: (1) All lines supported on the pole or structure are deenergized and grounded in accordance with all of the provisions of this §77.704-1 which apply to the repair of deenergized surface high-voltage lines; or (2) the provisions of §§77.704-2 through 77.704-10 have been complied with, with respect to all energized lines, which are supported on the pole or structure.

(c) Work may be performed on energized surface high-voltage lines only in accordance with the provisions of §§77.704-2 through 77.704-10, inclusive.

30 CFR § 77.704-2
Repairs to energized high-voltage lines.

An energized high-voltage line may be repaired only when:

(a) The operator has determined that,

(a)(1) Such repairs cannot be scheduled during a period when the power circuit could be properly deenergized and grounded;

(a)(2) Such repairs will be performed on power circuits with a phase-to-phase nominal voltage no greater than 15,000 volts;

(a)(3) Such repairs on circuits with a phase-to-phase nominal voltage of 5,000 volts or more will be performed only with the use of live line tools; and,

(a)(4) Weather conditions will not interfere with such repairs or expose those persons assigned to such work to an imminent danger; and,

(b) The operator has designated a person qualified under the provisions of §77.104 as the person responsible for carrying out such repairs and such person, in order to ensure protection for himself and other qualified persons assigned to perform such repairs from the hazards of such repair, has prepared and filed with the operator:

(b)(1) A general description of the nature and location of the damage or defect to be repaired;

(b)(2) The general plan to be followed in making such repairs;

(b)(3) A statement that a briefing of all qualified persons assigned to make such repairs was conducted informing them of the general plan, their individual assignments, and the dangers inherent in such assignments;

(b)(4) A list of the proper protective equipment and clothing that will be provided; and

(b)(5) Such other information as the person designated by the operator feels necessary to describe properly the means or methods to be employed in such repairs.

30 CFR § 77.704-3
Work on energized high-voltage surface lines; reporting.

Any operator designating and assigning qualified persons to perform repairs on energized high-voltage surface lines under the provisions of §77.704-2 shall maintain a record of such repairs. Such record shall contain a notation of the time, date, location, and general nature of the repairs made together with a copy of the information filed with the operator by the qualified person designated as responsible for performing such repairs.

30 CFR § 77.704-4
Simultaneous repairs.

When two or more persons are working on an energized high-voltage surface line simultaneously, and any one of them is within reach of another, such persons shall not be allowed to work on different phases or on equipment with different potentials.

30 CFR § 77.704-5
Installation of protective equipment.

Before repair work on energized high-voltage surface lines is begun, protective equipment shall be used to cover all bare conductors, ground wires, guys, telephone lines, and other attachments in proximity to the area of planned repairs. Such protective equipment shall be installed from a safe position below the conductors or other apparatus being covered. Each rubber protective device employed in the making of repairs shall have a dielectric strength of 20,000 volts, or more.

30 CFR § 77.704-6
Protective clothing; use and inspection.

All persons performing work on energized high-voltage surface lines shall wear protective rubber lineman's gloves, sleeves, and climber guards if climbers are worn. Protective rubber gloves shall not be worn wrong side out or without protective leather gloves. Protective devices worn by a person assigned to perform repairs on high-voltage surface lines shall be worn continuously from the time he leaves the ground until he returns to the ground and, if such devices are employed for extended periods, such person shall visually inspect the equipment assigned him for defects before each use and, in no case, less than twice each day.

30 CFR § 77.704-7
Protective equipment; inspection.

Each person shall visually inspect protective equipment and clothing provided him in connection with work on high-voltage surface lines before using such equipment and clothing, and any equipment or clothing containing any defect or damage shall be discarded and replaced with proper protective equipment or clothing prior to the performance of any electrical work on such lines.

30 CFR § 77.704-8
Protective equipment; testing and storage.

(a) All rubber protective equipment used on work on energized high-voltage surface lines shall be electrically tested by the operator in accordance with ASTM standards, Part 28, published February 1968, and such testing shall be conducted in accordance with the following schedule:

(1) Rubber gloves, once each month;

(2) Rubber sleeves, once every 3 months;

(3) Rubber blankets, once every 6 months;

(4) Insulator hoods and line hose, once a year; and

(5) Other electric protective equipment, once a year.

(b) Rubber gloves shall not be stored wrong side out. Blankets shall be rolled when not in use, and line hose, and insulator hoods shall be stored in their natural position and shape.

30 CFR 77.704-9
Operating disconnecting or cutout switches.

Disconnecting or cutout switches on energized high-voltage surface lines shall be operated only with insulated sticks, fuse tongs, or pullers which are adequately insulated and maintained to protect the operator from the voltage to which he is exposed. When such switches are operated from the ground, the person using such devices shall wear protective rubber lineman's gloves, except where such switches are bonded to a metal mat as provided in §77.513.

30 CFR § 77.704-10
Tying into energized high-voltage surface circuits.

If the work of forming an additional circuit by tying into an energized high-voltage surface line is performed from the ground, any person performing such work must wear and employ all of the protective equipment and clothing required under the provisions of §§77.704-5 and 77.704-6. In addition, the insulated stick used by such person must have been designed for such purpose and must be adequately insulated and be maintained to protect such person from the voltage to which he is exposed.

30 CFR § 77.704-11
Use of grounded messenger wires; ungrounded systems.

Solely for purposes of grounding ungrounded high-voltage power systems, grounded messenger wires used to suspend the cables of such systems may be used as a grounding medium.

30 CFR § 77.705
Guy wires; grounding.

Guy wires from poles supporting high-voltage transmission lines shall be securely connected to the system ground or be provided with insulators installed near the pole end.

Subpart I--Surface High-Voltage Distribution

30 CFR § 77.800
High-voltage circuits; circuit breakers.

High-voltage circuits supplying power to portable or mobile equipment shall be protected by suitable circuit breakers of adequate interrupting capacity which are properly tested and maintained and equipped with devices to provide protection against under voltage, grounded phase, short circuit and overcurrent. High-voltage circuits supplying power to stationary equipment shall be protected against overloads by either a circuit breaker or fuses of the correct type and capacity.

30 CFR § 77.800-1
Testing, examination, and maintenance of circuit breakers; procedures.

(a) Circuit breakers and their auxiliary devices protecting high-voltage circuits to portable or mobile equipment shall be tested and examined at least once each month by a person qualified as provided in §77.103.

(b) Tests shall include:

(1) Breaking continuity of the ground check conductor where ground check monitoring is used; and,

(2) Actuating any of the auxiliary protective relays.

(c) Examination shall include visual observation of all components of the circuit breaker and its auxiliary devices, and such repairs or adjustments as are indicated by such tests and examinations shall be carried out immediately.

30 CFR § 77.800-1
Testing, examination, and maintenance of circuit breakers; record.

The operator shall maintain a written record of each test, examination, repair, or adjustment of all circuit breakers protecting high-voltage circuits. Such record shall be kept in a book approved by the Secretary.

30 CFR § 77.801
Grounding resistors.

The grounding resistor, where required, shall be of the proper ohmic value to limit the voltage drop in the grounding circuit external to the resistor to not more than 100 volts under fault conditions. The grounding resistor shall be rated for maximum fault current continuously and insulated from ground for a voltage equal to the phase-to-phase voltage of the system.

30 CFR § 77.801-1
Grounding resistors; continuous current rating.

The ground fault current rating of grounding resistors shall meet the "extended time rating" set forth in American Institute of Electrical Engineers, Standard No. 32.

30 CFR § 77.802
Protection of high-voltage circuits; neutral grounding resistors; disconnecting devices.

High-voltage circuits supplying portable or mobile equipment shall contain either a direct or derived neutral which shall be grounded through a suitable resistor at the source transformers, and a grounding circuit, originating at the grounded side of the grounding resistor, shall extend along with the power conductors and serve as a grounding conductor for the frames of all high-voltage equipment supplied power from that circuit, except that the Secretary or his authorized representative may permit other high-voltage circuits to feed stationary electrical equipment, if he finds that such exception will not pose a hazard to the miners. Disconnecting devices shall be installed and so equipped or designed in such a manner that it can be determined by visual observation that the power is disconnected.

30 CFR § 77.803
Fail safe ground check circuits on high-voltage resistance grounded systems.

On and after September 30, 1971, all high-voltage, resistance grounded systems shall include a fail safe ground check circuit or other no less effective device approved by the Secretary to monitor continuously the grounding circuit to assure continuity. The fail safe ground check circuit shall cause the circuit breaker to open when either the ground or ground check wire is broken.

30 CFR § 77.803-1
Fail safe ground check circuits; maximum voltage.

The maximum voltage used for ground check circuits under §77.803 shall not exceed 96 volts.

30 CFR § 77.803-2
Ground check systems not employing pilot check wires; approval by the Secretary.

Ground check systems not employing pilot check wires shall be approved by the Secretary only if it is determined that the system includes a fail safe design which will cause the circuit interrupter to open when ground continuity is broken.

30 CFR § 77.804
High-voltage trailing cables; minimum design requirements.

(a) High-voltage trailing cables used in resistance grounded systems shall be equipped with metallic shields around each power conductor with one or more ground conductors having a total cross-sectional area of not less than one-half the power conductor, and with an insulated conductor for the ground continuity check circuit. External ground check conductors may be used if they are not smaller than No. 8 (AWG) and have an insulation rated at least 600 volts.

(b) All such high-voltage trailing cables shall be adequate for the intended current and voltage. Splices made in such cables shall provide continuity of all components.

30 CFR § 77.805
Cable couplers and connection boxes; minimum design requirements.

(a)(1) Couplers that are used in medium- or high-voltage power circuits shall be of the three-phase type and enclosed in a full metallic shell, except that the Secretary may permit, under such guidelines as he may prescribe, no less effective couplers constructed of materials other than metal.

(2) Cable couplers shall be adequate for the intended current and voltage.

(3) Cable couplers with any metal exposed shall be grounded to the ground conductor in the cable.

(4) Couplers shall be constructed to cause the ground check continuity conductor to break first and the ground conductor last when being uncoupled when pilot check circuits are used.

(b) Cable connection boxes shall be of substantial construction and designed to guard all energized parts from personal contact.

30 CFR § 77.806
Connection of single-phase loads.

Single-phase loads, such as transformer primaries, shall be connected phase to phase in resistance grounded systems.

30 CFR § 77.807
Installation of high-voltage transmission cables.

High-voltage transmission cables shall be installed or placed so as to afford protection against damage. They shall be placed to prevent contact with low-voltage or communication circuits.

30 CFR § 77.807-1
High-voltage powerlines; clearances above ground.

High-voltage powerlines located above driveways, haulageways, and railroad tracks shall be installed to provide the minimum vertical clearance specified in National Electrical Safety Code: *Provided, however,* That in no event shall any high-voltage powerline be installed less than 15 feet above ground.

30 CFR § 77.807-2
Booms and masts; minimum distance from high-voltage lines.

The booms and masts of equipment operated on the surface of any coal mine shall not be operated within 10 feet of an energized overhead powerline. Where the voltage of overhead powerlines is 69,000 volts, or more, the minimum distance from the boom or mast shall be as follows:

30 CFR § 77.807-3
Movement of equipment; minimum distance from high-voltage lines.

When any part of any equipment operated on the surface of any coal mine is required to pass under or by any energized high-voltage powerline and the clearance between such equipment and powerline is less than that specified in §77.807-2 for booms and masts, such powerlines shall be deenergized or other precautions shall be taken.

30 CFR § 77.808
Disconnecting devices.

Disconnecting devices shall be installed at the beginning of each branch line in high-voltage circuits and they shall be equipped or designed in such a manner that it can be determined by visual observation that the circuit is deenergized when such devices are open.

30 CFR § 77.809
Identification of circuit breakers and disconnecting switches.

Circuit breakers and disconnecting switches shall be labeled to show which units they control, unless identification can be made readily by location.

30 CFR § 77.810
High-voltage equipment; grounding.

Frames, supporting structures, and enclosures of stationary, portable, or mobile high-voltage equipment shall be effectively grounded.

30 CFR § 77.811
Movement of portable substations and transformers.

Portable substations and transformers shall be deenergized before they are moved from one location to another.

Subpart J--Low- and Medium-Voltage Alternating Current Circuits

30 CFR § 77.900
Low- and medium-voltage circuits serving portable or mobile three-phase alternating current equipment; circuit breakers.

Low- and medium-voltage circuits supplying power to portable or mobile three-phase alternating current equipment shall be protected by suitable circuit breakers of adequate interrupting capacity which are properly tested and maintained and equipped with devices to provide protection against undervoltage, grounded phase, short circuit, and over-current.

30 CFR § 77.900-1
Testing, examination, and maintenance of circuit breakers; procedures.

Circuit breakers protecting low- and medium-voltage circuits serving portable or mobile three-phase alternating current equipment and their auxiliary devices shall be tested and examined at least once each month by a person qualified as provided in §77.103. In performing such tests, the circuit breaker auxiliaries or control circuits shall be actuated in any manner which causes the circuit breaker to open. All components of the circuit breaker and its auxiliary devices shall be visually examined and such repairs or adjustments as are indicated by such tests and examinations shall be carried out immediately.

30 CFR § 77.900-2
Testing, examination, and maintenance of circuit breakers; record.

The operator shall maintain a written record of each test, examination, repair or adjustment of all circuit breakers protecting low- and medium-voltage circuits serving three-phase alternating current equipment and such record shall be kept in a book approved by the Secretary.

30 CFR § 77.901
Protection of low- and medium-voltage three-phase circuits.

(a) Low- and medium-voltage circuits supplying power to portable or mobile three-phase alternating equipment shall contain:

(1) Either a direct or derived neutral grounded through a suitable resistor at the power source;

(2) A grounding circuit originating at the grounded side of the grounding resistor which extends along with the power conductors and serves as a grounding conductor for the frames of all the electric equipment supplied power from the circuit.

Health Administration identification number if known; and the name and address of the mine operator.

30 CFR § 77.1001
Stripping; loose material.

Loose hazardous material shall be stripped for a safe distance from the top of pit or highwalls, and the loose unconsolidated material shall be sloped to the angle of repose, or barriers, baffle boards, screens, or other devices be provided that afford equivalent protection.

30 CFR § 77.1002
Box cuts; spoil material placement.

When box cuts are made, necessary precautions shall be taken to minimize the possibility of spoil material rolling into the pit.

30 CFR § 77.1003
Benches.

To insure safe operation, the width and height of benches shall be governed by the type of equipment to be used and the operation to be performed.

30 CFR § 77.1004
Ground control; inspection and maintenance; general.

(a) Highwalls, banks, benches, and terrain sloping into the working areas shall be examined after every rain, freeze, or thaw before men work in such areas, and such examination shall be made and recorded in accordance with §77.1713.

(b) Overhanging highwalls and banks shall be taken down and other unsafe ground conditions shall be corrected promptly, or the area shall be posted.

30 CFR § 77.1005
Scaling highwalls; general.

(a) Hazardous areas shall be scaled before any other work is performed in the hazardous area. When scaling of highwalls is necessary to correct conditions that are hazardous to persons in the area, a safe means shall be provided for performing such work.

(b) Whenever it becomes necessary for safety to remove hazardous material from highwalls by hand, the hazardous material shall be approached from a safe direction and the material removed from a safe location.

30 CFR § 77.1006
Highwalls; men working.

(a) Men, other than those necessary to correct unsafe conditions, shall not work near or under dangerous highwalls or banks.

(b) Except as provided in paragraph (c) of this section, men shall not work between equipment and the highwall or spoil bank where the equipment may hinder escape from falls or slides.

(c) Special safety precautions shall be taken when men are required to perform repair work between immobilized equipment and the highwall or spoil bank and such equipment may hinder escape from falls or slides.

30 CFR § 77.1007
Drilling; general.

(a) Equipment that is to be used during a shift shall be inspected each shift by a competent person. Equipment defects affecting safety shall be reported.

(b) Equipment defects affecting safety shall be corrected before the equipment is used

30 CFR § 77.1008
Relocation of drills; safeguards.

(a) When a drill is being moved from one drilling area to another, drill steel, tools, and other equipment shall be secured and the mast placed in a safe position.

(b) When a drill helper is used his location shall be made known to the operator at all times when the drill is being moved.

30 CFR § 77.1009
Drill; operation.

(a) While in operation drills shall be attended at all times.

(b) Men shall not drill from positions that hinder their access to the control levers, or from insecure footing or staging, or from atop equipment not designed for this purpose.

(c) Men shall not be on a mast while the drill bit is in operation unless a safe platform is provided and safety belts are used.

(d) Drill crews and others shall stay clear of augers or drill stems that are in motion. Persons shall not pass under or step over a moving stem or auger.

(e) In the event of power failure, drill controls shall be placed in the neutral position until power is restored.

(f) When churn drills or vertical rotary drills are used, drillers shall not be permitted to work under suspended tools, and when collaring holes, inspecting, or during any operation in which tools are removed from the hole, all tools shall be lowered to the ground or platform.

30 CFR § 77.1010
Collaring holes.

(a) Starter steels shall be used when collaring holes with hand-held drills.

(b) Men shall not hold the drill steel while collaring holes, or rest their hands on the chuck or centralizer while drilling.

30 CFR § 77.1011
Drill holes; guarding.

Drill holes large enough to constitute a hazard shall be covered or guarded.

30 CFR § 77.1012
Jackhammers; operation; safeguards.

Men operating or working near jackhammers or jackleg drills, or other drilling machines shall position themselves so that they will not be struck or lose their balance if the drill steel breaks or sticks.

30 CFR § 77.1013
Air drills; safeguards.

Air shall be turned off and bled from the air hoses before hand-held air drills are moved from one working area to another

Subpart L--Fire Protection.

30 CFR § 77.1100
Fire protection; training and organization.

Firefighting facilities and equipment shall be provided commensurate with the potential fire hazards at each structure, enclosure and other facility (including custom coal preparation) at the mine and the employees at such facilities shall be instructed and trained annually in the use of such firefighting facilities and equipment.

30 CFR § 77.1101
Escape and evacuation; plan.

(a) Before September 30, 1971, each operator of a mine shall establish and keep current a specific escape and evacuation plan to be followed in the event of a fire.

(b) All employees shall be instructed on current escape and evacuation plans, fire alarm signals, and applicable procedures to be followed in case of fire.

(c) Plans for escape and evacuation shall include the designation and proper maintenance of adequate means for exit from all areas where persons are required to work or travel including buildings and equipment and in areas where persons normally congregate during the work shift.

30 CFR § 77.1102
Warning signs; smoking and open flame.

Signs warning against smoking and open flames shall be posted so they can be readily seen in areas or places where fire or explosion hazards exist.

30 CFR § 77.1103
Flammable liquids; storage.

(a) Flammable liquids shall be stored in accordance with standards of the National Fire Protection Association. Small quantities of flammable liquids drawn from storage shall be kept in properly identified safety cans.

(b) Unburied flammable-liquid storage tanks shall be mounted securely on firm foundations. Outlet piping shall be provided with flexible connections or other special fittings to prevent adverse effects from tank settling.

(c) Fuel lines shall be equipped with valves to cut off fuel at the source and shall be located and maintained to minimize fire hazards.

(d) Areas surrounding flammable-liquid storage tanks and electric substations and transformers shall be kept free from grass (dry), weeds, underbrush, and other combustible materials such as trash, rubbish, leaves and paper, for at least 25 feet in all directions.

30 CFR § 77.1104
Accumulations of combustible materials.

Combustible materials, grease, lubricants, paints, or flammable liquids shall not be allowed to accumulate where they can create a fire hazard.

30 CFR § 77.1105
Internal comubstion engines; fueling.

Internal combustion engines, except diesels, shall be shut off and stopped before being fueled.

30 CFR § 77.1106
Battery-charging stations; ventilation.

Battery-charging stations shall be located in well-ventilated areas. Battery-charging stations shall be equipped with reverse current protection where such stations are connected directly to direct current power systems.

30 CFR § 77.1107
Belt conveyors.

Belt conveyors in locations where fire would create a hazard to personnel shall be provided with switches to stop the drive pulley automatically in the event of excessive slippage.

30 CFR § 77.1108
Firefighting equipment; requirements; general.

On and after September 30, 1971, each operator of a coal mine shall provide an adequate supply of firefighting equipment which is adapted to the size and suitable for use under the conditions present on the surface at the mine.

30 CFR § 77.1108-1
Type and capacity of firefighting equipment.

Firefighting equipment required under this §77.1108 shall meet the following minimum requirements:

(a) *Waterlines.* Waterlines shall be capable of delivering 50 gallons of water a minute at a nozzle pressure of 50 pounds per square inch. Where storage tanks are used as a source of water supply, the tanks shall be of 1,000-gallon capacity for each 1,000 tons of coal processed (average) per shift.

(b) *Fire extinguishers.* Fire extinguishers shall be:

(1) Of the appropriate type for the particular fire hazard involved;

(2) Adequate in number and size for the particular fire hazard involved;

(3) Replaced immediately with fully charged extinguishers after any discharge is made from an extinguisher; and

(4) Approved by the Underwriter's Laboratories, Inc., or the Factory Mutual Research Corp., or other competent testing agency acceptable to the Mine Safety and Health Administration.

(c) *Fire hose.* Fire hose and couplings shall meet the requirements of the Underwriter's Laboratories, Inc., or Factory Mutual Research Corp.'s specifications. Cotton or cotton-polyester jacketed hose shall be treated in accordance with the U.S. Department of Agriculture Forest Service Specification 182 for mildew resistance. The water pressure at the hose nozzle shall not be excessively high so as to present a hazard to the nozzle operator.

30 CFR § 77.1109
Quantity and location of firefighting equipment.

Preparation plants, dryer plants, tipples, drawoff tunnels, shops, and other surface installations shall be equipped with the following firefighting equipment.

(a) Each structure presenting a fire hazard shall be provided with portable fire extinguishers commensurate with the potential fire hazard at the structure in accordance with the recommendations of the National Fire Protection Association.

(b) Preparation plants shall be equipped with waterlines, with outlet valves on each floor, and with sufficient fire hose to project a water stream to any point in the plant. However, where freezing conditions exist or water is not available, a 125-pound multipurpose dry powder extinguisher may be substituted for the purposes of this paragraph (b) for each 2,500 square feet of floor space in a wooden or other flammable structure, or for each 5,000 square feet of floor space in a metal, concrete-block, or other type of non-flammable construction.

(c)(1) Mobile equipment, including trucks, front-end loaders, bulldozers, portable welding units, and augers, shall be equipped with at least one portable fire extinguisher.

(2) Power shovels, draglines, and other large equipment shall be equipped with at least one portable fire extinguisher; however, additional fire extinguishers may be required by an authorized representative of the Secretary.

(3) Auxiliary equipment such as portable drills, sweepers, and scrapers, when operated more than 600 feet from equipment required to have portable fire extinguishers, shall be equipped with at least one fire extinguisher.

(d) Fire extinguishers shall be provided at permanent electrical installations commensurate with the potential fire hazard at such installation in accordance with the recommendations of the National Fire Protection Association.

(e) Two portable fire extinguishers, or the equivalent, shall be provided at each of the following combustible liquid storage installations:

(1) Near each above ground or unburied combustible liquid storage station; and,

(2) Near the transfer pump of each buried combustible liquid storage tank.

(f) Vehicles transporting explosives and blasting agents shall be equipped with fire protection as recommended in Code 495, section 20, National Fire Protection Association Handbook, 12th Edition, 1962.

30 CFR § 77.1110
Examination and maintenance of firefighting equipment.

Firefighting equipment shall be continuously maintained in a usable and operative condition. Fire extinguishers shall be examined at least once every 6 months and the date of such examination shall be recorded on a permanent tag attached to the extinguisher.

30 CFR § 77.1111
Welding, cutting, soldering; use of fire extinguisher.

One portable fire extinguisher shall be provided at each location where welding, cutting, or soldering with arc or flame is performed.

30 CFR § 77.1112
Welding, cutting, or soldering with arc or flame; safeguards.

(a) When welding, cutting, or soldering with arc or flame near combustible materials, suitable precautions shall be taken to insure that smoldering metal or sparks do not result in a fire.

(b) Before welding, cutting, or soldering is performed in areas likely to contain methane, an examination for methane shall be made by a qualified person with a device approved by the Secretary for detecting methane. Examinations for methane shall be made immediately before and periodically during welding, cutting, or soldering and such work shall not be permitted to commence or continue in air which contains 1.0 volume per centum or more of methane.

Subpart M—Maps

30 CFR § 77.1200
Mine map.

The operator shall maintain an accurate and up-to-date map of the mine, on a scale of not less than 100 nor more than 500 feet to the inch, at or near the mine, in an area chosen by the mine operator, with a duplicate copy on file at a separate and distinct location, to minimize the danger of destruction by fire or other hazard. The map shall show:

(a) Name and address of the mine;

(b) The property or boundary lines of the active areas of the mine;

(c) Contour lines passing through whole number elevations of the coalbed being mined. The spacing of such lines shall not exceed 25-foot elevation levels, except that a broader spacing of contour lines may be approved by the District Manager for steeply pitching coalbeds. Contour lines may be placed on overlays or tracings attached to mine maps.

(d) The general elevation of the coalbed or coalbeds being mined, and the general elevation of the surface;

(e) Either producing or abandoned oil and gas wells located on the mine property;

(f) The location and elevation of any body of water dammed or held back in any portion of the mine: *Provided, however,* Such bodies of water may be shown on overlays or tracings attached to the mine maps;

(g) All prospect drill holes that penetrate the coalbed or coalbeds being mined on the mine property;

(h) All auger and strip mined areas of the coalbed or coalbeds being mined on the mine property together with the line of maximum depth of holes drilled during auger mining operations.

(i) All worked out and abandoned areas;

(j) The location of railroad tracks and public highways leading to the mine, and mine buildings of a permanent nature with identifying names shown;

(k) Underground mine workings underlying and within 1,000 feet of the active areas of the mine;

(l) The location and description of at least two permanent base line points, and the location and description of at least two permanent elevation bench marks used in connection with establishing or referencing mine elevation surveys; and,

(m) The scale of the map.

30 CFR § 77.1201
Certification of mine maps.

Mine maps shall be made or certified by an engineer or surveyor registered by the State in which the mine is located.

30 CFR § 77.1202
Availability of mine map.

The mine map maintained in accordance with the provisions of §77.1200 shall be available for inspection by the Secretary or his authorized representative.

Subpart N--Explosives and Blasting

30 CFR § 77.1300
Explosives and blasting.

(a) No explosives, blasting agent, detonator, or any other related blasting device or material shall be stored, transported, carried, handled, charged, fired, destroyed, or otherwise used, employed or disposed of by any person at a coal mine except in accordance with the provisions of §77.1301 through 77.1304, inclusive.

(b) The term "explosives" as used in this Subpart N includes blasting agents. The standards in this Subpart N in which the term "explosives" appears are applicable to blasting agents (as well as to other explosives) unless blasting agents are expressly excluded.

30 CFR § 77.1301
Explosives; magazines.

(a) Detonators and explosives other than blasting agents shall be stored in magazines.

(b) Detonators shall not be stored in the same magazine with explosives.

(c) Magazines other than box type shall be:

(1) Located in accordance with the current American Table of Distances for storage of explosives.

(2) Detached structures located away from powerlines, fuel storage areas, and other possible sources of fire.

(3) Constructed substantially of noncombustible material or covered with fire-resistant material.

(4) Reasonably bullet resistant.

(5) Electrically bonded and grounded if constructed of metal.

(6) Made of nonsparking materials on the inside, including floors.

(7) Provided with adequate and effectively screened ventilation openings near the floor and ceiling.

(8) Kept locked securely when unattended.

(9) Posted with suitable danger signs so located that a bullet passing through the face of a sign will not strike the magazine.

(10) Used exclusively for storage of explosives or detonators and kept free of all extraneous materials.

(11) Kept clean and dry in the interior, and in good repair.

(12) Unheated, unless heated in a manner that does not create a fire or explosion hazard.

(d) Box-type magazines used to store explosives or detonators in work areas shall be constructed with only nonsparking material inside and equipped with covers or doors and shall be located out of the line of blasts.

(e) Secondary and box-type magazines shall be suitably labeled.

(f) Detonator-storage magazines shall be separated by at least 25 feet from explosive-storage magazines.

(g) Cases or boxes containing explosives shall not be stored in magazines on their ends or sides nor stacked more than 6 feet high.

(h) Ammonium nitrate-fuel oil blasting agents shall be physically separated from other explosives, safety fuse, or detonating cord stored in the same magazine and in such a manner that oil does not contaminate the other explosives, safety fuse or detonating cord.

30 CFR § 77.1302
Vehicles used to transport explosives.

(a) Vehicles used to transport explosives, other than blasting agents, shall have substantially constructed bodies, no sparking metal exposed in the cargo space, and shall be equipped with suitable sides and tail gates; explosives shall not be piled higher than the side or end.

(b) Vehicles containing explosives or detonators shall be maintained in good condition and shall be operated at a safe speed and in accordance with all safe operating practices.

(c) Vehicles containing explosives or detonators shall be posted with proper warning signs.

