GENERAL STANDARD

FOR

FIRE PROTECTION IN GENERAL

AND

EXPLOSIVE STORES

ORIGINAL EDITION

MAY 1997

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2003. The approved modifications are included in the present issue of IPS.

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0. INTRODUCTION

This Standard aims to define good practice in handling, transporting, storage and use of explosive and combustible materials.

Emphasis has been placed on safety and fire prevention for general storage, particularly for those engaged in the use of explosives. The importance of security is recognized, but this Standard is not intended to address detailed Security measures.

Included in this Standard is parts of regulations that have been approved by the Home Office Security Council and are enforced at the present time, and also met the approval of the N.I.O.C. Technical Standardization Committee members.

1. SCOPE

This Standard is divided in two sections and covers the following minimum safety and fire requirements:

Section 1: General Storage

Section 2: Storage, Handling, Transportation and Use of Explosive Materials

Note:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 225 on Aug. 2003. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-SF-380	"Fire Protection in Buildings"
IPS-E-SF-200	"Fire Fighting Sprinkler Systems"
IPS-E-AR-160	"Venting, Ventilation and pressurization Systems"
IPS-E-SF-140	"Foam Generating and Proportioning Systems"
IPS-G-SF-126	"Hand and Wheel Type Fire Extinguishers"
IPS-E-SF-260	"Automatic Detectors and Fire Alarm Systems"
IPS-C-EL-105	"General Regulations"
IPS-C-PI-290	"Field Welding of On-Plot Piping Systems"
IPS-E-EL-110	"Electrical Classification and Extent"
NFPA-80A-2001	"Recommended Practice for Protection of Buildings from Exterior Fire Exposures"
NF PA-30-2000	Flammable and Combustible Liquids Code
NFPA-58	"Standard for Storage and Handling of LPG"
NFPA231D-4	"Standard for Storage of Rubber Tiers"
NFPA232	"Standard for Protection of Records"
NFPA495	"Standard for Explosive Material Code"
NFPA498	"Standard for Explosive Motor Vehicles Terminals"

3. DEFINITIONS AND TERMINOLOGY

3.1 Black powder

Gunpowder used in blasting.

3.2 Blasting Agent

Mixture used for blasting that does not contain self-explosive ingredients such as nitroglycerin or TNT.

3.3 Blasting Area

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

3.4 Canister

Portable container specifically intended and designed to carry a small quantity of explosives or accessories.

3.5 Capped Fuse

Length of safety fuse fitted with a plain detonator.

3.6 Cartridge

Wrapped or otherwise protected cylinder of defined size of a homogeneous explosive material.

3.7 Commodity

Combinations of products, packing material or combustible packages which commodity classification are based.

3.8 Danger Area

Defined area or zone in which there exists a possibility of hazard to persons or properties due to the use of explosives.

3.9 Delay Detonator

Detonator with a predetermined delay between initiation and detonation.

3.10 Detonating Cord

Flexible cord of spun textile fibers containing an explosive, with a plastic coating. When initiated, it propagates a detonation along its length.

Note:

There is a significant explosive effect outside the cord as the detonation propagates.

3.11 Detonating Relay

Device for inserting into a detonating cord to produce a predetermined delay in transmission of a detonating wave.

3.12 Detonator

Initiator for explosive materials that contains a charge of high explosive fired by means of a flame, spark, electric current or shock tube.

3.13 Emulsion Explosive

An explosive that contains sensitizers, oxidizers and fuels dispersed in an emulsion.

3.14 Encapsulated

A method of packing consisting of completely enclosing the sides and top of a pallet load containing a combustible commodity.

3.15 Exploder

Device designed for firing electric detonators.

3.16 Explosive

Substance or mixture of substances, which is manufactured to produce a practical effect by explosion.

3.17 Explosive Store

Building or structure for the storage of up to 1800 kg of explosive and licensed by a local authority.

3.18 Fly-Out

Projection of debris by an explosion.

3.19 Fume Characteristics

Qualitative nature of fumes produced by the detonation of an explosive, particularly as regards the percentages of noxious gases contained therein.

3.20 Fuse-Lighter

Device designed for igniting safety fuse and igniter cord.

3.21 High Explosive

Explosive that detonates and produces an intense shock wave.

3.22 Lay-On Blasting

Blasting by placing an explosive against a rock-boulder or other object without confining it in a shot hole.

3.23 Low Explosive

Explosive that produces large volumes of gases without creating an intense shock wave.

3.24 Magazine

Building or structure used for the storage of explosive and licensed by the government officials.

3.25 Misfire

Complete or partial failure of an explosion after action to initiate it.

3.26 Igniter Cord

Flexible cord of incendiary composition used mainly to ignite individual safety fuses when groups of shots are being fired in a sequence.

Note:

An intense side flame is emitted when burning.

3.27 Pop Shooting

Method used for the secondary breakage of material and employing small explosive charges confined in shot holes.

3.28 Pre-Splitting

Blasting technique used in solid ground in which relatively light charges are fired in closely spaced shot holes to effect a split.

3.29 Primary Blasting

Blasting by which materials are dislodged from its original location.

3.30 Primer

Cartridge or container of explosive into which a detonator or detonating cords is inserted or attached and which is designed to initiate a larger charge.

3.31 Round

Group of shots fired in one operation.

3.32 Safety Fuse

Flexible cord that contains an internal burning medium by which fire is conveyed at a continuous and uniform rate for the purpose of firing plain detonators or black powder, without burning in a similar fuse that may be in lateral contact alongside.

3.33 Secondary Blasting

Blasting to reduce oversize material to the dimensions required for handling.

3.34 Sensitivity

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.

3.35 Shaped Charge

Explosive charge shaped to concentrate the explosive force in a particular direction.

Note:

A shaped charge is sometimes known as cavity or hollow charge.

3.36 Shock Tube

A small diameter plastic tube used for initiating detonators.

Note:

It has virtually no effect outside the tube.

3.37 Shot firer

Person in immediate control of the use of explosives.

3.38 Warning Signals

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

3.39 All Clear Signals

Predetermined visual and/or audible signals given after an explosion and after checking that debris is free from misfires.

3.40 Slurry Explosive

Explosive that contains sensitizers, oxidizers and fuels dispersed in a gel.

3.41 Stemming

Inter incombustible material used to confine or separate explosives in a shot hole.

3.42 Unit Load

A pallet load or module held together in some manner and normally transported by material handling equipment.

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

SECTION 1

GENERAL STORAGE OF MATERIALS

5. CLASSIFICATION OF STORAGE

5.1 Commodity Classification

General storage is classified in 4 classes. Full details of each class are covered in IPS-E-SF-380, Clause 8.3.

5.2 Classification of Plastics, Elastomers and Rubber

Groups A, B and C is specified for various chemical materials. Details of them are in IPS-E-SF-380, Clause 8.4.

6. BUILDING CONSTRUCTION

6.1 Construction

6.1.1 Buildings used for storage of materials, which are stored and protected in accordance with this Standard, should be of any of the types described in IPS-E-SF-380.

6.1.2 Adequate access shall be provided to all portions of the premises for fire fighting purposes.

6.1.3 Emergency smoke and heat venting

Protection outlined in this Standard applies to buildings with or without roof vents and draft curtains.

7. STORAGE ARRANGEMENT

7.1 Piling Procedures and Precautions

7.1.1 Any commodities that may be hazardous in combination with each other shall be stored so they cannot come into contact with each other.

7.1.2 Safe floor loads shall not be exceeded. For water absorbent commodities, normal floor loads shall be reduced to take into account the added weight of water that can be absorbed during fire fighting operations.

7.2 Commodity Clearance

7.2.1 The clearance between top of storage and sprinkler deflectors shall conform to IPS-E-SF-200.

7.2.2 If the commodity is stored above the lower chord of roof trusses, at least 305 mm clear space shall be maintained to permit wetting of the truss unless the truss is protected with 1 hour fireproofing.

7.2.3 Storage clearance from ducts shall be maintained in accordance with IPS-E-AR-160.

7.2.4 The clearance between stored materials and unit heaters, radiant space heaters, duct

furnaces, and flues shall not be less than 0.9 m in all directions or shall be in accordance with the clearances shown on the approval agency label.

7.2.5 Clearance shall be maintained to lights or light fixtures to prevent possible ignition.

7.2.6 Sufficient clearance (at least 0.6 m) shall be maintained around the path of fire door travel to assure proper operation and inspection.

7.3 Aisles

7.3.1 Wall aisles shall be at least 610 mm wide in warehouses used for the storage of commodities that expand with the absorption of water.

7.3.2 Aisles shall be maintained to retard transfer of fire from one pile to another and to permit convenient access for fire fighting, salvage and removal of storage.

7.4 Storage of Idle Pallets

7.4.1 Wood pallets or nonexpanded polyethylene solid deck pallets

7.4.1.1 Pallets shall preferably be stored outside or in a detached building.

7.4.1.2 Pallets, when stored indoors, shall be protected as indicated in Table 1, unless the following conditions are met:

a) Stored no higher than 1.8 m, and;

b) Each pallet pile of no more than 4 stacks shall be separated from other pallet piles by at least 1.4 m of clear space or 7.6 m of commodity.

Note:

No additional protection is necessary as long as items (a) and (b) above are met.

TABLE 1 - PROTECTION FOR INDOOR STORAGE OF WOOD IDLE PALLETS OR NONEXPANDED POLYETHYLENE SOLID DECK IDLE PALLETS

HEIGHT OF PALLET STORAGE (m)	SPRINKLER DENSITY REQUIREMENTS (L/S)/m^2	AREA OF SPRINKLER DEMAND (m^2)	
		TEMPERATURE RATING (141°C)	(74°C)
1.8	[.14]	(186)	(279)
1.8 to 2.4	[.20]	(232)	(372)
2.4 to 3.7	[.41]	(325)	(557)
3.7 to 6.1	[.41]	(418)	---

7.4.2 Plastic pallets (other than noted in 7.4.1)

7.4.2.1 Plastic pallets shall preferably be stored outdoors or in a detached shed.

7.4.2.2 Plastic pallets where stored indoors shall be protected as follows:

a) When stored in cutoff rooms:

- The cutoff rooms shall have at least one exterior wall.

- The plastic pallet storage shall be separated from the remainder of the building by 3 hours rated firewalls.

- The storage shall be protected by sprinklers designed to deliver 0.41 (L/s)/m^2 for the entire room or by high expansion foam and sprinklers as indicated in Clause 8.2.

- The storage shall be piled no higher than 3.7 m.

- Any steel columns shall be protected by 1 hour fireproofing or a sidewall sprinkler directed to one side of the column at the top or at 4.6 m level, whichever is lower.

b) When stored without cutoffs from other storage:

- Plastic pallet storage shall be piled no higher than 1.2 m.

- Sprinkler protection shall employ 141°C rated sprinklers.

- Each pallet pile of no more than two stacks shall be separated from other pallet piles by at least 2.4 m of clear space or 7.6 m of stored commodity

7.5 Flammable and Combustible Liquids

Only limited quantities of flammable and combustible liquids shall be permitted in general storage warehouses. Any such storage shall be segregated from other stored combustible material.

8. FIRE PROTECTION-GENERAL

8.1 Automatic Sprinkler Systems

8.1.1 Sprinkler systems installed in buildings used for solid pile, bin box, shelf, or palletized storage shall be in accordance with IPS-E-SF-200.

8.1.2 The design density shall not be less than 0.10 (L/s)/m2 and design area shall not be less than 186 m2 for wet systems, 242 m2 for dry systems, for any commodity, class, or group.

8.1.3 The sprinkler design density for any given area of operation for a Class IV commodity shall not be less than the density for the corresponding area of operation for Ordinary Hazard Group 3 in IPS-E-SF-200.

