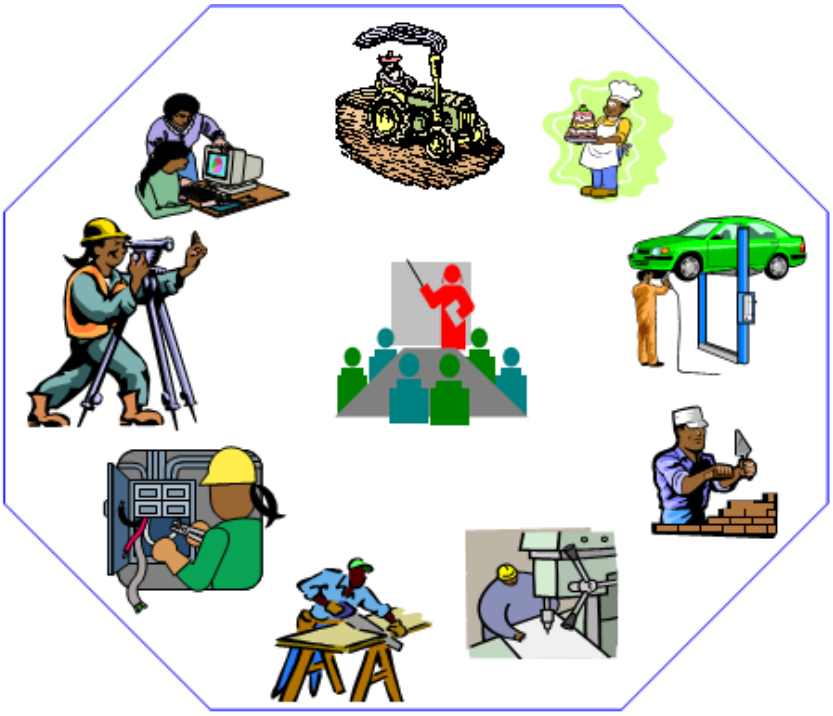
Surface Mining

Level-II

Based on Dec 2018, Version 1 OS and april. 2021, V1 Curriculum



Module Title: Storing, Handling and Transporting Explosives

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Table of contents

LG #32	LO #1- Plan and prepare for storage, Handling and transport of explosives

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics :

- OHS requirements
- Blast plan
- site security plan
- Accessing, interpreting and applying compliance documentation
- Explosives storage and transportation regulations
- Obtaining, confirming and applying work instructions
- Identifying, managing and reporting all potential hazards
- Identifying explosives and accessories
- Applying safe handling procedures and precautions
- Applying mathematical calculations.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to**:**

- Know OHS requirements
- Understand Blast plan
- Understand site security plan
- Access, interpret and apply compliance documentation

- Explosives storage and transportation regulations
- Obtain, confirm and apply work instructions
- Identify, manage and report all potential hazards
- Identify explosives and accessories
- Apply safe handling procedures and precautions

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, ask your trainer for further instructions

Information Sheet 1- Occupational health and safety requirements (OHS)

1.1 Introduction

Explosives are a vital part of many mining operations; the ability to break up hard rock makes the task of digging and transporting it significantly easier. Training is an important aspect of reinforcing safety. Explosives are very important, because it's the only really economic way to break up hard rock. The Management of Health and Safety at Work Regulations require the risks from a work activity to be assessed and appropriate measures taken to control them. This includes material aimed at those engaged in specific activities such as selling fireworks and other pyrotechnic articles, storing explosives, firework display operators, and explosives manufacturers. Further sections cover management arrangements, employee consultation, employee responsibilities, training and competence, information on safety precautions and actions, and workplace rule

1.2 Occupational health and safet

Occupational safety and health (OSH), is a multidisciplinary field concerned with the **safety, health**, and **welfare** of people at **work**. The goal of an occupational safety and health program is to foster a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. Mining operations include a diverse range of activities and involve work that has an equally diverse health and safety risk profile. Health and safety in the mining sector can only be improved if risks are identified and effectively addressed.

Accidents and fatalities can be attributed to management practices:

- violation of safety regulations,
- poor organization of work,
- deficiency of certified occupational safety specialists and

- Inadequate personnel training.

1.2.1 Comply with all work health and safety polices

It is important that you are adequately fit for duty when performing work activities. Your site will have specific requirements for fitness for duty. You must ensure that you know your site's requirements, and if you are unfamiliar, know how to access these requirements.

Your site may have requirements for fitness for duty relating to:

- Smoking restrictions
- Alcohol impairment.
- Improper use of drugs
- Fatigue management
- Physiological and psychological stress
- Medication
- Illness

There will be a number of general mine health and safety polices in procedures that you will be required to follow and fulfil noted earlier that include:

- Personal Protective Equipment (PPE)
- Hazard identification and risk assessment
- Personal health and hygiene
- Working with hazardous substances
- Working with plant and mobile equipment
- Environmental protection
- Fire prevention and fire fighting
- Site communications
- Training
- Emergency response

- Tagging and isolation
- Defect reporting system
- Standard Operating Procedures
- Work instructions

1.2.2 A Safe Job Analysis (SJA):

A Safe Job Analysis is a systematic review and assessment of hazards ahead of an activity during which hazardous situations may arise. Everyone who is to take part in the activity in question must participate in the completion of a SJA. The object is to evaluate whether adequate regard has been paid to safety through existing work procedures, instructions and plans, or whether there is a need to implement additional measures capable of eliminating or controlling the hazards. A SJA is also a tool for ensuring that the measures previously agreed are in fact implemented.

It is especially important to complete a SJA when:

- The work involves non-conformance with descriptions in procedures, instructions and plans
- The work operation is new and unfamiliar to those who are to perform it
- People who do not know one another are to work together
- Equipment of which the workers have no experience is to be used
- The conditions have changed, for example, weather conditions, time available, altered sequence of tasks, difficult coordination with other activities
- Accidents/undesirable events have occurred previously in connection with similar activities.

1.2.3 The purpose of the Work Health and Safety:

High standards of safety need to be in place before explosives operations start, and should remain in place – and be effective – for as long as the explosives operations continue. It is generally difficult or impossible to regain control of an event involving explosives once control has been lost.

- ✓ To protect the health, safety and welfare of employees and other people at work.
- ✓ It also aims to ensure that the health and safety of the public is not put at risk by work activities.
- ✓ To manage the risks associated with handling and transporting .
- ✓ To 'secure the health and safety of workers and workplaces through the elimination or minimisation of risks, fair and effective representation, consultation, co-operation and issue resolution, encouraging employer organizations and unions to play a constructive role, provision of advice, information, education and training, and effective and appropriate compliance and enforcement measures', among other matters.
- ✓ to limit the extent of fire or explosion, including measures to prevent the spreading of fires and the communication of explosions from one location to another; and
- ✓ To protect people from the effects of fire or explosion.
- ✓ to prevent unplanned fires and explosion;
- ✓ prevent the spread of fire and the communication of an explosion; and
- ✓ Protect people from the effects of a fire and explosion are identified using a structured approach.

Mine Workers must:

1. take reasonable care for their own health and safety,
2. take reasonable care that their acts or omissions do not adversely affect the health and safety of other persons, and

3. Cooperate with any reasonable policy or procedure which relates to work health or safety and that has been notified to workers.

Fig 1: safety signs

1.2.4 Protecting people from the effects of fire or explosion

Any one manufacturing or storing explosives to take steps to prevent a fire or explosion and to prevent the fire spreading and/or limit the size of any explosion, also requires them to take steps to protect people in the event of a fire or explosion. At its simplest this means taking steps to ensure that in the event of a fire, anyone in the immediate area of the explosives can quickly and safely escape. The following paragraphs cover:

- the establishment of emergency procedures;
- fire precautions;
- fire detection and warning systems;
- means of escape and evacuation;
- fire-fighting; and
- Measures to protect against explosion.

1.2.5 Fire Safety Procedures for the Workplace

A fire in the workplace can be one of the most devastating hazards for not only the workers but the public as well. It can result in numerous serious injuries or even fatalities in addition to the extensive property damage. So fire safety is pretty important. Be sure to familiarize yourself and your co-workers with your company's fire procedure.

Here we're going to explore some key universal safety procedures and tips for fire safety at your workplace.

1.2.6 Basic fire safety you must know for every worksite:

Know the location of the fire extinguishers in the workplace. You should be aware where the nearest extinguisher is at all times.

Know where your nearest emergency exits are.

Know the difference between alarm signals to quickly recognize the situation.

- **If you discover a fire:**

Alert all other individuals within the workplace by activating the nearest fire alarm, shouting clearly or by using other procedures set in place by your company.

Use the nearest exit to evacuate the workplace.

Use a fire extinguisher to put the fire out. Be careful while doing this and do not attempt if yours or others safety is at risk or on large fires.

Fig 2: Excessive fire

- **During evacuation of a worksite:**

Stay calm and evacuate the building immediately when you hear the fire alarm. For more check out our blog on evacuation checklists and procedures.

Along the escape route, close (don't lock) all the doors and windows you pass by so that you can cut the fire and the smoke off from spreading to the other rooms.

Go to the assembly point and alert your relevant supervisors that you are safe and outside the building.

Adhere to any protocols put in place by your company

A safe work place is crucial and ensuring that you have the right safety procedures and policies for things such as working at heights, first aid CPR, confined space entry, A workplace assessment for fire safety should be done for every new site or when your current site undergoes changes and all fire extinguishers should be routinely inspected.

Self-check 1	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the work health and safety?2 point
2. What does mean Occupational health and safety?2 point
3. List some of the mine health's, and safety polices in procedures?2 point

Note: **Satisfactory rating – Above 3 points** **Unsatisfactory - below3 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Blast plan

2.1 Blast plan

The purpose of Blasting Plan is to outline the steps that will be employed when conducting any blasting associated with any mining related project. Blasting Plan is being prepared prior to regulatory approvals and prior to the selection of the general contractor and blasting contractor. Any changes to the Blasting Plan will be filed for regulatory review and approval, to the extent required.Any mining project considers safety as the first priority during all phases of blasting operations. A blasting contractor will be selected that is knowledgeable and experienced in blasting operations and in complying with all applicable local, state and federal regulations related to the transportation and use of explosives. Each blast will be planned by the holder of a blasting certificate. The planning will involve determining as accurately as possible the quantities of explosives and accessories for each blast. The execution of each blast will be undertaken as follows:

The mine plan will be assessed to determine which blast is being executed and the applicable

- dimensions; The holder of the blasting ticket will then examine the area for blasting, for misfires, unsafe face
- conditions above and below the bench to be blasted, and the blaster will ensure that the area into which the rock will be blasted is clear of any infrastructure or personnel; The blaster will then mark out the holes to be drilled according to the dimensions and the mine planning
- department instructions; After drilling of the holes, the blaster will then measure the holes to ensure they are drilled correctly and
- for determining quantities of explosives and accessories; The blaster will then plan the blast by calculating the appropriate amount of explosive, boosters,

- initiation systems components and other accessories; The explosives and accessories will be drawn from the magazines, and the ANFO truck will be loaded;
- The blasting site will then be manned by a blasting assistant to ensure that no unauthorised person
- enters the site, or no other activity takes place at the site that could interfere with blasting procedures; Blasting accessories will be delivered to the blast in an approved explosive transportation vehicle, with
- appropriate warning decals; The blaster will check the accessories are the correct quantities;
- Boosters and down the hole initiation systems will then be distributed to the holes;
- The blaster will then commence with charging of the blast with help from blast assistants;
- If using pumped emulsion, the blaster will ensure that the emulsion is allowed to rise prior to closing the
- holes with stemming; Once the holes are charged and the emulsion has risen, the stemming will be placed into the holes;
- At this point the blaster will contact the mining personnel for the evacuation of the mining area to begin;
- Once stemming is complete the blaster will connect the down hole initiation system with trunk lines;
- The blaster will then leave an assistant to guard the blast and then undertake a check on the progress
- of the evacuation, place guards at access points and lay the firing cable for initiation; A guard will also be placed at the far end of the firing cable;

Fig 1: Blasting

2.1.1 Blast Design

Prior to commencing any blasting work, the General Contractor submits to mining project a blast design document. The document include as a minimum: hole sizes, depths, spacing and loading information. The designs are to be considering a good

starting point. Modifications are usually made, if necessary, following the first blasts to meet control and seismic considerations. All blasting operations will be strictly coordinated with mining project on-site representative, and emergency personnel as required. Work areas without impact to surrounding structures and roadways. Blasts will be developed so as to create adequate relief which will minimize ground vibrations and offer the greatest protection possible to the surrounding structures and roadways.

2.1.2 Blast Monitoring

All blasts will be monitored by a representative of a qualified firm approved by mining project, who has been properly trained in the setup and use of seismic monitoring equipment. At least one seismograph will be in use at all times. Placement of monitoring equipment will be at the nearest structure to the blast site. Results of blast monitoring will typically be available before the next blast, usually immediately following a blast. Results can be reviewed and modifications can be made to the blast design for the next blast if necessary.

Fig 2: Safety awareness.

2.1.3 Blasting Procedures:

1. Blasting operation conduct in between shifts or at the beginning /ending shift. Except on state holidays.
2. Blasting will not be conducted at times different from those announced in the blasting schedule except in emergency situations, such as electrical storms or unscheduled detonations that are required for public safety reasons.
3. . Warning and all-clear signals of different character that are audible within a range of one quarter mile from the point of the blast will be given. All persons within the permit area will be notified of the meaning of the signals through appropriate instructions provided during worker safety orientations and signs will be posted.

4. Access to blasting area will be restricted to protect the public from the effects of blasting. Access to the blasting area will be controlled to prevent unauthorized entry before each blast. Access to and travel in or through the area can then safety resume
5. Areas in which charged holes are awaiting firing will be guarded, barricaded and posted, against unauthorized entry.

6. . All blasts will be made in the direction of the stress relieved face of the rock being blasted that has been previously marked out or previously blasted.
7. Blasting mats shall be used for all blasts to prevent fly rock.
8. All rock-drilling operations will be equipped with either wet or dry dust emission controls to control fugitive particulate matter.

Fig 3: Blasting sequence

Self-Check – 2	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What does blasting mean? (3pts)
2. Mention the requirements of blast design. (3pts)
3. Why blasting operation conduct in between shifts or at the beginning /ending shift? (2pts)
4. List down the procedures of blasting.(2pts)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- site security plan

3.1 Site plan

The security plan will provide information to the regulatory authority about how you will meet security requirements. Employees should understand their role in security by the licence holder incorporating the Security Plan requirements into their operating procedures. In both the mining and construction industries, blasting is the predominant method for fragmentation of consolidated mineral deposits. The blasting process, however, remains a potential source of numerous hazards to people and surrounding objects. Investigations of fly rock accidents have revealed one or more of the following contributing factors: discontinuity in the geology and rock structure, improper blast hole layout and loading, insufficient burden, very high explosive concentration, and inadequate stemming. The accidents due to lack of blast area security are caused by failure to use appropriate blasting shelter, failure to evacuate humans from the blast area, and inadequate guarding of the access roads leading to the blast area. The plan results a positive impact on hazard awareness, prevention, and safe blasting practices in mining and construction industries.

3.2 Blast Area Security:

Communication is important. Everyone on-site needs to know what's going on and when things are going to happen .When it comes to clearing the blast area, you can never be too safe. At surface mine operations and construction sites, large amounts of earth need to be moved. Sometimes explosives are used. Many of the surface blasting injuries and fatalities are caused by the lack of good security around the entire blast location. Once the location has been selected for excavation, the blaster designates the blast area. All material displaced by the explosion should fall well within the designated area. Its boundaries should be large enough to accommodate the material and all access roads must be guarded during a blast to ensure safety. Clear communication

must be established between the site manager or mine foreman and the blaster. Details of the blast layout, security, and all other safety issues need to be discussed in detail. The time of detonation for the blast needs to coincide with the workers' schedules and area traffic.

The following factors shall be considered to determine the blast area:

- Geology or material to be blasted,
- Blast pattern,
- Burden, depth, diameter, and angle of the holes,
- Blasting experience of the mine,
- Delay systems, powder factor, and pounds per delay,
- Type and amount of explosive material, and
- Type and amount of stemming.

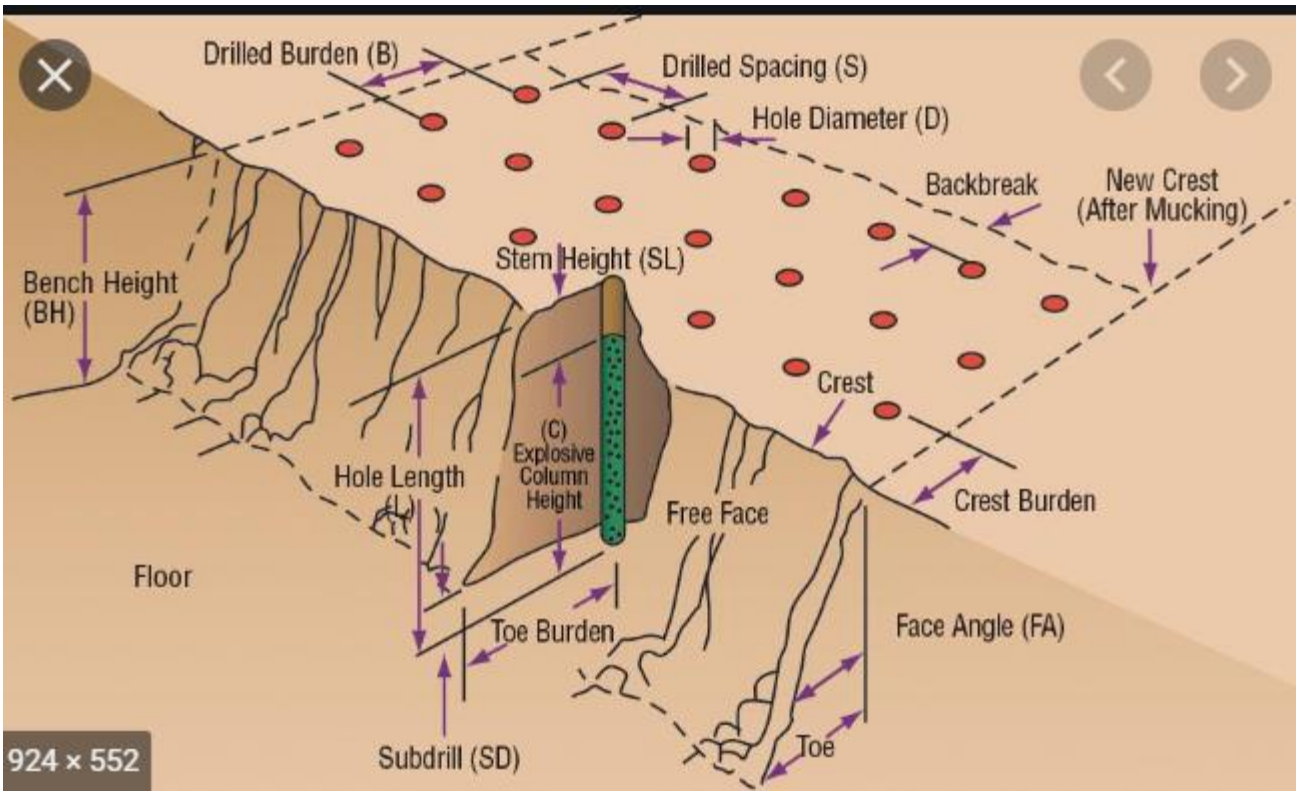


Fig 1: blasting parameters.

3.3 Blast Security and Warning Whistles

- Signage will be posted at a message board at the project site entrance indicating blasting activities and the signal sequence.

- Each blast will be preceded by a security check of the affected area and then a series of warning whistles. Communications will be made with job site supervisors and local officials as required to ensure the safest possible operation. All personnel in the vicinity closest to the blast area will be warned. \

- No blast will be fired until the area has been secured and determined safe. The blast site will be examined by the blaster prior to the all clear signal to determine that it is safe to resume work.

Fig 2 : Blast Security safety clothing

Self-Check – 3	Written test

Directions: **Answer all the questions listed below.** Use the Answer sheet provided in the next page:

1. What are the Requirements for site security plan ?(3pts)
2. Mention the factors to determine the blast area. (3pts)
3. What is the importance of having secure Blast Area? (4)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 4- Accessing, interpreting and applying compliance documentation

4.1. Introduction

Explosives are chemical compounds or mixtures which can rapidly change into other systems or substances under the influence of some external impulse, such as spark, impact, or heating, liberating great quantities of heat and gases. These causes disintegration of the material surrounding the charge. Explosives being used in mining. Drill and blast mining is a common method used to break up 'benches' of rock in order to send the smaller pieces of rock containing ore to the processing plant to further separate the valuable ore from the waste rock.

4.2. Components of explosives

Oxidizers: used to provide the required oxygen. Oxidizers contribute oxygen for oxygen balance, and include nitrated salts such as ammonium nitrate (AN), sodium nitrate (SN), and calcium nitrate (CN).

Fuels: to sustain the reaction include fuel oil, carbon, granular aluminum, TNT, black powder, Sulphur, charcoal or any carbonaceous material that produces heat. Many of these components are also referred to as sensitizers and can also act as absorbents.

Absorbents are products, such as wood pulp, sawdust, cotton, and cellulose that incorporate liquid explosive components such as nitroglycerin.

Stabilizers: include flame retardants, gelatins, densifiers, water, gum, emulsifying agents, and thickeners.

Sensitizer: To promote the explosive reaction Nitro-glycerin, TNT, voids and bubbles.

