



GUIDELINES FOR THE SAFE USE, STORAGE, AND DISPOSAL OF EXPLOSIVES IN UNDERGROUND MINES AND TUNNELS

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NOTE: These guidelines have been superseded by the Health and safety at opencast mines, alluvial mines and quarries Good Practice Guidelines available on the MinEx website. However, this document contains information you may still find valuable.

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1.0 EXPLOSIVES

- A. This guide is intended to provide reference material for persons who are Approved Handlers for underground shot-firing. It supports and should be read in conjunction with the Industry Code of Practice for Underground Mining.
- B. It does not cover technical information or blasting practices for the wide variety of blasting applications, and only provides basic information about the safe use of explosives, and the relevant legal requirements.

2.0 HAZARDOUS SUBSTANCES AND NEW ORGANISMS ACT 1996

- A. The Hazardous Substances and New Organisms (HSNO) Act 1996 was introduced to reform the law relating to the management of hazardous substances and new organisms in New Zealand. All explosives, initiation devices, storage and handling come under the HSNO Act and associated regulations. The relevant authority for the HSNO Act is ERMA New Zealand. The enforcement agency for places of work is the Department of Labour. Land Transport Safety Authority (LTSA) control transportation on roadways.

3.0 APPROVED HANDLERS

- A. The HSNO Act requires that all handlers and users of explosives have an "Approved Handlers" certification. In this Guideline, the term "Shot-firer" is used interchangeably with the term "Approved Handler" in relation to use of explosives.
- B. The HSNO regime prescribes certain qualifications that a handler must meet to qualify for a test certificate as an Approved Handler. These qualifications include knowledge of the HSNO regime and a working knowledge of the practical use of explosives.
- C. The Approved Handler certificate can only be issued by an authorized Test Certifier appointed under the HSNO Act. The certificate will specify the conditions of issue.
- D. All class 1 substances in any quantity (with some exceptions) must be under the personal control of an Approved Handler, or be being handled by a person under the



direct supervision / guidance of an Approved Handler, or secured (under lock and key). An Approved Handler is a person who holds a current test certificate certifying that he or she has met the competency requirements specified within the HSNO (Personnel Qualifications Regulations) 2001 in relation to handling class 1 explosives and related substances.

3.1 As an Approved Handler you must also have a good working knowledge of the following:

- A. Equipment and instruments used for testing and carrying out explosive charges.
- B. Safe and correct techniques for storing, handling, transporting explosives and related substances.
- C. Safe and correct procedures for carrying out blasting operations including;
 - a. Pre-checks,
 - b. Environment monitoring,
 - c. Loading explosives and primers,
 - d. Setting-up the initiation system,
 - e. Checking initiation circuits,
 - f. Carrying out shot-firing,
 - g. Determination and treatment of misfires
 - h. Mixing of explosives – ANFO, for operation where it applies
 - i. Post-blast checks and monitoring,
 - j. Reporting and recording in accordance with legal requirements.
- D. Disposal of unwanted or damaged/deteriorated explosives.
- E. The employer is required to record and verify details of the Approved Handler's certification, including, his name and address, his certificate number, all conditions/restrictions, and the expiry date. Most employers retain a copy of the Approved Handler's certificate. The original must be kept by the Approved Handler(s) and be readily available to be produced on request of an enforcement officer.

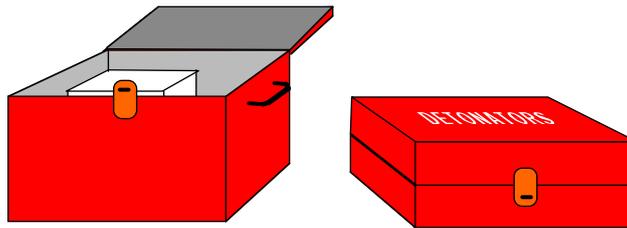
4.0 PROCEDURES

- A. The Health & Safety (Mining Underground) Regulations 1999 require that “explosives are not taken into or used in a mine or tunnel unless procedures relating to storage, transportation, and use are in place and complied with.”
- B. Procedures for the following should be developed:
 - a. Storage, stock rotation, and expiry of explosives
 - b. Transport of explosives

- c. Charging of explosives
- d. Initiation of explosives
- e. Treatment of misfires
- f. Disposal of unwanted or deteriorated explosives
- g. Mixing of explosives – ANFO
- h. Emergency procedures

5.0 STORAGE OF EXPLOSIVES

- A. When not being used in a blast or being transported, all explosives and detonators (any quantity) must be securely stored under lock and key and separate from any dwelling. Only an Approved Handler should have access to the keys. When the quantities of 0.2kg of class 1.1B detonators and / or 2.5kg of class 1.1D explosives (packaged explosives, detonating cord and (ANFO) is exceeded, containers (“magazines”) must be of an approved and sound construction standard (compressive strength of at least 500kN/m²), with a lining that is non-sparking, and have a lock with a tensile strength of 1250kN/m².



