Cambodian Mine Action Standards

Chapter 4

The Storage Transportation and Handling of Explosive

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Introduction

The need to reduce risk and to provide a safe working environment are fundamental principles of demining management (see CMAS 07.10).

The provision of a safe working environment includes the safe storage, transportation and handling of explosives and explosive materials. This requires appropriate storage facilities, equipment and vehicles to be made available, and for CMAA and demining organisations to develop and maintain appropriate policy and procedures.

This standard provides CMAA and demining organisations with guidance on the safe storage, transportation and handling of explosives and explosive materials.

Given the nature of demining operations it is anticipated that, under certain circumstances, the ideal conditions for storage will be difficult, if not impossible, to achieve. This standard describes the minimum storage requirements for centralised as well as field operations storage. The onus is on the user i.e. the demining organisation to achieve the best conditions possible for regional centralised storage as well as demining site storage.

Centralised and operational storage sites shall be inspected as part of the CMAA monitoring process.

Storage, transport and handling of explosives

1. Scope

This standard provides specifications and guidelines for the safe storage, transportation and handling of explosives used by demining organisations in Cambodia.

In this standard, the term 'explosives' is used to refer to both explosives and explosive materials, unless stated otherwise in the text.

This standard does not apply to bombs, rockets, projectiles, UXO or any other heavily encased explosives.

2. Terms and definitions

A complete glossary of all the terms and definitions used in the CMAS series of standards is given in CMAS 04.10.

The term 'explosives' is used to refer to a substance or mixture of substances that, under external influences, is capable of rapidly releasing energy in the form of gases and heat.

The term 'explosive materials' is used to refer to components or ancillary items used by demining organisations that contain some explosives, or behave in an explosive manner, such as detonators, fuses and primers.

3. General requirements

Modern explosives are safe if they are stored, transported and handled in accordance with the manufacturers' instructions. Demining organisations should not use explosives of uncertain origin or age, or when the environmental storage conditions have not met the manufacturers' requirements. The CMAA or demining organisation may impose additional requirements based on localised experience and conditions.

4. Environmental requirements

The environmental requirements (temperature, humidity and vibration) of explosives vary, and are dependent on their intended storage conditions (including shelf life), transportation, handling and use. The performance of explosives will be unpredictable and the safety will be reduced if the manufacturers' environmental conditions are not met. In general, explosives should be:

a) Kept dry and well ventilated;

b) Kept as cool as possible and free from excessive or frequent changes of temperature;

c) Protected from direct sunlight; and

d) Kept free from excessive and constant vibration.

Note 1: Some substances used in ammunition and explosives attract and hold moisture, which may result in the degradation of explosive performance. It may also cause them to become dangerous to handle, due to the potential for the formation of sensitive explosive crystals. Rain, dampness and humidity can cause enormous damage to explosives in a very short time. Every effort shall be made to ensure dry conditions prevail in storage and transportation.

Note 2: Good ventilation of explosives will help keep them cool and prevent condensation.

Note 3: Non-explosive materials, fabric including felt, paper and other materials that absorb water create the conditions that may cause the corrosion and decay of other materials in the same container.

5. Storage requirements

5.1. Storage design

General requirements for the design of magazines and containers used for the storage and transport of explosives used in the demining process is given in Annex A.

5.2. Warning signs and symbols

Explosive storage facilities are to be clearly marked as such. Signs are to be prominently displayed in Khmer and English.

5.3. Fire prevention

Demining organisations shall establish and maintain fire prevention policies and SOPs, which should be based on the general principles given in Annex B.

5.4. Table of safety distances

Demining organisations shall apply the safety distances for the storage of explosives given in Annex C, unless instructed otherwise by the CMAA.

5.5. Indoor storage

No indoor storage magazine shall be located in a residence or dwelling or office building.

6. Transportation requirements

6.1. General

Demining organisations shall establish and maintain SOPs that give procedures for the safe transportation of explosives. The procedures should include the following requirements:

a) Ensure the security of explosives;

b) Transport explosives in accordance with the manufacturers' instructions and specifications.

c) Marking of vehicles to indicate the carriage of dangerous cargo

d) Fire hazard precautions; and

e) Avoid accidents.

