Demilitarization and destruction of conventional ammunition
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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 SaferGuard 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 resolution³ 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 SaferGuard Programme with a view to developing cooperation and obtaining technical assistance.

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 first five-yearly review by the UN ODA 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/un-saferguard/.

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.
Introduction

There are a limited number of international treaties, agreements or instruments that refer to or require the mandatory destruction of ammunition and explosives, yet the principles of sound stockpile management and the inherent risks and hazards during the storage of stockpiled ammunition mean that demilitarization or destruction should be a key component of conventional ammunition stockpile management programmes.

A recent report from the Group of Government Experts (GGE) established pursuant to UN General Assembly resolution 61/72 identified that ‘poorly managed ammunition stockpiles pose an excessive risk because they can become unstable and threaten public safety with explosions or contamination. Moreover, unsecured and poorly managed stockpiles of ammunition may be easily diverted to illicit use, which can increase fatalities arising from various forms of armed violence’. The GGE recommended that a ‘whole life management’ approach be adopted towards the stockpile management of conventional ammunition; such an approach includes the demilitarization or destruction of ammunition at the appropriate stage of its life cycle.

Although there is a range of disposal options it is recognised that the most desirable is that of physical demilitarization or destruction. Techniques available range from the relatively simple open burning and open detonation (OBOD) techniques to highly sophisticated industrial (demilitarization) processes. Security concerns and practical considerations, including safety and economies of scale, indicate that the most effective option is often the demilitarization of surplus or obsolete ammunition. This should preferably be achieved using an environmentally sound demilitarization process whereby ammunition is stripped down to its component parts and compounds that are then recycled.

Surplus destruction or demilitarization removes many of the safety and security risks associated with surpluses, including problematic transfers and re-transfers, accumulations of unstable ammunition, and stockpiles that are at risk of theft or sabotage. The logistics of destruction or industrial demilitarization of conventional ammunition can, however, be very challenging because of the inherent risks and hazards during processing operations and the large tonnages and quantities of individual items involved. Decisions to demilitarize or destroy need to recognize a number of factors that can affect the efficiency and cost of the process, including the types and volumes of ammunition earmarked for demilitarization/destruction, the physical condition of the ammunition, the methods or technologies currently available and factors relating to domestic capacity. The most influential factor is likely to be economies of scale in that the more ammunition that requires demilitarization/destruction, the larger the economies of scale and therefore the wider range of available technology. Consequently, national authorities may wish to consider ammunition demilitarization/destruction on a co-operative basis in order to achieve larger economies of scale and hence more cost effective demilitarization/destruction.


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4 Currently Article 4 of the Anti-Personnel Mine Ban Treaty (Ottawa Convention), 1997 and Article 3 (2) of the Convention on Cluster Munitions (CCM), 2008 require the destruction of these ammunition types for those States that have ratified the treaties.

5 ISACS 05.51 Destruction: Ammunition was developed concurrently with this IATG and was used as the core basis. In technical content terms they are virtually identical.

6 UNGA A/63/182 Report of the Group of Government Experts established pursuant to General Assembly resolution 61/72 to consider further steps to enhance cooperation with regard to the issue of conventional ammunition stockpiles in surplus. UN. 28 July 2008.

7 For example, the NATO Support Agency (NSPA), (on request), manages ammunition destruction on behalf of member States. This means that ammunition from a number of States can be dealt with under a single, larger, contract leading to cost savings for individual States.
Stockpile demilitarization/destuction can be carried out by different types of organisations, such as commercial companies, international organisations or military units. Despite differences in approach, common core activities exist which carry common responsibilities. This IATG provides guidance and requirements for ammunition stockpile demilitarization and destruction. There are so many inter-relational factors involved in ammunition stockpile demilitarization and destruction that it would not be appropriate to provide a ‘template solution’ as part of this guide.
Demilitarization and destruction of conventional ammunition

1 Scope

This IATG establishes the guiding principles and introduces technical methodology for the safe planning and execution of ammunition demilitarization and destruction activities in support of a conventional ammunition stockpile management programme. The IATG does not cover the background, advocacy arguments or current national policies for the demilitarization or destruction of the large stockpiles of conventional ammunition that currently exist in some states.

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 guide and which form part of the provisions of this guide.

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

3 Terms and definitions

For the purposes of this guide the following terms and definitions, as well as the more comprehensive list given in IATG 01.40:2015(E) Terms, definitions and abbreviations, shall apply:

The term ‘demilitarization’ refers to the complete range of processes that render weapons, ammunition and explosives unfit for their originally intended purpose.8

The term ‘destruction’ refers to the process of final conversion of weapons, ammunition and explosives into an inert state so that it can no longer function as designed.

The term ‘disposal’ refers to the removal of ammunition and explosives from a stockpile by the utilisation of a variety of methods, that may not necessarily involve destruction.

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.

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8 Demilitarization not only involves the final destruction process but also includes all of the other transport, storage, accounting and pre-processing operations that are equally as critical to achieving the final result.
4 Disposal options

Definitions are an important area for stakeholders in the area of ammunition disposal. For example, the term disposal does not necessarily mean that ammunition has been destroyed or demilitarized. Ammunition could have been disposed of by sale, which is very different to the demilitarization or destruction of ammunition. There are six traditional methods for disposing of surplus ammunition:

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<th>Method</th>
<th>Explanation</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale</td>
<td>Ammunition is either sold or gifted to another country.</td>
<td>▪️ Cheap for the donor country.</td>
<td>▪️ Old ammunition is unattractive to reputable end users.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Ammunition may not be legal to move in accordance with international instruments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Transfers the eventual destruction problem to another location.</td>
</tr>
<tr>
<td></td>
<td>Increased use at training</td>
<td>▪️ Makes cost effective use of the ammunition.</td>
<td>▪️ Additional wear takes place on gun barrels, which will not last long enough to destroy significant stockpiles. Hence additional costs in barrel replacements.</td>
</tr>
<tr>
<td></td>
<td>Live firing is significantly increased during training of security forces.</td>
<td>▪️ Improved training standards in security forces.</td>
<td>▪️ Could negate confidence and security measures between neighbouring States.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Only limited stocks could realistically be destroyed this way.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Larger calibre ammunition will require large training areas, which are often unavailable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Disposal of fuzed ammunition may lead to a higher incidence of &quot;blinds&quot;, resulting in an increase in the need for Explosive Ordnance Disposal (EOD) action on ranges.</td>
</tr>
<tr>
<td>Deep Sea Dumping</td>
<td>The dumping of ammunition in deep water at sea in coastal or international waters.</td>
<td>▪️ Cost effective.</td>
<td>▪️ Banned by international treaty for some States. (See Clause 5.4).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪️ Relatively quick.</td>
<td>▪️ Long-term environmental impact of decaying ammunition on seabed is unknown.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Previous shallow water dumping has led to pollution and dangerous munitions being washed ashore.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Will not be supported by UN programmes.</td>
</tr>
<tr>
<td>Disposal by Landfill</td>
<td>The shallow or deep burial of ammunition and explosives.</td>
<td>▪️ Cost effective.</td>
<td>▪️ Long-term environmental impact of decaying ammunition on the ground and water table is unknown.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪️ Relatively quick.</td>
<td>▪️ There may be long term risks of spontaneous explosion due to degradation of safety mechanisms and chemical deterioration of the propellant and explosive content.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Restricts future use of land for development.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪️ Will not be supported by UN programmes.</td>
</tr>
</tbody>
</table>
### Method | Explanation | Advantages | Disadvantages
--- | --- | --- | ---
Destruction / Demilitarization | The physical destruction of ammunition, or the use of industrial processes to demilitarize ammunition and recover raw materials for reuse and recycling. | • Proven technologies exist.  
• Guarantees destruction or demilitarization.  
• Can be environmentally benign.  
• Can make effective use of recovery, reuse and recycling of components and materials. | • Can be expensive.  
• The idea that these programs can be self-financing is unproven because, despite much effort, there will be some cost. |

Table 1: Traditional methods of ammunition disposal

The most realistic, internationally acceptable and practical methods of disposal should therefore be destruction or demilitarization.

## 5 International legislation, instruments and agreements

### 5.1 Anti-Personnel Landmine Ban Convention

Article 4 of this convention, which entered into force on 01 March 1999, requires that, except as provided for in Article 3, each State Party undertakes to destroy or ensure the destruction of all stockpile anti-personnel mines it owns or possesses, or that are under its jurisdiction or control, as soon as possible but not later than four years after the entry into force of this Convention for that State Party.

### 5.2 Convention on Cluster Munitions

Article 3(2) of this convention, which entered into force on 01 August 2010, requires that State Parties shall destroy or ensure the destruction of all cluster munitions referred to in paragraph 1 of this Article as soon as possible but not later than eight years after the entry into force of this Convention for that State Party. Each State Party undertakes to ensure that destruction methods comply with applicable international standards for protecting public health and the environment.

### 5.3 UN Firearms Protocol

Article 6 of the UN Firearms Protocol requires that States that have ratified the treaty shall adopt, within their domestic legal systems, such measures as may be necessary to prevent illicitly manufactured and trafficked firearms, parts and components and ammunition from falling into the hands of unauthorized persons by seizing and destroying such firearms, their parts and components and ammunition unless other disposal has been officially authorized, provided that the firearms have been marked and the methods of disposal of those firearms and ammunition have been recorded. These requirements, already agreed by many states, are a core component of this IATG for illicitly manufactured and trafficked ammunition that may be seized.

### 5.4 International instruments (environmental)

Ammunition and explosives are considered to be hazardous or industrial waste and as such fall under the remit of international treaties that have been signed and ratified:

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11 As at 30 September 2010 a total of 86 were States Parties’, and a further 28 States are signatories to the convention.

a) the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 29 December 1972;

b) the 1996 Protocol to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Amended 2006); and

c) the Convention for the Protection of the Marine Environment of the North-East Atlantic, 1998.\(^{13}\)\(^{14}\)

Ammunition and explosives shall therefore not be dumped at sea by States that have ratified and signed the above treaties and should not be dumped at sea by non-participant States.

