Department for Disarmament Affairs

A DESTRUCTION HANDBOOK

small arms, light weapons, ammunition and explosives

UNITED NATIONS

NOTE

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Cover design by Josie K. Belamide-Zweig
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FOREWORD

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The worldwide proliferation of small arms, light weapons, ammunition and explosives has exacerbated many civil conflicts in recent years, prolonging such conflicts and contributing to human insecurity on a vast scale. It is particularly tragic that civilians, mainly women and children, have been the primary victims of the misuse of such weapons.

Any systematic effort to deal with the menace of small arms proliferation would require the retrieval of such weapons, ammunition and explosives from illicit circulation with the aim of destroying them, so that there is no possibility of their diversion through illegal channels into civilian possession. The destruction of surplus stocks would also contribute to this objective.

The destruction of small arms and light weapons is essential for post-conflict societies where peace-building efforts have often been hampered by the easy availability and continued misuse of such weapons. Their timely destruction in such situations will also help to stem the flow of arms and ammunition from one conflict or post-conflict zone to another, which has occurred all too often to the great detriment of regional, sub-regional and national security. Destruction however has to be undertaken under professional guidance with due care to safety and the environment.

This booklet is aimed at assisting planners and managers by providing them with a range of possible options, thereby helping them to identify feasible methods in the light of their specific situations and requirements.

This publication builds upon the Secretary-General's Report on "Methods of destruction of small arms, light weapons, ammunition and explosives" (S/2000/1092) of 15 November 2000. It is an expanded version of that report, drawing upon the material contained therein as well as incorporating additional material, particularly with regard to the destruction of ammunition and explosives associated with small arms and light weapons.

This is a first edition, which is to be followed by a more elaborate effort to develop a comprehensive reference manual with the assistance of interested States. Governments offering comments on the structure and content of this publication, as well as providing information that may add value, would facilitate the development of a comprehensive manual.

It is my hope that this booklet will prove useful to planners and managers, as well as other interested individuals and groups, who are involved in issues concerning the destruction of small arms, light weapons, ammunition and explosives. It is also my hope that this publication, which will be distributed widely, will further strengthen international support for the retrieval and destruction of illicit stocks of arms and ammunition, in addition to surplus stocks.

ACKNOWLEDGEMENT

This publication
has been made possible
in part through a generous grant
from the Government of the Netherlands
to the
Department for Disarmament Affairs.

Photo courtesy of the UN by Steen Johnson

1. Introduction

On 24 September 1999, the Security Council convened its first meeting at ministerial level devoted to the issue of small arms. A report (S/2000/1092) was prepared with the assistance of internationally recognized experts following the ministerial meetings request that the Secretary-General “develop a reference manual for use in the field on ecologically safe (amended in report S/2000/1092 to read 'environmentally sound') methods of weapons destruction in order better to enable Member States to ensure the disposal of weapons voluntarily surrendered by civilians or retrieved from former combatants”. The report has been used as a guide in the preparation of this aide mémoire.

This Handbook is seen as the first step in producing a definitive reference manual to be used primarily in post-conflict situations by planners charged with the recovery and destruction of weapons and ammunition. As recovery programmes are already under way it is thought that the first stage in developing the reference manual should be to offer planners already engaged on recovery programmes with as many destruction options as possible.

1.1 Background

This Handbook has been prepared for use by planners in the field as an easy reference guide to the various methods that may be employed in the destruction of small arms and light weapons (SALW) and their associated ammunition natures. It is aimed primarily at post-conflict situations and not at systematic stockpile destruction of a nation’s surplus or unserviceable SALW.

To date the principal work in this area has been undertaken by the Bonn International Center for Conversion (BICC), the Monterey Institute of International Studies (MIIS), and the United Nations Development Programme (UNDP)/ Department for Disarmament Affairs Albania Gramsh Pilot Weapons in Exchange for Development Project. Their work served as a primary basis for the S/2000/1092 report.

1.2 Aim

This Handbook is designed to assist planners in the field to choose methods of destruction that are most appropriate to the theatre of operations they find themselves in. It is not designed to be used as a substitute for the guidance that appropriately qualified and experienced technical experts should provide. It identifies the areas of expertise that will be required by the planning team. In identifying the likely environmental outcome of any course of action, it allows the planning team to weigh the resources available against the urgency and degree of destruction required in the unique circumstances that surround each project.

1.3 Scope

The weapons covered by this Handbook are those small arms and light weapons, ammunition and explosives as defined in the 1997 report of the Secretary General on small arms prepared with the assistance of the Panel of Governmental Experts on Small Arms. The exception will be landmines, which are, in part, the subject of a separate destruction protocol developed by UNDP in the context of the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel Mines and on Their Destruction, (otherwise known as the Ottawa Convention or the Mine-Ban Convention).

The report of the Panel of Governmental Experts (A/52/298, annex, para. 26) contains definitions for the following categories of small arms and light weapons, including ammunition and explosives:

1.3.1 Small arms

- Revolvers and self-loading pistols
- Rifles and carbines
- Sub-machine guns
- Assault rifles
- Light machine-guns

1.3.2 Light weapons

- Heavy machine-guns
- Hand-held, under-barrel and mounted grenade launchers
- Portable anti-aircraft guns
- Portable anti-tank guns and recoilless rifles
- Portable launchers of anti-tank missile and rocket systems

- Portable launchers of anti-aircraft missile systems
- Mortars of calibres less than 100 mm

Heavy machine-guns awaiting destruction

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

1.3.3 Ammunition and explosives

- Cartridges (rounds) for small arms
- Shells and missiles for light weapons
- Anti-personnel and anti-tank grenades
- Landmines (not included in this aide mémoire)
- Mobile containers with missiles or shells for single action
- Anti-aircraft and anti-tank systems
- Explosives

1.4 Principles

The primary principle is that safe destruction should be the overriding objective in operations designed to reduce or eliminate weapons, ammunition and explosives collected or rendered surplus for whatever reason.

The overall objective is to ensure that weapons can never be used to fire again and that ammunition and explosives are rendered completely inoperable and present no hazard to personnel engaged in the destruction process, the population at large and, to the extent possible, the environment.

In designing a destruction programme, planners, managers and operators must bear in mind the following principles, not necessarily in the order presented. Priority would be dictated by the specific circumstances:

1.4.1 Equipment

The conditions that destruction would take place could range from very austere to fairly sophisticated. The availability of equipment, together with an assessment of its reliability and maintainability, would be a major factor in deciding on the method of destruction.

An open-fronted vehicle bay being used for small-scale destruction of small arms. Even on small scale cutting operations, regular breaks occur to ensure the dispersal of fumes and to alleviate operator fatigue.

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

Rifles and carbines awaiting destruction

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

1.4.2 Cost

Cost would include both the acquisition of equipment for destruction and operational costs. It would be essential that cost be considered in relation to the wide range of benefits that flow from the destruction programme. An indigenous workforce should be used to the maximum extent possible consistent with safety and security. While opportunities for cost recovery through the recycling of scrap materials should always be a consideration, significant cost recovery would not be likely. Wherever possible, existing infrastructure should be utilized to the maximum effect.

1.4.3 Security

From the initial collection of weapons, ammunition and explosives, through to their eventual destruction, the security of the items collected must be assured. Storage, transportation and the provision of a security force must be considered.

1.4.4 Simplicity of operation

The destruction task could often be challenged by the lack of ideal resources, trained personnel, the urgency for action and other factors. This would mean that methods of destruction must be realistic in the light of prevailing circumstances on the ground. In such an environment, simplicity would be an important objective.

1.4.5 Safety

Lack of resources, time pressure and other constraints must never imply that safety would not have the highest priority in any destruction operation. The presence of explosive ordnance and the use of industrial equipment in many cases would call for extra vigilance.

Weapons in storage packaged in boxes to assist in accurate and ease of transport

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

1.4.6 Environmental impact

Although there are no completely ecologically safe procedures in the destruction of small arms and light weapons and ammunition and explosives, there are steps that must be taken to minimize the impact on the air, the ground and the water environment. Pollution control measures must always be considered in destruction planning. The collection of scrap and residue would assist in minimizing the impact on the environment.

Voluntary surrender of weapons

Photo courtesy of UN by Thomas Tolstrup

1.4.7 Accounting

From the initial assessment of the amount of weapons, ammunition and explosives involved in a particular operation, through the actual destruction and disposal, there must be an accurate and detailed account of the material involved, consistent with the operational circumstances.

1.4.8 Transparency

Accounting must be in a form that is understandable by the war-affected population from beginning to end. This is an essential confidence-building measure for civil society. The use of international observers, non-governmental organizations (NGOs) and the media could contribute to the value of this endeavour.

An assault rifle being destroyed

Photo courtesy of UN by Steen Johansen

2 The destruction of small arms and light weapons

2.1 Introduction

From the numerous cases in which small arms and light weapons have been collected, seized or otherwise declared surplus, a number of practical methods have been identified for their destruction. These methods can range from very cheap and simple to more complex and expensive.