6.2. Passengers

Demining organisations should not normally transport passengers with explosives. When passengers and explosives are transported in the same vehicle the senior person should ensure that the explosive are transported in a sensible fashion and that all fire consideration are met.

6.3. Transporting detonators and explosives

When detonators and explosives are carried in the same vehicle they should be stored separately, with the detonators carried in an appropriate container. See annex A.

6.4. Special Equipment

One 9 litre water extinguishers or equivalent and a container for storing smoking materials, matches, lighters, cigarettes etc. shall be carried on all vehicles transporting explosive.

7. Handling

Demining organisations shall establish and maintain SOPs that give procedures for the safe handling of explosives. The procedures should include the following requirements.

a) Access to explosives shall be tightly controlled;

b) Explosives shall be handled in accordance with the manufactures instructions and specifications; and

c) Only suitably qualified demining personnel, or personnel supervised by a qualified supervisor shall handle or use explosives.

8. Inert, drill, instructional or replica mines and ammunition

Mines and ammunition are inherently dangerous and it is essential that everyone involved in the handling and movement of ammunition should exercise extreme care. It is obviously safer to use inert or drill mines and ammunition for training or display purposes, but this requirement also carries its own specific risks. It is therefore a fundamental principle of ammunition and explosive safety that live ammunition and explosives are never mixed with inert, drill, instructional or replica ammunition and explosives. This is a proven principle designed to ensure that the risk of accidents during training and instruction is reduced to the minimum. The consequences of live mines and ammunition being inadvertently used during training could result in fatalities or injuries.

Demining organisations shall establish and maintain SOPs that give procedures for the storage and handling of inert, drill, instructional or replica mines and ammunition. The procedures shall include the requirements contained at Annex D.

9. Physical security

Demining organisations shall provide for appropriate levels of physical security for explosives in their possession during storage, transportation and use. Consideration should be given not only to the immediate physical security provided by the storage facility, but also to accounting procedures and control of access.

10. Responsibilities and obligations

10.1. CMAA

The CMAA shall develop documented procedures for the monitoring of the storage, transportation and handling of explosives, which include:

a) Monitoring of storage of explosives, including storage on demining sites;

b) Monitoring the carriage of explosives, including warning signs and symbols to be used on vehicles; and

c) Monitoring the safety distances for the storage and handling of explosives.

10.2. Demining organisation

The demining organisation shall establish and maintain SOPs that comply with the provisions of this CMAS.

10.3. Deminers

Demining workers shall;

a) Comply with instructions given for their own conduct and safety when carrying out the storage, transportation and handling of explosives; and

b) Report forthwith to their immediate superior any situation associated with the storage, transportation and handling of explosives that they have reason to believe could present a hazard which they cannot themselves correct.

Phnom Penh, Dated 20 October, 2005

Secretary General

Signed and Sealed

Sam Sotha

Annex A
(Informative)
General requirements for the construction of Magazines

1. Permanent structure

A permanent structure magazine may be a building, tunnel or dugout. It shall be fire-resistant, theft resistant, weather resistant and ventilated. Consideration should be given to ground and local features during design and siting of such structures.

Footings for concrete, concrete blocks, stone or brick construction shall be designed and constructed in accordance national building standards. If piers or posts are used the area under the building should be enclosed with metal.

Walls shall be constructed of a combination of steel, wood, masonry or other materials, which are fire resistant and structurally sound.

Note 1: Any wood on the exterior of the building shall be covered with fire resistant material. (Where possible, wood should be avoided due to the inherent fire risk).

Note 2: Voids in concrete blocks clay blocks should be filled with well-tamped dry sand or well-tamped sand cement mixture.

Note 3: Interior walls should be clad with wood or other suitable non-sparking material.

Floors should ideally be concrete, coated with a suitable non-sparking material.

The roof shall be constructed of structurally sound materials, which are or have been made fire and weather resistant. The roof or ceiling should include a thermal shield designed to assist in maintaining interior temperatures below 40^0 Celsius.

Doors shall fit tightly. Hinges and locking-ware shall be rigidly attached by welding, riveting or bolting, which cannot be removed when the door is locked. The doors should be fitted so as to open outward.

Adequate ventilation shall be provided to prevent dampening and heating of stored explosives. Climatic conditions, size of magazine and location will determine the amount of ventilation required.