(d) Other materials or supplies shall not be placed on or in the cargo space of a conveyance containing explosives, detonating cord or detonators, except for safety fuse and except for properly secured nonsparking equipment used expressly in the handling of such explosives, detonating cord or detonators.

(e) Explosives and detonators shall be transported in separate vehicles unless separated by 4 inches of hardwood or the equivalent.

(f) Explosives or detonators shall be transported promptly without undue delays in transit.

(g) Explosives or detonators shall be transported at times and over routes that expose a minimum number of persons.

(h) Only the necessary attendants shall ride on or in vehicles containing explosives or detonators.

(i) Vehicles shall be attended, whenever practical and possible, while loaded with explosives or detonators.

(j) When vehicles containing explosives or detonators are parked, the brakes shall be set, the motive power shut off, and the vehicles shall be blocked securely against rolling.

(k) Vehicles containing explosives or detonators shall not be taken to a repair garage or shop for any purpose.

30 CFR § 77.1303
Explosives, handling and use.

(a) Persons who use or handle explosives or detonators shall be experienced men who understand the hazards involved; trainees shall do such work only under the supervision of and in the immediate presence of experienced men.

(b) Blasting operations shall be under the direct control of authorized persons.

(c) Substantial nonconductive closed containers shall be used to carry explosives, other than blasting agents to the blasting site.

(d) Damaged or deteriorated explosives or detonators shall be destroyed in a safe manner.

(e) Where electric blasting is to be performed, electric circuits to equipment in the immediate area to be blasted shall be deenergized before explosives or detonators are brought into the area; the power shall not be turned on again until after the shots are fired.

(f) Explosives shall be kept separated from detonators until charging is started.

(g) Areas in which charged holes are awaiting firing shall be guarded, or barricaded and posted, or flagged against unauthorized entry.

(h) Ample warning shall be given before blasts are fired. All persons shall be cleared and removed from the blasting area unless suitable blasting shelters are provided to protect men endangered by concussion or flyrock from blasting.

(i) Lead wires and blasting lines shall not be strung across power conductors, pipelines, railroad tracks, or within 20 feet of bare powerlines. They shall be protected from sources of static or other electrical contact.

(j) For the protection of underground workers, special precautions shall be taken when blasting in close proximity to underground operations, and no blasting shall be done that would be hazardous to persons working underground.

(k) Holes shall not be drilled where there is danger of intersecting a charged or misfired hole.

(l) Only wooden or other nonsparking implements shall be used to punch holes in an explosive cartridge.

(m) Tamping poles shall be blunt and squared at one end and made of wood, nonsparking material, or of special plastic acceptable to the Mine Safety and Health Administration.

(n) Delay connectors for firing detonating cord shall be treated and handled with the same safety precautions as blasting caps and electric detonators.

(o) Capped primers shall be made up at the time of charging and as close to the blasting site as conditions allow.

(p) A capped primer shall be prepared so that the detonator is contained securely and is completely embedded within the explosive cartridge.

(q) No tamping shall be done directly on a capped primer.

(r) Detonating cord shall not be used if it has been kinked, bent, or otherwise handled in such a manner that the train of detonation may be interrupted.

(s) Fuse shall not be used if it has been kinked, bent sharply, or handled roughly in such a manner that the train of deflagration may be interrupted.

(t) Blasting caps shall be crimped to fuses only with implements designed for that specific purpose.

(u) When firing from 1 to 15 blast-holes with safety fuse ignited individually using hand-held lighters, the fuses shall be of such lengths to provide the minimum burning time specified in the following table for a particular size round:

30 CFR § 77.1304
Blasting agents; special provisions.

(a) Sensitized ammonium nitrate blasting agents, and the components thereof prior to mixing, shall be mixed and stored in accordance with the recommendations in Bureau of Mines Information Circular 8179, "Safety Recommendations for Sensitized Ammonium Nitrate Blasting Agents," or subsequent revisions.

(b) Where pneumatic loading is employed, before any type of blasting operation using blasting agents is put into effect, an evaluation of the potential hazard of static electricity shall be made. Adequate steps, including the grounding and bonding of the conductive parts of pneumatic loading equipment, shall be taken to eliminate the hazard of static electricity before blasting agent use is commenced.

(c) Pneumatic loading equipment shall not be grounded to waterlines, airlines, rails, or the permanent electrical grounding systems.

(d) Hoses used in connection with pneumatic loading machines shall be of the semiconductive type, having a total resistance low enough to permit the dissipation of static electricity and high enough to limit the flow of stray electric currents to a safe level. Wire-countered hose shall not be used because of the potential hazard from stray electric currents.

Subpart O--Personnel Hoisting

30 CFR § 77.1400
Personnel hoists and elevators.

Except as provided in §77.1430, the sections in this Subpart O apply only to hoists and elevators, together with their appurtenances, that are used for hoisting persons.

30 CFR § 77.1401
Automatic controls and brakes.

Hoists and elevators shall be equipped with overspeed, overwind, and automatic stop controls and with brakes capable of stopping the elevator when fully loaded.

30 CFR § 77.1402
Rated capacity.

Hoists and elevators shall have rated capacities consistent with the loads handled.

30 CFR § 77.1402-1
Maximum load; posting.

The operator shall designate the maximum number of men permitted to ride on each hoist or elevator at one time; this limit shall be posted on each elevator and on each landing.

30 CFR § 77.1403
Daily examination of hoisting equipment.

Hoists and elevators shall be examined daily and such examinations shall include, but not be limited to, the following:

(a) *Elevators.* (1) A visual examination of the ropes for wear, broken wires, and corrosion, especially at excessive strain points such as near the attachments and where the rope rests on the sheaves;

(2) An examination of the elevator for loose, missing or defective parts;

(b) *Hoists and elevators.* (1) An examination of the rope fastenings for defects;

(2) An examination of sheaves for broken flanges, defective bearings, rope alignment, and proper lubrication; and

(3) An examination of the automatic controls and brakes required under §77.1401.

30 CFR § 77.1404
Certifications and records of daily examinations.

At the completion of each daily examination required by §77.1403, the person making the examination shall certify, by signature and date, that the examination has been made. If any unsafe condition is found during the examinations required by §77.1403, the person conducting the examination shall make a record of the condition and the date. Certifications and records shall be retained for one year.

30 CFR § 77.1405
Operation of hoisting equipment after repairs.

Empty conveyances shall be operated at least one round trip before hoisting persons after any repairs.

WIRE ROPES

30 CFR § 77.1430
Wire ropes; scope.

(a) Sections 77.1431 through 77.1438 apply to wire ropes in service used to hoist--

(1) Persons in shafts and slopes underground;

(2) Persons with an incline hoist on the surface; or

(3) Loads in shaft or slope development when persons work below suspended loads.

(b) These standards do not apply to wire ropes used for elevators.

30 CFR § 77.1431
Minimum rope strength.

At installation, the nominal strength (manufacturer's published catalog strength) of wire ropes used for hoisting shall meet the minimum rope strength values obtained by the following formulas in which "L" equals the maximum suspended rope length in feet:

(a) *Winding drum ropes* (all constructions, including rotation resistant).

For rope lengths less than 3,000 feet:

Minimum Value=Static Load x (7.0-0.001L)

For rope lengths 3,000 feet or greater:

Minimum Value=Static Load x 4.0

(b) *Friction drum ropes.*

For rope lengths less than 4,000 feet:

Minimum Value=Static Load x (7.0-0.0005L)

For rope lengths 4,000 feet or greater:

Minimum Value=Static Load x 5.0

(c) *Tail ropes* (balance ropes).

Minimum Value=Weight of Rope x 7.0

30 CFR § 77.1432
Initial measurement.

After initial rope stretch but before visible wear occurs, the rope diameter of newly installed wire ropes shall be measured at least once in every third interval of active length and the measurements averaged to establish a baseline for subsequent measurements. A record of the measurements and the date shall be made by the person taking the measurements. This record shall be retained until the rope is retired from service.

30 CFR § 77.1433
Examinations.

(a) At least once every fourteen calendar days, each wire rope in service shall be visually examined along its entire active length for visible structural damage, corrosion, and improper lubrication or dressing. In addition, visual examination for wear and broken wires shall be made at stress points, including the area near attachments, where the rope rests on sheaves, where the rope leaves the drum, at drum crossovers, and at change-of-layer regions. When any visible condition that results in a reduction of rope strength is present, the affected portion of the rope shall be examined on a daily basis.

(b) Before any person is hoisted with a newly installed wire rope or any wire rope that has not been examined in the previous fourteen calendar days, the wire rope shall be examined in accordance with paragraph (a) of this section.

(c) At least once every six months, nondestructive tests shall be conducted of the active length of the rope, or rope diameter measurements shall be made--

(1) Wherever wear is evident;

(2) Where the hoist rope rests on sheaves at regular stopping points;

(3) Where the hoist rope leaves the drum at regular stopping points; and

(4) At drum crossover and change-of-layer regions.

(d) At the completion of each examination required by paragraph (a) of this section, the person making the examination shall certify, by signature and date, that the examination has been made. If any condition listed in paragraph (a) of this standard is present, the person conducting the examination shall make a record of the condition and the date. Certifications and records of examinations shall be retained for one year.

(e) The person making the measurements or nondestructive tests as required by paragraph (c) of this section shall record the measurements or test results and the date. This record shall be retained until the rope is retired from service.

30 CFR § 77.1434
Retirement criteria.

Unless damage or deterioration is removed by cutoff, wire ropes shall be removed from service when any of the following conditions occurs:

(a) The number of broken wires within a rope lay length, excluding filler wires, exceeds either--

(1) Five percent of the total number of wires; or

(2) Fifteen percent of the total number of wires within any strand;

(b) On a regular lay rope, more than one broken wire in the valley between strands in one rope lay length;

(c) A loss of more than one-third of the original diameter of the outer wires;

(d) Rope deterioriation from corrosion;

(e) Distortion of the rope structure;

(f) Heat damage from any source;

(g) Diameter reduction due to wear that exceeds six percent of the baseline diameter measurement; or

(h) Loss of more than ten percent of rope strength as determined by nondestructive testing.

30 CFR § 77.1435
Load end attachments.

(a) Wire rope shall be attached to the load by a method that develops at least 80 percent of the nominal strength of the rope.

(b) Except for terminations where use of other materials is a design feature, zinc (spelter) shall be used for socketing wire ropes. Design feature means either the manufacturer's original design or a design approved by a registered professional engineer.

(c) Load end attachment methods using splices are prohibited.

30 CFR § 77.1436
Drum end attachment.

(a) For drum end attachment, wire rope shall be attached--

(1) Securely by clips after making one full turn around the drum spoke;

(2) Securely by clips after making one full turn around the shaft, if the drum is fixed to the shaft; or

(3) By properly assembled anchor bolts, clamps, or wedges, provided that the attachment is a design feature of the hoist drum. Design feature means either the manufacturer's original design or a design approved by a registered professional engineer.

(b) A minimum of three full turns of wire rope shall be on the drum when the rope is extended to its maximum working length.

30 CFR § 77.1437
End attachment retermination.

Damaged or deteriorated wire rope shall be removed by cutoff and the rope reterminated where there is--

(a) More than one broken wire at an attachment;

(b) Improper installation of an attachment;

(c) Slippage at an attachment; or

(d) Evidence of deterioration from corrosion at an attachment.

30 CFR § 77.1438
End attachment replacement.

Wire rope attachments shall be replaced when cracked, deformed, or excessively worn.

Subpart P--Auger Mining

30 CFR § 77.1500
Auger mining; planning.

Auger mining shall be planned and conducted by the operator to insure against any hazard to underground workings located at or near such auger operations and all auger holes shall be located so as to prevent:

(a) The disruption of the ventilation system of any active underground mine;

(b) Inundation hazards from surface water entering any active underground mine;

(c) Damage to the roof and ribs of active underground workings; and

(d) Intersection of auger holes with underground mine workings known to contain dangerous quantities of impounded water.

30 CFR § 77.1501
Auger mining; inspections.

(a) The face of all highwalls, to a distance of 25 feet on both sides of each drilling site, shall be inspected by a certified person before any augering operation is begun, and at least once during each coal producing shift and all loose material shall be removed from the drilling site before persons are permitted to enter the drilling area. The results of all such inspections shall be recorded daily in a book approved by the Secretary.

(b) In addition, the face of all highwalls, to a distance of 25 feet on both sides of each drilling site, shall be inspected frequently by a certified person during any auger operation conducted either during or after a heavy rainfall or during any period of intermittent freezing and thawing and the results of such inspections shall be recorded as provided in paragraph (a) of this section.

(c) When an auger hole penetrates an abandoned or mined out area of an underground mine, tests for methane and oxygen deficiency shall be made at the collar of the hole by a qualified person using devices approved by the Secretary to determine if dangerous quantities of methane or oxygen-deficient air are present or being emitted. If such is found no further work shall be performed until the atmosphere has been made safe.

(d) Tests for oxygen deficiency shall be conducted with a permissible flame safety lamp or other means approved by the Secretary and all tests for methane shall be conducted with a methane detector approved by the Secretary.

(e) Internal combustion engines shall not be operated in the vicinity of any auger hole in which tests for methane or oxygen deficiency are being made.

30 CFR § 77.1502
Auger holes; restriction against entering.

No person shall be permitted to enter an auger hole except with the approval of the Coal Mine Health and Safety District Manager or Subdistrict Manager of the district in which the mine is located and under such conditions as may be prescribed by such managers.

30 CFR § 77.1503
Augering equipment; overhead protection.

(a) Auger machines which are exposed to highwall hazards, together with all those parts of any coal elevating conveyors where persons are required to work during augering operations, shall be covered with heavy gage screen which does not obstruct the view of the highwall and is strong enough to prevent injuries to workmen from falling material.

(b) No work shall be done under any overhang and, when a crew is engaged in connecting or disconnecting auger sections under a highwall, at least one person shall be assigned to observe the highwall for possible movement.

30 CFR § 77.1504
Auger equipment; operation.

(a) Persons shall be kept clear of the auger train while it is in motion and shall not be permitted to pass under or over an auger train, except where adequate crossing facilities are provided.

(b) Persons shall be kept clear of auger sections being swung into position.

(c) No person, including the auger machine operator, shall, where practicable, be stationed in direct line with a borehole during augering operations.

(d) Operator of auger equipment shall not leave the controls of such equipment while the auger is in operation.

(e) Adequate illumination shall be provided for work areas after dark.

30 CFR § 77.1505
Auger holes; blocking.

Auger holes shall be blocked with highwall spoil or other suitable material before they are abandoned.

Subpart Q--Loading and Haulage

30 CFR § 77.1600
Loading and haulage; general.

(a) Only authorized persons shall be permitted on haulage roads and at loading or dumping locations.

(b) Traffic rules, signals, and warning signs shall be standardized at each mine and posted.

(c) Where side or overhead clearances on any haulage road or at any loading or dumping location at the mine are hazardous to mine workers, such areas shall be conspicuously marked and warning devices shall be installed when necessary to insure the safety of the workers.

30 CFR § 77.1601
Transportation of persons; restrictions.

No person shall be permitted to ride or be otherwise transported on or in the following equipment whether loaded or empty:

(a) Dippers, shovels, buckets, forks, and clamshells;

(b) The cargo space of dump trucks or haulage equipment used to transport coal or other material;

(c) Outside the cabs and beds of mobile equipment;

(d) Chain, belt, or bucket conveyors, except where such conveyors are specifically designed to transport persons; and

(e) Loaded buckets on aerial tramways.

30 CFR § 77.1602
Use of aerial tramways to transport persons.

Persons other than maintenance men shall not ride empty buckets on aerial tramways unless the following features are provided:

(a) Two independent brakes, each capable of holding the maximum load.

(b) Direct communication between terminals.

(c) Power drives with emergency power available in case of primary power failure.

(d) Buckets equipped with positive locks to prevent accidental tripping or dumping.

30 CFR § 77.1603
Trains and locomotives; authorized persons.

(a) Only authorized persons shall be permitted to ride on trains or locomotives and they shall ride in a safe position.

(b) Men shall not get on or off moving equipment, except that trainmen may get on or off of slowly moving trains.

30 CFR § 77.1604
Transportation of persons; overcrowding.

(a) No man-trip vehicle or other conveyance used to transport persons to and from work areas at surface coal mines shall be overcrowded and all persons shall ride in a safe position.

(b) Supplies, materials, and tools other than small handtools shall not be transported with men in man-trip vehicles unless such vehicles are specifically designed to make such transportation safe.

30 CFR § 77.1605
Loading and haulage equipment; installations.

(a) Cab windows shall be of safety glass or equivalent, in good condition and shall be kept clean.

(b) Mobile equipment shall be equipped with adequate brakes, and all trucks and front-end loaders shall also be equipped with parking brakes.

(c) Positive-action type brakes shall be provided on aerial tramways.

(d) Mobile equipment shall be provided with audible warning devices. Lights shall be provided on both ends when required.

(e) Guard nets or other suitable protection shall be provided where tramways pass over roadways, walkways, or buildings.

(f) Guards shall be installed to prevent swaying buckets from hitting towers.

(g) Aerial tramway cable connections shall be designed to offer minimum obstruction to the passage of wheels.

(h) Rocker-bottom or bottom-dump cars shall be equipped with positive locking devices, or other suitable devices.

(i) Ramps and dumps shall be of solid construction, of ample width, have ample clearance and headroom, and be kept reasonably free of spillage.

(j) Chute-loading installations shall be designed so that the men pulling chutes are not required to be in a hazardous position during loading operations.

(k) Berms or guards shall be provided on the outer bank of elevated roadways.

(l) Berms, bumper blocks, safety hooks, or similar means shall be provided to prevent overtravel and overturning at dumping locations.

(m) Roadbeds, rails, joints, switches, frogs, and other elements on railroads shall be designed, installed, and maintained in a safe manner consistent with the speed and type of haulage.

(n) Where practicable, a minimum of 30 inches continuous clearance from the farthest projection of moving railroad equipment shall be provided on at least one side of the tracks; all places where it is not possible to provide 30-inch clearance shall be marked conspicuously.

(o) Track guardrails, lead rails, and frogs shall be protected or blocked so as to prevent a person's foot from becoming wedged.

(p) Positive-acting stop-blocks, derail devices, track skates, or other adequate means shall be installed wherever necessary to protect persons from runaway or moving railroad equipment.

(q) Switch throws shall be installed so as to provide adequate clearance for switchmen.

(r) Where necessary, bumper blocks or the equivalent shall be provided at all track dead ends.

30 CFR § 77.1606
Loading and haulage equipment; inspection and maintenance.

(a) Mobile loading and haulage equipment shall be inspected by a competent person before such equipment is placed in operation. Equipment defects affecting safety shall be recorded and reported to the mine operator.

(b) Carriers on aerial tramways, including loading and unloading mechanisms, shall be inspected each shift; brakes shall be inspected daily; ropes and supports shall be inspected as recommended by the manufacturer or as physical conditions warrant. Equipment defects affecting safety shall be reported to the mine operator.

(c) Equipment defects affecting safety shall be corrected before the equipment is used.

30 CFR § 77.1607
Loading and haulage equipment; operation.

(a) Vehicles shall follow at a safe distance; passing shall be limited to areas of adequate clearance and visibility.

(b) Mobile equipment operators shall have full control of the equipment while it is in motion.

(c) Equipment operating speeds shall be prudent and consistent with conditions of roadway, grades, clearance, visibility, traffic, and the type of equipment used.

(d) Cabs of mobile equipment shall be kept free of extraneous materials.

(e) Operators shall sit facing the direction of travel while operating equipment with dual controls.

(f) When an equipment operator is present, men shall notify him before getting on or off equipment.

(g) Equipment operators shall be certain, by signal or other means, that all persons are clear before starting or moving equipment.

(h) Where possible, aerial tramways shall not be started until the tramway operator has ascertained that everyone is in the clear.

(i) Dust control measures shall be taken where dust significantly reduces visibility of equipment operators.

(j) Dippers, buckets, loading booms, or heavy suspended loads shall not be swung over the cabs of haulage vehicles until the drivers are out of the cabs and in safe locations, unless the trucks are designed specifically to protect the drivers from falling material.

(k) Men shall not work or pass under the buckets or booms of loaders in operation.

(l) Tires shall be deflated before repairs on them are started and adequate means shall be provided to prevent wheel locking rims from creating a hazard during tire inflation.

(m) Electrically powered mobile equipment shall not be left unattended unless the master switch is in the off position, all operating controls are in the neutral position, and the brakes are set or other equivalent precautions are taken against rolling.

(n) Mobile equipment shall not be left unattended unless the brakes are set. The wheels shall be turned into a bank or berm, or shall be blocked, when such equipment is parked on a grade.

(o) Lights, flares, or other warning devices shall be posted when parked equipment creates a hazard to vehicular traffic.

(p) Dippers, buckets, scraper blades, and similar movable parts shall be secured or lowered to the ground when not in use.

(q) Shovel trailing cables shall not be moved with the shovel dipper unless cable slings or sleds are used.

(r) Equipment which is to be hauled shall be loaded and protected so as to prevent sliding or spillage.

(s) When moving between work areas, the equipment shall be secured in the travel position.

(t) Any load extending more than 4 feet beyond the rear of the vehicle body should be marked clearly with a red flag by day and a red light at night.

(u) Tow bars shall be used to tow heavy equipment and a safety chain shall be used in conjunction with each tow bar.

(v) Railroad cars shall be kept under control at all times by the car dropper. Cars shall be dropped at a safe rate and in a manner that will insure that the car dropper maintains a safe position while working and traveling around the cars.

(w) Railroad cars shall not be coupled or uncoupled manually from the inside of curves unless the railroad and cars are so designed to eliminate any hazard from coupling or uncoupling cars from inside of curves.

(x) Persons shall wear safety belts when dropping railroad cars.

(y) Railcars shall not be left on sidetracks unless ample clearance is provided for traffic on adjacent tracks.

(z) Parked railcars, unless held effectively by brakes, shall be blocked securely.

(aa) Railroad cars and all trucks shall be trimmed properly when they have been loaded higher than the confines of their cargo space.

(bb) When the entire length of a conveyor is visible from the starting switch, the operator shall visually check to make certain that all persons are in the clear before starting the conveyor. When the entire length of the conveyor is not visible from the starting switch, a positive audible or visible warning system shall be installed and operated to warn persons that the conveyor will be started.

(cc) Unguarded conveyors with walkways shall be equipped with emergency stop devices or cords along their full length.

(dd) Adequate backstops or brakes shall be installed on inclined-conveyor drive units to prevent conveyors from running in reverse if a hazard to personnel would be caused.

(ee) Aerial tram conveyor buckets shall not be overloaded, and feed shall be regulated to prevent spillage.

30 CFR § 77.1608
Dumping facilities.

(a) Dumping locations and haulage roads shall be kept reasonably free of water, debris, and spillage.

(b) Where the ground at a dumping place may fail to support the weight of a loaded dump truck, trucks shall be dumped a safe distance back from the edge of the bank.

(c) Adequate protection shall be provided at dumping locations where persons may be endangered by falling material.

(d) Grizzlies, grates, and other sizing devices at dump and transfer points shall be anchored securely in place.

(e) If truck spotters are used, they shall be well in the clear while trucks are backing into dumping position and dumping; lights shall be used at night to direct trucks.

Subpart R—Miscellaneous

30 CFR § 77.1700
Communications in work areas.

No employee shall be assigned, or allowed, or be required to perform work alone in any area where hazardous conditions exist that would endanger his safety unless he can communicate with others, can be heard, or can be seen.

30 CFR § 77.1701
Emergency communications; requirements.

(a) Each operator of a surface coal mine shall establish and maintain a communication system from the mine to the nearest point of medical assistance for use in an emergency.

(b) The emergency communication system required to be maintained under paragraph (a) of this section may be established by telephone or radio transmission or by any other means of prompt communication to any facility (for example, the local sheriff, the State highway patrol, or local hospital) which has available the means of communication with the person or persons providing emergency medical assistance or transportation in accordance with the provisions of paragraph (a) of this section.

30 CFR § 77.1702
Arrangements for emergency medical assistance and transportation for injured persons; reporting requirements; posting requirements.

(a) Each operator of a surface coal mine shall make arrangements with a licensed physician, medical service, medical clinic, or hospital to provide 24-hour emergency medical assistance for any person injured at the mine.

(b) Each operator shall make arrangements with an ambulance service, or otherwise provide for 24-hour emergency transportation for any person injured at the mine.

(c) Each operator shall, on or before September 30, 1971, report to the Coal Mine Health and Safety District Manager for the district in which the mine is located the name, title and address of the physician, medical service, medical clinic, hospital, or ambulance service with whom arrangements have been made, or otherwise provided, in accordance with the provisions of paragraphs (a) and (b) of this section.

(d) Each operator shall, within 10 days after any change of the arrangements required to be reported under the provisions of this section, report such changes to the Coal Mine Health and Safety District Manager. If such changes involve a substitution of persons, the operator shall provide the name, title, and address of the person substituted together with the name and address of the medical service, medical clinic, hospital, or ambulance service with which such person or persons are associated.

(e) Each operator shall, immediately after making an arrangement required under the provisions of paragraphs (a) and (b) of this section, or immediately after any change, of such agreement, post at appropriate places at the mine the names, titles, addresses, and telephone numbers of all persons or services currently available under such arrangements to provide medical assistance and transportation at the mine.

30 CFR § 77.1703
First-Aid training; supervisory employees.

The mine operator shall conduct first-aid training courses for selected supervisory employees at the mine. Within 60 days after the selection of a new supervisory employee to be so trained, the mine operator shall certify by signature and date the name of the employee and date on which the employee satisfactorily completed the first-aid training course. The certification shall be kept at the mine and made available on request to an authorized representative of the Secretary.

30 CFR § 77.1704
First aid training program; availability of instruction to all miners.

On or before December 30, 1971, each operator of a surface coal mine shall make available to all miners employed in the mine a course of instruction in first aid conducted by the operator or under the auspices of the operator, and such a course of instruction shall be made available to newly employed miners within 6 months after the date of employment.

30 CFR § 77.1705
First aid training program; retraining of supervisory employees; availability to all miners.

Beginning January 1, 1972, each operator of a surface coal mine shall conduct refresher first aid training programs each calendar year for all selected supervisory employees and make available refresher first aid training courses to all miners employed in the mine.

30 CFR § 77.1706
First aid training program; minimum requirements.

(a) All first aid training programs required under the provisions of §§77.1703 and 77.1704 shall include 10 class hours of training in a course of instruction similar to that outlined in "First Aid, A Bureau of Mines Instruction Manual."

(b) Refresher first aid training programs required under the provisions of §77.1705 shall include 5 class hours of refresher training in a course of instruction similar to that outlined in "First Aid, A Bureau of Mines Instruction Manual."

30 CFR § 77.1707
First aid equipment; location; minimum requirements.

(a) Each operator of a surface coal mine shall maintain a supply of the first aid equipment set forth in paragraph (b) of this section at or near each working place where coal is being mined, at each preparation plant and at shops and other surface installation where ten or more persons are regularly employed.

(b) The first aid equipment required to be maintained under the provisions of paragraph (a) of this section shall include at least the following:

(1) One stretcher;

(2) One broken-back board (if a splint-stretcher combination is used it will satisfy the requirements of both paragraph (b) (1) of this section and this paragraph (b) (2));

(3) Twenty-four triangular bandages (15 if a splint-stretcher combination is used);

(4) Eight 4-inch bandage compresses;

(5) Eight 2-inch bandage compresses;

(6) Twelve 1-inch adhesive compresses;

(7) An approved burn remedy;

(8) Two cloth blankets;

(9) One rubber blanket or equivalent substitute;

(10) Two tourniquets;

(11) One 1-ounce bottle of aromatic spirits of ammonia or 1 dozen ammonia ampules; and,

(12) The necessary complements of arm and leg splints or two each inflatable plastic arm and leg splints.

(c) All first aid supplies required to be maintained under the provisions of paragraphs (a) and (b) of this section shall be stored in suitable, sanitary, dust tight, moisture proof containers and such supplies shall be accessible to the miners.

30 CFR § 77.1708

Safety program; instruction of persons employed at the mine.

On or before September 30, 1971, each operator of a surface coal mine shall establish and maintain a program of instruction with respect to the safety regulations and procedures to be followed at the mine and shall publish and distribute to each employee, and post in conspicuous places throughout the mine, all such safety regulations and procedures established in accordance with the provisions of this section.

30 CFR § 77.1710

Protective clothing; requirements.

Each employee working in a surface coal mine or in the surface work areas of an underground coal mine shall be required to wear protective clothing and devices as indicated below:

(a) Protective clothing or equipment and face-shields or goggles shall be worn when welding, cutting, or working with molten metal or when other hazards to the eyes exist.

(b) Suitable protective clothing to cover the entire body when handling corrosive or toxic substances or other materials which might cause injury to the skin.

(c) Protective gloves when handling materials or performing work which might cause injury to the hands; however, gloves shall not be worn where they would create a greater hazard by becoming entangled in the moving parts of equipment.

(d) A suitable hard hat or hard cap when in or around a mine or plant where falling objects may create a hazard. If a hard hat or hard cap is painted, nonmetallic based paint shall be used.

