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Code of practice for the

Safe use of explosives in the construction industry

Code de bonne pratique pour l'emploi en toute
sécurité des explosifs dans l'industrie du bâtiment

Richtlinie für die sichere Verwendung von
Sprengstoffen im Bauwesen

British Standards Institution

BS 5607 : 1978

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This code of practice represents a standard of good practice but compliance with it does not confer immunity from statutory and legal requirements and bye-laws.

Foreword

This code of practice aims to define good practice in handling, transport and storage of explosives during the varied uses to which explosives may be put by the construction industry. Emphasis throughout the code has been placed on safety, particularly the safety of those engaged in using explosives for work on site and the safety of others who may be in the vicinity of that work. The code also lists the legislative requirements at present

in force concerning explosives. These should be closely studied and carefully followed.

All legislative requirements relating to explosives in Great Britain form 'relevant statutory provisions' as defined in the Health and Safety at Work etc. Act 1974. It is expected that legislation under that act will result in fundamental changes in the law. The advice on legal requirements given in this code relates to the law at the date of the publication of this code.

British Standard Code of practice for the

Safe use of explosives in the construction industry

Section one. General

1. Scope

This code of practice gives recommendations for the safe storage, handling, transport and use of blasting explosives and accessories in construction and demolition operations. Section two covers general requirements for handling and safety. Subsequent sections are concerned with safety in the use of explosives in special applications and situations such as tunnelling, demolition, excavation and underwater working.

2. References

The titles of the standards publications referred to in this code are listed on the inside back cover.

3. Definitions

For the purposes of this code the following definitions apply.

3.1 air blast. The production of air over-pressure caused by an explosion.

3.2 ANFO. A mixture of ammonium nitrate and fuel oil capable of being used as an explosive and prepared in conformity with the Health and Safety Executive licence granted under the provisions of the Ammonium Nitrate (mixtures) Exemption Order, 1967.

3.3 approved. Approved by the authority having jurisdiction.

3.4 authorized explosive. All explosives legally available in the United Kingdom and listed annually by the statutory authority of central government.

3.5 blackpowder. Gunpowder used in blasting.

3.6 blasting agent. The term 'blasting agent' is not a description which is used in official British classifications. It has however come into fairly common usage in literature relating to mining and explosives technology. As it relates to British practice, it describes mixtures used for the purposes of blasting which do not contain self explosive ingredients such as nitroglycerine or TNT. Blackpowder is also excluded from this definition. The most common forms of blasting agents are ANFO mixtures and certain types of slurry explosives. Confusion with the American meaning and usage of the term should however be avoided, as this is a wider description which encompasses relaxations in the laws concerning storage, transport and handling which do not apply in Great Britain.

3.7 blasting area. The area in which danger may arise from the preparation and handling of explosives prior to blasting, and from which outside hazards must be excluded (e.g. flame, radio signals, etc.).

3.8 canister. A specially designed portable unit made of approved materials for conveying small quantities of explosives or detonators.

3.9 capped fuse. A length of safety fuse already fitted with a plain detonator.

3.10 cartridge. A wrapped or otherwise protected cylinder of defined size of a homogeneous explosive material.

3.11 competent person. A person who, by reason of theoretical and practical training or actual experience or both, is competent to perform the task or function or assume the responsibility in question and is authorized to perform such a task or function.

3.12 danger area. A defined area or zone in which there exists a possibility of hazard to persons or property due to the deliberate initiation of explosives.

3.13 delay detonator. A detonator with a pre-determined delay between initiation and detonation.

3.14 detonating cord. A flexible cord containing a core of high explosive which, when initiated, will cause detonation of a sensitive explosive with which it is in contact.

3.15 detonating relay. A device for inserting in detonating cord to produce a pre-determined delay in the transmission of the detonating wave.

3.16 detonator. An instantaneous or delay initiator for explosive materials and containing a charge of high explosive fired by means of a flame, spark or electric current.

3.17 electric detonator. A detonator designed to be initiated by means of an electric stimulus.

3.18 exploder. A device specially designed for firing electric detonators, from a safe distance.

3.19 explosive. Any substance, whether or not contained in a device, used or manufactured with a view to producing a practical effect by explosion.