The site shall have adequate drainage to prevent water damage to the contents of the magazine

The magazine shall be equipped with a suitable padlock.

2. Portable or mobile magazine

A portable magazine is a portable structure such as a skid-mounted container, trailer or semi-trailer.

A portable or mobile magazine shall be theft-resistant, fire-resistant and weather-resistant. The magazine should be constructed of steel with an interior lining of timber

The magazine should be supported in a manner that will prevent the magazine from being in contact with the ground. Magazines of less than one cubic metre in size should be fastened to a fixed object to prevent theft of the entire magazine.

Doors shall fit tightly. Hinges and locking-ware shall be rigidly attached by welding riveting or bolting, which cannot be removed when the door is locked.

Adequate ventilation shall be provided to prevent dampening and heating of stored explosives. Climatic conditions, size of magazine and location will determine the amount of ventilation required.

The magazine shall be equipped with a suitable padlock.

3. Day box

A day box or other portable magazine should be lockable.

The magazine shall be equipped with log book and shall be removed to a portable or mobile magazine or permanent magazine.

4. Detonator transport container

Detonators and other explosives may be carried together on a vehicle using a detonator transport container or compartments designed and constructed specifically for that purpose. Whenever detonators and other explosives are transported on the same vehicle, the detonator transport container should be separated from the other explosives, preferably carried in the cab of the vehicle.

Use of detonator transport containers shall be under the following conditions:

c) No material is loaded on top of the portable detonator container

d) The detonator container shall be secured to the vehicle to prevent movement during transport

e) The container is clearly labelled "contains explosive, handle with care" in English and Khmer

5. Demining worksite storage

Explosives or mine and/or UXO hazardous material may be stored on a demining worksite. Explosives used in the demining process should be stored in a container approved for the type and quantity of explosive being stored, which will be located in a safe areas within the parameters of the minefield. Where provision of this standard of container storage is impracticable, the demining organisation shall be responsible for providing adequate safety measures (protective works, safety distances, physical security etc.) and should include protection against environmental factors in accordance with explosive manufacturers' instructions. Such storage should be considered as a temporary measure only.

The demining worksite storage point forms part of the overall site layout. The following are the minimum requirements:

a) The explosives and detonators shall be stored separately at the workplace and being stored above ground and protected by a double layer of sandbags with overhead protection.

b) At least 1m from one to another hole.

c) The detonator shall be stored in one hole and explosive and other ammunition shall be stored in another hole.

d) The storage area shall be covered by non-metal material to protect the sun light and raining.

e) The area around the storage is to be clearly marked, as containing explosive material.

f) The site must be physically secure whenever explosives are stored.

g) In the event that mines or UXO need to be stored prior to final disposal, a third, separate storage should be constructed in compliance with the requirements detailed above.

Annex B
(Informative)
Fire prevention

Demining organisations responsible for storing explosives and explosive materials shall establish and maintain documented fire prevention policies and SOPs. The policies and SOPs should include the following.

a) No smoking within 20m of the magazine. NO SMOKING / NO NAKED LIGHTS signs shall be prominently displayed around the magazine.

b) Grass and undergrowth shall be cut down and kept short in the area around the magazine.

c) Flame or spark producing equipment shall not be used within 20 m of a magazine. Where such equipment is required to carry out repairs to the magazine, all explosives shall be removed.

d) Paints, oils, petrol or any other flammable materials shall not be stored with explosives. Authorised cleaning materials may be used in the magazine for maintenance but are to be removed when not in use.

e) Empty containers of any type are not to be stored with explosives.

f) A minimum of two 9.0 litre water extinguishers shall be in a prominent position outside each explosive store.

g) All fire fighting equipment is to be maintained in a fully serviceable condition.

h) Some form of lightning protection should be used.

i) A board listing articles that are not permitted into the magazine shall be prominently displayed at the entrance to the magazine. Details of the information to be shown on the board are as follows.