8.1.4 The sprinkler design density for any given area of operation for a Class III commodity shall not be less than the density for the corresponding area of operation for Ordinary Hazard Group 2 in IPS-E-SF-200.

The water supply requirements for sprinklers only shall be based on the actual calculated demand for the hazard and adjusting (if necessary) to satisfy Paragraphs 8.1.2, 8.1.3 and 8.1.4.

8.1.5 Where palletized or solid pile storage is placed on top of racks, the provisions for Rack Storage of Materials, shall apply to the entire height of storage with regard to sprinkler requirements and water supplies for ceiling and rack sprinklers.

8.1.6 In warehouses that have portions containing rack storage and other portions containing palletized, solid pile, bin box, or shelf storage, the standard applicable to the storage configuration shall apply.

8.1.7 The densities and areas provided are based on fire tests using standard orifice 12.7 mm and large orifice 13.5 mm sprinklers. For use of other types of sprinklers consult the relevant authorities.

8.1.8 In buildings occupied in part for storage, within the scope of this Standard, the required sprinkler protection shall extend 4.6 m beyond the perimeter of the storage area.

8.1.9 The sprinkler system should be kept in operation during manual fire-fighting and map-up operations.

8.2 High Expansion Foam

8.2.1 High expansion foam systems installed in addition to automatic sprinklers shall be installed in accordance with IPS-E-SF-140.

High expansion foam used to protect the idle pallets shall have a maximum fill time of 4 minutes.

8.2.2 High expansion foam systems shall be automatic in operation.

8.2.3 Detectors shall be listed and shall be installed at no more than one-half listed spacing.

8.2.4 Detection systems, concentrate pumps, generators, and other system components essential to the operation of the system shall have an approved standby power source.

8.2.5 A reduction in ceiling density to one-half that required for Class I through IV commodities, idle pallets, or plastics (using the secondary demand point) will be allowed without revising the design area, but shall not be less than 0.10 (L/s)/m^2.

8.3 Manual Inside Protection

8.3.1 Hose reels

Hose reels as specified in IPS-M-SF-109 shall be available to reach all portions of the storage area, giving due consideration to access aisle configuration with maximum anticipated storage in place. Such small hose should be supplied from.

a) Outside hydrants.

b) A separate system approved by the company's authorities.

c) Valve hose connection on sprinkler risers where such connections are made upstream of sprinkler control valves.

d) Adjacent sprinkler control system.

8.3.2 Portable fire extinguishers

Portable fire extinguishers shall be provided in accordance with IPS-G-SF-126. Up to one-half of the required complement of portable fire extinguishers for Class A fires may be omitted in storage areas where fixed, small hose lines 38 mm (1½ in.) are available to reach all portions of the storage area.

8.4 Hydrants

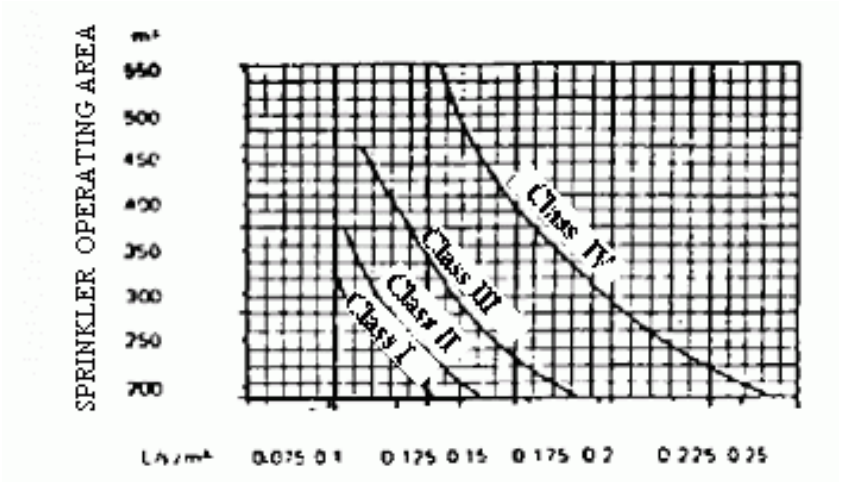
Hydrants shall be installed in accordance with IPS-M-SF-105 and NFPA 24 standard for the installation of private fire mains and their appurtenances.

8.5 Fire Protection-Commodity (Classes I Through IV)

8.5.1 General

8.5.1.1 Protection specified in this Section shall apply to nonencapsulated commodities upto 9.2 m high and encapsulated commodities upto 4.6 m high.

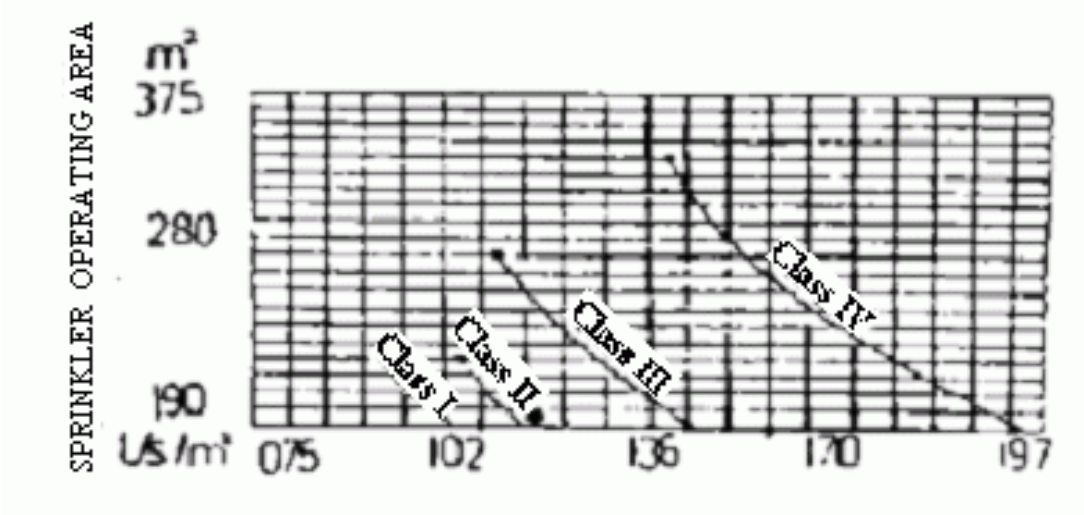
8.5.1.2 Sprinkler design criteria for solid pile, palletized, and bin box storage over 3.7 m, and shelf storage over 3.7 m to 4.6 m high, and encapsulated storage upto 4.6 m high shall be in accordance with Figs. 1a, 1b, and 2.



SPRINKLER DENSITY

SPRINKLER SYSTEM DESIGN CURVES 6.1 m HIGH STORAGE (74°C) SPRINKLERS

Fig. 1a



SPRINKLER DENSITY

SPRINKLER SYSTEM DESIGN CURVES 6.1 m HIGH 141°C SPRINKLERS

Fig. 1b

Note:

Sprinkler demand for 6.1 m high storage may be selected from any point on the appropriate class curve in Fig. 1b

Fig. 1b provides protection curves for sprinkler systems using only 14°C rated sprinklers.

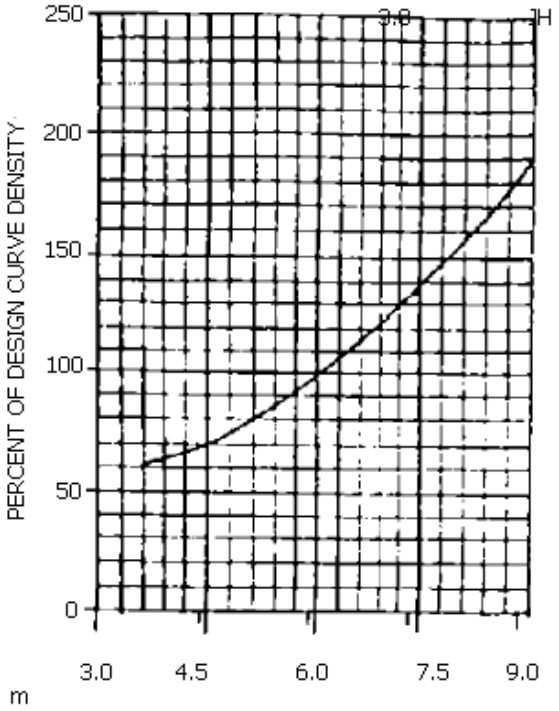
Exception: For bin boxes and closed shelves constructed of metal with a face area not exceeding 1.49 m^2, the area of application is permitted to be reduced by 50 percent, but not less than 186 m^2, for wet systems and 242 m^2, for dry systems.

The density provided for the area of application shall be permitted to be selected from any point on the curve applicable to the commodity, classification, and arrangement of the stored commodities and sprinkler temperature rating. It is not necessary to meet more than one point on the selected

curve.

8.5.1.3 For storage heights other than 6.1 m apply Fig. 2

8.5.2 Bin box and shelf storage over 2.7 m and provided with walkways at not over 3.7 m vertical intervals shall be provided with automatic sprinklers under the walkways as well as at the ceiling. The design density for ceiling and walkway sprinklers shall be permitted to be in accordance with the height adjustment of Fig. 2.



STORAGE HEIGHT

CEILING SPRINKLER DENSITY VERSUS STORAGE HEIGHT

Fig. 2

8.5.3 Water supplies

8.5.3.1 Sprinkler water demand for 6.1 m high-palletized storage, solid pile, and bin box storage shall be in accordance with Figs. 1a and 1b.

8.5.3.2 Where storage height is less than 9.1 m high, but more than 3.7 m high in solid piles, palletized, or bin box storage, ceiling densities indicated in the design curves in Figs. 1a and 1b shall be modified in accordance with Fig. 2, without revising the design area.

8.5.3.3 For shelf storage over 3.7 to 4.6 m high, ceiling densities indicated in the design curves in Figs. 1a and 1b shall be modified in accordance with Fig. 2 without revising the design area.

8.5.3.4 Where dry-pipe systems are used, the areas of operation indicated in the design curves shall be increased by 30 percent. Densities shall be selected so that areas of operation, after the 30 percent increase, do not exceed the upper area limits given in the design curves.

8.5.3.5 A minimum of 32 L/s shall be added to the sprinkler demand for large and small hose stream demand.

8.5.3.6 Water supply duration shall be:

DURATION (HOURS)

STORAGE HEIGHT (m)	COMMODITY CLASS	
	I, II & III	IV
Over (3.7) up to (6.1)	1½	2
Over (6.1) up to (9.1)	2	2½

8.5.4 High expansion foam

(See IPS-E-SF-140, Clause 7.)

8.5.5 Automatic detectors and fire alarm systems

Detectors and alarms shall be provided as specified in IPS-E-SF-260.

8.6 Protection of Outdoor Storage

8.6.1 General

8.6.1.1 The hazards of exposure to outdoor storage from ignition sources and exposing fires and the infinite variety of conditions under which such exposures may occur render impossible the formulation of any single table, formulae, or set of rules that will adequately cover all conditions.

8.6.1.2 Recommendations contained herein are for the protection of outdoor storage of commodities covered by the Standard.

8.6.1.3 In general, the provision of automatic fire protection is impractical for outdoor storage. As a result, emphasis must be placed upon:

a) Control of potential ignition sources such as from radiation of heat, smoking, transformers, refuse burners, overhead power lines, and open fire.

b) Elimination of adverse factors such as trash accumulations, weeds, and brush.

c) Provision of favorable physical conditions such as limited pile size, low storage heights, wide aisles, and possible use of fire retardant covers (e.g., tarpaulins).

d) The rapid and effective application of manual fire fighting efforts by the provision of fire alarms, hydrants, hose boxes, and hose reels, in accordance with Company's Standard.

8.6.1.4 Outdoor storage is acceptable for materials that are:

a) of low fire hazard;

b) of low value;

c) of such great fire hazard that indoor protection is impractical;

d) of large volume and bulk, making it impractical to construct and protect a building to house the storage.

