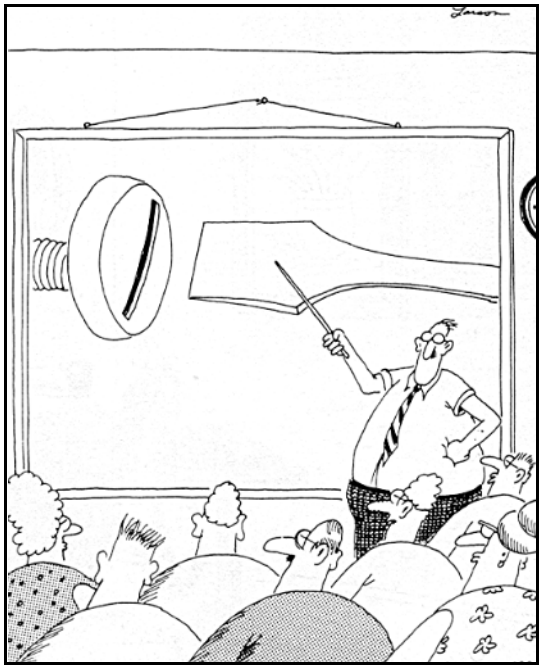
Section 10 — Supervise use of Tools and Explosives



School for the Mechanically Declined.[1]

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1 CHAPTER 1 – TOOLS

INTRODUCTION

ADAS COMPETENCY

Supervise use of tools and explosives in a dive operation.

Supervise the application and safe use of all tools utilised in a dive operation within area of responsibility.

Supervise the application and safe use of explosives in a dive operation.

Keep abreast of developments in tools, explosives and methods applicable to underwater work.

Ensure appropriate qualifications and/or training of personnel prior to use of any tools, explosives or related underwater work methods.

GENERAL

As a Part 2 or Part 3 dive supervisor, you need to be able to supervise the application and use of all tools and explosives, ensuring safe work procedures are employed. You will need to ensure the appropriate qualifications and training of people using tools and explosives.

You will have received detailed training in the use of most common tools in your technical diver training. For less commonly used tools, or new tools, you may need to revise your knowledge or update your skills. You could do this in a number of ways – for example, by consulting with the manufacturer, reading the documentation, checking their website or obtaining training from the supplier. As part of your professional development, you should, make sure that you keep up with developments in this area.

TOOLS

You should be able to:

- ✔ list all tools likely to be used in a dive operation within area of responsibility
- ✔ describe the basic function of all tools used in a dive operation within area of responsibility
- ✔ troubleshoot any problems associated with tool malfunction
- ✔ carry out basic on-site maintenance of tools within capabilities and according to manufacturer's instructions and organisational policies and procedures

Manufacturers and suppliers are a good source of information on the latest tools available for underwater use. Some examples of manufacturer's websites[2] with information on underwater tools are:

- ✔ BWS Pty Ltd (NSW, Australia) http://www.bwspl.com.au/
- ✔ BCA Equipment Company (New York, USA) http://www.bcaequip.com
- ✔ Danair Inc (California, USA) http://www.danairinc.com/
- ✔ National Torque Tools (Auckland, New Zealand) http://home.clear.net.nz/pages/national.torquetools/
- ✔ J W Fishers (Massachusetts, USA) http://www.jwfishers.com/home.htm

[2] Accessed Aug 2002. These sites and the opinions contained herein are those of a third party. ADAS cannot guarantee the information and takes no responsibility for accuracy, currency, reliability or completeness.

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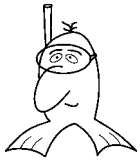
SAFE WORK PROCEDURES FOR TOOL USE



You are responsible for the safe conduct of the dive, including all the tasks performed by the divers. You will need to be able to:

- ✔ outline, in detail, work procedures related to tool use in a dive operation within area of responsibility
- ✔ identify any special hazards associated with tool use
- ✔ assess risks and apply appropriate risk control methods

As an experienced diver, you are expected to be familiar with tools use in your area of responsibility. We will therefore not produce specific tool related information in this manual.

However, as a supervisor, you may be expected to be able to demonstrate the use of new or unfamiliar tools to divers with little experience with a specific tool. The key here is to use all your communication skills to make sure that the diver(s) understand what you are saying. If possible, actually demonstrate the use of the tool. If this is not possible, it may be possible to obtain a training video from the manufacturer, or even get a representative from the manufacturer to demonstrate the tool and provide a brief training session.