(e) Suitable protective footwear.

(f) Snug-fitting clothing when working around moving machinery or equipment.

(g) Safety belts and lines where there is danger of falling; a second person shall tend the lifeline when bins, tanks, or other dangerous areas are entered.

(h) Lifejackets or belts where there is danger from falling into water.

(i) Seatbelts in a vehicle where there is a danger of overturning and where roll protection is provided.

30 CFR § 77.1710-1

Distinctively colored hard hats or hard caps; identification for newly employed, inexperienced miners.

Hard hats or hard caps distinctively different in color from those worn by experienced miners shall be worn at all times by each newly employed, inexperienced miner when working in or around a mine or plant for at least one year from the date of his initial employment as a miner or until he has been qualified or certified as a miner by the State in which he is employed.

30 CFR § 77.1711

Smoking prohibition.

No person shall smoke or use an open flame where such practice may cause a fire or explosion.

30 CFR § 77.1712

Reopening mines; notification; inspection prior to mining.

Prior to reopening any surface coal mine after it has been abandoned or declared inactive by the operator, the operator shall notify the Coal Mine Health and Safety District Manager for the district in which the mine is located, and an inspection of the entire mine shall be completed by an authorized representative of the Secretary before any mining operations in such mine are instituted.

30 CFR § 77.1713

Daily inspection of surface coal mine; certified person; reports of inspection.

(a) At least once during each working shift, or more often if necessary for safety, each active working area and each active surface installation shall be examined by a certified person designated by the operator to conduct such examinations for hazardous conditions and any hazardous conditions noted during such examinations shall be reported to the operator and shall be corrected by the operator.

(b) If any hazardous condition noted during an examination conducted in accordance with paragraph (a) of this section creates an imminent danger, the person conducting such examination shall notify the operator and the operator shall withdraw all persons from the area affected, except those persons referred to in section 104(d) of the Act, until the danger is abated.

(c) After each examination conducted in accordance with the provisions of paragraph (a) of this section, each certified person who conducted all or any part of the examination required shall enter with ink or indelible pencil in a book approved by the Secretary the date and a report of the condition of the mine or any area of the mine which he has inspected together with a report of the nature and location of any hazardous condition found to be present at the mine. The book in which such entries are made shall be kept in an area at the mine designated by the operator to minimize the danger of destruction by fire or other hazard.

(d) All examination reports recorded in accordance with the provisions of paragraph (c) of this section shall include a report of the action taken to abate hazardous conditions and shall be signed or countersigned each day by at least one of the following persons:

(1) The surface mine foreman;

(2) The assistant superintendent of the mine;

(3) The superintendent of the mine; or,

(4) The person designated by the operator as responsible for health and safety at the mine.

Subpart S--Trolley Wires and Trolley Feeder Wires

30 CFR § 77.1800

Cutout switches.

Trolley wires and trolley feeder wires shall be provided with cutout switches at intervals of not more than 2,000 feet and near the beginning of all branch lines.

30 CFR § 77.1801

Overcurrent protection.

Trolley wires and trolley feeder wires shall be provided with overcurrent protection.

30 CFR § 77.1801-1

Devices for overcurrent protection.

Automatic circuit interrupting devices that will deenergize the affected circuit upon occurrence of a short circuit at any point in the system will meet the requirements of §77.1801.

30 CFR § 77.1802

Insulation of trolley wires, trolley feeder wires and bare signal wires; guarding of trolley wires and trolley feeder wires.

Trolley wires, trolley feeder wires, and bare signal wires shall be adequately guarded:

(a) At all points where men are required to work or pass regularly under the wires; and

(b) At man-trip stations.

The Secretary or his authorized representative shall specify other conditions where trolley wires and trolley feeder wires shall be adequately protected to prevent contact by any person, or shall require the use of improved methods to prevent such contact. Temporary guards shall be provided where trackmen and other persons are required to work in proximity to trolley wires and trolley feeder wires.

Subpart T--Slope and Shaft Sinking

30 CFR § 77.1900

Slopes and shafts; approval of plans.

(a) Each operator of a coal mine shall prepare and submit for approval by the Coal Mine Health and Safety District Manager for the district in which the mine is located, a plan providing for the safety of workmen in each slope or shaft that is commenced or extended after June 30, 1971. The plan shall be consistent with prudent engineering design. The methods employed by the operator shall be selected to minimize the hazards to those employed in the initial or subsequent development of any such slope or shaft, and the plan shall include the following:

(1) The name and location of the mine, and the Mine Safety and Health Administration mine identification number, if known;

(2) The name and address of the mine operator;

(3) A description of the construction work and methods to be used in the construction of the slope or shaft, and whether part or all of the work will be performed by a contractor and a description of that part of the work to be performed by a contractor;

(4) The elevation, depth and dimensions of the slope or shaft;

(5) The location and elevation of the coalbed;

(6) The general characteristics of the strata through which the slope or shaft will be developed;

(7) The type of equipment which the operator proposes to use when the work is to be performed by the operator. When work is to be performed by a contractor the operator shall, as soon as known to him, supplement the plan with a description of the type of equipment to be used by the contractor;

(8) The system of ventilation to be used; and

(9) Safeguards for the prevention of caving during excavation.

30 CFR § 77.1900-1

Compliance with approved slope and shaft sinking plans.

Upon approval by the Coal Mine Health and Safety District Manager of a slope or shaft sinking plan, the operator shall adopt and comply with such plan.

30 CFR § 77.1901

Preshift and onshift inspections; reports.

(a) Examinations of slope and shaft areas shall be made by a certified person for hazardous conditions, including tests for methane and oxygen deficiency:

(1) Within 90 minutes before each shift;

(2) At least once on any shift during which men are employed inside any slope or shaft during development; and

(3) Both before and after blasting.

(b) The surface area surrounding each slope and shaft shall be inspected by a certified person and all hazards in the vicinity shall be corrected before men are permitted to enter the excavation.

(c) All hazards found during any preshift or onshift inspection shall be corrected before men are allowed to enter, or continue to work in such slope or shaft. If hazardous conditions cannot be corrected, or excessive methane concentrations cannot be diluted, the excavation shall be vacated and no person shall be permitted to reenter the slope or shaft to continue excavation operations until the hazardous condition has been abated.

(d) No work shall be performed in any slope or shaft, no drilling equipment shall be started, and no electrical equipment shall be energized if the methane content in such slope or shaft is 1.0 volume per centum, or more.

(e) Nothing in this §77.1901 shall prevent the specific assignment of men in the slope or shaft for purposes of abating excessive methane concentrations or any other hazardous condition.

(f) The results of all inspections conducted in accordance with the provisions of paragraph (a) of this section shall be recorded in a book approved by the Secretary.

30 CFR § 77.1901-1

Methane and oxygen deficiency tests; approved devices.

Tests for oxygen deficiency shall be made with a permissible flame safety lamp or other means approved by the Secretary, and tests for methane shall be made with a methane detector approved by the Secretary.

30 CFR § 77.1902

Drilling and mucking operations.

Diesel-powered equipment used in the drilling, mucking, or other excavation of any slope or shaft shall be permissible, and such equipment shall be operated in a permissible manner and shall be maintained in a permissible condition.

30 CFR § 77.1902-1

Permissible diesel-powered equipment.

Diesel-powered equipment which has been approved by the Bureau of Mines or the Mine Safety and Health Administration under Part 36 of this chapter (Bureau of Mines Schedule 31) is permissible under the provisions of this section.

30 CFR § 77.1903

Hoists and hoisting; minimum requirements.

(a) Hoists used in transporting persons and material during drilling, mucking, or other excavating operations in any slope or shaft shall have rated capacities consistent with the loads to be handled.

(b) Each hoist used in drilling, mucking, or other excavating operations shall be equipped with an accurate and reliable indicator of the position of the cage, platform, or bucket. The indicator shall be installed in clear view of the hoist operator.

30 CFR § 77.1904

Communications between slope and shaft bottoms and hoist operators.

(a) Two independent means of signaling shall be provided between the hoistman and all points in a slope or shaft where men are required to work. At least one of these means shall be audible to the hoistman. Signal codes used in any communication system shall be posted conspicuously at each slope and shaft.

(b) Signaling systems used for communication between slopes and shafts and the hoistman shall be tested daily.

30 CFR § 77.1905

Hoist safeguards; general.

(a) Hoists used to transport persons shall be equipped with brakes capable of stopping and holding the cage, bucket, platform, or other device when fully loaded.

(b) When persons are transported by a hoist, a second person familiar with and qualified to stop the hoist shall be in attendance, except where the hoist is fully equipped with overspeed, overwind, and automatic stop devices.

30 CFR § 77.1906

Hoists; daily inspection.

(a) Hoists used to transport persons shall be inspected daily. The inspection shall include examination of the headgear (headframe, sheave wheels, etc.), connections, links and chains, and other facilities.

(b) Prior to each working shift, and before a hoist is returned to service after it has been out of normal service for any reason, the hoist shall be run by the hoist operator through one complete cycle of operation before any person is permitted to be transported.

(c) At the completion of each daily examination required by paragraph (a) of this section, the person making the examination shall certify, by signature and date, that the examination has been made. If any unsafe condition in the hoisting equipment is present, the person conducting the examination shall make a record of the condition and the date. Certifications and records shall be retained for one year.

30 CFR § 77.1907

Hoist construction; general.

If hooks are used to attach cages or buckets to the socket or thimble of a hoisting rope, the hooks shall be self-closing.

30 CFR § 77.1908

Hoist installations; use.

(a) Where men are transported by means of a hoist and the depth of the shaft exceeds 50 feet, the hoist rope shall be suspended from a substantial hoisting installation which shall be high enough to provide working clearance between the bottom of the sheave and the top of the cage or bucket.

(b) Where men are transported by means of a hoist and the depth of the shaft exceeds 100 feet, temporary shaft guides and guide attachments, or other no less effective means, shall be installed to prevent the cage, platform, or bucket from swinging.

(c) All guides and guide attachments, or other no less effective means, installed in accordance with paragraph (b) of this section shall be maintained to a depth of not less than 75 feet from the bottom of the shaft.

(d) Where crossheads are used, the cage, platform, or bucket shall not be hung more than 10 feet below the crosshead.

(e) Where men are required to embark or disembark from a cage, platform or bucket suspended over or within a shaft, a loading platform shall be installed to insure safe footing.

(f) During the development of each slope or shaft, either a ladder or independently powered auxiliary hoist shall be provided to permit men to escape quickly in the event of an emergency.

(g) No person shall be permitted to ride the rim of any bucket or on the top of a loaded bucket.

(h) The number of persons permitted to ride in cages, skips, or buckets shall be limited so as to prevent overcrowding.

(i) Persons shall not be permitted to ride on a cage, skip, or bucket with tools or materials, except when necessary to handle equipment while in transit. Materials shall be secured to prevent shifting while being hoisted.

(j) The speed of buckets transporting persons shall not exceed 500 feet per minute and not more than 200 feet per minute when within 100 feet of any stop.

(k) A notice of established speeds shall be posted in clear view of the hoistman.

(l) Conveyances being lowered in a shaft in which men are working shall be stopped at least 15 feet above such men and shall be lowered further only after the hoistman has received a signal that all men who may be endangered by the conveyance are in the clear.

(m) No skip or bucket shall be raised or lowered in a slope or shaft until it has been trimmed to prevent material from falling back down the slope or shaft.

(n) Measures shall be taken to prevent material from falling back into the shaft while buckets or other conveyances are being unloaded.

(o) Properly attached safety belts shall be worn by all persons required to work in or over any shaft where there is a drop of 10 or more feet, unless other acceptable means are provided to prevent such persons from falling into the shaft.

30 CFR § 77.1908-1

Hoist operation; qualified hoistman.

Hoists shall be under the control of and operated by a qualified hoistman when men are in a slope or haf

30 CFR § 77.1909

Explosives and blasting; use of permissible explosives and shot-firing units.

Except as provided in §77.1909-1, only permissible explosives and permissible shot-firing units shall be used in sinking shafts and slopes.

30 CFR § 77.1909-1

Use of nonpermissible explosives and nonpermissible shot-firing units; approval by Health and Safety District Manager.

Where the Coal Mine Health and Safety District Manager has determined that the use of nonpermissible explosives and nonpermissible shot-firing units will not pose a hazard to any person during the development of a slope or shaft, he may, after written application by the operator, approve the use of such explosives and shot-firing units and issue a permit for the use of such explosives and devices setting forth the safeguards to be employed by the operator to protect the health and safety of any person exposed to such blasting.

30 CFR § 77.1910

Explosives and blasting; general.

(a) Light and power circuits shall be disconnected or removed from the blasting area before charging and blasting.

(b) All explosive materials, detonators, and any other related blasting material employed in the development of any slope or shaft shall be stored, transported, carried, charged, and fired in accordance with the provision of Subpart N, "Explosives and Blasting," of this Part 77. Except as provided in paragraph (c) of this section, all shots shall be fired from the surface.

(c) Where tests for methane have been conducted and methane has not been found and only permissible blasting units are being employed, shots may be fired from an upper level of the slope or shaft.

(d) Except as provided in paragraph (c) of this section, all men shall be removed from the slope or shaft prior to blasting.

(e) Blasting areas in slopes or shafts shall be covered with mats or other suitable material when the excavation is too shallow to retain blasted material.

(f) Where it is impracticable to prepare primers in the blasting area, primers may be prepared on the surface and carried into the shaft in specially constructed, insulated, covered containers.

(g) No other development operation shall be conducted in a shaft or at the face of a slope while drill holes are being charged and until after all shots have been fired.

(h) The sides of the slope or shaft between the overhead platform and the bottom where men are working shall be examined after each blast and loose material removed.

(i) Loose rock and other material shall be removed from timbers and platforms after each blast before men are lowered to the shaft bottom.

30 CFR § 77.1911

Ventilation of slopes and shafts.

(a) All slopes and shafts shall be ventilated by mechanical ventilation equipment during development. Such equipment shall be examined before each shift and the quantity of air in the slope or shaft measured daily by a certified person and the results of such examinations and tests recorded in a book approved by the Secretary.

(b) Ventilation fans shall be:

(1) Installed on the surface;

(2) Installed in fireproof housing and connected to the slope or shaft opening with fireproof air ducts;

(3) Designed to permit the reversal of the air current, and located in an area which will prevent a recirculation of air from the slope or shaft or air contamination from any other source;

(4) Equipped with an automatic signal device designed to give an alarm in the event the fan slows or stops which can be seen or heard by any person on duty in the vicinity of the fan, except where fans are constantly attended.

(5) Offset not less than 15 feet from the shaft; and

(6) Equipped with air ducts which are fire resistant and maintained so as to prevent excessive leakage of air;

(b)(6)(i) Flexible ducts shall be constructed to permit ventilation by either exhausting or blowing methods and when metal air ducts are used, they shall be grounded effectively to remove static and other electrical charges;

(b)(6)(ii) Ducts shall extend as close to the bottom as necessary to ventilate properly.

(c) A qualified person, designated by the operator, shall be assigned to maintain each ventilating system.

(d) The fan shall be operated continuously when men are below the surface. Any accidental stoppage or reduction in airflow shall be corrected promptly; however, where repairs cannot be made immediately, development work below the surface shall be stopped and all the men not needed to make necessary repairs shall be removed to the surface.

30 CFR § 77.1912

Ladders and stairways.

(a) Substantial stairways or ladders shall be used during the construction of all shafts where no mechanical means are provided for men to travel.

(b) Landings at intervals of not more than 30 feet shall be installed.

(c) Shaft ladders shall project 3 feet above the collar of the shaft, and shall be placed at least 3 inches from the side of the shaft.

30 CFR § 77.1913

Fire-resistant wood.

Except for crossties, timbers, and other wood products which are permanently installed in slopes and shafts, shall be fire resistant.

30 CFR § 77.1914

Electrical equipment.

(a) Electric equipment employed below the collar of a slope or shaft during excavation shall be permissible and shall be maintained in a permissible condition.

(b) The insulation of all electric conductors employed below the collar of any slope or shaft during excavation shall be of the flame resistant type.

(c) Only lamps and portable flood lights approved by the Bureau of Mines or the Mine Safety and Health Administration under Part 19 and Part 20 of this chapter (Bureau of Mines Schedules 6D and 10C) shall be employed below the collar of any slope or shaft.

30 CFR § 77.1915

Storage and handling of combustible materials.

(a) Compressed and liquefied gas, oil, gasoline, and other petroleum products shall not be stored within 100 feet of any slope or shaft opening.

(b) Other combustible material and supplies shall not be stored within 25 feet of any slope or shaft opening.

(c) Pyritic slates, bony coal, culm or other material capable of spontaneous combustion shall not be used for fill or as surfacing material within 100 feet of any slope or shaft opening.

(d) Areas surrounding the opening of each slope or shaft shall be constructed to insure the drainage of flammable liquids away from the slope or shaft in the event of spillage.

(e) Oily rags, waste, waste paper, and other combustible waste material disposed of in the vicinity of any slope or shaft opening shall be stored in closed containers until removed from the area.

30 CFR § 77.1916

Welding, cutting, and soldering; fire protection.

(a) One portable fire extinguisher shall be provided where welding, cutting, or soldering with arc or flame is performed.

(b) Welding, cutting, or soldering with arc or flame within or in the vicinity of any slope or shaft, except where such operations are performed in fireproof enclosures, shall be done under the supervision of a qualified person who shall make a diligent search within or in the vicinity of the slope or shaft for fire during and after such operations.

(c) Before welding, cutting, or soldering is performed in any slope or shaft designed to penetrate into any coalbed below the surface, an examination for methane shall be made by a qualified person with a device approved by the Secretary for detecting methane. Examination for methane shall be made immediately before and periodically during welding, cutting, or soldering and such work shall not be permitted to commence or continue in air which contains 1.0 volume per centum or more of methane.

(d) Noncombustible barriers shall be installed below welding, cutting, or soldering operations in or over a shaft.

Section VIII

General Definitions

Disclaimer

The definitions provided herein are solely for the purpose of general information. They should not be substituted for technical a questions. These definitions are not necessarily intended to conform to those set forth in any governmental regulations or guidelines, nor are they intended to describe any manufacturer's particular product configuration.

AC Alternating current.

Acceptor A charge of explosives or blasting agent receiving an impulse from an exploding donor charge.

Adobe Charge A mud-covered or unconfined explosive charge fired in contact with a rock surface without the use of a borehole-, Synonymous with Bulldoze and Mudcapping.

Air Blast The airborne shock wave or acoustic transient generated by an explosion.

American Table of Distances The quantity-distance table, prepared and approved by IME, for storage of explosive materials to determine safe distances from inhabited buildings, public highways, passenger railways, and other stored explosive materials.

Ammonium Nitrate The ammonium salt of nitric acid represented by the NH_4NO_3

Ampere A unit of electrical current produced by 1 volt acting through a resistance of I ohm.

ANFO An explosive material consisting of ammonium nitrate and fuel oil.

ANSI American National Standards Institute, a nongovernmental organization concerned with developing safety and health standards for industry.

Approved, Approval, or Authorized Terms that mean Approved, Approval, or Authorized by the authority having jurisdiction.

Artificial Barricade An artificial mound or revetted wall of earth of a minimum thickness of 3 ft.

Authorized Person An individual approved or assigned by management to perform a specific duty or duties or to be at a specific location or locations.

Authority Having Jurisdiction The governmental agency, office, or individual responsible for approving equipment, an installation, or a procedure.

Available Energy The energy from an explosive material that is capable of performing useful work.

Back Break Rock broken beyond the limits of the last row of holes in a blast.

Ballistic Mortar A laboratory instrument used for measuring the relative power or strength of an explosive material.

Barricaded The effective screening of a building containing explosives from a magazine or other building, railway, or highway by a natural or an artificial barrier. A straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine or other building or to a point 12 ft above the center of a railway or highway shall pass through such barrier.

Base Charge The main explosive charge in the base of a detonator.

Bench A horizontal ledge in or at the top of a highwall from which holes are drilled vertically down into the material to be blasted; benching is a process of excavating where a highwall is worked in steps or lifts.

Bench Height The vertical distance from the top of a bench to the floor or to the top of the next lower bench.

Black Powder A deflagrating or low-explosive compound of an intimate mixture of sulfur, charcoal, and an alkali nitrate, usually potassium or sodium nitrate.

Blast, Blasting The firing of explosive materials for such purposes as breaking rock or other material, moving material, or generating seismic waves; the assembly of explosive materials for such purpose.

Blast Area The area of a blast within the influence of flying rock missiles, gases, and concussion.

Blast Pattern The plan of the drill holes laid out on a bench; an expression of the burden distance and the spacing distance and their relationship to each other.

Blast Site The area where explosive material is handled during loading, including the perimeter of blastholes and 50 ft in all directions from loaded holes or holes to be loaded. In underground mines, 15 ft of solid rib or pillar can be substituted for the 50-ft distance.

Blaster That qualified person in charge of, and responsible for the loading and firing of a blast (same as *Shot Firer).*

Blasting Accessories Nonexplosive devices and materials used in blasting, such as, but not limited to, cap crimpers, tamping bags, blasting machines, blasting galvanometers, and cartridge punches.

Blasting Agent An explosive material that meets prescribed criteria for insensitivity to initiation. For storage, Title 27, Code of Federal Regulations, Section 555.11 defines a blasting agent as any material or mixture, consisting of fuel and oxidizer intended for blasting, not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined (Bureau of Alcohol. Tobacco and Firearms Regulation). For transportation, Title 49, Code of Federal Regulations defines a blasting agent as a material designed for blasting that has been tested in accordance with Section 173.114a and found to be so insensitive that there is very little probability of accidental initiation to explosion or transition from deflagration to detonation (U.S. Department of Transportation Regulation).

Blasting Cap A detonator that is initiated by a safety fuse (see Fuse Cap)

Blasting Crew A group of persons who assist the blaster in loading, tying in, and firing a blast.

Blasting Galvanometer An electrical resistance instrument designed specifically for testing electric detonators and circuits containing them. Along with blasting ohmmeters and blaster's multimeters, it is used to measure resistance or to check electrical continuity.

Blasting Log A written record of information about a specific blast as may be required by law or regulation.

Blasting Machine An electrical or electromechanical device that provides electrical energy for the purpose of energizing detonators in an electric blasting circuit.

Blasting Machine-CD Type See *Capacitor-Discharge Blasting Machine.*

Blasting Machine-Generator Type A hand-operated electromechanical device that provides an output current to energize electric detonators.

Blasting Machine Rheostat A graduated electrical resistance device used to simulate electric detonator resistances in the testing of blasting machines.

Blasting Mat A mat of woven steel wire, rope, scrap tires, or other suitable material or construction to cover blastholes for the purpose of preventing flying rock missiles.

Blasting Vibrations The energy from a blast that manifests itself in earthborne vibrations that are transmitted through the earth away from the immediate blast area.

Block-Holing The breaking of boulders by loading and firing small explosive charges in small-diameter drilled holes.

Booster An explosive charge, usually of high strength and high detonation velocity, used to improve the initiation of less sensitive explosive materials.

Bootleg The part of a drilled blasthole that remains when the force of the explosion does not break the rock completely to the bottom of the hole.

Borehole (Blasthole) A hole drilled in the material to be blasted, for the purpose of containing an explosive charge.

Breakage A term used to describe the size distribution of the rock fragments created by a blast.

Bridgewire A resistance wire connecting the ends of the legwires inside an electric detonator and which is imbedded in the ignition charge of the detonator.

Brisance The shattering power of an explosive material as distinguished from its total work capacity.

Bulk Mix A mass of explosive material prepared for use in bulk form without packaging.

Bulk Mix Delivery Equipment Equipment (usually a motor vehicle with or without a mechanical delivery device) that transports explosive materials in bulk form for mixing and/or loading directly into blastholes.

Bulk Strength The strength per unit volume of an explosive calculated from its weight strength and density.

Bulldoze A mud-covered or unconfined explosive charge fired in contact with a rock surface without the use of a borehole; Synonymous with Adobe Charge and Mudcapping.

Bullet-Resistant Magazine walls or doors of construction resistant to penetration of a bullet of 150-grain M2 ball ammunition having a nominal muzzle velocity of 2,700 ft/sec fired from a .30-caliber rifle from a distance of 100 ft perpendicular to the wall or door. When a magazine ceiling or roof is required to be bullet-resistant, the ceiling or roof shall be constructed of materials comparable to the sidewalls or of other materials that will withstand penetration of the bullet described above when fired at an angle of 45 degrees from the perpendicular. Tests to determine bullet resistance should be conducted on test panels or empty magazines that will resist penetration of 5 out of 5 shots placed independently of each other in an area at least 3 ft. x 3 ft.

Bullet-Sensitive Explosive Material Explosive material that can be detonated by 150-grain M2 ball ammunition having a nominal muzzle velocity of 2,700 ft/sec when the bullet is fired from a .30-caliber rifle at a distance of not more than 100 ft and the test material, at a temperature of 70 - 75°F, is placed against a backing material of $^1/_2$-in. steel plate.

Bureau of Explosives A bureau of the Association of American Railroads that the U.S. Department of Transportation may consult for recommendations on classification of explosive materials for the purpose of interstate transportation

Burden The distance from the borehole and the nearest free face or the distance between boreholes measured perpendicular to the spacing. Also the total amount of material to be blasted by a given hole, usually measured in cubic yards or tons.

Bureau of Alcohol, Tobacco, and Firearms (BAFT) A bureau of the Department of Treasury having responsibility for the promulgation and enforcement of regulations related to the unlawful use of explosive materials under 18 U.S.C. Chapter 40, Section 847.

Bureau of Mines See U.S. Bureau of Mines.

Bus Wire Expendable heavy-gauge bare copper wire used to connect detonators or series of detonators in parallel

Cap Crimper A mechanical device for crimping the metallic shell of a fuse detonator or igniter cord connector securely to a section of inserted safety fuse.

Cap Sensitivity The sensitivity of an explosive to initiation by a detonator. An explosive material is considered to be cap sensitive if it detonates with an IME No. 8 Test Detonator.

Capacitor-Discharge Blasting Machine A blasting machine in which electrical energy, stored on a capacitor, is discharged into a blasting circuit containing electric detonators..

Carton A lightweight inner container for explosive materials, usually encased in a substantial shipping container called a case.

Cartridge An individual closed shell, bag, or tube of circular cross section containing explosive material.

Cartridge Count (Stick Count) The number of cartridges in a standard case. A standard case typically contains about 50 LB of explosive material.

Cartridge Punch A wooden, plastic, or nonsparking metallic device used to punch an opening in an explosive cartridge to accept a detonator or a section of detonating cord.

Cartridge Strength Same as *Bulk Strength.*

Case An outer substantial shipping container meeting DOT specifications for explosive materials.

Case Liner A plastic or paper barrier used to prevent the escape of explosive materials from a case.

Cast, Extrude, or Pressed Booster A cast, extruded, or pressed solid high explosive used to detonate less sensitive explosive materials.

Certified Blaster A blaster certified by a governmental agency to prepare, execute, and supervise blasting.

Chemical Manufacturers Association (CMA) A nonprofit chemical trade organization of companies in the United States and Canada who manufacture chemicals for sale.

Circuit A completed path for conveying electrical current.

Class A Explosives Explosives, as defined by the U.S. Department of Transportation, that possess detonating or otherwise maximum hazard, such as, but not limited to, dynamite, nitroglycerin, lead azide, blasting caps, and detonating primers

Class B Explosives Explosives, as defined by the U.S. Department of Transportation, that possess flammable hazard, such as, but not limited to, propellant explosives. photographic flash powders, and some special fireworks.

Class C Explosives Explosives, as defined by the U.S. Department of Transportation, that contain Class A or Class B explosives, or both, as components but in restricted quantities.

Collar The term applied to the timbering or concrete around the mouth or top of a shaft. It also refers to the mouth or top of a drill hole in blasting.

Column Charge A charge of explosives in a blasthole in the form of a long, continuous unbroken column.

Column Depth/Column Height The length of each portion of a blast hole filled with explosive materials.

Commercial Explosives Explosives designed, produced, and used for commercial or industrial applications rather than for military purposes.

Confined Detonation Velocity The detonation velocity of an explosive material in a substantial container or a borehole.

Connecting Wire Wire used to extend the firing line or legwires in an electric blasting circuit.

Core Load The explosive core of detonating cord, expressed as the number of grains of explosive per foot.

Coupling The degree to which an explosive fills the cross section of a borehole; bulk-loaded explosives are completely coupled; untamped cartridges are decoupled.

Coyote Shooting A method of blasting using a number of relatively large concentrated charges of explosives placed in one or more small tunnels driven in a rock formation.

Crimp The folded ends of paper explosive cartridges, the circumferential depression at the open end of a fuse cap or igniter cord connector that serves to secure the fuse; or the circumferential depression in the blasting cap shell that secures a sealing plug or sleeve into electric or nonelectric detonators.

Crimping The act of securing a fusecap or igniter cord connector to a section of a safety fuse by compressing the metal shell of the cap against the fuse by means of a cap crimper.