8.6.1.5 Where materials that normally would be stored in buildings are stored outdoors in temporary emergencies, special precaution should be taken for their safeguard and that they be moved to inside the buildings after the emergency is over.

8.6.2 Responsibility

8.6.2.1 It is the responsibility of fire/material authorities to take proper consideration of the hazards

of the various materials handled. Protection requirements and storage arrangements will vary with the combustibility of the materials, and special precautions must be followed for the types of material stored. The care, cleanliness, and maintenance exercised will determine to a large extent the relative fire safety in the storage area.

8.6.2.2 Consideration should be given to proper storage of materials in order to prevent the undue concentration of quantities of such materials in a single location, subject to one catastrophe.

- Provision of favorable fence to prevent entering unauthorized personal and cars, etc…. inside the storage area.

- Periodic inspection of all fire protection equipment should be made in conjunction with regular inspection of the premises. Unsatisfactory conditions should be reported immediately and necessary corrective measures taken promptly.

8.6.3 Site

8.6.3.1 In selecting a site for outdoor storage, preference should be given to a location having:

a) adequate fire protection;

b) adequate public or private water system with hydrants suitably located for protection of the storage;

c) adequate all-weather roads for fire trucks to respond;

d) sufficient clear space from buildings or from other combustible storage that constitute an exposure hazard;

e) absence of flood hazard;

g) topography as level as possible to provide storage stability.

8.6.3.2 The entire site should be surrounded by a fence or other suitable means to prevent access of unauthorized persons. An adequate number of gates should be provided in the surrounding fence or other barriers so as to permit ready access of fire trucks.

8.6.4 Material piling

8.6.4.1 Materials should be stored in unit piles as low in height and small in area as is consistent with good practice for the materials stored.

The maximum height should be determined by the stability of pile, effective reach of hose streams, combustibility of the commodity, and ease of pile breakdown under fire or mop-up conditions. Long narrow piles are preferred over large square piles to facilitate manual fire fighting. (The short dimension increases the effectiveness of hose streams and eases pile breakdown).

8.6.4.2 Aisles should be maintained between individual piles, between piles and buildings, and between piles and the boundary line of the storage site. Sufficient driveways having the width of at least 4.5 m should be provided to permit the travel of fire equipment to all portions of the storage area.

Aisles should be at least twice the pile height to reduce spread of fire from pile to pile and to permit ready access for fire fighting, emergency removal of material, or for salvage purposes.

8.6.4.3 As the commodity class increases in combustibility, or where storage could be easily ignited from radiation, wider aisles should be provided. Smaller unit piles may be an alternative to wider aisles if yard space is limited.

8.6.4.4 For outdoor idle wooden pallet storage see 4.4 and A.4.4.1.1 of NFPA 231. Separation between piles of idle pallets and other yard storage should be as follows:

RECOMMENDED CLEARANCE BETWEEN OUTSIDE IDLE PALLET STORAGE AND BUILDING

WALL CONSTRUCTION		MINIMUM DISTANCE, ft(m) OF WALL FROM STORAGE OF:		
Wall Type	Openings	Under 50 Pallets	50 to 200 Pallets	Over 200 Pallets
Masonry	None	0	0	0
	Wired glass with outside sprinklers 1-hr doors	0	10 (3.0)	20 (6.1)
	Wired or plain glass with outside sprinklers ¾-hr doors	10 (3.0)	20 (6.1)	30 (9.1)
Wood or metal with outside sprinklers				
Wood, metal, or other		20 (6.1)	30 (9.1)	50 (15.2)

Notes:

1) Fire-resistive protection comparable to that of the wall should also be provided for combustible eave lines, vent openings, etc.

2) When pallets are stored close to a building, the height of storage should be restricted to prevent burning pallets from falling on the building.

3) Manual outside open sprinklers generally are not a reliable means, of protection unless property is attended to at all times by plant emergency personnel.

4) Open sprinklers controlled by a deluge valve are preferred.

8.6.4.5 Boundary posts with signs designating piling limits should be provided to indicate yard area, roadway and aisle limits.

8.6.5 Buildings and other structures

8.6.5.1 Yard storage, particularly commodities in the higher heat release category, should have as much separation as is practical from important buildings and structures, but not less than that offered by NFPA 80A, "Recommended Practice for Protection of Buildings from Exterior Fire Exposures".

8.6.5.2 As guidance in using NFPA 80A in establishing clear spaces, the following Classification of Severity with Commodity Classes of this Standard may be used on the basis of 100 percent openings representing yard storage:

a) Light Severity: Commodity Class I.

b) Moderate Severity: Commodity Class II.

c) Interpolate between Moderate and Severe Severity for Commodity Class III.

d) Severe Severity: Commodity Class IV and Class A plastics.

Note:

The above guidelines apply to the equivalent commodity classes of this Standard. The severity of the exposing building or structure should also be a consideration when establishing a clear space.

8.6.6 Yard maintenance and operations

8.6.6.1 The entire storage site should be kept free from accumulation of unnecessary combustible materials. Vegetation should not be allowed. Procedures should be provided for weed control and the periodic cleanup of the yard area.

8.6.6.2 Adequate lighting should be provided to allow supervision of all parts of the storage area at night.

8.6.6.3 All electrical equipment and installations should conform to the provisions of IPS-C-EL-105 "General Regulation".

8.6.6.4 No heating equipment should be located or used within the storage area. oven, braziers, portable heaters, and other open fires should not be used.

8.6.6.5 Smoking should be prohibited, except in locations prominently designated as smoking areas. "No Smoking" signs should be posted in prohibited areas.

8.6.6.6 Welding and cutting operations should be prohibited in the storage area, unless the precautions accordance with IPS-C-PI-290 field welding of on-plot piping systems are taken.

8.6.6.7 Tarpaulins, used for protection of storage against the weather, should be of fire retardant fabric.

8.6.6.8 Locomotives from which glowing particles may be emitted from exhaust stacks should not be permitted in the yard.

8.6.6.9 Motorized vehicles using gasoline, diesel fuel, or liquefied petroleum gas as fuel should be parked in a separate detached yard.

8.6.6.10 Storage and handling of fuel should conform to NFPA 30, Flammable and Combustible Liquids Code, and NFPA 58, Standard for Storage and Handling of Liquefied Petroleum Gases.

8.6.6.11 Provide a procedure for loading and unloading materials and also driver's performance.

8.6.7 Fire protection

8.6.7.1 Provisions should be made for promptly notifying the public fire department (if available) in case of fire or other emergency.

8.6.7.2 Hydrants should be spaced to provide a sufficient number of hose streams. Refer to IPS-E-SF-105.

8.6.7.3 Provisions should be made to permit direction of an adequate number of hose streams on any pile or portion of the storage area that may be involved in fire. Sufficient hose and other equipment be kept on hand at the storage property, suitably housed, and provision be made for trained personnel available to put them into operation and be kept in good condition to prevent deterioration.

8.6.7.4 Hydrants and all fire fighting equipment should be accessible for use at all times. No temporary storage should be allowed to obstruct access to fire fighting equipment and any accumulation of snow or obstructing material should be promptly removed.

8.6.7.5 Monitor nozzle should be provided at strategic points where large quantities of highly combustible materials are stored or where average amounts of combustible materials are stored in inaccessible locations.

8.6.7.6 Fire extinguishers of an appropriate type should be placed at well marked, strategic points throughout the storage area so that one or more portable fire extinguisher units can quickly be made available for use at any point.

Where the climate is such to involve the danger of freezing, suitable extinguishers for freezing temperatures should be used. For guidance in the type and use of extinguisher (see IPS-G-SF-126).

8.6.8 Fire protection-plastics and rubber

Factors affecting protection requirements are covered in NFC, Volume 6, No. 231-10 and shall be given serious consideration prior to given the final protection requirements.

9. STANDARD FOR RACK STORAGE OF MATERIALS

Full text of the above standards is covered in NFC, Volume 6, Code No. 231C-5.

10. STANDARD FOR STORAGE OF RUBBER TIRES

Full text of the above standards is covered in NFC, Volume 6, Code No. 231D-4.

11. STANDARD FOR PROTECTION OF RECORDS

Full text of the above standards is covered in NFC, Volume 6, Code No .232-4.

SECTION 2

STORAGE, HANDLING, TRANSPORTING AND USE OF EXPLOSIVE MATERIALS

12. GENERAL

12.1 Classification and Use of Magazines

12.1.1 Outdoor magazines shall be classified and used according to Table 2.

TABLE 2 - CONSTRUCTION FEATURES AND ALLOWABLE STORAGE IN MAGAZINES

CLASSIFICATION AND USE OF MAGAZINES CONSTRUCTION FEATURES	MAGAZINE TYPES				
	1	2	3	4	5
Permanent	×			×	×
Portable		×	×	×	×
Bullet-Resistant	×	×			
Fire-Resistant	×	×	×	×[2)]	
Theft-Resistan	×	×	×	×	×[2)] [1)]
Weather-Resistan	×	×	×	×	×
Ventilated	×	×	×	×[2)]	×[2)]
Storage in magazines high explosives	×	×	×		
(Dynamic; cap sensitive water gels;	×	×	×		
slurries; emulsions; cast boosters)	×	×	×		
Low explosives (black powder)	×	×	×	×	
Class A detonators	×	×	×		
Detonating cords	×	×	×		
Class C detonators[3])	×	×	×	×	
Safety fuse, electric squibs,[4])Igniters and igniter cord	×	×	×	×	
Blasting agents	×	×	×	×	×

Notes:

1) Each door of a mobile Type 5 magazine should be equipped with at least one 5-tumbler padlock having a 0.95 cm (3.8 in.) case-hardened shackle. The lock need not be hooded.

2) Over-the-road trucks or semi-trailers used for temporary storage as Type 4 or 5 magazines need not be fire-resistant or ventilated.

3) Includes electric detonators with leg wires 1.22m (4 ft.) long or longer or detonators with empty plastic tubing 3.66m (12 ft.) long or longer that contain not more than 1g (0.35 oz) explosives (excluding ignition and delay charges).

4) Detonators shall not be stored in the same magazine with other explosive materials, except that Class C detonators and those described in Note 3 may be stored with safety fuse, electric squibs, igniters or igniter cord in type 1, 2, 3 or 4 magazines.

12.1.2 Indoors magazines used for the storage of 22.7 kg or less of explosive materials in warehouses and in wholesale or retail establishments shall be fire-resistant and theft-resistant and shall be subject to the approval of the authority concerned.

12.2 Classification of Explosives

12.2.1 Classification of explosives is as follows:

Class A Explosives

Possessing detonating or otherwise maximum hazard, such as dynamite, desensitizing nitroglycerin, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

Class B Explosives

Possessing flammability hazards, such as propellants, including some smokeless propellants, photographic flash powders.

Blasting Agents

Possessing minimum accidental explosion hazard.

Class C Explosives

Including certain manufactured articles that contain Class A or B explosives, or both, as components, but in restricted quantities.

Forbidden Explosives

Explosives that are forbidden from or not acceptable for transportation by common carriers.

Certain chemicals and fuel materials may have explosive characteristics, but are not within the scope of this Standard and are not specifically classified as explosives. Authoritative information should be obtained for such materials, and action commensurate with their hazards, location, isolation, and safeguards should be taken.

12.2.2 In general, the wall having the largest area should be chosen to provide explosion relief. The entire area of the wall should be utilized. The term "weak-wall" is used to describe the relative strength of the explosion-relieving wall as compared to the rest of the building.

12.2.3 For information on the use of conductive surfaces to minimize the hazard of static electricity, see IPS-E-EL-200 Lighting and Wiring.

12.2.4 This requirement is for purposes of minimizing personnel exposure and is distinct from any requirement on maximum building occupancy that may exist.