- B. When quantities of 1kg of detonators and / or 5kg of explosives are exceeded, a “Hazardous Substance Location” must be established and the location (on a plan), capacity / quantity and person in charge / Approved Handler notified to an Enforcement Officer (Department of Labour) before use.
- C. When the quantities of 5kg of detonators and / or 50kg of explosives are exceeded, a Location Test Certificate issued by a Test Certifier is required for the magazine.
- D. *AS 2187.1 – 1998 – Explosives –Storage, Transport and Use -Part 1 - Storage* prescribes both construction materials for the magazines and methods to secure explosives against theft. Explosives and detonators must be segregated when stored.
- E. Approved Handlers must kept accurate and updated records of magazine stocks. The records should include;
- a. The description including name and quantity of each item stored in the magazine.
 - b. Quantity of each item removed for a daily job.
 - c. Quantity of each item returned upon completion of job.
 - d. Running total of quantity of stocks on site.

- F. Regular stock-takes should be completed to confirm no explosives have been lost or stolen.
- G. Any explosives taken underground should be in no larger quantities than what would be reasonably expected to be used during the shift. Surplus explosives should be collected, packed into their respective carrying cases and returned to the main magazine or secure storage area.
- H. Empty explosives boxes should have the hazard diamond removed and be safely destroyed or disposed of. They must not be used to contain other objects.
- I. The person in charge of new explosives magazines should ensure a proper rotation; it should be on a first-in, first-out basis.

6.0 TRANSPORT OF EXPLOSIVES

- A. Some of regulatory and other requirements for transportation include:
 - a. All class 1 substances are prohibited from carriage on any public transport vehicle.
 - b. Notification to LTNZ of the intended route and times of transportation on a public road (if over 50kg of explosives)
 - c. Ensuring that the substance is under the control of an approved handler or secured.
 - d. Ensuring that the explosives are not exposed to high levels of impact or pressure shock, spark energy or heat.
 - e. Exclusion of unessential personnel.
 - f. Detonators and explosives may be carried in the manufacturer's packaging cases.
 - g. Adequate and suitable fire extinguisher(s) must be carried in the explosives vehicle.
 - h. No detonators may be carried with explosives unless they are effectively separated.
 - i. There must be no smoking in or around the vehicle.
 - j. Vehicles containing explosives must never be left unattended, must never be overloaded, and should only contain explosives for the job at hand.
 - k. Loaded explosive vehicles must never be taken to workshops or store areas and no maintenance or repair should commence on a vehicle containing explosives.
 - l. Explosives vehicles must not be used to convey miscellaneous passengers or equipment.



- m. The explosives transporting vehicle (on a road) must have 250 mm Class 1 diamond placards front and rear if over 50kg
- n. The driver must also have a hazardous substance licence endorsement if over 50kg and transporting on a public road.

7.0 CHARGING OF EXPLOSIVES

- A. Every blasting operation must be conducted or directed by an Approved Handler (Shot-firer) who controls and is responsible for all aspects of the work. His authority covers all assistants, workers and equipment in the area which is known as the “blasting area” or “Designated Use Zone”. He must also ensure that a “Controlled Zone” (CZ) is established. A CZ means an area abutting a hazardous substance location that is regulated so that within the zone, the adverse effects of a hazardous substance are reduced or prevented; and beyond the zone, members of the public are provided with reasonable protection from those adverse effects.
- B. To avoid conflict when more than one certified shot-firer is involved in a blasting operation, the employer (person in charge) is required to designate one shot-firer (approved handler) responsible for conducting the shot-firing. The designated shot-firer must have authority to safely conduct and direct activities within the blasting area. The employer and supervisors must support the shot-firer in exercising this authority.
- C. A blasting area will be determined by site specific rules, although must be no less than 15 metres from the nearest assembled charges in all directions from any place in which explosive materials are being prepared or placed, or where an unexploded charge is known or believed to exist.
- D. No work shall be done within the blasting area without prior approval of the shot-firer. No person shall enter the blast area without first gaining permission from the shot-firer. Furthermore, if an activity or condition outside the blasting area endangers any person engaged in the operation, the shot-firer must take corrective action.
- E. During priming, placing, and connecting charges, only the shot-firer and his assistant(s) should remain in the blast area. No other person is allowed entry unless the shot-firer gives permission, and maintains control over that person’s activities. Appropriate signage used to restrict entry of unauthorised personnel.
- F. Before commencing charging operations, establish a safe, accessible position to place all explosives items that will be required as charging proceeds. This place must be away from machinery movement, dry and obvious to others who may enter the area. Detonators and explosives must not be left here in an assembled state until immediately prior to use.
- G. No hole should be charged when another hole is being drilled or a potential ignition source is present within 15 meters.
- H. There shall be no smoking, naked light, or machinery likely to generate heat or sparks within 15m of holes being charged.