Ask the diver to explain in his or her own words how they would use the tool and what safety features there are that they need to be aware of. In this way, you are checking for understanding and giving them the opportunity to consolidate what they have just learned.

Figure 1: Diver using ramset

TROUBLESHOOTING AND ON-SITE MAINTENANCE

As with all equipment used at the dive site, you will need to have sufficient knowledge of the tools to be able to troubleshoot and perform appropriate on-site maintenance.

Checklists for troubleshooting malfunctioning tools and doing basic on-site maintenance may be useful. You may obtain these from the manufacturer, or develop them with the assistance of experienced users.

Make sure you know the limits of your capabilities to do on-site maintenance, and remove and tag any tools that cannot be safely maintained on site. It is your responsibility to make sure that the tools are safe to use, so you must follow up and ensure that the tools are maintained by properly qualified personnel before being put back into service. Records of any maintenance should be kept.

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2 CHAPTER 2 – EXPLOSIVES

STATUTORY REQUIREMENTS PERTAINING TO EXPLOSIVES

ADAS COMPETENCY

Describe statutory requirements pertaining to the use of explosives.

List acts and/or regulations pertaining to the use of explosives.

Describe in general terms the statutory requirements pertaining to the use of explosives.

Express in own words, what needs to be done to conform to requirements.

EXPLOSIVES AND THE LAW

All requirements pertaining to the use of explosives are found in the Australian Explosives Code (2000).

REGULATIONS

The potential destructive power of any explosive substance, coupled with the need to ensure that it is handled only by competent, trained individuals, who have a regard for the public safety, makes it necessary for strict regulations in order that such materials can be purchased only by authorised individuals.

All users of explosives or explosive materials, or those who store explosives, other than certain government departments, must hold a valid Licence or Certificate appropriate to their operation.

WESTERN AUSTRALIAN STATUTORY AUTHORITIES FOR EXPLOSIVES[3]

THE CHIEF INSPECTOR OF EXPLOSIVES

The Chief Inspector of Explosives, Department of Industry and Resources, administers the Explosives and Dangerous Goods Act and Regulations through which is controlled the importation, manufacture, conveyance, storage, sale and at places other than mine-sites, the use of explosives throughout Western Australia.

Explosives may be purchased only by a person authorised to possess explosives namely:

- ✔ the owner of a mine or authorised agent of the owner
- ✔ the holder of a magazine license
- ✔ the holder of a shotfirer's permit; or
- ✔ the holder of a permit to purchase explosives

[3] Notes in this section were prepared by Gary Kalem, Gary Kalem Consultancy.

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THE STATE MINING ENGINEER

The State Mining Engineer, Department of Industry and Resources, administers the Mine Regulation Act and Regulation through which is controlled the use of explosives in mines and quarries in Western Australia.

The contact number for the Department of Industry and Resources is (08) 9222 3333. The Department has a homepage on the Internet on **http://www.doir.wa.gov.au.**

TYPES OF EXPLOSIVES

ADAS COMPETENCY

Describe the various types of commercially available explosives for use under water.

List the various types of commercially available explosives for use underwater.

Explain the advantages and disadvantages of each type.

Describe the selection process for choosing an explosive for a given underwater task.

Explosives can be classified in different ways but it is convenient for practical purposes to consider them according to the rate of reaction and the purpose for which they are used, namely:

✔ **Low Explosives or Propellants** are substances or mixtures, which react at a relatively low velocity. They can be used for a heaving effect on rock rather than shattering it, or they are used for driving projectile from a gun barrel without danger of shattering the casing, or for splitting wood. The velocity of detonation for these types of explosives is less than 1000 metres per second (m/s). Examples are gunpowder, cordite and smokeless powders.

✔ **High Explosives** include all the explosives used for mining and quarrying where maximum breakage is desired and those used in warfare for producing the maximum damage and destruction. All high explosives react with extreme high velocity and have a velocity of detonation in excess of 1000m/s. There are many types and grades suitable for different purposes and they vary in their sensitivity ti heat or mechanical shock. Examples of high explosives include TNT, gelignite, dynamite, water gel, emulsion, slurry, ANFO and detonation cord.