The United Nations shall not support any ammunition disposal activities that utilise deep sea dumping.

### 5.5 Supra-national legislation (environmental)


The directives provide a comprehensive standard and are in use by all European Union countries and those countries with associate status. States should reflect the requirements of these directives in their own national environmental legislation where it relates to the destruction of ammunition.

### 5.6 International standards (environmental)

#### 5.6.1. ISO 4220:1993(E) Measurement of air pollution

ISO 4220:1993(E), whilst not specifically legislation, lays down internationally accepted standards for the determination and measurement of air pollution from industrial processes. These standards should apply to any pollution control systems used during industrial demilitarization operations, ([http://www.iso.ch/](http://www.iso.ch/)), but only in terms of the measurement of emissions. The standard does not provide any guidance on what the overall emission limits should be; this remains the responsibility of the national authority.

#### 5.6.2. ISO 9612:2009(E) Acoustics

ISO 9612:2009 *Determination of occupational noise exposure – Engineering method* may be applied to open detonation destruction operations.

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\(^{13}\) Also known as the *OSPAR Convention*.

\(^{14}\) Entered into force on 25 March 1998 and replaced the 1972 *Oslo Convention*.

6 Demilitarization cycle

The physical demilitarization or destruction process of conventional ammunition is only one process of the complete demilitarization or destruction cycle. The processes in this cycle should be considered in parallel with the technical factors, (see Clause 7), before a final disposal solution is produced. The cycle is complex, comprehensive and wide-ranging and includes activities such as transportation and storage, processing operations, equipment maintenance, staff training and accounting. The full cycle is shown schematically at Annex C.

7 Technical factors

7.1 General

There are a wide range of technical factors that will determine the overall ammunition demilitarization or destruction plan, not least that of experienced and qualified personnel for demilitarization\textsuperscript{16} and potentially high funding requirements. There is a global shortage of qualified personnel experienced in developing ammunition demilitarization facilities and programmes.

In order that the demilitarization programme is developed efficiently and safely national authorities may wish to consult with appropriate regional and international organisations that are experienced in the development of demilitarization programmes, as well as the commercial companies and NGOs with the practical experience of operational demilitarization.\textsuperscript{17}

7.2 National legislation

Details of applicable international legislation, instruments and agreements can be found in Clause 5. National environmental legislation shall dictate the emission levels to be met\textsuperscript{18} which will in turn dictate the type of technology required to meet these emission levels, (also see Clauses 5.4, 5.5, and 5.6). Should this technology be too expensive, or not available, then agreement needs to be reached with the environmental authorities for an exemption. National environmental legislation should be based on the appropriate normative references at Annex A (from Clauses 5.3 and 5.4).

7.3 Chemistry of explosives

The stability in storage and degradation or deterioration rates of the explosive content should influence the degree of urgency for disposal, type of transport that can safely be used and destruction/demilitarization methodology.

7.4 Knowledge of ammunition design

A detailed knowledge of the ammunition design is essential to the formulation of a safe demilitarization/destruction plan. This knowledge should also include the type and rate of evolution of gases should a thermal destruction technique be under consideration as this will be a requirement for the design of a pollution control system that can meet the air emission levels laid down by national legislation.

\textsuperscript{16} There is wider experience available for the destruction of conventional ammunition by open burning and open detonation.

\textsuperscript{17} The EU Explosives Certification (EU-ExCert) scheme (www.euexcert.org) has recently been developed to establish a stable framework for the vocational education of people in the European explosives sector. Training and education institutions as well as social partners will have a tool for competency development and assessment. New training methods will also be developed in order to ensure that the explosives sector has access to enough trained and experience staff and that the current shortfall in qualified and experienced staff is overcome. Other regions should consider the development of a similar type of system.

\textsuperscript{18} Although donors may insist on higher standards if national legislation is less than the international norms at Clause 5.4.
7.5 Quantity for disposal

The most influential factor is likely to be economies of scale, in that the more ammunition that is requiring demilitarization or destruction, the larger the economies of scale and, therefore, the wider range of available technology at an affordable price. Consequently, national authorities may wish to examine the problem of ammunition demilitarization and destruction on a cooperative or regional basis in order to achieve larger, and hence more cost effective, economies of scale.

7.6 Available technology

See Clause 9.

7.7 Safe systems of work

Safe systems of work are a pre-requisite when handling and processing any types of ammunition and explosives. Formal risk management processes shall be developed to support ammunition demilitarization or destruction in accordance with the requirements of ISO Guide 51 and IATG 02.10:20105E Introduction to Risk Management Principles and Processes.

7.8 Security

Stockpile security is obviously an important issue. Every effort should be taken to ensure the physical security of ammunition during storage, transportation and processing in accordance with the requirements of IATG 08.10:2015[E] Transport of Ammunition and IATG 09.10:2015[E] Security Principles and Systems.

7.9 Logistics

7.9.1 Logistic factors

The demilitarization or destruction of ammunition stockpiles is primarily a logistics problem. The technology exists to destroy the vast majority of ammunition types, yet the major phases of the demilitarization/destruction cycle involve logistics. The demilitarization or destruction methodology should be dependent on logistic factors such as: 1) the availability of suitably qualified and trained manpower; 2) location and type of ranges and demolition grounds; 3) distance from storage to demilitarization facilities; 4) the availability of transport; and 5) the availability of water supply, power etc.

7.9.2 Transport of ammunition

Ammunition should be transported in accordance with the requirements of IATG 08.10:2015[E] Transport of Ammunition.

7.10 Transparency and accounting

The transparency of the demilitarization or destruction programme is an important security and confidence building measure. International organisations, national ambassadors, media and non-governmental organisations (NGO) should be invited to witness the destruction process. They may also be given access to the surplus or unserviceable ammunition account in order that they can verify the ammunition demilitarized or destroyed against the declared surplus stockpile levels.

Ammunition should be accounted for in accordance with the requirements of IATG 03.10:2015[E] Inventory Management of Ammunition.
7.11  Staff competencies

Staff planning demilitarization and destruction, or engaged as the OIC Disposals for destruction by open burning or open detonation should be fully compliant with the following competency standards:


8  Priority for demilitarization or destruction

The demilitarization and destruction of surplus ammunition stockpiles in countries that do not currently adopt a ‘whole life management’ approach to stockpile management does not often follow logical destruction priorities. Small arms ammunition often has priority as donors have budgets to support the demilitarization or destruction of these particular natures. Yet the destruction of the large stockpiles of other generic ammunition natures has been identified as a humanitarian and security priority. The hazards that certain ammunition natures present to local communities and the associated large costs of destruction mean that States shall determine demilitarization or destruction priorities.

Conventional ammunition should be destroyed in the priority order shown in Table 2:

<table>
<thead>
<tr>
<th>Priority</th>
<th>Ammunition</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Ammunition that poses the greatest risks to the civilian community in terms of explosive safety.</td>
<td>• This will usually be specific types of ammunition stored in a stockpile very close to the civilian community. Not all the ammunition in the Explosive Storage Area will require destruction. • This ammunition can be identified by surveillance (chemical analysis and visual inspection) and proof (performance) as part of ongoing stockpile management processes.</td>
</tr>
<tr>
<td>1</td>
<td>Ammunition that is Attractive to Criminal and Terrorist Organisations (ACTO).</td>
<td>• Detonators, Shoulder Launched Anti-tank Rockets, Man Portable Air Defence Systems (MANPADS), Bulk Explosives etc. • Or enhance security measures at current storage locations to reduce risk of proliferation.</td>
</tr>
<tr>
<td>2</td>
<td>Ammunition that must be destroyed in order to meet treaty obligations.</td>
<td>• Anti-Personnel Mines and Cluster Munitions for those States that have ratified the relevant treaty.</td>
</tr>
<tr>
<td>2</td>
<td>Small arms ammunition.</td>
<td>• &lt;20mm calibre. • Classed as Priority 2 as an Armed Violence Prevention (AVP) matter. The proliferation of this ammunition is particularly undesirable.</td>
</tr>
<tr>
<td>3</td>
<td>Ammunition that needs to be destroyed to release storage space.</td>
<td>• Usually as part of security sector reform and downsizing of armed forces.</td>
</tr>
<tr>
<td>3</td>
<td>Remaining ammunition types.</td>
<td>• May be done in order of ease of destruction.</td>
</tr>
</tbody>
</table>

Table 2: Demilitarization or destruction priorities
In order to determine demilitarization or destruction priorities it may be necessary to conduct an Ammunition Technical Assessment of the complete stockpile in order to determine ‘at risk’ ammunition.\textsuperscript{19}

Donors should ensure that one of their major priorities is capacity building of national institutions to develop and guarantee continuance of a longer-term nationally financed, safe, efficient and effective destruction of ammunition to appropriate technical standards.

9 Demilitarization and destruction technology and techniques

9.1 Open burning (OB) and open detonation (OD) (LEVEL 1)

Open burning (OB) and open detonation (OD) are usually regarded as the easiest way of stockpile destruction and are often the only cost effective option for States that have small quantities of ammunition for destruction (<1,000 tonnes), or do not have access to, or the resources to develop, more sophisticated ammunition demilitarization technology. There is obvious potential for environmental pollution and States should complete a formal environmental impact assessment before they select this option.\textsuperscript{20}

Open burning (OB) is usually used for the destruction of propellants and pyrotechnic compositions and has potential for significant environmental impact. Unconfined high explosives may also be destroyed by burning but only in small quantities to reduce the risk of burning to detonation. OB is generally done on concrete pads or metal pans to reduce ground contamination and to improve operational efficiency.

