INTERNATIONAL AMMUNITION TECHNICAL GUIDELINES

IATG 04.10

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Temporary storage

UN SaferGuard
Securing ammunition, protecting lives

Warning

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Foreword

In 2008, a United Nations group of governmental experts reported to the General Assembly on problems arising from the accumulation of conventional ammunition stockpiles in surplus.[1] The group noted that cooperation with regard to effective stockpile management needs to endorse a 'whole life management' approach, ranging from categorisation and accounting systems – essential for ensuring safe handling and storage and for identifying surplus – to physical security systems, and including surveillance and testing procedures to assess the stability and reliability of ammunition.

A central recommendation made by the group was for technical guidelines for the stockpile management of ammunition to be developed within the United Nations.

Subsequently, the General Assembly welcomed the report of the group and strongly encouraged States to implement its recommendations.[2] This provided the mandate to the United Nations for developing 'technical guidelines for the stockpile management of conventional ammunition', now commonly known as International Ammunition Technical Guidelines (IATG).

The work of preparing, reviewing and revising these guidelines was conducted under the United Nations Safe*r*Guard Programme by a technical review panel consisting of experts from Member States, with the support of international, governmental and non-governmental organisations.

In December 2011 the General Assembly adopted a resolution[3] that welcomed the development of IATG and continued to encourage States' to implement the recommendations of the Group of Government Experts;[1] the GGE Report included a recommendation that States' use the IATG on a voluntary basis. The resolution also encouraged States' to contact the United Nations Safe*r*Guard Programme with a view to developing cooperation and obtaining technical assistance.

In December 2015, the General Assembly adopted a resolution [4] that welcomed the continued application of the International Ammunition Technical Guidelines in the field, including the implementation software and training materials; Encourages, in this regard, the safe and secure management of ammunition stockpiles in the planning and conduct of peacekeeping operations, including through the training of personnel of national authorities and peacekeepers, utilizing the International Ammunition Technical Guidelines; The resolution also encourages States wishing to improve their national stockpile management capacity, prevent the growth of conventional ammunition surpluses and address wider risk reduction and/or mitigation to contact the SaferGuard programme, as well as potential national donors and regional organizations, as appropriate, with a view to developing cooperation, including, where relevant, technical expertise;

These IATG will be regularly reviewed to reflect developing ammunition stockpile management norms and practices, and to incorporate changes due to amendments to appropriate international regulations and requirements. This document forms part of the Second Edition (2015) of IATG, which has been subjected to the second five-yearly review by the UNODA Ammunition Expert Working Group. The latest version of each guideline, together with information on the work of the technical review panel, can be found at www.un.org/disarmament/convarms/ammunition/ .

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[1] UN General Assembly A/63/182, *Problems arising from the accumulation of conventional ammunition stockpiles in surplus*. 28 July 2008. (Report of the Group of Governmental Experts). The Group was mandated by A/RES/61/72, *Problems arising from the accumulation of conventional ammunition stockpiles in surplus*. 6 December 2006.

[2] UN General Assembly (UNGA) Resolution A/RES/63/61, *Problems arising from the accumulation of conventional ammunition stockpiles in surplus*. 2 December 2008.

[3] UN General Assembly (UNGA) Resolution A/RES/66/42, *Problems arising from the accumulation of conventional ammunition stockpiles in surplus*. Adopted on 02 December 2011 and dated 12 January 2012.

[4] UN General Assembly (UNGA) Resolution A/RES/70/35, Problems arising from the accumulation of conventional ammunition stockpiles in surplus. 11 December 2015

Introduction

While the ideal and most efficient method of storing ammunition is in purpose-built ammunition depots to ensure explosive safety, conventional ammunition can be stored safely, effectively and efficiently under temporary conditions. There may be, however, disadvantages to temporary storage in that the service life of ammunition could to be significantly reduced. Rapid turnover of ammunition stocks can minimize these disadvantages. Ammunition that is stored under temporary storage conditions for prolonged periods of time should be subjected to an effective technical surveillance and in-service proof programme.[5] This is the only way to ensure that the ammunition does not deteriorate to a condition that compromises performance or safety in storage.

This concept of temporary storage uses essentially the same Outside Quantity Distances (OQD) as used in IATG 02.20 *Quantity and separation distances*, thereby providing the same degree of protection to the public, non-related personnel and key facilities.[6] A somewhat higher level of risk is entailed with respect to Inside Quantity Distances (IQD), with a concomitant risk to mission safety. This is ameliorated by conservative aggregation rules and by limiting the NEQ of any site to a maximum of 4000 kg.

Temporary storage uses simplified tables which are not intended for long term or non-operational storage. To avoid confusion with the QD tables used in IATG 02.20 *Temporary Storage* uses Temporary Distances (TD) tables.

The temporary storage tables use a much reduced range of Potential Explosion Sites (PES) and Exposed Sites (ES). PES are limited to hardened, semi-hardened and open/light, with adjustments for barricades where appropriate. ES, for IQD, are similarly limited, with the addition of an ammunition processing area, barricaded or not. OQD possibilities are even more restricted: mission-related personnel and unprotected civilian population. This is a pared down system, for operational purposes[7].

Temporary storage should be considered for application in camps on deployed missions. If the camp may develop into a permanent ammunition storage facility, you are advised to use IATG 02.20, not this IATG.

[5] See IATG 07.20 *Surveillance and proof.*

[6] The additional protection afforded to vulnerable buildings is not included with Field Distances, but where considered appropriate, this protection level can be provided by doubling the distance recommended for unrelated personnel.

[7] This IATG is based on AASTP-5 NATO GUIDELINES FOR THE STORAGE, MAINTENANCE AND TRANSPORT OF AMMUNITION ON DEPLOYED MISSIONS OR OPERATIONS. AASTP-5 offers a wider range of PES/ES pairs in that vehicles are included. AASTP-5 is freely available on the internet.

Temporary storage

1 Scope

This IATG module introduces and explains the requirements for the safe, effective and efficient storage of conventional ammunition under temporary conditions.

For the purposes of this IATG module, temporary storage shall cover the storage requirements when appropriate and safe depot storage infrastructure is not available, or when that infrastructure has decayed to a condition where it provides no effective protection to either ammunition stocks or the local civilian community.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

A further list of informative references is given at Annex B in the form of a bibliography, which lists additional documents that contain other useful information on field, and temporary storage of conventional ammunition.