✔ **Initiators** are high explosives with small amounts of primary explosives and are in the form of detonators or percussion caps. They are highly sensitive to heat or shock and must be handled with care. They are used only in special small devices intended to initiate or detonate larger charges of propellant or high explosives. Examples are mercury fulminate, lead azide and lead styphnate.

INITIATION

ADAS COMPETENCY

Explain the principles of using explosives underwater.

Identify the advantages and disadvantages of electrical and safety fuse initiation.

Explain the principles of electric and non-electric detonation.

Explain the principles of detonating cord.

■ SAFETY FUSE

Safety fuse consists of a thin core of fine gunpowder enclosed in a tight wrapping of cotton and jute fibres, which are impregnated with wax or bitumen or enclosed in a sheath of thin plastic to make the fuse waterproof. It is produced in long reels or coils and is coloured with some distinctive colouring to be easily seen on the ground or underground. Beige or yellow colours are common and such fuses are available from all suppliers and licensed retailers throughout the State. Safety fuse can be lit with a match if the head is struck while held in close contact with the fuse end; otherwise, a special fuse lighter is used for lighting two or more safety fuses.

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Safety fuse must burn at a steady and uniform rate and there must be no spit of flame through the side of the fuse as it burns. Throughout Australia all safety fuse is required by Authorities in each State to have a burning rate within the limits of 90 to 120 seconds per metre of length. At the end of burning a length of safety fuse there is always a forward spit of flame of about 2cm or 3cm length, which can effectively ignite a charge of gunpowder or the primary charge of a detonator.

■ PLAIN DETONATORS

These consist of a small metal tube of about 7mm diameter and 35mm length, which is closed at one end, and open at the other. The open end is just the right size to fit the safety fuse. Nearly all detonators are now made of aluminium but some copper cases are still available.

The most common plain detonator available is the No. 8 size detonator; although some shotfirers may encounter detonators of the No. 6 variety. Only the No. 8 plain detonator (which is twice as strong as the No. 6 detonator) is commercially available. No. 6 detonators have not been commercially available for the past decade so if a shotfirer encounters them in the field they need to be checked for deterioration. In addition, No. 6 detonators are not recommended to initiate emulsion explosives, as these explosives are not as sensitive as the old gelignite explosives

Each detonator contains two explosive compositions, one of which serves as a primary charge (primary explosives) and the other a less sensitive but very powerful base charge (secondary explosives). Because of the primary charge, detonators are very sensitive and must always be handled with care and respect. A hot particle of cigarette ash can cause an explosion if it enters the detonator through the open end and insertion of a pin or nail to clear a particle of foreign matter can likewise cause an explosion if the primary composition is abraded against the side of the detonator. It is a firm rule that detonators are never stored or kept together with other high explosives. This is because if one detonator exploded, it could cause explosion of all other detonators and probably cause detonation of the high explosives, which is an extremely dangerous situation.

■ ELECTRIC FIRING

The main advantage of electric firing over safety fuse firing lies in the precise control the shotfirer can exercise on the timing of a blast. There are of course other means of initiation available where the shotfirer has direct control over the timing. Consequently, these types of firing should be used in situation exclusively where the timing of a blast is particularly important, for example:

- ✔ in built up areas
- ✔ in public thoroughfares
- ✔ where traffic cannot be unduly delayed

It should also be used in those situations where the shotfirer may have difficulty in withdrawing to safety from the site such as sinking wells for a water supply.

There are certain circumstances, which could cause the premature firing of electric detonators, and in such circumstances, electric firing must never be employed:

- ✔ where thunderstorm activity is approaching
- ✔ immediately under high voltage power lines

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- ✔ in the vicinity of radio transmitters
- ✔ where there is danger of stray current, for example, faulty generators, static electricity, etc.

ELECTRIC DETONATORS

These detonators consist of a metal tube charged with the same type of explosives as plain detonators. The difference lies in the means of firing. Electric detonators are fitted with two wires, which pass through a neoprene rubber plug. They are connected to a fuse head inside the detonator tube and positioned just above the primary composition. The fuse head encloses a fine resistance wire, which is heated when sufficient current is applied and this causes the fuse head to ignite and flash in the same manner as the head of a safety match. The flash ignites the primary charge, which then detonates the base charge of high explosives.