Open detonation (OD) uses serviceable explosive as donor charges to destroy surplus or unserviceable ammunition by sympathetic detonation.\textsuperscript{21} It allows for the destruction of ammunition without the need for special equipment, but it does have disadvantages:

a) large ‘danger areas’ are required to ensure safety from blast and fragmentation;

b) production is weather and time dependent, (normally restricted to daylight hours);

c) it is labour intensive;

d) possibility of ammunition not being destroyed, hence requiring further Explosive Ordnance Disposal (EOD) clearance;

e) environmental impact - noise, air and ground pollution, geology (water table and ground-shock); and

f) requires trained personnel to carry out the task, (the level of training they require should not be under-estimated).

OBOD operations should be planned and conducted in accordance with Annex D.\textsuperscript{22}

For larger stockpiles the sheer amount of ammunition available for destruction, with the resultant logistic challenges on a demolition area, will mean that industrial demilitarization is a more efficient and cost effective approach.

\textsuperscript{19} Examples available from UNDP for Croatia and Montenegro.

\textsuperscript{20} SALW ammunition destruction – environmental releases from open burning (OB) and open detonation (OD) events. SEESAC, 30 May 2004, provides useful data on the emissions to air to be expected from OBOD processes.

\textsuperscript{21} The process of sympathetic detonation is the ‘induced detonation of an explosive or ammunition item containing high explosive by exploding another high explosive charge adjacent to it’.

\textsuperscript{22} Developed from IMAS 11.20 Principles and procedures for open burning and open detonation operations.
9.2 Industrial demilitarization (LEVELS 2 and 3)

9.2.1. General

Industrial demilitarization of ammunition combines the skills of mechanical, production, chemical and explosives engineering and is a highly specialist operation to plan. Appropriate technical advice should be taken before planning and developing such an activity.

9.2.2. Advantages and disadvantages of industrial demilitarization

Industrial scale demilitarization has significant advantages:

a) mechanical disassembly using machines, thereby increasing operational efficiency and also reducing risk to personnel;

b) destruction (usually incineration) in environmentally controlled systems; and

c) the ability to operate 24 hours a day, up to 365 days a year.

Major disadvantages of industrial demilitarization are the high costs of design, project management, construction and commissioning, although their operating costs are generally lower than OBOD (when amortisation of the development capital is discounted).23

In many cases the development of such purpose-built demilitarization facilities to enable States to destroy their ammunition stockpiles will be well beyond available resources and therefore may not be a practical option. Factors such as low ammunition stockpile levels, cost, location and safety may mean that OBOD is the only pragmatic and feasible option.

9.2.3. Pre-processing

In many cases it may be necessary to disassemble or breakdown ammunition prior to the destruction process. Consequently ammunition will be destroyed at the component level rather than the complete round. This could be necessary because of limitations on the amount of contained explosive that can be incinerated, the ammunition design or the requirement for different components to have separate destruction methods. This could require the movement of exposed bare explosive to the final destruction facility.

Table 4 summarises the technology options, which may be used singly or in combination:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual disassembly (LEVEL 2)</td>
<td>▪ Uses human resources, usually on a process line, to physically remove components and breakdown ammunition using simple hand tools.</td>
</tr>
<tr>
<td></td>
<td>▪ Labour intensive and there is an obvious degree of risk.</td>
</tr>
<tr>
<td>Mechanical breakdown (LEVEL 2)</td>
<td>▪ Technology includes: 1) band saw; 2) guillotine; 3) cracker mill; 4) rock crusher; 5) punch; 6) hydraulic press; and 7) lathe.</td>
</tr>
<tr>
<td>Mechanical disassembly (LEVEL 2)</td>
<td>▪ Technology includes: 1) pull apart; 2) de-fuzing; and 3) de-priming.</td>
</tr>
<tr>
<td>Mechanical removal (LEVEL 3)</td>
<td>▪ Uses hydraulic press, water-cooled mechanical cutting or similar technique to remove cast explosive such as RDX, HMX.</td>
</tr>
<tr>
<td></td>
<td>▪ Only suitable for ‘straight walled’ ammunition.</td>
</tr>
<tr>
<td></td>
<td>▪ Requires removal of ogive and base/boat-tail by cutting</td>
</tr>
<tr>
<td>Robotic disassembly (LEVEL 3)</td>
<td>▪ Expensive technology that requires very large quantities and economies of scale to be cost effective. Usually used for the conversion of small arms ammunition from military to civilian use. Also often used for guided missiles containing cluster munitions.</td>
</tr>
</tbody>
</table>

23 Labour costs account for a large percentage of the OBOD costs but these are much lower in lesser-developed countries. OBOD can be a cheaper option dependent on the economy of scale.
Technology | Remarks
--- | ---
Cryo-fracture (LEVEL 3) | ▪ Developed originally for the demilitarization of chemical munitions.
▪ This involves freezing the ammunition body in liquid nitrogen to make it more brittle and hence easier to crack open by mechanical breakdown.

Hydro-abrasive cutting (LEVEL 3) | ▪ The use of abrasive entrained in, or directly injected into, high pressure water jets to cut open ammunition. Only suitable for large economies of scale.

Table 4: Demilitarization pre-processing technology

9.2.4. Explosive removal

Technology is often required to remove the explosive filling from the metal body of the ammunition after initial pre-processing. (Although explosive removal can be considered as a pre-processing operation it is also a major industrial process in terms of improving the recycling and re-use of military explosives for commercial use, hence a separate clause in this IATG).

Table 5 summarises the technology options.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| Hot steam/water melt out[^24] (LEVEL 2) | ▪ Hot water or steam is used to melt out TNT and TNT derivative (TNT/RDX) fillings, which melt at approximately 80°C[^25].
▪ Conversely RDX melts at 206°C and therefore RDX filled munitions are not suitable for this technique.
▪ The waste explosive is then often reprocessed and used in commercial blasting explosives.
▪ Can also be used for white phosphorus ammunition if the process is all done under water.
▪ The ammunition body will require further processing as a thin residue of explosive will remain. (See car bottom furnace below). |

| Water jet washout (LEVEL 3) | ▪ High pressure water is focused on the explosive, which is then washed out of the ammunition body using a rotating nozzle.
▪ Suitable for RDX and PBX[^26] ammunition.
▪ Requires a waste water treatment facility to prevent ground water pollution. |

| Solvent washout (LEVEL 3) | ▪ Uses a solvent that will easily dissolve the explosive, which is then extracted and reprocessed. (Methyl alcohol, methylene chloride, acetone or toluene are options).
▪ Large quantities of solvent are required and it is not a cheap process.
▪ It is best considered when high value explosive such as HMX needs recovering for re-use. |

Table 5: Demilitarization explosive removal technology

9.2.5. Physical destruction during demilitarization

The smaller ammunition calibres (<20mm) may be destroyed by incineration with no pre-processing necessary in a demilitarization programme. Large calibre ammunition should require pre-processing unless it is to be destroyed in a contained detonation chamber.

Table 6 summarises the technology options[^27]

[^24]: Microwave melt out is a new technology under development that has future potential to replace this system.
[^25]: WARNING. Do NOT attempt to steam out explosive compositions of TNT and Aluminium or Aluminium Powder as they will detonate.
[^26]: Plastic or Polymer Bonded explosives.
<table>
<thead>
<tr>
<th>Technology</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary kiln incineration&lt;sup&gt;27&lt;/sup&gt;</td>
<td>▪ This is the controlled thermal destruction of ammunition within a high temperature (&gt;500°C) oven that rotates.</td>
</tr>
<tr>
<td>(LEVEL 3)</td>
<td>▪ It is proven technology from the 1950s and is still among the most efficient destruction systems available today.</td>
</tr>
<tr>
<td></td>
<td>▪ It must be operated in parallel with a pollution control system to treat the exhaust gases.</td>
</tr>
<tr>
<td></td>
<td>▪ Dependent on design it can destroy ammunition of &lt;20m calibre or an explosive filling of less than 1kg with no pre-processing required.</td>
</tr>
<tr>
<td></td>
<td>▪ Transportable versions are approximately 33% of the cost of static systems yet have up to 70% of the capability albeit with lower</td>
</tr>
<tr>
<td></td>
<td>explosive limits which restricts them to small arms ammunition, detonators, primers, fuzes, propellant and pyrotechnics.</td>
</tr>
<tr>
<td>Fluidised bed incineration (LEVEL 3)</td>
<td>▪ Only suitable for the incineration of explosive waste and not complete munitions.</td>
</tr>
<tr>
<td></td>
<td>▪ The waste is pumped as a slurry onto hot silicon oxide (sand) particles, which act as a liquid because of the high temperature.</td>
</tr>
<tr>
<td></td>
<td>▪ It is a specialised system that is only really suitable for those States with excessively large stockpiles. (&gt;100,000 tonnes).</td>
</tr>
<tr>
<td></td>
<td>▪ Can cause problems if trying to dispose of pyrotechnics. This method is NOT suitable for the disposal of pyrotechnics as the</td>
</tr>
<tr>
<td></td>
<td>metal contents will form eutectic salts and these will reduce &quot;fluidity&quot;.</td>
</tr>
<tr>
<td>Car bottom furnace (LEVEL 3)</td>
<td>▪ Usually used in combination with a rotary kiln furnace and heated through a heat exchanger.</td>
</tr>
<tr>
<td></td>
<td>▪ Used to remove trace explosive contamination from munitions parts after explosive removal, although it can deal with small</td>
</tr>
<tr>
<td></td>
<td>calibres in limited quantities.</td>
</tr>
<tr>
<td></td>
<td>▪ A larger version is sometimes referred to as a Hot Gas Decontamination Facility.</td>
</tr>
<tr>
<td></td>
<td>▪ Supports demilitarization rather than being a system in its own right.</td>
</tr>
<tr>
<td>Contained detonation chamber (CDC)</td>
<td>▪ Effectively uses open detonation techniques within a protected structure, which has an integral pollution control system.</td>
</tr>
<tr>
<td>(LEVEL 3)</td>
<td>▪ Production rates are limited but is a useful system for States with smaller stockpiles of ammunition that do not justify capital</td>
</tr>
<tr>
<td></td>
<td>investment in explosive removal technology.</td>
</tr>
<tr>
<td></td>
<td>▪ Ammunition of up to, and including 155mm calibre, can be destroyed in the appropriate chamber.</td>
</tr>
<tr>
<td>Hot detonation chamber (HDC) (LEVEL 3)</td>
<td>▪ Destruction of explosives, propellants and munitions by &quot;cook-off&quot; in a heated detonation chamber. The explosive material is</td>
</tr>
<tr>
<td></td>
<td>destroyed through either burning, deflagration or detonation, (dependent on the type of ammunition).</td>
</tr>
<tr>
<td></td>
<td>▪ Operation temperature is around 500°C.</td>
</tr>
<tr>
<td></td>
<td>▪ No additional donor charges are necessary.</td>
</tr>
<tr>
<td></td>
<td>▪ High capacity, automatic process from loading to emptying with low energy consumption.</td>
</tr>
</tbody>
</table>

