

IMAS 10.50

2nd Edition
2003-01-01

Storage, transportation and handling of explosives

Director,
United Nations Mine Action Service (UNMAS),
DC2 0650, United Nations,
New York, NY 10017,
USA

E-mail: mineaction@un.org
Telephone: (1 212) 963 1875
Fax: (1 212) 963 2498

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Chief
United Nations Mine Action Service (UNMAS)
United Nations, FF-363, New York, NY 10017, USA
E-mail: mineaction@un.org
Telephone: (1 212) 963 1875
Fax: (1 212) 963 2498

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Foreword

In July 1996, international standards for humanitarian mine clearance programmes were proposed by working groups at a conference in Denmark. Criteria were prescribed for all aspects of mine clearance, standards were recommended and a new universal definition of 'clearance' was agreed. In late 1996 the principles proposed in Denmark were developed by a UN-led working group into *International Standards for Humanitarian Mine Clearance Operations*. A first edition of these standards was issued by the UN Mine Action Service (UNMAS) in March 1997.

This second edition reflects changes to operational procedures, practices and norms which have occurred over the past three years. The scope of these standards has been expanded to include the other components of mine action, in particular those of mine risk education and victim assistance.

The United Nations has a general responsibility for enabling and encouraging the effective management of mine action programmes, including the development and maintenance of standards. UNMAS is the office within the United Nations Secretariat responsible for the development and maintenance of international mine action standards (IMAS).

The work of preparing, reviewing and revising these standards is conducted by technical committees, with the support of international, governmental and non-governmental organisations. The latest version of each standard, together with information on the work of the technical committees, can be found at www.mineactionstandards.org. IMAS will be reviewed at least every three years to reflect developing mine action norms and practices, and to incorporate changes to international regulations and requirements.

Introduction

The need to reduce risk and to provide a safe working environment are fundamental principles of mine action management (see IMAS 07.10). Risk reduction involves a combination of safe working practices and operating procedures, effective supervision and control, appropriate education and training, equipment of inherently safe design, and the provision of effective personal protective equipment and clothing.

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 national mine action authorities and demining organisations to develop and maintain appropriate policy and procedures. Where existing national government regulations differ from those contained in IMAS, the more stringent requirement should be met.

This standard provides national mine action authorities and demining organisations with guidance on the safe storage, transportation and handling of explosives and explosive materials. Specifications for the storage of explosives and safety distances are those provided by the US Institute of Makers of Explosives (IME) and are consistent with the United Nations' Ammunition and Explosives Regulations. These specifications should not normally be reduced without the advice of a professionally qualified explosives engineer.

Safety and Occupational health

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 this standard, the term 'explosives' is used to refer to both explosives and explosive materials, unless stated otherwise in the text. (See Clause 3 below.)

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

2 References

A list of normative references is given in Annex A. Normative references are important documents to which reference is made in this standard and which form part of the provisions of this standard.

3 Terms and definitions

A list of terms and definitions used in this standard is given in Annex B. A complete glossary of all the terms and definitions used in the IMAS series of standards is given in IMAS 04.10..

In the IMAS series of standards, the words 'shall', 'should' and 'may' are used to indicate the intended degree of compliance. This use is consistent with the language used in ISO standards and guidelines.

- a) 'shall' is used to indicate requirements, methods or specifications that are to be applied in order to conform to the standard;
- b) 'should' is used to indicate the preferred requirements, methods or specifications; and
- c) 'may' is used to indicate a possible method or course of action.

The term 'national mine action authority or authorities' refers to the government department(s), organisation(s) or institution(s) in each mine-affected country charged with the regulation, management and co-ordination of mine action. In most cases the national mine action centre (MAC) or its equivalent will act as, or on behalf of, the 'national mine action authority'.

The term 'demining organisation' refers to any organisation (government, NGO or commercial entity) responsible for implementing demining projects or tasks. The demining organisation may be a prime contractor, subcontractor, consultant or agent.

The term 'explosives' is used to refer to a substance or mixture of substances which, 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 which contain some explosives, or behave in an explosive manner, such as detonators, fuzes and primers.

4 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 national mine action authority or demining organisation may impose additional requirements based on local experience and conditions.