In general, an explosive has four basic characteristics:

- It is a chemical compound or mixture ignited by heat, shock, impact, friction, or a combination of these conditions;
- Upon ignition, it decomposes rapidly in a detonation;

- There is a rapid release of heat and large quantities of high-pressure gases that expand rapidly with sufficient force to overcome confining forces; and
- The energy released by the detonation of explosives produces four basic effects;
    - Rock fragmentation;
    - Rock displacement;
    - Ground vibration; and
    - Air blast.

A general theory of explosives is that the detonation of the explosives charge causes a high-velocity shock wave and a tremendous release of gas. The shock wave cracks and crushes the rock near the explosives and creates thousands of cracks in the rock. These cracks are then filled with the expanding gases. The gases continue to fill and expand the cracks until the gas pressure is too weak to expand the cracks any further, or are vented from the rock.

4.3. Blasting Personnel:

All basting operations shall be conducted by experienced, trained and competent persons who understand the hazards involved. Persons working with explosive materials will:

1. Have demonstrated a knowledge of, and a willingness to comply with, safety and security requirements.
2. Be capable of using mature judgment in all situations.
3. Be of good physical condition and not addicted to intoxicants, narcotics, or other similar type of drugs.
4. The person(s) responsible for the explosives shall possess current knowledge of the local, State and Federal laws and regulations applicable to his work.
5. The person(s) responsible for the explosives shall have obtained a Certificate of Competency or a license as required by State law.

Self-Check – 4	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of explosive?(3pts)
2. List down the four basic effects The energy released by the detonation of explosives produces.(3pts)
3. What does Explosives mean? (2pts)
4. Mention some of the Components of explosive.(2pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 5- Explosives storage and transportation regulations

5.1 Methods of machine safeguarding

While safeguarding the machine the following guidelines are considered:

- An employer and a blaster must ensure that explosives are handled in accordance with the manufacturer's instructions.
- An employer and a blaster must ensure that explosives are protected from impact and rough handling.
- An employer and a blaster must ensure that any equipment used in connection with explosives is used in accordance with the manufacturer's instructions.
- An employer must ensure that no person primes a charge in an area where explosives are stored.
- A person must not prime a charge in an area where explosives are stored.
- An employer must ensure that only tools made of non-sparking material are used to open a container of explosives.
- An employer must ensure that no person carries an explosive in clothing.
- An employer must ensure that explosives are stored only in a magazine licensed in a day box.
- An employer must ensure that an explosive is attended by a designated person, except when it is stored in a locked magazine.
- An employer must ensure that a detonator is not stored in the same day box or magazine as another type of explosive.
- An employer must ensure that a detonator is not placed in the same compartment of a vehicle as another type of explosive, unless the detonator is separated from the other type of explosive by using a day box.
- An employer and a blaster must ensure that no person handles a detonator together with another type of explosive, except when priming a charge.

- A blaster must ensure that an electric detonator is kept shunted or short-circuited, except during the testing or use of the detonator.

5.2 Storage of Explosives:

A person who stores explosives must ensure, so far as is reasonably practicable, that the following issues should be considered. They should be kept **dry**, **clean and free of incompatible materials**. Magazines shall have no openings except for ventilation and entrance. It shall be of masonry or metal construction or a combination of both constructed and maintained as follows

:

a. **Doors** - Doors must be kept closed and securely locked at all times except when opened for the purpose of storing or removing explosives or to allow persons authorized to enter such magazines.

b. **Signs** - explosives are kept or stored must be clearly defined and marked by appropriate signs, such as, “EXPLOSIVE KEEP OFF”, legibly printed there on in letters not less than 15 cm. (6 in.) high. Such signs must not be placed on magazines but shall be so located that a bullets passing through the sign will not strike the magazine.At each end and on top of the magazine, above the side wall and on its barricades, there shall be noticeably posted at all times appropriate, signs, such as, “MAGAZINE EXPLOSIVE-DANGEROUS” legibly printed in letters not less than 15 cm. (6 in.) high.

c. **Locks** - magazines shall be provided with adequate locks.

5.3 Transport of explosives

For the safe and secure transport of explosives all vehicles should adhere to the following general requirements:

- Be in sound mechanical condition and repair.
- Provide adequate segregation of detonators from other explosives.

- All explosives to be transported in a safe and secure manner either in securely attached containers or other fit for purpose means.
- Where packaged explosives may be in contact with interior surfaces, the surfaces should be kept in a clean condition and free from any projections that are likely to cause damage.
- before vehicles are serviced they needs to be thoroughly cleaned, and inspected by a person who has the necessary competence and then certified in writing by that person to be free of explosive residues.

Self-Check – 5	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention some of the a person who stores explosives must ensure?(3pts)
2. What does Magazine mean? (4)
3. What are the general requirements for the safe and secure transport of explosives (3pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 6- Obtaining, confirming and applying work instructions

6.1 Blasting and explosives Work instruction

Work instructions indicate how one or more persons are to act in a given situation or during the performance of an activity. The instructions may be in the form of a text, a checklist, a flow chart, pictures or video.

a. General precautions.

Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution, including warning signals, flags, barricades, or mats to ensure the safety of the general public and workers.

b. Daylight blasting.

Blasting operations, except by special permission of the commissioner, must be conducted during daylight hours.

c. Notice to utilities.

When blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph, and steam utilities, the blaster shall notify the appropriate representatives of these utilities at least 24 hours in advance of blasting, specifying the location and intended time of blasting. Verbal notice must be confirmed with written notice. In an emergency this time limit may be waived by the local authority issuing the original permit.

d. Electricity precautions; incorporation.

Due precautions must be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. These precautions include: A. the suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm; B. the posting of signs that warn

against the use of mobile radio transmitters on roads within 1,000 feet of the blasting operation;

6.2 Blaster requirements:

All explosives work MUST be done under the direct supervision of a **competent**, **qualified** Blaster. Blasting operations will comply with all federal, state and local laws. If there is a conflict then the most rigid law will apply. A person will only be qualified as a blaster or a blaster in charge if:

- Is at least 21 years old
- Has not been previously adjudged to be mentally ill or to be incompetent due any mental disability or disease.
- Has not been convicted of a crime or misdemeanor involving the use of explosives
- Is not addicted to narcotics or intemperate use of alcohol
- Does not have a suspended or revoked license
- Successfully have completed an approved 16 hour training program with subsequent training every two (2) years.

Blasting Operations / Procedure:

- All blasting operations shall be in accordance with OSHA requirements.
- A blaster must be qualified, by reason of training, knowledge, or experience, in the field of transporting, storing, handling and using explosives and must have a working knowledge of the state and local laws and regulations that pertain to explosives.
- Blasters are required to furnish satisfactory evidence of competency in handling explosives and performing in a safe manner the type of blasting that will be required.
- The blaster must be knowledgeable and competent in the use of each type of blasting methods used.
- Procedures that permit safe and efficient loading must be established before loading is started.

- All drill holes must be large enough to enable the cartridges of explosive to be inserted.
- Tamping shall be done only with wood rods or plasticTamping poles without exposed connectors may be used for jointed poles. Violent tamping must be avoided. The primer must never be tamped.
- No holes shall be loaded except those to be detonators must be immediately returned to an authorized magazine.
- Drilling shall not be started are found must be re-fired before work proceeds.
- No person shall be allowed to deepen drill holes that have contained
- No explosives or blasting agents shall be left unattended at the blast site.
- Machines and tools not used for loading holes before explosives are delivered. Equipment must not be operated within 50 ft (15.24 m) of loaded holes.
- Do not use two-way radios and cell phones
- No activity other than loading holes with explosives is permitted in
- Power lines and portable, electric cables for equipment being used must be kept a safe distance from explosives and blasting agents being loaded into drill holes.
- Holes must be checked before loading to determine depth and conditions. There shall be no drilling within 50 ft (15.24 m) of a hole that has been loaded with explosives if the explosives have failed to detonate.
- When more than one loading crew is loading a long line of holes, the crews must be separated by practical distance and have proper supervision.
- No explosive shall be loaded or used
- Warning signs indicating a blast area must be maintained at all approaches to the blast area.
- Drill holes that are not water
- No loaded holes shall be left unattended or unprotected.
- The blaster must keep an accurate, must keep an accurate running inventory of all explosives and blasting agents stored on the operation.

Fig blaster

6.3 Transportation of Explosives:

During transportation of explosives, the following information is important.

- Transportation of explosives shall meet the provisions of Department of Transportation (DOT) regulations.
- Motor vehicles or conveyances transporting explosives shall only be driven by and be in the charge of a licensed driver who is qualified to handle and transport explosive materials. The driver must be familiar with local, state, and federal regulations governing the transportation of explosives.
- No person may smoke or carry matches or any other flame producing device, nor shall fire arms or loaded cartridges be carried while in or near a motor vehicle or conveyance that is transporting explosives.

- Explosives, blasting agents, and blasting supplies must not be transported with other materials or cargoes. Blasting caps (including electric) must not be transported in the same vehicle with other explosives.
- Vehicles used for transporting explosives must be strong enough to carry the load without difficulty and must be in good mechanical condition.
- When explosives are transported by a vehicle with an open body, a Class II magazine or original manufacturer's container must be securely mounted on the bed to contain the cargo.
- All vehicles used for the transportation of explosives must have tight floors. Any exposed spark inside of the body must be covered with wood or other non sparking material to prevent contact with containers of explosives.
- Every motor vehicle or conveyance used for transporting explosives must be marked or placarded on both sides and on the front and rear with the work "explosives" in red letters. The placard must be at least 4 inches (10.16cm) in height with a wither background. In addition, the motor vehicle or conveyance may display a red flag measuring 18 inches (45.72 cm) by 30 inches (76.20 cm) with the work "Explosives" painted, stamped, or sewed on it. The letters must be white and at least 6 inches (15.24 cm) in height, and the flag must be visible from all directions.
- Each vehicle used to transport explosives must be equipped with a fully charged fire extinguisher that is in good condition. An Underwriters Laboratory-approved extinguisher of not less than 10-ABC rating meets the minimum requirement. The driver must be trained in the use of the extinguisher on the vehicle.

Motor vehicles or conveyances carrying explosives, blasting agents, or blasting supplies shall not be taken inside a garage or shop for repairs or servicing.

Self-Check – 6	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the consideration during Transportation of Explosives?(3pts)
2. Mention some of the Blasting Operations / Procedure.(3pts)
3. List down the Blaster requirements? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 7- Identifying, managing and reporting all potential hazards

7.1 Introduction

The blasting process remains a potential source of numerous environmental and safety accidents. The majority of these accidents were contributed to the fly rock and lack of blast area security. The existence of this alteration caused a sliding of rock masses along the subsistent joint planes and there by reduced burden for the second row of blast holes.

7.2 Hazard identification and risk assessment methodology:

All types of industries face certain types of hazards which can disrupt normal activities abruptly.. Risk assessments will help mine operators to identify high, medium and low risk levels. This is a requirement of the Occupational Health and Safety. Risk assessments will help to priorities the risks and provide information on the need to safely control the risks. In this way, mine owners and operators will be able to implement safety improvements.

a. Basic Hazards

An explosive material is capable of releasing mechanical, chemical, or nuclear energy in a sudden and often violent manner that results in the release of high pressures and temperatures.

b. Human Factors

Improper handling of explosive components may not only result in malfunctioning and loss of test data/time, but may cause mishaps that could result in injury, loss of life and/or damage to property. Explosive mishaps resulting in loss of life and damage to property. Inattention to detail, failure to follow written instructions, improper work practices, complacency and poor housekeeping practices are just some of the human factors that contribute to a mishap. Explosives operations must be performed by trained and qualified employees under the supervision of an employee who is trained and

qualified to understand the hazards of the operation. Personnel must be trained to work with explosives and follow written work instructions.

The following natural/industrial problem may be encountered during the mining operation.

- ✓ Flood: Filling of the mine pit due to excessive rains,
- ✓ Blasting- fly rocks and Boulders,
- ✓ Drilling- Noise and Vibration,
- ✓ Handling of overburden and heavy machinery,
- ✓ Storage of diesel,
- ✓ Slope failures at the mine faces or stacks.
- ✓ Premature explosions may cause collapse of walls and roofs on the shot firer.
- ✓ Shot firers may be injured by flying rock or other projectiles.
- ✓ Handling of misfired charges may cause explosions in the immediate vicinity of the shot firer. Accidental detonations may occur during the transportation or handling of explosives.
- ✓ Fumes released in explosions are dangerous to health and in some cases may cause acute poisoning. Walking on uneven terrain and slippery surfaces, or climbing on rocks, may cause slips, trips and falls.

The Nine hazard classes are as follows:

Class 1: Explosives.

Class 2: Gases.

Class 3: Flammable and Combustible Liquids.

Class4: Flammable Solids.

Class 5: Oxidizing Substances, Organic Peroxides.

Class 6: Toxic Substances and Infectious Substances.

Class 7: Radioactive Materials.

Class 8: Corrosives.

Types of hazards:

Physical hazards 	• Sunburns when working under the sun
	• Exposure to excessive noise from mechanical equipment (e.g., drills) and during explosions
	• Exposure to ambient environmental factors (low or high air temperature, rain, snow, wind in the open, damp in mines, etc.
	• Exposure to radon in underground mines, and to radiation (e.g., in uranium or phosphates mining)
Chemical hazards 	• Skin exposure to nitroglycerin, trinitrotoluene, and other explosives and their vapors
	• Poisoning due to inhalation of explosive vapors during handling
	• Exposure to high concentrations of respirable dust in the atmosphere, in particular immediately after the explosions or during demolition work [See Note 1]
	• Poisoning (acute or chronic) due to inhalation of blasting fumes [See Note 2]
	• Asphyxiation as a result of the lowered oxygen content in the air of mines immediately after explosions
	• Irritation of eyes and mucous membranes by blasting fumes
	• Exposure to dust particles during drilling
Biological hazards 	• No specific biological hazards have been identified for shotfirers; however, such hazards may exist in some mines, e.g., because of accumulation of bat droppings in old mines or due to disease borne ticks in caves

Ergonomic, psychosocial and organizational factors 	• Physical strains on the upper and lower extremities due to the handling and moving of heavy loads, in particular on difficult terrain
	• Psychological problems related to prolonged states of anxiety due to work with explosives
	• Hand-arm problems, as a result of exposure to vibrations during drilling

Safety measures for explosives

To prevent hazard, there are several control measures that should be implemented:

- Follow the manufacturer's recommendation for the maximum weight loading for the tube.
- Ensure that excessive tension is not placed on the tube, such as pulling on the signal tube of a primer jammed in a blast hole.
- Avoid or limit vehicles operating on the blast site. When vehicles are on site, personnel should carefully follow procedures when operating vehicles near signal tube.
- Use spotters to assist vehicle drivers manoeuvre on the shot during loading and stemming activities.
- Shot firers should be properly trained, certified and experienced for the job at hand
- Do not smoke and do not allow smoking when working with explosives
- Obey all safety regulations for the storage, transportation and handling of explosives
- Always select and use personal protective equipment appropriate for the job
- Prepare an adequate shelter and use it before an explosion
- Use only wooden rods for tamping; do not tamp too vigorously

- Ensure that there are no stray currents, static electricity, or strong RF radiation sources that could cause a premature explosion
- Ensure that there have been no misfires before restarting work
- Wear clothing appropriate for the weather when working in the open

Self-Check – 7	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the effect of blasting? (3pts)
2. Mention at least five class of hazard. (3pts)
3. How to prevent hazard during blasting?(4)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 8- Identifying explosives and accessories

8.1 Classification of explosive

Detonation occurs when the rate of reaction in the explosive product exceeds the speed of sound (sonic velocity) in the product,

- Thus creating a shockwave.
- Detonation velocities for commercial explosives range from 1,500 to 7,830 m/s, which is much higher than the sonic velocities.

Deflagration is a process where the reaction occurs at rates much lower than the sonic velocity of the explosive material,

- So that no shock (primary pressure wave) is produced within the explosive material.

Explosives are classified in to three depending on degree of explosion as:

- low explosive
- High explosive
- Blasting agent

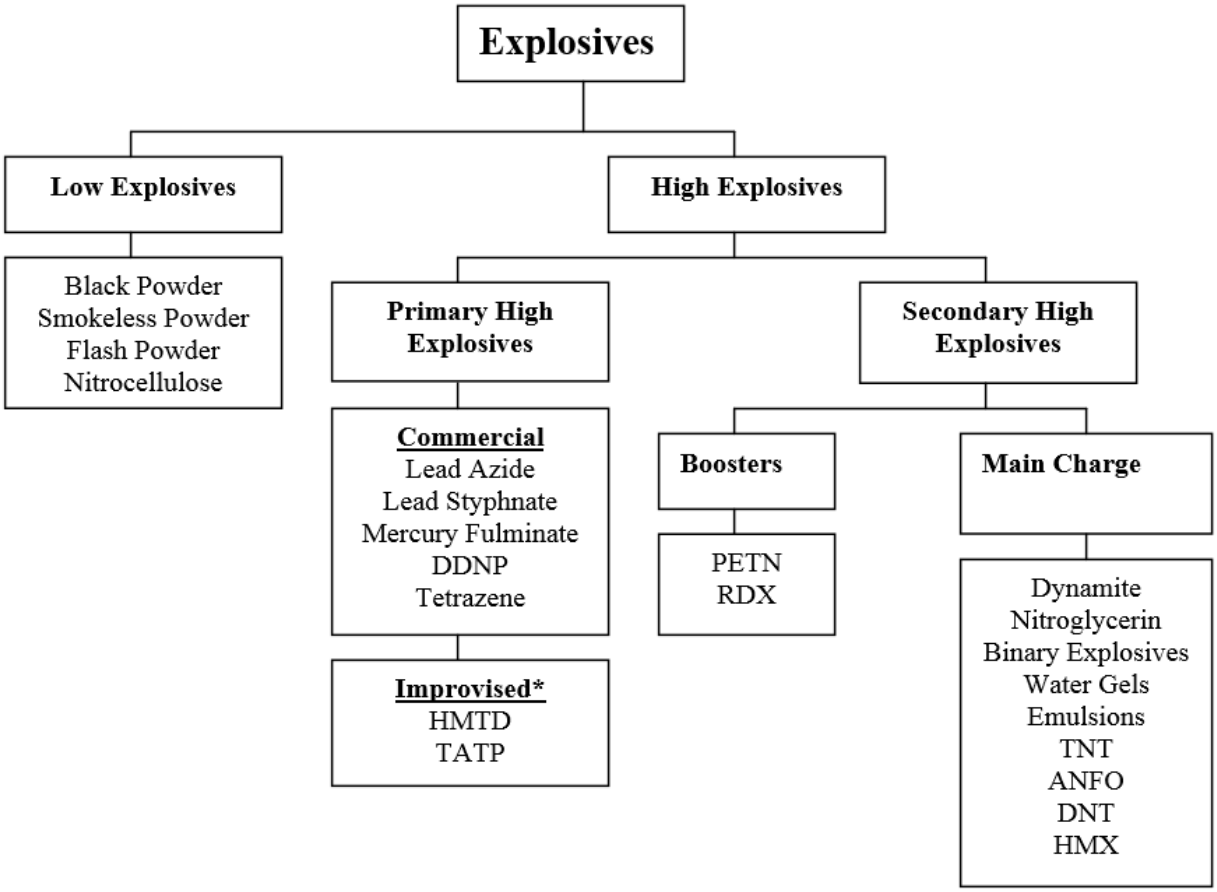


Figure 2–1. Classification of explosives

1. Low explosive

Low explosives deflagrate rather than detonate. Their reaction velocities are 2000 to less than 3000 feet per second. Black powder is a good example. These materials normally have little water resistance, are highly flammable, sensitive to a No. 6 strength blasting cap, and have a heaving action during blasting. Low explosives generally do not fragment rock as well as high explosives.

- Low explosives are explosive materials that can be caused to deflagrate when confined (e.g., black powder, smokeless powder, safety fuses, igniter cords, fuse lighters, and “display fireworks”)
- they simply burn do not explode rapidly
- Designed to burn or deflagrate

- Used for military and civilian applications
- Burning begins at one end of the charge and travels with blinding speed through the entire charge.
- Primarily used as a propellant.
- The distinction between high and low explosives by regulatory authorities closely follows the scientific definition; that is, high explosives detonate and low explosives deflagrate .

2. High explosives

A high explosive is any chemical mixture that detonates with a reaction velocity over 5000 feet per second.

- High explosives Explosive materials that can be caused to detonate by means of a blasting cap when unconfined (e.g., dynamite)
- High explosives are the chemical mixture that can be detonated with a #8 strength blasting cap, and liberates gas, heat and great pressure.
- High explosives are characterized by:

✓ High velocity of detonation (1,500-7,500 m/s).
✓ high pressure shock wave
✓ high density
✓ being cap sensitive

- high explosives are classified in to

1. Primary high explosive
2. Secondary high explosive

The reaction can be initiated by a No. 8 strength blasting cap (i.e., high explosives are

1. **Straight Dynamite** - Nitroglycerin in an absorbent, with velocities between 10,000 and 20,000 feet per second. This dynamite is the most sensitive of all commercial explosives. The weight strength is the actual percentage of nitroglycerin in the cartridge. This explosive has poor fumes, good water resistance, and poor cohesion.

2. **Ammonia Dynamite** - This is similar to straight dynamite except that ammonium and/or sodium nitrate and various carbonaceous fuels are substituted for a portion of the nitroglycerin. There are three subclasses of ammonia dynamite:

High Density*:* This product has a detonation velocity of 8000 to 13,000 feet per second, good water resistance, and fair to good fumes.