3.20 explosive store. Any building or structure used for the storage of up to 1815 kg (4 000 lb) of explosive and licenced by the local authority, made under the provisions of sections 15 and 39 of the 1875 Explosives Act.

3.21 fly-out/fly-rock. The projection of debris caused by explosion.

3.22 fume characteristics. The qualitative nature of fumes produced by the detonation of an explosive, particularly as regards the small percentages of noxious gases contained therein.

3.23 fuse-lighter. A special device for the purpose of igniting safety fuse and plastic igniter cord.

3.24 high explosive. An explosive which, on initiation, produces high velocity and produces an intense shock wave.

3.25 low explosive. An explosive which produces large volumes of gases without creating an intense shock wave.

3.26 magazine. Any building or structure used for the storage of explosives and licensed by the Health and Safety Executive for this purpose (not licensed by a local authority), under the provisions of the Explosives Act 1875.

3.27 misfire. When deliberate action has been taken to initiate an explosion and some or all of the explosive fails to explode.

3.28 permitted explosive. An explosive specifically approved by the Secretary of State for firing in gassy mines. (The term 'authorized explosives' designates all explosives legally available in the United Kingdom, and as listed annually by central government.) (The distinction between 'permitted explosives' and 'authorized explosives' should be noted.)

3.29 plain detonator. A detonator designed for use with safety fuse.

3.30 plaster shooting. Blasting by placing a quantity of explosive against a rock boulder or other object without confining the explosive in a shot hole.

3.31 plaster igniter cord. A flexible cord of incendiary compositions which emits an intense side flame when burning. The cord can be used to ignite individual safety fuses when groups of shots are being fired in a sequence. The safety fuse is attached to the cord by means of a simple connector which contains an igniting compound to light the fuse.

3.32 pop shooting. A method used for the secondary breakage of material and employing small explosive charges confined in shot holes.

3.33 pre-splitting. A blasting technique for use in solid ground whereby relatively light charges are fired in closely spaced shot holes to effect a split.

3.34 primary blasting. A blasting operation by which material is dislodged from its original location.

3.35 primer. A cartridge cord or container of explosive into which a detonator or detonating cord is inserted or attached and is designed to initiate a larger charge.

3.36 registered premises. Premises registered with the local authority and used for the keeping of small quantities of explosives in accordance with the provisions of sections 21, 22 and 39 of the Explosives Act of 1875.

3.37 round. A group of shots fired in one operation.

3.38 safety fuse. A flexible cord containing an internal burning medium by which fire is conveyed at a continuous and uniform rate for the purpose of firing plain detonators or blackpowder, without initiating burning in a similar fuse that may be in lateral contact alongside.

3.39 secondary blasting. The reduction of oversize material by explosives to the dimensions required for handling.

3.40 sensitivity. The ease with which a substance can be made to explode, or its liability to explode, when subjected to deliberate or accidental shock, friction or heat.

3.41 shotfirer. The person in immediate control of the use of explosives.

3.42 signals

3.42.1 warning signal. Predetermined visual and/or audible signals prior to the initiation of an explosion.

3.42.2 all clear signals. Predetermined visual and audible signal given after an explosion and after checking that debris is free from misfires.

3.43 slurry explosives. Explosives that contain sensitizers, oxidizers and fuels dispersed in a gel.

3.44 stemming. A suitable inert incombustible material used to confine or separate explosives in a shot hole.

3.45 vibration. The transmission of shock waves produced by blasting operations through structures or ground.

Section two. General requirements

4. Preliminary procedures

4.1 Legislation

4.1.1 Reference should be made to the following:

- (a) Health and Safety at Work Act, etc. 1974.
- (b) Explosives Acts 1875 and 1923 and Orders in Council and Orders of Secretary of State made under them. (Guide to the Explosives Act obtainable from HMSO.)
- (c) The Quarries (Explosives) Regulations 1959.
- (d) The Miscellaneous Mines (Explosives) Regulations 1959.
- (e) The Stratified Limestone, Shale and Fireclay Mines (Explosives) Regulations 1956.
- (f) The Coal Mines (Explosives) Regulations 1961 SI 1961 no. 854.
- (g) The Construction (Lifting Operations) Regulations 1961.
- (h) The Construction (General Provisions) Regulations 1961.
- (i) The Construction (Health and Welfare Regulations) 1966.
- (j) The Construction (Working Places) Regulations 1966.
- (k) The Noise Abatement Act 1960.
- (l) The Clean Air Act 1956.
- (m) Highly Flammable Liquids and Liquefied Petroleum Gas Regulations 1972, no. 917.
- (n) Public Health (Recurring Nuisances) Act 1969.
- (o) Asbestos Regulations 1969 and Joint Advisory Committee Report on Safety and Health in the Construction Industry — Precautions in the Use of Asbestos.