- Lanterns, oil lamps and stoves and all flame or fire producing appliances.
- Matches, cigarette lighters or other portable means of producing a spark or flame.
- Tobacco in any form and any article used for the purpose of smoking.
- Inflammable liquids and solvents other than those authorised for maintenance work on containers or contained in the tank of a vehicle.
- Food and drink.
- Radio equipment (all types) including mobile phones.
- Drugs and medicines other than those forming part of an authorised first aid kit.
- Ammunition not authorised to be stored.
- Any unprotected power source.

j) An external sign on storage facilities shall give details of emergency point of contact to obtain access to the facility, and shall list hazard divisions of the contents.

k) Grounding. All metallic enclosures for electrical wiring and fittings shall be effectively bonded throughout and grounded.

l) Fire Alarm. Some method of sounding an alarm in the event of fire shall be in place.

m) A Fire Symbol shall be displayed outside each building containing ammunition to alert personnel to the hazards associated with the ammunition in the event of fire.

Annex C
(Informative)
Table of distances for the storage of explosive materials

Qty of explosive kg		Distance m					
		Inhabited buildings distance in m		Public roads		Separation of magazines	
over	less than	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
0	2	32	64	14	27	3	5
2	5	41	82	16	32	4	7
5	9	50	100	20	41	5	9
9	14	57	114	23	45	5	10
14	18	64	127	25	50	5	11
18	23	68	136	27	54	6	13
23	34	77	154	32	64	7	14
34	45	86	173	34	68	7	15
45	57	91	182	36	73	8	16
57	68	98	195	39	77	9	17
68	91	107	213	43	86	10	19
91	114	116	232	48	95	10	21
114	136	123	245	50	100	11	22
136	182	134	268	54	109	12	25
182	227	145	291	59	118	13	26
227	272	109	218	61	123	14	28
272	318	161	322	66	132	15	29
318	363	170	341	68	136	15	30
363	409	177	354	70	141	16	32
409	454	182	363	73	145	16	33
454	545	193	386	75	150	18	35
545	636	204	409	77	154	19	37
636	726	213	427	79	159	20	39

Qty of explosive kg		Distance m					
		Inhabited buildings distance in m		Public roads		Separation of magazines	
over	less than	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
726	817	222	445	82	163	20	40
817	908	229	459	84	168	20	41
908	1135	247	495	86	173	22	44
1135	1362	263	527	89	177	24	47
1362	1816	288	577	95	191	26	53
1816	2270	311	622	102	204	28	55
2270	2724	331	663	107	213	30	59

Note 1: Barricaded means the effective screening of the magazine containing explosives from a building containing explosives, or other building or railway or roadway by a natural or by an artificial barrier. A straight line from the top wall of a building or magazine containing explosives to the eaves line of any other building or a point 3.5m above the centreline of any roadway or railway shall pass through such a barrier.

Note 2: Artificial barricade is an artificial mound or reveted earth wall not less than 90cm thick.

Note 3: Natural barricade means natural feature of the ground such as hills or timber with sufficient density that the magazine cannot be seen from the building or features requiring protection when the trees are bare of leaves.

Note 4: Storage of quantities in excess of 2724 kg shall be limited to a permanent storage facility that shall be regulated by the CMAA

Annex D
(Normative)
Inert, drill, instructional or replica mines and ammunition

1. General

The purpose of this annex is to ensure that inert, drill, instructional or replicas of mines and ammunition are handled, stored and accounted for accurately, in order to:

a) Avoid accidents;

b) Avoid incidents of mistaken identification leading to unnecessary demining operations or render safe procedures;

c) Ensure the security of drill and inert mines and ammunition, and

d) Ensure that drill and inert mines and ammunition are not subjected to unnecessary damage, which can be expensive.

2. Storage

Inert, drill, instructional and other replicas of mines and ammunition shall not be stored with live ammunition. They shall be stored in a separate location outside the explosive storage area.

Mines and ammunition that have been subjected to render safe procedures, and have been certified as Free From Explosive (FFE), shall be stored in the same manner as drill and inert ammunition.

Inert, drill, instructional and other replicas of mines and ammunition shall not be stored in the same containers as live ammunition. They shall be stored in a separate container, which shall be cleared marked INERT or DRILL in Khmer. It should also appear English. All other markings shall be eradicated from the container to ensure that there is no possibility that it could mistakenly be identified as containing live ammunition.

3. Movement

Inert, drill, instructional and inert replicas of mines and ammunition shall not be moved in the same containers as live ammunition. They shall be moved in a separate container, which must be cleared marked INERT or DRILL in Khmer. It should also appear in English. All other markings shall be eradicated from the container to ensure that there is no possibility that it could be mistakenly identified as containing live ammunition.