<sup>27</sup> There are also experimental techniques including: 1) super critical water oxidation; 2) plasma arc pyrolysis; 3) electrochemical oxidation; and 4) biodegradation. All these techniques are designed for the conversion of specific types of explosive waste. Their limitations and lack of general production experience means that they are unlikely to be suitable for the majority of States and are therefore not yet considered further in this IATG. As the technology develops they should be included in future editions of this IATG.

<sup>28</sup> Also often generically referred to as Explosive Waste Incinerators (EWI).
Moving bed reactor (MBR) (LEVEL 3)

- Developed for smaller calibre ammunition (105mm) (2002). Technology concept proven.
- New technology for large calibre ammunition (155mm) (2010).
- HE munitions are heated in a vertical chamber containing over 50 tonnes of constantly moving and re-circulating 25cm diameter steel balls.
- The steel balls present a mass to the blast wave, the kinetic energy of which is then absorbed because of the mass and dissipated because of all the interstitial boundaries.
- The steel balls also trap the fragmentation.

Table 6: Demilitarization destruction technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving bed reactor (MBR)</td>
<td>- Developed for smaller calibre ammunition (105mm) (2002). Technology concept proven.</td>
</tr>
<tr>
<td>(LEVEL 3)</td>
<td>- New technology for large calibre ammunition (155mm) (2010).</td>
</tr>
<tr>
<td></td>
<td>- HE munitions are heated in a vertical chamber containing over 50 tonnes of constantly moving and re-circulating 25cm diameter steel balls.</td>
</tr>
<tr>
<td></td>
<td>- The steel balls present a mass to the blast wave, the kinetic energy of which is then absorbed because of the mass and dissipated because of all the interstitial boundaries.</td>
</tr>
<tr>
<td></td>
<td>- The steel balls also trap the fragmentation.</td>
</tr>
</tbody>
</table>

9.2.6. Pollution control systems (LEVEL 3)

Pollution control systems (PCS) for ammunition demilitarization destruction technology shall:

a) destroy volatile organic compounds (VOC);

b) neutralise acid gases; and

c) filter out particulate and solid matter.

The final emissions to air, solid waste and liquid waste shall fall within the emission and waste toxicity levels contained within the appropriate national environmental legislation.

Table 7 summarises the technology options.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afterburner</td>
<td>- Required in all PCS to destroy the VOC.</td>
</tr>
<tr>
<td></td>
<td>- Minimum requirements are 850ºC for &gt;2sec.</td>
</tr>
<tr>
<td></td>
<td>- The VOCs then burn to carbon dioxide, water and acid gases, which are treated further downstream in the PCS.</td>
</tr>
<tr>
<td></td>
<td>- Can be ammonia injected to reduce nitrogen oxides.</td>
</tr>
<tr>
<td>Acid gas neutralisation</td>
<td>- Sorbents, usually sodium bicarbonate and charcoal, are added to neutralise acidic gases and reduce dioxin formation.</td>
</tr>
<tr>
<td></td>
<td>- Safe and inert solid waste, (sodium chlorides, sulphates and nitrates), is produced that can be safely sent to landfill.</td>
</tr>
<tr>
<td>Wet scrubbing</td>
<td>- Neutralises acid gas by the addition of compounds in a fine spray.</td>
</tr>
<tr>
<td></td>
<td>- Its efficiency is reduced because of the high exhaust gas temperature on entry to the ‘wet scrubber’ system.</td>
</tr>
<tr>
<td></td>
<td>- Can require an expensive waste water filtration and treatment system.</td>
</tr>
<tr>
<td>Activated carbon adsorption</td>
<td>- Required to remove high mercury (Hg) levels.</td>
</tr>
<tr>
<td></td>
<td>- Process gas is drawn through a bed of activated carbon granules for a gas residence time of just less than 3 seconds.</td>
</tr>
<tr>
<td></td>
<td>- The fixed bed requires renewal on a bi-annual basis.</td>
</tr>
<tr>
<td>Baghouse fabric filtration</td>
<td>- Uses fabric filter bags to remove particulate waste. A typical baghouse comprises an array of long, narrow bags, each about 25 cm in diameter, that are suspended upside down in a large enclosure.</td>
</tr>
<tr>
<td></td>
<td>- Prone to bag-house fires though, which can require replacement of the entire bag-house if not caught quickly enough.</td>
</tr>
<tr>
<td>Ceramic filtration</td>
<td>- Use hollow ceramic filters to remove particulate and solid waste.</td>
</tr>
<tr>
<td></td>
<td>- Individual filters are generally 1.0m x 0.06m and there are typically 256 filter elements in a system, giving a filtration area of 48m².</td>
</tr>
<tr>
<td></td>
<td>- Filters down to 1 micron and is fire resistant.</td>
</tr>
<tr>
<td></td>
<td>- Also supports bed of sorbent, thereby improving overall acid gas neutralisation efficiency.</td>
</tr>
<tr>
<td></td>
<td>- Regarded as one of the most effective filtration systems.</td>
</tr>
</tbody>
</table>
Technology | Remarks
--- | ---
On line monitoring | ‧ Required to monitor emission to air levels. Systems will require:
  ‧ Tribo-electric (Particulate)
  ‧ Flame ionisation (VOC)
  ‧ pH of solution (HCl, HF)
  ‧ Velocity (Flow Rate)
  ‧ Zirconia Electrode (O\(_2\))
  ‧ Thermocouple (Temperature)
  ‧ Pressure (Diaphragm Strain)
  ‧ It also requires a data processing system to calculate and display emission rates, concentration and history.

<table>
<thead>
<tr>
<th>Serial</th>
<th>Polluting substance</th>
<th>Limit value (mg/m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily average values</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Total Dust</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Gaseous and vaporous organic substances, expressed as total organic carbon</td>
<td>HCl, 10; HF, 1</td>
</tr>
<tr>
<td>3</td>
<td>Hydrogen Chloride</td>
<td>HCl, 10</td>
</tr>
<tr>
<td>4</td>
<td>Hydrogen Fluoride</td>
<td>HF, 1</td>
</tr>
<tr>
<td>5</td>
<td>Sulphur Dioxide</td>
<td>SO(_2), 50</td>
</tr>
<tr>
<td>6</td>
<td>Nitrogen Monoxide and Nitrogen Dioxide(^{31})</td>
<td>NO, 400; NO(_2), 0.0000001(^{32})</td>
</tr>
<tr>
<td>7</td>
<td>Dioxins and Furans</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Carbon Monoxide(^{33})</td>
<td>CO, 50</td>
</tr>
</tbody>
</table>

Table 7: Pollution control system (PCS) technology

The emission levels to air and water from pollution control systems during ammunition demilitarization operations may comply with those in Tables 8 and 9, which are generally regarded as international best practice.\(^{29,30}\)

<table>
<thead>
<tr>
<th>Serial</th>
<th>Polluting substance</th>
<th>Limit values(^{34})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Totally suspended solids as defined by Directive 91/271/EC</td>
<td>95% / 30mg/l; 100% / 45mg/l</td>
</tr>
<tr>
<td>2</td>
<td>Mercury and its compounds, expressed as mercury (Hg)</td>
<td>0.03 mg/l</td>
</tr>
<tr>
<td>3</td>
<td>Cadmium and its compounds, expressed as cadmium (Cd)</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>4</td>
<td>Thallium and its compounds, expressed as thallium (Tl)</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>5</td>
<td>Arsenic and its compounds, expressed as arsenic (As)</td>
<td>0.15 mg/l</td>
</tr>
<tr>
<td>6</td>
<td>Lead and its compounds, expressed as lead (Pb)</td>
<td>0.2 mg/l</td>
</tr>
<tr>
<td>7</td>
<td>Chromium and its compounds, expressed as chromium (Cr)</td>
<td>0.5 mg/l</td>
</tr>
</tbody>
</table>

Table 8: Emission to air daily average limit values

---

31 Expressed as Nitrogen Dioxide for existing incineration plants with a nominal capacity of 6 tonnes per hour or less.
32 0.1 ng/m\(^3\).
34 Expressed in mass concentrations for unfiltered samples at discharge point.
### Table 9: Waste water discharge daily average limit values

<table>
<thead>
<tr>
<th>Serial</th>
<th>Polluting substance</th>
<th>Limit values(^{34})</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Copper and its compounds, expressed as copper (Cu)</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>9</td>
<td>Nickel and its compounds, expressed as nickel (Ni)</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>10</td>
<td>Zinc and its compounds, expressed as zinc (Zn)</td>
<td>1.5 mg/l</td>
</tr>
<tr>
<td>11</td>
<td>Dioxins and furans, defined as the sum of the individual dioxins and furans in accordance with Annex 1 to the Directive.</td>
<td>0.3 mg/l</td>
</tr>
</tbody>
</table>

9.2.7. **Recovery, recycling and reuse (R3) (LEVEL 3)**

Certain demilitarization techniques result in the production of ‘special’ or ‘hazardous’ waste which itself requires destruction or disposal in an environmentally benign manner. This should be done by a specialist environmental disposal company.