4.1.2 Certain local authorities have special powers of control granted under local act of parliament.

4.1.3 Special regulations not mentioned above may well apply in Northern Ireland, the Channel Islands, Isle of Man and the Scilly Isles, and should be checked prior to operations in these areas.

4.2 Survey

4.2.1 Before any works involving the use of explosives are started, a detailed survey and examination of the site, buildings or structures and adjoining areas and property should be made. Procedures for the survey of sites is set out in CP 2001. When either demolition or earthworks are involved, reference should be made to the following

British Standard codes of practice:

CP 94 Demolition

CP 2003 Earthworks

*BS Code of practice on safety in tunnelling.

4.2.2 Special attention should be given to the character and structure of the geological strata present on site to ensure that it is not specially liable to transmission of ground vibration to areas where it is likely to cause damage to property or collapse or slip of sedimentary strata.

Due care should also be taken to avoid disruptions or damage to underground wells, tunnels, storage tanks, mine workings and other underground voids.

4.2.3 Utilities also require special consideration, and the proximity of underground and overground services should be carefully considered before blasting operations are carried out. Consultations should be carried out with the necessary authorities who are responsible for concealed underground works (e.g. pipes, cables etc.).

4.2.4 Special attention should be paid to the presence of power cables, radio and television transmitting stations sited within 3 km (2 miles) of intended blasting operations since under special conditions these can cause premature firing of electric detonators. (See BS 4992).

4.2.5 Blasting operations carried out close to public highways and railways also require special consideration, and it is necessary to give prior notification of intended blasting to the appropriate authority.

4.2.6 Expert advice or help should always be sought before proceeding with any work where the following sources of danger are found or could be expected. When working in existing industrial plants or areas, the appropriate managements should be consulted.

(a) Flammable gases or liquids, and toxic gases or liquids including carbon monoxide, sulphur compounds, carbon dioxide, deoxygenated air, town gas, natural gas, methane, oxides and nitrogen. This list is not necessarily comprehensive.

Consult: HM Inspector of Factories and HM Inspector of Mines.

(b) Flammable liquids. Consult: HM Inspector of Factories, or local authority petroleum officer as appropriate.

(c) Sewage and draining. Consult: regional water authority.

(d) Unexploded missiles or mines. Consult: police.

(e) Waste explosive. Consult: HM Inspector of Explosives.

4.3 Contract. A formal contract in writing should be entered into between the owner of the structure or site and the contractor appointed to carry out the construction or demolition operations. Professional advice should be taken in the preparation of tender and other contract documents.

4.4 Statutory notices

4.4.1 Before any construction or demolition works using explosives are started in England and Wales, the site owner or the appointed agent should give notice to the local authority (District Council) as required under the Public Health Act 1961 and comply with any requirements the Local Authority may make under this Act. In the inner

London area, the building owner should notify the District Surveyor under the London Building Act (Amendment) 1939.

In Scotland before any work is commenced a warrant is required from the Building Authority of the Region, District or Island Councils as laid down by the Buildings (Scotland) Act 1959, and the Scottish Development Department. In Northern Ireland, the police and local authorities should be advised before any work is undertaken.

No work should take place until permission from the appropriate authority is obtained.

Application for prior consent should also be made under Part 3 of the Control of Pollution Act 1974.

4.4.2 Special requirements come into force if it is intended to either transport explosives between sites or when there is an intention to store explosives on site. If it is intended that more than 1815 kg (4 000 lb) of explosives be stored, a licence is required from the Health and Safety Executive who will also specify the constructional requirements of the magazine. For quantities between 27 kg (60 lb) and 1815 kg (4 000 lb) the store has to be licensed by the appropriate local authority, who will lay down the requirements for the siting and construction of the store within the terms of their jurisdiction and powers. Smaller quantities than 27 kg (60 lb) can be stored in the appropriate registered premises. In case of difficulty it is advisable to obtain guidance from the Explosives Inspectorate, or the police for their advice on security.