The current required to fire an electric detonator is only about 300 milliamperes, but higher currents are normally necessary to overcome the resistance of the firing circuit and detonator lead wires, which are commonly of various lengths from 1.4 to 3.6 metres.

The colours of the lead wires are normally different to assist the shotfirer when preparing circuits and are colour coded to indicate the series the detonator belongs to.

RADIO TRANSMITTERS

The lead wires of an electric detonator can act as an antenna and under certain conditions can pick up transmitted radio, television or even radar frequencies. These transmissions can induce a current of sufficient magnitude to fire a detonator if the signal is of sufficient power and the circuit is sufficiently close to the transmitter. This energy may be picked up by the circuit whether it be shunted or open, or if connected to the exploder or not. Amplitude modulate (AM) broadcasters and mobile transmitters present the main hazard to the shotfirer. The high power, low frequency output of an AM transmitter is ideal for power generation in a firing circuit. Mobile transmitters also are particularly dangerous because they can be brought right up to the blasting circuit, and will usually be located in the worst possible position, that is, at the end of the firing cable away from the detonator.

For the above reasons it is necessary to take the following precautions:

- ✔ All portable transmitters shall be switched off within 30 metres of electric blasting operations.
- ✔ Electric detonators carried on vehicles equipped with radio transmitters shall be conveyed in metal containers lined with wood or soft yielding material.
- ✔ Keep all parts of the circuit, including the detonator, insulated from the earth.
- ✔ When connecting the circuit the work shall be carried out as close to the ground as possible.
- ✔ Use twin flex shot firing cable, run it along the ground, and avoid stringing it in the air.
- ✔ Major transmitting stations within Western Australia may be hazard up to 17 kilometres away depending on the power, frequency, height of masts, etc. It is advised that no electrical blasting be carried out within the minimum safe distance as indicated by the table below. The frequency of commercial radio stations is normally between 300 – 3000kHz.

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The safe distances given in the Table taken from AS2187.2-1993 are based on the worst possible conditions with regard to wire length, position of circuit, etc. and provide a substantial margin of safety. Should it be imperative that blasting be carried out closer to the transmitter than the above minimum safe distance, then the following shall be considered:

- ✔ safety fuse/detonating cord firing
- ✔ signal tube firing
- ✔ carry out blasting when the transmitter is not operating

SAFE DISTANCES FOR ELECTRIC DETONATORS SUBJECT TO RADIO FREQUENCY RADIATION

This table, which has been extracted from BS4992-1974, and should be read in conjunction with that Standard, sets out recommendations for safe distances for blasting from electromagnetic radiation, when electric detonators are being used to detonate explosives charges. For example, Clause 7.9 of BS4992-1974 points out that these distances may not apply under desert and marine conditions, where special shot firing methods adopted may give rise to worse hazard and Clause 7.10 states that of two or more significant field sources are superimposed at the firing site a safety assessment should be carried out.

Serial	Description of Equipment	Frequency Range	Maximum Transmitted Power	Safe Distances Metres
1	Radar	> 5 GHz	100 KW peak	500
2	Radar	1 to 5 GHz	6 MW Peak 50 KW continuous work	800
3	Radar	0.2 to 1 GHz	6 MW Peak 50 KW continuous work	1500
4	SHF: Radio Relay	≥ 3 GHz	20 W	80
5	VHF: Radio Relay	0.3 to 3 GHz	20 W	150
6	UHF: Fixed installation: broadcast	≥ 0.3 GHz	5 MW	600
7	UHF: Movable	≥ 0.3 GHz	50 KW	150
8	VHF: Fixed broadcast	30 to 300 MHz	50 KW	900
9	VHF: Broadcast	30 to 300 MHz	5 KW	150
10	HF: Broadcast	3 to 30 MHz	500 KW	1000
11	MF: Broadcast	0.3 to 3 MHz	500 KW	1000
12	LF: Broadcast	30 to 300 MHz	500 KW	500
13	VLF: Broadcast	< 30 KHz	200 KW	100
14	Mobile Radio	Any Frequency	100 to 500 W	40
15	Mobile Radio	Any Frequency	10 to 100 W	20
16	Mobile Radio	Any Frequency	< 10 W	No hazard, provided no direct contact is made with aerial
17	High frequency ovens (providing there is no significant r.f. leakage).			No hazard outside equipment
18	Civil aircraft equipment. All types at maximum permitted power.			50