- I. Tamping rods of suitable length of wood or other non-metallic material should be used for tamping. Where a Tamping rod is used for inserting a charge, the ends shall be kept clean and square and the rod shall be thoroughly clean of any adhering grit. AS2187.2-5.5.4
- J. No cartridge of explosives should be forcibly pressed into any hole and it should not be loaded unless it has a diameter of at least 6mm greater than the diameter of the cartridge to be used.
- K. When loading a hole with explosives or tamping the charge, only a purpose designed wooden (or other substance not being ferrous) rod, of good shape and condition, should be used and the primer should never be tamped. Tamping should commence lightly but may be gradually increased in force until the hole is filled. No cartridge of explosive should be forcibly pressed into any hole and it should not be loaded unless it has a diameter of at least 6mm greater than the diameter of the cartridge to be used. If a charge gets stuck, do not use force to remove it.
- L. When stemming is used, it should be dry sand or other inert material only.
- M. No greater number of holes should be than is intended to be fired in one blast unless the shot is to be "slept" in which case it should be barricaded off with signs to prevent access to the area. In all other cases, charged holes that are not fired or exploded in that blast should be treated as misfires.
- N. In addition to the general requirements outlined above, the following applies to underground coal mines.
 - a. No explosive or detonator should be used in an underground coalmine unless it is designated as "Permitted."
 - b. Detonators used for multiple shotfiring should be of the "Carrick" type and connected into the round in a simple series. The delay duration for any round of shots should not exceed 0.04 seconds.
 - c. No person should fire any shot unless, in addition to being a certified Approved Handler, he or she is the holder of the NZQA Unit Standards 21281 – Test for gas in an underground extraction site and 8921 - Design blast layouts and carry out shot-firing in underground coal mines.
 - d. A quantity of fresh air, sufficient to ensure continued compliance with R.3 of the Health and Safety (Mining Underground) regulations 1999 and sufficient to ensure that the working place is free from flammable gas, should be maintained constantly.
 - e. Prior to firing the shot in an underground coal mine:
 - i. Unless the mine is naturally wet throughout, or if the working face is being mined hydraulically, the working place and adjacent areas within a 5m radius should be heavily stone dusted to ensure that any coal dust present is rendered harmless.
 - ii. A competent person should check the working place and all accessible adjacent areas within a 40m radius for flammable gas. If gas is detected during this examination, it should be cleared immediately and re-checked and found to be clear before the shot is fired.

8.0 INITIATION OF EXPLOSIVES

- A. No person should fire any shot unless, in addition to being a certified Approved Handler and authorised in writing by the manager, he or she is the holder of the NZQA Unit Standard 8920 - Design blast layouts and carry out shot-firing in underground matalliferous mines and tunnels.
- B. The person firing the shot should, before doing so, see that all persons in the vicinity have taken proper shelter from projectiles, noise (air blast), vibration, dust and fumes, and they should also take suitable steps to prevent any person approaching the shot. These steps should include:
 - a. Signs (to indicate firing times and to exclude unauthorized access).
 - b. Audible signals (distinct from other sounds or signals).
 - c. Barricades and/or sentries at all places of ingress to ensure no traffic enter the area.
 - d. In the case of coalmines, an inspection is carried out to ensure every place in a 40 metre radius of the shot is free from flammable gas and that steps have been taken to ensure coal dust on the floor, roof and ribs is rendered harmless.
- C. The shot-firer is responsible for posting "sentries" to prevent access to the danger area. Warning signs, barricades, or other obstructions do not substitute for a guard. Only competent persons should be assigned to a sentry. Sentries should have the ability to verbally communicate with the shot-firer prior to firing of the blast.
- D. Duties and responsibilities of sentries include:
 - a. Staying at his post;
 - b. Giving warning signals;
 - c. Prevent persons from entering the blast zone for whatever reason;
 - d. He is not to re-enter or permit re-entry to the blast zone until the all clear signal is given
- E. The authorised shot-firer should fire from a safe position (to have been defined by the manager in terms of safe firing distances or locations). The following process should be used for electrical initiation:
 - a. Couple up the firing line to the detonator wires before coupling the firing line to the firing apparatus
 - b. Take care to prevent the firing line coming into contact with any power cables
 - c. Test the circuit using an approved blasting ohmmeter or other approved blasting circuit tester
 - d. Couple the firing line to the firing apparatus when all persons are clear
- F. All two-way radio communication should be silenced in the period immediately prior to blasting and during blasting itself.