4.4.3 Prior to the commencement of any works using explosives, the site owner or his appointed agent is required to give notice to all statutory undertakings who may be affected, for example, water, gas and electricity authorities, Post office, railways, police, and airports and to those responsible for other installations, such as relay radio and television lines, hydraulic pressure mains overhead lines so that arrangements may be made for cutting off, diverting and stopping and for ensuring that all services have been rendered safe.

Notification should be given at as early a date as possible but never later than 24 h before the planned blasting operation.

4.4.4 Where proposed use of explosives may affect any other property or persons on such property, the site owner should give notice to the owner of such properties prior to the commencement of work regarding such matters as the need for temporary and permanent protection, the effects of disturbance by noise or vibration, and to ensure that no damage or inconvenience is caused to the adjoining owner's rights and interests. In many cases this will mean the preparation of schedules of condition of adjoining property and contents. Photographs have proved to be of great assistance in this.

4.5 Code of signals

4.5.1 Before any blasting commences on the construction site, both audible and visual signalling systems giving warning of blasting operations should be established. These should be such that they can be clearly heard and seen by site personnel working within the site areas, and also by the general public who may be affected.

*In course of preparation.

4.5.2 Audible warnings should comprise a series of readily recognizable signals such as may be given by a hooter or whistle with a distinctive tone. A typical code of hooter signals might be as follows.

(a) Three 10 s hoots with 5 s intervals indicating that blasting is due to commence within a certain time. This advanced warning will usually be at a fixed time, i.e. 15 min, 20 min or 30 min before each blasting operation, according to site conditions (e.g. time required for personnel to reach shelter points). This signal should also indicate to site personnel that they should proceed to their appointed shelter location within 5 min.

(b) One 30 s hoot indicating that blasting is due to commence in 5 min. Before this signal is given, the shotfirer should have completed all his preparations for firing, up to the stage of being ready to light the fuse(s), or to connect the firing cable to the exploder. He should use the last 5 min to carry out a final check that all personnel have retired to appointed places of shelter.

(c) One continuous signal indicating that blasting is in progress. This signal should be continued until the blast (or all the shots in the case of fuse firing) has (have) been fired.

(d) A series of five hoots of 5 s duration at 2 s intervals indicating all clear for return to work.

No persons should return to their work location until this signal has been given.

The actual code of signals may be varied from the above to suit site conditions, but once established for a particular site, it is essential that they are not altered without good reason and adequate warning to personnel.

4.5.3 Visual signs should comprise clearly painted notices, posted on all access roads to the site and sited safely outside the danger zone. Sentries should be posted at the accesses at blasting times with clear instructions as to when they must stop access to the site, and when they can allow access to proceed. Where public roads pass sufficiently close to the site there may be danger to traffic etc., from projected material. The assistance of the police should be sought in controlling traffic.

Special sentries should be appointed to warn personnel who might fail to hear warning signals, because of noisy machinery or other diversions during blasting.

In situations where controlling public access to the site is difficult, it is important to consider the use of additional visual signals such as a red flag or flags, which are commonly indicative of danger. These should be displayed in prominent positions e.g. on a tower, flag pole or high fence when blasting is in progress, so as to be generally visible over a wide area.

Where control of site personnel is awkward because of the presence of different contractors and progression of different jobs on the site, special shelters with sentries should be appointed so that each sentry may check that all working groups and individuals under his control have retired to shelter during the blasting period.

4.6 Smoking and fires

4.6.1 Smoking, fires, use of flame or heat producing equipment such as welding or cutting torches, or equipment which could cause or produce sparks should not be allowed near an explosive store or any area where explosives are

being handled, transported or used except with the authority of the site manager and under the supervision of the shotfirer.

4.6.2 If a fire should occur in the vicinity of an explosive store, the local fire authority and police should be notified and all persons, apart from the fire fighting team, kept at a safe distance. If the fire reaches the outside of the store itself, all personnel should be moved to a safe distance.