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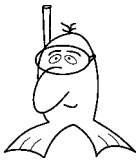
SINGLE TUBE DETONATORS



These types of detonators are very similar in construction to that of electric detonators. The detonator is of the same dimension as an electric detonator; it normally has an aluminium casing and has a primary and base charge similar to an electric detonator. The difference lies in the means of initiation. Instead of using an electric fuse head with wires to initiate the detonator, it is initiated by a signal tube, which is crimped through the neoprene rubber plug into the detonator casing.

The signal tube is a small hollow laminate tube, coated on the inside with a thin layer of reactive material. When initiated by a detonator, detonating cord or a starting pistol cap device, it transmits a low energy signal at the speed of approximately 2000m/s that initiates the detonator at the other end. The signal, (shock wave phenomena) is similar to a dust explosion. The shock wave travels inside the tubing, without damaging or consuming the tube when fired.

The tubing (at the other end from the detonator) has a plastic clip connected to it, which is used to attach the signal tube to the detonating cord. The tube is also ultrasonically sealed at this end to prevent the ingress of moisture. This end is not to be cut off when making connections.

These detonators are available with varying lengths of signal tubing. All of the detonators are preassembled in a factory, and unlike electric detonators, it is not normally possible for the shotfirer to extend the length of the tubing by connecting another length to it. A number of companies are working on products that will allow lengths of signal tube to be joined together with a connector unit in the trunkline.

Signal tube detonators are available with varying tube strengths depending on the abrasive nature of the ground, and are available with various delay periods.

GENERAL REQUIREMENT FOR ALL DETONATORS

All the detonators sold in Western Australia must be suitably marked to identify the item and stress their hazard, for example, Explosive, Detonator, and Danger.

FIRING DETONATING CORD

Detonating cord shall be initiated by the firing of a plain, electric detonator or signal tube detonator, which shall be fixed to the cord only after all the other work, has been completed.

In attaching a detonator to detonating cord, remember that special care must be taken to maintain the following features:

- ✔ the detonator shall be positioned parallel to the cord with the base about 75mm from the end of the cord (in case of moisture penetration) and pointing towards the main charge
- ✔ the detonator shall be attached firmly to the detonating cord by either wire or tape
- ✔ the detonator shall always be attached only to a trunkline

Delay firing with detonating cord can be achieved by the use of special delay elements.

DETONATING CORD FIRING

Detonating cord is used primarily to initiate any number of explosives charges. It may be described as a very strong, flexible cord containing a core of high explosive powder called penta-erythritoltetranitrate (PETN). When properly initiated the PETN explodes with great

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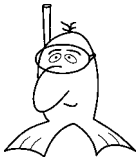
violence, having a high brisance or shattering effect along the whole length of the detonating cord. The velocity of detonation of detonating cords is close to 6,500 metres per second; hence the reason for the old name for it of instantaneous fuse

The normal (10 grams PETN/metre) detonating cord should be initiated by a No. 8 detonator, and when initiated has the detonating properties of a detonator at all points along its length. As a trunkline, it will initiate any number of additional lengths or branch lines, it will detonate all cap sensitive explosives with which it is in contact, and when used with a cartridge of explosive it is regarded as a primer.



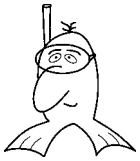
Special low noise detonating cords are available in various sizes, namely 8g/m, 5g/m and now even 3.6g/m detonating cords. The low noise detonating cords should not be used as down lines unless they are used with specially designed boosters as recommended by the manufacturer.

Although detonating cords may have the properties of a detonator, in that they can initiate detonator sensitive explosives, detonating cords must always be stored in a high explosives magazine because they do not contain the sensitive primary explosives.

When detonating cord is to be used to make a primer, the ordinary cartridge or booster charge should be prepared so that the cord cannot be easily pulled out from the charge, and that there is sufficient contact between the detonating cord and the cartridge or booster.