3 Terms and definitions

For the purposes of this module the following terms and definitions, as well as the more comprehensive list given in IATG 01.40 *Glossary of terms, definitions and abbreviations,* shall apply.

The term ‘hazard’ refers to *a potential source of harm*.

The term ‘exposed site’ refers to *a magazine, cell, stack, truck or trailer loaded with ammunition, explosives workshop, inhabited building, assembly place or public traffic route, which is exposed to the effects of an explosion (or fire) at the potential explosion site under consideration*.

The term ‘potential explosion site’ refers to *the location of a quantity of explosives that will create a blast, fragment, thermal or debris hazard in the event of an accidental explosion of its content*.

The term ‘risk’ refers to *a combination of the probability of occurrence of harm and the severity of that harm*.

The term ‘risk analysis’ refers to *the systematic use of available information to identify hazards and to estimate the risk.*

The term risk mitigation is used to describe the measures taken to reduce the effects should an explosion or deflagration occur. Examples would be following compatibility mixing rules to prevent an item in an incompatible group exacerbating the effects of an explosion, and keeping inhabited buildings outside the yellow line (inhabited building distance).

The term ‘risk reduction’ refers to *actions taken to lessen the probability, negative consequences or both, associated with a particular risk*. In ammunition management, risk reduction is the term used to describe those measures to be taken to reduce the risk of ammunition exploding or deflagrating. It also refers to the methods used to make the ammunition more secure. Examples would be continuous surveillance of ammunition to ensure any safety problems are detected at an early stage, and storing ammunition in optimum conditions in secure areas and buildings.

In all modules of the International Ammunition Technical Guidelines, the words 'shall', 'should', 'may' and 'can' are used to express provisions in accordance with their usage in ISO standards.

a) **'shall' indicates a requirement**: It is used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

b) **'should' indicates a recommendation**: It is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form, 'should not') a certain possibility or course of action is deprecated but not prohibited.

c) **'may' indicates permission**: It is used to indicate a course of action permissible within the limits of the document.

d) **'can' indicates possibility and capability**: It is used for statements of possibility and capability, whether material, physical or casual.

4 Background

The storage of ammunition and explosives under temporary storage conditions as a technique for daily storage of a stockpile is not desirable, but safety can still be assured. The impact of temporary storage on the in-service life of the ammunition is less certain, as protection from climatic conditions and diurnal cycling[8] may be less effective under temporary conditions.

Temporary storage may also be used in the design and management of an operational location. This dichotomy of purpose should be kept in mind when reading this IATG module.

Unless specifically stated within this IATG module, the requirements of all other IATG modules shall be observed in order to retain the most stringent safety standards and preservation of assets during temporary storage conditions.

Temporary Storage Areas should always be planned and operated by ammunition specialists in accordance with IATG 01.90 *Ammunition management staff competencies*, as a formal risk management process is necessary as part of the planning process for the establishment of safe separation distances.

5 Risk acceptance (LEVEL 2)

Temporary storage of conventional ammunition may require a balance to be struck between safety, operational requirements and resource requirements. Where safety is to be compromised it shall be subject to a formal risk assessment (in accordance with the principles contained within IATG 02.10 *Introduction to Risk management principles and processes)*, and an Explosion Safety Case (in accordance with IATG 02.10, Clause 13.4 and Annex G) shall be prepared. The appropriate civilian authorities (usually the Ministries of Interior and Defence) shall be informed of the risk in detail, particularly if it involves an increased risk to the general public. The appropriate authorities shall also be informed of the resources required by the ammunition management organisation to reduce or mitigate that risk to a tolerable level. If the recommended resources are not made available for whatever reason, then the residual risk should be formally accepted at Ministerial level, and this risk acceptance shall be appropriately recorded. Any reduced safety criteria should be authorised in progressive stages for each reduction in Quantity Distances (QDs).

[8] The exposure of ammunition and explosives to the temperature changes induced by day, night and change of season.

6 Temporary Storage Areas (LEVEL 1 and 2)

Ammunition shall be deemed to be under temporary storage conditions when appropriate and safe depot storage infrastructure is not available (see IATG Volume 05), or when that infrastructure has decayed to such a condition that it provides no effective protection to either ammunition stocks or the local civilian community. In some circumstances, temporary storage conditions may last for some time if resources are limited or unavailable to develop appropriate depot storage infrastructure.

As explained in the Introduction, temporary storage uses simplified tables which are not intended for long term or non-operational storage. To avoid confusion with the QD tables used in IATG 02.20, *Temporary Storage* uses Temporary Distances (TD) tables. The temporary storage tables use a much reduced range of Potential Explosion Sites (PES) and Exposed Sites (ES). PES are limited to hardened, semi-hardened and open/light, with adjustments for barricades where appropriate. ES, for IQD, are similarly limited, with the addition of an ammunition processing area, barricaded or not. OQD possibilities are even more restricted: mission-related personnel and unprotected civilian population. This is a pared down system, for operational purposes[9].

Temporary storage conditions permit the use of reduced Inside Quantity Distances (see Clause 7.4), while essentially retaining the same Outside Quantity Distances. The reduced Quantity Distances should be used sparingly, and all efforts shall be made to ensure that normal Quantity Distances in accordance with IATG 02.20 *Quantity and separation distances* are applied. The use of reduced Quantity Distances shall not be used as a justification for limited or reduced resource allocation for the stockpile management of conventional ammunition in appropriate permanent ammunition depot infrastructure. Should the reduced Quantity Distances not be achievable then an Explosion Safety Case shall be compiled in accordance with IATG 02.10 Clause 13.4 and Annex G.

During the planning of Temporary Storage Areas, decisions are made that may be difficult to rectify at a later date. Planning should therefore be focussed and conducted by qualified personnel. During the planning process, provision should be made to involve those personnel responsible for the storage and management of the ammunition that will be stored in the site. Engineers should cooperate closely in the planning phase, as they will be responsible for any construction works that may be required.

6.1 Location of Temporary Storage Areas

There are a range of factors that should be considered when selecting a location for a Temporary Storage Area. These are shown in Table 1.