Critical Diameter The minimum diameter for propagation of a detonation wave at a stable velocity. Critical diameter is affected by conditions of confinement, temperature, and pressure on the explosive.

Crosscut A horizontal opening driven across the course of a vein or in general across the direction of the main workings. a connection from a shaft to a vein.

Current Leakage Portion of the firing current bypassing part of the blasting circuit through unintended paths.

Current-Limiting Device An electric or electromechanical device that limits:
1) current amplitude,
2) duration of current flow. or
3) total energy of the current delivered to an electric blasting circuit

Cushion Blasting A blasting technique used to produce competent slopes. The cushion holes, fired after the main charge, have a reduced spacing and employ decoupled charges.

Cutoff A break in a path of detonation or initiation caused by extraneous interference, such as flyrock or shifting ground.

Date-Shift Code A code applied by manufacturers to the outside shipping containers, and, in many instances, to the immediate containers of explosive materials to aid in their identification and tracing.

D'Autriche Method-Detonation Velocity A method of determining the detonation velocity of an explosive material by employing detonating cord and a witness plate.

DC Direct current.

Decibel A unit of air overpressure commonly used to measure air blast.

Deck Loading(Decking) A method of loading blastholes in which the explosive charges, called decks or deck charges, in the same hole are separated by stemming or an air cushion.

Decks An explosive charge that is separated from other charges in the blasthole by stemming or an air cushion.

Deflagration An explosive reaction such as a rapid combustion that moves through an explosive material at a velocity less than the speed of sound in the material.

Delay A distinct pause of predetermined time between detonation or initiation impulses, to permit the firing of explosive charges separately.

Delay Blasting The practice of initiating individual explosive decks, boreholes, or rows of boreholes at predetermined time intervals using delay detonators, as compared to instantaneous blasting where all holes are fired essentially simultaneously.

Delay Detonator An electric or nonelectric detonator used to introduce a predetermined lapse of time between the application of a firing signal and the detonation of the base charge.

Delay Element The device in a delay detonator that produces the predetermined time lapse between the application of a firing signal and detonation.

Delay Interval The nominal time between the detonations of delay detonators of adjacent periods in a delay series; the nominal time between successive detonations in a blast.

Delay Period A designation given to a delay detonator to show its relative or absolute delay time in a given series.

Delay Series A series of delay detonators designed to satisfy specific blasting requirements. There are basically two types of delay series: millisecond (MS) with delay intervals on the order of milliseconds, and long period (LP) with delay times on the order of seconds.

Delay Tag A tag, band, or marker on a delay detonator that denotes the delay series, delay period, and/or delay time of the detonator.

Delay Time The lapse of time between the application of a firing signal and the detonation of the base charge of a delay detonator.

Density The mass of an explosive per unit of volume, usually expressed in grams per cubic centimeter or pounds per cubic foot.

Department of Transportation (DOT) A cabinet-level agency of the federal government. It has the responsibility for the comprehensive regulation of transportation safety and issues regulations governing interstate shipments of explosives and other hazardous materials.

Detonating Cord A flexible cord containing a center core of high explosive and used to initiate other explosives.

Detonating Cord Downline The section of detonating cord that extends within the blasthole from the ground surface down to the explosive charge.

Detonating Cord MS Connectors Nonelectric, short-interval (millisecond) delay devices for use in delaying blasts that are initiated by detonating cord.

Detonating Cord Trunkline The line of detonating cord that is used to connect and initiate other lines of detonating cord.

Detonating Primer A name applied for transportation purposes to a device consisting of a detonator and an additional charge of explosives, assembled as a unit.

Detonation An explosive reaction that moves through an explosive material at a velocity greater than the speed of sound in the material.

Detonation Pressure The pressure produced in the reaction/zone of a detonating explosive.

Detonation Velocity The velocity at which a detonation progresses through an explosive.

Detonator Any device containing any initiating or primary explosive that is used for initiating detonation. A detonator may not contain more than 10 g of total explosives by weight, excluding ignition or delay charges. The term includes, but Is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord delay connectors, and nonelectric instantaneous and delay blasting caps that use detonating cord, shock tube, or any other replacement for electric legwires.

Development The work of driving openings to and in a proved ore body, to prepare it for mining and transporting the ore.

Diameter The cross-sectional width of a borehole or an explosive cartridge.

Ditch Blasting The formation of a ditch by the detonation of a series of explosive charges.

Ditching Dynamite A nitroglycerin-type explosive especially designed to propagate sympathetically from hole to hole in ditch blasting.

Donor An exploding charge producing an impulse that impinges upon an explosive "acceptor" charge.

Dope Individual, dry, nonexplosive ingredients that comprise a portion of an explosive formulation.

Do's and Don'ts A list of precautions *(IME Safety Library Publication No. 4)* printed by the Institute of Makers of Explosives pertaining to the transportation, storage, handling, and use of explosive materials and inserted in cases of explosive materials and cartons of detonators.

Downline A line of detonating cord or plastic tubing in blasthole that transmits the detonation from the trunkline or surface delay system down the hole to the primer.

Drift A horizontal opening in or near an ore body and parallel to the course of the vein or long dimension of the ore body.

Drill Hole A hole drilled in the material to be blasted for the purpose of containing an explosive charge, also called *Blasthole or Borehole.*

Drilling Pattern The location of blastholes in relationship to each other and the free face, if any.

Dynamite A high explosive used for blasting, consisting essentially of a mixture of, but not limited to, nitroglycerin, nitrocellulose, ammonium nitrate, sodium nitrate, and carbonaceous materials.

Electric Blasting Circuit An electric circuit containing electric detonators and associated wiring.

Electric Detonator A detonator designed for, and capable of, initiation by means of an electric current.

Electrical Storm An atmospheric disturbance characterized by intense electrical activity, producing lightning strokes and strong electric and magnetic fields.

Emergency Procedure Card Instructions carried on a truck transporting explosive materials and giving specific procedures in case of emergency.

Emulsion An explosive material containing substantial amounts of oxidizers dissolved in water droplets, surrounded by an immiscible fuel.

Energy A measure of the potential for the explosive to do work.

Exploration The work involved in gaining a knowledge of the size, shape, position, and value of an ore body.

Explosion A chemical reaction involving an extremely rapid expansion of gases, usually associated with the liberation of heat

Explosive Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion.

Explosive-Actuated Device Any tool or special mechanized device that is actuated by explosives. The term does not include propellant-actuated devices.

Explosive Charge The quantity of explosive material used in a blasthole, coyote tunnel, or explosive device.

Explosive Loading Factor The amount of explosive used per unit of rock; also called *Powder Factor*

Explosive Materials These include explosives, blasting agents, and detonators. The term includes, but is not limited to, dynamite and other high explosives; slurries, emulsions, and water gels; black powder and pellet powder; initiating explosives; detonators (blasting caps); safety fuse; squibs; detonating cord; igniter cord; and igniters. A list of explosive materials determined to be within the coverage of 18 USC Chapter 40, "Importation, Manufacture, Distribution, and Storage of Explosive Materials" is issued at least annually by the Director of the Bureau of Alcohol, Tobacco, and Firearms of the Department of the Treasury. The U.S. Department of Transportation classifications of explosive materials used in commercial blasting operations are not identical with the statutory definitions of the Organized Crime Control Act of 1970, Title 18 USC, Section 84 1. To achieve uniformity in transportation, the U.S. Department of Transportation in Title 49, *Code of Federal Regulation.* Parts 1-999 subdivides these materials into:

Class A Explosives-detonating or otherwise maximum hazard
Class B Explosives-flammable hazard
Class C Explosives-minimum hazard
Blasting Agents-see definition of *Blasting Agent*

Explosive Oils Liquid sensitizers for explosives such as nitroglycerin, ethylene glycol dinitrate, and metriol trinitrate.

Explosive Strength The amount of energy released by an explosive upon detonation that is an indication of the capacity of the explosive to do work.

Extra (Ammonia) Dynamite A dynamite that derives a major portion of its energy from reaction of ammonium nitrate.

Extraneous Electricity Electrical energy, other than actual firing current or the test current from a blasting galvanometer, that is present at a blast site and that could enter an electric blasting circuit. It includes stray current, static electricity, RF (electromagnetic) waves, and time-varying electric and magnetic fields.

Fertilizer-Grade Ammonium Nitrate A grade of ammonium nitrate as defined by The Fertilizer Institute.

Fire Extinguisher Rating A rating set forth in the National Fire Code that may be identified on an extinguisher by a number (5, 20, 30, etc.) indicating the extinguisher's relative effectiveness followed by a letter (A, B, C, etc.) indicating the class or classes of fires for which the extinguisher has been found to be effective.

Fire-Resistant Construction designed to offer reasonable protection against fire.

Fireworks Combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects.

Firing Current An electric current of recommended magnitude and duration to sufficiently energize an electric detonator or a circuit of electric detonators.
Firing Line The wire(s) connecting the electrical power source with the electric blasting circuit.

Flags-Danger Flags, usually red, that may or may not be Imprinted with a warning and used to caution personnel around explosives operations, or displayed on trucks transporting explosives.

Flammability The ease with which an explosive material may be ignited by flame and heat.

Flare A pyrotechnic device designed to produce a single source of intense light.

Flashover The sympathetic detonation between explosive charges or between charged blastholes.

Flash Point The lowest temperature at which vapors from a volatile combustible substance ignite in air when exposed to flame, as determined in an apparatus specifically designed for such testing.

Flyrock Rocks propelled from the blast area by the force of an explosion.

Foot Wall The wall or rock under a vein. It's called the floor in bedded deposits.

Forbidden or Not Acceptable Explosives Explosives that are forbidden or not acceptable for transportation by common, contract, or private carriers, by rail freight, rail express, highway, air, or water in accordance with the regulations of the U.S. Department of Transportation.

Fragmentation The breaking of a solid mass into pieces by blasting.

Free Face A rock surface exposed to air or water that provides room for expansion upon fragmentation; sometimes called open face.

Freezing The semifusing and nonejection of the pulverized rock or ore in the cut portion of a blasting round; generally caused by providing insufficient void space for the initial holes blasted in the cut, little or no delay between charges, and/or excessive charge weights.

Fuel A substance that may react with oxygen to produce combustion

Fume Classification See *IME Fume Classification*

Fumes The gaseous products of an explosion. For the purpose of fume classification, only poisonous or toxic gases, such as carbon monoxide, hydrogen sulfide, and nitrogen oxides are considered.

Fuse See *Safety Fuse.*
Fuse Cap (Fuse Detonator) A detonator that is initiated by a safety fuse; also referred to as an ordinary blasting cap.

Fuse Cutter A mechanical device for cutting safety fuse clean and at right angles to its long axis.

Fuse Lighters Pyrotechnic devices for the rapid and certain lighting of safety fuse.

Gauge (Wire) A series of standard sizes such as the American Wire Gauge (AWG), used to specify the diameter of wire

Galvanometer See *Blasting Galvanometer.*

Gap Sensitivity The maximum distance for propagation between standard charge sizes of explosive donor and acceptor. It is used for measuring the likelihood of sympathetic propagation.

Gelatin Dynamite A type of highly water-resistant dynamite characterized by its gelatinous consistency.

Geology A description of the types and arrangement of rock in an area; the description usually includes the dip and strike, the type and extent of preexisting breaks in the rock, and the hardness and massiveness of the rock as these affect blast design.

Grains A system of weight measurement where 7,000 grains are equivalent to one standard 16-ounce pound (0.45 kg).

Ground Fault An electrical contact between part of the blasting circuit and earth.

Ground Vibration Shaking of the ground, by elastic waves emanating from a blast, usually measured in inches per second of particle velocity.

GVW-Gross vehicle weight.

Hangfire The detonation of an explosive charge at some nondetermined time after its normally designed firing time.

Hanging Wall The wall or rock on the upperside of an inclined vein. It is called the roof in bedded deposits.

Hardwood Red oak, white oak, hard maple, ash, or hickory, free from loose knots, wind shakes, or similar defects.

Heading Refers to the driving of openings of the various exploration and development passageways.

Hertz (Hz) A synonym for "cycles per second".

High Explosives Explosives that are characterized by a very high rate of reaction, high pressure development, and the presence of a detonation wave in the explosive.

Highwall A nearly vertical face at the edge of a bench, bluff or ledge on a surface excavation.

Highway Any public street, public alley, or public road.

Hole Diameter The cross-sectional width of the borehole.

Igniter Cord A small-diameter pyrotechnic cord that burns at a uniform rate with an external flame and used to ignite a series of safety fuses.

IME Fume Classification A classification indicating the amount of poisonous or toxic gases produced by an explosive or blasting agent. The IME Fume Classification is expressed as follows:

Fume Class	Cubic Feet of Poisonous Gases Per (1 $^{1}/_{4}$' x 8") Cartridge of Explosive Material
1	Less than 0.16
2	0.16 - 0.33
3	0.33 - 0.67

Incendivity The property of an igniting agent (e.g., spark, flame, or hot solid) whereby the agent can cause ignition.

Inhabited Building A building regularly occupied in whole or part as a habitation for human beings. or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage, or use of explosive materials.

Initiation The act of causing an explosive material to detonate or deflagrate.

Initiator A detonator or detonating cord used to start detonation in an explosive material.

Instantaneous Detonator A detonator that has a firing time of essentially 0 sec as compared to delay detonators with firing times of from several milliseconds to several seconds.

Institute of Makers of Explosives (IME) A nonprofit safety-oriented trade association representing leading producers of commercial explosive materials in the United States and Canada and dedicated to safety in the manufacture, transportation, storage, handling, and use of explosive materials.

Institute of Makers of Explosives No. 8 Test Detonator IME No. 8 test detonator has 0.40 - 0.45 g of PETN base charge pressed to a specific gravity of 1.4 g/cc and primed with standard weights of primer, depending on manufacturer.

Inventory A listing of all explosive materials stored in a magazine.

Issuing Authority The governmental agency, office, or official vested with the authority to issue permits or licenses.

Jackleg A single rotary-percussion pneumatically actuated machine with a hinged air-assisted feedleg; primarily used in small development headings and production stopes for drilling holes up to $1^3/_4$ in. in diameter.

Jumbo Vehicle mounted, boom-fed rotary-percussion drills, actuated by either compressed air or hydraulics, primarily used in large tunnels and room-and-pillar mining applications; generally capable of drilling holes $1^3/_4$ - $3^1/_2$ in. in diameters.

Kelly Bar A hollow bar attached to the top of the drill column in rotary drilling; also called grief joint, kelly joint, kelly stem.

Leading(Lead) Lines or Wires The wire(s) connecting the electrical power source with the circuit containing electric detonators.

Leakage Resistance The resistance between the blasting circuit (including lead wires) and the ground.

Legwires The two single wires or one duplex wire extending out from an electric detonator.

Level Mines are customarily worked from shafts through horizontal passages or drifts called levels. These are commonly spaced at regular intervals in depth and are either numbered from the surface in regular order or designated by their actual elevation below the top of a shaft..

Liquid Fuels Fuels in a liquid state. They may be used with oxidizers to form explosive materials.

Loading Placing explosive material in a blasthole or against the material to be blasted.

Loading Density The weight of explosive loaded per unit length of borehole occupied by the explosive, expressed as pounds per foot or kilograms per meter of borehole.

Loading Pole A nonmetallic pole used to assist the placing and compacting of explosive charges in boreholes.

Low Explosives Explosives that are characterized by deflagration or a low rate of reaction and the development of low pressure.

Magazine Any building, structure, or container, other than an explosives manufacturing building, approved for the storage of explosive material.

Magazine Keeper A person responsible for the inventory and safe storage of explosive materials, including the proper maintenance of explosive materials, storage magazines, and areas.

Magazine, Surface A specially designed and constructed structure for the storage of explosive materials on the surface of the ground.

Magazine, Underground A specially designed and constructed structure for the storage of explosive materials underground.

Main Explosive Charge The explosive material that performs the major work of blasting.

Manufacturing Codes Code markings stamped on explosive materials packages, indicating, among other information, the date of manufacture.

Mass Detonate (Mass Explode) Explosive materials mass detonate (mass explode) when a unit or any part of a larger quantity of explosive material explodes and causes all or a substantial part of the remaining material to detonate or explode simultaneously. With respect to detonators, "a substantial part" means 90% or more.

Maximum Recommended Firing Current The highest recommended electric current to ensure safe and effective performance of an electric detonator.

Millisecond One thousandth of a second.

Mine Safety and Health Administration (MSHA) An agency of the Department of Labor concerned with promulgation and enforcement of health and safety regulations in the mining field.

Miniaturized Detonating Cord Detonating cord with a core load of 5 or less grains of explosive per foot.

Minimum Recommended Firing Current The lowest recommended electric current to ensure reliable performance of an electric detonator.

Minimum Gap Sensitivity An air gap, measured in inches, that determines whether the explosive material is within specific tolerances for gap sensitivity.

Misfire A blast that fails to detonate completely after an attempt at initiation; also the explosive material itself that failed to detonate as planned.

Motor Vehicle Any self-propelled vehicle, truck, tractor, semitrailer, or full trailer used for the transportation of freight over public highways.

MS Connectors Nonelectric, short-interval (millisecond) delay devices for use in delaying blasts that are initiated by detonating cord.

Muck The broken rock or ore displaced from its position in the earth by blasting or caving.

Muckpile The pile of broken material resulting from a blast.

Mudcapping A mud-covered or unconfined explosive charge fired in contact with a rock surface without the use of a borehole.

Munroe Effect The concentration of explosive action through the use of a shaped charge.

National Fire Protection Association (NFPA) Standards Standards for explosive materials and ammonium nitrate issued by the National Fire Protection Association.

National Safety Council (NSC) A non profit organization chartered by Congress to provide a regular information service on the causes of accidents and ways to prevent them.

Natural Barricade Natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures that require protection cannot be seen from the magazine when the tress are bare of leaves.

Nitroglycerin An explosive chemical compound used as a sensitizer in dynamite and represented by the formula $C_3H_5(ONO_2)_3$.

No. 8 Test Cap See *Institute of Makers of Explosives No. 8 Test Detonator.*

Nonelectric Detonator A detonator that does not require the use of electric energy or safety fuse to function.

Nonsparking Metal A metal that will not produce a spark when struck with other tools, rock, or hard surfaces.

Occupational Safety and Health Administration (OSHA) An agency of the Department of Labor active in eliminating occupational hazards and promoting employee health and safety.

Office of Surface Mining (OSM) An agency of the U.S. Department of the Interior regulating surface coal mining and the surface effects of underground coal mining.

Overburden Worthless material lying on top of a deposit of useful material

Oxidizer or Oxidizing Material A substance, such as a nitrate, that readily yields oxygen or other oxidizing substances to stimulate the combustion of organic matter or other fuel.

Oxygen Balance The theoretical percentage of oxygen in an explosive material or ingredient that exceeds (+) or is less than (-) what is needed to produce ideal reaction products.

Parallel Blasting Circuit An electric blasting circuit in which the legwires of each detonator are connected across the firing line directly or through buswires.

Parallel-Series Circuit See *Series in Parallel Blasting Circuit.*

Particle Board A composition board made of small pieces of wood bonded together.

Particle Velocity A measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.

Parting A rock mass located between two seams of coal; a joint or crack in rock.

Passenger Railway Any steam, electric, or other railroad or railway that carries passengers for hire.

Pellet Powder Blackpowder pressed into cylindrical pellets 2 in. in length and $1^1/_4$ in. in diameter.

Permissible Diameter (Smallest) The smallest diameter of a permissible explosive, as approved by the Mine Safety and Health Administration (MSHA)

Permissible Explosives Explosives that are permitted for use in gassy and dusty atmospheres and that must be approved by the Mine Safety and Health Administration. Permissible explosives must be used and stored in accordance with certain conditions specified by the Mine Safety and Health Administration (MSHA).

Person Any individual, corporation, company, association, firm, partnership, society, or joint stock company.

PETN An abbreviation for the name of the explosive, pentaerythritoltetranitrate.

Placards Signs placed on vehicles transporting hazardous materials (including explosive materials) indicating the nature of the cargo.

Plywood Exterior construction-grade plywood.

Pneumatic Loading The loading of explosive materials into a borehole using compressed air as the loading or conveying force.

Powder A common synonym for explosive materials.

Powder Factor The amount of explosive used per unit of rock.

Power Source The source of power for energizing electric blasting circuits, e.g., a blasting machine or power line.

Preblast Survey A documentation of the existing condition of structures near an area where blasting is to be conducted.

Premature Firing The detonation of an explosive charge before the intended time.

Presplitting (Preshearing) A smooth blasting method in which cracks for the final contour are created by firing a single row of holes prior to the initiation of the rest of the holes in the blast pattern.

Prilled Ammonium Nitrate Ammonium nitrate in a pelleted or prilled form.

Primary Blast A blast used to fragment and displace material from its original position to facilitate subsequent handling and crushing.
Primary Explosive A sensitive explosive that nearly always detonates by simple ignition from such means as spark, flame, impact, friction, or other primary heat sources of appropriate magnitude.

Primer A unit. package, or cartridge of explosives used to initiate other explosives or blasting agents, and which contains;
1) a detonator, or
2) detonating cord to which is attached a detonator designed to initiate the detonating cord.

Propagation The detonation of explosive charges by an impulse received from adjacent or nearby explosive charges.

Propellant Explosive An explosive material that normally functions by deflagration and is used for propulsion purposes. It may be a Class A or Class B explosive, depending upon its susceptibility to detonation.

Propellant-Actuated Power Device Any tool or special mechanized device or gas generator system that is actuated by a propellant or that releases and directs work through a propellant charge.

Public Conveyance Any railroad car, streetcar, ferry, cab, bus, aircraft, or other vehicle that carries passengers for hire.

Pyrotechnics Any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects. Pyrotechnics are commonly referred to as fireworks.

Quantity-Distance Table A table listing minimum recommended distances from explosive materials stores of various weights to a specific location.

Radio Frequency Energy (RF) The energy transferred by electromagnetic wave in the radio frequency spectrum.

Radio Frequency Transmitter An electronic device that radiates radio frequency waves; the device may be fixed (stationary) or mobile.

Railway Any steam, electric, or other railroad or railway that carries passengers for hire.

Raise A vertical or incline opening driven upward from a level to connect with the level above, or to explore the ground for a limited distance above one level. After two levels are connected, the connection may be a winze or a raise, depending upon which level is taken as the point of reference.

Receptor (Acceptor) A charge of explosive materials receiving an impulse from an exploding donor charge.

Regulations-Federal, State, Local Regulations promulgated by federal, state, or local regulatory agencies governing the manufacture, transportation. storage, sale, possession, handling, and use of explosive materials.

Relief The effective distance from a blasthole to the nearest free face.

Resistance The measure of opposition to the flow of electrical current, expressed in ohms

Rotational Firing Delay blasting system used so that the detonating explosives will successively displace the burden into the void created by previously detonated explosives in holes that fired at an earlier delay period.

Round A set of holes drilled and charged with explosives in any phase of underground work, which are fired instantaneously or with delay detonators.

Safety Fuse A flexible cord containing an internal burning medium by which fire or flame is conveyed at a continuous and uniform rate from the point of ignition to the point of use, usually a fuse detonator.

Safety Standard Suggested precautions relative to the safety practices to be employed in the manufacture, transportation, storage, handling, and use of explosive materials.

Scaled Distance A factor relating similar blast effects from various size charges of the same explosive at various distances. Scaled distance referring to blasting effects is obtained by dividing the distance of concern by a fractional power of the weight of the explosive materials.

Seam A stratum or bed of coal or other mineral.

Secondary Blasting Blasting to reduce the size of boulders resulting from a primary blast.

Seismograph An instrument, useful in monitoring blasting operations, that records ground vibration. Particle velocity, displacement, or acceleration is generally measured and recorded in three mutually perpendicular directions.

Semiconductive Hose A hose used for pneumatic conveying of explosive materials having an electrical resistance high enough to limit flow of stray electric currents to safe levels, yet not so high as to prevent drainage of static electric charges to ground. Hose of not more than 2 megohms resistance over its entire length and of not less than 5,000 ohms per foot meets the requirements.
Sensitiveness A measure of an explosive's cartridge-to-cartridge propagating ability under certain test conditions. It is expressed as the distance through air at which a primed half-cartridge (donor) will detonate an unprimed half-cartridge (receptor).

Sensitivity A physical characteristic of an explosive material classifying its ability to be initiated upon receiving an external impulse such as impact, shock, flame, friction, or other influences that can cause explosive decomposition.

Separation Distances Minimum recommended distances from explosive materials accumulations to certain specific locations.

Series Blasting Circuit An electric blasting circuit that provides one continuous path for the current through all caps in the circuit.

Series in Parallel Blasting Circuit An electric blasting circuit in which the ends of two or more series of electric detonators are connected across the firing line directly or through buswire.

Shaft A vertical or inclined excavation in a mine extending downward from the surface or from some interior point as a principal opening through which the mine is exploited. A shaft is provided with a hoisting engine at the top for handling men, rock, and supplies, or it may be used only in connection with pumping or ventilating operations.

Shaped Charge An explosive with a shaped cavity, specifically designed to produce a high-velocity cutting or piercing jet of product reaction; usually lined with metal to create a jet of molten liner material.

Shelf Life The length of time of storage during which an explosive material retains adequate performance characteristics.

Shock Wave A transient pressure pulse that propagates at supersonic velocity.

Short-Delay Blasting The practice of detonating blastholes in successive intervals where the time difference between any two successive detonations is measured in milliseconds.

Shot Anchor A device that anchors explosive material charges in the borehole so that the charges will not be blown out by the detonation of other charges.

Shot Firer That qualified person in charge of and responsible for the loading and firing of a blast (same as a *Blaster).*

Shunt The shorting together of the free ends of :
1) electric detonator legwires, or
2) the wire ends of an electric blasting circuit or part thereof-, the name of an electrical shorting device applied to the free ends of electric detonators by the manufacturer.

Signs-Explosive (Placards) Signs, called placards, placed on vehicles transporting explosives denoting the character of the cargo, or signs placed near storage areas as a warning to unauthorized personnel.

Silver Chloride Cell A special battery of relatively low current output used in a blasting galvanometer.

Slurry An explosive material containing substantial portions of a liquid, oxidizers, and fuel, plus a thickener.

Small-Arms Ammunition Any cartridge for shotgun, rifle, pistol, revolver. and cartridges for propellant-actuated power devices and industrial guns. Military-type ammunition containing explosive bursting charges or any incendiary, tracer, spotting, or pyrotechnic projectile is excluded from this definition.

Small-Arms Ammunition Primers Small percussion-sensitive explosive charges encased in a cap or capsule and used to ignite propellant powder.

Smoke The airborne suspension of solid particles from the products of detonation or deflagration.

Smokeless Propellant (Smokeless Powder) Solid propellant, commonly called smokeless powder in the trade, used in small-arms ammunition, cannon, rockets, propellant-actuated power devices, etc.

Snakehole A borehole drilled in a slightly downward direction from the horizontal into the floor elevation of a quarry face: also, a hole driven under a boulder.

Softwood Douglas fir or other wood of equal bullet resistance and free from loose knots, wind shakes, or similar defects.

Spacing The distance between boreholes. In bench blasting, the distance is measured parallel to the free face and perpendicular to the burden.

Specific Gravity The ratio of the weight of any volume of substance to the weight of an equal volume of pure water.

Springing The practice of enlarging the bottom of a blasthole by the use of a relatively small charge of explosive material; typically used in order that a larger charge of explosive material can be loaded in a subsequent blast in the same borehole.

Squib A firing device that burns with a flash and used for igniting black powder or pellet powder.

Stability The ability of an explosive material to retain chemical and physical properties specified by the manufacturer when exposed to specific environmental conditions over a particular period of time.

Static Electricity Electric charge at rest on a person or object. It is most often produced by the contact and separation of dissimilar insulating materials.

Steady State Velocity The characteristic velocity at which a specific explosive at a given charge diameter will detonate.

Steel General purpose (hot or cold rolled) low-carbon steel, such as specification ASTM A366 or equivalent.

Stemming Inert material placed in a borehole after the explosive; used for the purpose of containing explosive materials or to separate charges of explosive material in the same borehole.

Stope An excavation from which ore has been extracted. The term stoping is commonly applied to the extraction of ore, but does not include the ore removed in sinking shafts and in driving levels, drifts. and other development openings.

Storage The safekeeping of explosive materials, usually in specially designed structures called magazines.

Stray Current A flow of electricity outside an insulated conductor system

Subdrilling The practice of drilling boreholes below floor level or working elevation to ensure breakage of rock to working elevation.

Subsonic Less than the speed of sound.

Supersonic Greater than the speed of sound.

Sympathetic Propagation The detonation of an explosive material as the result of receiving an impulse from another detonation through air, earth, or water.

Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents A quantity-distance table from National Fire Protection Association Standard No. 495.

Tachograph A recording device in a truck that indicates on a time basis the running and stopping times of a vehicle.

Tamping The action of compacting the explosive charge or the stemming in a blasthole.

Tamping Bags Cylindrical bags containing stemming material and used in boreholes to confine the explosive material charge.

Tamping Pole A wooden or plastic pole used to compact explosive charges or stemming.