4.6.3 Special precautions should be taken when using explosives in the presence of waste paper, dry timber and vegetation especially after a hot dry spell of weather which might produce unusual hazards. Should an occasion arise when there is a need to burn rubbish to clear a site, this should be done before explosives are brought on site or after their removal. If explosives are already present on site, then predetermined procedures should be followed to ensure that the fire produces no hazard. Any such fires should be closely contained and well supervised. Fire fighting procedures should be established.

4.6.4 No explosive or blasting agent should be taken into an area where there has been a fire until the fire is completely out and the ground quenched.

4.7 Supervision and responsibility

4.7.1 It is essential that only competent persons are employed as shotfirers for the type of work involved (where possible certificated by the Institute of Explosives Engineers).

4.7.2 When subcontractors are taking part in the work on the same site, the main contractor responsible should ensure a close liaison and collaboration with the other contractors in the planning and execution of the work so as to prevent any hazard to personnel, materials or equipment when carrying out work with explosives. It should be arranged that all site personnel present during blasting operations should come under the control of the shotfirer. It is also important that contractors agree hazard areas with particular reference to the danger of fire.

4.8 Security

4.8.1 General. All explosives should be under the control of the shotfirer. Under no circumstances should explosives be left unattended or abandoned. All unused explosives should be returned to an authorized store.

Proper precautions should be taken to ensure the security of explosives during storage and transport.

4.8.2 Damaged or contaminated explosives. These should be handled with particular care and disposed of on site if possible. If they are returned to store they should be kept separate from serviceable material until adequate disposal arrangements can be made. All reasonable speed should be used to dispose of such material.

4.9 Loaded shot holes. Loaded shot holes should not be left unattended.

5. Protective precautions

5.1 General. This clause is concerned with matters affecting the security of personnel, property, etc., when it is intended that blasting operations will be conducted on a construction site.

The safety and security of personnel employed on the site, whether or not they normally handle explosives in the course of their duties, is of particular concern in this context, but the protection of the general public from

injury is of equal importance. Plant, equipment and other site installations also require to be taken into account in considering what protective measures are necessary on the site.

5.2 Protection of site personnel and installations

5.2.1 The handling of explosives on the site should be restricted to personnel who are required to do so in the discharge of their duties and who are authorized, preferably in writing, by the site management. All site personnel should, however, be warned against maltreatment of explosives and blasting accessories, and of the dangers of premature ignition or initiation of explosives materials and devices by severe impact, friction, flame or electrical impulse.

5.2.2 The contractor should provide all tools and equipment used in charging and firing blasts, and the shotfirer should not use tools or equipment other than those provided by the contractor. Items such as connecting wire and insulation tape should be used only once, and other items such as charging/stemming rods, cartridge lowering ropes and shottfiring cables may, because of wear or damage, require frequent replacement, and the shotfirer should inform the management when this is necessary. Shottfiring cables particularly are prone to damage and should be examined before use for cuts or abraded insulation and for broken wires. Damaged shottfiring cables often lead to trouble with misfires because of current leakage in the detonator/cable/exploder circuit, and for this reason lengths of cable which show signs of damage should be discarded.

Circuit testers and exploders should give trouble free service if handled with care and used and maintained in accordance with the manufacturer's instructions. Any malfunction of these items should immediately be reported by the shotfirer to his management, and any repair should be carried out only by a competent person.

5.2.3 Personnel authorized to handle explosives should not carry any flame-producing equipment such as lighters or matches, when in, or close to, places of storage, or where explosives are being used, except for the express purpose of firing a charge.

5.2.4 At no time when they are being handled on site should explosives be placed in locations where there may be a danger from falling rocks, or other objects. Nor should they be placed in or near to the path of vehicles or mobile plant, nor close to sources of heat or sparks, e.g. boilers, steam pipes, etc. It is essential that electric detonators in particular are kept well away from electrical switchgear, cables, batteries, etc. Electrically operated machinery, or mechanical plant and vehicles which have ancillary electrical equipment such as starter motors, generators, batteries, lights, etc., can also be hazardous. Electric welding equipment can also be particularly hazardous in the vicinity of electric detonators.