It is recommended that inert, drill, instructional and other replicas of mines and ammunition are not moved on the same vehicle as live ammunition wherever possible, but is accepted that circumstances may not allow for this.

4. Breakdown of mines and ammunition

Demining organisations should not breakdown, modify or tamper with mines and ammunition, unless it is done in the course of inspection, modification or disposal in accordance with the appropriate technical procedures.

Technical procedures for the breakdown or modification of live mines and ammunition into inert, drill, instructional or replica items shall be developed by appropriately qualified EOD personnel.

All authorised breakdown or modification of live mines and ammunition into inert, drill, instructional or replica items shall be carried out by appropriately qualified and authorised EOD personnel. As such operations carry a high degree of inherent risk, the authorisation for such activities shall be the responsibility of the national programme manager, or equivalent, of the demining organisation.

Note 1: Drill and replica mines and ammunition are readily available on the commercial market. They are made up from empty components, either obtained direct from the original manufacturer or specifically made for the purpose. These should be used as the first choice. Locally manufactured drill and instructional mines and ammunition should only be used as a last resort.

5. Marking of inert or drill mines and ammunition

All inert, drill, instructional or other replicas of mines and ammunition shall be clearly marked on all sides as either "**INERT**" or "**DRILL**" as appropriate DRILL in Khmer. It should also appear in English. This ensures that they can be clearly identified from all angles, and are therefore do not inadvertently or accidentally become the focus of a demining operation or render safe procedure.

All inert, drill, instructional or other replicas of mines and ammunition shall also be marked with a unique serial number. This unique serial number should be in the following format:

ABC / 1234 / 01

(Demining organisation triagram / Serial Number / Year of manufacture / purchase)

There are no commonly accepted international standard for the body colour marking of ammunition and explosives. Consequently it is impracticable to lay down standard body colours for inert, drill, instructional or replica mines and ammunition as it could lead to a degree of confusion.

If an individual is in any doubt as to the explosive status of a mine or item of ordnance, then it shall be treated as live, and technical demining or EOD advice shall be immediately requested.

6. Registration and accounting of inert or drill mines and ammunition

The demining organisation shall maintain a master register of all inert, drill, instructional or other replica mines and ammunition that it has responsibility for. This register shall include the following information:

a) Serial number;

b) Type of APM or UXO;

c) Current location, and

d) Free From Explosive (FFE) certificate serial number.

The demining organisation shall operate an appropriate accounting system to ensure accountability and traceabilty for all inert, drill, instructional or replica mines and ammunition in its possession. It is recommended that this be based on their live ammunition accounting system.

7. Free From Explosive (FFE) certification

On initial acquisition, all supposedly inert, drill, instructional or replica mines and ammunition shall be visually inspected and physically examined by an appropriately qualified EOD technician to ensure that the item contains no explosive, pyrotechnic, lachrymatory, radioactive, chemical, biological or other toxic components or substances. The EOD technician shall also ensure that all ammunition markings, (designation, hazard division, hazard compatibility code, previous serial numbers, UN symbols etc), that refer to the previous live condition of the item have been removed or obliterated.

The EOD technician shall then issue a FFE certificate for the item. This certificate shall contain the following information:

a) Unique serial number. (It is recommended that for ease of administration that this is the same as the serial number at clause 5);

b) Date;

c) Name of inspecting EOD technician;

d) Brief description of item;

e) An FFE certification statement;

Note 1: It is recommended that the following statement is used in the local language:

I certify that I have visually inspected and physically examined the item referred to on this FFE certificate and confirm that this item contains no explosive, pyrotechnic, lachrymatory, radioactive, chemical, biological or other toxic components or substances. I also certify that I have ensured that all previous ammunition markings have been removed or obliterated and that the item as been remarked as either DRILL or INERT. I am content that it is safe to use for drill, display or instructional purposes.

f) Signature of inspecting EOD technician.

The demining organisation shall maintain a register of all FFE certificates issued.

WARNING

If an individual is in any doubt as to the explosive status of a mine or item of ordnance, then it shall be treated as live, and technical demining or EOD advice shall be immediately requested.