Test Blasting Cap No. 8 *See Institute of Makers o Explosive No. 8 Test Detonator.*

Theft-Resistant Construction designed to deter illegal entry into facilities used for the storage of explosive materials.

Toe In bench blasting, the distance from the free face to the blasthole, measured at the floor level of the bench.

Trunkline The line of detonating cord on the ground surface that connects detonating cord downlines.

Tunnel A horizontal or nearly horizontal underground passage that is open to the atmosphere at both ends. The term is loosely applied in many cases to an adit.

Unbarricaded The absence of a natural or artificial barricade around explosive storage areas of facilities.

Unconfined Detonation Velocity The detonation velocity of an explosive material without confinement, for example, a charge fired in the open.

Underwriters Laboratory, Inc. (UL) A nationally recognized incorporated testing laboratory qualified and equipped to conduct the necessary tests to determine compliance with appropriate standards and the satisfactory performance of materials or equipment in actual usage.

Volt The unit of electromotive force. It is the difference in potential required to make a current of 1amp flow through a resistance of 1 ohm.

Volume Strength Same as *Cartridge Strength or Bulk Strength.*

Warning Signal A visual or audible signal that is used for warning personnel in the vicinity of the blast area of the impending explosion.

Waste Acid Residual or spent acid from a nitration process.

Water Gel An explosive material containing substantial portions of water, oxidizers, and fuel, plus a cross-linking agent

Water Stemming Bags Water-filled plastic bags with a self-sealing valve classified as a permissible stemming device by the Mine Safety and Health Administration (MSHA)

Watt A unit of electrical power equal to 1 joule/sec

Weather-Resistant Construction designed to offer reasonable protection against weather.

Weight Strength The energy of an explosive material per unit of weight expressed as a percentage of the energy per unit of weight of a specified explosive standard.

Winze A vertical or inclined opening sunk from a point inside a mine for the purpose of connecting with a lower level and exploring the ground for a limited depth below a level.

Section IX
Calculations

Borehole Diameter

Selection of the proper hole diameter is important to obtain maximum fragmentation at minimum cost. For best fragmentation and design control, the rule of thumb is that the borehole diameter in inches should be approximately one tenth of the face height in feet.

$$\mathbf{D = \frac{H}{10}}$$

Where
D = borehole diameter (inches)
H = bench height (feet)

Burden
Burden is defined as the distance from a borehole to the nearest free face at the time of detonation.
Burden is a function of charge diameter. The rule of thumb for burden calculation is dependent on the borehole diameter.

Burden Calculation:

$$\mathbf{B = \frac{25\text{-}35 \times D_e}{12}}$$

Where
B = burden (feet)
D_e = explosive column diameter (inches)

For a given rock type, explosive, and blast hole spacing, there is an optimum burden dimension. The optimum burden dimension depends upon a combination of variables, which include the borehole diameter, the borehole depth, spacing between boreholes, the millisecond delay pattern, the explosive used, the rock mass characteristics, and degree of fragmentation and muck pile shape sought.

Spacing

The distance between adjacent blastholes, measured perpendicular to the burden, is defined as the spacing. Spacing calculations are a function of the burden.

S = 1.8 x B

Where
S = spacing (feet)
B = burden (feet)

Spacings that are significantly less than the burden tend to cause early stemming ejection and premature splitting between blastholes. These effects encourage rapid release of gases to the atmosphere, and result in noise and air blast. Conversely, when the spacing is too large, the rock may be inadequately fragmented between holes, leaving an uneven floor. Consequently, burden and spacing decisions are made by careful analysis of geology, explosives, conditions at the site, and experience.

Bench Height

To maintain a successful blast design, it is important that the burden and bench height are reasonably compatible. However, the face height is often determined by other factors; the rule of thumb covers only the recommended minimum.

H = 2 x B

Where
H = bench height (feet)
B = burden (feet)

Stemming

Stemming is an inert substance, loaded on top of the explosive charge to give confinement of the explosion gases. The amount of stemming required may be calculated from the burden dimension using the following formula:

T = 0.7 – 1.3 x B

Where
T = stemming (feet)
B = burden (feet)

Explosive Column Weight

The explosive column weight per borehole is a function of the density of the explosive, its diameter, and the explosive column length. The explosive column weight can be calculated by using the following formula:

$E_w = 0.34 \times D_e^2 \times \rho \times E_{cl}$

Where

E_w = explosives column weight (pounds)
D_e = diameter of explosive column (inches)
ρ = density of explosives (grams per cubic centimeter)
0.34 = coefficient of determination
E_{cl} = explosives column length (feet)

For example, given an explosive column diameter of 6.25 in. and 50 ft. in length and ANFO at a density of 0.81 g/cc, the charge weight is calculated by:

$E_w = 0.34 \times D_e^2 \times \rho \times E_{cl}$
$E_w = (0.34)\ (6.25)^2\ (0.81)\ (50)$
$E_w = (0.34)\ (39.06)\ (0.81)\ (50)$
$E_w = 537.9$ lb.

Powder Factor

Powder factor is the mathematical relationship between the weight of explosives and a given quantity of rock. The explosive weight is normally expressed in pounds and the rock quantity is normally expressed in cubic yards or tons. There are four methods of expressing powder factor.

1. Pounds of explosive per cubic yard of rock.
2. Pounds of explosive per ton of rock.
3. Cubic yards of rock per pound of explosive.
4. Tons of rock per pound of explosive.

- ***Cubic Yards*** To calculate cubic yards per borehole, the following formula is used:

$$V = \frac{B \times S \times H}{27}$$

Where

B = burden dimension (feet)
S = spacing dimension (feet)
H = Bench height (feet)
V = rock volume (cubic yards)

For example, given a burden of 10 ft., a spacing of 15 ft., a bench height of 50 ft., the calculated rock volume is as follows:

$$V = \frac{B \times S \times H}{27}$$

$$V = \frac{10 \times 15 \times 50}{27}$$

$$V = \frac{7{,}500}{27}$$

V = 277.77 cu yd per borehole

- ***Tons*** To calculate the tons of rock per borehole, the following formula is used:

$$\mathbf{W = \frac{B \times S \times H}{27} \times \frac{27\rho}{2{,}000}}$$

Where

B = burden dimension (feet)
S = spacing dimension (feet)
H = bench height (feet)
ρ = rock density (pounds per cubic foot)
W = rock tonnage

For example, given a burden of 10 ft., a spacing of 15 ft., a bench height of 50 ft., and a rock density of 168 lb/cu ft, the calculation for the total rock weight per borehole is as follows:

$$W = \frac{B \times S \times H}{27} \times \frac{27\rho}{2{,}000}$$

$$W = \frac{B \times S \times L}{27} \times \frac{(27)\,(168)}{2{,}000}$$

$$W = 277.77 \times \frac{4{,}536}{2{,}000}$$

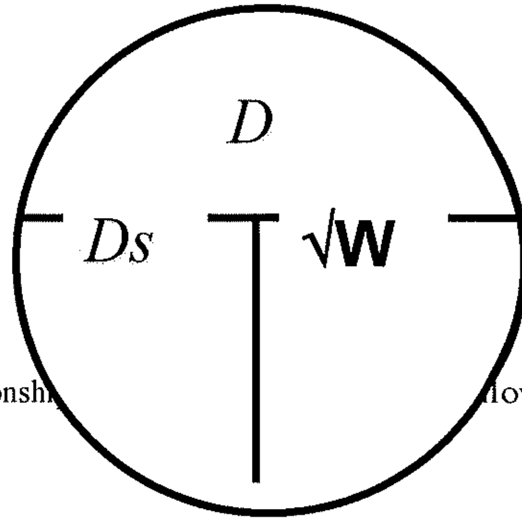
W = 277.77 cu yd x 2.268 tons per cubic yards

W = 629.98 tons per hole

Powder factor has generally been equated with the amount of explosive energy required to fragment and displace rock. A powder factor of 0.75-lb/cu yd would be expected to exhibit relatively less fragmentation and displacement than a powder factor of 1.0 lb/cu yd.

Scaled Distance

$$Ds = \frac{D}{\sqrt{W}}$$



W = Explosives Weight Per Delay Period
D = Actual Distance
Ds = Scaled Distance

We shall designate the W, D, and Ds relationsh lows:

Equation #1:

$$W = \left(\frac{D}{Ds}\right)^2$$

Equation #2:

$$\sqrt{W} = \frac{D}{Ds}$$

Equation #3:

$$Ds = \frac{D}{\sqrt{W}}$$

Equation #4:

$$D = Ds\,\sqrt{W}$$

Planning The Series Firing Circuit

Before loading a blast you must determine how much explosive will be needed. You should also determine what type of wiring circuit will be used, and then make the calculations that show you the basting machine will supply adequate current to fire the blast. Of the three wiring circuits used in electrical blasting, the series circuit is the simplest and most commonly used. In planning the series circuit, follow these steps:

1. Determine the *TOTAL RESISTANCE* (ohms) of the circuit.
2. Calculate the *CURRENT* (amperes) that the power source will deliver the total resistance.
3. Compare the calculated current with the recommended minimum firing current requirements for a series circuit.

FINDING TOTAL RESISTANCE (R_1)

For a series circuit, the total resistance (R_1) is simply the sum of all the individual resistances in the circuit. This will include the detonators (R_1), connecting wire (R_2), and firing line (R_3).

The formula is:

$$R_T = R_1 + R_2 + R_3$$

EXAMPLE:

Consider a series circuit with 20 Millidet delay electric blasting detonators having 40 ft. long copper leg wires, 200 lineal ft. of #20 B&S copper connecting wire and a 1,200 ft. long #14 B&S copper firing line. For the resistance values, ***see Table I and II.***

Resistance of one Millidet detonator with 40 ft. copper leg wire = <u>*2.72 ohms.*</u>
Resistance of 20 Millidet detonators = 20 x 2.272 ohms = <u>***54 ohms***</u>

Resistance of #20 B&S connecting wire = <u>*10.15 ohms per 1,000 ft.*</u>
Resistance of 200 lineal ft. - $\frac{200 \times 10.15 \text{ ohms}}{1,000} \times 2^* =$ <u>***4 ohms***</u>

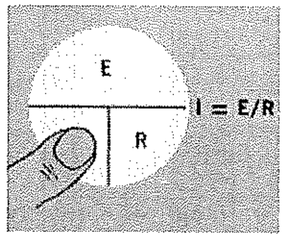
Resistance of #14 B&S firing line = <u>*2.52 ohms per 1,000 ft.*</u>
Resistance of 1,200 lineal ft. – $\frac{1,200 \times 2.52}{1,000} \times 2^* =$ <u>***6 ohms***</u>

Total resistance $R_t = R_1 + R_2 + R_3$
$R_t = 54$ *ohms* + 4 *ohms* + 6 *ohms*
$R_t = 64$ *ohms*

*Multiply by 2 because the firing cable and connecting wire have 2 wires.

Calculating Current (I)

Use Ohms Law to calculate the current for the circuit described under total resistance.



Example:

Consider a condenser-discharge blasting machine with a 225-volt output. Now, applying Ohms Law:

$$\text{Current (I)} = \frac{225 \text{ volts (E)}}{64 \text{ ohms (R)}}$$

$$I = 35 \text{ amperes}$$

Compare:

The minimum recommended firing current (***Table III***) required for a series circuit is 1.5 amps DC or 3 amps AC. In the examples given, the answer for the calculated current is 3.5 amps DC. This is greater than 1.5, the minimum, so the amperage in this case is adequate. If the current is not adequate, here are some alternatives:

1. Use a blasting machine that will deliver the needed current, or

2. Use a different wiring circuit. A series-in-parallel circuit can reduce the total resistance without the need for reducing the number of holes (detonators).

Leg Wire Length	Instadet*	Millidet* and Superdet*	Instadet*	Millidet, Superdet, and Coaldet*
4	1.41	1.86	2.25	2.7
6	1.49	1.94	2.75	3.2
8	1.58	2.03	3.25	3.7
10	1.66	2.11	3.75	4.2
12	1.74	2.19	4.25	4.7
14	1.82	2.27	4.75	5.2
16	1.9	2.35	5.25	5.7
20	2.06	2.51	6.25	6.7
24	2.22	2.68	7.25	7
No 12 Copper Wire				
30	2.02	2.47		
40	2.27	2.72		
50	2.53	2.98		
60	2.79	3.21		
70	3.04	3.49		
80	3.3	3.75		
100	3.81	4.26		
120	4.33	4.77		
150	5.09	5.54		
200	6.37	6.82		
250	7.65	8.1		
300	8.93	9.38		
350	10.16	10.66		
400	11.49	11.94		

* **CAUTION:** These resistance values apply only to detonators manufactured by Hercules Incorporated. Do not use these values with detonators made by other manufacturers.

B&S Gauge	Ohms per 1,000 ft.
No. 8	0.628
No. 10	0.999
No. 12	1.59
No. 14	2.52
No. 16	4.02
No. 18	6.38
No. 20	10.15
No. 22	16.14

CAP FACTS

Table III: RECOMMENDED MINIMUM FIRING CURRENT	
Series Wiring	1.5 amps DC or 3 amps AC
Parallel Wiring	1 amp AC or DC per Detonator
Series-In-Parallel Wiring	2 amps AC or DC per Series

Maximum recommended firing current is not to exceed 10 amperes continuous current through any detonator.

Section X

Series Circuit

The total resistance of a series circuit is equal to the resistance of each detonator multiplied by the number of detonators plus the resistance of the lead line and connecting wire.

Example 1
Assume a series circuit of 25 40-foot copper wire delay detonators with a 600-foot 14-gauge copper lead line:

> **Step 1** – Determine the resistance of the detonator circuit.
> Consult ***Table 16.1*** for the resistance of a 40 foot copper wire Delay. This is 2.06 ohms/detonator.

Resistance of Detonator Circuit = No. of Detonators x Resistance/detonator

R = 25x 2.06

R = 51.5 ohms

> **Step 2** – Determine resistance of the lead line:
> Consult ***Table 16.2*** for the resistance of 14-gauge copper wire.
> This is 2.525 ohms/1000 feet. A lead line that is 600 feet long has 1200 feet of wire.
> (600 feet x 2 conductors = 12000 feet)

$$\textit{\textbf{Resistance of Lead Line}} = \frac{\textit{\textbf{Length of Wire x Resistance / 1000 ft.}}}{\textit{\textbf{1000}}}$$

$$R = \frac{1200 \times 2.525}{1000}$$

R = 3.03 ohm

> **Step 3** – Determine total resistance of the blasting circuit.

Total Resistance = Detonator Circuit Resistance + Lead Line Resistance

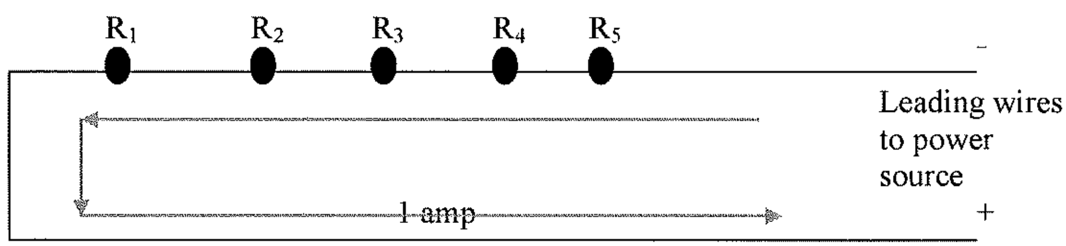
R = 51.5 + 3.03

R = 54.53 ohms

On a "swing needle" type tester the needle on the instrument must be adjusted to "zero" when it is shorted between terminals. Digital instruments should show "zero" on the readout. The terminals are then connected to the lead line. The instrument should then read approximately 54 to 55 ohms. Too low a reading indicates some detonators are not connected into the circuit. Too high a reading indicates too many detonators in the series or loose or dirty connections.

Series Circuit

1. A series circuit provides a single path for the current through all detonators.
2. The same current flows through each part of a series circuit.
3. The total resistance of a series circuit is equal to the sum of individual resistances.
4. Voltage applied to a series circuit is equal to the sum of the individual voltage drops.
5. The voltage drop across a resistor in a series circuit is directly proportional to the size of the resistor.
6. If the circuit is broken at any point, no current will flow.



- In a series circuit, the amperage at any point in the circuit is the same. This will help in calculating circuit values using Ohm's Law.
- In a series circuit you will need to calculate the total resistance of the circuit in order to figure out the amperage. This is done by adding up the individual values of each component in series.
- In this example we have three resistors. To calculate the total resistance we use the formula:

$$R_T = R_1 + R_2 + R_3 + R_4 + R_5$$

Parallel Circuit

A parallel circuit cannot be tested with the instruments usually available in field operation as the total resistance of the circuit is so small it will read close to zero resistance on the instrument and will not indicate a meaningful reading. This is true whether using a "swing needle" or digital meter.

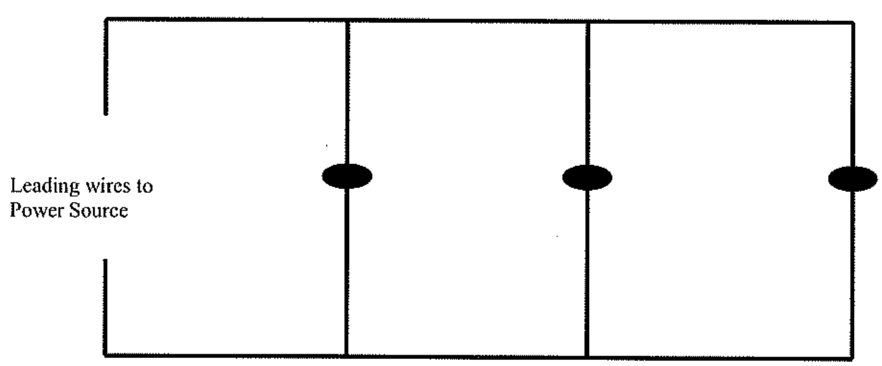
A Parallel circuit has certain characteristics and basic rules surmised here:

1. A parallel circuit has two or more paths for current to flow through.
2. Voltage is the same across each component of the parallel circuit.
3. The sum of the currents through each path is equal to the total current that flows from the source.

You can find total resistance in a Parallel circuit with the following formula:

1/Rt = 1/R1 + 1/R2 + 1/R3 + Rt = R (t)otal

If one of the parallel paths is broken, current will continue to flow in all the other paths.



Series-In-Parallel

In a series-in-parallel circuit each series should be electrically balanced with each series reading the same number of ohms. Usually, an equal number of detonators in each series will produce a balanced series.

In a balanced series-in- parallel circuit, the resistance of one series divided by number of series will equal the total resistance of the circuit.

Example 2

Assume a blast of 300 50-foot copper wire MS delays connected in six series with 50 detonators-per-series and a 700-foot 14-gauge copper wire lead line.

> **Step 1 –** Determine the resistance of a single series. Resistance of one series = No. of Detonators x Resistance of each. Consult **Table 16.1** for detonator and wire resistance.
>
> $$R = 50 \times 2.32$$
>
> $$\mathbf{R = 116\ ohms}$$
>
> **Step 2** – Determine the resistance as each series is connected to the lead line or bus wire:
>
> $$\textit{Resistance} = \frac{\textit{Resistance / Series}}{\textit{No of Series}}$$
>
> $$\textit{One Series Resistance} = \frac{116.0}{1}$$
>
> $$\textit{Two Series Resistance} = \frac{116.0}{2}$$
>
> $$\textit{Three Series Resistance} = \frac{116.0}{3}$$

Series-in-Parallel

The series-in-parallel circuit is the most common type of circuit used in blasting. The simplest series-in-parallel circuit is made by dividing a single series into two series as shown in ***Figure 16.6***. As shown, each of the two rows of electric detonators is connected in a straight series. The two free ends from each series are connected together and these are connected to the lead line.

The main advantage of the series-in-parallel circuit is the large number of detonators, which can be fired from a blasting machine without a large input voltage requirement. A series-in-parallel hookup with five balanced series is shown in
Figure 16.7.

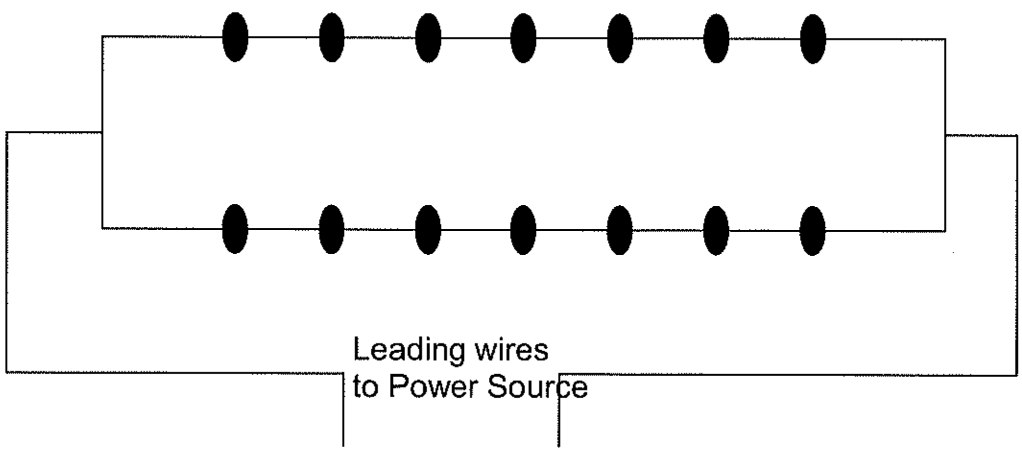


Figure 16.6 – Simplest series-in-parallel circuit is made by dividing a single series into two series. The two free ends from each series are then connected to the lead line.

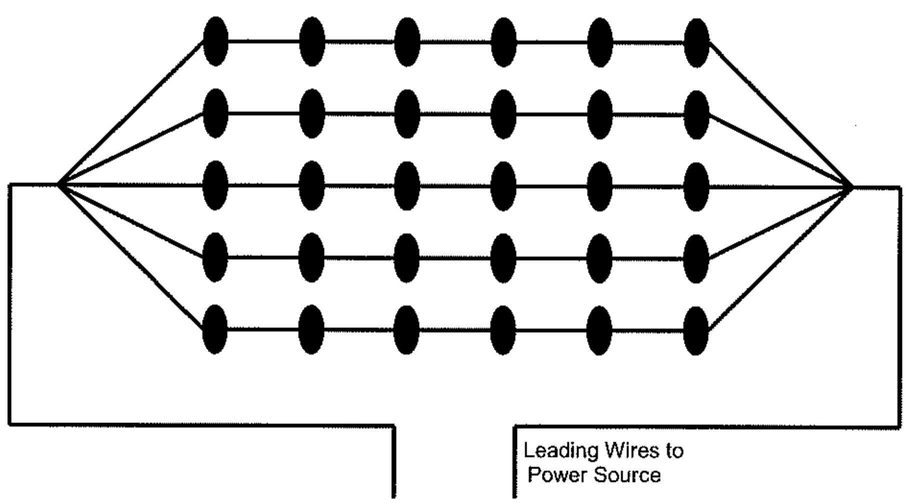
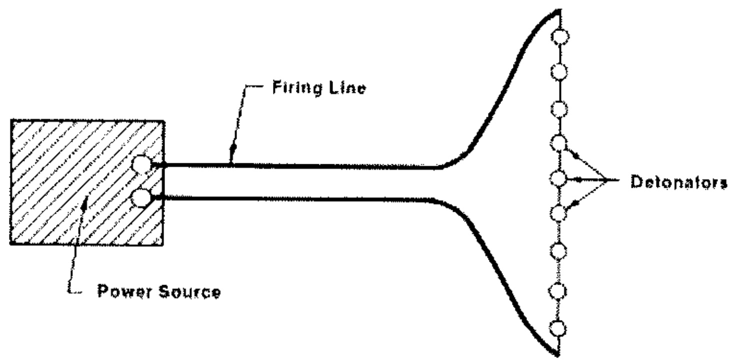
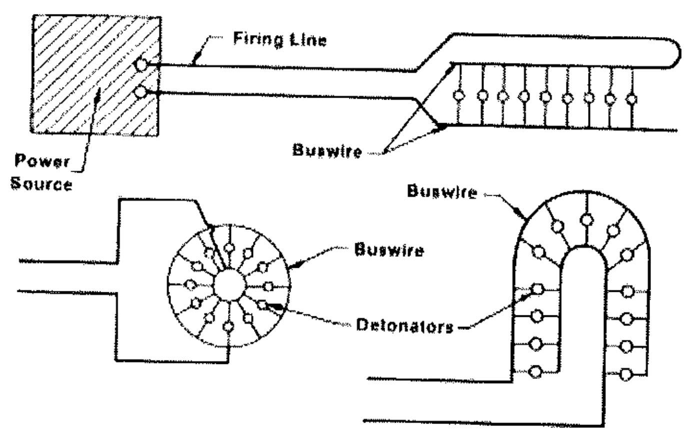


Figure 16.7 – Main advantage of the series-in-parallel is large number of detonators that can be fired from the blasting machine without large input voltage requirement.

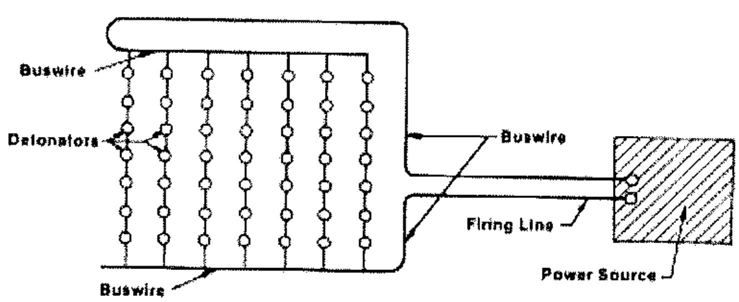
Single-Series Electric Blasting Circuit



Parallel Electric Blasting Circuit



Parallel Series Electric Circuit



Electric Firing Techniques

Electric blasting, with such refinements as delay detonators and electronic timers, has made possible the safe firing of a large number of charges in a predesigned sequence from a remote, safe location with precise control over the time of firing. The remarkable safety record compiled by explosives consumers is the result of knowledge applied with care.

Successful electrical blasting depends on four general principles: (1) proper selection and layout of the blasting circuit; (2) an adequate energy source compatible with the type of blasting circuit selected; (3) recognition and elimination of all electrical hazards; and (4) circuit balancing, good electrical connections, and careful circuit testing.

The selection of the circuit will depend on the number of detonators to be fired and type of operation. In general, a simple series circuit is used on small blasts consisting of less than 50 electric detonators. A series-in-parallel circuit is used where a large number of detonators are involved.

In almost every application capacitor discharge blasting machines offer the safest, cost dependable, and economical source of electrical energy for blasting.

Elimination of electrical hazards must be the first consideration before starting to load any blast.

Lack of attention to details is the most frequent cause of electrical misfires resulting in fatal or serious injury and costly property damage. The electrical connections must be tight, clean, and insulated from the ground. Care must be taken to avoid abrading or stripping the leg wires either in the hole or on the surface. Lead lines should be inspected and tested prior to every blast.

The resistance of all circuits should be calculated, and a Blaster's Multimeter or Blasting Ohmmeter should be used to verify the calculations. No attempt should be make to fire the blast until the theoretical calculations and test readings are the same.
In brief, extreme care in wiring and testing the circuit is absolutely necessary to avoid misfires.

Current Requirements

Successful simultaneous initiation of a large number of electric detonators requires delivery of sufficient current to all devices with a few milliseconds. The time required to heat the bridgewire in an electric detonator or to a temperature that will cause burning of the ignition charge is a function of the current intensity.

Although manufacturer's specifications may vary, the bridgewire in domestic commercial detonators is approximately 0.5 millimeters in diameter and requires 1 to 1.5 amperes for reliable initiation. The bridgewire heats up very quickly, but it rapidly transfers heat to the bridge posts and ignition mix. As a result, energy delivered over a time interval of more than 10 milliseconds is not as efficient in heating the bridge wire as the same amount of energy delivered in a few milliseconds.

The importance of delivering sufficient current to all detonators in the circuit within a few milliseconds cannot be overemphasized. At marginal low current levels, slight differences from one device to another can result in large variations in initiation times. In series circuits this can result in one detonator functioning prior to initiation of others in the circuit. This fast firing of one detonator cuts off the flow of current before all others have been initiated and results in failure of one or more detonators.

The internal construction of electric detonators manufactured by different companies varies considerably. As a result, they are not compatible in the same blasting circuit. Therefore, electric detonators of different manufacturers must never be used in the same blast. Such a practice is almost certain to result in dangerous misfires. Further, in the U.S., it is in direct violation of MSHA regulation 30 CFR 56/57.6400.

Basic Safety Requirements

In any blasting operation the blasting machine, or blasting switch, should be directly under the control of the blaster in charge. It should be kept locked while not in use with the key in blaster's possession.