A number of considerations have to be made when choosing a destruction method. These considerations include:

- Quantity and type of weapons collected
- Time and location restraints
- Requirements of security and government involved
- Psychological and publicity needs, such as the building of a peace monument with destroyed weapons
- National infrastructure (roads, equipment availability and domestic recycling capabilities)
- Labour costs
- Overall implementation

Whatever method is chosen, a number of common preparatory tasks need to be undertaken. These include collecting the weapons, ensuring they have been rendered safe (e.g., contain no ammunition), implementing and maintaining a chain of custody and accountability, sorting and segregating the weapons, inventorying and transferring them to suitable temporary storage or directly to the destruction site. At the same time, it is necessary to ensure that environmental concerns have been taken into account and that the verification system is in place to certify destruction. Within the organization tasked with carrying out the destruction operation, e.g., a peace-keeping mission, it must be clearly understood who has the authority to order destruction and to determine the method or methods to be used.

Stripped-down light support weapons prepared for destruction

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

2.2 Methods of destruction

The following is a description of various methods that have been used to destroy small arms and light weapons. Some methods may be considered to be complete in that the resulting products are totally unrecognizable as weapons. Other methods, while disabling the weapon, may require further processing to prevent either repair work or the collection of spare parts. All methods of destruction presuppose that the weapons have been unloaded. Any weapon that is jammed with the working parts forward or has a magazine, which cannot be removed, should be considered to be loaded and treated appropriately. A summary of destruction techniques is provided in ***Annex C***.

2.2.1 Cutting

Cutting has been widely used and can be done in a variety of ways. However, the various methods also produce different outcomes regarding effectiveness. More specifically, the slightly higher-technology methods of using either oxyacetylene torches or plasma cutters over conventional saw blades leave far fewer possibilities that the disabled weapons can be used for spare parts. In general, when cutting small arms from handguns to assault rifles, the weapons are cut completely through the barrel, receiver, bolt and trigger mechanism. The higher the temperature generated by the cutting device, the higher the damage to the metal and the less chance the weapon or parts can be rebuilt. There are several ways to destroy small arms and light weapons through cutting:

2.2.1.1 Oxyacetylene cutting

Oxyacetylene cutting is a proven method of destroying all types of weapons. The equipment is relatively simple to use; the personnel can be trained to use it in one day. The equipment needed is available for lease or sale worldwide, and can be transported by helicopter, light aircraft or light truck. Additionally, the torch is almost maintenance-free and spare parts are easily available in almost every country.

The cost of an oxyacetylene cutter appropriate for this type of task would be from $200 to $500. There is no electric power requirement.

The only real disadvantage of this method is the number of weapons that can be destroyed in a given time. The time it takes varies from weapon to weapon based on size. Operator skill and experience also have a bearing on the speed of destruction. The average number of assault rifles that can realistically be destroyed in an eight-hour day would be 300 to 400. Another disadvantage that could arise, depending on the situation in which the destruction is being carried out (i.e., whether destruction is done by a mobile unit or at a well-secured stationary site), would be the attractiveness of the equipment to theft. This is a disadvantage for all methods using any sort of machinery.

Advantages

- Simple, safe and requires little training
- Close to 100 per cent effective in rendering weapons useless, especially if two cuts are made
- Easily maintained and transported
- Environmentally sound despite the generation of some toxic fumes
- Some material is available for recycling

Disadvantages

- Time-consuming if a large quantity of weapons is to be destroyed
- Labour-intensive

Oxyacetylene cutting method, using basic facilities

Photo courtesy of Small Arms Destruction Project [Albania, Germany, Norway and the United States]

2.2.1.2 Oxygasoline cutting

The oxygasoline torch cuts steel using gasoline for fuel, and can be used as a direct replacement for the acetylene torch. The design keeps the fuel as a liquid all the way to the cutting tip, which prevents flashback down the fuel line since gasoline cannot ignite without oxygen. Like oxyacetylene, where certain polymers and plastics are burned, environmental and user health precautions should be taken such as ensuring adequate ventilation and/or the wearing of an appropriate mask filter. The oxygasoline system has certain advantages over the acetylene torch, including: cutting faster, reduced fuel costs, increased safety and easier fuel storage.

Advantages

- Simple, safe and requires little training
- Environmentally sound despite the generation of some toxic fumes
- Cost-effective to operate
- Easily maintained and transported

Disadvantages

- More costly for initial purchase
- Time-consuming if a large quantity of weapons is to be destroyed

2.2.1.3 Plasma cutting

In equipment cost, a plasma cutter is more expensive than an oxyacetylene torch. However, it can do the same job as the torch in about half the time and is easier to use, thus labour costs could be saved. This difference in labour and equipment cost would have to be calculated for the most cost-efficient method. The plasma cutter makes a much cleaner cut than an oxyacetylene torch. Plasma cuts rather than burns, thus it is best for weapons with high levels of polymers and plastics. It also releases fewer toxic fumes. Because this cleaner cut does not produce the same amount of slag, it may make pieces more susceptible to repair or reuse. However, this should be of minor concern, especially when double cuts can be made more efficiently with the plasma cutter.

The average cost of a plasma cutter is $2,000. It would require 220 volts of electrical current and could be used with a portable generator. A 5-kilowatt generator costs approximately $800. Additionally, the cutter would require an air compressor.

Advantages

- Safe; requires little training
- Environmentally friendly despite generating some toxic fumes
- Close to 100 per cent effective in rendering weapons useless, especially if two cuts are made
- Can do twice the work in the same amount of time as the oxyacetylene torch

Disadvantages

- Could be too expensive if used to destroy small quantities of weaponry

- A cleaner could increase the risk of parts being reused (only a minor concern)
- Somewhat labour-intensive

2.2.1.4 Hydraulic shears cutting

Numerous police forces around the world have used this method of destruction for collected or seized weapons. Cutting shears provide a simple, environmentally friendly and effective way of destroying weapons of all sizes and types. Additionally, hydraulic shears can destroy thousands of weapons in one day. While this method is simple and efficient, it may also be cost-prohibitive.

Shears can cost from $10,000 to $15,000, depending on the power source, the thickness of steel they can bend or cut and how fast they can do the job. The machinery can be bought new or used, and can be custom-designed to fit individual needs (mobile vs. stationary destruction). Although these machines are quite expensive, they are rugged, can cut wood, plastics and polymers, have a long life, are easily serviced, and can take advantage of low-cost labour owing to their ease of use. Thus, hydraulic shears may be a worthwhile investment if a well-planned and sustained weapons collection and destruction programme is to be implemented.

Hydraulic shears already installed in an existing industrial facility are an attractive option because the capital acquisition cost can be absorbed by an operation other than the destruction operation.

Advantages

- Simple to use and requires little training
- 100 per cent effective in rendering the weapons useless if two cuts are made
- Fast, reliable and long-lived
- Environmentally benign if scrap is not buried
- Large numbers of weapons can be destroyed

Disadvantages

- Could be too expensive for small quantities of weapons
- High maintenance level
- Limitations with some of the heavier small arms and light weapons

Single cut placement on selected small arms

Photos courtesy of the Royal Canadian Mounted Police Forensics, Ottawa.

AK-47, Union of Soviet Socialist Republics, 1953

9mm Uzi Model A – Made in Israel (IMI)

2.2.1.5 Other cutting methods

There are numerous other lower-technology methods that could be used to destroy weapons, such as hacksaws, bench saws and band saws. These methods would obviously not be practical for destroying more than a handful of weapons if labour costs are a consideration. Advantages of these cutting methods are mobility and low cost. If a collection programme were to move around a country or region, and it was expected to collect only a few weapons at each site, then this method might be considered.

Advantages

- Simple to use
- Inexpensive
- Mobile

Disadvantages

- Labour-intensive
- Not 100 per cent effective in destroying weapons unless there are numerous cuts

All methods of cutting will leave scrap metal, plastics and polymers that will require disposal action. There may also be associated parts, such as sighting systems that will require other disposal techniques.

2.2.2 Bending/crushing

The destruction or rendering unserviceable of weapons through bending or crushing ranges from very sophisticated factory systems to practical systems in the field.

2.2.2.1 Crushing by hydraulic press

Hydraulic presses may be employed in bending and partly crushing weapons. These presses are typically large, very heavy, fixed installation machines that require mounting on a solid foundation and an adequate power supply. They also require the degree of maintenance associated with large industrial equipment.

Weapons would be severely mutilated, but strict verification would be required to ensure that a pool of spare parts for weapons is not created. Supplementary destruction methods might be required depending on the weapon type or types involved. It is very suitable for anti-tank guns, recoilless rifles, missile launchers and similar systems.

Any sighting systems containing liquids or gases and any batteries should be removed prior to crushing and set aside for separate disposal.