Critical Factors	Requirements
Ground	▪ No underground hazards, such as oil or gas tanks and pipelines. ▪ Firm ground capable of taking heavy vehicles (of up to 14 tonnes) even during inclement weather. ▪ Ideally, the ground should be dry, well drained, pervious to water and fairly level. ▪ Natural barricades fformed by hills are desirable to reduce the size of the area required and the risk to neighbouring areas. ▪ Large quarries or farm complexes normally make suitable Temporary Storage Areas.
Dispersion	▪ Adequate space must be allowed for dispersion of the stock and separation between the different PES. ▪ Specific ammunition natures should be split between at least two locations to prevent all the stock of a specific nature being lost in a single accident.

[9] This IATG is based on AASTP-5 NATO GUIDELINES FOR THE STORAGE, MAINTENANCE AND TRANSPORT OF AMMUNITION ON DEPLOYED MISSIONS OR OPERATIONS. AASTP-5 offers a wider range of PES/ES pairs in that vehicles are included. AASTP-5 is freely available on the internet.

Critical Factors	Requirements
Expansion	▪ Extra space must be planned to allow for expansion in case of a requirement to hold increased levels of stock. ▪ Such extra space can alternatively be used should a part of the area in use become unsuitable as a result of inclement weather or the cutting up of tracks by heavily laden vehicles.
Communications	▪ Temporary Storage Areas must be readily accessible to major roads or railways, yet far enough away that they do not present an explosive hazard. ▪ Good minor roads are required on the approaches to, and in, the area.
Natural Fire Protection	▪ Natural firebreaks to prevent the spread of fire from one PES to another are advantageous. ▪ Similarly, roads can be used as effective firebreaks.
Security	▪ Temporary Storage Areas are necessarily large and security will be a concern. ▪ Access can be temporarily denied by the use of armed guards and guard dogs. ▪ More permanent structures, such as barbed wire fences, will be required for longer-term use as Temporary Storage Areas.
Isolation	▪ A Temporary Storage Area should not be located adjacent, or close to, other main storage areas, airfields or hospitals. ▪ They should be located well away from any large radio transmitters.
Improvement	▪ The selected site should be capable of improvement if it is to become a permanent storage area[10].

Table 1: Temporary Storage Area location criteria

A Temporary Storage Area may require a range of supporting facilities and activities to ensure its efficient operation. These should include:

Facility or Activity	Requirements
Administrative Area	▪ This should be co-located with the Site Access Control. ▪ An appropriate Outside Quantity Distance (OQD) between the administrative area and the nearest field storage sites should be implemented to ensure the reduction and/or mitigation of the risk to site workers. ▪ The administrative area should have line communications to the civilian exchange.
Disposals area	▪ A small disposals area should be identified that can be used for the destruction of unsafe ammunition that presents an immediate risk of detonation or deflagration.
Returned Ammunition Group (RAG)	▪ At least one PES should be kept empty and used for the storage of ammunition returned from units. ▪ This ammunition will require technical inspection before it can be stored normally or re-issued.
Ammunition Processing Area	▪ Tasks could include, for example, repackaging, defuze/refuze and/or inspections. ▪ At least one PES should be kept empty and used for the storage of ammunition awaiting ammunition processing. ▪ This shall comply with the requirements of IATG Volume 07 *Ammunition processing*.
Site Access Control	▪ Access to the Temporary Storage Area, or individual PES, should only be permitted for authorised personnel. ▪ A strict system of access control should be implemented. ▪ The access control system shall ensure that contraband (smoking materials, matches, lighters, mobile telephones etc) is not permitted within the storage area.

[10] If a temporary storage area is likely to be developed into a permanent storage area, consideration should be given to implementing QDs as per IATG 02.20 as early as possible.

Facility or Activity	Requirements
Traffic Circuits	▪ Traffic circuits within the Temporary Storage Area should be signposted and made one way wherever possible. ▪ A sketch map of the Temporary Storage Area should be made available to drivers of ammunition vehicles.

Table 2: Temporary Storage Area facilities and activities

7 Explosive safety

7.1 Mixing rules (LEVEL 2)

Ideally each PES should consist of ammunition belonging to a single Compatibility Group (CG).[11] Should CGs have to be mixed then the rules at Table 3 shall apply.

Compatibility Group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B	NO	YES	(1)	(1)	(1)	(1)	(1)	NO	NO	NO	NO	NO	YES
C	NO	(1)	YES	YES	YES	(2)	(3)	NO	NO	NO	NO	(5)	YES
D	NO	(1)	YES	YES	YES	(2)	(3)	NO	NO	NO	NO	(5)	YES
E	NO	(1)	YES	YES	YES	(2)	(3)	NO	NO	NO	NO	(5)	YES
F	NO	(1)	(2)	(2)	(2)	YES	(2,3)	NO	NO	NO	NO	NO	YES
G	NO	(1)	(3)	(3)	(3)	(2,3)	YES	NO	NO	NO	NO	NO	YES
H	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
J	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	YES
K	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO
L	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	(4)	NO	NO
N	NO	NO	(5)	(5)	(5)	NO	NO	NO	NO	NO	NO	(7)	(6)
S	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	(6)	YES

Table 3: Compatibility Group mixing rules

NOTE 1 Compatibility Group B fuzes may be stored with the articles to which they belong, but the NEQ shall be aggregated and treated as Compatibility Group F. Compatibility Group B ammunition (other than fuzes) shall be stored in a separate site.

NOTE 2 Storage in same area permitted if effectively segregated to prevent propagation.

NOTE 3 Providing Compatibility Group G is in its authorised outer packaging and at discretion of national authority.

NOTE 4 Compatibility Group L articles shall always be stored separately from all articles of other compatibility groups as well as from other articles of different types of Compatibility Group L.

NOTE 5 Articles of Compatibility Group N should not be stored with other Compatibility Groups except S. However, if such articles are stored with articles of Compatibility Groups C, D and E, the articles of Compatibility Group N should be considered as having the characteristics as Compatibility Group D and the Compatibility group mixing rules apply accordingly.

NOTE 6 A mixed set of munitions of HD 1.6N and HD 1.6S may be considered as having the characteristics of Compatibility Group N.

NOTE 7 It is allowed (see comment).

[11] See IATG 01.50 *UN Explosive Classification System and Codes*.