EXPLOSIVES

DEFINITION



The term explosive generally refers to the blasting charge, which accomplishes the bulk of work required in breaking rock, making excavations or demolishing structures. There are many explosives each designed with particular qualities and special features for specific tasks. The main characteristics and properties of explosives will be discussed in later sections, but in general the harder the material the faster and more intense the explosive reaction should be. That is, the velocity of detonation should be greater for hard materials than for soft, easily broken materials. The following are examples of commonly used explosives.

EMULSION EXPLOSIVES

Emulsion explosives consist of extremely small droplets of a super concentrated ammonium nitrate solution in an oil and wax matrix. These tiny droplets are kept apart by surfactants. The droplets must be kept apart to form an intimate mixture between the ammonium nitrate solution and the fuel. If the droplets were to combine, the mixture would no longer be explosive. Small hollow glass spheres called micro balloons are added to increase sensitivity of the emulsion. Without voids, or hot spots, the emulsion would not initiate.

An increasing number of emulsion mixtures, particularly the bulk formulations, are chemically gassed to sensitise the mixture prior to use. This allows the emulsion mixture to be transported as a non-Class 1 explosive to the point of use such as a mine site, and there be sensitised to become an explosive prior to use.

Emulsion explosives, like water gel and slurry explosives, do not contain nitro-glycerine. Emulsion explosives therefore have the same advantages as water gel and slurry explosives because they are safer to handle and there are no physiological effects as no nitro-glycerine is present.

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The consistency of emulsion explosives can range from that of mayonnaise to the consistency of plasticine, both of which are emulsions. In general, the viscosity of a cartridge emulsion will be higher so a solid but malleable cartridge is produced. Bulk emulsions tend to be of lower viscosity (a gel type consistency) so it is easier to pump. The viscosity and stability of an emulsion depends upon the oil and wax used the surfactants and the size of droplets. A flowchart showing how emulsion explosives are made is shown below.

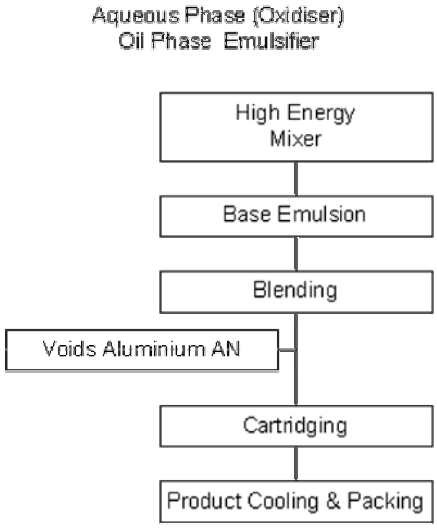

Figure 2: Flowchart showing how emulsion explosives are made.

Velocities of detonation for emulsion explosives range from 4000 to 5500m/s. Emulsion explosives have a high water resistance and can be used in wet holes.

Emulsion explosives are not as sensitive as nitro-glycerine based explosives and have low impact sensitivity. The sensitivity ranges from those that can be initiated by a No. 8 detonator to those that can only be initiated by a large booster.

Various grades and strengths of emulsion explosives are available in various sized cartridges ranging from 25mm x 20mm to 12.5kg sausages and are packaged in 25kg cases.

ANFO BLASTING AGENTS

The dry climate in Western Australia has enabled industry to make much use of the explosive manufactured from ammonium nitrate and fuel oil (ANFO). Although it has very poor water resistance, it is the cheapest explosive available and may be manufactured onsite as a blasting agent under a licence issued by the Chief Inspector of Explosives, provided the mixtures conform to the prescribed composition with low sensitivity. A blasting agent is a substance that cannot be initiated by a No. 8 detonator when tested unconfined.

ANFO shall consist of 94% by weight ammonium nitrate prill mixed with 6% fuel oil. It is usually primed with a booster or a charge equivalent to 125 grams (one 25mm 200mm cartridge) of emulsion explosives for holes 75mm diameter or can be reliably initiated with small PETN/TNT boosters.

The composition of ANFO must not be altered unless specifically approved and indicated on the licence to manufacture. In this manner, approval may have been given to increase the power of ANFO by adding aluminium powder, but because of the hazard of an aluminium dust explosion, such approval is only given to those who can guarantee to maintain the stringent safety precautions necessary for such operations. Similarly, the strength of ANFO may be reduced by adding low-density combustibles, but again this may be done only with approval and under a licence.