The salvage of metallic scrap, or explosive waste, can result in an income stream. Some explosive fillings of ammunition may be useful to the commercial explosive industry whilst scrap steel is always in demand. Ammunition demilitarization programmes should aim to recover, recycle and reuse (R3) the maximum amount of waste possible.

9.2.8. **Future techniques**

States and commercial companies should aim to develop more environmentally benign techniques for the demilitarization of ammunition and explosives.\(^{35}\)

### 10 Management of stockpile demilitarization or destruction

The demilitarization or destruction management process that should be followed is shown in outline in Annex E. In practice, the process may not be linear and the activities may not always be consecutive. Nevertheless the process indicates the general sequence and logical progression from defining the problem to the final demilitarization or destruction of the stockpiled ammunition. The four stages of the management process (planning, preparation, destruction and verification activities) are addressed below.

10.1 **Planning**

Planning is the collection, assessment and processing of information, selection of an appropriate way to proceed, and subsequent formulation of the detailed method by which a task is to be carried out.

Planning for stockpile demilitarization or destruction requires accurate and timely information on the quantity, storage location, type and technical design of the ammunition, together with a knowledge of the available demilitarization or destruction technology. Finance will obviously have an influence, but until the destruction of the stockpile has been planned it is difficult to calculate the real costs. Indeed, once the real costs have been identified, it may be necessary to re-plan the destruction operation in an attempt to find a more cost-effective route.

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\(^{35}\) See Footnote 27 for some examples of ongoing work.
For new stockpile demilitarization or destruction programmes, the planning process should ideally start with a formal assessment of the country situation. This assessment, which may take the form of an Ammunition Technical Assessment, will draw heavily on existing information provided by the military, research agencies and, if applicable, commercial companies. Technical expertise is essential during the planning process and countries can request the support of the UN,\textsuperscript{36} or regional organisations,\textsuperscript{37} to assist in the planning process.

\textbf{10.2 Preparation}

Preparation should include all enabling activities that help clarify the demilitarization or destruction requirement and develop the capacity of a national authority and demilitarization/destruction organisation to carry out a demilitarization or destruction task. All aspects of the demilitarization and destruction cycle at Clause 7 should be considered.

\textbf{10.2.1. Ammunition account}

The accuracy of the national ammunition account is very important to ensure that future monitoring and verification activities do not identify accounting errors once the stockpile demilitarization or destruction process has started. A 100\% stock check of the ammunition stockpile should take place prior to the commencement of the demilitarization or destruction process. Any accounting errors should then be rectified at this point which also contributes to security and confidence building measures.

Ammunition should be accounted for in accordance with the requirements of IATG 03.10:2015[E] Inventory Management of Ammunition. The accounting system must also account for all sub-components.

\textbf{10.2.2. Storage at demilitarization or destruction facility}

Sufficient stocks of ammunition should be stored at the demilitarization or destruction facility to ensure that destruction is a continuous process. This ammunition should usually be stored in accordance with the safety requirements of IATG Series 02 Risk management and IATG Series 06 Explosive facilities (storage) (operations) although field or temporary storage in accordance with IATG 04.10:2015[E] Field storage and IATG 04.10:2015[E] Temporary storage may be permitted.

\textbf{10.2.3. Selection of demilitarization or destruction technology}

See Clauses 8 and 9 for factors and technologies that will influence the final selection.

\textbf{10.2.4. Development of demilitarization or destruction facility}

National authorities should be aware that the development of even relatively simple demilitarization or destruction systems can be a time consuming process. Safety shall be paramount, therefore there is little opportunity to ‘fast track’ many of the necessary processes.

The development of OBOD processes will take weeks to months, whilst the development of industrial demilitarization processes can take months to years. This time requirement should be incorporated into the planning and preparation processes.

\textsuperscript{36} UNDP BCPR and UNMAS have previous experience of either ammunition demilitarization or destruction projects.

\textsuperscript{37} NATO and OSCE also currently provide this capability. Other regional organisations should be encouraged to develop a similar capability.
10.2.5. Funding (resource mobilization)

The funding of ammunition demilitarization or destruction programmes comes from many sources. Funding may be provided by the host government, from donor governments, the United Nations or other international organisations. Funds may be held in trust funds or some other form of controlled accounts. Regardless of the source of funding it is important that the funds match the true cost of demilitarization or destruction and that a long term commitment is provided by the donor. This is particularly important for major projects that require the demilitarization/destruction organisation to make major investments in staff, infrastructure and expensive new equipment such as furnaces and pollution control systems.

The cost of ammunition destruction is probably the most important factor as the destruction of large quantities of conventional ammunition is expensive. Little data is publicly available on the costs of ammunition demilitarization. An example of indicative costs that are available for Western Europe is shown at Table 10 below; costs for lesser developed countries will be significantly less due to lower labour charges:

<table>
<thead>
<tr>
<th>Ammunition Nature</th>
<th>Indicative Costs (Euro/Tonne)</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| Small arms ammunition | 101 – 529 | • Dependent on technique and economy of scale.  
• Less than 20mm Calibre. |
| Fuzes | 237 – 1039 | |
| Propellant | 856 | • Although conversion to commercial explosives may lead to cost recovery. |
| Warheads (High Explosive) | 564 – 610 | • Costs AFTER removal and destruction of cartridge cases. |
| Cannon and Medium Calibre | 419 - 757 | • 20mm – 105mm. |
| Pyrotechnics | 1654 | |

Table 10: Indicative demilitarization costs

Donors should recognize that the costs associated with the structural development, technical training, and equipment procurement of demilitarization facilities means that the initial costs per tonne will be high in the first year but subsequent demilitarization is a lot cheaper as economies of scale take effect and national capacity has been built. This is sometimes a problem when the donor single-year funding cycle is applied as the decreasing cost of demilitarization in subsequent years is often difficult to specify.

10.2.6. Training

Demilitarization programmes require well-qualified managers and well-trained workers. The majority of training should be conducted at the demilitarization facility, not only for cultural and linguistic reasons, but also for access to details of the ammunition stockpile and destruction technology. Training programmes should be included in all contracts for the procurement of equipment.

10.3 Physical demilitarization or destruction

Throughout the demilitarization or destruction process occupational health and safety shall be a priority. Similarly an effective quality management system should also be implemented.

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38 Source: Presentation by Dr F Peugeot, NAMSA to RASR Workshop, Zagreb, 05 – 07 May 2009. (Derived from US JOCG Munitions Demilitarization Study 1996 (MIDAS Family) and adjusted for inflation and currency exchange). (http://www.rasrinitiative.org/overview.html).
10.3.1. Safety and occupational health

Managers of ammunition demilitarization or destruction programmes shall achieve a safe working environment by providing effective management and supervision, by developing work practices that contribute to risk reduction, by selecting equipment with inherently safe design, by providing appropriate training, and by making available effective personal protective equipment (PPE). Given the wide range of possible technical solutions, it is not possible to provide a precise and complete set of specifications that apply to all situations. Thus ammunition demilitarization/destruction organisations should develop and maintain management procedures and processes that will enable safety and occupational health (S&OH) risks to be identified, evaluated and reduced in a systematic and timely manner for each demilitarization or destruction task and for each demilitarization or destruction worksite.

10.3.2. Explosive safety procedures

The need for effective and safe operational procedures is essential. Standing operating procedures (SOPs) should be prepared for all operational procedures, practices and drills. SOPs are instructions that define the preferred method of conducting an operational task or activity. Their purpose is to establish recognisable and measurable degrees of uniformity, consistency and commonality within an organisation with the aim of improving operational effectiveness and safety. SOPs should reflect local requirements and circumstances but shall remain flexible and responsive to new concepts and technologies.

10.3.3. Quality assurance

Demilitarization or destruction involves the establishment and monitoring of management processes and operational procedures before and during the ammunition demilitarization or destruction process. Internal quality assurance will be conducted by demilitarization/destruction organisations themselves, but external inspections by an external monitoring body should also be conducted.

The purpose of quality assurance is to confirm that management practices and operational procedures for destruction are appropriate, and will achieve the stated requirement in a safe, effective and efficient manner. Monitoring should involve structured discussions with management and employees and formal inspections of SOPs, reports and records.

The national authority may appoint an agent to carry out the monitoring and inspections of the demilitarization/destruction organisation and its sub-units under its authority and responsibility, exercised under conditions agreed in the contract or formal agreement. Any agent so appointed by the national authority shall be required to have all the facilities, qualified staff, management systems and SOPs necessary for adequate monitoring.

More detailed guidance on quality management is included in Clause 11 of this IATG.

10.4 Verification and accounting

10.4.1. General

Records should be kept in accordance with IATG 03.10:2015[E] Inventory Management of Ammunition.
10.4.2. Media operations

Transparency of the demilitarization or destruction process is an important pre-requisite as a security and confidence building measure. The role of the media in obtaining national and international visibility of the demilitarization or destruction of an ammunition stockpile should not be underestimated. The national authority, in conjunction with the demilitarization/destruction organisation, should develop a media plan during the planning phase of the operation. This plan should include:

a) press releases;

b) access to the demilitarization or destruction site by journalists and film crews at short notice; and

c) video and photographic record of destruction.