The lead wires should never be laid out until the blast circuit is completely wired and all unnecessary personnel have been removed to a safe location. After the lead line is laid out, it should be checked electrically with a Blaster's Multimeter for continuity of circuit. It should also be visually inspected for cuts and serious abrasions in the insulation. The end of the lead line must be shunted before the other end of the line is connected to the blasting circuit. After the final connections are completed, the resistance of the entire circuit should be tested with a Blaster's Multimeter or a Blasting Ohmmeter (Blasting Galvanometer). The calculated resistance of the entire circuit must always agree with the readings on the instrument or no attempt should be made to fire the blast. If proper readings are not obtained, reshunt the lead line before returning to the blast area to locate and correct the source of trouble. Do not allow the bare ends of the circuit or the lead line to come in contact with the ground or with any metallic object.

When the instrument readings confirm the calculated resistance, the blasting machine, or blasting switch, can be unlocked and the lead lines can be connected for firing.

After the blast, the blasting machine, or blasting switch, should be locked before returning to the blast area. Never leave a blasting machine or blasting switch unguarded.

Lead Lines

Lead lines or firing lines are an essential part of the blasting circuit and must be inspected, tested, and kept in good repair to insure a successful blast.

Well-insulated, solid-core copper wire or 10-gauge to 14-gauge is recommended for series and series-in-parallel circuits of normal size. Where the basting line is soled on a reel after every blast, stranded wire should never be used because individual strands may break due to flexing. This results in a reduced load-carrying capacity that is not readily detectable with the instruments normally available in the field.

The lead line should be tested with a Blaster's Multimeter for continuity of circuit before every blast. It should be replaced when there is any evidence of physical damage to the insulation.

Where lead lines are permanently installed, the lines should be tested under load by an electrician. This test should be carried out on a regular schedule.

Connecting Wires

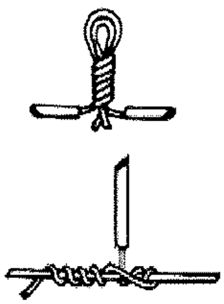
Connecting wire is usually 16-gauge to 20 gauge, plastic-insulated copper wire used to connect between holes or to connect individual series to the lead line. They are always subject to damage by the blast and should be considered expendable. Never reuse connecting wire.

Bus Wire

Bus wire is usually 10, 12, or 14-gauge, solid-core uninsulated copper wire used in connecting parallel circuits in tunnel and shaft rounds. Aluminum bus wire is not recommended because oxidation of the aluminum can result in high resistance connections.

Splices

The reliability of every circuit is dependent on the number and quality of the wire splices in that circuit. Their importance is as significant as any other factor in good blasting practice.



The twisted loop shown is recommended for joining light gauge wires of similar size (legwire to legwire or connecting wire). It is easy and quick to make, yet strong and reliable. It is also a highly visible splice that is easy to disassemble if a circuit has to be taken apart for any reason

When joining lighter gauge legwires or connecting wire to heavier gauge firing line or buswire, the lighter gauge wire is wrapped around the heavier gauge wire as shown. These splices are easy to make and provide a strong and

To prevent current leakage or the shorting out of two wires, the bare wire at the splices should be insulated with electrical tape. If insulating tape is not available, support the splices in the air by propping up the wire on boxes or dry cardboard and staggering their locations so that they cannot accidentally short out. The need to make a splice stronger and keep the bare wire connections from pulling apart can be accomplished by various means. One method is to join the insulated portion of the wires about 4 in. back from the splice by tying or twisting the together. This secondary connection will then absorb strain induced into the wire and prevent separation of the splices. It is now easier to position the bare wire splice so that it is off the ground, hence reducing the chance of current leakage.

Extraneous Electricity

Sources of hazardous extraneous electricity include: (1) Lightning discharges to ground from electrical storms; (2) Stray ground currents from poorly insulated and improperly grounded electrical equipment; (3) Radio Frequency (RF) energy from transmitters; (4) Induced currents, present in alternating electromagnetic fields, such as those commonly found near high-voltage transmission lines; (5) Static electricity generated by wind-driven dust and snow storms, by moving conveyor belts, and by the pneumatic conveying of ANFO; (6) Galvanic currents generated by dissimilar metals touching or separated by a conductive material.

The accepted "safe" level of extraneous electricity for electrical blasting is derived from the current required to detonate the most sensitive commercial electric detonators plus a safety factor. The minimum firing current for commercial electric detonators presently manufactured in the United States is approximately 0.25 amperes (250 milliamperes). The Institute of Makers of Explosives (IME) has established the maximum "safe" current permitted to flow through an electric detonator without hazard of initiation as one-fifth of the minimum firing current, or 0.05 amperes (50 milliamperes). Operators using electric detonators must be alerted to the measure of extraneous current and if a source is suspected, should measure for extraneous currents in the area of the blast site at frequent intervals to insure that all extraneous currents are at a safe level.

When extraneous currents exceed 0.05 amperes (50 milliamperes), the source of the current must be traced and eliminated before electric detonators can be safely used. If the source of the current cannot be traced and eliminated, a Nonelectric initiating system must be utilized. It must be remembered however that high voltages such as lightning can potentially initiate even Nonelectric initiating devices. Extremely high static levels also can be reached by the pneumatic loading of ANFO.

ELECTRICAL HAZARDS TO BLASTING

Electrical Energy	Source	Products Affected	Safety Measures	Shunt Protection
Lightning (DC)	Atmosphere	Direct hit, all Products, Nearby, Electric Detonators	Detect potential Lightning, Clear & guard	No help, keep shunted but don't assume protected
Stray Current (AS and DC)	Leaking power Source, utilities & Machinery	Electric Detonators	Stray Current Test, Place wires safely	Yes, Keep detonators & circuits shunted
Radio Frequency (AC)	RF Transmitters	Electric Detonators in use, & in original package.	Follow IME Safety Library Publication No.20	No Help
Induced Current (AC)	AC Power Lines	Electric Detonators	Keep shunted & avoid high voltage transmission lines	Some protection, Keep shunted until blast
Static (DC)	Pneumatic loading of ANFO, dust & snow storms, belts	Electric and Nonelectric detonators, cap and fuse	Do not use in dust or snowstorms. Use grounded semi-conductive hose	Some protection. Keep shunted until blast
Galvanic Current (DC)	Dissimilar metals in ionic solutions	Electric Detonators	Keep shunted until blast	Yes

Mechanical Static

The following recommended precautions should be taken for cases in which static electricity is generated mechanically.

1) All parts of moving equipment in the vicinity of blasting operations should be electrically connected at a common point and this common point should be connected to a good earth ground rod.
2) All conductors and metal parts of the system should be kept away from electric detonators and blasting circuit wires.
3) The ground wires and earth ground rod for the system should be kept away from rails, wiring, and piping that might conduct stray currents from these sources to the blasting site.
4) All moving equipment in the immediate area that might be capable of generating static electricity should be shut down while the blasting circuits are being connected and until the blast has been fired.

Electrostatic Discharges
Lightning

Lightning undoubtedly represents the greatest single hazard to blasting because of its erratic nature and high energy. A lightning strike can have over a million volt potential and discharge currents of over 100,000 ampere. If lightning strikes a blast area, all or part of the blast probably will be detonated. Because of the extremely high currents involved, even distant lightning strikes can be hazardous to electric initiating systems in both underground and surface operations.

Therefore, in the interest of safety, blasting on land, on water, and in some underground operations should be suspended, and all personnel should be evacuated to a safe distance from the blast area whenever lightning storms are in the vicinity.

The danger from lightning is considerably increased if there is a transmission line, water line, compressed air line, fence, stream, or other conductor available to carry the current between the storm and the shot location.

Where permanent firing lines and electric blasting caps are used, typically in underground operations, a 15-foot (4.6m) air gap should be provided to act as a "lightning break" between the blasting system and the supply power circuit. This air gap should be bridged by a flexible jumper cable just prior to firing the blast.

Blasting operations must constantly be alert to atmospheric conditions that indicate the possibility of lightning and be prepared to temporally abandon all explosive loading activities until the threat passes. Lightning storms tend to be somewhat seasonal and often occur during the late afternoon and early evening hours. Scheduling blasting to avoid these hours is a common sense option.

A common sense rule is to evacuate the shot area when thunderstorm activity comes within 5 miles of the shot site. Regulations require that electric blasting circuits be shunted at all times unless being tested or tied in. In wiring situations where some series are complete and shunted and some are incomplete and in the process of being wired and the approach of thunderstorm activity is noted, common sense dictates that the shot wiring activity be abandoned and the area cleared and guarded.

Radio Frequency (RF)

All radio transmitters send out energy in the form of electromagnetic waves; leg wires and lead lines can act as antennae, converting energy from these waves into electrical energy in the wire.

The amount of electric produced in the wires depends upon: the output power of wattage of the transmitter; the frequency of the radio waves; he distance from the source of the RF energy to the blast site; the configuration of the wires which act as the antenna

The hazard exists regardless of whether the wires are shunted (short circuited) or left unshunted (open circuit).

Recommended Distances for Blasting

50,000 watt AM radio (540 – 16500 KHz)...................2900 ft (880 m)
100,000 watt FM radio (88 – 108 MHz)......................2600 ft (790 m)
300,000 watt VHFTV (Channels 7-13)........................2500 ft (760 m)
1,000,000 watt UHFTV (Channels 14-83)....................2000 ft (610 m)
100 watt mobile police radio (35-44 MHz).....................260 ft (80 m)
5 watt Citizen's Band radio (26.96 – 27.41 MHz)................5 ft (1.5 m)

Precaution

Keep mobile transmitters away from the area.
Posting adequate signs to remind operators to turn off radio transmitters.

Testing Blasting Circuits

A Blaster's Multimeter, Blasting Ohmmeter or Blasting Galvanometer can be used to test blasting circuits for continuity and resistance.

Never use any test instruments not specifically designed for blasting circuits.

Before using an instrument, make certain the needle can be adjusted to "zero" when the terminals are shunted. Digital meters should read, "zero" in the display. If not replace the batteries and make the necessary adjustments as recommended in the meter instructions.

Replace the battery with the same type of battery specified by the manufacturer for use in the blasting instrument. If in doubt, contact your supplier's technical representative. Do not change batteries in the presence of electric detonators.

To properly test the circuit, the theoretical resistance of the circuit must be calculated. ***Table 16.1*** gives the resistance of a typical series of electric detonators with copper and iron leg wire of various lengths. This table is presented only for purposes of illustrating how to make circuit calculations. The actual resistances of the electrical detonators available to the blaster from the various manufacturers may vary widely from those shown in the table. Be sure to use your manufacturer's data when actually making circuit calculations in the field. ***Table 16.2*** gives the resistance per 1,000 feet for the various types of wire.

NOMINAL RESISTANCE* OF ELECTRIC BLASTING DETONATORS IN OHMS PER DETONATOR

(This is for example calculation only: refer to your supplier for actual resistances of your products)

COPPER WIRE			***IRON WIRE***		
Length of Wire in Feet	Instantaneous Delay Detonators	Delay Detonators	Instantaneous Detonator	Delay Detonators	Length of Wire in Feet
4	1.26	1.16	2.10	2.00	4
6	1.34	1.24	2.59	2.49	6
7	-	-	2.84	-	7
8	1.42	1.32	3.09	2.99	8
9	-	-	3.34	-	9
10	1.50	1.40	3.59	3.49	10
12	1.58	1.48	4.09	3.99	12
14	1.67	1.57	4.58	4.48	14
16	1.75	1.65	5.08	4.98	16
20	1.91	1.81	6.06	5.98	20
24	2.07	1.97			24
30	2.31	2.21			30
40	2.15	2.06			40
50	2.42	2.32			50
60	2.69	2.59			60
80	2.71	2.61			80
100	3.11	3.01			100
120	3.51	3.41			120
150	4.11	4.01			150
200	5.12	5.02			200
250	6.12	6.02			250
300	7.13	7.03			300
400	9.13	9.03			400

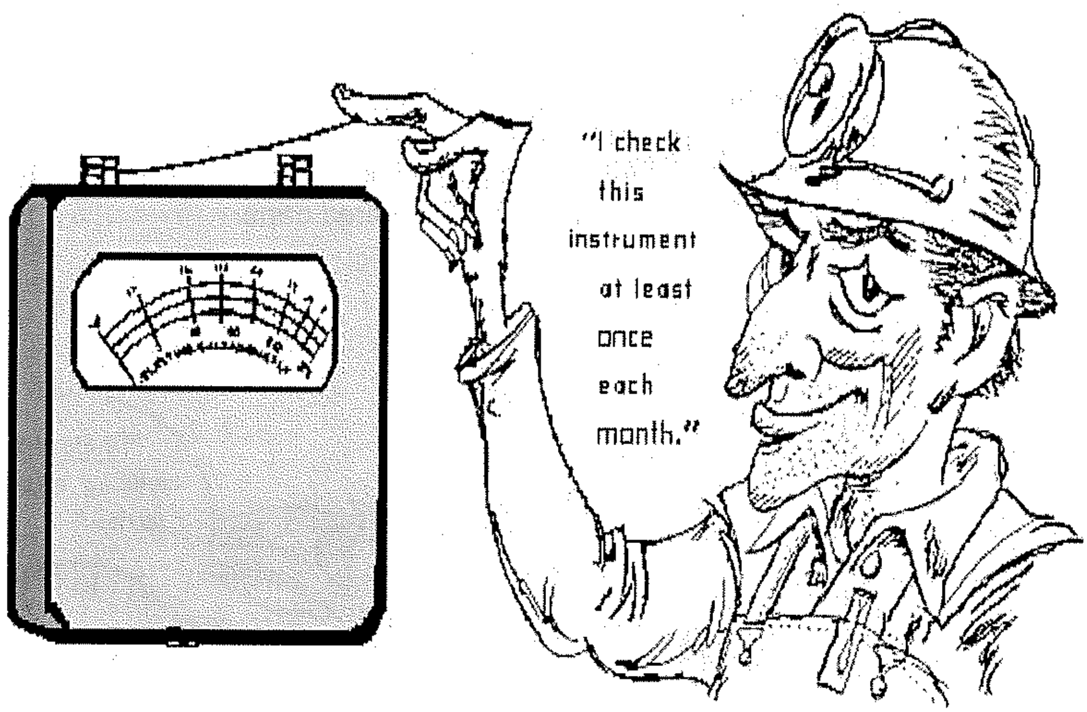
Table 16.1

*At 68^0 Fahrenheit

Resistance* of Copper Wire	
AWG Gauge No.	**Ohms per 1,000 Feet**
6	0.395
8	0.628
10	0.999
12	1.588
14	2.525
16	4.02
18	6.39
20	10.15
22	16.14

*At 68^0 Fahrenheit

***Table 16.2* – Resistance* of Copper Wire**



USING A BLASTING GALVANOMETER

Proper use of the blasting galvanometer helps assure safe blasting practice. You should consider using this test instrument in some, or all, of the following cases:

1. Check electric blasting caps for circuit continuity prior to stemming the hole. If this is done, be sure to twist the cap leg wires together after the test, so that they are short-circuited.
2. When wiring a blasting circuit series-in-parallel, check each series after wiring is completed and also when hooking up to the bus line or firing cable. Note the galvanometer reading. Readings should be approximately the same for every series. This assures an equal current distribution to each series.
3. Check firing cables in both the open are shunted positions. This will verify that there are no shorts or breaks in the cable.
4. When placing protective mats over a shot, lead wires on the terminals of the blasting galvanometer and make sure there is no change in instrument reading. If mats are of wire cable good practice to tape each leg wire connection.
5. Upon completion of all wiring, check circuit continuity at the firing end of the firing cable. Read the continuity check immediately prior to hooking up to the blasting machine.
6. Inspect the shot after blasting for possible missed holes. Use the galvanometer to check suspected misfired caps.

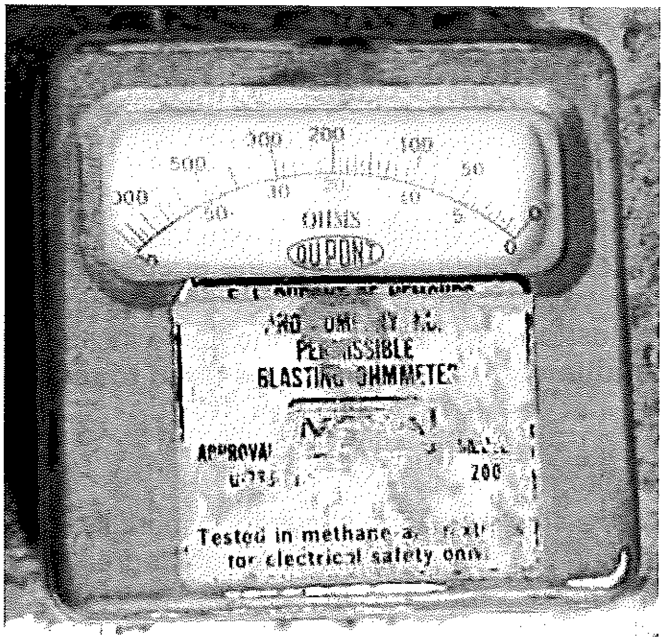
Blaster Multimeter

The Blaster's Multimeter is a compact volt-ohm-milli-volt meter specifically designed to measure resistance, voltage, and current in electric blasting operations. As with all blasting test devices, be certain the name includes the work ***Blaster's***. **A standard multimeter should never be used to test a blasting circuit.**

This versatile meter can be used to:

- Measure the resistance of a single blasting circuit for continuity, and the total resistance in a series-in-parallel circuit, with a high degree of precision and accuracy.
- Survey blast sites in order to determine if extraneous current hazards exist. For operating instructions, refer to stray current measurement methods recommended by the manufacturer.
- Measure a wide range of resistances necessary to investigate static electricity hazards, such as those possible in a pneumatic loading operation.
- Measure power line voltages up to 1500 volts AC and DC.

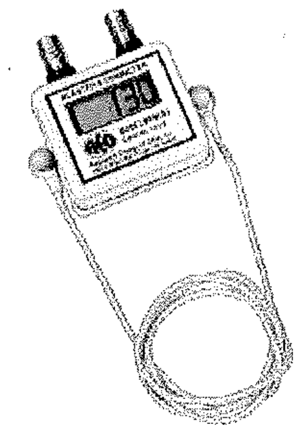
Blasting Ohmmeter



The Blasting Ohmmeter (sometimes called "Blaster's Ohmmeter") is an analog ("swing needle") device utilized to measure the resistance in ohms of the blasting circuit: (1) in order to determine if the bridgewire of an individual electric detonator is intact; (2) to determine the continuity of an electric detonator series circuit, (3) to locate broken wires and connections in a series or series-in-parallel circuit. To measure resistance with this compact instrument, place each of the two lead-in wires from the open end of the circuit on the two contact posts that extend out of the top of the Blasting Ohmmeter. The meter reading will approximate the circuit's resistance (number of ohms). To determine if the meter is functioning properly, short circuit the contact posts and determine if the meter is reading zero. If not, turn the adjustment screw on the instrument until the needle indicates zero ohms on the scale that will be used to test the circuit. If the needle cannot be adjusted to zero, or the needle is drifting when the instrument is shorted, the battery may be weak or other circuitry must be repaired prior to use. Never use an instrument that cannot be adjusted to zero.

Some Blasting Ohmmeters use special silver chloride batteries. When the battery is exhausted, it must be replaced with the same type of cell. Never attempt to replace it with a standard battery. Never change batteries near electric detonators. Never allow the silver chloride cell, or any battery, to come in direct contact with electric detonators.

Blasting Digital Ohmmeter



The Blasting digital ohmmeter is used to measure the resistance of blasting circuits and individual detonators in the same manner as the Blasting Ohmmeter, but with greater accuracy and range. Blasting Digital Ohmmeters are available in both permissible and non-permissible versions. Never use a non-permissible instrument underground in a gassy environment. The Blasting Digital Ohmmeter will give a direct reading of the resistance (ohms) of the blasting circuit when the two wires from the circuit are placed against the posts of the ohmmeter. A test of the ohmmeter can be made by shorting across the posts. The reading should be zero.

Blasters must use only the recommended batteries in these machines. Other batteries will produce a hazardous current level. Never test an electric detonator or blasting circuit directly with a battery, recommended or otherwise, and never allow any battery to come in direct contact with electric detonators.

Date / Plant / Shift Code

In 1971 IME member companies implemented a product identification system for packaged explosive products manufactured in the United States.

The code for the date, work shift and plant of manufacture is plainly marked on each unit to be identified. Marked units include all cartridges of dynamite, blasting agent, water gel, slurry, cast boosters, primers, cartons of detonating cord, containers of blasting caps and similar accessories. The shipping case bears the same number as the units.

The following is the format for the Date / Plant / Shift code used for product tracing:

Day	Month	Year	Location	Shift or Machine
2 digits	2 digits	2 digits	1 digit	1 digit
Numeric	**Alpha**	**Numeric**	**Alpha**	**Numeric**

When writing months, a two letter abbreviation is used:

January	**JA**	**July**	**JY**
February	**FE**	**August**	**AU**
March	**MA**	**September**	**SE**
April	**AP**	**October**	**OC**
May	**MY**	**November**	**NO**
June	**JU**	**December**	**DE**

As an example, a product manufactured on September 30, 1997 during the first shift at a plant which the manufacturer has assigned the letter "A" would be **30SE97A1**.

Manufacturers advise the Bureau of Alcohol, Tobacco and Firearms (BATF) when codes are changed.

Approved by the IME Board of Governors December 8-9, 1987

Ammonium Nitrate Oil (ANFO)

Ammonium nitrate is an essential ingredient in nearly all-commercial explosives including dynamite, emulsions, and water gels. Its predominant use, however, is in the form of a small porous pellet, called a prill, mixed with fuel oil. Nearly four billion pounds of these mixtures, commonly referred to as ANFO, are consumed each year in the U.S. They account for approximately 80 percent of the domestic commercial explosive market.

Since their introduction in the 1950's, ANFO products have found extensive use in a wide variety of blasting applications such as surface mining of coal, metal mining, quarrying, and construction. Their dominant use is attributed to economy and convenience.

Their limitations—no water resistance and low-product density—should be recognized as product deficiencies prior to introducing ANFO into a blasting system.

The most widely used ANFO product is an oxygen-balanced, free flowing mixture of about 94 percent ammonium nitrate prills and 6 percent No. 2 diesel fuel oil. Other ANFO products are modifications of this basic ANFO formula in which:

1) Substances such as finely-sized aluminum or carbon aceous materials are used in conjunction with No. 2 diesel fuel, or,
2) The AN prill is crushed, mixed with No. 2 diesel fuel (and possibly other substances), and packaged in water resistant package for use in damp to slightly wet boreholes.

The AN Blasting prill

This material is also frequently referred to by the terminology *porous, explosive-grade, industrial,* or *low-density* prilled ammonium nitrate.

Production of ammonium nitrate (AN) prills is a multi-step process that begins with natural gas and air.

The end point in this process involves spraying a concentrated (94% to 96%) AN solution through perforated plates or shower heads at the top of a prill tower. Liquid AN droplets are formed as the solution exits the shower heads.

During a free fall of 100 to 200 feet (30.5 – 61m), the droplets crystallize into spherical AN prills. These prills are dried, cooled, and may be coated with anti-setting agents prior to shipment.

A major domestic use of AN prills is for agricultural fertilizers. However, the agricultural AN prill differs from the AN prills most suitable for explosive use. Blasting prills are usually less dense and, consequently, more porous.

Density

Prills best suited for blasting products have a particle density in the range of 1.3 to 1.5 g/cc. AN prills with particle densities approaching the density of solid ammonium nitrate (slightly over 1.7 g/cc) are less sensitive to detonation. The voids in the porous, less dense blasting prill serve two functions:

1) They enable the prill to absorb and retain fuel oil in a uniform and intimate manner; and
2) They improve sensitivity by acting as sites for high-temperature "hot spots" or ignition points.

Anti-setting Coating

Liquid surface-active agents (surfactants) and finely ground (minus 325 mesh) kaolin or talc coat prill to disperse ambient humidity. This retards the prill's affinity for moisture on its surface, thereby minimizing caking. In some cases, the use of the surfactant alone has proven to be an effective anti-setting coating. Excessive amounts of talc or kaolin will, 1) decrease ANFO sensitivity because of the inert nature of those minerals and 2) interfere with the oil distribution, which will affect ANFO performance. Excessive quantities of certain surfactants may affect the stability of the emulsifier in blasting emulsions. This could in turn affect the performance of ANFO/emulsion blends. A good blasting rill has typically less than 1.0 percent anti-setting coating.

Loading of Holes

ANFO is extensively used because of the low cost advantages. When property stored, handled, and used, ANFO will give good performance. ANFO mixed to the proper proportion (94.3% ammonium nitrate and 5.7% fuel oil or Corvus oil for less oil fumes) has a Fume Class 1 rating. However, improper storage or usage can result in the generation of toxic fumes. Prolonged storage can also result in evaporation of the fuel oil. Ammonium nitrate is highly hydroscopic and will absorb moisture from the humid mine air if left stored in an open container. The loading of wet holes must also be avoided. Excessive moisture and/or unbalanced fuel ratios will result in poor sensitivity reduced explosive efficiency, and the generation of toxic fumes.

ANFO is normally packaged in 50-lb pillow - type or poly-burlap bags for easy handling by the mine personnel. However, recently some mine operators have adopted a bulk handling system to reduce handling cost. Since mine layout and systems vary greatly, any bulk handling system must be evaluated and designed for each situation.

Pneumatic Loading

The degree of sensitivity of ANFO mixes allows for the use of pneumatic loaders. Pneumatic loaders can be classified into three categories: pressure pots, Venturi loaders, or a combination of both systems.

A pressure pot consists of a pressure vessel with a conical base and a loading hose of proper diameter and length, the pot is sealed and a pressure of 25 - 40 psi is applied. The flow of ANFO is controlled by a ball valve at the base. Pressure pots can load at a rate of 25-50 lb per minute through a 100 ft 1in. ID hose. A disadvantage of a pressure pot is that it will not crush or compact the ANFO in the blast hole because of its lower air stream velocity in the loading hole as efficiently as the Venturi loader. This will result in lower velocity of detonation, density, and energy. Boreholes that are inclined upward cannot readily be loaded with the pressure pot system..

A Venturi loader consists of a hopper with suction at its base supplied by a Venturi. Venturi loaders are simple, portable, and inexpensive. This is offset by slow loading rates of 8-15 lb per minute. They are also restricted to short boreholes, but provide very good compaction of the ANFO prill in the blast hole.

The pressure pot/Venturi loader combines the advantages of both loaders. It has a high loading rate (50 - 75 lb per minute) with good crushing and compaction of the ANFO in the blast hole.

Static Electricity

Static electricity is a form of potential energy in which electric charges are stored on some person or object. When the static electricity is converted to kinetic energy by means of a static discharge, it represents a possible hazard to the use of flammable or explosive materials. When considering commercial blasting, the primary concern is that static electricity may cause a premature detonation when blasting electrically. Experience has shown, however, that static electricity, under some conditions, may also represent a hazard to nonelectric blasting.

The safety procedures that eliminate the accumulation of a static charge are listed below. They should be made an integral part of the pneumatic loading Operation, since they are the principal mechanism for minimizing the static electricity hazard.

1. *Ground the Pneumatic Loader* The pneumatic loader (includes both pressure pot and Venturi types) should be constructed of a conductive material and should be grounded to earth. The resistance between the loader and earth should be a maximum of 1,000,000 ohms. This can usually be accomplished by physical contact between the loader and earth. If the loader is mounted on a vehicle of some type, a positive grounding means should be used. One grounding method

that has proved satisfactory is to bolt or weld one end of a heavy, flexible wire to the loader. The opposite end should be connected to a metal rod imbedded in the earth. If the loader is moved often, the opposite end of the wire should be bolted or welded to a metal plate (about 8" x 8" x 1/2" thick with a handle for easy handling) that is rested on wetted earth during loading. Never ground the loader to metal air or water lines, metal support frames, or to any fixture that is also used to ground electrical equipment, as these may be sources of stray currents.

2. *Use a Semi conductive Loading Hose* when loading ANFO pneumatically, use a semi conductive hose that is electrically connected to the pneumatic loader. In most cases, this can be accomplished by clamping the hose to the outlet from the loader. The semi conductive hose should have a minimum resistance of 5,000 ohms per foot and a maximum total resistance of 2,000,000 ohms. There are a number of companies that manufacture acceptable semi conductive hoses.

3. *The Operator Handling the Loading Hose Should Not Wear Gloves* unless some other positive means is utilized to ground the operator, he or she should be in direct physical contact with the semi conductive loading hose. This is necessary to prevent the accumulation of a static charge on his or her person. If he or she wears gloves, the direct physical contact between the two cannot be achieved.

4. *The Resistance of the Earth between the Ground from the Pneumatic Loader and the Boreholes Should Be a Maximum of 1,000,000 Ohms* The resistance of the ore body and/ or rock between the ground from the pneumatic loader and the location of the boreholes being pneumatically loaded must be less than 1,000,000 ohms, so that the charge on the ANFO particles can neutralize the opposite charge that is left on the loading hose. Experience has shown that this requirement is easily satisfied in most mines.