Advantages

- High volume
- Reliable for most weapons

Disadvantages

- Requires a supplementary method in some circumstances

2.2.2.2 Crushing by vehicles

A fairly simple method to at least disable weapons is through the use of heavy vehicles. The most effective vehicles are those with caterpillar tracks and weighing in excess of 30 tons, e.g., tanks or heavy construction vehicles. The track pads need to be removed and the weapons laid on a hard flat surface such as concrete. The vehicle then runs over the weapons. The effect can be further enhanced if the weapons are supported at one end by a kerb, log or steel rail. The weapons should be separated to ensure that the full weight of the vehicle is allowed to assert itself. If any supports are being used, it may be necessary to restrain the weapons to ensure they are not pushed aside by the vehicle. Front-end loader vehicles can use their bucket/blade to bend or break weapons in a manner similar to the use of shears.

A disadvantage to this method is the lack of completeness. This can be overcome by having visual inspections conducted by competent supervisors to determine the number of runs required to destroy the weapons. Additionally, this could simply be an intermediate method to disable the weapons before a more complete destruction by some other method.

Advantages

- Simple to execute, minimum training required
- Requisite equipment widely available
- Inexpensive
- High volume of weapons can be processed in one day
- Environmentally benign if scrap is not buried
- Provides an opportunity for high visual impact

Disadvantages

- Not 100 per cent effective in destroying all weapons
- Strict verification required
- Difficult to do in remote rural areas
- Not practical for wide-ranging mobile destruction plan

2.2.3 Burning

There are two main options when considering the use of heat in destroying weapons. The simplest is the inclusion of the weapons to be destroyed in a fire. Provided enough heat is generated, the weapons will be distorted; all wood, plastic and polymers will have been burnt, but recognizable scrap will remain that will require further disposal action. The second method is to introduce the weapons into a smelting vat. This offers one of the most complete methods of destroying small arms and light weapons.

Small arms awaiting burning

Photo courtesy of MWO G. Crocker, DSSPM 5-3

A major disadvantage to burning is that verification that all weapons have been effectively destroyed is very difficult. Theoretically, weapons near the centre, bottom of the pyre could still be useable.

2.2.3.1 Open-air burning

Open-air burning has been used effectively in a number of situations. It is a simple and cheap way to destroy weapons successfully. The only materials necessary for this method would be some type of fuel (wood or coal), and a flammable substance to intensify the heat. The skill levels involved are low.

If burning is to be conducted at a collection point at the time of collection, then care needs to be taken that the weapons are properly accounted for and are unloaded prior to their inclusion in the fire.

Burning has the added advantage of making a highly visible, political and psychological statement to the conflict-affected population.

However, the main disadvantage of burning is in its effectiveness, if there is not enough heat produced. This could be overcome by re-burning, recycling the weapons, burying them beyond economical recovery, or by disabling them further through other means, such as crushing.

Advantages

- Simple and cost-effective
- Can be done in or near the collection point
- Has minimum training or equipment requirements
- High visible impact

Disadvantages

- Not always 100 per cent effective in destroying weapons
- Environmental concerns with temporary air pollution, especially if there is a high percentage of plastics or polymers in the weapons

2.2.3.2 Melting in foundries

Where it is possible to utilize electrical, blast or foundry furnaces, this is probably the optimum method of destruction. It inevitably means transporting the weapons over some distance, and, as the infrastructure is rarely co-located where the weapons are collected or stored, there will likely be cost concerns.

This method also requires a comprehensive destruction plan, including stripping the weapons of all non-metallic components, providing secure transportation and maintaining oversight of what will essentially be a commercial operation.

The melting process is technically safe and has minimal environmental impact. It dispenses with the need for any supplementary process, except for the stripping of non-metallic parts and ancillary equipment. Depending on the quantity of weapons and the quality of the metal, there are possibilities for recycling the molten metal residue. This may offset some of the costs.

This method could be used in conjunction with open air burning, the weapons having been effectively stripped of all non-metallic components prior to their introduction into the furnace.

Advantages

- Complete and absolute destruction
- Possible cost recovery

Disadvantages

- Requires a fixed facility
- Could involve significant transportation costs

2.2.4 Open-pit detonation

Open-pit detonation is a relatively simple exercise, assuming the availability of qualified technicians. Destruction can be effected by laying weapons out in a shallow pit and placing explosive charges so that, in the case of destruction of assault rifles, the receiver, bolt barrel and trigger housing would be destroyed. This could be an expensive process unless there are donor charges such as plastic explosives that have been collected as part of the disarmament process.

Safety procedures have to be rigid, not just in the handling and use of explosives, but in ensuring that adequate safety distances are in place between the demolition site, the personnel involved, the general population and property. There is always the possibility that some weapons or parts might be thrown or kicked out of the pit by the explosion. Therefore the surrounding area must be thoroughly checked after the blast. In addition, a detailed check will have to be done to ensure complete destruction. These concerns can be minimized by tamping the site with earth, sandbags or water bags. A well-executed procedure would mutilate the weapons beyond use or repair.

This method is particularly well-suited for the destruction of mortars, anti-tank guns and portable launchers of anti-aircraft missile systems. In addition, large calibre weapons can be destroyed by detonating a high explosive charge in the chamber.

Advantages

- Destruction rate is very good, especially with larger weapons
- Highly visible and has symbolic value

Disadvantages

- Requires qualified technicians
- Could involve bringing explosives into an insecure operational area
- Requires detailed safety procedures
- Residue must be removed
- The environment could be impacted by noise, air and ground pollution
- Not cost-effective for destruction of small arms unless there is an abundance of donor charges

2.2.5 Cast weapons in cement blocks

Cement has been used in the recent past as a means of taking weapons beyond use. It should not be viewed as destruction because recovery of the weapons is possible, although costly in time and effort. The effectiveness of this method could be enhanced if the weapons have previously been cut using one of the techniques described above. There may be circumstances where it is considered expedient to encase weapons in this manner. Weapons can be placed in simple moulds and then cement is poured into the mould. The dried block can then be placed in a landfill site. Alternatively, the weapons can be placed in a suitable landfill site and then have cement poured on top.

Advantages

- Cheap and simple
- Requires limited training of personnel
- Could be used in conjunction with cutting

Disadvantages

- Recovery of the weapons is possible
- Could involve high transportation costs
- Needs a suitable landfill site
- Requires detailed accounting supervision

2.2.6 Deep-sea dumping

This method of destruction is often rejected for environmental reasons. While the protection of the environment must always be of high importance, there could be circumstances where the method is acceptable. Historically, this has been one of the most frequently used methods and it is, in fact, more environmentally sound than many other methods as it involves only inert metal with small amounts of contaminants. In any case, global, national and regional norms and instruments must be consulted in accordance with the provisions of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention).

This method can be expensive, as it requires moving the weapons to a port, packaging them in barrels or sea containers (drilled with holes to ensure that they sink and free air space filled with concrete ballast), arranging for a ship with onboard crane facilities and passage to an area with a deep ocean trench, i.e., beyond the continental shelf. There are scientific formulas available to calculate the buoyancy and density of the package to be dumped to ensure that it does not float. This is essentially a commercial operation so no training is required. Security prior to dumping and verification that the dump has actually been made requires a certain amount of planning and resources:

Advantages

- High volume capacity
- Recovery virtually impossible

Disadvantages

- Expensive, depending on the volume
- Logistically difficult
- No recycling possibilities
- Negative psychological impact owing to low visibility to the conflict-affected population

2.2.7 New and emergent technologies

Managers and planners should make every effort to keep abreast of new and emergent technologies, as there are many industrial processes that may lend themselves to the destruction of small arms and light weapons with minimal adaptations, e.g., hydro-abrasive cutting. The armed forces of some countries are exploring the use of hydro-abrasive cutters in relation to bomb-disposal, as these machines are ideally suited to cutting up weapons with minimal environmental impact.

Surrender and display of collected small arms and light weapons

Photo courtesy of the UN by Steen Johansen

3 Destruction of small arms ammunition

3.1 Introduction

Only trained professionals who are knowledgeable about the material and methods of destruction should attempt safe and successful destruction of small arms ammunition (SAA).

Small arms ammunition contains very little explosive (propellant) that can be usefully used to effect its own destruction. Due to the low explosive-to-weight ratio, SAA is the safest group of munitions to transport and store. It is also the most difficult to destroy using normal detonation techniques.

Small arms ammunition has the following characteristics, which will need consideration when deciding the most appropriate method of disposal:

3.1.1 Comparatively heavy

Loose rounds should be packed in small metal ammunition boxes or in sandbags that should be no more than one-third full to enable ease of movement.

3.1.2 Comparatively inert

When packed in small metal ammunition boxes, SAA can be used to form barriers between stacks of dissimilar ammunition types, either in storage or transport, if sufficient suitable storage or vehicles are not available.

3.1.3 High scrap ratio

Most methods of destruction dispose only of the propellant, which leaves the cartridge case and projectile material relatively intact. This means that the now inert mix of metals have to be disposed of.

The quantity of SAA to be destroyed of will probably be the major logistical factor in deciding which disposal method is chosen.