5.2.5 The area where explosives are to be used should be defined by warning notices or flags before the charging of blasts. Explosives and accessories should be stacked in orderly piles close to the blast holes. Vehicles and other mobile equipment should be prohibited from entering the defined blast area, except as required to deliver or remove explosives.

At other times when explosives are in transit between the explosives store and the blasting site, or at an intermediate standing point, their presence should be clearly indicated by warning signs or flags.

5.2.6 Electric detonators should only be transported around a construction site in a box or boxes made of non-conducting material, preferably wood, with a lid and catch. While he is still at the blasting site, the shotfirer should check the number of detonators used against the number issued so as to avoid losing or misplacing detonators. A system of recording issues against usages is essential to establish correct working practices in this respect. Detonator boxes should be kept locked until detonators are needed.

5.2.7 All surplus explosives, detonators, fuses, etc., after charging a blast should be returned immediately and moved to a safe and secure position under the shotfirer's control. As soon as practicable they should be returned to the store.

The only situations in which this procedure may be relaxed are:

- (a) in tunnels where surplus explosive may be kept, between successive blasts, in a lockable reserve station authorized by the site management;
- (b) at blasting sites where there are no permanent storage premises, supplies being drawn instead from a distant licensed store as required; in such cases, surplus explosives and accessories after charging a blast should be returned to the custody of designated senior site supervisors who should be authorized and instructed as to their safe keeping. The supervisor should ensure that such surplus explosives are returned the same day to the licensed store before work is finished for the day.

5.2.8 Blasting should not be carried out in confined spaces without adequate ventilation to disperse and remove the blasting fumes before returning. In tunnels and sinking shafts in particular, where blasting operations are a routine, positive ventilation at the working face should be maintained at all times. No one should return to the working face until adequate time has been allowed for fume dispersal. (See 10.6.3.)

5.2.9 The danger area from each blast has to be determined by the shotfirer, preferably after consultation with the site foreman. All site personnel should be instructed in the signalling systems giving warning of blasting operations. They should also be instructed as to what places of shelter they are to take up. Before firing a blast the shotfirer should satisfy himself that all personnel have cleared the danger area and that sentries are posted at all access points. He should himself take proper shelter.

After a blast no personnel should be allowed to return to the danger area until the shotfirer (and site foreman) have conducted a general examination, declared the area safe and sounded the all clear signal. The examination should include a search for misfires, and general observation of the site security from the point of view of ground stability, rock overhangs, dispersal of blasting fumes, etc.

NOTE. It is never safe for shelter points to be located in front of a blasting face. In this context 'in front', refers to the direction in which the debris might be expected to be displaced from the blast.

5.2.10 Mobile plant and equipment such as excavators, haul and dump trucks, compressors and drilling machines may be severely damaged by debris projected by blasting. Such equipment should be moved to a place of shelter when a blast is to be fired, switched off, and the operator should also take shelter.

Where blasting is in close proximity to services such as overhead electricity supply lines, telephone lines, water and

gas mains, care should be taken both in the choice of blasting technique and in the provision and placing of coverings, barriers, etc., to protect the installations.

5.3 Safety and convenience of third parties

5.3.1 As distinct from the site personnel, the security of the general public who may reside, work or travel in the vicinity of a construction site should be considered when blasting operations are planned.

5.3.2 The safety of persons who reside or work in the vicinity of the site should be considered particularly in relation to the hazards to which they might be exposed by excessive debris projection from blasting. It should be remembered that injury to persons or property near to blasting sites is most often caused by relatively rare occurrences when a small quantity of debris is projected much further than is normally experienced during blasting on the site.

It should also be appreciated that members of the public who are not familiar with blasting operations, may become intensely curious about observing blasts, while they may not appreciate the hazards which exist from the unpredictable possibilities of debris projection.

5.3.3 Persons living or working in the vicinity should therefore be thoroughly familiarized with the blasting procedures, frequencies and warning signals. Where necessary they should be advised to vacate their homes or offices during blasting operations.

Where the hazard is severe, the co-operation of the police should be sought in ensuring that all buildings are vacated.

5.3.4 In areas where there is no property adjoining the site, attention to security may tend to become lax, resulting in the possibility that members of the general public can approach the site unnoticed. In addition to notices giving warning of blasting on all roads and paths approaching the site, the practice should be adopted of posting sentries in such locations that they maintain an uninterrupted ring of surveillance around the site when blasting is in progress.