5 International legislation

5.1 Movement of explosives by road

The movement by road of explosives is a complex issue dependent on what area of the world the demilitarization operation is to take place. In Europe, for example, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) applies. A summary of this treaty, which illustrates the dangers and risk reduction measures to be implemented can be found at <http://www.unece.org/trans/danger/publi/adr/intro.htm>.

There is also the Central Asian Agreement on the International Transport of Dangerous Materials, which may be referred to.

The UN have issued United Nations Recommendations on the Transport of Dangerous Goods Model Regulations (*Eleventh revised edition*). Details of how to obtain this publication can be found at <http://www.unece.org/trans/danger/publi/unrec/pubdet.htm>.

5.2 Storage of ammunition and explosives

There are no specific international regulations or codes of practice that relate directly to the safe storage of ammunition and explosives, this is a national responsibility.

However, international alliances do have consolidated literature that covers this technical area. An excellent example is the NATO Allied Ammunition Storage and Transportation Publications 2 (AASTP 2) - Safety Principles for the Storage and Transport of Military Ammunition and Explosives.

6 Environmental requirements

The environmental requirements (temperature, humidity and vibration) of ammunition and 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: 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 between the fuze and main body of the munition. Rain, dampness and humidity can cause enormous damage to ammunition and explosives in a very short time. Every effort shall be made to ensure dry conditions prevail in storage and transportation.

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

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

7 Storage requirements

7.1 Storage design

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

7.2 Warning signs and symbols

The national mine action authority shall specify the warning signs and symbols to be used on explosive storage facilities in their countries.

7.3 Fire prevention

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

7.4 Table of safety distances

Demining organisations shall apply the safety distances for the storage of explosives given in Annex F, unless instructed otherwise by the national mine action authority.

7.5 Indoor storage

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

8 Transportation requirements

8.1 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, and other relevant international and national standards and regulations provided by the national mine action authority; and
- c) avoid accidents.

8.2 Passengers

Demining organisations should not normally transport passengers with explosives. If it is necessary that passengers are carried in the same vehicle as explosives, a team member shall be appointed as the responsible person in charge. The responsible person shall then ensure the safety of passengers and enforce all fire hazard precautions.

8.3 Transporting detonators and explosives

Detonators and explosives shall not be carried on the same vehicle unless the storage container for the detonators meets the minimum design requirements given in Annex D.

8.4 Special Equipment

The following additional equipment shall be carried on all vehicles transporting explosive:

- a) two 9 litre water extinguishers or equivalent; and
- b) a container for storing smoking materials, matches, lighters, cigarettes etc.

9 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 other relevant standards and regulations provided by the national mine action authority; and
- c) only suitably qualified demining personnel, or personnel supervised by a qualified supervisor shall handle or use explosives.

10 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.

There is no specific international legislation that refers to the use of inert, drill, instructional and replica mines and ammunition, therefore this part of the IMAS has been derived from "best practice".

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 H.

11 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. There may be occasions when additional measures such as appropriately equipped guards are necessary. The national standard should be the minimum level provided.

12 Responsibilities and obligations

12.1 National mine action authority

The national mine action authority shall develop documented procedures for the storage, transportation and handling of explosives, which include:

- a) standards for storage of explosives, including storage on mine clearance sites;
- b) standards for the carriage of explosives, including warning signs and symbols to be used on vehicles; and
- c) safety distances for the storage and handling of explosives.

12.2 Demining organisation

The demining organisation shall establish and maintain SOPs that comply with the provisions of this IMAS, established international standards, the national mine action authority standards and other relevant standards or regulations.

In the absence of a national mine action authority or authorities, the demining organisation should assume additional responsibilities. These include, but are not restricted to:

- a) issue, maintain and update their own regulations, codes of practice, SOPs and other suitable provisions on the storage, transportation and handling of explosives;
- b) co-operate with other employees in the same country to ensure consistency of standards for the storage, transportation and handling of explosives; and
- c) assist in framing national regulations and codes of practice for the storage, transportation and handling of explosives.

12.3 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 which they have reason to believe could present a hazard which they cannot themselves correct.

Annex A (Normative) References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of the standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of the standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid ISO or EN:

- a) Institute of Makers of Explosives; Safety Library Publication No. 22 – 'Recommendations for the safe transportation of detonators in a vehicle with certain other explosive materials';
- b) United Nations; UN ammunition and explosives regulations manual, 'Ammunition and explosives regulations – For use by the United Nations field missions';
- c) IMAS 10.10 S&OH – General requirements; and
- d) IMAS 09.30 EOD Operations.