12.2.5 Smoking materials include matches, lighters, cigarettes, cigars, and pipes.

12.2.6 Oxidizers include nitrates, chlorates, and per chlorates.

12.2.7 A bullet resistant roof may be constructed according to any of the specifications listed in Appendix A. A bullet resistant ceiling may be constructed at the eave line, covering the entire area of the magazine, except for the necessary ventilation space. Examples of bullet resistant ceiling construction include:

1) Any construction meeting the specifications listed in Appendix A.

2) A sand tray having a sand depth of at least 102 mm.

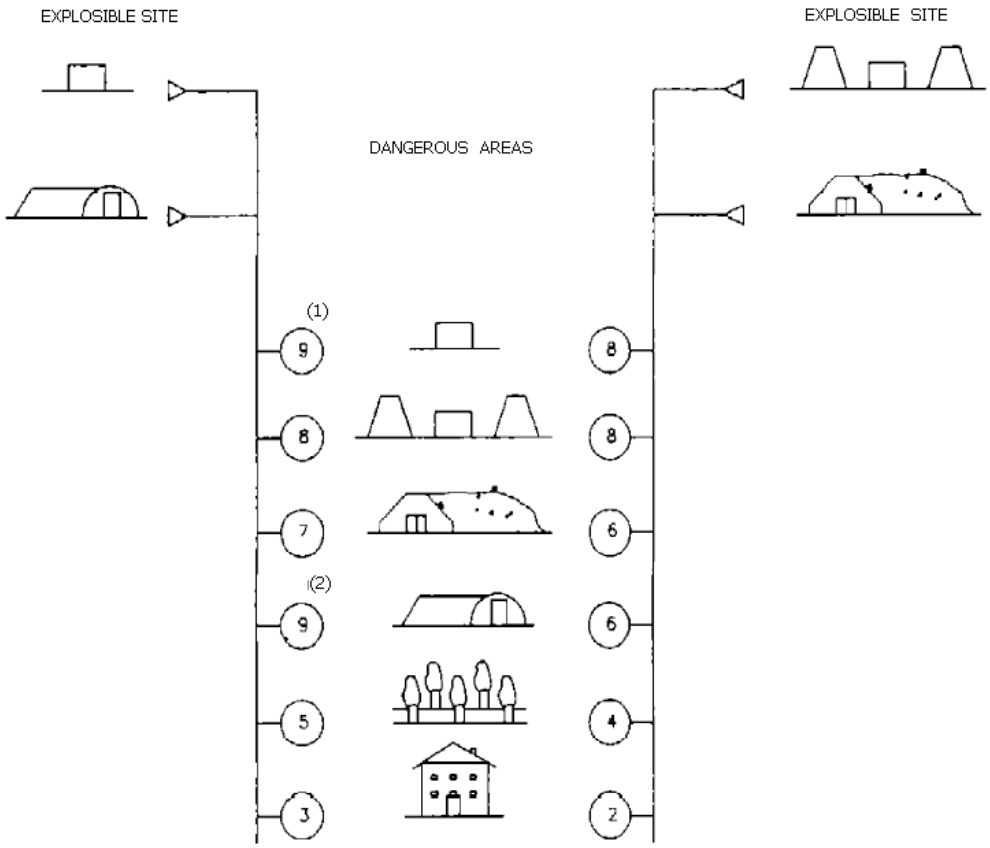
13. LOCATION OF MAGAZINES

13.1 The distance of explosive stores from housing areas, roads, working places and remote offices shall be in conformity with its capacity and relevant to Table 3.

13.2 The minimum distance of vehicle loaded with explosives from open fire or lighted smoking shall be 100 meters (the opposite windward direction should be noted).

TABLE 3 - SAFETY DISTANCES FROM EXPLOSIBLE SITE

NET WEIGHT OF EXPLOSIVE OR ACTIVE MATERIAL IN kg.	SAFETY DISTANCES (M)							
	DOMETIC HOUSING AREAS		INTER CONNECTING MAIN ROAD		DISTANCE BETWEEN STORES			
1	2	3	4	5	6	7	8	9
500	80	100	55	65	5	15	20	30
750	100	125	65	85	5	15	15	30
1000	125	155	85	105	10	20	25	35
1250	160	180	105	120	10	20	25	40
1500	175	200	115	135	10	20	30	40
1750	180	220	120	145	10	20	30	45
2000	185	230	125	155	10	20	30	45
2250	200	250	135	165	10	25	35	50
2500	210	265	140	175	10	25	35	50
3000	240	300	160	200	15	25	35	50
3500	265	325	175	225	15	25	40	55
4000	360	360	240	210	15	30	40	55
4500	370	370	245	225	15	30	40	60
5000	385	385	260	260	15	30	40	60
7500	440	440	295	290	15	35	50	70
10000	485	485	325	325	20	40	55	80
12500	520	520	350	350	20	40	55	85
15000	555	555	370	370	20	45	60	90
17500	585	585	390	390	20	45	65	95
20000	610	610	410	410	20	50	65	100
25000	655	655	440	440	20	55	70	105
30000	700	700	470	470	25	55	75	110
35000	735	735	490	490	25	60	80	120
40000	765	765	510	510	30	60	85	125
45000	800	800	535	535	30	65	85	130
50000	825	825	550	550	30	65	90	135
60000	880	880	590	590	35	70	95	140
75000	945	945	630	630	35	75	100	150
100000	1040	1040	695	695	40	80	110	165
125000	1120	1120	750	750	40	90	120	180
150000	1190	1190	795	795	45	95	130	190



SAFETY DISTANCES FROM EXPLOSIBLE SITE

Fig. 3

13.3 The separation distances given by the American Table of Distances or the Table of Recommended Separation Distances, or both, shall be used to determine minimum separation of storage facilities for explosives, blasting agents, and ammonium nitrate. The tables to be applied shall be as specified in Table 6-4a.

13.4 An indoor magazine shall only be located on a floor that has an entrance at or a ramp to grade level. It shall be located no more than 3 m from the entrance.

13.5 Two magazines may be located in the same building only if one magazine is used solely for the storage of detonators in quantities not exceeding 5,000. A distance of 3 m shall be maintained between the magazines.

13.6 Type 3 magazines shall be located away from neighboring inhabited buildings, railways, highways, and other magazines.

13.7 Type 3 magazines shall be attended when explosive materials are stored within. All explosive materials shall be removed to appropriate storage magazines for unattended storage at the end of the workday.

13.8 Two type 3 magazines may be located at a blasting site, if one magazine is used solely for the storage of detonators.

13.9 Type 5 magazine shall not be located in a residence or dwelling.

14. MAGAZINE CONSTRUCTION (see Appendix A)

14.1 Basic Requirements

14.1.1 Magazines shall be constructed so as to comply with this Section or in a manner substantially equivalent to the requirements for safety and security embodied in this Section.

14.1.2 The ground around a magazine shall be graded so that water drains away from the magazine.

14.1.3 Magazines requiring heat shall be heated by either hot water radiant heating within the magazine building or by indirect warm air heating.

14.1.4 Indirect warm air shall be heated by either hot water or low-pressure 103 kPa (15 psig) or less steam coils located outside the magazine building.

14.1.5 Magazine heating systems shall meet the following requirements:

a) Radiant heating coils within the building shall be installed so that explosive materials or their containers cannot contact the coils and so that air is free to circulate between the coils and the explosive materials. The surface temperature of the coils shall not exceed 74°C.

b) Heating ducts shall be installed so that the hot air discharged from the ducts is not directed against explosive materials or containers.

c) The heating system shall be controlled so that the ambient temperature of the magazine does not exceed 54°C or as specified by the Manufacturer.

d) Any electric fan or pump used in the heating system shall be located outside the magazine, separate from the magazine walls, and shall be grounded.

e) Any electric motor and any controls for electric heating devices used to heat water or produce steam shall be equipped with overload control device to disconnect accordingly. All electrical switchgear shall be located at least 7.6 m from the magazine.

f) Any fuel-fired heating source for the hot water or steam shall be separated from the magazine by a distance of not less than 7.6 m. The area between the heating unit and the magazine shall be cleared of all combustible material.

g) Explosive materials stored in magazines shall have uniform circulation of air.

14.1.6 When lighting is necessary within the magazine, electric safety flashlights or electric safety lanterns shall be used.

Exception:

As provided for in 14.1.6.1.

14.1.6.1 Electric lighting may be used within a magazine only if the installation meets the following requirements:

a) Junction boxes containing fuses or circuit breakers and electrical disconnects shall be located at least 7.6 m from the magazine.

b) Disconnects, fuses, and circuit breakers shall be protected by a voltage surge arrestor capable of handling 2500 amperes for 0.1 seconds.

c) All wiring from switches, both inside and outside the magazine, shall be installed in rigid conduit. Wiring leading to the magazine shall be installed underground.

d) Conduit and light fixtures inside the magazine shall be protected from physical damage by suitable guards or properly located.

e) Light fixtures shall be suitably enclosed to prevent sparks or hot metal from falling on the floor or onto material stored in the magazine.

f) Junction boxes located within the magazine shall have no openings and shall be equipped with close-fitting covers.

g) Magazines containing explosive materials, which may release flammable vapors, shall have wiring and fixtures, which meet the requirements of IPS-E-EL-110 "Electrical Area Classification & Extent".

h) Lights inside magazines shall not be left on while the magazine is unattended.

14.1.7 There shall be no exposed ferrous metal on the interior of a magazine where it may contact packages of explosives.

Exception:

This requirement does not apply to Type 5 magazines.

14.2 Requirements for Specific Types

14.2.1 Type 1 magazine

A type 1 magazine shall be a permanent structure, such as a building or igloo, that is bullet-resistant, fire-resistant, theft resistant, weather-resistant and ventilated.

a) Walls and doors shall e bullet-resistant and may be constructed according to any of the specifications listed in Appendix C of NFPA, Section 495.

b) The roof may be constructed of any type of structurally sound materials which are or have been made fire-resistant on the exterior.

c) Where the natural terrain around a Type 1 magazine makes it possible for a bullet to be shot through the roof and ceiling at such an angle that the bullet can strike the explosive materials within, then either the roof or ceiling shall be of bullet-resistant construction.

d) The foundation may be of masonry, wood, or metal and shall be completely enclosed except for openings to provide cross ventilation. A wood foundation enclosure shall be covered on the exterior with metal of not less than 26 gage thickness.

e) The floor shall be constructed of wood or other suitable material. Floors constructed of materials that may cause sparks shall be covered with a nonsparking surface or the packages of explosive materials shall be placed on pallets of nonsparking material.

f) Type 1 magazines shall be ventilated to prevent dampness or heating of explosive materials. Ventilation openings shall be screened to prevent entrance of sparks. Ventilators in sidewalls shall be offset or shielded. Magazines having foundation and roof ventilators, with the air circulating between the side walls and floor and between the side walls and ceiling, shall have a wood lattice lining or equivalent means to prevent packages of explosive materials from being stacked against side walls and blocking air circulation. A 51 mm air space shall be provided between the sidewalls and the floor.

g) Each door of a Type 1 magazine shall be equipped with one of the following locking systems:

1) two mortise locks;

2) two padlocks in separate hasps and staples;

3) a mortise lock and a padlock;

4) a mortise lock that requires two keys to open; or

5) a three-point lock or an equivalent lock that secures the door to the frame at more than one point.

Padlocks shall be steel, have at least five tumblers, and a 9.5 mm case-hardened shackle. All padlocks should be protected by steel hoods installed so as to discourage insertion of bolt cutters.

Doors secured by a substantial internal bolt do not require additional locking devices. Hinges and hasps shall be securely fastened to the magazine and all locking hardware shall be secured rigidly and directly to the doorframe.

14.2.2 Type 2 magazines

A Type 2 magazine shall be a portable or mobile structure, such as a box, skid-magazine, trailer, or semi-trailer that is fire-resistant, theft-resistant, weather-resistant, and ventilated. If used for out-door storage, Type 2 magazines shall also be bullet-resistant.