Ammunition being laid out for destruction

Photo courtesy of UN/DPI by Eric Kanalstein

3.2 Methods of destruction

3.2.1 Procedure 1. Firing

3.2.1.1 Best suited for:

- Small quantities of similar SAA types
- SAA still in factory packaging

3.2.1.2 Least suited for:

- Large quantities
- Mixed SAA types
- Old or poorly maintained SAA stocks

Advantages

- Leaves only empty cases to dispose of
- For small quantities it produces an expedient method of disposal

Disadvantages

- Could cause confusion or distress in a post-conflict environment
- Contaminates the impact area with projectile debris
- With large quantities of SAA, the task becomes boring and fatiguing to the firers and thus requires strict supervision to ensure that bad practices do not appear
- With mixed SAA types careful sorting is required prior to disposal
- With old or poorly maintained SAA a high incidence of misfires can be expected at best, and at worst, a high rate of breach explosions
- Requires a large safety trace to ensure any projectiles missing the impact area do not constitute a hazard

3.2.1.3 Equipment required

Weapon-type appropriate to the SAA to be disposed of.

Aural protection for the firing party.

3.2.1.4 Personnel required

An *ammunition technician* to inspect the SAA prior to firing and to dispose of any misfires that may occur.

An *armourer* to inspect the weapons prior to firing and to examine and repair any that develop faults during firing.

A *range supervisor* to authorize the use of an area as safe and suitable for this method of disposal and to further ensure the safety and well-being of those conducting the disposal along with any other personnel required.

Medical personnel to provide first aid in case of accident.

A *firing party* who should be familiar with the weapon type and tested in safe handling and fault diagnosis prior to the commencement of firing.

3.2.1.5 Real estate required

An area that has been designated by the range supervisor as suitable. As a rough guide for planning purposes, this would normally, in open ground, be an area 1.5 times the maximum range of the weapon system being used, extending in a 45% arc from the firing point.

The danger area must be secured to ensure that no one can enter.

The use of purpose-built military short ranges will reduce the danger areas considerably.

Any hard backstops that are being used should be fronted by sand to a depth of at least 2 m to protect the firers from projectile debris and fragmented stone.

3.2.1.6 Method

Load and fire the weapons as on any range.

3.2.1.7 Environmental impact

Noise for the duration of the firing.

Small quantity of quickly dispersed propellant gases.

The impact area will be contaminated by projectile debris.

3.2.1.8 Further disposal actions

The weapons used.

Empty cartridge case.

Any associated packing materials.

Quantity of misfired rounds.

3.2.2 Procedure 2. Burning using an improvised incinerator

3.2.2.1 Best suited for:

- Small to medium quantities of mixed SAA types
- Damaged, old or poorly maintained SAA stocks
- Loose SAA rounds

3.2.2.2 Least suited for:

- Large quantities of SAA (In excess of 20K)
- SAA still in factory packaging

Advantages

- Requires very little equipment
- Does not require much manual effort
- If properly conducted is 100 per cent effective
- Mobile

Disadvantages

- Requires a long cooling-down period before verification of total destruction can take place
- Produces a dense cloud of smoke

3.2.2.3 Equipment required

A robust metal ammunition box approximately 1000 x 600 x 300 mm with the lid removed.

A piece of expanded metal sheet that overhangs all sides of the ammunition box by at least 300 mm on all sides.

A quantity of house bricks to raise the ammunition box at least 300 mm clear off the ground and to place on the expanded metal sheet to hold it in place.

A sufficient quantity of firewood to place under the ammunition box and around the sides up to the height of the expanded metal sheet.

A quantity of fuel oil or kerosene (but not petrol).

A remote means of igniting the fire.

3.2.2.4 Personnel required

An *ammunition technician* to ensure that no round larger than .50 calibre is placed in the burning tank or that any rounds that have a secondary effect other than tracer are inserted. He/she will also ensure that the remote means of initiation is safe and viable.

Medical personnel to provide first aid in case of accident.

A *workforce* to build the fire/fires and to move the SAA.

3.2.2.5 Real estate required

An exclusion zone extending 100 m in diameter from the fire site.

3.2.2.6 Method

Place the house bricks on a firm piece of ground so as to support the four corners of the ammunition box.

Put some firewood in the centre of the box up to approximately three quarters of its height.

Fill the box to approximately three quarters of its height with SAA ammunition.

If an electrical means of initiation is available, thread the igniters through the expanded metal sheet, which is now placed over the ammunition box. DO NOT, at this stage, connect the igniters to the firing circuit.

Place bricks on the overhanging sections of the expanded metal sheet.

Place firewood under and around the ammunition box up to the underside of the expanded metal sheet.

If more than one fire is to be ignited, then repeat stages 1-6 until all SAA to be destroyed are in position. Leave at least a 5m gap between each stack.

All non-essential personnel are now to leave the exclusion zone.

The fire site should now be liberally doused with fuel oil.

If electrical initiation is to be used, then further igniters should be placed in the surrounding firewood.

Connect all igniters and retire to the designated firing point.

When the person in charge is satisfied that the exclusion zone is clear of personnel, ignite the fire.

3.2.2.7 Environmental impact

Noise as the rounds ‘cook off’.

Dense smoke mixed with propellant gases.

There may be some ground contamination due to unburnt fuel oil.

3.2.2.8 Further disposal actions

The burnt-out ammunition box containing a mixture of cartridge cases and projectiles.

A quantity of wood ash.

3.2.3 Procedure 3. Large-scale burning using improvised means

3.2.3.1 Best suited for:

- Large quantities of SAA (in excess of 50K)
- Damaged or poorly maintained stocks of SAA

3.2.3.2 Least suited for:

- Small quantities of SAA (less than 50K)

Advantages

- Very large quantities can be destroyed at one time
- The SAA can remain in its associated inner packaging
- All types of SAA can be destroyed
- Pyrotechnics can be destroyed at the same time
- Has potential to be used for ceremonial destruction

Disadvantages

- Requires a lot of preparation
- Produces a lot of smoke
- Requires a long cooling-down period prior to verification that total destruction has been achieved

3.2.3.3 Equipment required

At least one mechanical earth digger.

A large quantity of wooden railway sleepers.

A large quantity of firewood.

A large quantity of fuel oil or kerosene (not petrol).

At least two electrical firing circuits.

A fire set capable of delivering the required current over 500 m.

A quantity of scaffolding poles long enough to reach over the closest sides of the trench with at least 1 m of its length on each side.

Sufficient expanded metal sheets to completely cover the trench and 1 m on each side.

Ladders.

3.2.3.4 Personnel required

An *ammunition technician* to ensure that nothing that could detonate is included in the stack and also that the quantity of pyrotechnics (if included) is not excessive and is evenly distributed within the stack.

Medical personnel to provide first aid in case of accident.

A *suitably qualified person* to operate the mechanical digger.

A *workforce* to build the structure, fire and to move the ammunition to be destroyed.

3.2.3.5 Real estate required

An exclusion zone extending for 500 m from the disposal site.

If it is intended that this is to be a ceremonial destruction, then it would be an advantage to have viewing confined to one area (to ease crowd control), which ideally is slightly elevated from the burning area (to facilitate viewing). It should be situated upwind of the burn site.

3.2.3.6 Method

Use the mechanical digger to excavate a trench four times the volume of the ammunition to be destroyed and at least 2 m in depth.

Line the base and sides of the trench with the railway sleepers.

Make stacks of firewood to a height of 1 m in such a way that no two stacks are more than 2 m apart.

Insert electrical igniters into the stacks running the leads to the nearest side. Ensure the leads lie flat on the wooden base. DO NOT connect any of these leads to the firing circuits at this stage.

Fill the trench to a depth of no more than one quarter with the ammunition to be destroyed. If pyrotechnics are included, ensure all ammunition is placed in a controlled manner and that the pyrotechnics are evenly distributed. As a rough guide they should not constitute more than one quarter by volume of the total amount of ammunition to be destroyed, but the ammunition technician in overall charge will decide the appropriate quantities depending upon the précis natures of pyrotechnics being disposed of.

Use the scaffolding poles to construct a supporting framework for the expanded metal sheets, fit the sheets over the framework ensuring there are no gaps and that the edges of the sheets are flat on the surface of the ground surrounding the trench.

Use metal ammunition boxes filled with earth to hold the edges of the sheets of expanded metal firmly in place.

Evacuate the exclusion zone of all non-essential personnel.

Douse the ammunition with the fuel oil.

Connect the igniters to the firing circuits and retire to the firing point.

When the person in charge is satisfied that the exclusion zone is clear of all personnel then ignite the fire.

The fire will burn for some hours and should not be approached until at least an hour after the last smoke was seen.

It may be some days before the residue is cool enough to handle.

The trench should be examined by the ammunition technician prior to any attempt being made to empty it.

3.2.3.7 Environmental effect

Noise as the rounds/pyrotechnics ‘cook off’.

Dense smoke mixed with propellant and pyrotechnic gases.

Depending on the future envisaged use of the land, it may be possible just to backfill the trench.