10.4.3. Post project review

Wherever possible, demilitarization/destruction organisations should conduct a formal post project review (PPR). This will identify lessons-learned during the planning, preparation and demilitarization or destruction phases of the operation. The PPR should include a report on the suitability of the equipment, procedures, training and support. Issues of concern should be identified and prioritised, and solutions proposed. The requirement for PPRs should be included in demilitarization or destruction contracts by donors and national authorities. PPRs should be distributed to the appropriate international organisations, regional organisations, donors and sponsors. Where PPRs highlight shortcomings in established equipment or procedures, particularly issues involving safety, they should be more widely distributed.

11 Quality management (LEVEL 3)

The effective management of demilitarization or destruction operations shall aim to destroy ammunition stockpiles in a safe and efficient manner. This is achieved by developing and applying appropriate management processes, by establishing and continuously improving the skills of managers and workers, by obtaining accurate and timely information on the stockpile, by applying safe and effective operational procedures, and by using appropriate and efficient equipment. But management is not just about planning and supervising current tasks, it is also about reviewing current practices and procedures to improve safety, effectiveness and efficiency. In the case of the disposal of ammunition by industrial demilitarization a quality management process should be developed and applied.

The process and procedures that aim to achieve this continuous improvement to an organisation's management system and operational practices is commonly referred to as quality management. One method of demonstrating quality management for an organisation is to become ISO 9001:2008 compliant. There is much general information and training materials available for ammunition demilitarization organisations that choose to adopt the ISO 9001:2008 approach.

A summary of how the ISO 9001:2008 approach can relate to the demilitarization of ammunition stockpiles is given in Annex F. In essence, ISO 9001:2008 is a series of international standards for quality systems. They specify requirements and recommendations for the development of a management system, the purpose of which is to ensure that the ‘products’ or ‘services’ delivered meet the agreed needs. In this case, the product is the safe and efficient demilitarization of the ammunition stockpile.
Managers of ammunition demilitarization organisations should be encouraged to examine how to apply the principles of quality management to ammunition stockpile demilitarization. In doing so they should take particular note of two issues. Firstly, they should note how special processes should be planned, implemented, monitored and reviewed. Secondly, they should note the responsibilities of all managers and workers to identify and take advantage of opportunities for improvement to the process.

12 Environmental management

Clauses 5.4, 5.5 and 5.6 cover international standards and instruments that relate to specific aspects of ammunition stockpile destruction. Destruction and demilitarization organisations may both therefore address the issue of environmental management through compliance with the ISO 14001:2004(E) Environmental management systems standard.

An environmental management system that is ISO 14001:2004 compliant provides a management tool enabling an organisation of any size or type to:

a) identify and control the environmental impact of its activities, products or services;

b) improve its environmental performance continually; and

c) implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.

ISO 14001:2004 does not specify levels of environmental performance. If it did the levels of environmental performance would have to be specific to each business activity, and this would require a specific Environmental Management Standard (EMS) for each business. That is not the intention as environmental performance levels, such as emission to air limit values, are the responsibility of the State.

The intention of ISO 14001:2004 is to provide a framework for a holistic, strategic approach to the organisation's environmental policy, plans and actions. The standard provides the generic requirements for an environmental management system. The underlying philosophy is that whatever the organisation’s activity, the requirements of an effective EMS are the same.

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39 ISO 14004:2004 Environmental management systems - General guidelines on principles, systems and support techniques. This provides general guidelines on environmental management systems.
Annex A
(normative)

References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of the guide. 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 guide 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:

f) Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction. Ottawa. 18 September 1997;
g) Convention on Cluster Munitions. Dublin. 30 May 2008;
h) Convention for the Protection of the Marine Environment of the North-East Atlantic. (Entered into Force 25 March 1998);
k) IATG 01.40:2015[E] Terms, glossary and definitions. UN ODA. 2015;
m) IATG 03.10:2015[E] Inventory management of ammunition. UN ODA. 2015;
n) IATG 04.10:2015[E] Field storage. UN ODA. 2015;
o) IATG 04.20:2015[E] Temporary storage. UN ODA. 2015;
p) IATG 08.10:2015[E] Transport of ammunition. UN ODA. 2015;
q) IATG 09.10:2015[E] Security principles and systems. UN ODA. 2015;

40 Also known as the OSPAR Convention.
s) ISO 4220:1993(E) Determination and measurement of air pollution from industrial processes. ISO. 1993;

t) ISO 9001:2008(E) Quality management systems – requirements. ISO. 2008; \(^{41}\)

u) ISO 9612:1997(E) Guidelines for the measurement and assessment of exposure to noise in a working environment. ISO. 1997;

v) ISO 14001:2004(E) Environmental management systems – Guidelines. ISO. 2004; \(^{42}\)


y) SALW ammunition destruction – environmental releases from open burning (OB) and open detonation (OD) events. SEESAC. 30 May 2004; and


The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UN ODA) holds copies of all references \(^{43}\) used in this guide. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UN ODA, and can be read on the IATG website: www.un.org/disarmament/un-saferguard/. National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition stockpile management programmes.

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\(^{41}\) To shortly be replaced by ISO 9001:2015.

\(^{42}\) To shortly be replaced by ISO 14001:2015.

\(^{43}\) 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 guide:

a) *A Destruction Handbook – small arms, light weapons, ammunition and explosives.* UN Department for Disarmament Affairs (UNDDA). 2001;


d) *ISACS 05.51:2015(E) Destruction: Ammunition*; and

e) UNGA A/63/182, *Report of the Group of Government Experts established pursuant to General Assembly resolution 61/72 to consider further steps to enhance cooperation with regard to the issue of conventional ammunition stockpiles in surplus.* UN. 28 July 2008.

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

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44 Where copyright permits.
Annex C  
(informative)  
The demilitarization or destruction cycle
Annex D
(normative)
Procedures and principles for OBOD operations

D.1 Scope

The purpose of this Annex to the IATG is to explain the principles and procedures for the conduct of large-scale Open Burning and Open Detonation (OBOD) operations. It includes recommendations as to the layout of demolition grounds and the contents of Standing Operating Procedures (SOPs) in order to ensure a safe system of work.

D.2 Priorities and principles

The destruction of ammunition and explosives is a potentially hazardous task. The risks are minimised if the correct procedures are followed. If they are not, the possibility of serious accident becomes very high.

The following priorities, that shall always be observed, are:

D.2.1 Safety

The safety of both personnel and property is paramount. If a method is not safe it shall not be used.

D.2.2 Security

Both the items destroyed and the explosives used to destroy them are attractive to terrorists and criminals. The security of target and donor explosives shall be ensured at all times.

D.2.3 Accounting

This links with security. Any loss shall be promptly identified, investigated and reported.

D.2.4 Speed of Work

This shall never be achieved at the expense of the first three priorities.

There are many different detailed disposal procedures but certain principles apply to all disposal tasks.

D.2.5 Know the ammunition

Know in detail both the item being destroyed and the explosives used to destroy it. Unless the design characteristics of both are known, it will not be possible to determine a safe and effective means of disposal.

D.2.6 Plan the task carefully

Do not leave the planning until arrival at the disposal site. Work out the programme and procedures in detail well in advance.

D.2.7 Create a safe working environment

Create and maintain a safe working environment so that it is safe for the Demolition Party, other personnel, property, livestock, vehicles and equipment.
D.2.8 Give and obey directions precisely

The disposal site is no place for ambiguity or misunderstanding. Directives must be clearly understood by all personnel.

D.2.9 Observe all the safety precautions and use only the approved methods.

Do not take short cuts, they kill.

D.2.10 Clear the disposal area prior to departure

No disposal task is complete until the demolition area has been cleared of all hazards and contamination. Implicit in this is also the clearance of all rubbish and litter.

D.2.11 Summary

Almost all known accidents that have occurred would not have happened had the priorities and rules given above been obeyed. After every accident the Officer in Charge (OIC) of Disposals concerned shall be called upon to explain why it was not prevented.

D.3 Authority for disposal

The responsibility for authorising ammunition disposals is vested in the national authority.

No ammunition disposal should take place without the prior approval of the national authority. The exceptions to this rule are:

a) Ammunition identified during surveillance or repair tasks which the local Ammunition Officer considers to be dangerous; and

b) Blinds and stray ammunition - which by definition are potentially dangerous. (See IMAS 09.30 EOD for further details).

Foreign ammunition should be destroyed using the appropriate procedure based on sound first principles. Should no procedure exist, then instructions for its disposal must be requested from the national authority. Foreign ammunition is not to be broken down without the specific authority and instructions from the national authority.

D.5 Methods of local disposal - general

There are three methods of local destruction:

a) open detonation;

b) open burning; or

c) incineration.

The method used with a particular ammunition type will obviously depend upon its type of explosive filling and design.

D.5.1 Detonation

Ammunition can be disposed of by inclusion in mixed stacks during large-scale demolitions. The quantities of such items included in a mixed stack have to be kept down to a small percentage of the overall stack.
D.5.2 Burning

This is generally used with propellant (bagged or loose), smoke, pyrotechnic and lachrymatory stores but is also suitable for certain plastic-bodied APM. It can also be used as an alternative to detonation for certain explosives, ie composition explosive, TNT, nitro-glycerine based explosives and black powder - but detonation is the cleaner method.

D.5.3 Incineration

Is a specialised form of burning authorised for certain small APM with minimal explosive content.

D.6 Siting of disposal sites

D.6.1 Definition

A disposal site is in an area authorised for the destruction of ammunition and explosives by detonation and burning. These in turn are referred to as demolition grounds and burning grounds and may be co-located on a disposal site.

NOTE 1 The national authority shall approve and formally licence disposal sites within ammunition depots only after professional ammunition technical advice.

D.6.2 Hazards of detonation

The hazards created by detonation are:

a) flash and heat;

b) blast and noise;

c) ground shock;

d) fragments; and

e) toxic smoke.

D.6.2.1 Flash and heat

These effects are localised but still significant. Flash could injure the eyes, but the reddish flash produced by most detonations is unlikely to do so. Heat will start fires if combustible materials are present: dry grass, undergrowth, trees or peaty soil.