14.2.2.1 Type 2 outdoor magazines

a) Walls and roof or ceiling shall be constructed according to the provisions of 14.2.1 (a), (b) and (c).

b) Doors shall be of metal, constructed according to the provisions of 14.2.1 (a), or shall have a metal exterior with an inner door.

c) Floors constructed of ferrous metal shall be covered with a non-sparking surface.

d) A magazine that is top-opening shall have a lid that overlaps the sides by at least 25.4 mm when in the closed position.

e) The magazine shall be supported so that its floor does not directly contact the ground.

f) The magazine less than 0.766 m^3 in size shall be securely fastened to a fixed object to prevent theft of the entire magazine.

g) Hinges, hasps, locks and locking hardware shall comply with 14.2.1 (g).

Exception:

Padlocks on vehicular magazines need not be protected by steel hoods.

h) Whenever a vehicular magazine is left unattended, its wheels shall be removed or its kingpins shall be locked or it shall otherwise be effectively immobilized.

14.2.2.2 Type 2 indoor magazines

a) The magazine shall have substantial wheels or casters to facilitate removal from the building in case of emergency.

b) The cover of the magazine shall have substantial strap hinges and a means for locking. The magazine shall be kept locked, except during placement or removal of explosive materials, with a five-tumbler padlock or its equivalent.

c) The magazine shall be painted red and the top shall bear the words "Explosive-Keep Fire Away" in white letters at least 76 mm high.

d) Type 2 indoor magazines constructed of wood shall have sides, bottoms, and covers or doors constructed of 51 mm hard- wood, well braced at corners.

The magazines shall be covered with sheet metal of not less than 26 gauge. Nails exposed to the interior of the magazines shall be countersunk.

e) Type 2 indoor magazines constructed of metal shall be of 12-gauge sheet metal and shall be lined with a no sparking material. Edges of metal covers shall overlap the side by at least 25.4 mm.

14.2.3 Type 3 magazines

A Type 3 magazine is a "day box" or portable structure used for the temporary storage of-explosive materials. Type 3 magazines shall be fire-resistant, theft-resistant, and weather-resistant.

a) The magazine shall be equipped with one (1) steel padlock (which need not be protected by a steel hood) having at least 5 tumbles and a case-hardened steel shackle at least 3/8 in. (9.5 mm) in diameter. Doors must overlap sides by at least 1 in. (25.4 mm). Hinges and hasps are to be attached by welding, riveting, or bolting (nuts on inside).

b) Magazine to be constructed of not less than 12 gauge (.1046 in-2.66 mm) steel, lined with at least in. (12.7 mm) plywood or in. (12.7 mm) masonite-type hardboard.

c) Type 3 magazines containing explosive materials shall be within line-of-site vision of a blusterer.

14.2.4 Type 4 magazines

A Type 4 magazine shall be a permanent, portable, or mobile structure such as a building, igloo, box, semi trailer, or other mobile container that is fire-resistant, theft-resistant and weather-resistant.

14.2.4.1 Type 4 outdoor magazines

a) A Type 4 outdoor magazines shall be constructed of masonry, wood covered with sheet metal, fabricated metal, or a combination of these materials. Doors shall be metal or wood covered with metal.

b) Permanent Type 4 magazines shall comply with 14.2.1 (d), (f) and (g).

c) Vehicular Type 4 magazines shall comply with 14.2.2.1 (g) and shall be immobilized when unattended, as described in 14.2.2.1 (h).

14.2.4.2 Type 4 indoor magazines

Type 4 indoor magazines shall comply with all provisions of 14.2.2.2.

14.2.5 Type 5 magazines

Type 5 magazines shall be a permanent, portable, or mobile structure such as a building, igloo, box, bin, tank, semi trailer, bulk trailer, tank trailer, bulk truck, tank truck, or other mobile container that is theft-resistant. No ventilation is required and ferrous metal need not be covered with no sparking material.

14.2.5.1 Type 5 outdoor magazines

a) Type 5 permanent outdoor magazine shall be weather-resistant and shall be locked with at least one steel fivetumbler padlock having at least a 9.5 mm case-hardened shackle. A hood for the padlock is not required.

b) Hinges and hasps shall be securely fastened to the magazine and all locking hardware shall be secured rigidly and directly to the door frame.

c) A vehicular Type 5 magazines shall be immobilized when unattended as described in 14.2.2.1.

14.2.5.2 Type 5 indoor magazine

a) A Type 5 indoor magazine shall be constructed according to the requirements for Type 5 outdoor magazines.

Exception:

A Type 5 indoor magazine need not be weather-resistant.

14.3 Storage Within Magazines

14.3.1 Magazines shall be under the responsibility of a competent person at all times. This person shall be at least 21 years of age and shall be responsible for the enforcement of all safety precautions.

14.3.2 All magazines containing explosive materials shall be opened and inspected at intervals not exceeding three days to determine whether there has been unauthorized or attempted entry into the magazines or whether there has been unauthorized removal of the magazines or their contents.

14.3.3 Magazine doors shall be kept locked except during placement or removal of explosives or during inspection.

14.3.4 Safety rules covering the operations of magazines shall be posted on the interior side of the magazine door.

14.3.5 When explosive materials removed from the magazine for use, the oldest stock shall be used first.

14.3.6 Corresponding grades and brands of explosive materials shall be stored together so that brand and grade markings are readily visible. All stocks shall be stored so as to be easily counted and checked.

14.3.7 Containers of explosive materials shall be piled in a stable manner, laid flat and with top side up.

14.3.8 Open containers of explosive materials shall be securely closed before being returned to a magazine. No container without a closed lid may be stored in the magazine. Only fiberboard containers may be opened in the magazine.

14.3.9 Containers of explosive materials other than fiberboard shall not be unpacked or repacked inside or within 15.25 m of a magazine or in close proximity to other explosive materials.

14.3.10 Tools used for opening containers of explosive materials shall be constructed of nonsparking material.

Exception:

Metal slitters may be used for opening fiberboard containers.

14.3.11 Magazines shall be used exclusively for the storage of explosive materials, blasting materials, and blasting accessories. Metal tools other than nonferrous transfer conveyors shall not be stored in a magazine containing explosives or detonators. Ferrous metal conveyor stands protected by a coat of paint may be stored within a magazine.

14.3.12 Magazine floors shall be regularly swept and kept clean, dry, and free of grit, paper, empty packages, and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from magazine floors shall be disposed of according to manufacturers' instructions.

14.3.13 When any explosive material has deteriorated to the extent that it is in an unstable or dangerous condition or if nitroglycerin or other liquid is leaking from any explosive, the person responsible for the explosives shall immediately contact the authorities concerned (see Clause 18.6). Magazine floors stained with nitroglycerin or other liquid shall be cleaned according to manufacturers' instructions.

14.3.14 Before making repairs to the interior of a magazine, all explosive materials shall be removed and the floor shall be cleaned.

14.3.15 In making repairs that may result in sparks or fire to the exterior of a magazine, all explosive materials shall be removed.

14.3.16 Explosive materials removed from a magazine-undergoing repair shall be placed either in another magazine or at a safe distance from the magazine. They shall be properly guarded and protected. Upon completion of the repairs, they shall be promptly returned to the magazine.

15. STORAGE AND TRANSPORT ON SITE

15.1 General

15.1.1 Any organization that stores explosives or detonators is required to keep such explosive materials in either a magazine or local licensed store or possibly, in the case of smaller amounts, in designated premises. Before they can get explosives, they need to be in possession of a certificate certifying that they are authorized to have and keep explosives and without such a certificate they are not allowed to order them from the manufacturers or suppliers.

15.2 Planning

15.2.1 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 should 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 security and local authorities responsible for explosives.

It may not be possible to obtain storage facilities for the required quantity of explosives because of the proximity of structures and services, which need to be protected. It should be realized that no organization has the authority to reduce the safety distances required by the stores under the security and local authorities orders. These authorities should 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 for the construction of stores to ensure that they are difficult to break into.

15.2.2 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.

15.2.3 Transport of explosives in quantities of more than 50 kg is subject to special regulations, which requires the use of 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 50 kg or more, on site, and it is proposed to use the contractor's vehicle 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 50 kg, 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 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.

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

15.3 Storage Procedure

15.3.1 Unloading

15.3.1.1 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 qualified trained storekeeper, 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 storekeeper as mentioned above. 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.

15.3.2 Housekeeping

15.3.2.1 Again, the cleaning of such stores should be carried out by men under personal supervision of the storekeeper. 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.

15.3.3 Record keeping

15.3.3.1 It is essential that an up-to-date record is kept of all incoming and outgoing explosives and explosive items (including detonators, detonating cords, safety and other fuses). This is important, as it is the usual method of checking that the weight of explosives in the store does not exceed the licensed quantity. The store licensee should retain records of receipts, issues and transfers from the store, which should be kept at his office. For the purposes of such calculations, commercial, plain or electric detonators may be reckoned to weigh 1 kg per thousand. Linear cutting charge or similar explosive articles have to be reckoned on gross weight, including the metal case. 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.

15.3.3.2 Care should be taken to ensure that explosives are used in the order in which they have been delivered and old stocks should not be allowed to accumulate. Stocks of explosives should be regularly checked for signs of deterioration.

15.3.3.3 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 discharge are returned to store that detonators and blasting explosives are kept completely separate, each in its appropriate place.

15.3.4 Contamination

15.3.4.1 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 discharge 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.

15.4 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. Fire, naked lights or lighted cigarettes are not permitted within 25 m of any explosives store.

No gasoline, oil, flammable solvents, wastepaper or similar material whose ignition might endanger the explosives store should be permitted within 25 m of any place where explosives are stored. Further-More care should be taken that grass particularly dry and undergrowth in the vicinity of an explosives store is cut regularly to minimize the fire hazard. (See Clause 18.6)

15.5 Tools and Equipment

No tools or equipment should be kept in explosive stores except such as are required for keeping the stores clean. Cleaning equipment should not incorporate parts made of iron or steel.

Where tools are required for opening cases it is preferable that these should be of wood or soft non-ferrous metal.

15.6 Special Precautions

The inside of explosive stores should be kept clean and free from dust or grit. This problem is best considered during the planning stage and the store should, if possible, be so sited that it is protected from the prevailing wind across the site concerned.

When inside a store, personnel should take suitable precautions as regards footwear (e.g. rubber overshoes) to prevent contamination with grit. Under no circumstances should boots or shoes with exposed metal studs, nails or metal protectors be worn in explosive stores.

All sweepings from inside any explosive stores should be removed from the store itself and treated as explosives for destruction. The stor- keeper is responsible for the proper location of stock, the keeping of records and for good housekeeping. Rules for explosive stores or magazines should be displayed in prominent place for the attention of those using explosives.

15.7 Repairs to Stores

Before any repairs or alterations are made to a store it is essential that all explosives be removed to another licensed store or placed under constant attendance and the safety officer advised. Should welding, flame cutting or cold cutting be required then the wooden lining should be carefully examined for explosive contamination and the wood removed. Only after careful examination for sparks and after the cooling of any hot spots, should the lining and the explosives be replaced.

15.8 Workshops for Explosives

When a considerable amount of work is planned on any particular site, a properly prepared and constructed workshop should be used for preparing charges for use on that site. It is necessary to notify the security and safety authorities of intention to construct such a workshop. They will be in a position to give advice as to the siting which is permissible and as to the type of work, which may be carried out within it.