3.2.3.8 Further disposal actions

If it is unacceptable to backfill the trench then the residue will have to be removed. Due to the high temperatures resulting from this method of disposal, large amounts of the residue will be fused and will require breaking up to facilitate manhandling.

The scaffolding poles and the expanded metal sheets will have to be removed from the site.

The ammunition containers that were used to transport the ammunition to the site will have to be recovered.

3.2.4 Procedure 4. Burning using a mobile incinerator

3.2.4.1 Best suited for:

- Small quantities of SAA
- Damaged, old or poorly maintained SAA stocks

3.2.4.2 Least suited for:

- Large quantities of SAA

Advantages

- Reusable
- Mobile
- Does not require a high degree of training to use

Disadvantages

- Can only handle small quantities in any one cycle. (Typically 500 9 mm rounds)
- Requires heavy gauge steel and welding equipment to construct

3.2.4.3 Equipment required

A mobile incinerator. This is a steel box with sides and base of at least 15 mm steel plate. It should be mounted on legs that give it ground clearance of at least 300 mm. One of the sides should be removable to facilitate removal of burnt ammunition and to allow the placing of the wood or coal that will sustain the fire.

Internally, there should be a lip running around all sides, which will support a grate that divides the firebox from the chamber that contains the ammunition. This grate should be very loose-fitting as it will be subjected to high temperatures and will thus tend to buckle with use. The lid should be of expanded metal and capable of complete removal.

A quantity of firewood or coal.

A quantity of fuel oil or kerosene (not petrol).

A means of remote initiation.

A vehicle with a suitable load-carrying capability.

3.2.4.4 Personnel required

A person who has been trained to use the incinerator. It should take no more than a day to teach a person how to safely use and maintain the incinerator.

Assistance to load and unload the incinerator from a vehicle.

3.2.4.5 Real estate required

An exclusion zone extending 50 m around the incinerator.

3.2.4.6 Method

Place the incinerator on firm ground so that it is horizontal.

Load the firebox with the firewood or coal.

Insert the means of remote initiation in place, but DO NOT connect to the firing circuit.

Put the grate in place.

Distribute the SAA to be destroyed evenly over its surface.

Put the lid in place and secure it.

Douse the SAA with the fuel oil or kerosene.

Connect the initiator to the firing circuit and retire to the firing point.

When the person in charge is satisfied that the exclusion zone is clear of all personnel, fire the initiator.

The incinerator should be back to ambient temperatures before it is reloaded with SAA for another burn.

3.2.4.7 Environmental impact

Small amount of noise.

Small quantity of smoke.

3.2.4.8 Further disposal actions

The grate will contain cartridge case and projectile debris.

The firebox will contain ash.

3.2.5 Procedure 5. Burning using a fixed incinerator

3.2.5.1 Best suited for:

- Long-term projects
- Centralized stocks

3.2.5.2 Least suited for:

- Dispersed stocks

Advantages

- Can be fitted with air filters to cut down on emissions
- Can be enclosed in a sound attenuator to reduce noise levels
- Can be used for pyrotechnics
- Can be used for demolition accessories

Disadvantages

- Not mobile
- Involves some capital cost
- Requires constant supply of fuel, normally LPG, fuel oil or similar fuel

3.2.5.3 Equipment required

A fixed incinerator has basically the same components as the mobile incinerator, i.e., a combustion chamber and a firebox. The only additions in the simplest model are the inclusion of a feed tube to allow for the introduction of more ammunition, a regulated flow of fuel into the firebox and a blast wall to protect the operators. The feed tube needs to be fitted with a safety cut-out to prevent blowbacks. The base of the combustion chamber should have a remote rake to allow for the chamber to be periodically cleared of debris.

3.2.5.4 Personnel required

A person suitably trained to use the incinerator. It should take no more than three days to train someone how to use it.

A safety supervisor who makes frequent checks on the operation of the incinerator. The operation of the incinerator is a very boring task and it is easy for the operator to fall into bad practices.

3.2.5.5 Real estate required

In open ground this should extend for 100 m in an arc from the unprotected face of the blast wall.

3.2.5.6 Method

The fire is ignited in the firebox and heats up the combustion chamber.

When a sufficiently high temperature has been achieved, the operator commences loading small arms into the chamber via the feed tray. The actual quantities loaded will depend on the size and strength of the incinerator. The operator will then hear the rounds ‘cooking off’. When no sound has been heard for at least five minutes, the operator repeats the loading process.

Again, depending upon the size of the incinerator, the operator will have to periodically clear the now inert debris from the combustion chamber. This is best achieved using a remote rake so that the burning process can continue without undue breaks.

3.2.5.7 Environmental impact

There will be a low level of noise as the SAA ‘cooks off’.

If an air filtration system is installed there will be little smoke produced.

If no air filtration system is installed, there will be propellant gases and smoke from the fuel will be released into the atmosphere.

3.2.5.8 Further disposal actions

The cartridge case and projectile debris removed from the combustion chamber will have to be disposed of.

3.2.6 Procedure 6. Rotary kiln incineration

3.2.6.1 Best suited for:

- Large quantities of ammunition
- Static operations

3.2.6.2 Least suited for:

- Small and dispersed quantities of SAA

Advantages

- Continuous operation is possible
- Hand grenades, small calibre high explosive (H.E.) rounds and pyrotechnics can all be incinerated using this method
- There is little or no pollution associated with this method, provided that an appropriate air filtration system is fitted
- The production rate is very good (approximately 8 tons in nine hours).

Disadvantages

- Extremely high capital cost (in the order of $1 million)
- Not very mobile
- High maintenance and training costs
- Requires a fuel supply

3.2.6.3 Equipment required

A commercially available rotary kiln.

3.2.6.4 Personnel required

An *ammunition technician* to ensure that only appropriate items are placed in the feed hopper.

A *team* of people who have been trained in the operation and basic maintenance of the equipment by the manufacturer.

3.2.6.5 Real estate required

A lot will depend on the actual specification of the machine acquired, but at bare minimum the machinery will have to be mounted on a large concrete base with an exclusion zone of 100 m around it.

3.2.6.6 Method

This type of machine operates by taking ammunition from a feed hopper into the combustion chamber via a continuously turning Archimedean screw. Heat is applied as the ammunition moves along the screw; the rate at which it moves is dependent upon the amount and nature of the ammunition being processed. Scrap metal is released into a hopper at the end of the screw.

3.2.6.7 Environmental impact

Minimal as very efficient air filtration is employed.

3.2.6.8 Further disposal action

The scrap metal, the composition of which will depend on what mixture of ammunition types have been processed.

3.2.7 Procedure 7. Destroying small arms ammunition using high explosives

3.2.7.1 Best suited for:

- Small quantities of SAA when other ammunition is being destroyed

3.2.7.2 Least suited for:

- Large quantities of SAA

Advantages

- Can completely destroy SAA with no scrap

- In its simplest form can be very quick
- Can be used to destroy weapons concurrently

Disadvantages

- If only SAA ammunition is to be destroyed then large quantities of high explosives are required
- If too high a ratio of SAA to high explosives is used, then there is a danger that rounds will be expelled from the demolition pit, either intact or damaged, over a large radius
- Areas that have been used for demolition by detonation are littered with metal fragments and require extensive searching for unexploded items prior to being returned to normal use

3.2.7.3 Equipment required

Sufficient high explosives and demolition accessories to destroy the SAA.

3.2.7.4 Personnel required

An *ammunition technician* to certify an area as being suitable for the safe use of high explosives and to supervise the laying of the demolition pits.

Medical personnel to provide first aid in case of accident.

A *work party* whose skills are commensurate with the scale of demolition to be undertaken.

3.2.7.5 Real estate required

An area of ground that has been deemed suitable for the purpose by an ammunition technician, the actual size of which will be determined by the amount of explosive to be used, but would not normally be less than 300 m in diameter.

The whole area must be secured to ensure people and livestock are not able to enter.

3.2.7.6 Method

Where possible pits should be dug to contain all of the items to be destroyed, as they will also assist in the containment of fragments.

The pits are then loaded with the items to be destroyed and with any donor charge that may be required under the direction of the senior ammunition technician.

If available, sand-filled bags or water bags should now be placed over the prepared demolition pits. This will assist in the containment of fragments and reduce noise levels.

Once the area is clear of all personnel the pits are fired.

The pits and immediate area should be checked by an ammunition technician prior to anyone else entering the area.

3.2.7.7 Environmental impact

Noise, the level of which will be a product of the amount of explosive used, may be mitigated by the use of tamping, elevated ground and weather conditions.

Digging trenches to at least the depth of the demolition pits can reduce ground shock, if this presents a problem.

A quickly dispersed cloud of smoke and gas.

Metal fragments, some surface lying and others buried, will contaminate the ground within the danger area.

3.2.7.8 Further disposal actions

The entire danger area will need to be searched for any items of ammunition that have been thrown from the pits.

The pits should be filled in.