D.6.2.2 Blast and noise

These have greater range. Blast can cause injury or damage - but persons and equipment would have to stand unprotected and reasonably close to a detonation to be affected by blast. Injury and damage are far more likely to be caused by fragments.

Noise presents a greater problem. At close range it can cause ear damage and at a greater range it will have a nuisance effect that will generate complaints from the general public.

D.6.2.3 Ground shock

The main effect will be on persons and equipment relatively close to the detonation - although rock strata can sometimes transmit the effect for considerable distances. It is another potential source of public nuisance and complaint.
D.6.2.4 Fragmentation

These are the real killers. In practice the size of the “danger area” is determined by the maximum range of fragments. All persons, property and equipment that are within this range and which are not adequately protected are in hazard.

D.6.3 Properties of demolition grounds

To overcome the above hazards, demolition grounds require the following properties:

D.6.3.1 Isolation

This is the most important requirement. They must be as remote as possible from a person and all his/her artefacts.

D.6.3.2 Deep soil

Free of rocks and stones with no peat, (which could burn underground).

D.6.3.3 No secondary fire hazards

Demolition grounds should not be located over pipelines, over power cables or near fuel storage areas.

D.6.3.4 No radio/radar transmitters

Major demolitions are normally initiated using electric cable or radio control (RC) systems and, as such, are vulnerable to external electro-magnetic force (EMF) influence. Consequently, demolition grounds shall not be situated near radar installations, radio transmitters or near high-voltage power lines.

D.6.3.5 High ground

High ground reduces the effects of blast and ground shock and is also relatively well drained. The latter property aids digging. However, high ground also tends to increase fragment range.

D.6.4 Hazards of burning

The hazards created by burning APM are:

a) intense heat;
b) Intense light; and
c) toxic fumes (occasionally).

But there are no blast, ground shock or fragmentation hazards unless the demolition burns to detonation.

D.6.4.1 Properties of burning grounds

To counter these hazards burning grounds require the following properties:

a) no secondary fire hazards;
b) an adequate water supply;
c) sufficient isolation to prevent heat or fume casualties; and
d) sandy soil with no peat.
An isolated, sandy, barren area is the most suitable site. Avoid sites near high cliffs as these encourage rising hot air currents that can carry burning debris considerable distances.

D.9 Approval of disposals sites and SOPs

Formal approval, (commonly referred to as licensing), of the disposal site and its associated SOPs shall be given by the national authority prior to the commencement of disposal activities on a site. Such approval shall be based on consideration of the following factors:

D.9.1 Reference to publications

All SOPs are in effect the local interpretation of regulations issued by a higher authority. The SOPs should open by listing all such regulations (and any related local SOPs).

SOPs should not reproduce large slabs of information contained in other publications. Rather they should concentrate on detailing how these regulations are to be applied under local conditions.

D.9.2 Maps and grid references

Maps shall be sent to the national authority with the draft standing orders. These shall include:

a) a map of the area upon which the grid reference, name and area of the site are marked. This information should be repeated in the body of the SOPs; and

b) a larger scale sketch map of the disposals site showing its layout (a schematic layout is at Appendix 1 to Annex D). This sketch map shall be included as an Annex to the SOPs. The layout of the disposals site is worked out with careful regard to safety and, once approved by the national authority, shall be mandatory. Any required changes shall be re-approved by the national authority.

D.9.3 Locations of sentries and Observation Posts

Sentries have to be so sited that they control all access routes into the disposal site. In ammunition depots sentries will normally be located on the edge of the disposal site in Splinter/Fragment Proof Shelters (SPS). When SPS are not available, e.g on open ranges, the sentries have to be located outside the danger area.

D.9.4 Marking of the site

Disposal sites shall be marked with notice boards sited so that they are visible on all possible approaches. In ammunition depots the disposal site shall also be fenced.

D.9.5 Location of the firing point

This shall be close enough to blows for the OIC Disposals to be able to hear partial explosions. The firing point is normally inside the danger area and within an SPS.

D.9.6 Communications

Good communications are essential to safety and the following telephone links are required:

a) firing point to emergency services. Fire, Medical, Police via the local main (military or civil) exchange;

b) firing point to sentries; and

c) sentries to firing point. There shall also be a back up system e.g radio, whistles.

The SOPs shall list all the emergency telephone numbers and lay down an accident telephone drill.
D.9.7 Explosive limits

These are determined by two main limiting factors:

a) maximum fragmentation range. This determines the danger area and all persons and equipment must be either outside this area or under shelter in SPS. The perimeter of the disposal site shall contain the danger area. The size of the disposals area will therefore limit the permissible size of blows. No blows shall be permitted above the level where fragments may travel further than the perimeter; and

b) ground shock and noise effect. The local “tolerance” level of the public to the effect of shock and noise on themselves and their property has to be determined and may impose lower limits than the fragment range.

A method of determining the explosive limit for a new disposals area is as follows:

a) from Explosive Ordnance Disposal (EOD) or ammunition technical advice;

b) position observers in communication with the firing point at the perimeter and at all sensitive points; and

c) carry out a series of blows, gradually increasing in net explosive content (NEC) until the theoretical limit is reached. Stop before this point if the observers report that the local “tolerance” level has been reached. Check with the observers on this after each blow.

The end result of the trial shall be an explosive limit, which will ensure that:

a) a person standing unprotected at the disposals area perimeter is safe from blast and fragmentation. This person should also be safe from toxic fumes regardless of the wind direction;

b) there is no possibility of injury to persons or damage to property outside the perimeter of the disposal site; and

c) the effect of noise is kept to a tolerable level.

Where it is intended that more than one type of activity will be carried out in a disposal site, e.g burns, demonstration, White Phosphorus (WP) and pyrotechnic burning tanks, then a location for each type of activity has to be specified, and separate explosive limits have to be laid down for each type of activity.

D.9.8 Man limits

The number of persons present shall be the minimum required to ensure efficiency. Certain tasks are subject to mandatory man limits given in the detailed procedures for these tasks.

D.9.9 Spectators

Spectators shall be allowed at official demonstrations only. Civilian spectators (or their organisations) shall be required to sign a standard indemnity form before the demonstration commences.

D.9.10 Orders for sentries

These are normally contained in a separate Annex to the local SOPs and shall cover the following points:

a) their duties. “To keep all approaches to the disposal site under observation and to prevent any intrusions”;

b) reporting. To report to the OIC Disposals any intrusions that they cannot prevent; and

c) safety. To remain under cover in their SPS when disposals are in progress.
D.9.11 Contraband

This includes all fire making and smoking materials. These shall be kept under control in a locked container by the OIC Disposals. Smoking shall only take place in a designated area - remote from all explosives - at times decided by the OIC Demolitions.

D.9.12 Eating and drinking

This has also to be controlled to prevent the ingestion of explosive particles or contaminated materials. Where necessary the OIC Disposals shall ensure that personnel wash and scrub their hands before meal and refreshment breaks.

D.9.13 Transport discipline

The points to be covered are:

D.9.13.1 Vehicle routes

These shall be laid down (preferably hard core) and shall not cross firing or telephone cables unless they are adequately buried and protected.

No vehicle shall approach to within 30 metres of the disposal pits or ammunition being unpacked and prepared for disposal.

D.9.13.2 Unloading and parking

Engines shall be switched off when vehicles are loaded or unloaded.

Vehicles shall be parked in a designated parking area outside the danger area during blows.

D.9.13.3 Segregation of loads

Separate vehicles shall be required for Condition A ammunition, Condition D ammunition, WP stocks and personnel. A person in charge of loading/unloading shall be nominated.

D.9.14 Dress

Special dress is called for with certain disposal tasks. In all other cases the dress should be appropriate to the weather conditions. In particular, sentries require adequate protection against bad weather.

D.9.15 Safety precautions peculiar to the disposal site

Mandatory use of ear protectors by the firing party if the size of blows and the proximity of the firing point to the pits warrants it.

Limitations on WP disposals and burns are required when the wind direction may carry fumes towards a sensitive area.

D.9.16 Accident procedures

The mandatory requirements shall be:

a) the disposals party shall include at least one person trained and equipped to administer first aid;
b) this person shall stay readily available outside the danger area, or under cover, to deal with casualties; and

c) there shall be an established casualty evacuation procedure and standby medical cover has to be available.

Following an accident the following procedure shall be implemented:

a) stop disposals, make safe prepared demolitions, carry out first aid and casevac/call on back up medical aid;

b) inform higher authority. Note all details pertinent to the eventual enquiry; and

c) render safe and repack all ammunition and explosives that have been unpacked and prepared for disposals - segregate awaiting investigation.

D.9.17 Records and reports

A permanent disposals diary shall be kept. This shall be completed daily and signed by the OIC Disposals.

D.10 Planning and preparation

The first step should be to prepare a list of the items awaiting local disposals. Confine the list to those items where local disposal has been approved by the national authority. Do not anticipate approval.

Select the most suitable disposal method and location:

a) if the list is confined to small quantities of items with low NEC use a local disposal area (with a small explosive limit);

b) if the list contains larger quantities of items with NEC in excess of the explosive limit of the local disposal area, the programme will have to take place at a more distant disposals area with a larger explosive limit. These normally have to be selected well in advance;

c) determine the best method of disposal for each item. This will necessitate knowing the make up of each item. You shall achieve safety and complete destruction of the item and its filling(s);

d) determine the types and quantities of serviceable explosive required to effect disposal;

e) breakdown the list of items for disposal into individual serials;

f) ensure that the total NEC per pit (including serviceable demolition explosives) does not exceed the explosive limit for the disposals area; and

g) ration out high capacity items between the pits to enhance the effect of the serviceable demolition explosives. The combination of items within blows will influence the method of disposal chosen.