15.9 Transport of Explosives on Site

15.9.1 All vehicles used for the conveyance of explosives on a working site should comply with the requirements for vehicles for the conveyance of explosives by road (see Clause 15.2.3). Where site

conditions do not allow such vehicles to be used the following general conditions should apply to any vehicle used.

a) The vehicle should be cleaned out, and a clean tarpaulin, etc., placed for receipt of explosive boxes.

b) The vehicle should be in a safe mechanical condition and carry an adequate fire extinguisher. (see Clause 16.2.6).

c) The vehicle should be supervised by the shotfirer.

d) No flammable liquids or gases should be carried other than in the vehicle's fuel tank.

e) Detonators should be kept in a suitable container, which should be kept locked when access is not required to the contents.

f) Detonators should be carried, separated from explosives by at least 1 m (see Clause 19.3.2.3).

g) Explosives should be protected from weather during transit.

h) It is essential that "No Smoking" restrictions are observed.

i) It is essential that charges of explosives, which have already been fitted with detonators, be not carried in any vehicle.

j) It is essential that the vehicle carry a red flag to indicate the presence of explosives.

15.10 Portable Canisters for Explosives

15.10.1 Small quantities of explosives being conveyed on site should be carried either in their original packing or in properly constructed canisters. Such canisters should be soundly constructed of non-ferrous material such as leather, moulded rubber or plastics, wood or reinforced canvas. On no account should blasting explosives and detonators be carried out in the same pouch. All joints of the pouches should be suitably sealed to prevent entry of water or dust and their interiors should be lined.

Each canister should be fitted with a strap attached to its main body and should be fitted with a closely fitting cover. This cover should be fitted with a catch capable of keeping the pouch securely closed during conveyance. All attachments, e.g. locks, rivets, should be made of brass.

15.10.2 As stated in 15.10.1, detonators should always be carried in separate containers apart from other explosives. Preferably they should be carried by a second person. It is recommended that, where practicable, the interior design of any canister used to carry detonators be such that it is divided into compartments each allowing sufficient space for a detonator and its leading wires or capped fuse. Each compartment should be distinctively labeled so as to facilitate easy identification of detonators of different types and delay periods.

16. TRANSPORT OF EXPLOSIVES ON ROADS AND HIGH WAYS

16.1 General

16.1.1 Explosive materials shall not be transported through any prohibited vehicular tunnel or subway or over any prohibited bridge, roadway, or elevated highway.

16.1.2 No person shall smoke, carry matches or any other flame-producing device, or carry unauthorized firearms or cartridges while transporting explosive materials.

16.1.3 No person shall drive, load, or unload a motor vehicle transporting explosive materials in a careless or reckless manner.

16.1.4 Explosive materials shall not be carried or transported in or upon a public conveyance or

vehicle carrying passengers for hire.

16.1.5 Explosive materials shall not be transferred from one vehicle to another without informing the relevant authorities. In the event of breakdown or collision, the local authority shall be promptly notified to help safeguard such emergencies. Explosive materials shall be transferred from the disabled vehicle to another only when proper and qualified supervision is provided.

16.1.6 Detonators shall not be transported in the same vehicle with Class A or B explosive materials or with blasting agents.

16.1.7 In extreme high temperatures, explosives should be transported at night, taking extra safety precautions.

16.1.8 Parking of vehicles carrying explosives in domestic areas is prohibited. In circumstances of emergencies, vehicles can be parked if the minimum distance to the nearest housing area is 300 meters.

16.1.9 Vehicles used for transporting explosives shall be escorted and security officials shall make the necessary arrangements.

16.1.10 Vehicles carrying explosives shall take the loads within the capacity limits. In the case of detonators, dynamites, and black powder vehicle's load shall be 2/3 (two third) of its capacity.

16.1.11 Two red flags, one in front and the other on rear left side of vehicle loaded with explosives shall be installed.

16.1.12 The floor area of vehicle carrying explosives shall be covered with mats or tarpaulin.

16.1.13 Before reaching an areas where tractors or any other kind of piston engine machineries are operating, vehicles transporting explosives shall be parked and the operators shall be warned to stop their operations until the vehicle is passed through from the working area.

16.1.14 Loading and unloading of explosives shall take place during the daytime, and if loading and unloading during the night is compulsory extra safety precautions shall be taken.

16.1.15 The following points should be noted in areas where there is no traffic road for vehicles and transport of explosives have to be done by animals:

a) transport of explosives in excess of 50 kg by any animal is prohibited;

b) for every animal transporting explosives one guard should be appointed;

c) harness should be firmly tightened by ropes and every precautions shall be taken.

16.2 Transportation Vehicles

16.2.1 Vehicles used for transporting explosive materials shall be strong enough to carry the load and shall be in good mechanical condition.

16.2.2 When explosive materials are transported on a vehicle with an open body, a portable magazine, securely fastened to the vehicle body, shall be used to store the explosive materials.

16.2.3 Vehicles used for transporting explosive materials shall have no exposed spark-producing surface on the inside of the body.

Exception:

Vehicles transporting blasting agents and oxidizing materials need not comply with this requirement.

16.2.4 Floors of transportation vehicles shall be tight.

16.2.5 Motor vehicles used for transporting any quantity of explosive materials on public highways shall display all placards, lettering, or numbering required by the local authorities.

16.2.6 Each motor vehicle used for transporting explosive materials shall be equipped with fire extinguishers according to the following schedule.

a) Trucks-Gross Vehicle Weight At least 2 extinguishers having combined capacity of

(GVW) less than 6350 kg	4-A:20-B,C.(see IPS-G-SF-126)
b) Trucks-GVW 6350 kg or greater; tractor/semitrailer units	At least 2 extinguishers having combined capacity of 4-A:70-B,C. (see IPS-G-SF-126)

16.2.6.1 Only listed extinguishers shall be used. They shall be equipped with a device permitting visual determination of the charge condition.

16.2.6.2 Extinguishers shall be located where they will be accessible for immediate use.

16.2.6.3 Extinguishers shall be examined and recharged periodically according to manufacturers recommendations.

16.2.6.4 Where motor vehicles are operated in temperatures below -17.8°C, dry chemical extinguishers shall be pressurized with nitrogen.

16.2.7 A motor vehicle used for transporting explosive materials shall be inspected to determine that it is in proper condition. The following items shall be checked.

a) Fire extinguisher is filled and in working order.

b) All electrical wiring completely protected and securely fastened to prevent short-circuiting.

c) Chassis, motor, oil pan, and body undersides reasonably clean and free of excess oil and grease.

d) Fuel tank and fuel lines secure and not leaking.

e) Brakes, lights, horn, windshield wipers, and steering apparatus functioning properly.

f) Tires inflated properly and free of defects.

g) Vehicle is in proper condition in every other respect and is acceptable for handling explosive materials.

16.2.8 Tires shall be checked for proper inflation and general condition after each 2 hours or 161 km of travel, whichever occurs first. Flat or overheated tires shall be removed from the vehicle immediately. After removal the tire shall be placed far enough from the vehicle so that a spontaneous ignition of the tire will not endanger the vehicle or its cargo.

The tire shall not be replaced on the vehicle until it has been cooled below the danger of ignition nor shall it be used until the problem has been corrected.

16.3 Operation of Transportation Vehicles

16.3.1 Vehicles transporting explosive materials shall only be driven by and be in the charge of a properly licensed driver who is physically fit, careful, capable, reliable, able to read and write the Farsi language, and not addicted to the use of, or under the influence of, intoxicants, narcotics or other dangerous drugs.

16.3.2 The driver of a vehicle transporting explosive materials on public highways shall not be less than 21 years of age. The driver shall be familiar with traffic regulations, applicable regulations concerning explosive materials, and the provisions of this Section.

16.3.3 No vehicle transporting explosive materials shall be parked before reaching its destination, even though attended, on any public street adjacent to or in proximity to any bridge, tunnel, dwelling, building, or place where people work, congregate or assemble.

Exception:

This requirement does not apply under emergency conditions.

16.3.4 Every motor vehicle transporting any quantity of Class A or B explosives shall, at all times, be attended by a driver or other qualified representative of the motor carrier operating the vehicle. This attendant shall have been made aware of the class of the explosive in the vehicle and its

inherent dangers, and shall have been instructed in the procedures to be followed in order to protect the public from those dangers. The attendant shall be familiar with the vehicle assigned and shall be trained, supplied with the necessary means, and authorized to move the vehicle when required.

16.3.4.1 For the purpose of this Section, a motor vehicle shall be considered "attended" only when the driver or attendant is physically on or in the vehicle or has the vehicle within his field of vision and can reach it quickly and with no interference. "Attended " also means that the driver or attendant is awake, alert, and not engaged in other duties or activities, which may divert his attention from the vehicle.

16.3.4.2 A vehicle carrying explosive materials may be left unattended if parked in an area where such parking is permitted, such as an area meeting the requirements of NFPA 498, Standard of Explosives Motor Vehicle Terminals.

16.3.5 Vehicles transporting explosive materials shall avoid congested areas and heavy traffic. Where routes through congested areas have been designated by the traffic authority, such routes shall be followed.

16.3.6 Delivery shall only be made to authorized persons and into authorized magazines or approved temporary storage or handling areas.

Unauthorized passengers shall not be permitted to ride on vehicle.

Refueling at gas station or by cans is not allowed when transporting explosives.

Safety cans can be carried in separate transport.

16.4 Transport of Explosives by Air

16.4.1 General

16.4.1.1 The transport of explosives by air is regulated for the Safe Transport of Dangerous Goods by Air drawn up by the International Civil Aviation Authority. The Regulations permit only low hazard explosives, i.e., those of 1.4 or some of 1.3 divisions, to be transported routinely by air. Large consignments of more hazardous types are handled, generally by charter flights from specified airports under individually specified conditions.

16.4.1.2 It is strongly recommended that the advice of a competent forwarding agent or airline is taken before attempting to transport any explosives by air.

16.4.1.3 Methods of air transport

In general terms, explosives may be carried as follows:

a) Passenger aircraft

CAA (Civil Aviation Authority) Classification 1.4S (e.g. safety fuse, safety electric fuse, beanhole connectors).

b) Cargo aircraft

CAA Classification 1.4S

CAA Classification 1.4G (e.g. igniter cord, portfires)

CAA Classification 1.4B (e.g. electric detonators in special packing).

c) Charter aircraft

All Classes

The aircraft is dedicated solely to transport of explosives and prior permission has to be obtained from the Civil Aviation Authority (CAA) by the airline concerned.

The CAA will also require the shipper to prepare a dangerous goods transport document (sometimes called a Restricted Articles Certificate). These may only be prepared by trained, competent persons.

17. SECURITY OF EXPLOSIVE MATERIALS

17.1 Basic Requirements

17.1.1 The authority concerned may restrict the quantity of explosive materials that may be handled at any location.

17.1.2 All explosive materials and any newly developed and unclassified explosive materials shall meet the license and permit requirements of this Section.

17.2 Permit Requirements

17.2.1 No person shall be in possession of explosive materials, or conduct an operation or activity requiring the use of explosive materials, or perform or supervise the loading and firing of explosive materials without first obtaining the proper permit.

17.2.2 Explosive materials shall not be given, delivered, or transferred to any person not possessing a valid permit.

17.2.3 Every organization conducting an operation or activity that requires the use of explosive materials shall obtain a permit to use explosive materials and shall be responsible for the results and consequences of any loading or firing of explosive materials. Such organization shall also ensure that loading and firing are performed or supervised by a person possessing a Permit to Blast.

17.3 Permit Classes

17.3.1 Permit to use

Before an organization may conduct an operation or activity that requires the use of explosive materials, shall obtain a Permit to Use, which will provide authorization to possess, store, and use such materials.