4 Destruction of rockets, missiles, shells, mortars and grenades

4.1 Introduction

Only trained professionals who are knowledgeable about the material and methods of destruction should attempt the safe and successful destruction of explosive ordnance.

Some commercially viable destruction techniques that are useful in reducing major stockpiles are of little value in micro-disarmament. The bulk of the munitions handed over for destruction will come in relatively small quantities of mixed types, probably without its original packing and almost certainly without any continuous storage record. These circumstances will mean that any reverse engineering solution is impractical both from a financial and logistical perspective.

The quantity and the condition of the ammunition surrendered will be major factors in determining exactly how and when they are going to be destroyed.

Destruction by detonation offers the most complete solution to munitions in a post-conflict environment, but it must be very carefully coordinated to ensure that it is achieved in the safest, most efficient and sensitive way possible.

4.2 Open-pit destruction by detonation[1]

4.2.1 Introduction

This form of destruction by detonation is the most common and the easiest to arrange. As the name implies, the munitions to be destroyed are placed in an open pit and donor charges are added. The pit may be man-made or naturally occurring and is sometimes back-filled or tamped to arrest the flight of fragments and to cut down on noise.

Advantages

- Large quantities of mixed ammunition natures can be destroyed

[1] Detailed technical instructions for this method can be found in International Mine Action Standards (IMAS) 11.20 *Open Burning and Open Detonation* (www.mineactionstandards.org).

- No capital costs are involved
- Completely effective in destroying ammunition. Can be used to destroy weapons simultaneously

Disadvantages

- Requires a large depopulated area
- Extensive clean-up of the site on completion of operations is required
- Usually involves bringing in quantities of serviceable explosives to the region

Open-pit detonation of high explosives

Photo courtesy of R. Scott QGM BEM

4.3 Safety

Safety of the personnel performing the destruction programme and the public at large must be the overriding consideration; all other factors are subordinate to this.

4.4 Quantity

How much ammunition is there to be destroyed? This in conjunction with the proposed disposal site, and the labour force at his/her disposal will enable the planner to determine what timescale is likely to apply to the programme.

4.5 Specific ammunition natures

While it is probably impossible to know in advance every type of ammunition that will be encountered during a collection programme, information gathered from local sources and reconnaissance should give a reasonably accurate forecast of what is likely and in what quantities. This information is important as some ammunition types such as white phosphors will need special handling or disposal techniques, and it will also allow the planner to forecast how much additional, if any, high explosive will be required.

4.6 Ammunition requiring special treatment

The target effect of some ammunition requires specific action to safely dispose of it. These natures are: white phosphorus, anti-riot (CS gas), shaped charges and tube-launched missiles. In any demolition of size these items do not normally present a problem unless they are present in disproportionate quantity. The technical advice of an ammunition technician should be sought as soon as it becomes apparent that large quantities or dispersed stocks of any of these natures are present. The disposal site may have to be modified to include larger downwind exclusion zones, etc.

4.7 Disposal site

In any major disposal programme, which is based upon the collection of widely dispersed stocks, the early identification of a suitable site to carry out demolitions is of great importance, as it will ensure that resources are not wasted in double-handling munitions stocks. There are many factors involved and it would be unlikely that the ideal solutions will be met; local conditions will dictate which factors have the higher priority and compromises will have to be made. But safety can never be compromised. Factors involved in determining a suitable demolition site are:

4.7.1 Ground

Where possible, the chosen site should be elevated from the surrounding countryside, as this will enable the sound wave to dissipate quickly without becoming focused by surrounding hills. Deep soils are preferred as they will cut down on ground shock.

Undergrowth should be at a minimum, as hot fragments ejected from the demolition pits will start fires. There must be clear line of sight from the firing point to the demolition area and the entire surrounding danger area. If this is not possible, then a series of sentry posts outside the danger area must be established that do have sight of the whole danger area and are in radio or telephone contact with the firing point.

4.7.2 Infrastructure

There should be a good road leading to the immediate vicinity of the demolition site. This will enable maximum use to be made of vehicles to move ammunition and personnel. It will also assist in the rapid evacuation of casualties should an accident occur.

4.7.3 Location

From a logistical viewpoint, the site should be as central as possible to the region being cleared in order to maximize the use of resources.

4.7.4 Personnel

The scale of operations will determine exactly how many of each discipline are required. However, at a minimum, an ammunition technician to oversee operations and medical personnel to administer first aid are required. In order to carry out the task safely and effectively, there should only be the minimum number of people that can be suitably supervised in the danger area.

Additional personnel who may have a role to play in operations could include a labour force, sentries, a guard force, representatives of the previously warring factions, members of the press, local dignitaries and representatives of governments. All of these people will need to be controlled and accounted for.

4.7.5 Security

In any society there are always criminal elements that will seek to procure weapons and ammunition to further their own ends. In a post-conflict environment, there will also be a greater degree of expertise in the use of these weapons, possibly accompanied by a black market in arms and ammunition. Great care must be taken to ensure that the recovered weapons and ammunition do not re-enter this chain, and that the local population that have surrendered them can see that care is being taken. Security measures to be taken will be dictated by local circumstances but must be adequate to ensure that the surrendered weapons and ammunition are beyond illegal use.

4.7.6 Non-ammunition items

The great destructive force unleashed when explosives are detonated makes it an attractive option for destroying non-ammunition items at the same time. Depending on the quantity of explosives to be detonated at any one time, extra non-explosive items may be added to the demolition stack. Weapons can be destroyed in this manner, although care should be taken that weapon components containing noxious or radioactive substances, such as tritium used in some sighting systems, are excluded.

4.7.7 Environmental impact

Detonation produces sound, the volume of which is a product of the net explosive quantity (NEQ) detonated. In small to medium (maximum 10 kg NEQ) demolitions this sound may be reduced by tamping the demolition pit with sandbags or water bags. Use could also be made of disused mine shafts, caves or underground bunkers, but it will then not normally be possible to check the demolition site for complete destruction. If a series of demolition pits is to be fired, then adequate time should be left between the detonation of each pit to allow the sound wave to completely dissipate prior to the firing of the next pit. This time lapse will depend upon the terrain in the surrounding countryside and the weather conditions at the time of firing. The time lapse will help to prevent sound waves becoming focused and causing damage outside the danger area. A cloud of quickly dispersed smoke and gas will accompany the detonation. In terrain that has dry undergrowth, fires caused by hot fragments expelled from the demolition pit can be expected. Detonation is accompanied by ground shock; again, the magnitude of this is a product of the NEQ and the structure of the subsoil. The area surrounding the demolition site will be littered with metal fragments and the sides of the demolition pits will be heavily impregnated with fragments.

4.7.8 Post-demolition actions

On completion of the demolition programme, or at intervals during a protracted demolition programme, the area that has been used will need to be cleaned up. This clean-up can never achieve 100 per cent removal of all the metal fragments that are present. What should be achieved is the removal and disposal of any items of ordnance that have been thrown clear of the demolition site and still constitute an explosive hazard along with all the larger metal fragments. All buried firing cables should be removed.

4.7.9 Ceremonial destruction

Destruction by detonation offers the most spectacular opportunity for demonstrating the complete destruction of the weapons of war. However, great care must be taken in the planning of stage-managed events such as this. If the ‘audience’ is too far away the effect will be lost, but if the ‘audience’ is too close then casualties could occur. If it were deemed necessary or desirable that some public show of the demolition process be celebrated, then it would be wise to ensure that no fragment-producing ammunition is included in the stack or any extraneous material.

4.8 Contained detonation

4.8.1 Introduction

There are a range of commercially available detonation chambers designed to allow small quantities of high explosives to be detonated in a sealed chamber and thus reduce noise and gaseous pollution levels through a series of filters.

Advantages

- Greatly reduces pollution
- Contains all fragments

Disadvantages

- Only the smallest versions are mobile
- The highest NEQ that static versions can deal with is 15 kg NEQ
- Extremely expensive

4.9 Contained burning/deflagration

A rotary kiln, as described in Destruction of SAA, Procedure 6, can be used to destroy small quantities of ammunition containing high explosives.

Advantages

- SAA and pyrotechnics can be destroyed at the same time
- Continuous operation is possible
- There is little or no pollution associated with this method, provided that an appropriate filtration system is fitted
- Mortar bombs up to 81 mm may be disposed of

Disadvantages

- Extremely high capital cost (in the order of $1 million)
- Not very mobile
- High training and maintenance costs

- Requires a fuel supply
- High explosive rounds must have the associated fusing system removed prior to introduction into the kiln

5 Destruction of pyrotechnics

Only trained professionals who are knowledgeable about the material and methods of destruction should attempt the safe and successful destruction of pyrotechnics.

Pyrotechnics is the generic term that refers to all military fireworks. There are a wide variety of pyrotechnics, each type producing a battlefield effect, which may be illumination, smoke or sound. The various effects are produced by burning chemical compositions at different rates and can include the addition of particulate suspensions such as CS Gas or vegetable dyes to produce coloured smoke.