5.3.5 Blasts should normally be fired during the hours of daylight, and, particularly where operations may cause disturbance to the general public, blasts should only be fired during limited specified periods.

5.3.6 The blasting technique should be chosen so that any annoyance to the general public from noise, ground vibration, dust, etc., is reduced to a minimum.

In heavily built-up areas, small-scale blasting techniques employing light charges in small diameter holes will be necessary in most cases, and short delay blasting techniques will often be beneficial. In such situations careful placement of shot holes and the correct choice of charge weights are essential to minimize occurrences of excessive debris projection and the work should only be done by a shotfirer of wide experience. Such projection is most often from the 'collar' or top of the shot holes. Placing sandbags over the top of each hole is often the most effective means of eliminating excessive fly-out. In the most difficult cases these should be supplemented by blasting mats or other screening material of suitable construction and size.

6. Safety in transport and storage on site

6.1 General

6.1.1 Any person who stores explosives or detonators in the United Kingdom is required by law to keep such explosive materials in either a magazine or local authority licensed store or possibly, in the case of smaller amounts, in registered premises. Before he can acquire explosives he will need to be in possession of a certificate from the police certifying that he is a fit and proper person to acquire and keep explosives, and without such a certificate he will be unable to acquire them from the manufacturers or suppliers. If, as is usually the case, a contractor wishes to store between 6 kg (15 lb) and 1815 kg (4 000 lb) of explosives it will be necessary for him to obtain a local authority store licence. If the quantities required are less than 6 kg (15 lb) [and in certain cases up to 27 kg (60 lb)] he may be able to keep them in registered premises.

In either case he should consult the explosives officer of the district in which he proposes to carry out his work. Only if the amounts of explosives to be kept exceed 1815 kg (4 000 lb) or if, for special reasons, he wishes to keep the explosives in conditions which cannot comply for some reason with the requirements for either of the above methods of storage, will it be necessary for him to apply for a magazine licence from the Health and Safety Executive.

6.1.2 Persons wishing to keep explosives should apply for the necessary licence in ample time. The local authority explosives officer should be consulted as soon as the need to keep the explosives has been established.

6.2 Planning

6.2.1 As the requirements regarding transport and storage of explosives will depend to some extent on the type and quantities of materials to be used, it is important to decide the techniques which are to be applied before any action is taken to arrange storage or transport. Once this has been decided the best position for any store needed should be determined in consultation with the local authority explosives officer. It will often be found necessary to come to a compromise solution which will give adequate safety distance around any store and at the same time be reasonably practicable from the user's point of view. It should be realized that the local licensing authority has no discretion whatsoever to reduce the safety distances required by the stores under the Explosives Orders, see 4.1.1(b). The police should also be consulted when the matter of siting is under consideration as they will be concerned as to the vulnerability of any store to an attempt at theft. There are stringent requirements as to the construction of stores to ensure that they are difficult to break into. Local authority explosives officers will be able to give detailed advice as to the standards of construction required, sources from which stores may be purchased and the method of mounting of such stores.

6.2.2 If it is proposed to use ANFO types of explosive, prepared in situ, it will be necessary for the user to obtain a licence to manufacture such explosives. Application should be made to Her Majesty's Inspectors of Explosives at the Health and Safety Executive.

6.2.3 In general, the types of explosives used in this country may all be stored in the same place whether they be nitroglycerine or TNT based explosives, slurry explosives or of the ANFO type. Detonating fuse may also be stored in the same compartment as such explosives. It is essential that detonators are stored separately but most of the commercially available explosives stores have, attached to them, a separate structure suitable for the storing of detonators. Special conditions apply to explosive devices containing exposed iron or steel. Care should be taken to ensure that any store or magazine used is licensed for the type of explosives to be stored within it and in any case of doubt the explosives officer for the area concerned should be consulted.

6.2.4 Transport of explosives in quantities of more than 45 kg (100 lb) is subject to special regulations (Order of Secretary of State no. 11 — Explosives Act 1875) and it will be necessary to use specially constructed vehicles to convey explosives in such quantities. It is usually more convenient to arrange that the suppliers of the explosive, who will normally have special vehicles available to them, should deliver explosives in such amounts when any part of the transport involves conveyance on public roads. If the work proposed will involve conveyance of explosives in quantities of 45 kg (100 lb) or more, on site, and it is proposed to use the contractor's vehicles for this purpose, it is desirable that at least one vehicle be provided which meets the requirements for conveyance of explosives on public roads.