5. *The Ambient Relative Humidity Should Be a Minimum of 50%* Humidity serves two functions in minimizing the accumulation of static electricity, Under conditions of high humidity, a thin film of moisture condenses onto the surfaces of objects on which static accumulates. The moisture film is usually sufficiently conductive that it backs up the grounding procedures by permitting electrostatic charges to drain to earth as they are being generated. The humidity in the compressed air that conveys the ANFO to the boreholes provides moisture that is absorbed by the ANFO particles. This provides a conductive film on the surfaces of the particles that drains any electrostatic charges to earth that may be on the ANFO as it is packed in the borehole.

6. *Avoid the Use of Nonconductive Borehole Liners* A plastic liner is sometimes used to keep the water in the borehole away from the ANFO or to prevent the ANFO from escaping from the borehole into cavities, cracks, or vugs. The nonconductive nature of these liners prevents the grounding of the static charge on the ANFO particles. Hence, they should not be used in boreholes that are

pneumatically loaded unless some positive means is provided to drain electrostatic charges to earth from inside the liner. There are semi conductive ground straps available to accomplish this grounding.

7. *Make Periodic Tests to Check the Effectiveness of the Recommended Safety Procedures* There are three types of tests that should be made prior to the introduction of pneumatic loading and periodically thereafter. These are:
1) Grounding resistance measurements,
2) Static voltage measurements, and
3) Relative humidity measurements.
The purpose of the grounding resistance measurements is to ensure that static charges will be dissipated to earth and neutralized instead of accumulating on some person or object. They entail checking the resistance of the loading hose, the pneumatic loader grounding, and the surrounding ore body to ascertain that they do not exceed the maximum values previously recommended. The purpose of the static voltage measurements is also to ensure that static electricity is not being accumulated. These measurements entail using an electrostatic voltmeter to monitor the pneumatic loader, the loading hose, the operator, and the ANFO particles as they are packed into the borehole for the presence of excessive electrostatic' voltages. Although condensation on the surfaces of objects is not depended only to drain off static charges, experience has shown that static is more likely to be a problem when the relative humidity is low less than 50%. Therefore, measurements of the relative humidity of the ambient air and the compressed air that services the pneumatic loader will help to further define the overall background conditions. The test instruments and procedures that are used in making the grounding resistance, static voltage, and relative humidity measurements are discussed in the next section.

When blasting non-electrical, the safety procedures listed above should be followed to eliminate the accumulation of static electricity generated by pneumatic loading.

Emulsion Explosives

Explosive Properties--Physical Form

An emulsion is an intimate mixture of two immiscible liquids with one liquid phase dispersed uniformly throughout the second phase. Emulsion explosives are dispersions of water solutions of oxidizers in oil medium or "water-in-oil" emulsions. It is this unique structure and high ratio of oxidizer to fuel that give emulsion explosives their special characteristics.

The oil or fuel phase is known as the continuous or external phase because it surrounds and coats all of the oxidizer droplets. The fuel phase is generally oil or wax or a combination of the two. No. 2 diesel fuel oil (FO) is common to emulsion explosives.

The water or oxidizer solution phase is called the discontinuous or internal phase because the microscopically fine droplets are kept apart and surrounded by the continuous fuel phase. The oxidizer phase always contains ammonium nitrate. Other salts such as sodium nitrate, calcium nitrate and ammonium or sodium perchlorate may also be included.

The oxidizer remains dispersed in the fuel to form a stable emulsion through the action of a surfactant (emulsifier). For example, oil and vinegar are held together by egg yolks to form the emulsion known as mayonnaise. There are many different emulsifiers, and choosing which one to use depends on the particular requirements for the product. The emulsion formed from the fuel phase, oxidizer phase and emulsifier, before any addition of bulking agent, aluminum, or solid ammonium nitrate, is called the matrix and is the foundation of subsequent products.

Structure

Because of the necessity to have close to zero oxygen balance, emulsion explosives need the volume of oxidizer to be much greater than the volume of fuel: the ratio is approximately 9 to 1. Because the relative volume of fuel is so much less than tat of the oxidizer, it must be spread in a very thin layer in order to cover all of the oxidizer droplets. The size of the droplets is very small: and, due to the oxidizer/fuel ratio, the droplets are in the shape of many-sided polyhedrons. Droplets are usually in the range of 0.2-10 microns in diameter, or about 1/4th to 1/2000th the size of a grain of table salt.

The rheology or viscosity of the emulsion is controlled by the nature of the fuel phase and the droplet size. The composition (wax, oil, emulsifier) of the full fuel phase has the greatest influence on the final viscosity of the product. Low viscosity oils, such as No. 2 diesel fuel, can be used to make pumpable emulsions. Waxes and high viscosity oils are used to make thick, putty-like packaged products. The droplet size is controlled by the amount of work pt into the emulsion. The faster and longer it is stirred, the greater the work input and the smaller the droplet size and size distribution. The smaller the droplet size, the thicker the emulsion.

Thermochemical Energy

The addition of aluminum or ANFO to an emulsion explosive can be used to increase its energy (cal/g). Aluminum does not significantly increase the sensitivity of emulsions, so a much coarser and less costly aluminum can be used rather than the high cost paint-grade aluminum used to attain sensitivity in some water gels. Theoretically, an addition of 5% aluminum will increase the energy of the emulsion by about 25-35%. Ten percent aluminum increases the energy by about 40-60%. Above 10% the addition of aluminum may not be cost effective.

ANFO added to emulsions can increase the energy by about 5% for every 10% increment added. ANFO also has the added advantage of producing only gaseous detonation products, and therefore, an increase in gas volume is also realized. An increase in gas volume usually leads to better heave and throw of rock being blasted.

The ratio of the amount of energy released to the calculated thermochemical energy is the measure of the efficiency of an explosive. Water gels generally have a liquid and a solid phase. They are generally made at elevated temperatures; as the product cools, oxidizer salt crystals begin to form. The colder the product becomes, the greater the tendency for crystals to form. The more crystals present and the larger they are, the more insensitive and less efficient the product becomes. The components are not intimately associated with one another because a relatively large amount of oxidizer surrounds a relatively small amount of fuel. In contrast, the increased intimacy between fuel and oxidizer in emulsions, and the very small particle size of the droplets, is believed to be responsible for the greater efficiency and enhanced detonation properties of these products.

The emulsions are two phase systems. In order to have a suitable oxygen balance, only a very small amount of fuel is available to spread over each individual oxidizer droplet. This results in a very intimate mixture. Because there are so many oxidizer droplets and because they are so small, the oxidizer salts, regardless of temperature, will not easily crystallize and grow. Since the oxidizer salts remain in solution, the detonation properties of emulsion explosives remain unchanged for long periods of time and over wide temperature ranges.

Detonation, Physical and Safety Properties

Safety

Emulsions fail to detonate in impact and friction tests, which have been standard to the explosive industry for years. When placed against a metal plate, the emulsions fail to detonate under the impact of a 30-06 projectile. Other high velocity impact tests with larger caliber projectiles show emulsions to have a greater resistance to initiation by impact than either water gels or dynamites. Normally, emulsion explosives will not detonate during burning, but there is no guarantee of this, particularly if the material is contaminated with foreign materials such as rust, detonators, dynamites or aluminum powders. When pumping emulsions, care must be taken so that the pump does not run dry or against a closed system ("deadhead"). In either case, friction can raise the temperature of the emulsion in the pump beyond the decomposition point of ammonium nitrate or other ingredients. If this happens a detonation can occur. Remember—it can be just as hazardous to pump unsensitized emulsion oxidizers, as it is to pump sensitized ones. Although tests have demonstrated that emulsions offer a great degree of safety, they will detonate if subjected to severe conditions. They are explosives, and regardless of their degree of safety should never be abused.

Velocity

It is an established fact that the smaller the particle size of the ingredients of an explosive, the higher the velocity of detonation (VOD). Since the droplet size of emulsions is so fine, the VOD of explosive emulsions is very high – close too theoretical. The VOD does decrease somewhat as the charge diameter decreases or as solids such as aluminum or AN prills are added, but the VOD generally remains relatively high when compared to most water gels.

Detonation Pressure

Since emulsions have a high velocity of detonation and a reasonable density, they also have a relatively high detonation pressure. Emulsion detonation pressures measured by the "aquarium" technique are found to be between 100 and 120 Kbar/(1.45-1.74 x 10^6 psi). As a result, emulsions are particularly well-suited for improving fragmentation in hard massive rock, for breaking hard bottom rock, and for use as a booster for ANFO mixtures and other blasting agents.

Sensitivity

Because emulsions have a very fine particle size and are an extremely intimate mixture of fuel and oxidizer, only a density reducing agent needs to be added to make them detonate. It is not necessary to use high explosives or chemical sensitizers for sensitivity. The density can be reduced by occluded air, chemically generated gas, perlite, expanded plastic, hollow glass or phenolic microspheres, or even AN prills. The sensitivity of the emulsions can be made to vary from that of a No. 8 strength detonator (or less) for a high explosive classification at 68°F (-20°C) to booster sensitivity for blasting agent 1.5D products. The emulsions are sensitive over a wide temperature range, and they also maintain their sensitivity over a wide range of diameters (7/8 inch [22mm] and up for "Explosive, Blasting, type E 1.5D" [blasting agent]). Different density reducing agents are used for different reasons, but the glass microspheees are the most common, although chemical gassing is becoming popular. Because certain glass microspheres will withstand high pressures, they are especially useful in sensitizing emulsion products for use in deep bore holes or close borehole spacing where high hydrostatic or shock pressures are likely to be encountered.

Generally, the lower the density of an emulsion explosive, the more sensitive it becomes. Also, the lower the water content of the emulsion explosive, the more sensitive it becomes. The water content of blasting agents is usually higher than that of 1.1D emulsions, but so is the density. This keeps the overall bulk strength energy level of blasting agents close to that of the high explosive emulsions.

Water Resistance

Water-in-oil emulsions have a continuous, water-immiscible oil phase and are extremely water resistant. They do not depend upon the integrity of the package for water resistance. Emulsions are a good choice when wet holes are encountered, because they will perform successfully after sleeping underwater for weeks or even months.

DYNAMITES

Straight Dynamite

Guhr dynamite, originally formulated by Nobel in 1864, was the forerunner of today's straight dynamites. Nobel's guhr dynamite contained kieselguhr totally saturated with liquid NG. The kieselguhr absorbes three times its weight in NG; as such, guhr dynamite contained about 75% NG. Kieselguhr, being inert, detracted from the explosive strength. In time, this problem was solved by using sawdust to absorb the NG, which added to the energy.

Present-day straight dynamites are no longer straight because they contain various proportions of active ingredients substituted for much of the kieselguhr, with resulting higher performance. Among the ingredients added to increase the performance was sodium nitrate, which created higher energy and a more favorable oxygen balance.
High density and high velocity result in good *brisance*, the shattering effect. They generally have fair water resistance, but poor fume characteristics, which disqualifies them for underground applications. Because of their high cost, industrial use and importance are declining, with ammonia dynamites being used as a substitute. Today straight dynamite is used in ditch blasting in wet soil by the sympathetic propagation technique.

Ammonia Dynamite

The first use of ammonium nitrate in explosives was patented by Nobel in 1867. In the first ammonia dynamite, ammonium nitrate was mixed with charcoal and nitroglycerin. This was an advancement, as the ammonium nitrate decomposes completely, adding to the energy. It also supplies oxygen to the reaction for better fume characteristics.

Since a portion of the NG is replaced by ammonium nitrate, ammonia dynamite generally has a lower density and higher shock and friction tolerance. Ammonia dynamites have low to medium VODs and exhibit good heaving action due to increased gas production. Ammonia dynamites are suited for use in relatively soft ground. The strength and density of ammonia dynamite can be varied greatly by changing the ingredient ratios. Most ammonia dynamites, however, have poor to fair water resistance and are thus limited in their use.

Gelatin Dynamite

In 1862, Alfred Nobel first prepared nitrocotton (nitrocellulose), searching for a substance that would retain NG in the presence of water. Guncotton (i.e., nitrocotton or nitrocellulose), listed as an absorbent in a dynamite patent by Nobel in 1863, did not perform as desired. In 1873, Maynard, an American medical student, found that a nitrocellulose with a lower nitrogen content than that used earlier by Nobel would produce a solution called collodion. Initially, it was used as a protective film over a cut as it dried into a thin tough coating. In 1875, Nobel cut his finger and applied the collodion. He then decided to try its effects on NG, which resulted in a very plastic and cohesive gelatin.

Straight Gelatin Dynamite

Straight gelatin contains a high ratio of nitrocellulose to nitroglycerin. Because of its highly gelatinous "rubber like" consistency, it has excellent water resistance. Nobel's straight gelatin composition contained 91% NG, 8% nitro cotton, and 1% chalk, and produced a plastic substance resembling crepe rubber in appearance and texture. This was called 100% blasting gelatin. Similar to the development of the straight dynamites, sodium nitrate and other carbonaceous ingredients were added to obtain a closer oxygen balance and higher energy characteristics.

Ammonia Gelatin Dynamite

This type of gelatin dynamite has ammonium nitrate substituted for some of the nitroglycerin to form a plastic cohesive product with good water resistance. Ammonia gelatins have high densities and high velocities, giving them high detonation pressure, which make them excellent boosters. Because of high-energy output, they are particularly suited for shooting tough rock.

Semi-gelatin Dynamite

A semi-gelatin is a cross between the high-density ammonia dynamites and the ammonia gelatins. The semi-gelatin dynamites exhibit moderately high detonation pressure and an adequate amount of water resistance for all but the most severe conditions. The rationale of the semi-gelatin dynamite is based upon economics. They have a higher cartridge count per case and cost less per cartridge than gelatins of equivalent strength, but exhibit less water resistance.

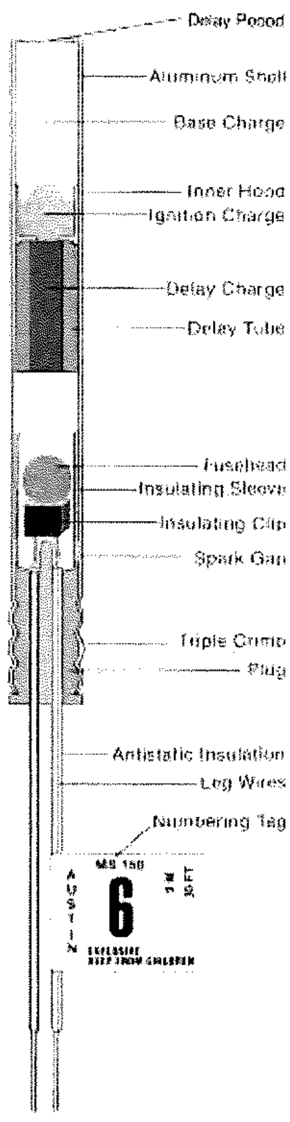
Permissible Dynamite

Permissible dynamites are specifically formulated and developed for underground coal mining. Each formula must pass many tests conducted by the U.S. Bureau of Mines and has been assigned an individual permissible certificate by MSHA. They are also subject to periodic testing to ensure permissibility for use in underground coal and gaseous metal and nonmetal mines.

Electric Detonators

This classification includes high, medium, and low firing-current electric detonators, semiconductor bridge detonators, toroid induction/electric blasting detonator. Exploding bridgewire (EBW) detonators and the electronic detonator.

Over the years, in the North American market the most widely used electric detonator has been of the low firing-current variety. With the proper electrical energy source and blast circuitry, large numbers of electric detonators can be initiated on command from a location that is safely removed from the immediate blast area.



The electric detonator consists of a metal shell containing a high explosive base charge designed to initiate other explosives. Above the base charge is a small charge of primary explosive (primer charge) that converts a burning reaction transmitted from the ignition or pyrotechnic fuse into a detonating reaction. Above the primer charge, in delay detonators, is a pyrotechnic delay element that burns at a known rate and whose length and composition control the transit time of the burning front. Detonators classified as instantaneous or zero delay does not contain a delay feature. The topmost reactive element in the electric detonator is the ignition area where a bridge wire is attached between the leg wire pins and is embedded in an ignition mixture. The ignition mixture may be in the form of loose powder, a primer spot, or match head, depending on the manufacturer's design. When sufficient electrical current passes through the system, a bridge becomes hot enough to ignite the ignition mixture. The majority of electric detonators surround the ignition area with a plastic ferrule that insulates and protects the ignition mixture from the shell. The leg wire pins are embedded in a thermosetting resin plug, and are connected to the detonator's leg wires within an electrometric material above the resin plug. The electrometric material top seal is securely crimped near the open end of the initiator shell, forming a water-resistant closure that firmly positions and secures the leg wires inside the shell.

All modern commercial electric detonators include an internal feature to prevent electrostatic energy from accidentally initiating the detonator. There are several designs, some of which provide a bypass path around the bridgewire using a semi conductive material and others, which utilize a printed circuit, which provides a controlled path to ground.

Detonator leg wires are made of solid copper, iron, or copper-clad iron wire in a variety of gauges and lengths. Iron or copper-clad iron leg wires are designed for use in operations where it is desirable or necessary to remove the leg wire remnants from the blasted rock by magnetic means. Plastic insulation provides insulation, abrasion resistance, and flexibility. The wire insulations typically color-coded to provide product identification with maximum visibility and to assist in wiring hookups. Most short-length electric detonator leg wires are coiled in a figure eight fold that is secured with a paper band. Longer length detonator wires are usually supplied as either duplex wire with a single color and wound on spools or single individually colored wires that are coiled in a figure eight fold. Longer length leg wires are typically heavier gauge wire in order to provide improved tensile strength and lower resistance per unit of length.

All electric detonators produced in North America have shuts on the free ends of the leg wires to provide a low resistance path to prevent current from flowing through the bridgewire. In addition, some designs completely enclose the ends of the wires in order to prevent corrosion and to keep bare wires from contacting extraneous electrical current sources. In one design the shunt consists of aluminum foil with an insulation layer on the outside.

Electric detonators are supplied with a distinctive, numbered tag to facilitate easy identification of the delay period.

Instantaneous Electric Detonators generally contain the same charges as fuse caps and function in a similar manner with the exception that the activating energy is applied electrically.

Two electrical wires, commonly called leg wires, enter the shell through a non-conductive plug of rubber or plastic around which the shell is crimped during manufacture. These are connected to each other within the shell at a point within or close to the ignition charge by a high resistance bridge wire or match head. The plug through which the leg wires enter prevents moisture or other contaminants from reaching the ignition charge. Electric detonators are not as subject to mass detonation as are fuse caps provided that the leg wires are kept folded until the cap is to be used. They are, however more subject to accidental initiation by extraneous electricity.

When the proper amount of current is passed through the leg wires, the high resistance of the bridge wire or match head causes it to heat very quickly. This heat ignites the ignition charge and from that point functioning is essentially the same as in a fuse cap.

Leg wires may be made of copper or iron. Iron wires are normally used only in coal and salt mines where the iron can later be magnetically separated from the coal or salt. Where iron wires are used, they are available in standard lengths from 4 to 20 ft.

Electric detonators with copper legwires are most commonly used because of their lower electrical resistance. Generally, they are available in standard lengths from 4 ft. to 400 ft. Other lengths are available on special order.

Because of differences in resistance, timing characteristics and designation of delay periods, brands of different manufacture should never be mixed in the same round, as risk of misfire is likely.

For all practical purposes, instantaneous electric detonators detonate when sufficient current is applied, although there actually is a measurable interval between the application of the current and the development of sufficient heat in the bridge wire or matchhead to activate the cap. This interval varies so slightly within **caps of the same manufacturer** that it can normally be ignored so long as sufficient current is applied. Thus, instantaneous electric detonators, unlike fuse caps, can be used for reliable simultaneous detonation of a large number of separate charges.

Long period electric detonators contain a delay train as an additional component. The delay train is interposed between the ignition and primer charges and delays detonation of the cap by the amount of time required to burn through it. This may depend on either the composition or the length or diameter of the delay train or both. Because the time interval between successive delay periods approximates one-half second, this type is sometimes referred to as slow or long delay electric detonators. It should be clearly understood, however, that each manufacturer establishes his own delay interval and numbers his delays in accordance with his own system. These facts provide an additional reason why caps of different manufacture must not be used in the same round.

Long period detonators are numbered to indicate progression and can normally also be identified by the manufacturers color code system. The lowest number, normally "0", indicates the shortest delay while the highest, presently 14 or 15, indicates the highest. It is emphasized that a "0" delay is not an instantaneous cap and that it will delay from 8 to 25 thousandths of a second, depending on the brand.

Primer:

A unit, package, or cartridge of explosives used to initiate other explosives or blasting agents, and which contains:

1) A detonator, or
2) Detonating cord to which is attached a detonator designed to initiate the detonating cord.

MAKING PRIMERS WITH ELECTRIC / ELECTRONIC DETONATORS

SMALL DIAMETER CARTRIDGES

(Less than four inches in diameter) –

Step 1: Punch a hole straight into one end of cartridge,
Step 2: Insert the detonator into the hole.
Step 3: Tie leg wires around the cartridge using a half hitch.
NEVER pull the wires too **tightly.** This may break them or damage the insulation

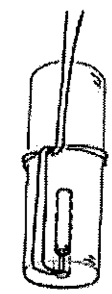


Figure 1: Recommended method of making primer with small diameter cartridge and electric detonator.

LARGE DIAMETER CARTRIDGE

(Four inches and larger in diameter) –

Step 1: Punch a slanting hole from the center of one end of the cartridge coming out through the side two or more inches from the end.
Step 2: Fold over the leg wires about 12 inches from the detonator to form a sharp bend.
Step 3: Push the folded wires through the hole starting at the end of the cartridge and coming out through the side.
Step 4: Open the folded wires and pass the loop over the other end of the cartridge
Step 5: Punch another hole straight into the end of the cartridge beside the first, insert the detonator in this hole, and take up all the slack in the wires.

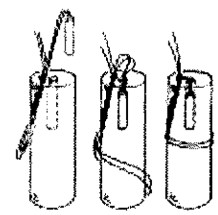


Figure 2: Recommended method of making primer with large diameter cartridge and electric / electronic detonator.

CAST BOOSTERS –

ALWAYS follow the manufacturer's recommendations for the attachment and use of detonators with cast or manufactured boosters.

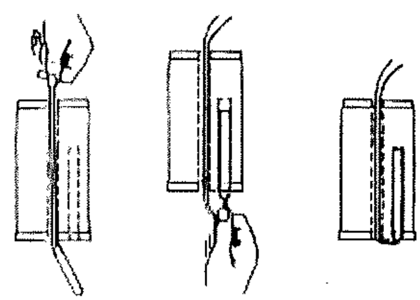


Figure 3: Recommended method of making primer with cast booster and electric detonator.

PLASTIC FILM CARTRIDGES –

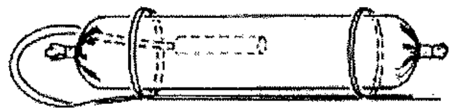


Figure 4: Recommended method of making primer with plastic film cartridge and electric / electronic detonator.

MAKING PRIMERS WITH FUSE OR NONELECTRIC DETONATORS

SIDE PRIMING METHOD –

***Step 1*: Punch a hole in the side of the cartridge. Make the hole deeper than length of detonator and pointed downward rather than across the cartridge.**
***Step 2*: Insert the detonator.**
***Step 3*: Fold back the fuse, shock tube or plastic tubing over the end so that it lies along the length of the cartridge.**
***Step 4*: Tape the fuse, shock tube or plastic tubing over the end so that it lies along the length of the cartridge.**

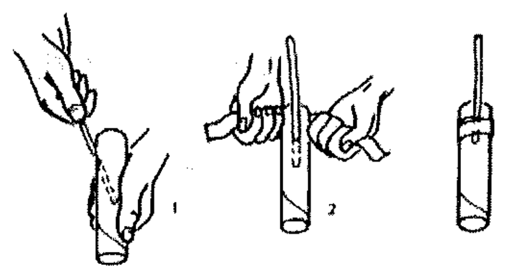


Figure 5: *Recommended method of making primer using the side priming method.*

REVERSE PRIMING METHOD

Step 1: **Punch a hole in the side of the cartridge. Make the hole deeper than length of detonator.**
Step 2: **Insert the detonator.**
Step 3: **Fold back the fuse, shock tube or plastic tubing over the end so that it lies along the length of the cartridge.**
Step 4: **Tape the fuse, shock tube to the cartridge.**

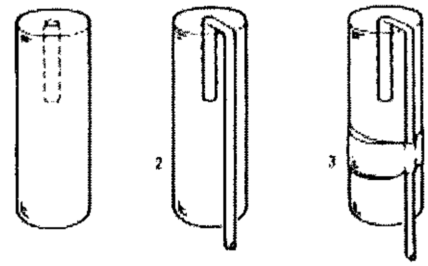


Figure 6: Recommended method for making primer by reverse priming method.

- ***CAUTION:*** **If miniaturized detonating cord is used, the explosives must be insensitive to initiation by the detonating cord for this method to work.**

PLASTIC FILM CARTRIDGE PRIMER –

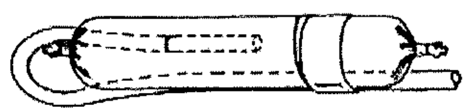


Figure 7: Recommended method of making primer with plastic film cartridge and fuse or nonelectric detonator.

MAKING PRIMERS WITH DETONATING CORD

DETONATING CORD WITH CAST BOOSTERS –

ALWAYS follow manufacturer's recommendations for using detonating cord with cast or manufactured boosters.

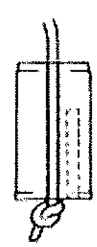


Figure 8: Recommended method for making primer with cast booster and detonating cord.

MISCELLANEOUS TYPES OF PRIMERS

ALWAYS follow manufacturer's recommendations for preparation of primers not covered elsewhere in these recommendations.

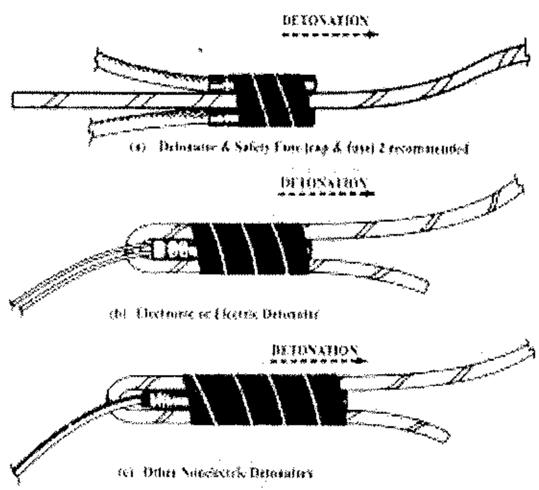


__Figure 9:__ Methods for attaching detonators to detonating cord.

ALWAYS use a detonating cord matched to the blasting methods and type of explosive materials being used.
ALWAYS Handle detonating cord as carefully as other explosive materials.
ALWAYS Cut the detonating cord from the spool before loading the rest of the explosive material.
ALWAYS Use a sharp knife, razor blade, or instrument designed for cutting detonating cord.
ALWAYS Make tight connections, following manufacture's directions.
ALWAYS Attach detonators to detonating cord with tape or methods recommended by the manufacturer.
ALWAYS Point the detonators toward the direction of detonation.

ALWAYS Attach the cord initiating detonator at least six inches from the cut end of the detonating cord.
ALWAYS Use a suitable booster to initiate wet detonating cord.
ALWAYS Use surface delay connectors designed for use with detonating cord.
NEVER Make loops, kinks, sharp angles in the cord, which might direct the cord back toward the oncoming line of detonation.
NEVER Damage detonating cord prior to firing.
NEVER Attach detonators for initiating the blast to detonating cord until the blast area has been cleared and secured for the blast.
NEVER use damaged detonating cord.
NEVER cut detonating cord with devices such as scissors, pliers type cutters, cap crimpers, or similar instruments.

Detonating Cord

Standard detonating cords commonly consist of a core of PETN (Pentaerythritoltetranitrate) encased in various textile wrappings and waterproofing compounds for the purpose of either:

1) Direct initiation of high explosives at any one point along its length and;

2) Propagation of the detonation wave from one detonating cord to another or;

3) Propagation of the detonation wave of the detonating cord to a non-electric delay detonator, by transmission of the detonation wave in the core.

The various textile wrappings and waterproofing compounds that encase the core are intended to:

1) Provide protection of the core from abrasion.

2) Provide a reasonable working tensile strength.

3) Resist side penetration of contaminating fluids.

4) Enhance knot-tying characteristics while maintaining flexibility.

Therefore, any procedure that may damage the protective encasement of the core, or permitting contaminating fluid to reach the core, will result in erratic performances.

DESCRIPTION AND APPLICATION OF DETONATING CORD

Type of Cord

1. Fineline, 10 grain, 100 lb. tensile strength, magenta in color.

General Applications: Recommended for use as a downline when used with a specially designed Austin Powder cast booster.

2. Lite Line, 15 grain, 230 lb. tensile strength, pink in color.

General Applications: Downline or upline under all but the most severe conditions.

3. Scotch Cord, 18 grain, 230 lb. tensile strength, orange in color.

General Applications: Surface trunklines, secondary blasting and downlines in shallow small diameter holes.