G. Before firing a charge, the shot-firer must:

- a. Make a visual inspection of the blasting circuit to ensure all connections are secure and the blast can be safely detonated; confirm that any surplus explosive materials have been removed to a safe place
- b. Determine that adequate protective measures have been taken for the safety of persons and protection of property; and
- c. Verify that the danger area is clear and the necessary guards are at their posts.
- d. Ensure that every person in the blast zone understands the warning signals which must be distinct from other signal devices in the area.
- e. Ensure that the audible warning is given

H. The firing apparatus should be an approved electrical firing device (for electrical initiation). It should be constructed so that it can only be operated by a removable handle or plug that is not placed into position until a shot is about to be fired, and is removed as soon as a shot has been fired. It should be ensured that the handle or plug is at all times in the custody of the authorised shot-firer.

I. After firing the shot:

- a. The cable should be disconnected and isolated in an approved manner with the key removed from the shot-firing apparatus and stored appropriately.
- b. The shot-firer shall be first to examine the working place to ensure, as far as possible: that no misfired shots remain.
- c. A person should not enter any working place after blasting has taken place until the dust, fumes and toxic gases arising from the explosion have been effectively dispersed. Senses of sight and smell should be sufficient for most determinations, but oxygen deficiency and other gases are a real risk particularly in small headings and rises. In these instances, a gas detector measuring oxygen content should be used.
- d. The muck pile should be wet down to suppress dust.

J. The authorised shot-firer should keep a daily written record (blast record) of the number of shots fired by them, the number of misfires and the quantity and the number and type of explosives used in each shot. This record should be kept at the site.

9.0 MISFIRES

- A. "Misfire" means any part of an explosive charge, which after initiation, fails to completely detonate. Any misfire is potentially dangerous; it may be highly sensitive and could readily detonate. When preparing the blast every precaution should be taken to minimize the risk of a misfire.
- B. Never drill into or within 150mm of any hole or part hole (butt hole) as it may contain misfired explosives.

- C. The shot-firer must carefully examine the site for misfired (un-detonated) explosive materials and other dangers. The shot-firer must not leave the blasting site until he has attended to any misfired explosive materials or other dangers caused by the blast. Equipment operators and others entering the site should also be taught to recognize misfires. They must understand a misfire may be handled only by or under the direction of an Approved Handler. Regardless of precautions taken, misfires can still occur and are dangerous. Some Common Causes of Misfires are:
- a. Explosive is damaged or defective;
 - b. Explosive is wet, cold or frozen;
 - c. Explosives have become desensitized, possibly by dead pressing;
 - d. Detonator is damaged or defective;
 - e. Detonator has become detached from charge;
 - f. Incorrect use of initiation system;
 - g. Cut-off or damage to initiation system
- D. When dealing with misfires, keep the number of persons in the blasting area to a minimum, only the shot-firer and those required to assist are allowed in the blasting area. Helpers should be experienced workers selected from the blasting crew.
- E. Until all dangers are eliminated or controlled, treat the blasting area as a "blast zone" and leave guards posted to prevent others from entering.
- F. Once a misfired charge has been located and identified, it should be destroyed before other work commences. Misfired charges are usually destroyed by detonation, using a fresh detonator. Treat a misfire like any other blast; sound the warning signals and guard the danger area.

Note: The wait time before re-entry after misfires should be a minimum of 30 minutes for cap and fuse and 5 minutes for electric.

10.0 DISPOSAL

- A. In the event where any cartridge, or part of a cartridge, of explosives is found after shot-firing it should be inserted into another blast-hole in such a manner that it will be completely destroyed when the later shot is fired.
- B. A faulty detonator should be disposed of by inserting it into a primer in another blast in a manner that ensures it will be completely destroyed when the shot is fired.

References:

- Hazardous Substances (Classes 1 to 5 Controls) Regulations 2001
- Hazardous Substances (Identification) Regulations 2001
- Hazardous Substances (Disposal) Regulations 2001
- Hazardous Substances (Emergency Management) Regulations
- Hazardous Substances (Tracking) Regulations 2001
- AS 2187.1 – 1998 – Explosives –Storage, Transport and Use -Part 1 - Storage
- AS 2187.2 – 1993 – Explosives –Storage, Transport and Use -Part 2 - Use