Low Density*:* This product has detonation velocities between 7,000 and 11,000 feet per second, fair to good fumes and fair to poor water resistance.

Permissible Types*:* These products are similar to the low- density ammonia dynamites except that they contain cooling salts such as sodium chloride. Permissible must be approved by the U.S. Bureau

of Mines under specified conditions of usage. This material usually has good fumes and fair to poor water resistance.

3. **Gelatin Dynamite** - Contains nitroglycerin gelled with nitrocellulose, and various absorbent filler materials. Forms a soupy to rubber-like mixture which is water-resistant.

(a) ***Straight Gelatin*** - Has a detonation velocity of 13,000 to 23,000 feet per second. Varieties with strength rating above 60 percent have poor fume characteristics. Water resistance is excellent and material is very cohesive.

(b) ***Ammonia or Special Gelatins*** - Similar in composition to straight gelatin except that some of the nitroglycerin is replaced with ammonium and sodium nitrates and carbonaceous fuels. Has a detonation velocity between 10,000 and 23,000 feet per second. Water resistance is good.

4. **Semi-gelatin Dynamite** - A combination of ammonia gelatin and ammonia dynamite, with lower strength than gelatin, yet has good water resistance. Velocities between 10,000 and 15,000 feet per second.

PETN-PETN (penta erythritol tetra nitrate) has a crystal density of 1.76 g/cc and a confined detonation velocity of over 25,000 fps. In various degrees of granulation it is used as a priming composition in detonatators, a base charge in blasting caps, a core load for detonating cord, and in the manufacturer of pentolite. PETN is a secondary explosive and as such is not as sensitive as primary explosives such as lead azide. Cast primers of PETN are also supplied as shaped charges.

RDX - RDX (cyclo tri methylene tri nitramine) is second in strength to nitroglycerin among common explosives substances. When compressed to a density of 1.70, it has a confined detonation velocity of 27,000 fps. RDX is a primary ingredient in composition B. Plasticity and high detonation velocity make it ideal in shaped charges for oil well perforators (jet perforators) and furnace papers jet tappers. **RDX** is sometimes the base charge for detonators.

Composition B - Composition B is a mixture of RDX and TNT with one to four percent wax added. When cast, it has a density of 1.65 and a detonation velocity of about 25,000 fps. Like pentolite, composition B is used in the cast form as a primer and booster for blasting agents.

Pentolite - Pentolite is a mixture of PETN and TNT. The percentage of PETN can be from 20 percent to 50 percent, with the remainder being TNT. It was originally used for booster charges in military explosives devices and is now used for commercial boosters.

3. Blasting agents:

- Blasting agents Materials that can be detonated but are not a detonator (e.g., ANFO and certain water gels)
- These explosive products have relatively lower sensitivity than other high explosives.
- This classification includes any mixture consisting of an Oxidiser and a fuel which is intended for blasting.
- The final mixed product cannot be detonated by a No. 8 strength blasting cap when unconfined.
- Blasting agents are explosive products that cannot be detonated by a Number 8 blasting cap.

Number 8 blasting cap is defined as one having 0.4 to 0.45 PETN (Penta Erythritol tetra nitrate) base charge. Blasting agents are not “cap sensitive.”

Blasting agents includes any mixture consisting of an Oxidizer and a fuel which is intended for blasting. The final mixed product cannot be detonated byaNo.8 strength

blasting cap when unconfined.external impulse, such as spark, impact, or heating, liberating great quantities of heat and gases.

Self-Check – 8	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are The most important characteristics of an explosive?(3pts)
2. Mention the characteristics' of high explosive.(3pts)
3. What does blasting agent mean? (4 pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 9- Applying safe handling procedures and precautions

9.1 Handling, storage and use of explosives

Explosives may be handled only by a person experienced in the use of explosives or by an employee who is at least 18 years of age and is supervised by a person experienced in the use of explosives. Explosives are to be handled in a manner that prevents operations that could lead to ignition or initiation of explosives. Mishandling of explosives such as throwing of primers can result in ignition caused by impact with the ground.

- Only authorized and qualified employees shall be permitted to handle explosives.
- Smoking, firearms, matches, open flame lamps, and other open flame or heat producing devices and sparks shall be prohibited in or near explosive magazines of while explosives are being handled, or transported, or used.
- No person should be allowed to handle of use explosives while under the use of intoxicating liquors, narcotics, or other dangerous drugs.
- All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not authorized to handle them. Only designated and licensed employees shall maintain an inventory and use record of all explosives. Appropriate authorities shall be notified of any loss, theft, or unauthorized entry into a magazine.
- No explosives or blasting agents shall be abandoned.
- No fire shall be fought where the fire is in eminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area guarded against intruder
- Original containers, or Class II magazines, shall be used for taking detonators and other explosives from storage magazines to the blasting area.
- Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning,

adjacent power lines, dust storms, or other sources of extraneous electricity. These precautions shall include:

- ✓ Detonators shall be short-circuited in which holes have been primed and
- ✓ Shunted until wired into the blasting circuit.

9.2 Handling and storage of explosives materials

While handling explosive materials , use the following general procedures:

1. Follow the OHS procedures for handling of explosives.
2. Must have EMPTY signs when no explosives are present.
3. Must be of wood construction and covered with 20 gauge steel plate.
4. Covers must be substantial and constructed so it can be locked.
5. Must be painted red and marked in white, "EXPLOSIVES - KEEP FIRE AWAY."
6. Designed to prevent leakage.
7. Marked with the Hazard Class/Division or type of explosives or hazard stored inside.
8. Portable storage magazines must be kept locked except when materials are added to or removed from storage or when other approved and adequately supervised operations are in progress.
9. Only the minimum amount of explosives required for the current operation may be kept in an explosives operating area.
10. Only the minimum amount of explosives required to accomplish the mission may be kept in a licensed location.

Self-Check –9	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Is that possible to handle explosive by any person? (3pts)
2. Mention the methodology of explosive storage. (3pts)
3. How can handle explosive materials? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

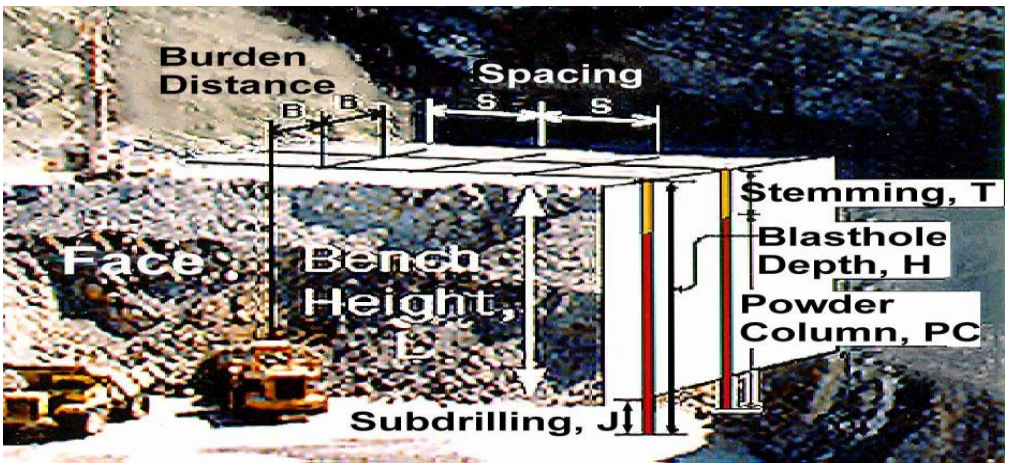
Rating: _____

Information Sheet 10- Applying mathematical calculations

10.1 Blasting calculations:

Blasting design parameters

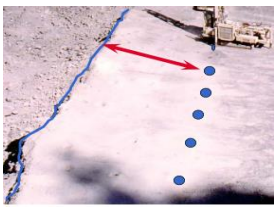
1. **Drilled burden (B) -** is defined as the distance between the individual rows of holes. It is also used to describe the distance from the front row of holes to the free face. When the bench face is not vertical the burden on this front row of holes varies from crest to toe.
2. **Spacing (S) -** is the distance between holes in any given row**.**
3. **Sub grade (J) -** Generally the holes are drilled below the desired final grade. This distance is referred to as the sub grade drilling or simply the sub-drill.
4. **Stemming (T) -** A certain length of hole near the collar is left uncharged. This will be referred to as the stemming length (T) whether or not it is left unfilled or filled with drill cuttings/crushed rock.
5. **Bench height (H) –** is the vertical height from the toe to the crest.
6. **Drilled length (L) -** is equal to the bench height plus the sub-drill.
7. **Length of the explosive column (L)** - is equal to the hole length minus the stemming. This column may be divided into sections (decks) containing explosives of various strengths separated by lengths of stemming materials.



BURDEN:

Burden distance is the most critical dimension in blast design. It is the distance to the free face of the excavation. An empirical formula for approximating a burden distance to be used on a first trial shot is

$$B = \left(\frac{2SG_e}{SG_r} + 1.5 \right) D_e$$



Where

- B = burden, ft
- SG_e = specific gravity of the explosive
- SG_r = specific gravity of the rock

D_e = diameter of the explosive, in.

Example 1: A contractor plans to use dynamite that has specific gravity of 1.3 to open an excavation in granite rock. The drilling equipment available will drill a 3-in blast hole. Dynamite comes packaged in 2 3/4-in diameter sticks. What is the recommended burden distance for the first trial shot?

Given Required

Granite SG= 2.6 to 2.9 Burden=?

Specific gravity of dynamite=1.3

- Diameter of the explosive= 2 ¾ inch

Specific gravity granite= 2.6+2.9/2=2.8 from table

Solution

B= (2SGe/SGr + 1.5) De

= (2*1.3/2.8 +1.5)2.75 = 6.7 ft

- **The burden distance, *B*, based on relative bulk energy is given by**

$$B = 0.67 D_e \sqrt[3]{\frac{St_v}{SG_r}}$$

Where SG_r = specific gravity of the rock

D_e = diameter of the explosive, in. St_v = relative bulk strength compared to ANFO.

8. Stemming

Stemming is the adding of an inert material, such as drill cuttings, on top of the explosive in a blast hole for the purpose of confining the energy of the explosive. To function properly, the stemming material should have an average diameter 0.05 times the diameter of the hole and should be angular.

If the stemming distance is too great, there will be poor top breakage from the explosion and back break will increase.

9. Sub drilling

When the stemming distance is inadequate, the explosion will escape prematurely from the hole.

- Under normal conditions, properly designed burden and explosive, and good stemming material, a stemming distance, T, of 0.7 times the burden distance, B, will be satisfactory.

  $T = 0.7 \times B$

- A shot will normally not break to the very bottom of the blast hole.
- To achieve a specified grade, one will need to drill below the desired floor elevation. This portion of the blast hole below the desired final grade is termed "sub drilling."
- The sub drilling distance, J, required can be approximated by the following formula:

  $J = 0.3 \times B$

- Sub drilling represents the depth required for explosive placement, not a field drilling depth.

10. Blast hole size

- The size (diameter) of the blast hole will affect blast considerations concerning fragmentation, air blast, fly rock, and ground vibration.
- The economics of drilling is the second consideration in determining blast hole size.
- Larger holes are usually more economical to drill but they introduce possible blast problems.

- Once again, the second mechanism of rupture and the stiffness ratio (SR) need to be considered.
- The **stiffness ratio (SR)** for blasting purposes is the bench height (*L*) divided by the burden distance (*B*). *SR* = L/B=bench height/burden.
  - ❑ SR affects several critical blasting considerations. Like:
  - ✓ Fragmentation,
  - ✓ Air blast,
  - ✓ Fly rock,
  - ✓ Ground vibration.

SPACING:

- ❑ Spacing is controlled by initiation timing and stiffness ratio.
- Instantaneous initiation: SR greater than 1 but less than 4
- Instantaneous initiation: SR equal to or greater than 4
- Delayed initiation: SR greater than 1 but less than 4
- Delayed initiation: SR equal to or greater than 4

❑ An *SR* of less than 4 is considered a low bench and a high bench is a *SR* value of 4 or greater. This means that there are four cases to be considered:

1, Instantaneous initiation with the SR greater than 1 but less than 4.

$S = (L + 2B)/3$

2 , Instantaneous initiation, with the SR equal to or greater than 4

S=2B

3, Delayed initiation, with the SR greater than 1 but less than 4.

S= (L+7B)/8

4, Delayed initiation, with the SR equal to or greater than 4.

S = 1.4B

Example 2: A project in granite rock will have an average bench height of 20 ft. An explosive having a specific gravity of 1.2 has been proposed. The contractor's equipment can easily drill 3-in diameter holes. Assume the packaged diameter of the explosives will be 2.5 in. Delay blasting techniques will be used. Develop a blast design for the project.

Given:

- Specific Gravity of Granite is 2.6+2.9/2=2.75
- Bench height =20 ft ,
- specific gravity of explosive=1.2
- diameter of hole=3 in,
- diameter of explosive=2.5 in and Delay blasting techniques

Required: Develop a blast design for the project

B= (2SGe/SGr+1.5) De = (2*1.2/2.75 +1.5)*2.5=5.93ft

Hence, use 6 in for the burden distance B

SR=L/B=20/6=3.3 good (according to Table)

- The stemming depth (T) = 0.7 × B = 0.7(6) = 4.2 ft Use 4 ft for the stemming depth, T.
- The sub drilling (J) = 0.3× B = 0.3(6) = 1.8 ft Use 2 ft for sub drilling depth, J
- 1 < SR < 4 and delayed initiation ⇒S= (L+7B)/8 =(20+7*6)/8=7.75 ft

Range = 7.75 ± 0.15(7.75) : S = 6.6 to 8.9 ft

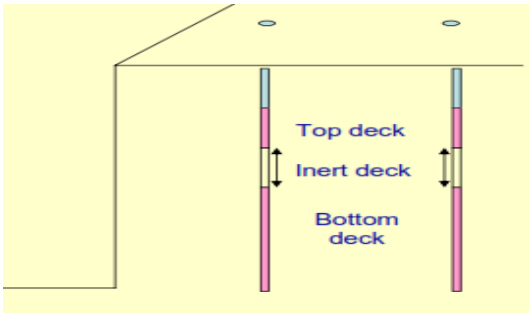
- As a first trial, use a 6-ft burden X 8-ft spacing pattern

11. decking:

Decking is the separation of the explosives column in a blast hole into two or more parts with stemming between them. The thickness of the deck material should be 6 times the hole diameter for dry holes and 12 times the hole diameter for wet holes.

Decks are used for the following reasons:

- ✓ To lower the powder factor
- ✓ To reduce the amount of explosives detonated per delay
- ✓ To reduce the amount of explosive in the hole.
- ✓ To avoid loading a weak seam or to bypass a void in the rock



Powder column and powder factor

The amount of explosive required to fracture a cubic yard of rock is a measure of economy of blast design.

1) **Powder column**

Powder column length is the blast hole depth minus the stemming depth.

- ✓ Blast hole depth = bench height + sub drilling
- ✓ Powder column = blast hole depth – stemming
- ✓ The powder column length is the total hole length less stemming" that is
- ✓ Powder Length = L + J – T

2) **powder factor**

"The powder factor is the ratio of the total weight (lb)of explosive in powder column length to the total volume (cu yd) of rock fractured by one blast hole under the pattern area to a depth of bench depth equal L" that is:

Powder Factor=Total Weight (lb) of Powder Column Length/Total Volume under Pattern Area (cu yd)

Means that the powder factor for a single borehole is calculated as:

$$PF = \frac{PC \times (0.34\,\rho) \times d^2}{B \times S \times H/27}$$

Example3; calculate the powder column length, the total weight of explosive used per blast hole, and the powder factor.

Where L = 20 ft, J = 4 ft, and T = 4 ft, Pattern = 6 X 8

Specific Gravity of Explosive = 1.2, Explosive diameter = 2.5

- From Table: Loading Density = 2.55 lb per ft

Solution

- Powder Column Length = (L + J) − T = 20 + 2 − 4 = 18 ft
- The Total Weight of Explosive per Column = 18× 2.55 = 45.9 lb

Powder Factor=total weight of the explosive per hole/ Volume of Rock Fractured under Pattern Area

=45.9/(6*8*20)/27=1.29

Self-Check –10	**Written test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the difference between spacing and burden?(3pts)
2. Mention the parameters for Blast design .(3pts)
3. What does powder factor mean? (4)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

LG #33	LO #2- Access and manage explosives storage

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Gaining access to magazine as authorized person
- Maintaining compliance requirements for signage, construction, safety and security of magazines
- Receiving and dispatching explosives
- Keeping apart blasting agents and explosives
- Preventing deterioration, spoilage and spillage of explosives
- Ensuring rotation of explosives in magazine
- Maintaining stock records
- Conducting housekeeping of magazine continuously
- Completing all required documentation in standard format
- Passing information regarding explosives stock and storage

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Gain access to magazine as authorized person
- Maintain compliance requirements for signage, construction, safety and security of magazines
- Receive and dispatching explosives
- Keep apart blasting agents and explosives
- Prevent deterioration, spoilage and spillage of explosives
- Ensure rotation of explosives in magazine

- Maintain stock records
- Conduct housekeeping of magazine continuously
- Complete all required documentation in standard format
- Pass information regarding explosives stock and storage

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, see your trainer for further instructions

Information Sheet 1- Gaining access to magazine as authorized person

1.1 Gaining Access to Magazine:

Magazine shall mean a building or structure, other than factory building, used exclusively for the storage of explosives. The person appointed in charge of the magazine is obligated to ensure that only authorized persons have access to the magazine. The person needs to also ensure that the magazine is secured at all times and the magazine key is in the care of an authorized person or locked in a secure location. Factory or Explosive Building shall mean a building or structure (except magazines) in which explosives are manufactured or any process involving explosives are carried on.

1.1.1 Access to observing blasts

Authorized person means – a person (in addition to the authority holder) who is named in the security plan and authorized under that plan to have unsupervised access. This person will have successfully undergone police national criminal history checks (NCHC) and politically motivated violence (PMV) checking.

- ✓ No untrained/unauthorized persons shall be allowed in active loading or blasting areas without permission and guide from the Blast Foreman, Lead blaster or designee.
- ✓ An employer must designate all persons who are authorized by the employer to have access to explosives.
- ✓ An employer must ensure that only persons designated by the employer have access to explosive

- ✓ All persons requesting to observe any blast must obtain permission and clearance from the Blast Foreman, lead blaster or designee.
- ✓ Blasts will only be observed from locations permitted / designated by the Blast Foreman.

- ✓ Observers must have a means of communication with the Blast Foreman.
- ✓ Photographing / filming blasts must be approved by Blast Foreman and General Mine Foreman.
- ✓ Observers will be required to understand blast procedures and comply with all procedures.
- ✓ No observer shall be allowed inside cleared / blocked areas without permission from the Blast Foreman, lead blaster or designee.

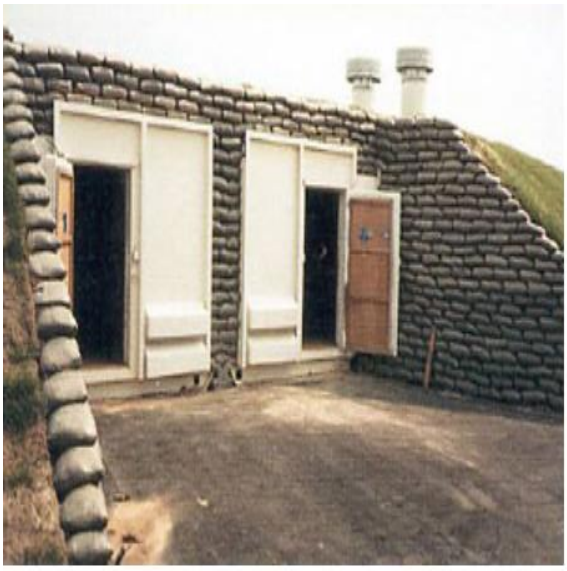


Fig 1: explosive storage

1.1.2 Authorized personnel

Only authorized personnel will be permitted to enter the magazine and explosives storage areas. Every person required to transport or handle explosives should be authorized.

The following are the type of personnel who will be permitted to enter the magazine and explosive storage areas: Authorised person Includes:

- shot firers, magazine keepers, drillers

- drivers, miners, visitors, trainees or apprentices, inspectors
- maintenance staff
- management
- service personnel
- supervisors, surveyors
- Explosive contractor employees;
- Appointed blasters

✓ Personnel involved in manufacturing explosives

✓ Personnel required for explosive delivery

✓ Personnel involved in site maintenance Blasting assistants;

- Security guards (external area only, no magazine access);
- Mine Manager;
- Mines or explosives inspectors; and

Authorization: Training is critical to the miners who do blasting.

➢ Explosives shall be manufactured, handled or stored only in approved places.

➢ Building authorized for use in the manufacture of explosives shall not be used for any other purpose.

➢ Specially approved precautions shall be undertaken where primary or initiating explosives are manufactured, handled or stored in addition to the precautions.

Blasting safety demands the highest level of attention among employees working in metal and nonmetal mining. All mine operators, independent contractors and miners must follow strict explosives safety procedures to prevent fatalities.