7.2 Ammunition requiring separate storage (LEVEL 1)

In addition to the mixing rules (Clause 7.1) certain types of conventional ammunition should always be stored in separate PES, or under specific conditions, from other types of ammunition:

a) white phosphorous (WP). The PES for this ammunition should be very near to a source of water, or a water container large enough to fully accept the largest ammunition container should be on the site. If unpackaged, WP ammunition should be stored in an upright position with the base nearest the ground;

b) missiles in a propulsive state. These should be stored in a barricaded PES with the warheads pointing away from other ammunition stocks and away from civilian populations. If barricading is not available, then they should be stored at a PES near the external perimeter of the Temporary Storage Area, even if this complicates security requirements. It should be pointed slightly downwards into a structure which will disrupt its flight, eg 1.4S ammunition pallets, sandbags etc;

c) damaged ammunition. If considered unsafe for storage, damaged munitions should be destroyed at the earliest convenience;

d) ammunition in an unknown condition, of unknown origin or which is unpackaged. This shall be stored at such a distance that detonation of this ammunition will not jeopardize other stocks;

e) ammunition awaiting destruction or demilitarization;

f) ammunition that is constrained[12] or banned for use; and

g) ammunition that has deteriorated and become hazardous. (This shall be stored in isolation and destroyed at the earliest convenience).

7.3 Aggregation rules (LEVEL 1)

When the quantity distances at Clause 7.4 are used, all ammunition with the exception of HD 1.4 must be treated as HD 1.1. The aggregate must be 4000 kg or less. Otherwise the Quantity Distances and aggregation rules must be applied in accordance with IATG 02.20 *Quantity and separation distances*.

7.4 Quantity and Separation Distances (LEVEL 2) [13]

Ammunition in Temporary Storage Areas is particularly vulnerable to fire. Inadequate separation from site to site may cause large losses through secondary effects, such as explosions initiated by the fire. It is therefore important that consideration be given to applying adequate Quantity Distances[14] between sites and ensuring that natural barricades and overhead cover are used wherever possible. The use of reduced Quantity Distances from those contained within IATG 02.20 *Quantity and separation distances* may be permissible subject to formal approval by the appropriate national authority. IATG 02.20 *Quantity and separation distances* should be consulted at all stages during the determination of the reduced QD permitted in this Clause. The aim of this Clause is to detail the reduced QDs that may be authorised for the storage of ammunition in Temporary Storage Areas. In all cases, QDs shall be measured from the nearest point of the

[12] Not all ammunition that is constrained needs to be stored separately. The nature of the constraint should make clear the need for separate storage.

[13] Derived from NATO AASPT-5, Part 2. (See Annex B as informative reference)

[14] See IATG 02.20 *Quantity and separation distances* for further information on this risk management concept. QD prevents propagation from prompt sympathetic detonation, primary fragmentation and thermal flux, there is no guarantee that there will not be delayed propagation from the results of fire.

Potential Explosion Site (PES) to the nearest point of the Exposed Site (ES). (See Clause 7.4.2 for limitations on the semi-permanent use of reduced Quantity Distances for Temporary Storage Areas).

Each Potential Explosion Site (PES) shall store no greater than 4,000 kg Net Explosive Quantity (NEQ). This is to ensure that the Maximum Credible Event (MCE) should avoid or reduce the loss of personnel and material, minimize the effects of unintended detonations/reactions during storage, transportation and handling or as a result of enemy action. If the 4,000 kg MCE is exceeded, then IATG 02.20 *Quantity and separation distances* shall apply.

If Temporary QDs (see below) cannot be achieved in a particular situation, the advice of an explosives safety expert should be sought, to conduct an explosives safety case using Risk Assessment techniques and commercially-available software.

7.4.1. Temporary Distances (TD)

The term Temporary Distance (TD) is introduced to distinguish between the Quantity Distances contained within IATG 02.20 *Quantity and separation distances* and the reduced Quantity Distances authorized by this IATG module. A TD is; 1) a distance between two PES whereby prompt sympathetic detonations will be avoided; or 2) the distance between a PES and ES where the TD will maintain adequate protection levels.

The TD recommended in this IATG module;

a) are dependent on the PES, ES, NEQ, HD and type of ammunition. The TD may be reduced by using appropriately designed barricades, (Clause 7.5);

b) requires that all ammunition, with the exception of HD 1.4, is considered to be of HD 1.1; and

c) provide a high level of protection against sympathetic detonation, but other types of reaction, such as occasional explosions of single articles (HD 1.2), mass burning (HD 1.3) or delayed mass explosions may occur.

As protection of stocks by appropriate infrastructure is not in place during temporary storage conditions the Potential Explosion Sites shall be assumed to be either Open Stack or Open Stack (Barricaded).

7.4.2. Reduced Inside Quantity Distances (TD) (LEVEL 2)

The reduced IQD (TD) at Tables 5 and 6 may be applied in a Temporary Storage Area. The TD is the temporary quantity distance reference to be used in Table 6.

ES (Structures containing explosives)	PES (Structures) [1] [2]				
				Open / Light	
				Barricaded	Un-Barricaded
Hardened				**TD1**	**TD1**
Semi-Hardened **Barricaded**				**TD1**	**TD1**
Semi-Hardened **Un-Barricaded**				**TD1**	**TD2**
Open / Light **Barricaded**				**TD1**	**TD1**

ES (Structures containing explosives)	PES (Structures) [1] [2]				
				Open / Light	
				Barricaded	Un-Barricaded
Open / Light Un-Barricaded				TD1	TD3
Ammunition Process Area [4] Barricaded				TD1	TD1
Ammunition Process Area Un-Barricaded				TD1	TD3

Table 5: IQD (TD) for Temporary Storage Areas

NOTE 1 Non-earth covered buildings that can generate debris like structures of concrete or bricks shall NOT be used as PES, unless constructed in accordance with Clause 7.5.

NOTE 2 Reduced distances may be implemented if authorised by the national authority.

NOTE 3 Hardened structures are by definition barricaded.

NOTE 4 Only for ammunition related personnel. For an ammunition process area as a PES use the appropriate PES structure type column.

NEQ	IQD (TD)'s (m)		
	TD1	TD2	TD3
25	4	7	14
50	4	9	18
75	4	10	20
100	4	11	22
150	4	13	26
250	4	15	30
500	4	19	38
750	4	22	44
1000	4	24	48
1500	7	28	55
2000	8	30	61
2500	8	33	65
3000	9	35	69
4000	10	38	76

Table 6: IQD (TD) (metres) for Temporary Storage Areas

7.4.3. Outside Quantity Distances (TD) (LEVEL 2)

The OQD (TD) at Tables 7 and 8 may be applied in a Temporary Storage Area.