Produce a Demolition Order, the disposals programme and list:

a) date, time and location;

b) nominal roll of personnel in disposals party;

c) list of APM and ammunition to be destroyed;

d) list of serviceable explosives required;

e) breakdown of disposals by serials and pits;

f) safety and casualty evacuation arrangements;

g) administration arrangements, (accommodation, food, transport);

h) route(s) - if applicable; and
i) list of stores required. Duplicate essential items.

Give notice of disposals as required, in organisation orders and to the general public.

Earmark and check explosives, ammunition and equipment. The equipment should also be tested for serviceability at this point.

Brief personnel who are involved in the disposal programme.

D.11 Conduct of disposals

Detailed instructions should be given in local technical instructions for particular disposals tasks.

Procedures for the control of disposal activities at the disposal site are given at Appendix 2 to Annex D.
Appendix 1 to Annex D
(Informative)
Schematic layout of a disposal site

- Sentry Post
- Contraband Point
- Administration Area
- Vehicle Unloading Area
- Splinter Proof Shelter (SPS)
- Communications
- Road
- White Phosphorus Disposal Site
- Demolition Pits
- Burning Ground
- Sentry Posts
Appendix 2 to Annex D  
(Normative)  
Control of disposals activity

2.D.1 On arrival before disposals commence

2.D.1.1 Contraband
The Officer in Charge (OIC) of Disposals shall apply contraband restrictions and advise all personnel of smoking break arrangements.

2.D.1.2 Briefings and nominal roll
The OIC Disposals shall:
  a) check the nominal roll and brief all personnel;
  b) establish the nominated first aid person and his/her equipment in the first aid point. This must be in a Splinter/Fragment Proof Shelter (SPS) if inside the danger area;
  c) instruct the sentries on their duties and the means of communication. Post the sentries and instruct them to hoist the red flags;
  d) detail the routes for vehicles and personnel; and
  e) detail the parking area. All vehicles shall be parked outside the danger area while disposals are in progress.

2.D.1.3 Safety checks
The OIC Disposals shall:
  a) check the telephone links both to the exchange and to the sentries. Phone around the system with final warning of disposals, (as required by local instructions);
  b) check the routes are clear of suspect Unexploded Ordnance (UXO) and, if any are present, treat them as blinds. This shall be checked before and after each blow;
  c) ensure that routes do not cross cables unless these are adequately buried;
  d) nominate a safety vehicle. This is to be equipped with a stretcher and blankets. It is to remain available for the evacuation of casualties throughout the disposals programme;
  e) when disposing of ammunition by burning await the arrival of Fire Brigade cover or establish and test fire fighting parties and equipment;
  f) check the demolition pits (where applicable). OIC Disposals shall check again for suspect UXO before and after each blow. He/she shall establish a safe and firm route into the pit and firm working areas and create sandbag “steps” and working platforms as necessary;
  g) ensure that personnel do not walk or stand on undercuts; and
  h) where appropriate, e.g with nitro-glycerine based explosives, establish hand washing facilities. Give instructions that all persons who handle such explosives shall wash and scrub their hands before they eat or drink.

2.D.1.4 Unloading of ammunition
The OIC Disposals shall:
  a) order the unloading of ammunition. Serviceable and unserviceable items shall be kept separate. A nominated individual shall control the accounting and issues for each series;
b) ensure that vehicles avoid soggy ground. Vehicles should keep to hard standing or rubble tracks. Create sandbag “stepping stones” for personnel as necessary;

c) ensure vehicles shall not approach within 30 metres of the disposal pits or of unpacked ammunition and explosives; and

d) ensure engines shall be switched off during loading and unloading.

2.D.2 During disposals

2.D.2.1 Supervision and control

The OIC Disposals shall remain free to supervise all activity. He/she shall not become responsible for the activities of one group or area to the exclusion of others.

The nominated person shall remain free to guard the ammunition and explosives. He/she shall control and account for the issues to pits for disposal.

2.D.2.2 Safety

2.D.2.2.1 General

Observe all safety precautions.

2.D.2.2.2 Preparation of demolition or burn

Safe areas away from the edge of the pits shall be selected for the unpacking and preparation of ammunition and explosives. Serviceable and unserviceable items shall be prepared in separate areas:

a) protect sensitive items when unpacked. Do not step on or over ammunition or explosives - this includes detonating cord;

b) do not “dribble” plastic explosive (PE) or other explosives during preparation;

c) eliminate all contaminated material; and

d) avoid the inclusion of packages on stacks as much as possible. Check all surplus packaging is free from explosive (FFE) and remove to a central empty package point.

Site undercuts and stack positions in the pits so that the blast and fragmentation/debris effects are minimised and directed away from sensitive areas. As far as possible blow uphill - this facilitates drainage.

Test the firing cables before each blow.

2.D.2.3 Stack configuration

In terms of the stack configuration, the OIC Disposals should aim for:

a) minimum use of explosive compatible with complete destruction of the item(s) being disposed of;

b) make the best use of the explosive fillings of items to effect destruction;

c) the correct mixture of high capacity and low capacity items etc in mixed stacks;

d) no air gaps and the minimum of metal/material between explosive fillings;

e) stacks and their exploding chains are to be stable enough and sufficiently shielded so as not to be affected by detonations in other pits; and

f) do not place un-bagged earth directly onto stacks. Tamp with sandbags - this facilitates digging out partial explosions.
2.D.2.4 Preparation of detonating cord

Ensure that the detonating cord:

a) is as straight as possible and not crossed over;

b) has taped junctions of at least 100 mm and spare ends of at least 300 mm. The cut ends should be taped over to prevent moisture ingestion, prevent spillage of loose explosive and thereby reduce the risk of a misfire due to detonating cord failure; and

c) all junctions must be outside the pit and the main lead must extend at least two metres out of the pit. This facilitates dealing with misfires.

2.D.2.5 Tools and explosives

Tools and explosives shall be carried in separate marked boxes. Loose items shall not be carried on the person. Detonators shall be carried in totally enclosed, marked metal boxes.

2.D.3 At close of work

The OIC Disposals shall:

a) search the disposal area, ensure that it is FFE and free of all litter contamination;

b) ensure that empty packages are re-inspected, sealed and marked FFE;

c) reconcile the closing stocks of ammunition and explosives with the record of what has been destroyed. Do not allow personnel to leave the disposals area until all discrepancies have been satisfactorily investigated and explained;

d) take a declaration from each person in the disposals party that he/she has no explosives, ammunition or accessories in his/her possession before he/she leaves the disposals area; and

e) complete and sign the disposals diary.
**Annex E (informative)**

**Stockpile destruction management schematic**

- **Start**
  - Determine stockpile destruction requirements

**Programme planning**
- Collect and collate the information necessary to enable the planning, development and/or refinement of a national stockpile destruction programme.
- Develop a stockpile destruction programme which aims to reduce the technical risk, and is conducted in a safe, efficient and cost effective manner.

**Technical evaluation**
- Determine technical solution and develop the logistic plan.
- Collect sufficient information to enable the destruction requirement to be defined, including the technology to be used, accounting and verification systems.

**Contractual arrangements**
- Specify the technical requirements and responsibilities
- Authorise desk (provisional) accreditation and license(s)
- Develop appropriate capabilities & establish funding arrangements
- On-site inspections to confirm accreditation and license(s)

**Preparation**
- The demilitarization cycle

**DESTRUCTION**
- Monitoring and inspections (quality assurance)

**VERIFICATION**
- Inspection of destruction process by independent QA team (quality control)

**Finish**
- Prepare and submit reports
- Conduct post-project review
Annex F  
(informative)  
Stockpile demilitarization and ISO 9001:2008 (LEVEL 3)

This Annex should only be used to support large-scale ammunition demilitarization operations.

The concept of total quality management (TQM) and the development of quality management systems (QMS) evolved in the 1980s and were used by management to achieve levels of excellence in manufacturing. Those companies that embraced the philosophy to change their organisations and empower their staff achieved remarkable levels of performance and a clear competitive edge. During the 1990s this approach has been applied to the public sector and ‘non profit’ organisations with similar improvements in performance.

Quality management systems comprise three components: (1) standards and common procedures that define the rules, norms and required performance of an organisation; (2) an internal management system (such as ISO 9001:2008) that encourages an organisation to achieve these standards; and (3) institutional arrangements, such as national and international professional bodies that establish the rules, norms and required performance and monitor the performance of its member organisations.

Organisations that seek ISO 9001:2008 accreditation are required to comply with an agreed set of criteria: the 5 major standard clause ‘areas’ that define the agreed criteria. The interpretation of the criteria depends on the role of the organisation and whether it delivers a product or service. Many professional bodies have produced guidelines that relate to their own business sectors and professions. Currently no agreed international criteria or guidelines exist for ammunition stockpile destruction.

The 5 major standard clause ‘areas’ of ISO 9001:2008 need to be modified to reflect the role of organisations engaged in ammunition stockpile demilitarization.

The relevance of these clauses to ammunition stockpile demilitarization can be established by mapping them onto the IATG 10.10:2015(E) compliance clauses, as shown in Appendix 1 to Annex F. The resulting matrix provides a deeper and more comprehensive understanding of the total quality requirements of ammunition stockpile demilitarization. For example, a demilitarization organisation seeking ISO 9001:2008 accreditation would be expected to demonstrate how its internal quality assurance and quality control procedures would be used to identify critical non-conformities, an action that is currently required in many contracts.

Such an approach would provide a common framework to assess and evaluate the suitability and preparedness of contractors and sub-contractors as part of any contractual, accreditation or licensing procedures. It would generate transparency and this, in turn, would improve confidence in the product.

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### Appendix 1 to Annex F
(informative)

**IATG 10.10:2010(E) and ISO 9001:2008 (LEVEL 3)**

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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 SaferGuard IATG website at www.un.org/disarmament/un-saferguard/.

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