Pyrotechnics are by their nature easily destroyed by burning. However, when large quantities are being burnt then dense clouds of toxic fumes are produced. Pyrotechnics can also be added to demolition pits and destroyed in conjunction with high explosive ordnance, although if the ratio of pyrotechnics to high explosive is too high or the pyrotechnics are carelessly placed, then the surrounding area will be littered with functioning or damaged pyrotechnics.

5.1 Methods of destruction

5.1.1 Procedure 1. Burning in an open pit

5.1.1.1 Best suited for:

- Large quantities

5.1.1.2 Least suited for:

- Damaged pyrotechnics
- Loose propellant

Advantages

- Cheap and expedient method of destroying large stocks
- Small quantities of SAA may be included
- All non-metallic packing materials may be included in the burn

Disadvantages

- Leaves a residue of ash and melted metal to be removed
- Items will be thrown from the pit, some of which will require further disposal action
- Creates a downwind hazard of noxious smoke

5.1.1.3 Equipment required

A means of digging a suitable pit.

A means of remote initiation.

5.1.1.4 Personnel required

An *ammunition technician* to ensure that only suitable items are included in the pit and that any items expelled from the pit are safely destroyed.

Medical personnel to administer first aid in case of accident.

Depending upon the quantity to be destroyed, a *work party*.

5.1.1.5 Real estate required

Although this method is termed burning, there is always the possibility that the contents of the pit may explode en masse at any stage during the burning process. Therefore, a danger area commensurate with the total NEQ to be destroyed needs to be enforced.

The ground needs to be clear of any combustible undergrowth as expelled pyrotechnics will ignite it, and no firefighting will be possible in the vicinity of the pit for the duration of the burn.

5.1.1.6 Method

Dig a pit with sufficient volume to enable all the pyrotechnics to be laid in the bottom to a depth of no greater than .5 m and allow at least 1 m depth from the top of the pyrotechnics to the lip of the pit.

Loading the pit should be done under control, with items being placed rather than tipped from the edge.

If destructor incendiaries are not available to ignite the burn, then a quantity of firewood needs to be placed in the pit and doused in fuel oil or kerosene (not petrol).

The contents of the pit are then remotely initiated.

The burn will build in intensity, accompanied by dense smoke and a large volume of sound, the effects of which will gradually subside.

No attempt should be made to approach the pit until it has been deemed safe by the ammunition technician in charge.

5.1.1.7 Environmental impact

A dense cloud of noxious gas and smoke.

A volume of sound with sporadic louder bangs.

There may be some soil contamination in the pit.

5.1.1.8 Further disposal actions

All metallic ammunition boxes used to transport the pyrotechnics.

The residue from the pit, which will be a mixture of melted metals.

A sweep of the area surrounding the pit, to the maximum distance that items have been expelled to, will have to be made. Care should be taken as partially functional and damaged pyrotechnics will be encountered along with inert debris.

5.1.2 Procedure 2. Burning using a mobile incinerator

5.1.2.1 Best suited for:

- Low capacity pyrotechnics

5.1.2.2 Least suited for:

- Pyrotechnics with large bursting charges
- Damaged pyrotechnics

Advantages

- It is relatively mobile

- It is reusable
- It does not expel items during normal burning

Disadvantages

- Requires heavy gauge steel plate, heavy gauge expanded steel sheet and welding equipment to construct

5.1.2.3 Equipment required

A mobile pyrotechnic incinerator. The dimensions of this box should be 600 mm x 400 mm x 300 mm, with the sides constructed of steel plate at least 15 mm thick. The base should have an internal lip extending continuously, which protrudes at least 50 mm. The top should have a lip that is recessed from the upper edge by 80 mm; this lip should only protrude a maximum of 30 mm into the box. The base and the top are cut from sheets of heavy gauge expanded steel and fit loosely on the 2 lips. The top edges of the longest sides should have holes drilled so that when the lid is in place, metal rods can be pushed through them to secure the lid. The lid and base are removable, as they will need to be replaced at frequent intervals. The incinerator should be mounted on legs that will elevate the base to at least 1 m.

A vehicle with a suitable load-carrying capacity.

5.1.2.4 Personnel required

An *ammunition technician* who will decide what pyrotechnics are suitable for destruction using this method.

Assistance to load and unload the incinerator from the vehicle.

5.1.2.5 Real estate required

An area of hard surface, clear of combustible undergrowth, out to a distance of 50 m from the incinerator. The incinerator should be centred in an exclusion zone that extends out to 250 m.

5.1.2.6 Method

The incinerator is loaded with pyrotechnics.

If destructor incendiaries are not available, then a layer of firewood will need to be placed on the pyrotechnics and doused with fuel oil or kerosene (not petrol).

The lid is placed on the incinerator and secured using metal rods.

All personnel are evacuated from the area to at least 250 m.

The remote means of initiation is ignited.

Burning will now occur and the incinerator will remain hot for a considerable time.

The incinerator should be allowed to return to ambient temperature before it is reloaded for another burn.

5.1.2.7 Environmental impact

A dense cloud of noxious gas and smoke.

A volume of sound with sporadic louder bangs.

5.1.2.8 Further disposal action

The incinerator will contain a quantity of ash and metal debris.

5.1.3 Procedure 3. Burning using a rotary kiln

5.1.3.1 Best suited for:

- Large quantities of pyrotechnics
- Static operations

5.1.3.2 Least suited for:

- Small and dispersed stocks of pyrotechnics

Advantages

- Continuous operation is possible
- SAA and small H.E. natures (up to 81 mm) can be incorporated in the burning process
- There is little or no pollution associated with this method, provided the appropriate air filtration system is fitted

Disadvantages

- Extremely high capital cost
- Not very mobile

- High maintenance and training cost
- Needs a supply of fuel

For further description, see 3 - Destruction of small arms ammunition, Procedure 6.

5.1.4 Procedure 4. Destroying by detonation

5.1.4.1 Best suited for:

- Small dispersed stocks of pyrotechnics
- Damaged or unsafe pyrotechnics

5.1.4.2 Least suited for:

- Large stocks of pyrotechnics

Advantages

- Relatively quick method
- Can destroy lachrymatory natures without the release of gas

Disadvantages

- Requires a high ratio of donor H.E. to pyrotechnics if only pyrotechnics are to be destroyed

For further description, see 4 - Destruction of rockets. missiles, shells, mortars and grenades, 4.2 - Open pit destruction by detonation.

6 Destruction of explosives

6.1 Introduction

Only trained professionals who are knowledgeable about the material and methods of destruction should attempt the safe and successful destruction of explosives.

Explosives can be divided into two major groups: high explosives and low explosives. High explosives are those that normally function by detonation and are generally used as the main filling of shells, mortars, rockets, missiles and grenades. In bulk form H.E. is used in the demolition of bridges, roads, railways etc. Low explosives are those that do not detonate, but burn. When confined, this rate of burning is indistinguishable from detonation to the human eye. This group of explosives consists of propellants, gunpowder and pyrotechnic compositions.

This chapter deals with the destruction of explosives in their bulk form and not when filled in munitions.

Destruction of serviceable bulk explosives should be the last group of munitions and weapons destroyed, unless there is an overriding operational necessity for this. That is because stocks of bulk explosives can be used to destroy all other groups of munitions and weapons, thereby cutting down on the cost of having to import donor charges to the affected region.

6.2 Methods of destroying bulk high explosives

6.2.1 Procedure 1. Detonation

6.2.1.1 Best suited for:

- Large stocks
- Dispersed stocks

6.2.1.2 Least suited for:

- Unserviceable stocks

Advantages

- Little on-site preparation is required
- Stocks may be destroyed in their packing.

Disadvantages

- Noisy
- If packing material is not removed, the immediate area will be contaminated with fragments of the packing material

6.2.1.3 Equipment required

An appropriate amount of donor H.E.

A means of remote detonation

6.2.1.4 Personnel required

An *ammunition technician* to oversee the demolition.

Medical personnel to administer first aid in case of accident.

Depending on the scale of operations, a *work party* to assist in the laying out of the demolition and to provide sentries, if necessary.

6.2.1.5 Real estate required

An exclusion zone, the size of which will depend upon the amount of explosives to be destroyed and the ground upon which it will be destroyed.

If the demolition site or any part of the exclusion zone cannot be seen from the firing point, then sentry posts that can see those blind areas will have to be established on the perimeter of the exclusion zone to prevent people and livestock from entering the exclusion zone. These sentry points should be in telephone or radio contact with the firing point.

6.2.1.6 Method

The precise method used will be determined by the senior ammunition technician, who will consider factors such as the quantity to be disposed of and the ground conditions.

6.2.1.7 Environmental impact

Sound and localized blast.

A quickly dispersed cloud of gas and smoke.

Fragments of packing material in the immediate area of the demolition.

A crater the size of which will depend upon the amount of explosive destroyed and the soil composition.

6.2.1.8 Further disposal action

Removal of any scattered fragments.

Filling in of the crater.