The latest version/edition of these references should be used. UNMAS hold copies of all references used in this standard. A register of the latest version/edition of the IMAS standards and references is maintained by UNMAS, and can be read on the project website: (www.mineactionstandards.org). National mine action authorities, employers and other interested bodies and organisations should obtain copies before commencing mine action programmes.

Annex B (Informative) Terms and definitions

B.1.1

drill

an inert replica of ammunition specifically manufactured for drill, display or instructional purposes.

B.1.2

explosives

a substance or mixture of substances which, under external influences, is capable of rapidly releasing energy in the form of gases and heat.

B.1.3

explosive materials

components or ancillary items used by demining organisations which contain some explosives, or behave in an explosive manner, such as detonators, fuzes and primers.

B.1.4

inert

an item of ammunition that contains no explosive, pyrotechnic, lachrymatory, radioactive, chemical, biological or other toxic components or substances.

Note: An inert munition differs from a drill munition in that it has not necessarily been specifically manufactured for instructional purposes. The inert state of the munition may have resulted from a render safe procedure or other process to remove all dangerous components and substances. It also refers to the state of the munition during manufacture prior to the filling or fitting of explosive or hazardous components and substances.

B.1.5

lachrymatory ammunition

lachrymatory ammunition contains chemical compounds that are designed to incapacitate by causing short-term tears or inflammation of the eyes.

B.1.6

magazine

any building, structure or container approved for the storage of explosive materials.

B.1.7

non-sparking material

material that will not produce a spark when struck with other tools, rocks, or hard surfaces

B.1.8

particle board

a composition board made of small pieces of wood, bonded together

B.1.9

steel

general purpose (hot or cold rolled) low-carbon such as ASTM A366b or equivalent

B.1.10

theft resistant

construction designed to deter and/or delay illegal entry into facilities used for the storage of explosives.

B.1.11

weather resistance

construction designed to provide reasonable protection against weather

Annex C (Informative) Bibliography

Institute of Makers of Explosives (1993). *Safety Library Publication No. 1 – "Construction guide for magazines"*. Institute of Makers of Explosives, Washington D.C.

Institute of Makers of Explosives (1993). *Safety Library Publication No. 2 – "The American table of distances"*; Institute of Makers of Explosives, Washington D.C.

Institute of Makers of Explosives (1993). *Safety Library Publication No. 3 – "Suggested code of regulations for manufacture, transportation, storage, sale, possession and use of explosive materials"*. Institute of Makers of Explosives, Washington D.C.,

Institute of Makers of Explosives (1993). *Safety Library Publication No. 14 – "Handbook for the transportation and distribution of explosive materials"*. Institute of Makers of Explosives, Washington D.C.

Institute of Makers of Explosives (1993). *Safety Library Publication No. 17 – "Safety in the transportation, storage, handling and use of explosive materials"*. Institute of Makers of Explosives, Washington D.C.

Institute of Makers of Explosives (1993). *Safety Library Publication No. 20 – "Safety guide for the prevention of radio frequency radiation hazards in the use of commercial electric detonators"*; Institute of Makers of Explosives, Washington D.C.

Institute of Makers of Explosives (1993). *Safety Library Publication No. 22 – "Recommendations for the safe transportation of detonators in a vehicle with certain other explosive materials"*. Institute of Makers of Explosives, Washington D.C.

United Kingdom (1999). *Ammunition and Explosive Regulations (Land Service), Volume 2 - "Unit Ammunition Storage and Handling"*. (Issue 2/99). Director Land Service Ammunition, Ammunition Services 4b, Didcot, UK.

United Nations (2000). *UN ammunition and explosives regulations manual, "Ammunition and explosives regulations – For use by the United Nations field missions", (Draft UN ammo & explosives Reg on UNFOD)*. DPKO, UN, New York

United States Army (1973). *Technical manual TM 9-1300-206, "Ammunition and explosives standards"*. Headquarters of the Department of the Army; Washington D.C.

United States Army (1989). *Technical manual TM 9-1300-206, "Ammunition and explosives safety standards"*. Headquarters of the Department of the Army, Washington D.C.

United States Army (1993). *Pamphlet 385-64, "Safety - Ammunition and explosives safety standards"*, Headquarters of the Department of the Army, Washington D.C.