The TD is the temporary quantity distance reference to be used in Table 8.

ES (not	PES (Structures)

containing explosives)	Hardened	Semi-Hardened		Open / Light	
		Barricaded	Un-Barricaded	Barricaded	Un-Barricaded
Hardened	TD4	TD4	TD4	TD4	TD4
Semi-Hardened Barricaded	TD4	TD4	TD4	TD4	TD4
Semi-Hardened Un-Barricaded	TD5	TD5	TD6	TD5	TD6
Open / Light Barricaded	TD8 TD7 [1]	TD8 TD7 [1]	TD8 TD7 [1]	TD8 TD7 [1]	TD8 TD7 [1]
Open / Light Un-Barricaded	TD8 TD7 [1]	TD8 TD7 [1]	TD9	TD8 TD7 [1]	TD9
Open Mission Related Personnel	TD8 TD7 [2]	TD8 TD7 [2]	TD9	TD8 TD7 [2]	TD9
Unprotected Civilian Population	TD8	TD9 TD8 [3]	TD9	TD9 TD8 [3]	TD9

Table 7: OQD (TD) for Temporary Storage Areas

NOTE 1 If an Overhead Protection protects against falling fragments then FD7 may be applied.

NOTE 2 Reduced distances may be implemented if the national authority has approved the storage structures.

NOTE 3 TD9 shall be applied except for heavy calibre artillery shells stored in a vertical position where TD8 may be applied.

NEQ	OQD (TD)'s (m)					
	TD4	TD5	TD6	TD7	TD8	TD9
25	12	18	23	23	100	130
50	15	22	30	33	100	212
75	17	25	34	40	100	260
100	19	28	37	46	100	294
150	21	32	43	56	100	342
250	25	38	51	73	100	400
500	32	48	64	103	155	400
750	37	55	73	118	203	400
1000	40	60	80	130	235	400
1500	46	69	92	149	283	400
2000	51	76	101	164	320	400
2500	54	82	109	177	352	400
3000	58	87	116	188	381	400
4000	64	95	127	207	400	400

Table 8: OQD (TD) (metres) for Temporary Storage Areas

7.5 Barricades (LEVEL 2)

7.5.1. General

The QD (TD) shown in Clauses 7.4.2 and 7.4.3 for barricaded structures assume that an effective barricade is in place. If the barricade is deemed to be non-effective then the Open/Light Un-Barricaded Stack QD (TD) shall be used. Information on the requirements for purpose built effective barricades may be found in IATG 05.30 *Barricades*, which should be referred to before using the QD (TD) for Open/Light Un-Barricaded Stack. Information on temporary barricades that may be used follows.

An effective barricade at an Exposed Site will arrest high velocity projections at low elevations from an adjacent explosive event in a Potential Explosive Site (PES) and thereby mitigate the risk of direct propagation. A vertical faced barricade sited close to a PES also reduces the projection of burning packages, explosives and debris.

The main advantage of interposing barricades between explosives stacks is in the storage of explosives in HD 1.1. Significantly reduced IQD (TD) may be permitted compared to the un-barricaded situation, thus permitting much greater storage density. For this simple reason, all Temporary Storage Areas should be constructed on the principle of barricaded storage.

Temporary barricades shall be used if the use of purpose-built barricade is impracticable. The construction of proper barricades is a major civil engineering task, whereas temporary barricades can be installed relatively quickly. Temporary barricades should be maintained regularly to ensure that they remain effective.

7.5.2. Types of temporary barricade

Table 9 summarises the more realistic options for temporary barricades in ascending order of costs.

Barricade Option	Requirements	Remarks
Waste Oil Drums	▪ Filled with sand, earth or gravel (<20mm diameter). ▪ 1m wide. ▪ Height to be 300mm above the stack height.	▪
Bastion / Gabion	▪ A wire frame filled with sand, earth or gravel (<20mm diameter). ▪ 1m wide. ▪ Height to be 300mm above the stack height.	▪ A Gabion is a cage within which can be placed various fill materials (e.g. gravel, sand, earth), and which is used for building walls, barricades and protective barriers.
Water Tank Barriers or Walls	▪ Filled with water. ▪ 1m wide. ▪ Height to be 300mm above the stack height. ▪ Can be reused.	▪ Propriety brand systems (such as MRP or Waterwall)[15] are available at relatively low cost. ▪ Require anti-freeze additives in cold climates.
ISO-Containers	▪ Filled with sand, earth or gravel (<20mm diameter). ▪ Double width. ▪ Stacked two high.	▪
HD 1.4S Ammunition	▪ 450mm wide. ▪ Height to be 300mm above the stack height.	▪ Only practicable in limited situations.
Concrete Walls (Thick)	▪ 450mm wide. ▪ Height to be 300mm above the stack height.	▪

[15] http://www.mrpsystemsuk.com/ballistic.html or http://www.waterwallblastprotection.com/ammunition.php. IATG does not specifically endorse these products, they are used to illustrate a protection concept.

Barricade Option	Requirements	Remarks
Concrete Walls (Thin)	▪ Require an earth backing on the side away from the ammunition.	▪ See IATG 05.30: for earth requirements.
Empty Ammunition Containers	▪ Filled with sand, earth or gravel (<20mm diameter). ▪ 450mm wide. ▪ Height to be 300mm above the stack height.	▪ Only practicable where an adequate supply exists. ▪ The least practicable temporary option.

Table 9: Options for temporary barricades

A barricade does not necessarily prevent subsequent propagation or damage caused by blast, lobbed items, debris or secondary fires.

7.5.3. Configuration of gabion barricades

Gabions are the most generally used type of temporary barricade, so specific advice is provided. Only gabion barricade configurations shown at Figure 1 with the measurements mentioned in Table 9 should be used between adjacent PES.