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NITROGLYCERINE BASED EXPLOSIVES

As mentioned before, nitro-glycerine explosives are no longer manufactured in Australia, although they are still manufactured elsewhere around the world.

Several grades of nitro-glycerine explosives were available to the shotfirer and these differed in water resistance, density, strength and velocity of detonation. They were available in various lengths of cartridge and of different diameters.

Gelatinous explosives contain a large percentage of nitro-glycerine within the composition and can be used under wet conditions. Their velocities of detonation range from 3000 to 5000m/s.

BOOSTERS

These are high detonating velocity explosives specifically designed to initiate explosives of low sensitivity, for example, ANFO and some bulk emulsion explosives. They are usually prepared from TNT or mixtures of TNT, PETN and RDX (cyclotrimethylene trinitramine), all of which are very high velocity explosives used extensively by the military.

Boosters are cast from molten explosives in the form of cylinders of various sizes and normally have a hole through them into which can be inserted a detonator or detonating cord for initiation. Though they may be initiated by a No. 6 detonator, they are a very stable and safe explosive particularly with regard to shock and heat sensitivity. It is for this reason they are used as military explosives.

Boosters come in several sizes varying from 25 to 500 grams in weight.

BLASTING POWDER

Sometimes referred to as Black Powder, this is gunpowder of granular or pelleted form which, though a very old form of explosive, is still used in some places for splitting timber or for quarrying and breaking dimensional stone, marble, etc. Blasting powder is fired directly by safety fuse with no detonator required and it reacts at speeds greatly dependent on the degree of confinement. It must be handled and stored with particular care, as it is extremely sensitive to spark and friction.

RESPONSIBILITY OF THE SHOTFIRER

ADAS COMPETENCY

Describe safety precautions when using explosives and explain the need for such safety precautions.

Discuss the effects of an explosive blast on the surrounding environment (atmosphere/water).

Describe safety precautions when using explosives underwater.

Explain why such safety precautions are necessary.

All explosives handled in the course of blasting operations shall be under the direct supervision of a licensed shotfirer. The responsibility of the shotfirer shall not cease until the "All Clear" signal is given. Confusion on the issue of responsibility leads to looseness in the maintenance of safety regulations and in many instances reduces the shotfirer to a Powder Monkey, a name which indicates little authority or knowledge of explosives.

It is reasonable to presume the shotfirer to be the person controlling blasting operations, especially as he/she should be fully conversant with relevant safety and statutory regulations and experienced in the practices required for the safe handling of explosives. The engineer or supervisor in charge of a works party should recognise the authority of the shotfirer and entrust all blasting operations to his/her care. If for any reason insufficient confidence is placed in a shotfirer then he/she should not be employed as such.

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PRECAUTIONS AT THE SITE

✔ **Local authority approval:** Before starting a blasting operation within the limits of any city, town, or built up area, it is necessary to notify the Clerk of the Local Authority at least 24 hours in advance. The Clerk will issue official approval and will advise of any requirements or restrictions placed on the use of explosives within the area under his/her control. A shire or Town Clerk may issue a Permit, as approval if the shotfirer fails to observe any of the conditions it should be clearly understood that Council has authority to withdraw and cancel the Permit.

✔ **Times of use:** Explosives may be used only between the hours of sunrise and sunset unless special approval has been given otherwise by the police or by the Chief Inspector of Explosives.

✔ **Signals:** Warning notices must be displayed on all approach roads to the blasting site and if necessary traffic must be stopped prior to firing. It is also necessary that any persons likely to be affected by the noise or vibration from the blast be warned that blasting is intended, and be advised of the audible warning signals to be used prior to every firing.

✔ **Note:** It is essential that warning signals can be heard by those persons likely to be affected by the blast.

✔ **Before charging:** Tools and equipment not required by the shotfirer shall be removed before charging operations begin. All explosives removed from a magazine must be carried to the site in covered containers each holding not more than 25kg and until the site is ready for charging, those explosives must be kept at least 15 metres away.

Where possible, particularly with small operations in developed areas, charging and firing shall be completed without any waste of time, and where any time delay is unavoidable the charged hole shall be left guarded or the site made secure against unauthorised entry.