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

D.1 Permanent structure

A permanent structure magazine may be a building, igloo, tunnel or dugout. It shall be bullet resistant, 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: 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: Voids in concrete blocks clay blocks should be filled with well tamped dry sand or well tamped sand cement mixture.

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

Floors should be 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 40⁰ 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.

Note: The recommended minimum is 60 cm² per 1.0 m³ of space in the magazine.

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

The magazine shall be equipped with at least a five tumbler steel padlock that has at least a 9.5mm diameter casehardened shackle.

D.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, weather-resistant and bullet resistant. The magazine should be constructed of steel with an interior lining of timber

- Note: 15.9mm steel with an interior lining of any spark-proof material
12.7 mm steel with an interior lining of not less than 9.5mm plywood or particleboard
9.5mm steel with an interior lining of 57mm of plywood or particle board

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.

Note: The recommended minimum is 60 cm² per 1.0 cubic metre of space in the magazine.

The magazine shall be equipped with at least a five tumbler steel padlock has at least a 9.5mm diameter casehardened shackle. Trailers or semi-trailers use as portable magazines should be immobilised by removing the wheels of or locking with a wheel locking device approved by the national mine action authority.

D.3 Day box

A day box or other portable magazine shall be theft-resistant, fire-resistant and weather-resistant. It need not be bullet resistant.

The day box shall be constructed of not less than 2.6mm steel with an interior lining of not less than 12.7mm plywood or particleboard.

The door of the day box shall overlap the door opening by not less than 25mm. Hinges and locking-ware shall be rigidly attached by welding riveting or bolting which cannot be removed when the door is locked.

The magazine shall be equipped with at least a five tumbler steel padlock that has at least a 9.5mm diameter casehardened shackle. Explosive materials shall not be left unattended in a day box and shall be removed to a portable or mobile magazine or permanent magazine.

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

- a) Explosives that are transported on the same vehicle are limited to:
- Detonators
 - detonators, electric; 1.4B and 1.4S
 - detonators electric 1.1B that contain no more than 1gm of explosive (excluding ignition and delay charges and are electric detonators with leg wires 1.2m or longer or
 - detonators, non-electric 1.4B or 1.4S and
 - Class 1 explosive materials (explosives A,B and C) excluding 1.1A materials

Note: IMAS 04.10 includes detailed guidance on the hazard classification and compatibility codes 1.1A, 1.1B, 1.4B and 1.4S

- b) Packaging for detonators described in sub-clause 4.1 a) above are as follows:
- detonators electric 1.4B, 1.4S and 1.1B that contain no more than 1gm of explosive and are transported in quantities of less than 1000 shall be packed in inner packing or cartons that meet the manufactures specifications before loading into the container.
 - detonators non-electric 1.4B and 1.4S shall be loaded into the container in the manufacturers original outer packing.
- 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 the official languages commonly use in the demining organisation.

Annex E **(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 l 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.
 - Firearms with the exception of armed guards.
 - 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 F
(Informative)
Table of distances for the storage of explosive materials

Qty of explosive kg		Distance m							
		Inhabited buildings distance in m		Public roads Traffic volume				Separation of magazines	
				less than 3000 veh/day		more than 3000 veh/day			
over	less than	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
0	2	32	64	14	27	23	46	3	5
2	5	41	82	16	32	29	58	4	7
5	9	50	100	20	41	37	74	5	9
9	14	57	114	23	45	42	84	5	10
14	18	64	127	25	50	47	94	5	11
18	23	68	136	27	54	50	100	6	13
23	34	77	154	32	64	58	115	7	14
34	45	86	173	34	68	63	126	7	15
45	57	91	182	36	73	68	136	8	16
57	68	98	195	39	77	72	144	9	17
68	91	107	213	43	86	79	159	10	19
91	114	116	232	48	95	86	172	10	21
114	136	123	245	50	100	91	183	11	22
136	182	134	268	54	109	100	201	12	25
182	227	145	291	59	118	108	216	13	26
227	272	109	318	61	123	115	230	14	28
272	318	161	322	66	132	103	235	15	29
318	363	170	341	68	136	126	252	15	30
363	409	177	354	70	141	131	262	16	32
409	454	182	363	73	145	136	272	16	33
454	545	193	386	75	150	144	289	18	35
545	636	204	409	77	154	153	305	19	37
636	726	213	427	79	159	159	319	20	39