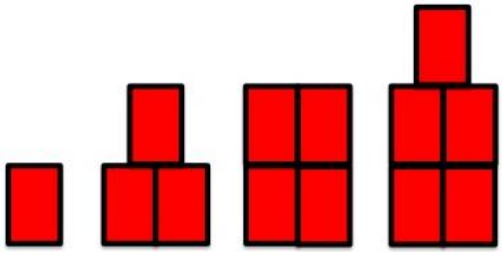

Figure 1: Temporary barricade configurations (Side of PES)

The maximum stock levels shown at Table 10 shall only be stored in each PES for Figure 1 configurations:

Figure 1 Barricade Configuration	Maximum NEQ (kg)
1	100
2 + 1	1000
2 + 2	4000

Table 10: Maximum stock levels (NEQ) for barricade configurations

The barricade configurations shown at Figure 2 do not provide more protection than those configurations at Figure 1 but can produce more mass movement onto the adjacent storage container, which may not necessarily be advantageous. The configurations shown at Figure 2 should therefore only be used in front of the container opening.

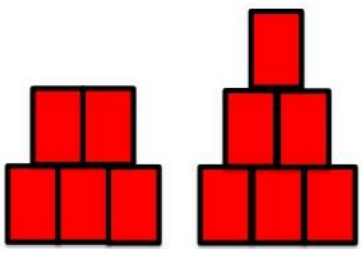

Figure 2: Temporary barricade configurations (Front of PES)

The maximum stock levels shown at Table 11 shall only be stored in each PES for Figure 1 configurations:

Figure 2 Barricade Configuration	Maximum NEQ (kg)
3 + 2	4000
3 + 2 + 1	4000

Table 11: Maximum stock levels (NEQ) for barricade configurations

7.5.4. Overhead protection

Overhead protection (OHP) may be used, under certain circumstances, to reduce explosion effects and protect against enemy fire. OHP also has the added benefit of providing shading for the ammunition (see Clause 8.2). Any OHP provided shall have the following requirements;

a) in a row of PES separated by barricades with OHP, each PES should have its own independent OHP;

b) combustible materials shall not be used for OHP;

c) the fill material for OHP shall not be hazardous to surrounding ES should it be launched. The fill material should be free of organic material and shall consist of sand, earth or gravel of less than 20mm diameter;

d) the fill material shall be at least 600mm deep and must cover the entire roof area of the PES;

e) a gap of at least 600mm shall be provided between the top of the barricade and the OHP to allow for rapid venting of blast overpressure. This gap also has additional ventilation advantages; and

f) any columns required as support for the sectional roof may be inserted within the barricade.

One recommended design for OHP is at Figure 3.

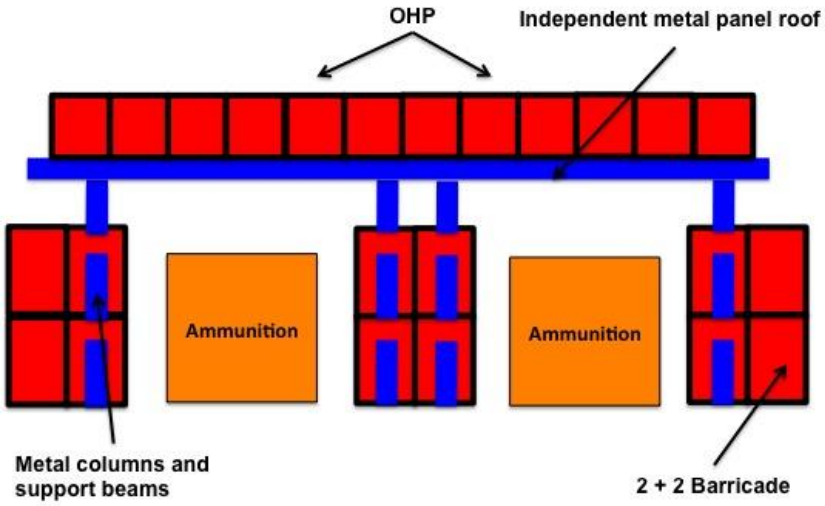

Figure 3: Recommended OHP design

7.6 Safeguarding

The requirements for safeguarding in accordance with IATG 02.40 *Safeguarding of explosive facilities* shall apply for all temporary storage areas.

8 Stock protection from environmental factors (LEVEL 1)

8.1 Degradation of explosives and the weather

The effects of weather, hot temperatures, direct solar radiation, daily temperature changes (diurnal cycling) and high humidity may rapidly degrade the performance and safety of explosives. Ammunition is designed for use under stated climatic conditions, and its service life will be significantly reduced if it is stored under climatic conditions that it was not designed for. In some cases, the ammunition may rapidly become unserviceable and dangerous to use. [16]

Although it is safe to store ammunition under temporary conditions, if appropriate conditions are met, it is unusual as it usually significantly reduces the safe service life of the ammunition. The worst condition for storing explosives under temporary conditions is where there is a considerable temperature fluctuation from day to night, combined with high humidity.

IATG 07.20 *Surveillance and proof* contains further technical information on the degradation of explosives due to climatic conditions and should be consulted prior to undertaking temporary storage of ammunition. As an example, this IATG module will consider the impact of high temperature and direct solar radiation (also see Clause 9).

In the Middle East recorded temperatures have ranged from -1^{0}C to +31^{0}C in the winter months and from +22^{0}C to +51^{0}C in the summer months. This means that the ammunition was exposed to daily diurnal cycles of up to +31^{0}C in the winter months and +29^{0}C in the summer months. These are usually considered as extreme ranges for ammunition, and a reduction in service life shall be exected. Yet, these temperatures are ambient air temperatures and do not take into account the effects of direct solar radiation on ammunition or on packaged ammunition.

Tests have shown that, when fully exposed to the sun, the temperature on the external surface of the ammunition can be as much as 50^{0}C higher than the ambient air temperature. This means that ammunition could theoretically reach external surface temperatures of 101^{0}C in the Middle East. It should be noted that the melting point of TNT based explosives is approximately 80^{0}C; **the very real danger of using TNT filled ammunition at this temperature cannot be overstated.**

8.2 Climatic protection options (LEVEL 1)

The options for the protection of ammunition stocks in Temporary Storage Areas from climatic conditions are limited unless covered infrastructure is available. Table 13 summarises the available options. The option selected should depend on what sort of protection is required.