Self-Check – 1	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements of gaining accesses to magazine as authorized person? (3pts)
2. Mention the type of personnel who will be permitted to enter the magazine and explosive storage areas. (3pts)
3. What does authorized personnel mean? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 2- Maintaining compliance requirements for signage, construction, safety and security of magazines

2.1 Maintaining magazine:

An employer must ensure all of the following conditions **:**

- Magazine is kept in good repair;
- Magazine is kept clean;
- Magazine is decontaminated as necessary;
- Magazine is kept organized to allow explosives to be easily selected, issued and inventoried;
- Uncovered boxes, loose cartridges, loose spools and loose detonators are not kept in a magazine;
- Cases of explosives in a magazine are not piled higher than allowed by the magazine licenses and
- The quantity of explosives stored in a magazine does not exceed the amount allowed by the magazine license.

2.1.1 Security of magazines:

When siting the magazine, do not make it easy for unauthorized personnel to locate or access the magazine. If possible it should be located on site in a position that is not viewable from outside the mine or quarry. Adequate security installations should be in place to prevent accidental or un authorized disclosure of the magazine location.

a. Remote Security To enhance the security of a surface magazine consideration can be given to incorporating either a camera or alarm system with the required door and locking devices. All alarm and camera fittings and installations inside the

explosive storage area are required to comply with AS 3000 for electrical equipment in hazardous locations.

b. Locking devices every magazine needs to be fitted with a six level 'safe lock'. Where a padlock is used it shall have a hardened shackle and pad constructed to provide a high level of resistance to fracture and rupture.

Figure 1: Relocatable magazine fixed to prevent unauthorized removal.

2.1.2 Construction and Maintenance:

- ✓ All buildings, permanent or temporary shall be structurally safe and sound to prevent their collapse.
- ✓ Roof shall be of sufficient strength to withstand normal load, typhoons and strong winds in addition to normal weather conditions and where required to carry suspended loads.

- ✓ Foundations and floors shall be of sufficient strength to sustain safely the loads for which they are designed and under no condition shall they be overloaded.
- ✓ Plans for proposed new construction and alterations or substantial repairs of buildings shall be submitted to the Building Official for examination and approval.

2.1.3 Types of magazines:

There are five types of magazines. These types, together with the classes of Explosive materials, which will be stored in them, are as follows:

Type 1 Magazines - Permanent magazines for the storage of high explosives, other classes of explosive materials may also be stored in type l magazines.

Type 2 Magazines - Mobile and portable indoor and outdoor magazines for the storage of high explosives. Other classes of explosive materials may also be stored in type 2 magazines.

Type 3 Magazines - Portable outdoor magazines for the temporary storage of high explosives while attended

(For example, a “day-box”), other classes of explosive materials may also be stored in type 3 magazines.

Type 4 Magazines - Magazines for the storage of low explosives, Blasting agents may be stored in type 4 magazines,

Type 5 Magazines - Magazines for the storage of blasting agents.

2.2 Signs of workplace

Common signage that you will come across in the workplace is based around safety and risk. When moving around your work site you need to be aware of the specific rules regarding plant and equipment, pedestrians, signage and devices and no go zones. Become familiar with the main locations, access routes and especially restricted zones, the Traffic Management Plan will identify these areas.

These sign are colour coded and many are stylized so they are recognizable.

- ➢ Check site plans for
  - First aid kits
  - Spill kits

- Parking
- Firefighting equipment
- Emergency exits
- Maintenance areas
- Restricted areas

Please see below some categories and examples of signage

Fig:

Fig: warning

Fig: Prohibitory

Fig:Dangerous goods

Fig: first Aid

Fig: fire related

Fig:Exits

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of safety sign? (3pts)
2. Mention the types of Magazine.(4pts)
3. List down some of the safety sign. (3pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Receiving and dispatching explosives

3.1 Introduction:

Receiving goods from suppliers is a fundamental part of retailing. Due to the potential financial losses that can result, it is critical that staff follow the related procedures to ensure that this is done effectively.

While different procedures apply to different merchandise, the following are typical receiving and dispatch procedures.

3.2 Manage the receipt of explosive substances and/or articles

While receiving and managing use the following as guide lines:

- work safely at all times, complying with Health & Safety, environmental and other relevant regulations, Legislation and guidelines.
- ensure that the receipt function complies with the organizational explosive safety and security management systems
- confirm that your organization can receive the incoming explosive substances and/or articles
- identify the storage requirements for the nature and quantities of explosive substances and/or
- articles to be received
- allocate storage in accordance with the storage strategy
- allocate appropriate resources to tasks
- ensure that systems are in place that result in the prompt notification of any discrepancies and
- delivery problems
- ensure that the receipt is completed within agreed timescales
- carry out regular reviews of the storage plan to ensure continuing optimized use of the storage facility
- respond to developing events and priorities in accordance with procedures

- develop and communicate an appropriate storage contingency plan
- maintain accurate records, in accordance with organizational procedures

3.3 Receiving Goods

While receiving goods/explosives in this case confirm the following general check points:

1. Goods are for your store
2. Goods have been ordered
3. Goods received agree with order and invoice quantity, description and quality.
4. Goods are not signed for before they are thoroughly checked
5. If invoice is not received with goods, there must be provision to process it in the correct manner when it is received
6. Goods are correctly ticketed and immediately placed on the selling floor
7. Pre-sold goods allocated for earliest possible delivery
8. Damaged or incorrect goods are rejected and arrangements made for immediate repair or replacement - delivery slip marked accordingly
9. Stock held in reserve promptly ticketed after inspection and carefully stored
10. Reserves are organized so that oldest items will be drawn first for the selling floor or for delivery.
11. Daily goods received record kept and processed with all relevant invoices and /or delivery dockets.
12. Receiving area kept clear at all times.

3.4 Dispatching goods

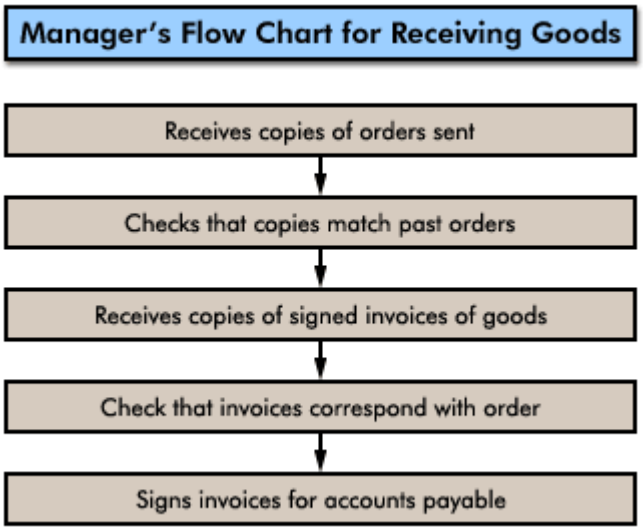
While dispatching follow the following procedures:

1. Dispatch person alert to false or incorrect paperwork
2. Ensure customers are notified of impending delivery - address checked and any money collected carefully documented so driver cannot overlook it
3. Double check goods to be delivered are correct in quantity, description and quality
4. Damaged goods not dispatched unless agreement from customer
5. Regularly check loaded vehicles to ensure packing is

satisfactory and only the items to be delivered are in the vehicle

6. Ensure you are satisfied with the appearance of the vehicle and the driver - they create a lasting impression
7. Maintain daily goods delivered records - ensure drivers sign for goods in good order and condition
8. All paperwork processed promptly.

It is the manager's responsibility to ensure that every one adheres to the receiving and dispatching procedures. The process involved in receiving goods will vary from store to store.



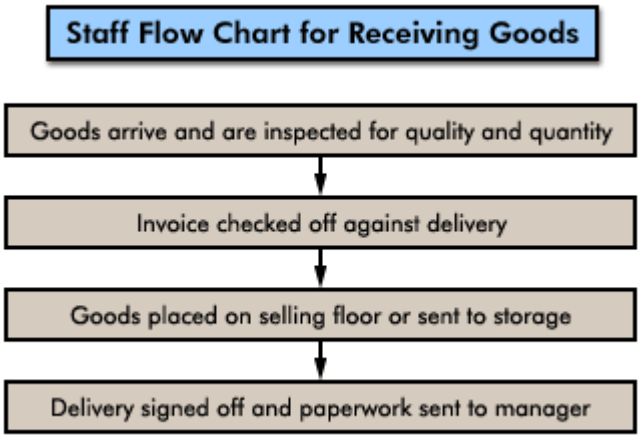


Fig: flow chart for receiving goods

If a discrepancy appears, talk to staff and find out what procedure is being used. Then either accept it, or modify the procedure to reflect the store policy. The key to effective inventory control is that the manager has a full understanding of what the staff are doing.

3.5 Threat Receipt and Forwarding:

Receiving the Information: Members receiving explosive-device threats shall obtain the following information, when available:

1. Where the threat was received (whether received by a Department member to or at another location);?
2. How threat was received (letter, phone call, etc.);?
3. As much investigative information as possible, including:
    - Location, type, size, composition and description of device;
    - Time/date of detonation;
    - Offender?s motive and/or group association.
    - Specificity (of the threat):?

Members who receive explosive device threats (or complaints of threats) shall pay particular attention to the specificity of the threat.

Communications Center Responsibilities

After Communications personnel receive a complaint of an explosive device, they shall dispatch an officer and a supervisor to the identified location.

a. **Providing Information:** Communications shall provide the responding units with the following information, at a minimum:

   - Location of complainant, if known;
   - Targeted location / location of suspected explosive device;
   - Type of suspected explosive device, if known;
   - Time threat was received, and time the device is to detonate, if known;
   - Actions taken by on-scene personnel, if known (if they initiated searches, evacuations, etc.)
   - Notification and/or response of other agency support.

b. **Notification:** Communications personnel shall immediately notify the on-duty shift commander.

Self-Check – 3	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the difference between receiving and dispatching goods? (3pts)
2. Mention some of the dispatching goods.(3pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____
Rating: _____

Information Sheet 4- Keeping apart blasting agents and explosives

3.1 Introduction:

Blasting agents are explosive materials or mixtures which are not detonatable by standard #8 caps. The best known blasting agent is **ammonium nitrate fuel oil** (ANFO) explosive, a mixture containing primarily ammonium nitrate with a small quantity (typically around 6%) of fuel oil, most commonly diesel fuel. Other fuels and additives are used as well. While ANFO is often made on-site using fertilizer grade ammonium nitrate, blasting agents can also be purchased in prepackaged form, usually in metal or cardboard cylinders. Some brand names of packaged blasting agents include:

- Nitramon
- Nitramite
- Pellite
- Carbomite
- Vibronite
- Dynatex
- Hydratol
- Anoil

3.2 Blasting agents

- Blasting agents Materials that can be detonated but are not a detonator (e.g., ANFO and certain water gels)
- These explosive products have relatively lower sensitivity than other high explosives.
- This classification includes any mixture consisting of an Oxidiser and a fuel which is intended for blasting.

- The final mixed product cannot be detonated by a No. 8 strength blasting cap when unconfined.
- Blasting agents are explosive products that cannot be detonated by a Number 8 blasting cap. Number 8 blasting cap is defined as one having 0.4 to 0.45 PETN (Penta Erythritol tetra nitrate) base charge. Blasting agents are not “cap sensitive.”

3.3 Storage of explosives and blasting agents

1. Explosives and related materials shall be stored in approved facilities.
2. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the magazine with other explosives or blasting caps.
3. Smoking and open flames shall not be permitted within 50 feet of explosives and detonator storage magazine
4. No explosives or blasting agents shall be permanently stored in any underground operation until the operation has been developed to the point where at least two modes of exit have been provided
5. Permanent underground storage magazines shall be at least 300 feet from any shaft, or active underground working area
6. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.

Fig1: blasting

A booster for detonating cap-insensitive explosives is provided comprising a container having a main body portion and a neck portion of smaller cross-sectional area than the main body portion and having an opening in the neck portion for introduction of a detonating-fuse-insensitive explosive charge which fills the main body portion, and a detonating-fuse sensitive explosive charge which fills the neck portion. The booster of the present invention is conveniently prepared and handled or loaded and has inherent water-resistance even though not necessarily water-proof and though inexpensive water-soluble explosive ingredients may be employed.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. How can Store explosives and blasting agents?(3pts)
2. Mention some of the blasting agent.(3pts)
3. What does blasting agent mean? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 5- Preventing deterioration, spoilage and spillage of explosives

5.1 Methods of disposal

‘**Disposal of explosives** means their destruction or exposé them permanently explosively inert, or their safe and legal transfer to a competent person. The method used will depend on the nature of the explosive and its hazards, and the type and position of the disposal site.

There are five main methods for the safe disposal or destruction of explosives:

- functioning in the design mode
- burning
- detonation
- dissolving or diluting by a solvent or
- chemical destruction (including bioremediation)

Sea dumping and burial are not suitable methods for disposal and are not generally considered as being safe ways to discard explosives, as they will not generally destroy the explosives or render them harmless. Identification of the most suitable disposal method needs to consider the nature of the explosive and its hazards, and any hazards associated with the disposal method or created during the disposal process. The nature and position of any disposal site should also be considered as part of the identification of the most suitable method.

Anyone disposing of explosives should be aware that they have duties to do so in a way that is not harmful to the environment:

- When explosive materials are discontinued every effort should be made to return to manufacturer or supplier.
- Outdated or discontinued explosives shall be disposed of in accordance to Federal, State, and Local Regulations on an active blast.
- Determination of amount and location of disposal shall be made by the Blast Foreman and Mine General Foreman.

- Entry shall be made on the Blast report indicating number and type of explosives disposed of and reason.
- The blast report will be signed by the Lead Blaster/Blaster and kept on file.

5.2 Destroying explosives

A person who holds a license authorizing the storage of explosives must ensure that any Damaged or defective package of explosives in storage is removed and the explosives are repacked and returned to the storage as soon as possible after discovery of the damage or defect.

A person who stores detonators

- Must not store them in the storage with any other types of explosives; and
- Must, if they are stored in a receptacle, ensure that the receptacle is separated from any other types of explosives in the storage or any other receptacle containing explosives by a partition or an intervening space sufficient to prevent a sympathetic detonation.

Explosives that are considered unsafe for normal transport, storage, or use shall be destroyed. Disposal shall be carried out under the control of a competent person and in accordance with procedures based on advice from the manufacturer or supplier, advice from the Department of Labour, and in accordance with applicable environmental legislation. Explosives shall not be abandoned, thrown away, or buried, or discarded with rubbish. Before destroying explosive an exclusion zone shall be established and made secure. Records shall be kept of the quantities and types of explosives destroyed and the destruction method used. The residue from explosives destroyed by burning may be poisonous to animals. It shall be buried or otherwise disposed of in accordance with applicable environmental legislation. An employer must ensure that waste, deteriorated, damaged or time-expired explosives are destroyed promptly and in accordance with the manufacturer's instructions.

An employer must ensure that explosives are destroyed by 1 of the following:

- a blaster;
- a representative of the manufacturer of the explosive;

- a qualified member Police, the Department of National Defence, or a local police force.

Explosives, and explosive contaminated items, must be discarded and disposed of safely.

The guidance is aimed at those responsible for:

- managing the disposal and destruction of explosives
- Planning and implementing disposal activities.

It is also aimed at professional explosive users, such as:

- fireworks display operators
- demolition operators
- shot firers

The guidance will also be of interest to duty holders, regulatory authorities, the emergency services and others who may be called upon to manage the disposal of explosives or explosives contaminated waste such as:

- the police
- the Fire and Rescue Service
- trading Standards officers
- Coastguard
- waste disposal operators

5.2.1 Problems associated with disposal of explosives

One of the main causes of accidents in the explosives industry is the disposal of explosives waste.

The risks associated with disposal of explosives waste means that incidents often lead to injuries or fatalities.

Accidents can be avoided by:

- a better appreciation of the properties and behaviour of explosives under certain conditions – explosives earmarked for destruction may be unusually unstable due to deterioration
- drawing up properly considered systems of work, with appropriate safety precautions

5.2.2 Disposal of Explosives

Explosives and explosive materials can be disposed of by burning, detonation, dissolution in water or solvent, or by chemical destruction. The selected disposal method will depend on the type of explosive, quantity, condition, and specifications from the manufacturer. All destruction of explosives will be carried out by licensed blasting personnel. Destruction of large quantities of explosives will be carried out at a designated location at least 500 m from any building that could be damaged by the detonation. Personnel and other property damage will be avoided by sheltering the detonation area. Small quantities of explosives may be added to production charges in blast-holes for destruction. Blasting personnel will adhere to the following procedures:

- Only a licensed person, or a person under the supervision of a licensed person, is allowed to dispose of or destroy explosives.
- Use a method of disposal that provides the greatest degree of safety to humans and protection of property and the environment. Take adequate precautions to protect against injury or damage to property.
- Ensure that the method of disposal is appropriate to the type and condition of explosives.
- Follow recommended disposal method indicated by manufacturer or responsible authorities.
- Unused explosives and explosive waste must be removed and disposed of under the supervision of or by the blasting contractor.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements Anyone disposing of explosives should be aware?(3pts)
2. Mention some of the methods for the safe disposal or destruction of explosives.(3pts)
3. What are the problems associated with disposal of explosives?(4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 6- Ensuring rotation of explosives in magazine

6.1 Rotation of Stock:

The person appointed in charge of the magazine needs to ensure that the explosives stock is rotated on a regular basis and that the explosives are within the expiration dates indicated by the manufacturer. Explosives that are more than one year old should not be used without first contacting the explosives manufacturer.

Figure 1: Explosives stacked with their labeling towards the access way for easy identification.

6.2 Classes of explosive materials:

There are three classes of explosive materials. These classes, together with the description of explosive materials comprising each class, are as follows:

- **High Explosives** - Explosive materials which can be caused to detonate by means of a blasting cap when unconfined, (for example, dynamite, emulsions, water gels, flash powders, and bulk solutes).
- **Low Explosives** - Explosive materials which can be caused to deflagrate when confined, (for example, black powder, safety fuses, and ignitor cords, fuse lighters, and “special fireworks”.
- **Blasting Agents** - (For example, ammonium nitrate-fuel oil and certain water gel.

6.3 Movement of explosive materials

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

- In the process of manufacture;
- Being physically handled in the operating process of a licensee or user;
- Being used; or
- Being transported to a place of storage or use

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for rotation of explosives in magazine?(3pts)
2. Mention three classes of explosive materials.(3pts)
3. List some types of Low Explosives**.** (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 7- Maintaining stock records

7.1 Maintaining stock records

The person appointed in charge of the magazine is required to keep a record of incoming and outgoing stocks. These records need to be kept for a period of not less than five years. The record is to include the date of receipts and the quantities received, the date and quantity booked out and a balance of all explosives stored at the magazine. Every attempt has to be made to account for individual explosive items that are distributed collectively. Best practice is for a second record of the explosive stock levels to be kept in a separate location. An audit and inspection of the magazine, its contents and surrounds needs to be conducted and recorded frequently, preferably monthly and usually not more than every three months.

7.2 Management of the magazine:

A suitable stock management system is essential. In its simplest form the stock management system will involve:

- Rotating stock to ensure that the oldest stock is used first;
- Checking to ensure that the stock is in good condition; and
- Checking the position, height and stability of stacks, condition of packaging etc.

Depending on the results of the risk assessment it may also be necessary to:

- Ensure that incompatible items are kept separate;
- Control the temperature and humidity; and
- Monitor the chemical and thermal stability of the explosives.

7.2.1 Stock control

Person in Charge of Magazine

A person in charge of the magazine will demonstrate competency and be assessed in the storage and handling of explosives before being appointed. The duties of the person appointed to be in charge of a magazine are include the following:

a. Access to Magazine:

The person appointed in charge of the magazine is obligated to ensure that only authorized persons have access to the magazine. The person needs to also ensure that the magazine is secured at all times and the magazine key is in the care of an authorized person or locked in a secure location.

b. Explosive Limits

The person appointed in charge of the magazine needs to ensure that the explosives stock levels in the magazine are within the licensing limits. For determining the quantity of explosives that can be held within a specific magazine. Best practice is for a record of the licence to store to be kept at the magazine location. This will ensure that all authorised personnel with access to the magazine are aware of the explosive capacity of the magazine.

c. Stacking Packages:

The person appointed in charge of the magazine is obligated to check that the packaging for the explosives, to be stored in the magazine, is of such construction strength and character that it cannot break or open accidentally and are required to be stacked to a height no greater than that recommended by the explosives manufacturer. If the person in charge of the magazine is not satisfied with the condition of packaging supplied there is no obligation to store the product in the magazine. To ensure adequate ventilation, an air space is to be maintained between the explosives and the magazine walls and ceilings.

7.2.2 Maintenance systems:

It is essential to have systems in place at all manufacturing sites to ensure preventative measures are properly maintained. These should include suitable arrangements for:

- Identifying safety-critical systems, plant and equipment as part of the risk assessment;
- Record keeping;

- Planning and prioritization of maintenance work;
- planned preventative maintenance;
- Inspection by a competent person at regular specified intervals; and
- Reporting and acting on faults with systems, plant and equipment.

It is strongly recommended that a system of planned preventative maintenance is put in place to ensure that systems which are critical to safe operation are inspected and maintained at specific intervals.

It is important to bear in mind that in safety-critical applications, such as explosives, inspection and maintenance of equipment may need to be more frequent than manufacturers' recommendations. In some cases this may include a daily visual inspection of equipment. Only replacement parts from the manufacturer or approved supplier should be used with safety critical equipment.

The maintenance regime must include a system of periodic inspections.

Inspections will need to include checking safety-critical factors such as, for example, the condition of:

a. The roof to ensure that it provides adequate weather protection;

b. Any earthing system and the arrangements to avoid static build-up;

c. the floor, in particular to see that slip or trip hazards are avoided, that there are no cracks where explosives could accumulate and that conducting floors are effective; and

d. The internal surfaces, particularly to ensure there are no areas of exposed iron, steel, rust etc.