Qty of explosive kg		Distance m							
		Inhabited buildings distance in m		Public roads Traffic volume				Separation of magazines	
				less than 3000 veh/day		more than 3000 veh/day			
over	less than	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
726	817	222	445	82	163	166	332	20	40
817	908	229	459	84	168	172	343	20	41
908	1135	247	495	86	173	185	370	22	44
1135	1362	263	527	89	177	196	392	24	47
1362	1816	288	577	95	191	215	430	26	53
1816	2270	311	622	102	204	233	466	28	55
2270	2724	331	663	107	213	248	496	30	59

Note: Weights and distances are converted from the imperial weights and distances used in the American table of distances (IME safety library publication No2)

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

Note: 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: Storage of quantities in excess of 2724 kg should be limited to a permanent storage facility which should be regulated by the host nation or the national mine action authority.

Annex G

(Normative)

Hazard classification codes

G.1 Hazard divisions

Explosive items are allocated one of five Hazard Divisions (HDs); dependent on the hazard it presents when initiated. The HDs are identified by a two number code as follows: 1.1, 1.2, 1.3, 1.4 and 1.5.

The description and definition of each of the HDs are included in appendix 1 to this annex.

G.2 Compatibility groups

In addition to HDs all ammunition has been allocated to one of twelve Compatibility Groups (CGs) indicated by the letters A to H, J, K, L, and S in order to ensure correct segregation during storage and transportation.

The description and definition of each of the CGs is included as appendix 2 to this annex.

G.3 Hazard Classification Code

Hazard Classification Codes (HCC) are formed by combining the HD and CG of an item of ammunition to produce a two/three number, one letter code. For example "1.1 D" or "1.21C".

Appendix 1 to Annex G (Informative) Ammunition hazard divisions

Ammunition is divided into five Hazard Divisions (HD) according to the hazard it presents when initiated.

HD 1.1 - Ammunition which has a mass explosion hazard

The explosion will produce severe structural damage to surrounding buildings in the immediate neighbourhood, the severity being determined by the amount of explosives involved and the distance of the buildings from the explosion site. Blast and high speed fragments are the major hazards although there may be a danger from heavy debris propelled from the structure in which the explosion occurs.

HD 1.2 - Ammunition which has a projection hazard but not a mass explosion hazard

The explosion will result in items burning and exploding progressively a few at a time. Fragments, fire brands and unexploded items may be projected in considerable numbers; some of these may explode on impact and propagate fire or explosion. Blast effects will be limited to the immediate vicinity of the explosion site.

For the purpose of determining the quantity distance this hazard division is subdivided, namely:

- a) Subdivision 1.21 - Ammunition which will produce large fragments with a considerable range.
- b) Subdivision 1.22 - Ammunition which will produce small fragments with a limited range.

HD 1.3 - Ammunition which has a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

For the purposes of determining the quantity distance this hazard is subdivided, namely:

- a) Subdivision 1.33 - Ammunition which will burn with great violence and intense heat emitting considerable thermal radiation.
- b) Subdivision 1.34 - Ammunition which will burn sporadically. Items may explode producing minor fragments. Firebrands and burning containers may also be projected.

HD 1.4 - Ammunition which presents no significant hazard.

Ammunition included in this division is primarily a moderate fire hazard. It will not contribute excessively to the fire. The effects are largely confined to the package; however the external fire may cause a package to be degraded such that it cannot contain the effects of the ammunition. No fragments of appreciable size or range are to be expected. An external fire will not cause a mass explosion of the total contents of the package when there are a number of items in the package.

HD 1.5 - Ammunition which although mass exploding is very insensitive.

Ammunition in this division is confined to certain bulk explosives that are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of storage and transport. For the purposes of determining quantity distances, ammunition belonging to Hazard Division 1.5 is to be deemed to belong to HD 1.1.

Appendix 2 to Annex G (Informative) Ammunition compatibility groups

Ammunition and explosives have been grouped into twelve Compatibility Groups (CGs) A to H, J, K, L and S. Group I is omitted to avoid possible confusion between the letter I and the Roman numeral 1. Group S is given a distinctive letter since it corresponds to a unique possibility for mixing in storage and transport.

Definitions of compatibility groupings:

Group A

Primary explosive.

Group B

Ammunition containing primary explosive.

Group C

Propellant, explosive or other secondary deflagrating explosive or ammunition containing such explosive.