Option	Impact	Remarks
Directly covered by tarpaulins (or equivalent) in contact with ammunition.	▪ Protects ammunition from rain and wind. ▪ The temperature at the external surfaces of ammunition temperature is up to 5^{0}C greater than if left unprotected. ▪ Condensation due to poor air ventilation may lead to moisture ingression in very hot climates.	▪ WARNING. This option should NOT be used in hot climates.

[16] More technical detail on this issue may be found in IATG 07.20 *Surveillance and proof*.

Option	Impact	Remarks
Shaded by camouflage nets or sheeting raised above the ammunition.	▪ Protects ammunition from radiant heat. ▪ The ammunition is vulnerable to rain and wind, hence moisture ingression is possible. ▪ In hot climates, the temperature at the external surfaces of the ammunition can be reduced by up to 23^0C compared to unprotected ammunition.	▪ The nets or sheeting should be raised to at least 300 mm to 500mm above the surface of the ammunition or ammunition packaging. ▪ Much preferred to direct coverage.
Raised off the ground by use of dunnage.	▪ Protects ammunition from moisture ingression. ▪ This allows for free air circulation, which will reduce the build up of moisture and condensation.	▪ A height of 75mm should be achieved. ▪ Regular maintenance is required to ensure that sand, earth etc does not build up around the base of the ammunition.
ISO-Containers	▪ Protects ammunition from radiant heat, rain and wind.	▪ These shall be grounded to earth. ▪ Ammunition shall not touch the walls or roof of the container. ▪ Paint containers white in order to reduce heat load ▪ They should be elevated.
Improvised Structures such as large tents, locally constructed shelters etc.	▪ Protects ammunition from radiant heat, rain and wind.	▪ Should be the minimum requirement for ammunition in temporary storage.

Table 12: Ammunition stock protection options from high temperature

8.2.1. Priorities for covered storage (LEVEL 1)

When covered storage is not available for all the explosives in Temporary Storage Areas, priority should be given to the natures that are likely to deteriorate most rapidly. However, rigid adherence to fixed guidelines may not always be feasible. The priorities may have to be altered to take into account, for example, the packaging of individual natures. For instance, in extremely hot climates, shells containing WP, which are normally fairly robust, may have to be accorded a high priority for covered storage because circumstances do not allow them to be stored in an upright attitude.

Assuming a normal standard of packaging, with no other requirements, the following order of priority for covered storage should be applied:

a) water activated explosives;

b) guided weapons and torpedoes;

c) anti-tank, ranging and spotting ammunition;

d) propelling charges;

e) pyrotechnics;

f) mortar ammunition;

g) grenades and mines;

h) boxed shell;

i) small arms ammunition (SAA); and

j) loose shell.

9 Surveillance and in-service proof (LEVEL 2 and 3)

It is highly likely that the service life of ammunition would be significantly reduced if kept under temporary storage conditions for prolonged periods of time. It should be subjected to an effective technical surveillance and in-service proof programme. This is the only way to ensure that the ammunition does not deteriorate to a condition that compromises performance or safety during handling, storage, and transportation.

An example of the impact that temporary storage conditions have on ammunition is the chemical deterioration of propellant. When propellant is stored in high temperature environments for prolonged periods the stabilizer is depleted far quicker, and the probability of spontaneous combustion due to auto catalytic ignition becomes much higher. For instance, most propellants have a shelf life of at least 15 to 40 years when stored at a constant 25°C and will last much longer in temperate climates. Well acknowledged methods for the determination of safe storage life of propellants[17] allow prediction of stability for a period of up to 10 years. This is the longest period recommended before reinspection should be conducted. At 10 degrees above the 25 degree baseline, the rate of deterioration may be as much as tripled. For example, if a propellant is stored at 50°C for one year, this would be equivalent to 12 years storage at 25°C. Therefore, if a propellant has a certificate of chemical stability for 10 years, this certificate is outdated after one year [18]of storage at 50°C, which means that the health status of the propellant is no longer defined and has to be checked. It doesn´t necessarily mean that propellant is unsafe, but the safe storage life has to be re-established.

Clause 8.1 indicated that ammunition could theoretically reach external surface temperatures of 101^0C in the Middle East, although internal temperatures would be substantially less. Propellant degradation and stabiliser depletion is not linear, and the decay rate reduces during the night when the ammunition cools. Yet it is clear that temporary storage conditions for propellant in these types of temperature extremes would not be a particularly sensible idea. If temporary storage is operationally necessary under such climatic conditions, the propellant should be separated from the parent ammunition wherever possible.

IATG 07.20 *Surveillance and proof* contains further technical information on the degradation of explosives and should be consulted prior to undertaking temporary storage of ammunition.

10 Fire precautions (LEVEL 1)

Ammunition that is being stored in Temporary Storage Areas is more vulnerable to fire than ammunition held in purpose-built ammunition depots. Therefore, even more importance shall be paid to fire prevention and fire fighting measures.

The fire precautions, fire-fighting principles and procedures contained within IATG 02.50 *Fire safety* shall be complied with as far as is reasonably practicable.

10.1.1. Fire precautions (supplementary to IATG 02.50)

Firebreaks, 2m wide, shall be maintained around all PES. Additionally, all vegetation within 10m of a PES should be strictly controlled by cutting back and weed killing.

[17] STANAG 4620 and related AOP 48, STANAG 4582

[18] A standard test replicates 10 years of 25°C aging in 301 days at 50°C, 191 days at 55°C….or 3.43 days at 90°C.

10.1.2. Fire fighting (supplementary to IATG 02.50])

The equipment recommendations in IATG 02.50 *Fire safety* shall be supplemented by an adequate supply of fire extinguishers (water and powder), fire-beaters, shovels, machetes etc near each PES to deal with bush and scrub fires that are not normally encountered within an ammunition depot.

An Emergency Water Supply should be located near each PES.

The appropriate Fire Division Signs and Supplementary Fire Signs shall be displayed on posts at the approaches to each PES, although black and green tactical versions may be used if justified by the operational environment. Standard orange signs shall be used in Temporary Storage Areas after one year.

All fires in the vicinity of the ammunition should be fought until stacks of ammunition or explosives become involved in the fire or the fire is extinguished. If ammunition becomes involved in a fire, personnel shall be removed immediately from the site to safe locations/distances.

All personnel shall be made aware of the appropriate emergency withdrawal safe distance that they shall place between themselves and the ammunition should immediate firefighting prove to be ineffective at controlling the spread of the fire. This safe distance shall not be less than 800m.