7.3 Perimeter Fences:

A perimeter fence should be installed around the magazine for additional security purposes. In determining whether fencing is required, consideration should be given to the magazine's location and security requirements. It should be noted that a perimeter fence is not intended to provide complete security of explosives, but act as a deterrent to unauthorized access.

Figure 4: Magazine with chain and barbed wire fencing

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of perimeter fence should be installed around the magazine?(3pts)
2. What does magazine mean? (4pts)
3. How can manage the magazine? (3pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 8- Conducting housekeeping of magazine continuously

8.1 Housekeeping of magazine:

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.

8.2 Handling and Housekeeping:

- Packages of explosives shall not be opened within 15 m. (50 ft.) of any magazine. Only wooden, rubber, rawhide, fiber, zinc or babbit mallet and wood wedge shall be used in opening packages of explosives.
- All premises surrounding magazines must be kept free from bush, dry grass, and similar growth for at least 7.5 m. (25 ft.) around and no flammable materials shall be placed near or about magazines; and
- Only authorized persons shall have access to magazines.

High standards of housekeeping are maintained to:

- provide control over sources of initiation;
- prevent fires and explosions;
- reduce the likelihood of a fire spreading or an explosion communicating; and
- Reduce the risks of people becoming trapped or harmed if a fire or explosion occurs.

It is essential that explosives buildings and areas are kept clean and tidy. It is particularly important to ensure that quantities of explosive waste are kept to a minimum and that explosive waste and other dangerous material are not allowed to build up in sinks drains etc. A system for regular cleaning and disposal must be established. Workstations should be designed so that they are easy to keep clean. The quantity of flammable and combustible material in explosives areas should be kept to the minimum.

All materials not necessary for the processes of manufacturing or storing explosives should be kept out of explosives buildings and areas. Systems to prevent grit, dirt and foreign matter being carried on shoes into explosives buildings and areas should be used where such contamination is likely to increase the risk of accidental initiation. The traditional system involves the use of 'clean boundaries' beyond which iron-nailed boots or other outdoor or dirty shoes should not be worn unless contained in a suitable overshoe or boot. The overshoe or boot should not be placed outside the clean boundary. A system is required for sweeping of floors and disposal of sweepings to prevent the uncontrolled build-up of waste explosives.

Waste and contaminated materials must not be allowed to accumulate in process or storage areas. Other specific measures include:

(a) Keeping escape routes clear;

(b) keeping floors, workbenches, shelves, clean platforms, plant and machines scrupulously clean and free from grit and from all accumulations of explosives and explosive dust; and

(c) Cleaning protective clothing that has been contaminated with explosives. Disposable protective clothing must be removed and disposed of safely after use.

8.3 Magazine Rules

Magazine rules for the operation of the magazine are to be displayed inside the magazine in a prominent position. These rules should include explosives quantities and segregation requirements for correct storage, security procedures, housekeeping rules and whom to contact for maintenance work approval. Any person storing explosive materials shall inspect the magazine 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 magazine. Notify the nearest regional office within 24 hours of any loss, theft, or unauthorized entry into a magazine.

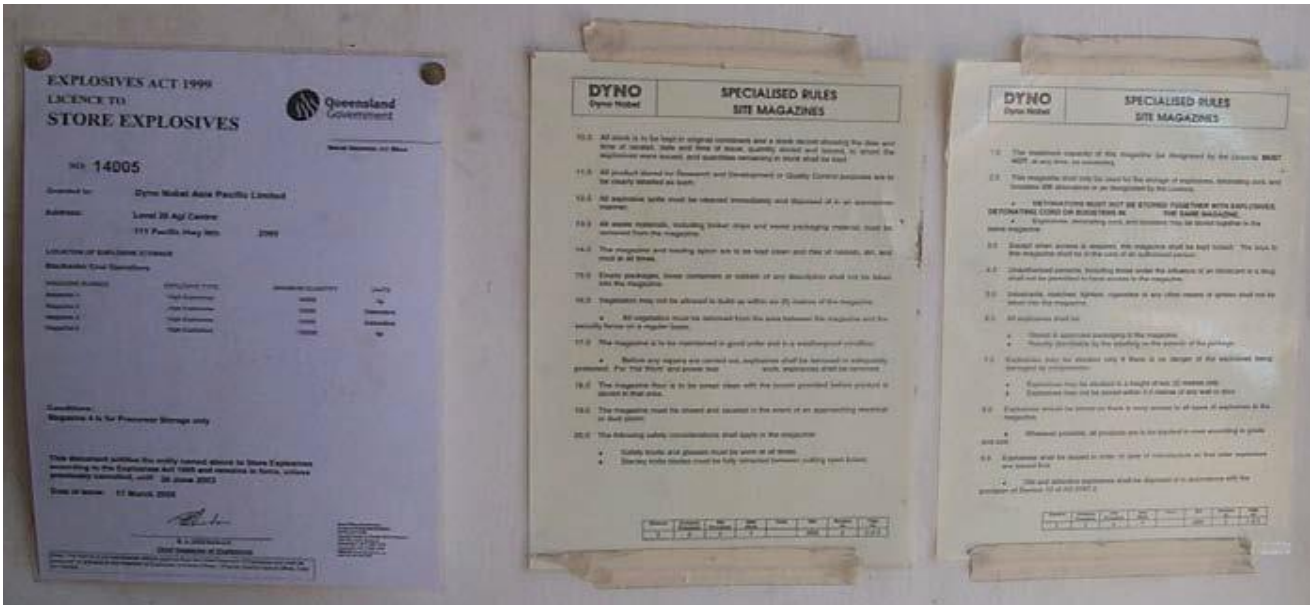


Figure1: Magazine rules displayed in an easily viewable position inside the magazine

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention down the procedures for Handling and Housekeeping of the magazine ?(3pts)
2. How can you keep magazine clean? (3pts)
3. List down some of the Magazine Rules? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 9- Completing all required documentation in standard format

7.1 Types of explosives to be used on site

Plans to use the following types of explosive equipment and supplies in blasting operations:

- Bulk ammonium nitrate fuel oil (ANFO)
- Emulsion (bulk and packaged)
- Non-electric initiation tubes (nonel tubes)
- Pentolite boosters
- Electric detonators
- Detonating cord; and
- Inlinedelays. Descriptions of each type of explosive are provided below.

A. Ammonium nitrate fuel oil (ANFO)

Ammonium Nitrate Fuel Oil (ANFO) is one of the possible blasting agents to be used for the mining Projects. ANFO consists of a mixture of Ammonium Nitrate and Fuel Oil. The mixture will be 94% by weight porous, prilled Ammonium Nitrate that will act as an oxidizing agent and absorbent for the remaining 6% Fuel Oil. ANFO will act as the primary blasting agent for an estimated 70% of blast holes.

B. Emulsion (bulk and packaged)

Emulsion explosives will be considered for wet conditions. Emulsion is water resistant and can be blended with ANFO for a product that is better suited to variable weather conditions. The end product is a mixture of emulsion and ammonium nitrate prill (usually 70:30, respectively). This is expected to be required for roughly 30% of blast holes.

C. Non-electric detonators

The explosives contractor will have the option to use a non-electronic detonation method. In this case, the initiation system is composed of a series of shock tubes

connected to detonation devices. The shock tubes transmit shock waves to the non-electric detonators to initiate the blast.

D. Electric detonators:

If warranted electronic detonation may also be considered to increase the accuracy of firing times and programmable detonation, if desired. The precision timing provided by electronic detonators may allow for a more uniform muck pile when conducting controlled pit blasting in different rock units. A more uniform muck pile will reduce processing costs and losses associated with the presence of oversized material and fines.

E. Pentolite boosters

The explosives contractor may have to use pentolite boosters to detonate bulk explosives that are known to be booster sensitive. Pentolite boosters are considered to be stable and have a long shelf life when stored under recommended conditions. Pentolite boosters are water resistant and the ingredients do not dissolve in water. Hydrostatic heads commonly found in a mining environment also have no effect on pentolite boosters.

F. Detonating cord

Detonating cord is a thin, flexible plastic tube filled with penta erythritol tetranitrate (PETN). Detonating cord may be used by the explosives contractor as a high speed fuse capable of detonating multiple charges almost simultaneously. This may be used to initiate pre-splitting blasts or for detonating large boulders simultaneously with the blast.

G. Inline delays

The proper inline delays will be selected by the explosives contractor as part of the design for each blast. The type of delay will vary depending on whether electric detonation or non-electric detonation is used.

7.2 Tests for Authorizing Explosive

- Tests for physical properties — including consistency, reaction rate, rate of moisture-absorption, tendency for separation, exudation, behaviour at both high and low temperatures, density and specific gravity

- Tests for chemical composition — including the determination of the percentage of each ingredient in the explosive
- Tests for stability — including the determination of the stability of the explosive by subjecting it to varying environmental conditions, such as high temperatures, that might produce spontaneous ignition of the explosive or a variation of its sensitivity
- Tests for ignition behaviour
- Tests to determine the potential for mass explosion in a fire
- Tests to determine whether ignition of an explosive article might ignite other explosive articles when stored or transported together
- Tests for mechanical sensitivity — including sensitivity to friction and impact
- Tests for sensitivity to electrostatic discharge
- Tests for sympathetic initiation and detonation
- Tests for velocity of detonation
- Tests for explosive strength
- Tests for or calculation of the composition of gases that evolve on explosion
- Performance tests
- Tests for minimum burning pressure
- Packaging tests
- Any other tests that are necessary for the purpose of authorizing an explosive

7.3 Blast logs

- A blaster with direction and control of a blasting operation must make a blast log for the blast.

- An employer must ensure that a blaster makes a blast log.

- A blaster must give a copy of a completed blast log to their employer as soon as reasonably possible and, if reasonably practicable, before the end of the day on which the inspection conducted after the blast is concluded.
- An employer must keep the copy of a blast log received from a blaster for at least 3 years after the date of the blast.

A blast log must include all of the following information:

- the date and time of the blast;
- the location of the blast;
- the name, address and telephone number of the employer;
- the name, blaster certificate number and signature of the blaster who had direction and control of the blasting operation;
- the distance from the nearest house, residence, shop, church, school or other structure occupied in whole or in part by people;
- the distance from the nearest structure other than one referred to in clause (e);
- how the blast was initiated;

The following drilling and loading characteristics for each hole or for each group of holes sharing the same characteristics:

- hole identifier number,
- hole diameter,
- hole depth,
- burden,
- spacing,
- quantity of explosives planned to be loaded in each hole, recorded in kilograms,
- total quantity of explosives planned to be used for the blasting operation, recorded in kilograms,
- type and length of stemming,
- type and brand of explosive,
- type of detonator;

- a sketch of the loading pattern for the blast;
- the total quantity of explosives actually loaded into each hole, recorded in kilograms
- the maximum quantity of explosives per delay, recorded in kilograms;
- the specifics of the delay pattern;
- the number of detonators used in the blast;
- the period numbers of the detonators used in the blast;
- the resistance in the electric blasting circuit as tested under subsection 78(2), recorded in ohms;
- the type of warning signal used;
- whether blasting mats were used;
- whether warning signs were posted on all public roads near the blasting area, leading to the blasting area and leading from the blasting area;
- whether all roads and approaches were guarded or barricaded;
- the results of the inspection of the blasting area conducted after the blast as required by Section
- whether a misfire occurred;
- Whether there was any injury to persons or damage to property resulting from the blast.

7.4 Safety:

Safety is of paramount importance. The goal of every blast plan is to coordinate a quality controlled blast that will achieve the desired results needed for the job while protecting people, property and the environment. If you ever find material marked “explosives” please do not handle the material and contact law enforcement or the fire department. Safety, for professionals handling explosives and for the public around blasting projects, has improved over time to what it is today for reasons such as:

- A commitment to training and continuous improvement.

- A safety-first culture within the industry.
- Ongoing development of safer explosives products.
- Past experience and research that help shape regulations and laws.
- Clear communications of blasting safety protocols to communities.

At blast time, a combination of warning signals, signs, barricades and guards will be used to secure the blasting area. Never enter a blast area without permission or an authorized escort. Sometimes local police or regulators help secure the blast area or redirect traffic. At the time of the blast, keep your distance according to the area communicated by company representatives. Blasting times are usually scheduled, but on occasion may be changed due to unforeseen circumstances. So be alert to the blast signals used at the job site. These procedures help ensure your safety and the safety of those conducting the work.

Signs are meant to help inform and protect the public. Some types of signs are:

- Storage magazine signs identify where explosives are stored and serve as warning to fire fighting professionals.
- Perimeter signs typically identify project boundaries.
- Blast area signs inform the public of where blasting may be occurring within the project area.
- Entry point signs may specify blast warning signals.
- Transportation vehicle signs inform first responders of the vehicle's contents.

Please comply with any signage and maintain your distances as posted. If you see unauthorized people entering signed areas, please call the local police. In the event you see a fire at or near explosives storage, keep away and call the fire department. Never attempt to fight an explosives fire.

Explosives transportation on public roads is regulated and controlled.

- Drivers are trained in proper shipment and handling of explosives.
- Travel routes are usually designated to facilitate the safest route.
- Vehicles are properly placarded regarding their contents.

In the event of an accident, contact local emergency response personnel and stay clear of the area.

When blasting near homes, precautions associated with the job site will be communicated to the public. This communication may include dates and times of blasting and the blast warning signals. Notifications may be provided:

- In person: This will provide you with an opportunity to ask questions and request contact information.
- In the mail: If you receive a notice of blasting in the mail, read the entire mailing and make note of pertinent information.
- On your door: If you receive a notice of blasting on your door, read the entire notice and make note of pertinent information.
- At public meetings or in public notices.

If questions remain, be sure to contact the company listed on the notice and ask specific questions to meet your concerns. The explosives industry relies on the cooperation of surrounding neighbors and the public at large to adhere to precautions communicated by blasting professionals to ensure

7.5 Limitation of Explosives:

In addition to any limitation imposed by the explosives licence, the quantity of explosives present in a process building is to be kept to the minimum quantity consistent with a sensible working regime for the processing task in hand. This is in order to minimise the severity of any consequences arising from an accidental fire or initiation. The total quantity of explosives in a process building, including that in transit areas, should not exceed that necessary for a day's working. Similarly it is good practice to keep the quantity of exposed explosives to the minimum. Whenever possible, only one box or container of explosives should be open at any one time and all explosives, not being worked on, should be suitably covered to minimise the risk of initiation by spark.

Self-Check –9	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down some of the information a blast log must include? (3pts)
2. How can you Tests for Authorizing Explosives ?(3pts)
3. What does Ammonium nitrate fuel oil (ANFO) mean? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 10- Passing information regarding explosives stock and storage

10.1 Storage of blasting agents:

1. Processed blasting agents may be stored in either a magazine or a blasting agent storage building.

2. Blasting agents shall only be stored in any magazine in accordance with the conditions of the license for such magazine. Every storage building used for the storage of blasting agents shall:

- Be a one-storey construction;
- Not have a basement;
- Be constructed of non-combustible or fire resistant material;
- Be adequately ventilated
- Be kept clean and maintained in good order.

Fig: safety Taggings

10.2 Measures to limit the extent of fire or explosion

As well as taking steps to prevent a fire or explosion occurring, regulation also requires anyone manufacturing or storing explosives to take steps to limit the severity of the consequences in the event of a fire or explosion. At its simplest this will involve:

- managing stocks of explosive to limit the amount of explosive in areas in which people are likely to be present;
- limiting the number of people in areas where explosives are present; and
- Keeping explosives away from flammable or combustible materials which could fuel a fire, and away from toxic substances which could be released in the event of a fire. In other situations, particularly in manufacturing, it may also be necessary to take other steps to contain and safely release the blast effects.

10.3 Markings

Every magazine is to be marked on the door or lid with either the word ‘EXPLOSIVE’ or ‘DETONATOR,’ as appropriate. The markings are required in red lettered characters on a white background and sized to make them clearly defined. In addition an explosive hazard class diamond is required on the magazine door. A clearly defined ‘NO SMOKING or NAKED FLAMES’ sign should be positioned at the entrance of the magazine to warn persons entering the magazine area. A sign is also required at the entrance of the magazine to warn persons at the magazine of their liability to penalty for an offence if reasonable precautions and reasonable care is not taken to prevent an explosives incident at the magazine.

10.2.2 Site Information:

As part of accessing and applying your site safety procedures, you will need to locate relevant destinations within the site. To do this you will need to gain access to site plans. Ask you supervisor or WHS safety officer for a copy. Site plans will detail the locations of all buildings, facilities and structures within the site including travel ways and parking areas. You may also need to access and interpret the transport rules and signage for the site. Any signs and barricading that have been put in position should not be moved if it is in the way of any work you are doing.

Fig 2: Safety sign information

Self-Check –10	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for Store of blasting agents?(3pts)
2. What Does Marking mean.(3pts)
3. What does explosives stock and storage mean? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

LG #34	LO #3- Prepare to transport explosives

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Receiving orders
- Selecting sufficient quantities of explosives and associated materials
- Conducting pre-start check on explosive transport vehicle
- Confirming operability of relevant safety equipment
- Carrying out vehicle start-up procedures
- Equipment operational procedures, technical capability and limitations
- Displaying relevant signs on vehicles and ensuring legibility
- Loading vehicle with separation and segregation requirements
- Adhering emergency procedures in case of fire and/or accident

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Receive orders
- Select sufficient quantities of explosives and associated materials
- Conduct pre-start check on explosive transport vehicle
- Confirm operability of relevant safety equipment
- Carry out vehicle start-up procedures
- Equipment operational procedures, technical capability and limitations
- Display relevant signs on vehicles and ensuring legibility
- Load vehicle with separation and segregation requirements
- Adhere emergency procedures in case of fire and/or accident

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, see your trainer for further instructions

Information Sheet 1- Receiving orders

1.1 Receiving orders

Receiving orders to use explosives is issued to cover any specialized or specific stated purpose on the licence for the use of explosives as opposed to the conventional explosives user licences such as shot firers and fireworks operators. The need for a competency assessment to be conducted by an inspector to demonstrate that the person has the skills, knowledge and experience to carry out the explosives activities. The Safe and Efficient Blasting is designed to further enhance the skills and knowledge of mining industry personnel including:

- Shot firers
- Blasting Crew
- Foremen
- Supervisors
- Mine Operations Staff
- Government/Regulatory Inspectors
- Anyone seeking a blasting overview.

1.2 Transportation regulations:

- No person shall transport any explosive within the Town in violation of the Interstate Commerce Commission regulations or regulations of the State.
- No person shall transfer an explosive from one vehicle to another without the express permission of the authority having jurisdiction and upon receiving approval, shall notify the Fire Chief and Police Chief.
- Blasting agents shall not be transported in the same vehicle with explosives without the express permission of the authority having jurisdiction.

- All vehicles used for transporting explosives shall be marked or placarded on the sides, fronts, and rears of such vehicles with the word "Explosives" in letters not less than three inches in height in contrasting colors.
- Except in emergency conditions, no vehicle transporting explosives shall be parked before reaching its destination, even though attended, on any public street adjacent to or in proximity to any bridge, tunnel, dwelling, building, or place where people work, congregate, or assemble.
- No explosive shall be delivered to a destination between the hours of sunset and sunrise without the express permission of the authority having jurisdiction.
- Explosive deliveries shall only be made to authorized persons and into authorized magazines or approved temporary storage or handling areas.

1.3 Objective of receiving order:

To give participants a greater understanding of drilling and blasting technology so they can carry out their jobs with greater:

- Safety – without risk of injury or damage
- Efficiency – maximizing blast performance while optimizing blast costs

Importance of receiving orders

- To compare explosive types for cost-effective blast patterns
- To correctly prime and charge blast holes for optimum performance
- To select a suitable initiation system, including delay intervals and hook-up methods
- To modify blast patterns in difficult areas to maintain good results
- To Control excessive fly rock, vibrations and air blast
- To identify potential safety hazards relating to explosives and how to avoid them
- To comply with explosives and mining regulations
- To evaluate risks associated with blasting
- To analyse the wider operational cost implications of changing blast methods

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the Importance of receiving orders? (3pts)
2. Mention at least five Explosive Transportation regulations.(3pts)
3. List down some of the mining industry personnel. (4)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Selecting sufficient quantities of explosives and associated materials

2.1 Explosive

Building in which any quantity of explosives are manufactured, handled, used or temporarily stored shall be classified as “explosives buildings”. These buildings wherein finished explosives are kept or are stored for periods exceeding forty eight (48) hours shall be classified as “Magazine”. An explosive is classified as a low or high explosive according to its rate of combustion: low explosives burn rapidly (or deflagrate), while high explosives detonate. While these definitions are distinct, the problem of precisely measuring rapid decomposition makes practical classification of explosives difficult.

2.2 Selection of explosives:

There have been many systems developed to rate the strength or power or an explosive. Although these systems work, it is still not clear as to whether or not the information is useful to the field blaster. By knowing what properties are critical to performance, meaningful predictions can be made in blastdesign. These properties are: detonation velocity, density, detonation pressure, water resistance, and fume class. For a given explosive, these properties vary with the manufacturer.

There are many reasons for choosing an explosive. These reasons range from the specifications of the product, the price, availability, and reliability. Whatever the reason for selection, the blaster should consider the following properties:

1. Velocity

If fragmentation is desired, the best results are obtained when the detonation velocity is at or near the sonic velocity of the rock. If mass movement is more important (as in blast casting) or very large fragments are desired (as in riprap production or slabbing), detonation velocity should be notably below the rock's sonic velocity.