Group D

Secondary detonating explosive or black powder or ammunition containing secondary detonating explosive, in each case without its own means of initiation and without a propulsive charge.

Group E

Ammunition containing secondary detonating explosive, without its own means of initiation, with a propulsive charge.

Group F

Ammunition containing secondary detonating explosive, with its own means of initiation, with or without a propulsive charge.

Group G

Pyrotechnic substance, or ammunition containing pyrotechnic substance, or ammunition containing both an explosive and an illuminating, incendiary, lachrymatory or smoke producing substance (other than a water-activated article or one containing WP, phosphide or flammable liquid or gel).

Group H

Ammunition containing both an explosive and WP.

Group J

Ammunition containing both an explosive and a flammable liquid or gel.

Group K

Ammunition containing both an explosive and a toxic chemical agent.

Group L

Ammunition containing explosive and presenting a special risk needing isolation of each type.

Group S

Ammunition so packaged or designed that any explosive effect during storage or transport is confined within the package except when an external fire has degraded the packaging.

Note: CG D applies only when secondary detonating explosive (high explosive) or black powder is properly packed in a dust-tight container. OTHERWISE, CG L applies.

Note: CG D or E may apply to ammunition that is fused or packed together with fuses.

Note: CG F does not necessarily apply to ammunition that is fused or packed together with fuses.

Compatibility groups which may be stored together

Compatibility group	A	B ^{1,3}	C	D	E	F ²	G	H	J	K	L	S
A	yes	no	no	no	no	no	no	no	no	no	no	no
B	no	yes	no	no	no	no	no	no	no	no	no	yes
C	no	no	yes	yes	yes	no	yes	no	no	no	no	yes
D	no	no	yes	yes	yes	no	yes	no	no	no	no	yes
E	no	no	yes	yes	yes	no	yes	no	no	no	no	yes
F	no	no	no	no	no	yes	no	no	no	no	no	yes
G	no	no	yes	yes	yes	no	yes	no	no	no	no	yes
H	no	no	no	no	no	no	no	yes	no	no	no	yes
J	no	no	no	no	no	no	no	no	yes	no	no	yes
K	no	no	no	no	no	no	no	no	no	yes	no	no
L	no	no	no	no	no	no	no	no	no	no	yes	no
S	no	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes

Figure 1. Compatibility groups storage table

Note: Detonators may be stored or transported with other materials, provided they are adequately segregated.

Exception: Detonators that are not mass detonating may be stored with safety fuse, electric squibs, igniters, or igniter cord and as specified in IMAS 10.50.

Note: Compatibility group F CAN are stored in the same magazine as C, D and E, but it must be well segregated and the entire quantity must be considered as Compatibility Group F.

Note: Fuses in B with D or E of which fuses are components. The load is treated as Compatibility Group F.

Note: Compatibility Group G MUST be stored in its standard service packaging for it to be allowed to be stored with C, D or E. Otherwise it MUST be stored separately.

The magazine specifications provided in IMAS 10.50 are specifications that apply to the storage of explosives normally used for the destruction of mine and UXO hazards. Organisations should

not presume that these specifications are safe for the storage of munitions awaiting EOD procedures for destruction in a central disposal site or other requirements.

Annex H **(Normative)**

Inert, drill, instructional or replica mines and ammunition

H.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 clearance 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.

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. Such operations should only be carried out by a Level 4 EOD technician.

Note: 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.

National mine action authorities and demining organisations should not indulge in the production of FFE ammunition and explosives as souvenirs.

H.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 the local language. It should also appear in one of the six recognised languages of the United Nations, (Arabic, Chinese, English, French, Russian and Spanish). 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.

H.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 the local language. It should also appear in one of the six recognised languages of the United Nations, (Arabic, Chinese, English, French, Russian and Spanish). 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 local circumstances may not allow for this.

H.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.

H.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 the local language. It should also appear in one of the six recognised languages of the United Nations, (Arabic, Chinese, English, French, Russian and Spanish). This ensures that they can be clearly identified from all angles, and are therefore do not inadvertently or accidentally become the focus of a clearance 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, although international alliances have made standard agreements (STANAG) for standardisation within their alliance. 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.

H.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 traceability for all inert, drill, instructional or replica mines and ammunition in its possession. It is recommended that this is based on their live ammunition accounting system.

H.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: 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.