4. "A" Cord, 25 grain, 230 lb. tensile strength, green in color.

General Applications: Small, medium and large hole downlines and trunklines, secondary blasting and one hole blasting underground.

5. 50 Reinforced, 50 grain, 250 lb. tensile strength, yellow in color.

General Applications: Excellent general purpose cord for reliable blasting initiation under virtually all conditions.

6. Heavy Duty, 100, 150, and 200 grain. 100 grain has 200 lb. tensile strength and is orange in color, 150 grain has 275 lb. tensile strength and is purple in color, and 200 grain has 275 lb. tensile strength and is red in color.

General Applications: Constructed for severe service to meet a wide range of specialized applications such as presplit or dimensional stone.

7. Slide Line, different core loads available, 15 grain through 50 grain General Applications: For use with bulk loaded blends and emulsions.

Selection of Detonating Cord

1. Type of explosives being used (example, whether using ANFO, Emulsions or High Explosives)

2. Hole Diameter (example, if using detonating cord in small diameter holes in the lowest core load is preferred.

3. Using cord as trunkline, things to consider:

    A. Locations (example, if you are close to a dwelling or other structures where airblast or noise is a problem, you should use a lower core load detonating cord and cover it with at least 6" of dirt or sand.

    B. Avoid using sharp angles such as 10^0.

    C. Avoid kinks in the trunkline or downlink.

4. Using detonating cord with NDS (Non-Electric Delay Slider).

A low core load of 15 gr/ft to 25 gr/ft is a must when using NDS, because if you use a 50 grain cord, you will destroy the delay element attached to the booster.

5. Slide Line - Slide Line is detonating cord without the woven outer layer. It is used when using bulk emulsions or blends, because of the build-up of product along the cord length prohibiting the NDS booster from easily sliding down the cord.

6. When tying detonating cord to downlines or trunklines, make sure the knots are snug to the cord for detonation. A square knot will do fine in splicing.

7. When hooking a detonator to detonating cord, a few things must be considered:

   1. The detonator must be attached pointing in the direction of detonation.

   2. The detonator should be attached several inches from the end of the cord because of PETN leakage from the core. If the cord is wet at the end, the PETN will not perform.

Firing with Detonating Cord

Detonating cord is a flexible cord containing a center core of a high velocity, detonator-sensitive explosive, usually PETN, which is used to:

- Detonate other high explosives with which it comes in contact.
- Transmit a detonation wave from one detonating cord to another or to a nonelectric delay detonator.

Other core loadings, such as RDX and HMX are used in cords designed for specialized uses, such as in oil wells or other hot environments. If such applications arise, contact the cord manufacturer for recommendations.

The number of grains of explosive per linear foot and the type and thickness of countering (coverings or wrappings) determine the cord's priming ability. With this product, the term "50 grain" used in relation to cord means "50 grains per linear foot of cord." The various combinations of textile and plastic wrappings provide the cord's tensile strength, tie-in characteristics, and abrasion and water resistance.

Although PETN detonating cords are sensitive enough to be initiated by all strengths of commercial detonators, they are relatively resistant to accidental detonation from impact, shock, friction, or extraneous electricity.

The most widely used detonating cords have 15 to 50 grains of PETN per foot (3.2 – 10.6 g/m) of cord. All cords detonate at approximately 23,000 fps (7,000 m/s). Their explosives initiating energy varies with the core load. In all cases, they will initiate nitroglycerin-based explosives and many other detonator-sensitive products. Some products may not be initiated, but might be dead pressed or otherwise damaged by the energy output of cord. Consult with the explosive manufacturer as to which products can safely be used with detonating cord. Detonating cord initiation is particularly well suited for:

- Operators who prefer a nonelectric blasting system because potentially hazardous stray currents may be present.
- Firing multiple charges of explosives without significant delay between charges (e.g., as done in preshear blasting).
- Multiple priming or decking in deep, large-diameter boreholes.
- Coyote blasting or for large blasts to fracture low-grade ore bodies for in situ leaching.
- Initiating chute-blasting charges in underground mines.
- Submarine blasting where it is difficult to insulate electrical connections.
- Firing a single down line to initiate multiple nonelectric delay detonators for each explosive deck.

Fumes

The reaction product gases resulting from the detonation of commercial explosives and blasting agents consist principally of carbon dioxide, nitrogen, and water vapor (steam). Admixed with air these are, in the ordinary sense nontoxic. However, poisonous gases, including carbon monoxide and nitrogen oxides, are also present in some small concentration in the detonation reaction products from all real explosives. In the explosives industry these toxic gases are called fumes. The toxic gas components, carbon monoxide and nitrogen oxides are sometimes referred to jointly as noxious gas. Fumes should not be confused with smoke, which is composed mainly of steam and the solid products of combustion or detonation. Although smoke is nontoxic, excessive exposure to smoke, especially that produced by dynamite, can cause severe headaches and should be avoided. The headache may be the result of small particles of unreacted or partially reacted nitroglycerin/nitro glycol in the smoke. Both the nature and the total quantity of poisonous gases and smoke vary between types of explosives. For example, the detonation of emulsion explosives or water gels may produce significantly less smoke than dynamite. Fumes may also vary according to conditions of use. Anything that tends to cool the gases quickly increases the formation of oxides of nitrogen.

In open blasting, fumes cause little concern if they can be quickly dispersed by air movement, but in underground work the type and amount of explosive, the conditions, ventilation, and other factors should be considered.

Where fumes can be a problem, properly formulated and manufactured explosives and basting agents will give minimum quantities of toxic gases.

However, it must be recognized that some carbon monoxide and some oxides of nitrogen will result from every detonation of an explosive or blasting agent and that conditions of use can drastically shift the types of gases produced.

Some factors that increase fumes are poor product formulation, inadequate priming, insufficient water resistance, lack of confinement, reactivity of the product with the rock or other material being blasted, and incomplete product reaction. Adequate waiting periods before returning to the blast area are mandatory. This is important because some toxic gases are odorless and colorless. Absence of post blast smoke is no guarantee that hazardous levels of toxic gases are not still present. Never return to an area before ventilation has cleared the fumes from the area.

IME Fume Classification

A classification indicating the amount of poisonous or toxic gases produced by an explosive or blasting agent. The IME Fume Classification is expressed as follows:

Fume Class	Cubic Feet of Poisonous Gases Per (1 ¼" x 8") Cartridge of Explosive Material
1	Less than 0.16
2	0.16 – 0.33
3	0.33 – 0.67

Note: The U.S. Bureau of Mines limits poisonous or toxic gases to 2.5 cu ft per pound of permissible explosive

For the purpose of fume classification, only poisonous or toxic gases, such as carbon monoxide, hydrogen sulfide, and nitrogen oxides are considered.

Section XI

Category of gases

Noxious: Asphyxiant due to lack of oxygen

Toxic: **Poisonous - short term exposure**

Physics of gases

Specific Gravity / Vapor Density: The weight of a ratio of a specific gas compared to the same ratio of air. (Air = 1.000)

Temperature: Cold gases will diffuse slowly - hot gases will diffuse quickly

Barometric Pressure: The lower the pressure, the faster a gas will diffuse.

Solubility: The ability to dissolve in water (taste and / or smell)

Exposure Limits

Threshold Limit Value (TLV): The amount of a gas exposure for an 8-hour day for 5 days a week without any harmful effects.

Ceiling Limits: The amount of gas at no time a person can be exposed to..

Immediately dangerous to life or health (IDLH): The maximum concentration of a gas, incase of SCBA failure, one could escape without any irreversible health effects.

Measurement of Gases

Parts Per Million (PPM): The most accurate measurement of a contaminant in the atmosphere.

PERCENT	PPM
1.0	10,000
.1	1,000
.01	100
.001	10
.0001	1

MINE GASES & THEIR COMPONENTS

Air:

Chemical Formula:	None
Specific Gravity:	1.00
Source:	Atmosphere
Characteristics:	No color, odor, or taste

Pure dry air at sea level contains the following:

Oxygen	20.94 %
Nitrogen	78.09 %
Argon	0.94 %
Carbon Dioxide	0.03 %

Oxygen:

Chemical Formula:	O_2
Specific Gravity:	1.105
Source:	Atmosphere
Characteristics:	No color, odor, or taste, Oxygen will not burn or explode.

Note: When another gas is introduced into the atmosphere of artificial environment, such as a mine, tunnel or manholes, oxygen is usually displaced causing asphyxiation.
Health Effects:

CONCENTRATION (%)	PHYSIOLOGICAL EFFECT
21 %	Breathing easiest
19.5 %	Minimum required by law
17 %	Breathing faster and deeper, possible impaired judgment
16.25 %	First signs of anoxia or hypoxia occur
15 %	Dizziness, buzzing in ears, headache, blurred vision, rapid breathing
12 % to 16 %	Rapid breathing and pulse, impaired muscular coordination
10 % to 12 %	Emotional upset and abnormal fatigue on exertion
6 % to 10 %	Nausea and vomiting, inability to move, unconsciousness
< 6 %	Convulsive movements, gasping respiration, breathing ceases, cardiac arrest occurs

CARBON MONOXIDE

Chemical Formula: (CO)
Specific Gravity: 0.967
Source: Carbon monoxide results from incomplete combustion of organic carbon-based materials. It is also an after-product of detonated explosives and diesel engines. Carbon monoxide is highly toxic to the body. When inhaled, CO quickly bonds with the body's hemoglobin, thus reducing the blood's ability to carry oxygen throughout the body.

Characteristics: Flammable, Colorless, Tasteless, Odorless, Lighter than air.
Ignition Temperature: 1100°
Explosive Range: 12.5 % to 74 %
Limits: TLV – 50 PPM
Ceiling – 200 PPM
IDLH – 1500 PPM

Health Effects:

CONCENTRATION (PPM)	PHYSIOLOGICAL EFFECT
200	Slight headache, tiredness, dizziness, and nausea after 2 to 3 hrs.
400	Frontal headache within 1 to 2 hrs, life threatening after 3 hrs.
800	Dizziness, nausea and convulsions within 45 minutes. Unconsciousness within 2 hours. Death in 2 to 3 hours.
1,600	Headache, dizziness, nausea within 20 minutes. Death within 1 hour.
3,200	Headache, dizziness, and nausea within 5 to 10 minutes. Death within 30 minutes.
6,400	Headache, dizziness, and nausea within 1 to 2 minutes. Death within 10 to 15 minutes.

NITROGEN

Chemical Formula: (N_2)
Specific Gravity: 0.967
Source: Nitrogen composes 78.09 % of the atmosphere. It is a non-flammable gas.
Characteristics: Colorless, Odorless, Tasteless, Non-flammable, Lighter than air.
Limits: Ceiling – 810,000 PPM

NITROGEN DIOXIDE

Chemical Formula: (NO_2)
Specific Gravity: 1.589
Source: Nitrogen dioxide is an extremely toxic gas to the human body. It is produced from the detonation of explosives and it is found in diesel exhaust. It is a non-flammable gas that is heavier than air. In high concentrations, nitrogen dioxide forms nitric acid in the lungs causing pulmonary edema.

Characteristics: Reddish-brown color in high concentrations, Acrid or "bleach" odor, Non-flammable, Heavier than air.

Limits: TLV – 1 PPM
Ceiling – 5 PPM
IDLH – 50 PPM

Health Effects:

CONCENTRATION (PPM)	PHYSIOLOGICAL EFFECT
1 to 13	Irritation of nose and throat
10 to 20	Mild irritation of eyes, nose and upper respiratory tract
80	Tightness in chest after 3 to 5 minutes
90	Pulmonary edema after 30 minutes

HYDROGEN SULFIDE

Chemical Formula: (H_2S)
Specific Gravity: 1.191
Source: Hydrogen sulfide is an extremely toxic gas. It blocks the use of oxygen by the body's cells. It is produced when sulfur compounds decompose. It is commonly associated with acid mine water. This gas is released whenever a mine pool is agitated. Can be produced in mine fires should sulfide ores be present.

Characteristics: Colorless, Sweet taste, Odor similar to rotten eggs at very low concentrations (0.003 PPM), Extremely flammable, heavier than air, highly soluble.
Ignition Temperature: 700°
Explosive Range: 4.3 % to 46 %
Limits: TLV – 10 PPM
Ceiling 15 PPM
IDLH 300 PPM

Health Effects:

CONCENTRATION (PPM)	PHYSIOLOGICAL EFFECT
10	Obvious and unpleasant odor (rotten eggs)
50	Mild conjunctivitis, respiratory tract irritation in 30 to 60 minutes
100	Kills sense of smell in 3 to 5 minutes, may sting eyes and throat
200	Stings eyes and throat
250	Exposure for 1 hour is the Hazardous Limit concentration which may cause death
300	Immediately dangerous to life
500	Dizziness, coughing, breathing ceases within minutes, artificial respiration required
600	May cause death within 2 minutes
700	Unconscious quickly, death if not rescued immediately
1000	Unconscious instantly, breathing ceased, death within a few breaths. Death may occur even if rescued immediately.

SULFUR DIOXIDE

Chemical Formula: (SO_2)
Specific Gravity: 2.264
Source: Sulfur dioxide is produced when iron pyrite burns in gob fires or by blasting sulfide ores. It is also found in diesel exhaust. Sulfur dioxide has the same effect on the body as nitrogen dioxide, except that sulfuric acid is created in the lungs. It is a non-flammable gas.

Characteristics: Colorless, Heavy sulfur odor, Acidic taste, Heavier than air, Non-flammable.
Limits: TLV – 5 PPM
Ceiling – 10 PPM
IDLH – 100 PPM

Health Effects:

CONCENTRATION (PPM)	PHYSIOLOGICAL EFFECT
0.3 to 1	Detectable by taste rather than odor
3 to 5	Detectable odor
10	Maximum concentration allowable for prolonged exposure
20	Least amount causing coughing and irritation of eyes
50	Irritation to eyes, lungs, throat
50 to 100	Maximum concentration for short exposure (30 to 60 minutes)
150	May be endured for several minutes. Extremely disagreeable
400 to 500	Life threatening

CARBON DIOXIDE

Chemical Formula: (CO_2)
Specific Gravity: 1.529
Source: Carbon Dioxide is a natural component of air at approximately 0.03 %. It is also a key component of Black Damp, caused by biological oxidation such as rotting mine timbers. Increased concentrations of carbon dioxide replace the oxygen content of the mine air thus producing a toxic atmosphere.

Characteristics: Colorless, Odorless, Heavier than air, Acidic taste at high concentrations.
Health Effects: At 5 %, stimulated respiration
At 7 % to 10 %, unconsciousness after few minutes of exposure.

Limits: Ceiling – 1.5 %
IDLH – 50,000 PPM

METHANE

Chemical Formula: CH_4
Specific Gravity: 0.555
Source: Carbon products decaying in anoxic environment.
Characteristics: No color, odor or taste. Needs 12.5 % O_2 to ignite.
Ignition Temperature: 1100° -1300° F
Explosive Range: 5 – 15 %

HYDROGEN

Chemical Formula: (H_2)
Specific Gravity: 0.0695
Source: Hydrogen is an extremely explosive gas that is commonly found in battery charging stations. It can also be created when water is applied to super hot mine fires or from the incomplete combustion in explosions. Adding strong acids to iron or steel can also release hydrogen into the atmosphere.

Characteristics: Colorless, Odorless, Tasteless, Flammable, Lighter than air, Explosive when exposed to heat or flame, Needs 5 % oxygen to ignite.
Ignition Temperature: 1030° - 1130° F
Explosive Range: 4.1 % - 74 %
Health Effects: Asphyxiant at high concentrations

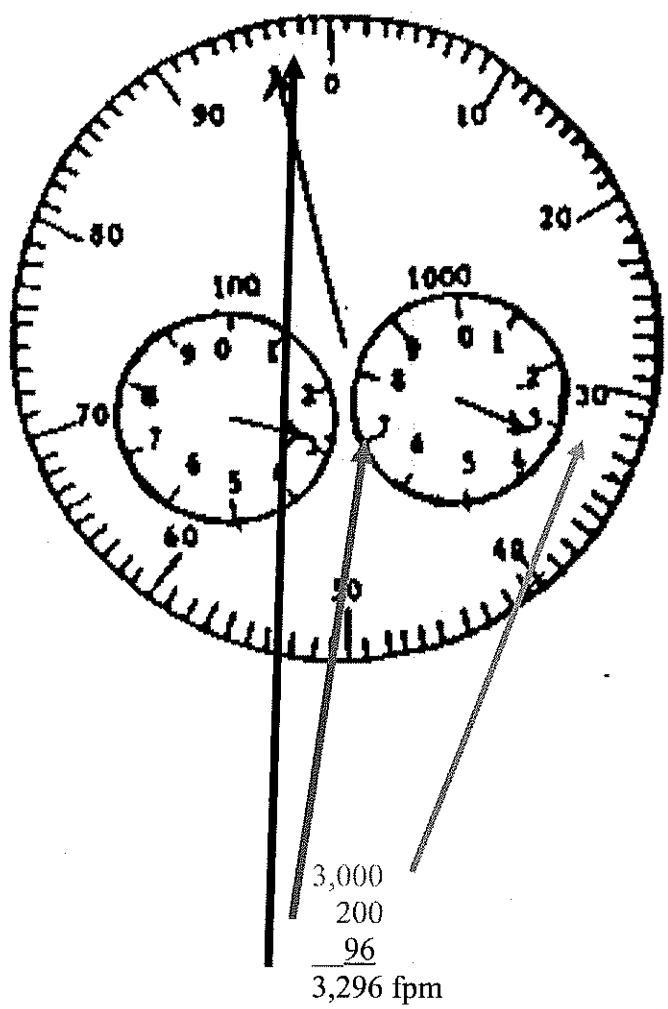
SECTION XII

Ventilation

Anemometer

Most common instrument to measure air velocity over 100 feet per minute.
The air flowing against the vanes causes the wheel to rotate which in turn cause the dals to move.
Large dial registers a velocity of 1 to 100 feet per minute.
Smaller dials registers 100+ and 1000+
When neddle is not on a number, go back to the preceding number.
Usually anemometer reading is taken over 1 minute.

Reading is 3,296, taken for one (1) minute.
If taken for more than one (1) minute, divide the reading by the time in minutes.
If taken under one (1) minute, multiply the reading.
Example:
30 second reading = x 2
15 second reading = x 4
All readings are in feet per minute.



CORRECTING ANEMOMETER READINGS

The indicated velocity (dial reading) does not indicate true air velocity. Therefore, a correction table is provided with each instrument.

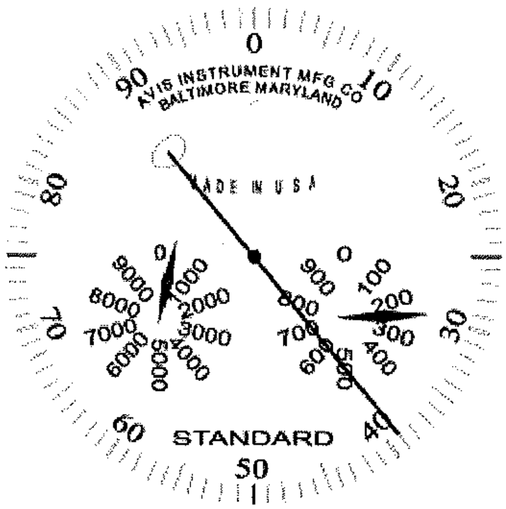
An example is shown below. Each anemometer has a unique correction table and cannot be used with any other anemometer.

Calibration Factor Chart

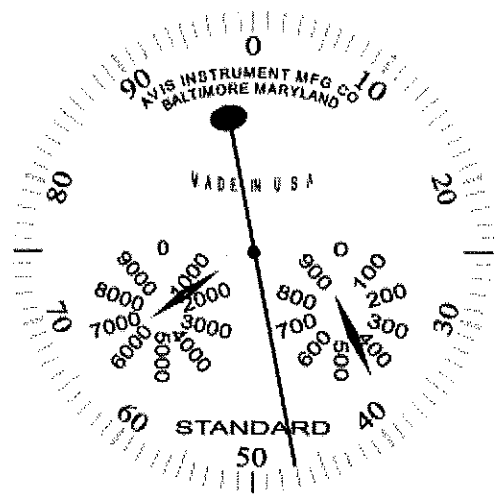
Serial Number	**52832**		
Date	04/14/99		
Ind. Vel.	Correction	Ind. Vel.	Correction
50	+64	500	-15
75	+53	550	-19
100	+41	600	-22
125	+33	700	-27
150	+27	800	-33
175	+21	900	-40
200	+17	1000	-45
250	+9	1200	-56
300	+2	1400	-65
350	-3	1600	-84
400	-8	1800	-104
450	-12	2000	-112
When sign is: + Add	- Subtract		

Practice Reading

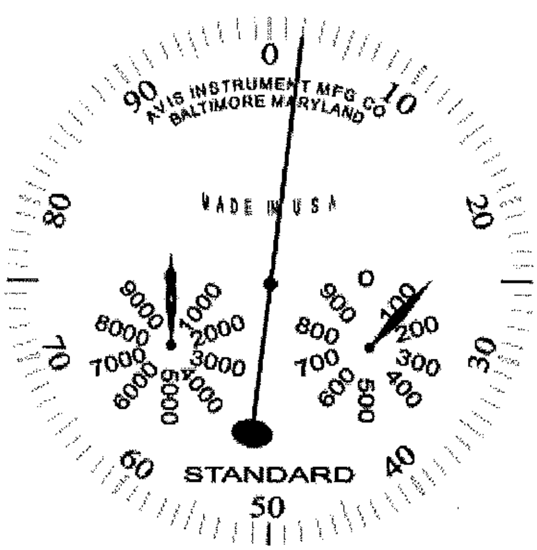
(Use Correction Chart on preceding page)



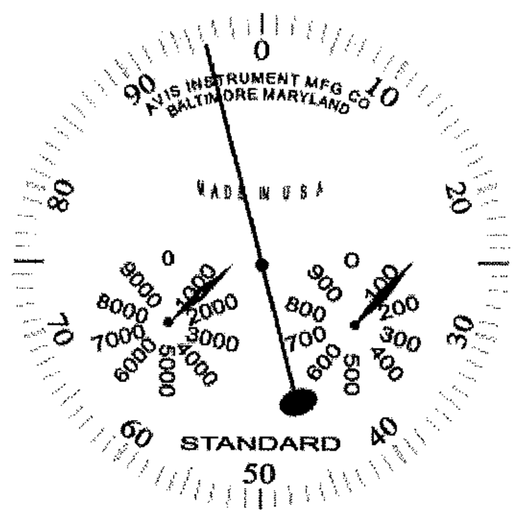
Reading: ______________



Reading: ______________



Reading: ______________

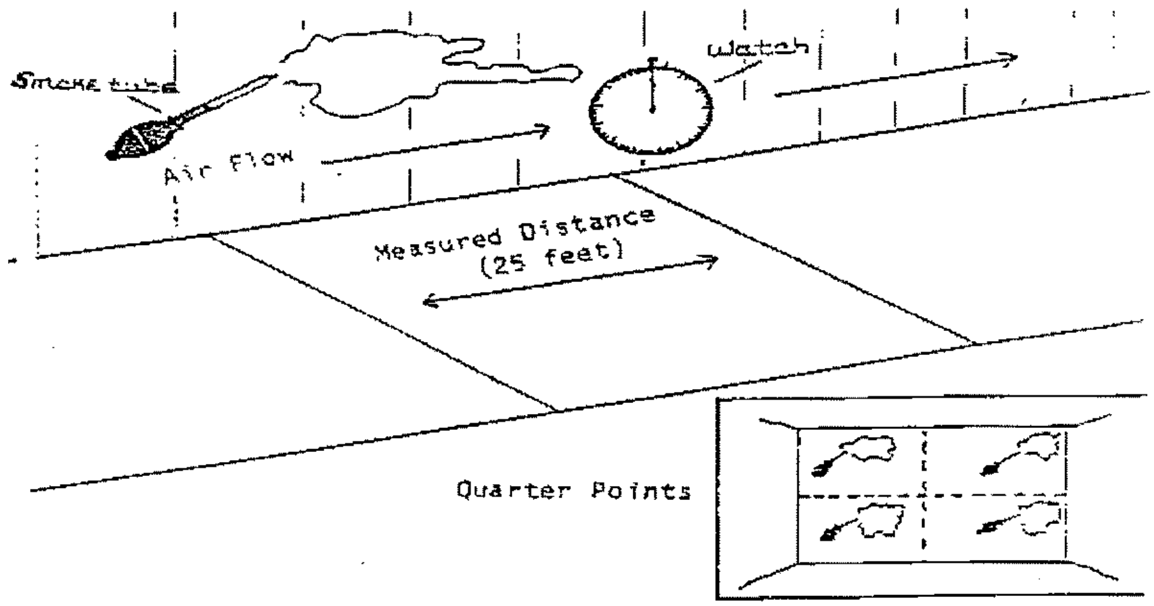


Reading: ______________

Smoke Tube Velocity Readings

When air velocity is less than 100 fpm, the dial on the anemometer hardly turns.

Items needed: aspirator bulb, smoke tubes, tape measure, watch, and two persons are needed to perform this task.



- To calculate air velocity using a smoke tube.
- As shown above, the measured distance is 25 ft., and it averages 23 seconds to travel to the down wind point.
- You first have to convert the smoke tube reading into feet per minute.
- Find the decimal equivalent of 23 seconds of 60 seconds.
    - To find what fraction of a minute is:

$\frac{23 \text{ seconds}}{60 \text{ seconds}} = .38$ minute, then $\frac{25 \text{ feet of travel}}{.38 \text{ minute}} = 67.7$ feet per minute

Velocity = 67.7

Use the Quantity Formula to calculate the Quantity of Air: Q = A x V

Section XIII

Basic Math & Problem Solving

Review of Formula Terms

a = sectional area of airway, in square feet ($ft.^2$)
v = velocity of air current, in feet per minute (fpm)
q = quantity of air, in cubic feet per minute (cfm)

COMMON AREA FORMULAS

Rectangular or Square Dimension:

Area = Height X Width

Note: Please remember to convert inches into the decimal equivalent of one foot - inches divided by 12.

Practice Problems – Area ; Rectangle

Determine the area of a mine entry that is 19 feet wide and 7 feet high:

Solution:

A = W x H
A = 19 x 7'
A = 133 sq. ft.

Practice Problems – Area ; Rectangle

Determine the area of a mine entry that is 18 feet wide and 5 feet, 6 inches high:

Solution:

A = W x H
A = 5.5' x 18'
A = 99 sq. ft.

Practice Problems

Determine the area of a mine entry that is 17 feet 3 inches wide and 6 feet 9 inches high:

Solution:

A = W x H
A = 17.25' x 6.75'
A = **116.43 sq. ft.**

COMMON AREA FORMULAS

Practice Problems – Area; Trapezoid

Determine the area of a mine entry that is 6 foot high, and 18 feet wide across the top, and is 19 feet wide across the bottom.

Solution:

$$\text{Area} = \frac{\text{Top Width} + \text{Bottom Width} \times \text{Height}}{2}$$

$$A = \frac{18' + 19'}{2} \times 6'$$

$$A = \frac{37'}{2} \times 6'$$

$$A = 18.5' \times 6'$$

A = 111.00 sq. ft.

Practice Problems – Area; Trapezoid

Determine the area of a mine entry that is 5 foot high, and 20 feet wide across the top, and is 22 feet wide across the bottom.

Solution:

$$\text{Area} = \frac{\text{Top Width} + \text{Bottom Width} \times \text{Height}}{2}$$

$$A = \frac{20' + 22'}{2} \times 5'$$

$$A = \frac{42'}{2} \times 5'$$

$$A = 21' \times 5'$$

A = 105 sq. ft.

Practice Problems

Determine the area of a mine entry that is 4 foot 6 inches high, and 17 feet wide across the top, and is 20 feet wide across the bottom.

Solution:

$$\text{Area} = \frac{\text{Top Width} + \text{Bottom Width} \times \text{Height}}{2}$$

$$A = \frac{17' + 20'}{2} \times 4.5'$$

$$A = \frac{37'}{2} \times 4.5'$$

$$A = 18.5' \times 4.5'$$

A = 83.25 sq. ft.

COMMON AREA FORMULAS
Practice Problems – Area; Circle

Circular:

$$A = \frac{¶ \times D^2}{4}$$

or

$$A = ¶ \times R^2$$

Please use the following For Pi.........¶ = 3.1416

Practice Problems –Area; Circle

Determine the area of a circle that has an diameter of 20 feet 9inches.

Solution:

$A = ¶ \times R^2$

$R = \frac{20.75}{2} = 10.375$

$A = 3.1416 \times 10.375^2$

$A = 3.1416 \times 107.640$

$A = 338.16$ sq. ft.

Area - Circle

Determine the area of a circular airshaft with a diameter of 20 feet
Solution:

$A = ¶ x R^2$

$R = \frac{20}{2} = 10$

$A = 3.1416 \times 10^2$

$A = 3.1416 \times 100$

$A = 314.16$ sq. ft.

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