2. Sensitivity

When using charges in small diameter boreholes, the blaster needs sensitive products such as cap sensitive emulsions or water gels. The smaller the hole, the more sensitive the product needs to be. ANFO functions well in large diameter holes (four inches and above), but has trouble sustaining detonation in small holes.

3. Gas or Pressure Release –

This is the amount of gas and pressure released when the explosive or blasting agent detonates. Generally, the more gas release, the more heave or displacement that is possible.

4. Fume Quality

When working in a poorly ventilated operation such as in a tunnel, mine, or deep trench, select a product with a good (Class I) fume rating. Even when working in the open, allow all evidence of smoke and dust to clear before reentering the blast area, and remember that the toxic gases produced are colorless, odorless, and potentially lethal. Ideally, detonation of a commercial explosive produces water vapor, carbon dioxide, and nitrogen. In addition, undesirable poisonous gases such as carbon monoxide and nitrogen oxides are usually formed. These gases are known as fumes, and the fume class of an explosive indicates the nature and quantity of the undesirable gases formed during detonation. Better ratings are given to explosives producing smaller amounts of fumes. For open work, fumes are not usually an important factor, In confined spaces, however, the fume rating of an explosive is important. In any case, the blaster should ensure that everyone stays away from fumes generated in a shot. Carbon monoxide gradually destroys the brain and central nervous system, and nitrogen oxides immediately form nitric acid in the lungs.

5. Density

The density of an explosive may be expressed in terms of specific gravity. Specific gravity is the ratio of the density of the explosive to the density of water under standard conditions. The specific gravity of commercial explosives ranges from 0.6 to 1.7 g/cc. For free running explosives, the density is often specified as the pounds of explosives per foot of charge length in a given size borehole. With few exceptions, denser

explosives give higher detonation velocities and pressures. Density is an important consideration when choosing an explosive. For difficult blasting conditions or where fine fragmentation is required, a dense explosive is usually necessary. In easily fragmented rock or where fine fragmentation is not needed, a low-density explosive will often suffice. Low-density explosives are particularly useful in the production of riprap or other coarse products. The density of an explosive is also important when working under wet conditions. An explosive with a specific gravity of less than 1.0 will not sink in water.

6. Detonation and borehole pressure:

Detonation pressure is a function of the detonation velocity and density of an explosive. The nomograph can be used to approximate the detonation pressure of an explosive when the detonation velocity and specific gravity are known. As can be seen, the detonation pressure is more dependent on detonation velocity than specific gravity. A high detonation pressure is necessary when blasting hard, dense rock. In softer rock, a lower pressure is sufficient. Detonation pressures of explosives range from 10 to over 140 Kilo bars (l Kilo bar = 14,504 psi).

7. Water resistance:

An explosive's water resistance is a measure of its ability to withstand exposure to water without deteriorating or losing sensitivity. Sensitivity is the ease with which an explosive detonates. In dry work, water resistance is of no consequence. If water is standing in the borehole, and the time between loading and firing is fairly short, an explosive with a water-resistance rating of “good” is sufficient. If the exposure is prolonged, or if the water is percolating through the borehole, “very good” to excellent” water resistance is required. In general, gelatins and emulsions offer the best water resistance. Higher-density explosives have fair to excellent water resistance, whereas low-density explosives and blasting agents have little or none. Brown nitrogen oxide fumes from a blast often mean the explosive has deteriorated from exposure to water. In conditions where the holes are producing water or ground water is a problem, packaged ANFO, water gels or emulsions function best. There are also plastic borehole liners that can be used for bulk loading operations.

When selecting explosives there are four basic categories:

1. Dynamites, including Granular Dynamite (Straight Dynamite, High-Density Extra Dynamite, and Low-density Extra Dynamite) and Gelatin Dynamite (Straight Gelatin Dynamite, Ammonia Gelatin Dynamite, and Semi gelatin Dynamite). Use is prohibited by policy unless a case specific waver is obtained from the regional blasting officer.

2. Water Gels, Emulsions, and Slurries - Consisting of Cartridges and Bulk products.

3. Dry Blasting Agents - Consisting of Poured or Bulk ANFO, Aluminized ANFO, Densified ANFO, and Packaged (waterproof) ANFO.

4. Binary Explosives - Consisting of two-component products that are mixed in the field to form an explosive.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the procedures for Selection sufficient quantities of explosives and associated materials? (3pts)
2. Mention the four basic categories When selecting explosives.(3pts)
3. List down the properties of explosives (4 pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Conducting pre-start check on explosive transport vehicle

3.1 Explosive Transport

Explosives must be securely locked in the receptacle, carry box or enclosed vehicle body whenever explosives are on the transport vehicle (except during loading and unloading).

Vehicle daily checks are a simple and effective way to spot potentially dangerous issues or defects before vehicles are used. Employers and self employed people should have a system of routine daily checks in place to ensure that vehicles are in good working order, safe and fit for purpose at the start of each working day or work shift. The Health and Safety Authority, Road Safety Authority have developed resources to help employers manage vehicle risks. They include vehicle check posters and check sheets and videos.

Some of regulatory and other requirements for transportation include:

- All class 1 substances are prohibited from carriage on any public transport vehicle.
- Ensuring that the substance is under the control of an approved handler or secured.
- Ensuring that the explosives are not exposed to high levels of impact or pressure shock, spark energy or heat.
- Exclusion of unessential personnel.
- Detonators and explosives may be carried in the manufacturer's packaging cases.
- Adequate and suitable fire extinguishers must be carried in the explosives vehicle.
- No detonators may be carried with explosives unless they are effectively separated. h. There must be no smoking in or around the vehicle.

- Vehicles containing explosives must never be left unattended, must never be overloaded, and should only contain explosives for the job at hand.
- Loaded explosive vehicles must never be taken to workshops or store areas and no maintenance or repair should commence on a vehicle containing explosives.
- Explosives vehicles must not be used to convey miscellaneous passengers or equipment.

3.2 Requirements for explosives transport and driver licences

Explosives transport and explosives driver licences are required for the transport of explosives by road. An explosives transport licence authorises the transport of explosives by road, and is applicable for both businesses and individuals. A single explosives transport licence may cover one or more vehicles owned by the same licence holder. An explosives driver licence authorises an individual to drive a vehicle transporting explosives by road, and only individuals, not businesses, may apply for explosives driver licences. Explosives transport and driver licences are not required for the transport of explosives at a mine site. However, licences are needed for transport on a public road.

- Explosive material will be transported without undue delay to the storage area or blasting site.
- Closed non-conductive containers (cargo areas/spaces) will be used to carry explosives and detonators to and from blast sites. Separate containers will be used for explosives and detonators
- Explosive material and detonators will not be transported on the same vehicle.

Explosives pose additional risk to health, safety, and property during transportation. Therefore, special requirements have been developed for transporting various types of explosives by motor vehicle, over water, by rail, and by aircraft.

3.3 Transporting explosives by motor vehicle

Operator requirements

Vehicle operators must hold a valid state commercial motor vehicle operator's license for the class of vehicle being operated, including any required hazardous materials endorsements. Vehicles transporting explosives shall be driven by drivers certified to

transport explosives. The driver must be familiar with the traffic regulations and state laws governing the transportation of explosives. When transporting explosives, a written document describing the type and quantity of explosives shall be in the vehicle and readily available.

Vehicles must have the following features:

- Vertical and horizontal fire screens
- Acid resistant, ventilated and electrically insulated battery cover
- Wiring carried in approved conduit
- Fuse protected circuits
- Battery isolation switch
- Compression engine (e.g. diesel)
- fuel tank located to the front or rear of the vertical fire screen, but if located to the rear it must be mounted below the horizontal fire screen and protected from damage and spilt fuel

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for explosives transport and driver licences?(3pts)
2. Mention the main Vehicles features.(3pts)
3. List down some of regulatory and other requirements for transportation of explosive? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 4- Confirming operability of relevant safety equipment

2.3 Safety of Equipment

As required safety equipment is to be utilized whilst using explosives. The potential risks should be identified and suitable equipment selected for the procedure. This may include personal protective equipment such as fire retarding clothing, gloves, goggles and in some instances, anti-static footwear. Safety measures are particularly important because they reduce the risk of an explosion being initiated, and limit the consequences in the event of an initiation. These safety measures are:

- appropriate training and competence;
- safe systems of work and working practices;
- high standards of housekeeping;
- providing and maintaining appropriate mounds and traverses;
- effective stock management;
- segregating explosives presenting different likelihoods of initiation (or different hazard types);
- segregating explosives operations from other activities; and
- Safely handling and transporting explosives on site.

2.3.1 Safety Rules:

- Never handle or allow anyone to handle explosives while under the influence of drugs or alcohol
- Use only authorized blasting procedures.
- Notify local police 24 hours in advance that blasting will be taking place.
- Warn nearby residences well in advance that blasting will be taking place.
- Wear all appropriate PPE including hard hat, safety glasses (prescription safety glasses if required) with side shields and hearing protection.
- Have the required conforming warning signs, guard and flaggers to protect the area, workers and the traveling public.
- Prohibit smoking, matches, open flames, firearms, or any heat producing object or device within 50’ of the explosives magazine or while explosives are being handled, transported or used..
- Evacuate to the required distance, post signs and or flaggers to prevent access.
- Pedestrians and traffic will be maintained at a minimum of 1,000’ from the blast area.
- NEVER assume the area is clear.
- always make personal visual inspections before blast.
- Insure that unauthorized visitors do not enter the blast area.
- Conduct blasting operation between sunup and sunset and during times of clear visibility.

- If aerial lights are needed, use only APPROVED non-sparking battery operated lights.
- Always face the blast area and watch for flying rocks.
- Never allow horseplay during blast operations.
- Never store primers or detonators in packets or in the same container with explosives.
- Never abandon an explosive or detonator.
- Mainintain accurate inventory of magazines keep them locked

The risk assessment must be undertaken before any new work activity involving dangerous substances begins. The risk assessment has five steps:

1) Identify the hazards;
2) Decide who might be harmed, and how;
3) Decide what safety measures are needed;
4) Record the significant findings of the assessment; and
5) Review the assessment.

It is important to consult and involve safety representatives and employees in the process of drawing up the risk assessment.

2.3.2 Vehicles containing explosives must:

- Be attended, guarded or alarmed if left stationary
- Be secured at temporary stops, preferably within view of the driver and inaccessible to public
- Be parked at least 5 m away from combustible material, including tall, dry vegetation, fuel and LP gas storage

- Be attended for at least 15 minutes after the engine has been stopped to recognise any delayed brake or tyre fire
- Not be parked in the same place for consecutive days or nights unless the local police and emergency services have been notified

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down the safety measures?(3pts
2. Mention the five steps of risk assessment. (3pts)
3. What are the basic requirements for Vehicles transporting explosives? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 5- Carrying out vehicle start-up procedures

5.1 Explosives management plan:

The objectives of the Explosives Management Plan can be described as follows:

- Communicate a methodical approach to explosives management for the Project;
- Ensure that infrastructure constructed for explosives is compliant with all applicable regulations;
- Ensure that structures are constructed to prevent any safety or environmental incidents
- onsite explosives storage; Ensure that handling of explosives is done in a manner that will minimize the possibility of safety or
- environmental incidents; Prescribe safe and environmentally sound measures for disposal or destruction of explosives;
- Prescribe procedures for safe blasting;
- Prescribe procedures for dealing with spills of explosives materials; and
- Indicate the chain of responsibility for explosives management.

5.2 Loading of explosives or blasting agent;

- Procedures that permit safe and efficient loading shall be established before loading is started.

- All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.
- No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives and detonators shall be immediately returned to an authorized magazine.
- No person shall be allowed to deepen drill holes, which have contained explosives, or blasting agents
- No explosives or blasting agents shall be left unattended at the blast site.
- Machines and all tools not used for loading explosives into bore-holes shall be removed from the immediate location of holes before explosives are delivered. Equipment shall not be operated within 50 feet of loaded holes
- No activity of any nature other than that which is required for loading holes with explosives shall be permitted in the blast area.
- Power lines and portable electric cables for equipment being used shall be kept a safe distance from explosives or blasting agents being loaded into holes. Cables in the proximity of the blast area hall be de- energized and locked out by the blaster.
- Holes shall be checked prior to loading to determine depth and conditions. Where a hole has been loaded with explosives but the explosives have failed to detonate (explode), there shall be no drilling within 50 feet of the hole.
- When loading a long line of holes with more than one crew, the crews shall be separated by practical distance consistent with efficient operation and supervision of crews
- No explosive shall be used or loaded underground in the presence of combustible gasses or combustible dust

5.3 Haul road design considerations

Width; gradient: radius of curvature; super elevation; rolling resistance: vehicle requirement: speed limits; sight distance: run-off lanes; Berm height; traffic control and signage

5.4 Preparimg vehicle and equipment:

While preparing we need to consider the followind:

- Types and range of explosive materials.
- Dimensions and loading limits of vehicles.
- Methods and procedures to protect and secure the load.
- Requirements of vehicle pre-start checks.
- Control of substances hazard to health, in relation to materials carried by the vehicle, or required for its operation.
- Security rules and procedures; action to take in cases of breach of security; potential risks to security.
- Approved procedures and practices in the context of the operations, the work activity and the workplace environment (organizational; environmental; regulatory; emergency; operational).
- Responsibilities under the health and safety statutory requirements.
- Types and range of documents, tools and equipment to be carried by the vehicle whilst travelling on public roads, and their use.

- Types and range of documents, tools and equipment to be carried by the vehicle to gain access to and whilst travelling in the quarry/mine to the blast site, and their use.
- Types and range of documents, tools and equipment to be carried by the vehicle to facilitate hole loading.
- Types and range of documents, tools and equipment to be carried by the vehicle to enable routine cleaning and/or maintenance whilst away from depot.
- Types and use of personal protective equipment that may be required whilst loading, driving, loading, purging and dealing with emergency situations.
- Actions to be taken in event of vehicle not being fit to travel.
- Actions to be taken if vehicle is not fully equipped to travel.
- Actions to be taken if vehicle is not correctly loaded to travel, and/or to meet customer requirements.
- organizational operational rules and procedures in the event of emergencies; to include fire, spillage, vehicle breakdown

Fig 1: Explosive transporting vehicle

Self-Check – 5	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the consideration for Haul road design?(3pts)
2. Mention the procedures to Prepare vehicle and equipment.(3pts)
3. What is the importance of safe Explosives management plan? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 6- operational procedures, technical capability and limitations of Equipment

6.1 Explosives transport equipment:

The explosives contractor will transport the explosives from the manufacturing facility to the blast site using a truck designed for the safe delivery of ANFO. The truck used for product transport will be capable of delivering explosives blends suited for both wet and dry conditions. The ANFO truck will meet all conditions specified under the Occupational Health and Safety Act (OHSA) of Yukon. Placards will be displayed on the side of all explosives transporting equipment as per the Transportation of Dangerous Goods Shipping Regulations. The explosives delivery truck will be equipped with a metering system that will enable SGV to reconcile the amount of explosives used with the amount of explosives delivered to site. This reconciliation will be an integral part of maintaining responsible explosives use on the Project. Explosives delivery equipment will be managed under a strict maintenance program. The program will be designed to prevent mechanical failures that would endanger personnel or have a negative effect on mine production. Electric detonators, when used, will be transported to the blast site in a separate vehicle than the ANFO. The detonators will be stored in a closed metal container lined with wood, or other suitable material. The container will be secured to the vehicle to prevent unintentional unloading during transport. The following inspection, as required under the OHSA, will be performed on each vehicle prior to the transport of any explosives.

- Fire extinguishers are filled and in working order;
- The electrical wiring is completely insulated and firmly secured;

- The fuel tank and feed lines have no leaks;
- The chassis, engine, pan and bottom of the conveyance are reasonably clean and free from surplus of Oil and grease;
- The brakes and steering apparatus are in good condition; and
- The conveyance is in sound mechanical condition.

6.1.1 Preparing vehicle and equipment

While preparing vehicle and equipment you must be able to:

- Vehicle pre-start checks are completed to organizational operational requirements and in compliance with vehicle manufacturer's specification.
- Vehicle is loaded and load is secured to meet delivery requirements and in conformity with organizational and operational requirements and relevant legislation.
- vehicle is equipped with all necessary tools, equipment, safety signs and equipment, personal protective equipment, communication devices and documentation required for leaving the depot, journey to site, entry to blast area and off-loading in accordance with statutory requirements, customer requirements, and organizational operational rules and procedures.
- Documentation in relation to the vehicle, load and delivery is checked and completed according to organizational operational procedures.
- Vehicle is confirmed as fully in compliance and ready for travel.

Only authorized persons are allowed into the loading area in accordance with security procedures.

- Any problems and conditions outside the responsibility of the candidate are referred to an authorized person.

- Work is carried out to approved procedures and practices and in compliance with statutory requirements.

6.1.2 Best Practices:

- Follow manufacturers' guidelines for the storage, handling, transportation and use of explosive materials.
- Keep all explosive storage areas clean, dry and orderly.
- Rotate the inventory of explosive materials, making sure to use the oldest stock first.
- Never use damaged or deteriorated explosive materials, including initiation (detonating) devices, boosters, dynamite and blasting agents. Contact the explosives manufacturer if damaged, deteriorated or outdated explosives are discovered.
- Ensure that all locations where explosives are stored or used are properly ventilated before miners enter.
- Utilize technology such as face profilers and borehole probes to obtain specific details about areas of weak burden and potential borehole deviation.
- Communicate with the driller and understand the geology of the blast site.
- Review and follow the site-specific blast plan prior to loading any explosives. Develop a drill pattern appropriate for the location, and adjust stemming depth and/or decking to maintain adequate burden for the blast.
- Establish the blast area and remove all persons from the area before the blast is fired.
- Guard or barricade all access routes to the blast area to prevent people and vehicles from entering.

- Before firing a blast, give ample warning to allow all persons to be evacuated from the blast area.
- Conduct a post-blast inspection to be certain the blast area is safe before anyone re-enters.

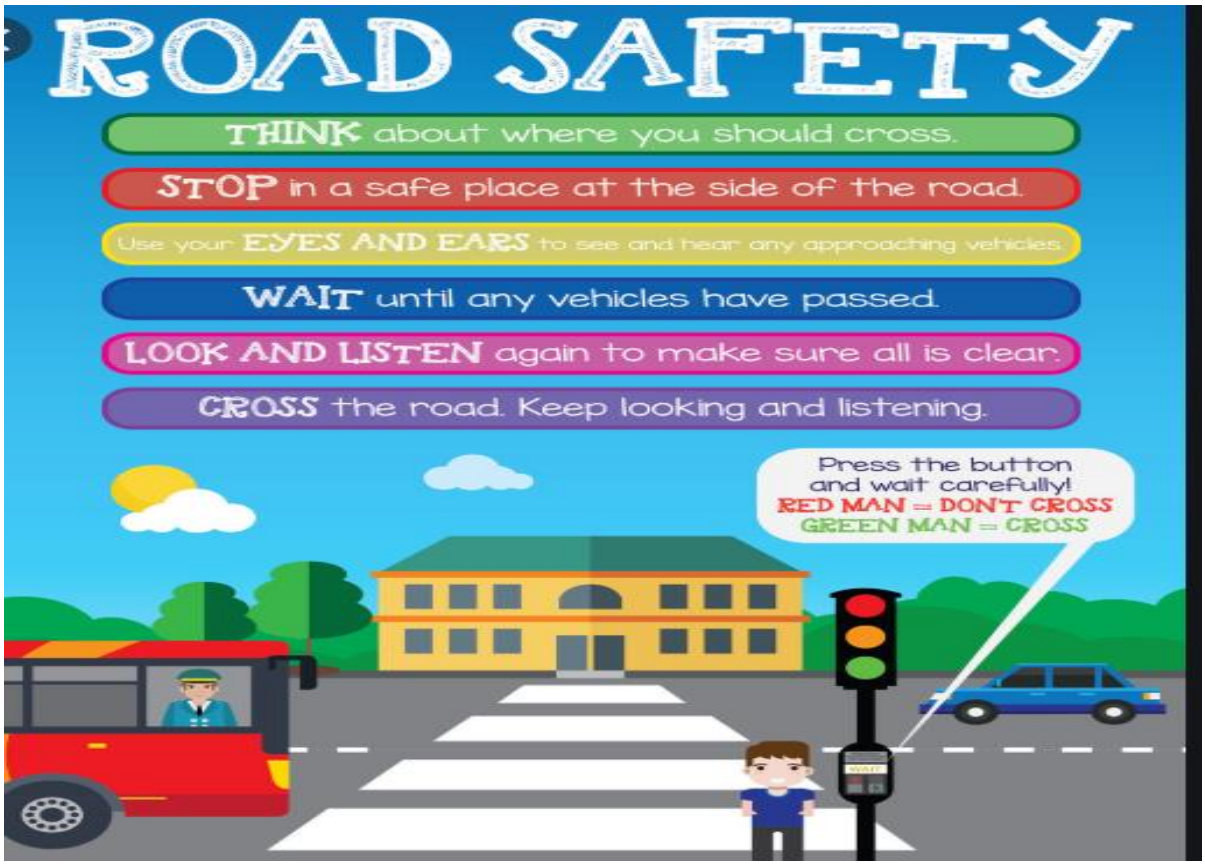


Fig 1: Road safety

Self-Check –6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for Explosives transport equipment?(3pts)
2. Mention some of the road safety.(3pts)
3. What are the priorities of vehicles to transport of any explosives? (4pts)

Score = _____

Rating: _____

Information Sheet 7- Displaying relevant signs on vehicles and ensuring legibility

7.1 Transporting explosives:

The following guidelines should be taken into account while transporting explosives

- A licence to transport authorises you to possess and transport explosives and/or security sensitive dangerous substances.
- A licence to transport explosives and/or security sensitive dangerous substances allows you to possess, transport and store these substances.
- A licence to transport does not permit the import or export of explosives and/or security sensitive dangerous substances.
- You can only transport the products specified in the licence.
- This licence can be issued to you, or a nominated person on behalf of a company.