17.3.2 Permit to Blast

Before an organization supervise and arrange to perform the loading and firing of explosive materials, shall obtain the appropriate Permit to Blast, as categorized below:

CLASS	CATEGORY	BLASTING PERMITTED
A	Unlimited	All Types of Blasting
B	General Aboveground	All Phases of Blasting Operations in Quarries Open Pit Mines, and Aboveground Construction.
C	General Underground	All Phases of Blasting Operations in Undergro-ound Mines, Shafts, Tunnels, and Drifts
D	Demolition	All Phases of Blasting in Demolition Projects
E	Seismic	All Phases of Blasting in Seismic Prospecting
F	Special	Special Blasting as Described on the Permit

17.4 Requirements for Blaster's Permit

17.4.1 The applicant for an initial permit to supervise and perform the loading and firing of explosive materials, as set forth in 17.3.2, shall demonstrate adequate training and experience in the use of explosive materials in the class authorized by the specific permit for which application is made.

17.4.2 Each applicant shall pass a qualifying examination. The examination may be written, oral, or by such other means as necessary to determine that the applicant is competent to conduct blasting operations and to perform the duties of a blaster.

17.4.3 Any holder of a Permit to Blast who is convicted of a violation of any explosives law or regulation shall be required to pass a qualifying examination as a condition of retention of the permit.

17.4.4 Any organization whose Permit to Blast has been revoked shall be required to nominate a person to pass a qualifying examination as a condition of reinstatement of the permit.

17.4.5 Any person whose Permit to Blast has lapsed for a period of one year or more shall be required to pass a qualifying examination as a condition of renewal of the permit.

17.5 Posting of Permits

17.5.1 Permit to use

A copy of the permit shall be posted at each place of operation.

17.5.2 Permit to blast

A copy of the permit shall be carried by the permit holder during blasting operations.

17.5.3 Permit holders shall take every reasonable precaution to protect their permits from loss, theft, defacement, destruction, or unauthorized duplication. Any such occurrence shall be reported immediately to the issuing authority.

17.6 Permit Restrictions

17.6.1 No permit can be assigned or transferred.

17.6.2 No permit shall be issued to a person under 21 years of age.

17.6.3 Permits shall be dated and numbered and shall be valid for no more than three years from the date of issue.

17.7 Denial or Revocation of Permits

17.7.1 A permit for the possession and use of explosive materials may be denied or revoked for any reason that is given by the Company's Security Authorities.

17.8 Record Keeping and Reporting

17.8.1 A holder of a Permit to Use shall keep a record of all operations involving explosive materials. Such record shall be retained for five years and shall be made available to the issuing authority upon request.

17.8.2 An accumulation of invoices, delivery, receipts, or similar records representing transaction should satisfy the requirements for record keeping, provided they include the signature of the receiver of the explosive materials.

17.8.3 A holder of a Permit to Blast shall keep a daily record of all explosive materials received and fired or otherwise disposed of by the permit holder. Such records shall be retained for five years and shall be made available to the issuing authority upon request.

17.8.4 The loss, theft, or removal of explosive materials shall be reported within 24 hours to the security authorities.

17.8.5 Accidents involving explosive material that cause a lost-time injury or property damage shall be reported immediately to the safety authorities.

17.9 Applications and Renewals

17.9.1 Application for a permit or for renewal of a permit shall be made to the issuing authority on forms provided by it and shall contain such information as may be required.

17.9.2 If an application for renewal is filed with the issuing authority before expiration of the current permit, the renewal will become effective upon expiration of the current permit.

No renewal permit shall be issued more than 30 days prior to the expiration date of the current permit.

17.9.3 An application for renewal filed after the expiration date of the current permit shall be considered an application for a new permit.

18. USE OF EXPLOSIVE MATERIALS FOR BLASTING

18.1 Basic Requirements

18.1.1 All company and local laws and regulations applicable to obtaining, transporting, storing, handling, and using explosive materials shall be followed.

18.1.2 Explosive materials shall be protected from unauthorized possession and shall not be abandoned.

18.1.3 Explosive materials shall be used only by experienced persons who are familiar with the hazards involved and who hold all required permits.

18.1.4 Loading and Firing shall be performed or supervised only by a person possessing an appropriate blaster's permit.

18.1.5 Trainees, helpers, and other persons who do not hold the required permits shall work only under the supervision of persons holding such permits.

18.1.6 No explosive materials shall be located or stored where they may be exposed to flame, excessive heat, sparks, or impact.

18.1.7 No firearms shall be discharged into or in the vicinity of a vehicle containing explosive materials or into or in the vicinity of a location where explosive materials are being handled, used, or stored.

18.1.8 No smoking shall be permitted within 15.25 m of any location where explosives are being handled or used.

18.1.9 No person within 15.25 m of any location where explosives are being handled or used shall carry any matches, open light, or other fire or flame.

Exception:

Suitable devices for lighting safety fuse are exempt from this requirement.

18.1.10 No person under the influence of intoxicating liquors, narcotics, or other dangerous drugs shall be allowed to handle explosive materials.

18.1.11 No attempt shall be made to fight a fire which cannot be contained or controlled before it reaches explosive materials. In such cases, all personnel shall be immediately evacuated to a safe location and the area shall be guarded from entry by spectators or unauthorized persons.

18.1.12 Unauthorized or unnecessary personnel shall not be present where explosive materials are being handled used or stored.

18.1.13 Explosive materials shall be kept in closed containers or packages while being transported between the storage magazine and the blasting site.

Exception:

Partial reels of detonating cord need not be in closed containers, unless transported over public highways.

18.1.14 Containers of explosive materials shall not be opened in any magazine or within 15.25 m of any magazine.

Exception:

Explosive materials in fiberboard containers need not comply with this requirement.

18.1.15 Nonsparking tools shall be used for opening any package or container of explosive materials.

Exception:

Metal slitters may be used for opening fiberboard containers.

18.1.16 No blasting operation shall be done in a manner contrary to the instructions of the Manufacturer of the explosive materials being used.

18.1.17 When blasting is done in a congested area or in close proximity to a structure, railway, or highway, or any other installation that may be affected, special precautions shall be taken to prevent damage and to minimize earth vibrations and air blast effects. Blasting mats or other protective devices shall be used to prevent fragments from being thrown.

18.1.18 Persons authorized to prepare explosive charges or to conduct blasting operations shall use every safety precaution, including but not limited to warning signals, flags, barricades, mats, or other equally effective means to ensure the safety of the general public and workers.

18.1.19 Surface blasting operations shall be conducted during daylight hours only.

Exception:

This requirement may be waived with the approval of the security and safety authorities.

18.1.20 Whenever blasting is being conducted in the vicinity of utility lines or rights-of-way, the blaster shall notify the appropriate representatives of the utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notice shall be confirmed with written notice.

Exception:

In an emergency situation, this time limit may be waived by the security and safety authorities.

18.1.21 Precautions shall be taken to prevent accidental discharge of electric detonators from currents induced by radar and radio transmitters, lightning, adjacent power lines, dust and snow storms, or other sources of extraneous electricity. These precautions shall include:

a) The posting of signs warning against the use of mobile radio transmitters on all roads within 107 m of blasting operations.

b) Observance of the latest recommendations with regard to blasting in the vicinity of radio transmitters or power lines, as set forth in IME Safety Library Publication No. 20, Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Electric Blasting Caps.

c) Surface use and all handling of explosive materials shall be discontinued during the approach and progress of an electrical storm. All personnel shall move to a safe location.

18.1.22 Consideration shall be given to the fact that lightning has been known to follow steel, piping, and conductive ore into underground mines.

18.1.23 Precautions shall be taken to prevent accidental initiation of nonelectric detonators from stray currents induced by lighthing or static electricity.

18.1.24 Reference should be made to BS-5607, Section 2 for standards in the use of electric detonators, cords, safety fuse and two-part explosives.

18.2 Pre-Blast Operations

18.2.1 During the time that holes are being loaded or are loaded with explosive materials, blasting agents, or detonators, the blast site shall be barred to all but those authorized persons engaged in the drilling and loading operations or otherwise authorized to enter the site. The blast site shall be guarded or barricaded and posted.

18.2.2 Drill holes shall be large enough to permit free insertion of cartridges of explosive materials. Drill holes shall not be collared in bootlegs or in holes, which have previously contained explosive materials. Holes shall not be drilled where there is a danger of intersecting another hole containing explosive material.

18.2.3 All drill holes shall be inspected and cleared of any obstruction before loading.

18.2.4 Pneumatic loading of blasting agents into blast holes primed with electric detonators or other staticsensitive initiation systems shall comply with the following requirements:

a) A positive grounding device shall be used for the equipment to prevent accumulation of static electricity.

b) A semiconductive discharge hose shall be used.

c) A qualified person shall evaluate all systems to assure that they will adequately dissipate static charges under field conditions.

18.2.5 Tamping shall be done only with wooden rods or approved plastic poles having no exposed metal parts.

Exception:

Nonsparking metal connectors may be used on jointed tamping poles.

18.2.5.1 Violent tamping shall be avoided.

18.2.5.2 The primer shall never be tamped.

18.2.6 After loading for a blast is completed and before firing, all excess explosive materials shall be removed from the area and returned to the proper storage facilities.

18.2.7 As soon as practical after all blast holes are connected, prior to connecting to a source of initiation such as a blasting machine, and until the shot has been fired and subjected to post-blast examination, the blast area shall be guarded or barricaded and posted.

18.3 Initiating Blasts

18.3.1 Cap and fuse shall not be used to initiate blasts in congested areas or on or adjacent to highways open to traffic.

18.3.2 When safety fuse is used, the burning rate shall be determined and in no case shall fuse lengths less than 120 seconds be used. The detonator shall be securely attached to the fuse with a standard ring-type cap crimper.

18.3.3 When electric detonators are used, stray current tests shall be made as frequently as necessary. Maximum stray current shall not exceed 0.05 amperes through a 1-ohm resistor, measured at the location of the blasting cap. Nonelectric initiating systems shall be used if extraneous currents exceed this limit. Electric detonators of different brands shall not be used in the same firing circuit.

18.3.4 All electric blasting circuits and other initiating systems whose continuity can be tested (such as gas detonator initiating systems) shall be tested with a blasting galvanometer or other blast continuity test instrument, as appropriate, which has been designed and approved for the purpose. All electrically initiated blasts shall be made by using blasting machines suitable for the circuitry being fired.

18.3.5 No detonator shall be inserted in explosive materials, which do not have a cap well without first making a hole in the cartridge with a proper size nonsparking tool, or the appropriate pointed handle of an approved cap crimpier.

18.3.5.1 Primers shall not be assembled closer than 15.25 m from any magazine. Primers shall be made up only when and as required for immediate needs.

18.3.5.2 Adequate priming if shall be used. If any uncertainty exists about the amount of priming necessary, the manufacturer shall be consulted. Primers shall be assembled only at the time of use and as close to the blast site as conditions allow.

18.3.5.3 In underground blasting, consideration shall be given to making up primers at a location away from the face to be fired. Where using non-electric initiation systems, all of the following shall apply:

1) The selection of the initiation system and the design of the blast shall be under the supervision of the blaster in charge.

2) The initiation system shall be used in accordance with the manufacturer's instructions.

3) The blaster in charge shall conduct a visual check after blast hookup.

4) The blast layout shall be tested for continuity as recommended by the manufactures where using a system that can be tested for continuity.

5) A double trunk line or closed-loop hookup shall be used where judged to be necessary by the blaster in charge.

18.3.5.4 A redundant or closed-loop circuit shall be used with any initiating system whose continuity cannot be checked.

18.3.6 Only the person making the lead line connections shall fire the blast. All connections shall be made progressively from the bore-hole back to the initiation point. Blasting lead lines shall remain shunted (shorted) and shall not be connected to the blasting machine or other source of current until the blast is to be fired.

18.3.7 No blast shall be fired until the blaster in charge has made certain that all surplus explosive materials are in a safe place, all persons and equipment are at a safe distance or under sufficient cover, and that an adequate warning signal has been given.

18.4 Procedures after Blasting

18.4.1 No person shall return to the blast area until permitted to do so by the blaster.

18.4.2 The blaster shall allow sufficient time for smoke and fumes to dissipate and for dust to settle before returning to the blast site.