Personnel whose duties require them to fight secondary fires shall not approach within 300 m of any fire involving ammunition and explosives other than Fire Division 4. They shall immediately withdraw to the designated safe distance, (at least 800m or to the IBD, whichever is greater), when the fire fighting teams at the ammunition site withdraw.

After an ammunition fire has been extinguished, personnel shall wait at least six hours before entering the area to inspect the consequences of the fire.

10.2 Lightning protection (LEVEL 1)

In cases where Temporary Storage Areas are likely to be a mid-term (> 2 years) solution to ammunition storage appropriate lightning protection should be deployed. Protection should be fitted in accordance with the requirements of IATG 05.40 *Safety standards for electrical installations*.

In all cases ammunition stacks should be located no less than 15m from trees, telegraph poles, and pylons in order to reduce side flash should there be a lightning storm in the area.

11 Security (LEVEL 1 and 2)

The security for Temporary Storage Areas is always problematic due to the large ground area that they have to cover for explosive safety reasons. Although many of the security principles contained with IATG 09.10 *Security principles and systems* should be implemented, many of the guidelines for technical protection systems such as alarms, Class 1 to 4 security fencing etc are clearly inappropriate on financial grounds alone.

Perimeter security should be the highest priority, and this may be achieved by using a combination of armed guards, patrols, guard dogs and temporary fencing. Figure 4 shows examples of temporary fencing that can be erected by unskilled labour and upgraded through Levels 1, 2 and 3 as resources become available.

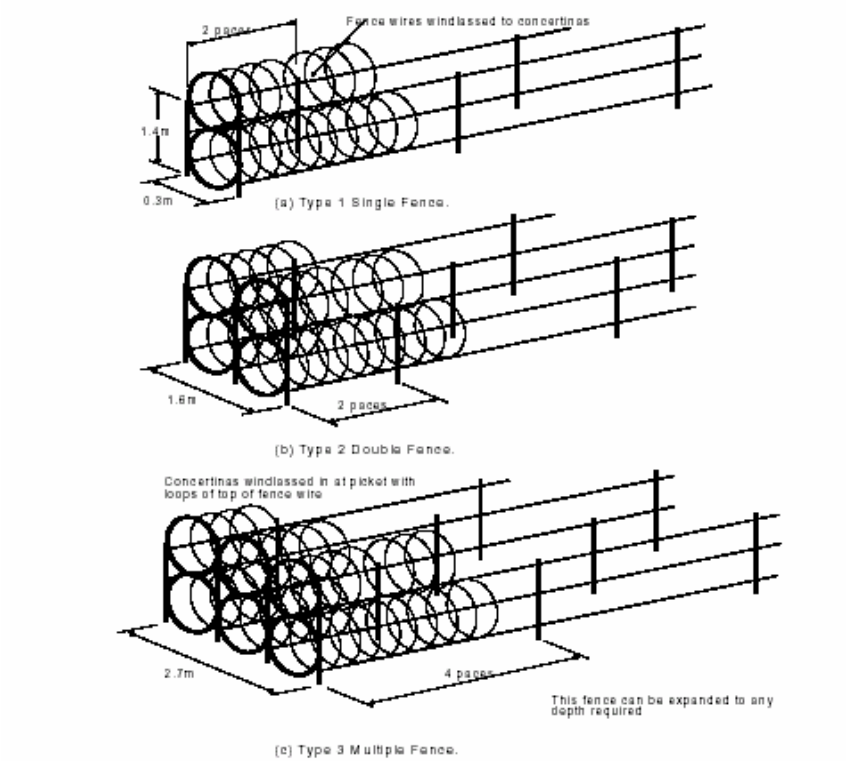

Figure 4: Temporary fencing options

Annex A
(normative)
References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of the guideline. 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 guideline 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 maintain registers of currently valid ISO or EN:

a) IATG 01.40*Terms, glossary and definitions*. UNODA.;

b) IATG 01.50*UN Explosive classification system and codes*. UNODA.;

c) IATG 01.90*Ammunition management staff competencies.* UNODA.;

d) IATG 02.20*Quantity and separation distances*. UNODA.;

e) IATG 02.50*Fire safety*. UNODA.:

f) IATG 05.30*Barricades*. UNODA.;

g) IATG 05.40*Safety standards for electrical installations*. UNODA.; and

h) IATG Volume 07 *Ammunition processing*. UNODA.

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references[19] used in this guideline and these can be found at: www.un.org/disarmament/un-saferguard/references/. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/convarms/ammunition/ . National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition management programmes.

[19] Where copyright permits.

Annex B
(informative)
References

The following informative documents contain provisions which should also be consulted to provide further background information to the contents of this guideline:

i) AASPT-5, Edition 1, Version 3, *NATO Guidelines for the Storage, Maintenance and Transport of Ammunition on Deployed Missions or Operations*. NATO Standardization Organization (NSO). June2016;

j) Joint Service Publication 482, Edition 4, *MOD Explosive Regulations*. Chapter 11. UK MOD. January 2013 – updated 10 April 2017. www.gov.uk/government/publications/jsp-482-mod-explosives-regulations.

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references[20] used in this guideline and these can be found at: www.un.org/disarmament/un-saferguard/references/. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/convarms/ammunition/ . National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition management programmes.

[20] Where copyright permits.

Examples of Hardened, Semi-Hardened and Light Structures

Examples of hardened structures.

Examples of semi-hardened structures.

Examples of light structures.

Amendment record

Management of IATG amendments

The IATG guidelines are subject to formal review on a five-yearly basis, however this does not preclude amendments being made within these five-year periods for reasons of operational safety and efficiency or for editorial purposes.

As amendments are made to this IATG they will be given a number, and the date and general details of the amendment shown in the table below. The amendment will also be shown on the cover page of the IATG by the inclusion under the edition date of the phrase *'incorporating amendment number(s) 1 etc.'*

As the formal reviews of each IATG are completed new editions may be issued. Amendments up to the date of the new edition will be incorporated into the new edition and the amendment record table cleared. Recording of amendments will then start again until a further review is carried out.

The most recently amended, and thus extant, IATG will be the versions that are posted on the UN *Safer*Guard IATG website at www.un.org/disarmament/convarms/ammunition/ .

Number	Date	Amendment Details