7.2 Security and safety while in transport

The following general precautions should be taken to ensure the security and safety of explosives during transport:

- Before leaving the magazine, the vehicle operator needs to ensure that all explosives are securely stowed and the quantity and type of explosives recorded.
- Explosives should be kept in their original boxes where possible to facilitate ready identification and containment.
- The transport route between the magazine and shot area should be pre-planned and all relevant mine personnel notified.

- No smoking or naked flames allowed within the vicinity of the vehicle. If any ignition sources are required they should be carried in a sealed container in an appropriate section of the vehicle.
- If the vehicle is unavoidably left unattended (e.g. emergency), it should be parked in an appropriate area with all receptacles and the vehicle locked.
- Where a vehicle is parked on a slope it should be suitably located to avoid the possibility of unplanned movement.

7.3 Eligibility criteria

To be eligible for this licence you must:

- be at least 18 years old
- hold a current security clearance (previously called an unsupervised handling licence (UHL)) and be able to ensure only people with this clearance have unsupervised access
- have a legitimate reason for transporting security sensitive dangerous substances
- Have made adequate arrangements for the safe and secure handling and storage of explosives and/or security sensitive dangerous substances.

7.4 Vehicle markings

Vehicles, that are used to carry explosives, need to be identifiable. This is to be achieved by being fitted with appropriate signs. Additionally, vehicles carrying explosives at mine sites are to be easily identified other than by signs, for example a flashing light of a distinctive colour is required, and this enables, in the underground environment, to show that explosives are being transported on the vehicle.

Fig 1: explosive sign

7.5 Proximity of vehicles to explosives

Where vehicles have access to the explosives storage section of the magazine (e.g. forklifts), they need to have the necessary modifications for operation within the vicinity of an explosive area.

The following requirements are applicable to all powered vehicles

- The vehicle shall not be started inside the explosive storage section of the magazine.
- The vehicle shall not be stored in the explosive storage section of the magazine.
- The vehicle shall not be refuelled, maintained or left running unattended within the vicinity of the magazine.

Fig 2: Explosive storage

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for Transporting of explosives?(3pts)
2. Mention the criteria for ensuring Eligibility.(3pts)
3. List down at least five signs on vehicles? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 8- Loading vehicle with separation and segregation requirements

8.1 Introduction:

Before leaving the loading place all documents should be checked. Always remove old documents from the vehicle to avoid any misunderstanding in case of an emergency. See that the documents are completed. If passing through customs check that the emergency instructions are written in the appropriate languages. The packages and containers should not be broken, and the actual amount should be the same as stated in the documents. Dangerous goods should always be well attached to avoid load movements during transport and they should be loaded away from food and animal feedstuffs. Attach the placard to the vehicle.

8.2 Segregating explosives:

Storage sites for the explosive magazine and detonator magazine shall be located as to reduce to acceptable levels the risk of sympathetic detonation between the different storages. The separation and segregation distances are based on international testing and need to be observed as a minimum, however this minimum distance can be increased to further reduce the risk.Explosives which have significantly different likelihoods of initiation are segregated from one another. Storage buildings should be separated from production buildings and other areas where explosives are worked on. Separation should be sufficient to ensure that an explosion which takes place in a production area (where the risk of an explosion is greatest) does not rapidly propagate to storage buildings (where the greatest amount of explosive substances or articles is kept, and therefore the hazard is greatest). Explosives should not in general be

manufactured or processed in storage buildings or storage areas. Where it is necessary to have finished explosives articles in a production area (eg the packing of a selection of components or the use of a finished explosive article as a component part of another explosive), stocks must be planned and managed with the aim of keeping the quantities of explosive in production areas to that needed for the job in hand.

Whenever practicable, the quantity of explosives present in the production area should be minimized and risks reduced by:

- keeping articles which are not being worked on in an expense store;
- keeping detonators and other initiating devices necessary for the process in segregated storage until they are required;
- fitting detonators and other initiating devices to explosive articles as late in the manufacturing process as practicable;
- returning packages of explosives to a store when those articles are no longer required for the task at hand; and
- Placing articles which have been worked on into appropriate packaging, and then placing those packages in an appropriate store. Explosives should only be removed from their transport packaging in an appropriate place. Normally, this will be in a production building, a picking store, or another place where an event involving the explosives being handled will not communicate directly with the explosives in storage.

Segregation from Other Goods

- Ammonium nitrate, ammonium nitrate mixtures or ammonium nitrate based explosives must not be carried with chlorates or chlorate based explosives.

- Explosives must not be transported in the same compartment of the vehicle as domestic, commercial or industrial refuse or waste; e.g. empty packagings, excess pallets.

- Explosives must not be transported on the same vehicle or combination road vehicle as other Classes of dangerous goods, fire risk substances or any other materials likely to cause, communicate or intensify fire,

8.3 Separation of transported explosive material.

Detonators shall not be transported on the same vehicle or conveyance with other explosives except as follows:

A. Detonators in quantities of more than 1000 may be transported in a vehicle or conveyance with explosives or blasting agents provided the detonators are -

1) Maintained in the original packaging as shipped from the manufacturer; and
2) Separated from explosives or blasting agents by 4 inches of hardwood or equivalent, or a laminated partition. The hardwood or equivalent shall be fastened to the vehicle or conveyance. When a laminated partition is used, operators must follow the provisions of the Institute of Makers of Explosives (IME)

B. Detonators in quantities of 1000 or fewer may be transported with explosives or blasting agents provided the detonators are -

1) Kept in closed containers; and
2) Separated from explosives or blasting agents by 4 inches of hardwood or equivalent, or a laminated partition.

Blasting explosives and detonator products must be kept and handled separately until the last most practicable moment, before bringing them together. A key measure to reduce the severity of an explosion is to separate storage buildings from production buildings. The aim is to ensure that an explosion which takes place in a production area

(where the risk of an explosion is greatest) does not propagate to storage buildings (where the greatest amount of explosive substances or articles is kept and therefore the hazard is greatest).

Self-Check – 8	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of Separation of transported explosive material?(3pts)
2. What does Segregating explosives mean.(3pts)
3. How can you separate of explosives? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 9- Adhering emergency procedures in case of fire and/or accident

9.1 Emergency procedures:

Wherever possible, employers must reduce the potential for fire by reducing the quantity of flammable materials present and by using fire-resistant or non- flammable materials. Combustible materials include items such as oily rags, plastic, paper, wood and coal dust. These materials can be easily ignited by an ignition source and can rapidly grow into an uncontrollable fire. Good housekeeping minimizes the potential for such a fire to occur. Employers and workers are responsible for being constantly on the lookout for these and any other hazards. The hazard can be mitigated by using fire resistant hydraulic fluids.

9.2 Emergency warning system

Workers must be made aware of fires or other emergencies as soon as they are detected. The emergency warning system in some mines consists of compressed air lines that release a distinctive smelling gas that workers are trained to recognize as an immediate order to evacuate. Faster and more sophisticated communication systems are used in other mines. The types and sophistication of emergency communication systems available vary significantly.

9.3 Hazardous Workplaces

The following are considered “hazardous workplaces:”

- Where the nature of work exposes the workers to dangerous environmental elements, contaminants or work conditions including ionizing radiation, chemicals, fire, flammable substances, noxious components and the like;
- Where the workers are engaged in construction work, logging, fire fighting, mining, quarrying, blasting, stevedoring, dock work, deep-sea fishing and mechanized farming;

- Where the workers are engaged in the manufacture or handling of explosives and other pyrotechnic products;
- Where the workers use or are exposed to power driven or explosive powder actuated tools;
- Where the workers are exposed to biologic agents such as bacteria, fungi, viruses, protozoas, nematodes, and other parasites.

9.3.1 Fire extinguishers:

The fire extinguishers around the campus have been strategically placed by potential hazard, size, and type. In most cases fire extinguishers should be located next to the main door of a room, near an exit door. Fire extinguishers should not be located on the opposite side of the room away from your only means of egress. For health and safety reasons as required by OSHA, only persons who have been trained in the handling, selection, and use of a fire extinguisher shall operate them. The use of the wrong type of extinguisher could cause the fire to spread or the user to become seriously injured.

Fig: signs of different fire extinguishers

A. Types of extinguishers*:*

1. **Pressurized Water** (P/W)- These are normally found in residence halls where cloth, paper, and wood are the most common hazards. They are metallic colored and hold approximately 2 ½ gallons of water. They are capable of discharging a distance of 25' – 30' for approximately 1 minute.
2. **Dry Chemical** (ABC) or (BC) – These are normally found in cars, laboratories, and other places where gasoline, oil, and other combustible/flammable liquids are used. They are usually red in color and are capable of spraying 10' – 15' for approximately 30 seconds.
3. **Carbon Dioxide** (CO2) – These are normally found only in electrical or mechanical rooms where electricity is the hazard. They are used to put out electrical fires while the equipment is still energized. The carbon dioxide extinguishers are red in color, have no gauge to indicate amount of contents, and are limited to a spray distance of 5' – 10' for about 10 seconds.
4. **Halon** - These extinguishers were used for computer room fires in the past, but there use now is questionable because of health risks associated with the halon agents in a fire situation. Amherst College no longer uses this type of extinguisher or extinguishing agent.

B. Types of fires – A, B**, &** C**:**

1. Type A - Cloth, paper and wood that produce **A**sh
2. Type B - Gasoline, oil, and other combustible/flammable material placed in a **B**arrel.
3. Type C - Electrically energized fires involving equipment and **C**ircuits or **C**urrent

C. Fire extinguisher – use:

1. **Check the type of extinguisher**
   - Is it the right type for the fire involved? Check the side of the extinguisher to determine type.
2. **Check the extinguisher for operation**

- Does the extinguisher have an inspection tag, plastic tie, and pin in place?
- Does the pressure gauge needle point straight up, indicating fully charged?

3. **PASS Procedure**
   - **P**ull the pin. – Test the extinguisher to see if it works.
   - **A**im the extinguisher at the base of the fire.
   - **S**queeze the handle to activate the agent.
   - **S**weep across or at the base of the fire depending on the fire type.
4. Never turn your back towards the fire, even if you think it is out.

D. Fire Prevention Plan:

It is the responsibility of each Facilities employee to correct or report unsafe conditions that could cause a fire, hamper emergency egress, or result in a personal injury accident. Therefore, it is the responsibility of each employee to:

1. **Correct certain hazards at the time of discovery**, such as replacing bulbs in exit signs, removing cardboard, paper, and other combustible material from corridors, or taking out chocks from fire and smoke doors. Report discharge or missing extinguishers and burned out emergency lights to the Physical Plant Service Desk.
2. **Notify the supervisor of hazards needing corrective action**, such as hazardous materials left in the corridors, leaking sprinkler heads, potential ignition sources, open (uncovered) electrical panels.
3. **Contact the Environmental Health & Safety Office for corrective action**, such as hazardous materials left in the corridors, leaking sprinkler heads, potential ignition sources, open (uncovered) electrical panels, missing fire extinguishers, or burned out emergency lights.

9.3.2 Evacuation Procedures

Fire and evacuation alarms are intended to alert building occupants that a fire or other life-threatening situation exists. Upon hearing the alarm, everyone should leave the building immediately. In the event of a fire, the following steps should be taken to ensure the safety of all building occupants:

1. Activate the fire alarm.
2. Call 911 immediately and provide information.
3. Assist injured personnel or notify emergency responders of the medical emergency.
4. Exit the building following emergency maps.
5. Assist physically impaired individuals to a secure area and notify emergency responders.
6. Ensure all personnel are out of the building.
7. Do not use the elevators.
8. Use a fire extinguisher only if safe to do so and you have been trained.
9. Assemble personnel at a remote location noted on evacuation maps.
10. Report hazardous conditions.
11. Stay low if confronted with smoke. Check closed doors for heat before opening.
12. Stay away from the building until it is safe to return.

Figure : Explosives vehicle at a mine site with separate explosives receptacles and fire extinguishers.

Self-Check – 9	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for Fire Prevention Plan**?** (3pts)
2. Mention the Evacuation Procedures of hazard.(3pts)
3. List down the Types of extinguishers. (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

LG #34	LO #4- Transport Explosives

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Communicating with other equipment operators and other persons
- Transporting explosives and accessories separately in approved and secured containers
- Applying secure and safe driving conventions
- Checking delivery site suited to explosives storage
- Implementing emergency procedures
- Returning surplus explosives to magazine without delay
- Completing and reporting required documentation to relevant personnel

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Communicate with other equipment operators and other persons
- Transport explosives and accessories separately in approved and secured containers
- Apply secure and safe driving conventions
- Check delivery site suited to explosives storage
- Implement emergency procedures
- Return surplus explosives to magazine without delay
- Complete and report required documentation to relevant personnel

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, see your trainer for further instructions

Information Sheet 1- Communicating with other equipment operators and other persons

1.1 Mining communication:

A communication device is any type of hardware capable of transmitting data, instructions, and information between a sending device and a receiving device. One type of communications device that connects a communications channel to a sending or receiving. Basically mining is a hazardous job involving lot of risks and series of challenges along with the huge investments for equipment and skilled manpower. So a reliable communication platform can reduce the gaps between the effective utilization of the equipment with zero accident potential and also helps in proper management of emergency situations. Communication systems and devices used in effective operation of the mine/pit along with the other connected units like power plant, washery, mineral handling plant, township etc. It also includes the information about truck dispatch system (TDS) for productive utilization of the equipment to achieve the targets .this also includes data management and MIS for managing the business in cost effective manner.

1.2 Classification of communication systems

Communication is the flow of information from one entity to another. Communication Devices

When using electric initiation, there is a possibility of the blasting circuit being energized by the electric field produced by radio transmitters, mobile telephones two ways, etc.

The basic models of communication systems are classified in to:

a. person (s) to person(s)
b. person to machine
c. machine to persons
d. machine to machine

a. Person(s) to Person(s)

Person to Person communication systems includes communication with the help of Telephones, PBX also with connection to PSTN, VOIP (voice-over-internet protocol) phone systems,

Wireless communication devices and Two-way radio communication or walkie-talkies (Fig 1)

Fig 1 Person to Machine

Fig 2Two-way radio communication

b. Person to Machine

This type of communication is mainly required in case Some danger is expected at the working place with the Machine or surroundings. This type of situations is more prevailing in case of underground mining but whereas in Opencast mining such type of situations is very rare and can be dealt easily.

c. Machine to Persons

The classic example for this type of communication is Operator Independent Truck Dispatch

System (TDS), this system will make the effective utilization of the equipment and manpower toavoid unnecessary delays.

The different type of systems covered under this are conveyor alignment tracking, conveyor belt scaling system , In-Line Coal analysis system, Pre indication of Maintenance of the equipment,TDS, Block flow diagrams of different systems currently in operation, Security monitoring systems Environmental monitoring system

d. Machine to Machine

This is fully automated system where personal interference is very limited. This type of systemsis needed for effective control of emergency situations and managing the same. These systemsincludes

- Fire detection/protection system
- Emergency Response/Communication System
- Auto Inter locking between different equipment

1.3 Information and communication technology (ICT)

Basically mining is a hazardous job involving lots of risks and series of challenges along with the huge investment for equipment and skilled manpower. So a reliable communication Plat form can reduce the gaps between the effective utilization of the equipment with zero accident potential and also helps in proper management of emergency situations.

Signal systems

Throughout a blast sequence, the blaster-in-charge and others in the blast area (most particularly the guards) communicate by means of signal systems. Signal systems may range from hand signals and/or shouts, using horns or whistles, to direct radio communication. OSHA mandates that regardless of other means used, there must be an audible warning system as part of the signal system. No matter what methods are used, the signal system must always meet the following minimum standards:

a. It must be simple and understood by everyone in the vicinity. If sign text states a signal sequence, then the system used must match the message in the sign.

b. The system must include an “All Clear” signal, given after the post-blast inspection and distinctly different from the warning signals.

c. The signal system must be a “positive-response” system where the guards can effectively communicate to the blaster-in-charge any need to halt the blast prior to instant of detonation, and the blaster-in charge can effectively acknowledge that communication.

d. The signals must be readily identifiable by the guards, with no risk of confusion about each signal's meaning. For this reason, the use of radio communication is strongly encouraged, while the use of hand signals or voice-only signals (yelling) are strongly discouraged.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements of the signal system must always meet minimum standards?(3pts)
2. Mention the basic models of communication systems.(3pts)
3. What does communication mean? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Transporting explosives and accessories separately in approved and secured containers

2.1 Transportation of explosives

- Transportation of explosives shall meet the provisions of the Department of Transportation regulations
- Motor vehicles or conveyances transporting explosives shall only be driven by, and be in charge of, a licensed driver who is physically fit. He shall be familiar with the local State and Federal regulation governing the transportation of explosives..
- No person shall smoke, or carry matches or any other flame-producing device, nor shall firearms or loaded cartridges be carried while in or near a motor vehicle or conveyance transporting explosives.
- Explosives, blasting agents, and blasting supplies shall not be transported with other materials or cargoes. Blasting caps (including electric)shall not be transported in the same vehicle with other explosives.
- Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty, and shall be in good mechanical condition.
- When explosives are transported by a vehicle with an open body, a Class II magazine or original manufacturer's container shall be securely mounted on the bed to contain the cargo
- All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood or other non-sparking material to prevent contact with containers of explosives.
- Every motor vehicle or conveyance used for transporting explosives shall be marked or placarded on both sides, the front, and the rear with the word "EXPLOSIVES" in red letters, not less than 4 inches in height, on white

background. In addition to such marking or place carding, the motor vehicle or conveyance may display. Must in such manner that it will be readily visible from all directions, a red flag 18 inches by 30 inches, with the word “EXPLOSIVES” painted, stamped, or sewed there on, in white letters, at least 6 inches in height

- Every vehicle used for transportation of explosives shall be equipped with a fully charged fire extinguisher, in good condition. The driver shall be trained in the use of the extinguisher on his vehicle
- Motor vehicles or conveyances carrying explosives, blasting agents, or blasting supplies, shall not be taken inside a garage or shop for repairs or servicing.
- No motor vehicle transporting explosives shall be left unattended.
- Explosives carried in a vehicle must be in a fully enclosed, locked, fire resistant fixed container or compartment, separate from the passenger compartment.
- Detonators and electric igniters must be transported in their original containers as shipped by the manufacturer
- Detonators must be adequately separated from other explosives during transport.

2.2 Marking of Containers

Original containers or authorized containers must be used for taking detonators and other explosives from storage magazines to the blasting area. All containers with hazardous substances shall be properly labelled. No employer within the scope of this Rule shall accept any container of hazardous substances for use, handling or storage unless such containers are labelled. Labels shall contain the following information:

- Symbol of the relevant category of hazard of the substance contained; categories of hazards shall be explosive, flammable, oxidizing, toxic, corrosive and radioactive.
- manufacturer name may be used in addition to the chemical name of the substance;
- a description of the principal risk or risks;

- a statement of the necessary precautions to be taken; and
- If necessary, a statement of the first-aid or other simple measures to be taken in case of injury or emergency.

Fig: rescue container

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the procedures of Transporting explosives and accessories ?(3pts)
2. What is the importance of marking of containers? (3pts)
3. Define what a container mean. (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Applying secure and safe driving conventions

3.1 Safety procedures

There are several precautions that will be in place for the safety of the workers in the mine. While the mine supervisor holds senior authority over the workers, blasters have complete authority to control all activities at the mine site during blasting.

Key factors which will be implemented for ensuring that evacuation processes are well managed include:

- Effective communication with mine personnel prior to blast;
- Clearly defined safe distances from blast site;
- Effective barricading of entrances to blast sites;
- Blaster will only leave the blast site last after checking that the site is clear and connecting the initiating
- detonator; Blaster will confirm that all blasting guards are in place and that all is clear prior to initiating the blast,
- A smooth floor will provide a safe work area for the drilling and blasting crew;
- The blast pattern will be staked by the mine surveyors and blaster in accordance to the engineers'
- design; Access to the blast pattern will be attained from the blaster in charge;
- The pattern will be drilled in the sequence prescribed by the blast supervisor;
- Loading will be under the direction of the blaster in charge of the pattern; The blaster will follow the loading quantities of the engineered design;
- Modifications due to field conditions will be noted and reported;
- The explosives contractor will deliver the bulk product to the hole and track the quantity; and
- The blaster will sign for the delivery and file all paperwork for each blast undertaken

3.2 Safely transporting explosives on site;

Particular care is taken when transporting explosives on site, and only appropriate methods are used.

Vehicles used for transport of explosives on site should be constructed of materials suitable for the type of explosive being carried to avoid inadvertent contamination or contact between incompatible substances.

All movements of explosives around the site should be properly supervised to ensure that:

- Vehicles and people carrying explosives can be clearly identified;
- The explosives can be identified as such;
- The explosives are never left unattended;
- Explosives are not placed, however briefly, where they could be inadvertently mixed up with other goods, especially flammable products;
- Packaging containing explosives is not inadvertently handled by staff unaware of their contents;
- Explosives leaving the site are loaded immediately before the vehicle is due to depart; and
- Explosives arriving on site are unloaded into safe storage as soon as practicable.