18.4.3 The blaster shall inspect the entire blast site for misfires before allowing other personnel to return to the blast area.

18.5 Misfires

18.5.1 If a misfire is found, the blaster shall provide the proper safeguards for excluding all personnel from the blast area. Misfires shall be reported to the supervisor immediately.

18.5.2 No other work shall be done other than that necessary to remove the hazard. Only those persons necessary to do this work shall remain at the blast site.

18.5.3 No attempt shall be made to extract explosive materials from a misfired hole. A new primer shall be inserted and the hole shall be reblasted.

Exception:

If reblasting presents a hazard, the explosive materials may be washed out with water, or, where the misfire is under water, blown out with air.

18.5.4 If there are any misfires using cap and fuse, all personnel shall stay out of the blast site for at least one hour.

18.5.5 If there are any misfires using other nonelectric detonators (i.e., other than cap and fuse) or using electric detonators, all personnel shall stay out of the blast site for at least 30 minutes.

18.5.6 Misfires shall be handled under the direction of the person in charge of the blasting operation.

18.5.7 All wires shall be carefully traced and search made for unexploded charges.

18.5.8 No drilling, digging, or picking shall be permitted until all misfires have been detonated or until the relevant authority approves the resumption of work.

18.5.9 The shotfirer is required to deal with misfires as follows:

a) Disconnect from the shotfiring apparatus any removable handle or key and the shotfiring cable and shunt or ground the bare wires together;

b) After waiting 5 min., examine the cable and connections for any defects, and remedy any defect so found;

c) Make a further attempt to fire the shot.

18.6Disposal of Unwanted Explosives or Explosives, which Have Deteriorated During Storage

18.6.1 Extreme care is necessary when dealing with any blasting materials, which have apparently deteriorated whether they be explosives or detonators. Advice should be sought before handling any such material or disposing of unwanted explosives, firstly from a supplier or manufacturer's literature, failing this from the security and safety experts in disposing explosives.

Care should be taken when disposing of packing, materials such as cases, case linings, wrappers, or other materials used in cleaning up waste explosives.

These materials may have become impregnated with explosives. Disposal operations must not be carried out within 50 m of the magazine.

When the disposal of explosives is by burning it has to be assumed that there is a possibility of an explosion. It is therefore essential that the quantities of explosives burnt on any one occasion be related to the size of the disposal site and a procedure adopted for the safety of personnel and public as in any blasting operation.

18.6.2 Explosive materials recovered from blasting misfires shall be stored in a separate magazine until disposal instructions have been received from the Manufacturer. Such explosive materials shall then be disposed of in the manner recommended. Detonators recovered from blasting misfires shall not be reused.

18.6.3 Property on which Type 1 magazines and outdoor magazines of Types 2, 4 and 5 are located shall be posted with signs reading "Explosives-Keep Off". Such signs shall be located so as to minimize the possibility that a bullet shot at the sign will hit the magazine.

18.6.4 Empty containers and packages and paper or fiberboard packing materials, which have previously contained explosive materials, shall not be reused for any purpose. Such packaging materials shall be destroyed by burning at an approved outdoor location.

18.6.5 All personnel shall remain at a safe distance from the disposal area.

19. SAFETY REQUIREMENTS

19.1 Protective Precautions

19.1.1 General

This clause is concerned with matters affecting the safety of all persons, including the general public, property and equipment on a construction site where explosives are to be used and in the adjacent area likely to be affected by their use. A written system of work should be prepared that defines the overall plan of work and the duties and responsibilities of the persons and authorities involved.

19.1.2 Protection of site personnel and installations

19.1.2.1 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 accidental ignition or initiation of explosives and explosive devices by sever impact, friction, flame or electrical impulse.

19.1.2.2 The contractor (if work is done by them) should provide all tools and equipment used in charging and firing blasts, and the shot-firer 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 shotfiring

cables may, because of wear or damage, require frequent replacement, and the shotfirer should inform the management when this is necessary. Shotfiring cables particularly are prone to damage and should be examined before use for cuts or abraded insulation and for broken wires. Damaged shotfiring 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 be a competent person. The regular testing of exploders and calibration of ohmmeters is essential.

19.1.2.3 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.

19.1.2.4 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. It is essential that electric detonators in particular are kept well away from electrical switch-gear, cables, batteries, etc. Electrically operated machinery, or mechanical plant and vehicles, which have ancillary electrical equipment, such as starter motors, generators, batteries, lights, can also be hazardous.

Electric welding equipment can also be particularly hazardous in the vicinity of electric detonators.

19.1.2.5 The area where explosives are to be used should be defined by warning notices or flags before the charging of blasts. Explosives and accessories other than detonators should be stacked in orderly piles close to the shot holes and should never be left unattended. Vehicles and other mobile equipment should be prohibited from entering the defined blasting area, except as required to deliver or remove explosives.

At other times when explosives are in transit between the explosives store and the blasting area their presence should be clearly indicated by warning signs or flags. Where intermediate standing points cannot be avoided they should not be left unattended.

19.1.2.6 Electric detonators should only be transported around a construction site in a box or boxes made of nonconducting material, preferably wood, with a lid and catch. Their design should make it impossible for any detonator leading wire to be exposed when the box is closed. While 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 when access is not required to contents.

19.1.2.7 After the setting of a charge all surplus explosives, detonators, fuses, etc., 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 as follows:

a) In tunnels, where surplus explosive may be kept, between successive blasts, in a lockable reserve station authorized by the site management. If the station is not handed over to the following shift then all explosives have to be returned to the store.

b) At blasting areas where there are not permanent storage premises, supplies are drawn instead from a distant store as required. In such cases, after setting a charge, surplus explosives and accessories should be returned to the custody of designated senior site supervisors who should be authorized and instructed as to their safekeeping.

The supervisor should ensure that such surplus explosives are returned the same day to the licensed store before work is finished for the day.

19.1.2.8 Blasting should not be carried out in confined sapces without adequate ventilation to disperse and remove the blasting fumes before returning. In tunnels and sinking shafts in particular, where blasting operations are 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.

19.1.2.9 The danger area from each blast has to be determined by the shotfirer, preferably after consultation with the site supervisor. All site personnel should be instructed in the signaling 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 supervisor) 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.

19.1.2.10 Mobile plant and equipment can 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.

19.2 Safety and Convenience of Third Parties

19.2.1 The safety 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.

19.2.2 Consideration should be given to the possibility of excessive debris projection and to the projection of a small quantity of debris over a greater distance than normally expected. The latter is particularly important because of the natural curiosity of members of the public wanting to observe blasts.

19.2.3 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 places of work during blasting operations.

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

19.2.4 In areas where there is no property adjoining the site, attention to security may tend to become lax, and members of the general public may approach the site unnoticed. In addition to notices giving warning of blasting on all roads and paths approaching the site, sentries should be posted to maintain an uninterrupted ring of surveillance around the site when blasting is in progress.

19.2.5 The blasting technique should be chosen so that any annoyance to the general public from noise, ground vibration, dust, etc., is limited as far as possible.

In heavily built-up areas, small-scale blasting techniques employing light charges in small diameter holes and delay detonation will often be most suitable. In such situations careful placement of shot holes and the correct choice of charge weights are essential to minimize excessive debris projection.

The work should only be done by a shotfirer of wide experience. Such projection of debris is most

often from the "collar" or top of the shot holes. It is essential that care is exercised in the selection, placing and securing of screening materials so that the screening does not itself become a missile.

19.3 Safety when Using Explosives

19.3.1 General

This clause is concerned with those aspects and procedures of preparing blasts which relate to conducting such operations safely and efficiently. Since different blasting operations call for widely differing blasting methods and techniques, it is the main purpose of this clause to cover general principles applying to various stages of the blasting process.

19.3.2 Prior considerations

19.3.2.1 A sketch plan giving details of the drilling pattern, hole depths, angle of drilling and charge weight in each hole should be prepared for each blast. There should be sufficient duplicates for all who may be involved in the blast and for file records.

In situations, as for example in a surface blast using a large number of small diameter holes, variations from the planned charges may again be allowable at the shotfirer's discretion. If a shotfirer observes changes in rock conditions or encounters short or block holes, it may be unwise to stick too rigidly to a charging plan. The shot-firer might notice, for example, that individual holes are drilled in loose or soft ground and decide to reduce the planned charge. Such variations, which should be recorded, will normally be on the side of caution, but in any event should be carried out against the back-ground of specific instructions as to the minimum depth of stemming allowable in any hole, and other general instructions relating to safety. In surface blasts employing deep, large diameter holes heavier individual charge-weights will be required. Planning of hole placement, followed by precise survey and measurement of the complete lay-out, together with observations of the rock conditions, become necessary in these circumstances, and less variation from the calculated charge-weights is permissible. The shotfirer should be instructed that any situation calling for such variation should be referred to the site management.

19.3.2.2 Before the explosive is deposited at the point of use a check should first be made of the depth of each shot hole to ensure that it is drilled to the planned depth and free from obstruction. The site management should be informed of any serious departures from the planned arrangements so that corrective remedies can be applied before any explosive is delivered to the point of use.

19.3.2.3 Detonators should not normally be inserted into explosives until the charges are about to be finally placed. There may however be exceptional circumstances when it is not possible to achieve the safest conditions at the charging place (e.g. uncontrollable wet conditions). Under such circumstances carefully considered additional planning will be necessary for the procedures for priming at a designated priming station and for transport of primed explosives to the charging place. This planning should extend to include the adjacent operations and equipment that might affect the safety of the priming and transport of the primed explosives.

19.3.2.4 For further safety requirements during charging of shot holes and the relevant operations reference should be made to BS 5607, Section 2.

APPENDICES

APPENDIX A
MAGAZINE CONSTRUCTION

Magazines constructed according to the following minimum specifications are approved as bullet-resistant. All steel and wood dimensions are actual thickness; concrete block and brick dimensions are nominal.

Steel Exterior

15.9 mm steel with an interior lining of nonsparking material.

12.7 mm steel with an interior lining of plywood at least 9.5 mm thick.

9.5 mm steel lined with one of the following:

a) 50.80 mm of hardwood;

b) 76.20 mm of softwood;

c) 57.15 mm of plywood.

6.35 mm steel lined with one of the following:

a) 76.20 mm of hardwood;

b) 127 mm of softwood;

c) 133.35 mm of plywood;

d) 38 mm of plywood with an intermediate layer of 2 inch of hardwood.

4.7 mm steel lined with one of the following:

a) 101.6 mm of hardwood;

b) 177.80 mm of softwood;

c) 171.40 mm of plywood;

d)19.05 mm of plywood with an intermediate layer of 76.2 mm of hardwood.

3.17 steel lined with one of the following:

a) 127 mm of hardwood;

b) 228.6 mm of softwood;

c) 19.05 mm of plywood with an intermediate layer of 101.6 mm of hardwood.

d) Two layers of 19 mm plywood with an intermediate layer of 92 mm of well tamped dry sand or sand/cement mixture.

Fire-Resistant Exterior

Exterior of any type of fire-resistant material, which is structurally sound with:

a) An interior lining of 12.7 mm plywood placed securely against an intermediate 101.6 mm thick layer of solid concrete block, solid brick, or solid concrete.

b) An interior lining of 19 mm plywood, a first intermediate layer of 19 mm plywood, a second intermediate layer of 92 mm of well-tapmed dry sand or sand/cement mixture, a third intermediate layer of 19 mm plywood, and a fourth intermediate layer of 50.80 mm hardwood or 14 gage steel.

c) An intermediate 152.4 mm space filled with well-tamped dry sand or sand/cement mixture.

d) Masonry Exterior

Standard 203.2 mm concrete block with voids filled with well-tamped dry sand or sand/cement mixture.

e) Standard 203.2 mm-solid brick.

f) 203.2 mm solid concrete.

g) Two layers of 101.6 mm concrete block.