There are also regulations which have to be met for the conveyance of explosives in quantities of less than 45 kg (100 lb), although these are not quite as stringent. If it is foreseen that it will be necessary to carry explosives, on site, in a motor vehicle, such a vehicle should be provided for the use of the shotfirer. While explosives are being handled this vehicle should be used solely for the purpose of conveying explosives and should not be regarded as being available for general site use.

6.2.5 As the techniques to be used and the phasing of work on a site will have a marked effect both on the size of explosives store needed and the transport arrangements necessary, it is essential that these be established at the planning stage.

6.3 Safety during storage. The shotfirer should be made responsible for the explosives store or magazine, for its cleanliness, for the proper location of stock, the keeping of records and for good housekeeping in general. It is a legal requirement that copies of the appropriate general rules for explosives stores (or magazines) be displayed in the place used to store explosives.

6.4 Storage procedure

6.4.1 Extreme caution should always be exercised during the unloading of explosives. Cases containing explosives should never be roughly handled, slid on ramps or dropped. Either, the explosives should be handled only by the supplier's own men or by the shotfirer himself, or, if it is necessary to use unskilled men for this purpose they should be allowed to handle the materials only under the direct supervision of the shotfirer. Care should be taken to ensure that, during delivery of explosives to a storage place or during the removal of material from it, no grit is allowed to contaminate the cases or the store and the floor of any such storage place should be thoroughly swept after any delivery or withdrawal of explosives to or from it.

Again, the cleaning of such stores should be carried out by the shotfirer or under his personal supervision. During storage all cases of explosives should be stored flat with their top side uppermost and in such a way as to allow the identifying name of the explosive and of its manufacturer and the date of manufacture to be clearly visible. Cases of explosive should be so stacked that any pile of boxes is stable and is positioned so as to allow all-round ventilation.

6.4.2 It is essential that an up to date record is kept of all incoming and outgoing explosives (including detonators).

It is also essential that on delivery to the site all explosives are transferred either to their place of immediate use or to the licensed place of storage without delay.

6.4.3 Care should be taken to ensure that explosives are used in the order in which they have been delivered and old dated stocks should not be allowed to accumulate. If, for some reason, a particular batch of explosives has been present in a magazine or store for some time it should be checked at intervals to ensure that there is no sign of deterioration.

6.4.4 If explosives have been issued in excess of requirement and it is desired to return them to their licensed place of storage, they should be examined by the shotfirer before return. If they are neither wet nor contaminated in any way, they should be taken into store as normal but should be kept separately and should be the first material to be re-issued. Special care should be taken when explosives are returned to store that detonators and blasting explosives are kept completely separate, each in its appropriate place.

Any explosives which have been contaminated, whether by water or dirt, should be examined to make sure that detonators and blasting explosives are separated. They should be specially wrapped to ensure that contamination of the store does not occur and should be placed in a clearly identified container within the store itself. Efforts should be made to use up or dispose of any such material within one week of its being returned to store. In any event, contaminated material should not be allowed to accumulate over long periods.

Should any explosive be observed to be exuding liquid, the material should not be touched and expert advice should be sought as to the best method of removing it from the place of storage. In the first instance such advice should be sought from the manufacturers or their agents.

6.5 Fire. It is essential that contraband, i.e. smoking materials, matches, lighters or any other sources of ignition, is not taken into an explosives store.

Fires, naked lights or lighted cigarettes are not permitted within 25 m (80 ft) of an explosives store.

No petrol, oil, flammable solvents, wastepaper or similar material whose ignition might imperil the explosives store should be permitted within 25 m (80 ft) of any place where explosives are stored. Furthermore care should be taken that grass and undergrowth in the vicinity of an explosives store is cut regularly to minimize the fire hazard. (Also see 6.12.)

6.6 Tools and equipment. No tools or equipment should be kept in an explosives store except such as are required for keeping the store clean. Cleaning equipment should not incorporate parts made of iron or steel.