All explosives remaining after charging must be removed to a position of safety. If it is not intended for immediate use, they must be returned to the security of the magazine. Capped safety fuse must never be stored with explosives but shall be stored in a detonator magazine. Prepared primer charges shall not be stored under any circumstances but must be either dismantled or destroyed.

When there is likelihood of danger or of damage from material projected by the blast, it is essential that the charges be effectively covered by blasting mats or other protective cover such as steel plates to minimise fly rock.

MISFIRED CHARGE

Occasionally, for one reason or another, no matter how careful a shotfirer may be in preparing his/her charges, a shot will fail to fire. Such occurrences will certainly be of much less frequency if the shotfirer has followed good blasting practice, however, there are some circumstances in the field over which the shotfirer has little or no control. For example, the existence of a natural seam or weakness in the rock strata at the blasting site may cause rock slip when the first charge explodes, particularly as in a pattern of sequential or delayed, causing separation of some of the other charges from their primer.

For this reason, the position of the primer in delay firing should always be at the bottom of the hole. If rock slip occurs on the firing of the first charge causing separation of subsequent charges, upon expiry of the delay interval the bottom portion of the charge will fire (if bottom primed) and either sympathetically detonate the separated portion or throw it out into the open where it can be readily removed. If the charges were top primed then more inaccessible misfire would result.

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Other causes, which may result in a misfire, include:

- ✔ improperly made primers or inadequate priming
- ✔ improper loading practices where lead wires, tubes or cords are damaged
- ✔ improper connections
- ✔ using non-water resistant explosives in wet holes
- ✔ not wiring up or connecting all branch lines to the circuit
- ✔ exploder has insufficient current
- ✔ cut-offs
- ✔ using deteriorated explosives

DECLARING A MISFIRE

When the charge fails to fire at the expected time, or the number of charges fired is less than expected, the "misfire" shall be declared. No person shall approach the blast site until a specified period has elapsed, since it is known for a charge to fire after the misfire has occurred. With electric and signal tube, firing the time is 5 minutes, but with safety fuse, firing a period of 30 minutes must be allowed before it is considered safe to approach the site. Where a safety fuse is used to fire detonating cord or unfired signal tube remains, this interval may be reduced to 5 minutes.

Similarly, if upon inspection of the site the shotfirer finds evidence of an unexploded charge or the shotfirer suspects a charge has not exploded, then he/she shall retire immediately from the danger area and declare a misfire. No person shall enter the site until after the misfire period has elapsed.

After the misfire period has elapsed, the shotfirer shall ensure that no person approaches the site without his/her permission. The shotfirer shall carefully examine the site, remove any explosives lying among the debris, and clearly mark any hole suspected of containing an unexploded charge.

LINKS

The internet provides some useful information on explosives regulations and safe handling of explosives. The following links may be useful.

- ✔ http://www.orica-explosives.com Orica Australia Explosives is one of the leading suppliers of explosives.
- ✔ There is specific safety information on explosives on the Orica site at http://www.orica-explosives.com/Australia-Asia/Australia/Safety/Safe%20Handling%20of%20Explosives.asp

The various regulations may be found by searching on Explosives regulations or legislation. One example is:

- ✔ http://www.dms.dpc.vic.gov.au/sb/2000_SR/S01206.html Victorian Dangerous Goods (Explosives) Regulations 2000.

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RESPONSIBILITY OF DIVE SUPERVISOR

The dive supervisor retains overall responsibility for the supervision of the dive site when explosives are being used. This means that you are responsible for ensuring that all communications are passed through you. Although the shotfirer has responsibility for the actual discharge and handling of explosives, he or she does not have direct authority over other personnel. It is up to you to take advice from the shotfirer, such as information on misfires, and pass on the appropriate instructions to the dive team and others on the dive site.

SUMMARY

- ✔ Manufacturers and suppliers are a good source of information on tools and explosives.
- ✔ Dive supervisors need to know procedures for safe tool use, identify special hazards, assess risks and apply appropriate risk controls.
- ✔ Dive supervisors should demonstrate tool use or convey safety critical information to inexperienced divers on tool use and check for understanding.
- ✔ Explosives are only to be used by appropriately qualified personnel.
- ✔ The dive supervisor retains overall responsibility for supervision of the dive site, even when explosives are being used, but should heed the advice of the shotfirer.

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