3.3 Securing and storing explosives:

A person who stores explosives must ensure that any storage of explosives—

- Is kept securely locked, except when it is required to be open for purposes relating to its use or management; and
- Is kept in a secure building or container that is locked, and is separate from buildings in which persons live.
- A person who stores explosives other than consumer fireworks must ensure that any container used to store explosives is kept securely locked, except when it is required to be open for purposes relating to its use or management.

Fig 1: Danger area

Safe and correct procedures for carrying out blasting operations include:

- Pre-checks,
- Environment monitoring,
- Loading explosives and primers
- setting-up the initiation system,
- checking initiation circuits,
- Carrying out shot-firing
- Determination and treatment of misfires
- Post-blast checks and monitoring
- Reporting and recording is done in accordance with legal requirements

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. How can you explosives to be kept secure.(3pts)
2. Write down the safety procedures who stores explosives? (3pts)
3. List some of the factors for ensuring that evacuation processes. (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 4- Checking delivery site suited to explosives storage

4.1 Storage of Explosive Materials:

- Magazine sites must be labeled with appropriate warning signs that indicate the contents and are visible from each approach. The signs shall be placed so that a bullet passing through them will not strike the magazine. The magazines areas shall be fenced and locked with a single lock.
- Magazines shall be secured in accordance with MSHA regulations.
- Only explosive material and essential non-sparking equipment (pens and inventory records) used for the operation of the magazine may be stored in the magazines.
- Metal magazines will be grounded and equipped with electrical bonding connections between all conductive portions so the entire structure is at the same electrical potential.
- Ground checks shall be conducted on the blast magazines
- All explosive material must be stored in approved magazines
- Magazine keys shall be kept in the key card box and accessed only by authorized personnel approved by the Blast Foreman.
- Metal magazines will be grounded and equipped with electrical bonding connections between all conductive portions so the entire structure is at the same electrical potential.
- During manufacture and storage, appropriate measures are taken to:

- prevent an unplanned fire or explosion;
- limit the extent of fires or explosions;
- prevent fires spreading;
- stop explosions communicating from one place to another; and
- protect people from the effects of a fire or explosion

4.2 Location of magazine:

When siting a magazine the risk management process can be carried out to identify hazards that may arise from its proximity to public installations, facilities and roads. Risk acceptability should be evaluated based on the quantity of explosives stored in the magazine (magnitude of the hazard) and the possible consequences of an unplanned explosive incident.

4.3 Safe Inspection of Explosives Magazines:

- Persons entering the magazine should not carry Cellular Phones, Pagers, Wireless Instruments, Cigarettes, Matches, Lighters, Knives, other Articles made of Iron/Steel, Substances of Flammable Nature liable to spontaneous ignition or to cause/communicate fire/explosion such as Acids, Petroleum, Calcium Carbide & Compressed Gases.
- Storage/existence of the above mentioned items and smoking should also be avoided within the 15 metres of radius of Explosives Magazine.
- Use of Boots/Shoes with exposed nails or shod at the base should be strictly avoided inside the magazine.
- Numbers of person entering into the magazine should not exceed 2 Nos. during inspection.

- Prior to inspection, magazine shall be well ventilated by opening the windows and doors for at least 10 min.
- Operation/inspection of magazines should be avoided, whenever a thunderstorm appears to be imminent in the vicinity of a magazine. On such occasion, every person engaged in such magazine should be withdrawn to a safe distance and such magazine should be kept closed & locked until the thunderstorm has ceased.
- Person who has not completed the age of 18 years, person in a state of intoxication and person who is of unsound mind should not be taken inside the magazine.
- Routine inspections of Explosives Magazines should be carried out only between the hours of sunset and sunrise.
- In case of opening explosives boxes, the opening tool must be of wood, brass, copper or bronze, since use of tools made of iron is prohibited.
- During inspection, the packages containing the explosives should not be thrown or dropped down or rolled or pulled along the ground or floor but shall be passed from hand to hand carefully.
- Where a package is to be slung, due precaution should be taken to slung it in such a manner as effectively to prevent the possibility of a fall.
- Packages containing explosives should not be allowed to remain in the sun or exposed to excessive heat, during inspection.
- During physical examination of explosives: a) Avoid use of Wristwatch and Rings. b) Use non-synthetic dress materials; i.e., ideally cotton. c) Be on bare foot or with boot made up of conducting rubber.

- The explosives products namely: Gunpowder; Slurry/Emulsion Explosives Cartridges; Boosters, Safety Fuse and Detonating Cord shall be stored together in one room of the magazine.

- Detonators should never be stored along with the above-mentioned explosives. Detonators shall be stored in a separate room of the same magazine separated by an air gap of 1.5 mt followed by concrete/brick wall of thickness not less than 60 cm.

4.4 Checking delivery site to explosives storage

You should check that loaded dangerous goods have not moved and that the packages/containers are not leaking. If there is a spillage follow cleaning instructions described in the attached documents. Dangerous goods can be delivered only to the authorized persons and should not be left without observation. Check that the name(s) of the goods and the amounts correspond to those in documents. Supervise the unloading to avoid an overflow. Do not forget to give the documents to the receiver of the cargo and remember to remove the placards when they are no longer needed. When used for temporary storage at a job site for blasting operations, magazines shall be located away from neighboring buildings, railways, highways and other magazines. Portable magazines for transporting small amounts of explosives from the permanent magazine to the work site and for temporary storage in the work site shall be constructed or built of 5 cm. (2 in.) hard wood or 7.5 cm. (3 in.) soft wood, well braced at corners, with sheet metal exterior sheating.

Fig 1: Explosives

4.5 Management of explosives on site

A risk assessment is to be carried out to identify hazards that may arise with the arrival of an explosives vehicle onsite. Explosives vehicles should arrive on site in a location that ensures the magnitude of the hazard and nature of the consequences are reduced to an acceptable level. Safe allocated stopping areas are required to reduce the vehicles proximity to populated areas, ignition sources and staff working areas.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements for Safe Inspection of Explosives Magazines?(3pts)
2. List down some of the procedures to Store Explosive Materials.(3pts)
3. How can you Check delivery site suited to explosives storage? (4)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Information Sheet 5- Implementing emergency procedures

5.1 Emergency equipment and procedural requirements:

Emergency procedure guide to be written and provided to driver of vehicle and attached, or located adjacent to, the inside of the driver's door in a clear position. A telephone service to be provided and attended at all times while explosives are aboard a road vehicle so that technical advice about the hazards and management of the explosives is readily available, and a suitably trained person can attend the scene if requested by a dangerous goods officer or an officer of the emergency services.

Emergency instructions

- When the alarm sounds, evacuate the building IMMEDIATELY.
- Respond as directed by alarm system or persons who are in control. Do not question whether an alarm or warning is actual, simply evacuate.
- Keep calm; do not shout during any emergency. Panic will injure more persons than a fire or an explosion.
- Follow the directions of the individual(s) in control of your location. If necessary, take control and assume responsibility of your respective area.
- Be aware of any disabled or challenged persons within your area. Discuss these procedures with them before an incident occurs.
- Do not utilize the phone system – except to report casualties.
- Do not use the elevators.

- Before explosives are transported, the employer must establish suitable written emergency procedures, and must ensure that all workers who may be affected are adequately instructed in the procedures.
- A person operating a vehicle that is transporting explosives

- must operate the vehicle in a safe manner, consistent with prevailing road and weather conditions, a
- Must not drive faster than 90 km/h (55 mph).

Fire Fighting Equipment

As required, fire hydrants and on site fire installations should be positioned at the magazine access or immediately inside the magazine. It should be noted that in the case of an actual explosive burning no attempt is to be made to fight the fire. Fire fighting equipment is located in the magazine to prevent the possible spreading of a fire to an explosive. Selection of suitable fire extinguishers and hydrants is dependent on the hazards present within the magazine area. The suitability of an extinguisher for uses on fires that involve paper, wood, liquids or electrical equipment can be determined e.g. dry powder, water. Fire hydrants should be clearly marked and have a service tag. Best practice is to advise the local fire brigade and other emergency services of the magazine's location.

Figure : Firefighting equipment clearly accessible inside the magazine perimeter


EMERGENCY PROCEDURES
State that you are at UMass Amherst, Building _____, Room/Floor_____
If you find yourself in harm's way, take fast and decisive action.
ACTIVE THREAT/SHOOTER
RUN
IF A SAFE PATH IS AVAILABLE
Have an escape route and plan in mind
Leave your belongings
Prevent others from entering the area
HIDE
IF YOU CAN'T GET OUT SAFELY
Silence your phone
Lock/barricade doors
Stay out of shooter's view and be quiet
FIGHT
ONLY AS LAST RESORT
Be physically aggressive
USE improvised items as weapons
Fight with all-out commitment
Fight to incapacitate the shooter
CALL 911 WHEN IT IS SAFE TO DO SO
Information You Should Provide:
- Location, physical description, and number of shooter(s)
- Number and type of weapon held by the shooter(s)
- Number of potential victims at the location
When Law Enforcement Arrives:
- Remain calm and follow officers' instructions
- Keep hands visible at all times
- Avoid making quick movements, pointing, screaming, and/or yelling
SUSPICIOUS Behavior OR Activity
DO NOT physically confront a suspicious person or handle a suspicious package
DO NOT let anyone into locked buildings/offices
Note the person's description and suspicious activity
CONTACT UMass Police and provide as much information as possible about the situation. Call UMPD or 911
EMERGENCY
Police / Fire / EMS
911
911 CALLS made on your cell phone will be answered by Massachusetts State Police.
It is recommended that you have UMass Police (UMPD) saved on your phone at 413-545-3111.
NON-EMERGENCY
UMPD(non-emergency): 413-545-2121
Facilities Solution Center: 413-545-6401
EH&S: 413-545-2682
SEVERE WEATHER
SEEK SHELTER indoors away from windows
TAKE COVER against interior wall
Stay away from large objects that may fall
If unable to find shelter when storm hits, lie down flat and cover head with hands
Monitor campus advisories and media
CHEMICAL SPILL
ALERT all persons nearby
SECURE area and do not attempt to clean
EVACUATE to a safe area
Call Environmental Health and Safety (413-545-2682) or UMPD
Call 911 if spill is large or presents significant hazard
NOTIFY emergency personnel if you have been exposed or have information about the release
FIRE
ACTIVATE nearest fire alarm
EVACUATE building using nearest exit: DO NOT use elevators
Call UMPD or 911 to report location of fire
Meet at designated assembly area
MEDICAL
Call UMPD or 911
PROVIDE the location, nature of injury or illness, current condition of the victim, and other requested information
DO NOT move the victims unless they are in immediate danger
If trained, administer first aid, CPR/AED

5.2 Blasting Safety Measures:

Blasting safety procedures are described below for blasting on quarry operations:

- No unauthorized person is allowed inside a posted blast area whether the holes have been loaded or not;
- The Blasting Supervisor and the Blaster are responsible for the safe handling, loading and connection of a blast;
- The Shift Supervisor is responsible for the evacuation of all personnel and equipment from the blast area and the guarding of the blast;
- The Project Superintendent is responsible for notifying the appropriate personnel, aerodromes, and other departments and personnel who may be affected by a particular blast;
- Once guards are posted, the blast area must be inspected by the shift supervisor to ensure that no personnel or equipment remain inside the blast area;
- A blast-warning siren will be sounded for one (1) minute; three (3) minutes after this, the blast will be fired;
- The blaster will only fire the blast when given a direct verbal order to do so by the shift supervisor;
- Before firing a shot, the blaster must ensure the immediate area is clear (i.e. aircraft, etc.); and radio silence is maintained
- The Shift Supervisor and blaster will inspect the fired shot for indications of any problems such as misfires or cut-offs;
- Areas in which charged holes are awaiting firing shall be guarded or posted against unauthorized entry;
- Vehicles containing explosives shall not be taken to the repair shop or any other building for any purpose; no open flames or welding are to be used for field repairs unless explosives are first removed;
- Down hole initiation lines must be attached to a stake planted in the cuttings on all holes;

- All loaded patterns, in addition to being marked with blasting signs, shall be clearly delineated to outline the pattern;

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the Requirements of health and safety legislation?(3pts)
2. Mention some of the Emergency procedures.(3pts)
3. What is the importance of applying Emergency instructions? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 6- Returning surplus explosives to magazine without delay

6.1 Disposal of Surplus Explosives:

Regulation of the Safety, Health and Welfare at Work (Quarries) Regulations state that no person, other than an explosives supervisor, a shot firer or trainee shot firer, shall dispose of surplus explosives, detonators, accessories or packaging remaining following shot firing operations at a quarry.

Any surplus explosive (including detonators) must be removed from the blast area before any attempt is made to fire the shot. The shot firer must ensure that surplus explosives are not left unattended.

Surplus explosives should be returned to the explosives store or returned to the manufacturer/supplier. It is often very expensive and logistically difficult to return explosives to the manufacturer/supplier so where this is not possible the explosives should be destroyed by the shot firer in accordance with the manufacturers/supplier's instructions and guidance.

Consideration should be made of the controls that could be implemented to mitigate the effects of not only any destruction activity where it is expected that noise will be generated but also those that have the potential to result in an explosion or other significant noise. These could include:

- Destroying explosives in the smallest unit quantity conducive to the control of the explosive risks such that the potential impulse of any blast effect is minimized
- The use of blast mitigation systems.
- Designing the disposal location such that the effects of any explosion are contained absorbed or deflected.
- The application of exclusion zones.
- The soundproofing of occupied buildings including those provided as refuges

- The provision of suitable hearing protection to employees.

Where the only reasonably practicable disposal technique is one where the balance of risks are such that an explosion is to be expected it will be necessary to ensure that persons are located at distances that will prevent them being exposed to noise above the relevant action levels or to ensure that they are otherwise protected from the effects of noise.

Where such disposal activities take place on a routine basis it is expected that they would be subjected to routine noise monitoring.

6.2 **Explosives management plan** (EMP):

An explosives management plan must be prepared for all licensed explosives storages. Completion of the associated template will satisfy the requirement to submit an EMP with the licence application. If further evidence is required for assessment, verification of the measures in place may be requested. The EMP describes how the license holder ensures safe and secure operations in relation to the storage of explosives. The operations must be documented, communicated to all relevant persons, implemented, enforced and reviewed regularly and when circumstances change.

The EMP includes:

- a site plan showing the location of the storage in relation to buildings and other structures on site, roads, buildings on neighboring properties (a second, more detailed, site plan of the storage compound showing separation distances within the compound and to the fence is also recommended)
- the measures that will be taken to ensure the required details of any explosive received at, or despatched from, the site are recorded and reconciled with the required details of any explosive on the site
- the measures that will be taken to ensure no explosive at the site is supplied to a person unless the person is an authorized person
- the measures that will be taken to ensure a record is kept of the details of any person to whom an explosive at the site is supplied and the person's authority to possess the explosive

- what measures will be taken to ensure any unlawful entry or attempted unlawful entry to the site or any theft, attempted theft or unexplained loss of any explosive is investigated and reported to the chief officer
- general matters (including emergency management plans, incident reporting, training, monitoring and record keeping)
- security matters (including the assessment, minimisation and monitoring of security risks)

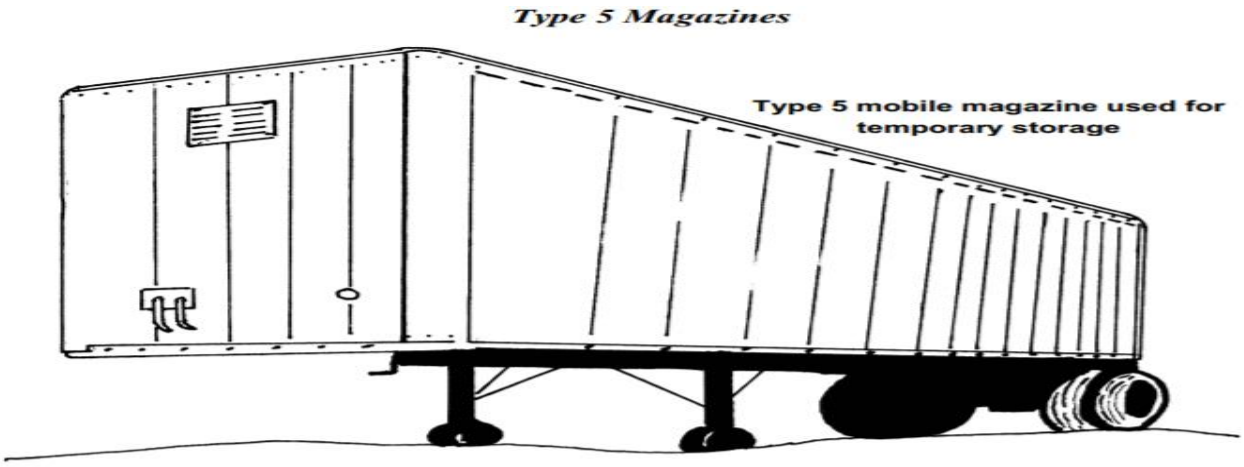


Fig1: Magazine

6.3 Excess explosives:

The carrier bringing explosives to the site may have explosives onboard, and in transit, that are to be delivered to other mine sites. These excess explosives represent an additional hazard and the site senior executive is responsible for the additional risk, whilst the explosives are on this mine. Best practice is for an exact record of all explosives in the consignment to be provided to the site senior executive before entry to the mine site is authorised.

Self-Check –6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention some of the Explosives management plan. (3pts)
2. What does Surplus Explosives mean? (3pts)
3. How can return surplus explosives to magazine without delay? (4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 7- Completing and reporting required documentation to relevant personnel

7.1 Reporting of accidents and incidents:

- A manager should have a report within forty-eight hours after an accident or incident involving explosives report the accident or incident by means of telephone, facsimile or any other appropriate method of communication to the nearest Inspector and police station and shall within seven days of the incident confirm the report in writing, stating full particulars of the incident to the Chief Inspector.
- A person shall not interfere with a site, where an accident or incident involving explosives has occurred, with or without the permission of an Inspector.
- Manager shall report an accident or incident within twenty four hours after the occurrence of the accident or incident if the accident or incident.

If a blasting accident occurs which causes personal injury, or if there is any other dangerous incident involving explosives, whether or not there is personal injury, the employer must

- Report the incident immediately to the Board, and
- Forward a written report of the incident to the Board without undue delay.

The written report of the incident must contain the following components:

- The date, time and location of the incident,
- The names and certificate numbers of all blasters involved,
- The names and occupations of any persons injured,
- The types of explosives, including detonators, and initiating device used,
- A factual account of events including the blaster's log records,
- The names of all employers responsible for workers present at the worksite when the incident occurred, and

-

7.2 Safe Inspection of Explosives Vans

- The explosives van should be stationed in a non-congested location during inspection, where the public safety is not endangered.
- When a convoy of two or more vans carrying explosives is inspected, they should not be stationed together for inspection.
- When an explosives van containing explosives need to be parked over night due to the reasons beyond control, the same to be communicated by the Driver to the nearest police station and the premises in which the van is parked—
- If any fire occurs on a vehicle containing explosives, all other traffic should be stopped at least 300 meters from the vehicle and that all persons in the vicinity should be warned of the danger.
- A van transporting explosives is involved in an accident, fire or any other occurrence, which causes a significant delay in the delivery of explosives or damage to the vehicle or explosives
- Use of Boots/Shoes with exposed nails or shod at the base should be strictly avoided inside the explosives van.
- Persons inspecting vans carrying explosives should not carry Cellular Phones, Pagers, Wireless Instruments, Cigarettes, Matches, Lighters, Knives, other Articles made of Iron/Steel, Substances of Flammable Nature liable to spontaneous ignition or to cause/communicate fire/explosion such as acids, Petroleum, Calcium Carbide & Compressed Gases.
- During physical examination of explosives carried in a van:
    - ✓ Avoid use of Wristwatch and Rings.
    - ✓ Use non-synthetic dress materials; i.e., ideally cotton.
    - ✓ Be on bare foot or with boot made up of conducting rubber.
- In case of handling of explosives from a van, no bale hooks or other metal tools should be used for the loading, unloading or handling of packages containing explosives. On such events, the loading/unloading/handling of explosives in the

explosives van is commenced, the operation should not be stopped until completed and shall be completed as expeditiously as possible.

- Packages containing explosives should not be allowed to remain in the sun or exposed to excessive heat, during inspection.
- Detonators should never be transported along with the any other explosives.
- Explosives should not be transported in any towed vehicle or tow any vehicle transporting explosives.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of Report of accidents and incidents?(3pts)
2. What does explosive mean? (3pts)
3. How can report required documentation to relevant personnel?(4pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Operation Sheet-1	carrying out blasting operations

Procedures carry out blasting operations

steps	operations
1	Performing preoperational checks
2	Environment monitoring
3	Loading explosives and primers
4	setting-up the initiation system,
5	checking initiation circuits,
6	Carrying out shot-firing
7	Determination and treatment of misfires
8	Post-blast checks and monitoring
9	Reporting and recording

LAP Test 1	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Use all necessary tools, equipment and materials that you require to perform the following tasks within **2hour**

Task 1: carry out blasting operation with given 2 hrs.

Reference Materials

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- Good practice guide for the safe storage of solid technical grade ammonium nitrate www.safex-international.org/_index.php
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- Ministry of Defence explosives regulations JSP 482 MOD 2013 www.gov.uk/government/collections/jsp-482-mod-explosives-regulations?
- RIIWHS201D Work safely and follow WHS policies and procedures

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The trainers who developed this learning guide

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