6.2.2 Procedure 2. Burning

6.2.2.1 Best suited for:

- Unserviceable stocks of high explosives

6.2.2.2 Least suited for:

- Large stocks of high explosives

Advantages

- Creates very little noise
- Ensures the complete destruction of unserviceable stocks

Disadvantages

- Requires removal of outer packing
- Creates a downwind smoke and fume hazard

6.2.2.3 Equipment required

A metal tray to contain the explosives. This may be dispensed with but there will then be some ground contamination as a result.

A quantity of sawdust or similar combustible material.

Fuel oil or kerosene but not petrol.

If the explosives to be destroyed are nitroglycerine-based, then anyone handling them will require rubber gloves. Nitroglycerine is a heart stimulant that can be absorbed through the skin.

A means of remote initiation.

6.2.2.4 Personnel required

An *ammunition technician* to supervise the operation.

Medical personnel to administer first aid in case of accident.

Depending upon the quantities to be disposed of, a *work party*.

6.2.2.5 Real estate required

Although this method is designed to destroy the high explosives by burning, there is always the risk that the explosives will burn to detonation; therefore an exclusion zone appropriate to the quantity of explosives to be destroyed needs to be imposed. The size of this zone is based on the premise that all the available high explosives detonate as soon as the burning process begins.

The ground should be clear of combustible undergrowth to a radius of 50 m from the burn site.

6.2.2.6 Method

The metal tray is placed on a horizontal surface and sawdust is scattered evenly to a depth of approximately 100 mm across the whole surface.

The high explosive to be destroyed is removed from its outer packing and placed on the sawdust. The explosives should not be stacked and a gap of approximately 50 mm should be left between each block. Ideally, block size should not exceed 2.5 kg.

The means of remote initiation is placed between the first and second rows of explosives at the upwind end of the tray. The whole tray is doused with fuel oil.

When all personnel have left the exclusion zone the remote means of initiation is ignited.

The explosives will burn fiercely.

6.2.2.7 Environmental impact

There will be a downwind cloud of smoke and fumes.

If burning trays have not been used then there will be some ground contamination from the fuel oil.

6.2.2.8 Further disposal action

The outer packing material.

A quantity of ash in the tray.

6.3 Methods of destroying low explosives

6.3.1 Procedure 1. Burning

6.3.1.1 Best suited for:

- Bagged propellant charges and augmenting cartridges

6.3.1.2 Least suited for:

- Damaged or unserviceable propellant

Advantages

- The safest way of destroying bulk propellant under field conditions

Disadvantages

- Can be a very lengthy process
- Is not a suitable method during periods of extreme weather conditions

6.3.1.3 Equipment required

A means of remote initiation.

6.3.1.4 Personnel required

An *ammunition technician* to supervise operations.

Medical personnel to provide first aid in case of accident.

Depending upon the quantity of low explosives to be destroyed, a *work party*.

6.3.1.5 Real estate required

An area of ground sufficient to lay out the explosives in a continuous train, the depth of which will depend on the nature of the explosive to be destroyed.

The ground should be clear of all combustible undergrowth over the burn site and out to a radius of at least 250 m.

There should be an exclusion zone of at least 300 m around the disposal area; with very large quantities this will need to be increased, as there is extreme radiated heat associated with this method of disposal.

6.3.1.6 Method

The propellant to be destroyed is placed on a train facing into the wind. The downwind end, which is going to be the ignition point, should start with very little propellant and gradually widen out until the required width has been achieved. From this point on, the propellant is laid in a train with parallel sides.

If large quantities of propellant are to be destroyed care should be taken to ensure that only the minimum number of personnel necessary to achieve the objective are close to the laid out propellant at any one time. Propellant is extremely sensitive to heat, sparks and friction.

When all personnel are clear of the exclusion zone the propellant is ignited using the remote means of initiation.

The propellant will then burn fiercely.

If further burns are required the same piece of ground should not be used for at least 24 hours, and then only after rigorous inspection.

6.3.1.7 Environmental impact

There will be a dense cloud of smoke and noxious gas downwind.

6.3.1.8 Further disposal action

All the packing material.

Depending upon the types of charges burnt, there may be barrel lubricants such as lead foil, or salt compositions used as flash suppressants, left on the burning ground.

The only other residue should be the remains of charge bags or igniters.

7 Other explosive hazards

This Handbook has been produced primarily to give guidance to planners and managers directly involved in the post-conflict destruction of small arms, light weapons and associated ammunition. However, in any post-conflict situation it would be unusual to find only these items in isolation. Therefore, the manager or planner should have an overview of other explosive items that may be present in the theatre of operations, and that could impede, delay or otherwise affect the safe and efficient collection and destruction of SALW. These are:

- Landmines
- Booby-traps
- Unexploded ordnance
- Stockpiles of large calibre munitions
- Unstable munitions

In order to implement a safe and efficient programme, it may well be the case that one or more of the above associated problems will have to be dealt with prior to the commencement of operations. Specialist assistance should be sought in dealing with these problems. Non-governmental organizations, government departments and the military will all have experts whose assistance should be sought. For example, there is now available a containerized system that will safely and quickly deal with large quantities of H.E. shell. This system uses heated paraffin to remove the explosives from shells; the explosives can then be used for the destruction of SALW or associated ammunition.

Annex A
Definitions and terminology[2]

A.1
accident
an undesired event which results in **harm**

Note: Modified from definition in OHSAS 18001:1999.

A.2
amended protocol II (APII)

Note: Amended Protocol II (APII) to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (CCW) prohibits the use of all undetectable **anti-personnel mines** and regulates the use of wider categories of **mines**, **booby-traps** and other devices. For the purposes of the International Mine Action Standards (IMAS), Article 5 lays down requirements for the **marking** and **monitoring** of **mined areas**. Article 9 provides for the recording and use of information on **minefields** and **mined areas**. The Technical Annex provides guidelines on, *inter alia*, the recording of information and international signs for **minefields** and **mined areas**.

A.3
ammunition
See **munition**

A.4
anti-handling device
a device intended to protect a mine and which is part of, linked to, attached or placed under the mine and which activates when an attempt is made to tamper with or otherwise intentionally disturb the mine [Mine-Ban Convention]

A.5
anti-personnel mines (APM)
a mine designed to be exploded by the presence, proximity or contact of a person and that will incapacitate, injure or kill one or more persons

Note: Mines designed to be detonated by the presence, proximity or contact of a vehicle as opposed to a person, that are equipped with anti-handling devices, are not considered anti-personnel mines as a result of being so equipped. [Mine-Ban Convention]

A.6
bomblet
see **submunition**

[2] These definitions are consistent with those used by the International Organization for Standardization (ISO) and IMAS 04.10 *Glossary of mine action terms and abbreviations*. See ISO Guide 51: 1999 (E), *Safety aspects - Guidelines for their inclusion in standards*.

A.7
booby trap
an **explosive** or non-explosive device, or other material, deliberately placed to cause casualties when an apparently harmless object is disturbed or a normally safe act is performed

A.8
burning ground
an area authorized for the destruction of **ammunition** and **explosives** by burning

A.9
buy back
"The direct linkage between the surrender of weapons, ammunition and explosives in return for cash". [3]

Note: Buy Back schemes have been practised in the past, but the concept is often unacceptable to international donors. There is a perception that such schemes reward irresponsible armed personnel who may have already harmed society and the innocent civilian population. They also provide the opportunity for an individual to conduct low level trading in SALW.

A.10
cluster bomb unit (CBU)
an expendable aircraft store composed of a dispenser and **sub-munitions.** a bomb containing and dispensing **sub-munitions** which may be **mines** (anti-personnel or anti-tank), penetration (runway cratering) bomblets, fragmentation bomblets etc.

A.11
commercial off-the-shelf (COTS)
in the context of mine action equipment **procurement**, the term refers to …. an **equipment** that is available direct from the manufacturer and requires no further development prior to introduction into service apart from minor modifications

A.12
cost-effectiveness
an assessment of the balance between a system's performance and its whole life costs

A.13
deflagration
the conversion of **explosives** into gaseous products by chemical reactions at or near the surface of the explosive (**detonation**)

A.14
demobilization
the process by which armed forces (government and/or opposition or factional forces) either downsize or completely disband, as part of a broader transformation from war to peace

[3] Micro-disarmament programmes have also offered food, housing, construction materials or any other tangible benefits in return for the surrender of SALW. These are not considered to be Buy Back programmes as the potential for trading is significantly lower.

Note: Typically, demobilization involves the assembly, quartering, disarmament, administration and discharge of former combatants, who may receive some form of compensation to encourage their transition to civilian life.

A.15
demilitarization
"The complete range of processes that render weapons, ammunition and explosives unfit for their originally intended purpose".[4]

Note: 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.

demolition (dml)
destruction of structures, facilities or material by use of fire, water, **explosives**, mechanical or other means

A.16
demolition ground
an area authorized for the **destruction** of **ammunition** and **explosives** by **detonation**

A.17
destruction
the process of final conversion of weapons, ammunition and explosives into an inert state that can no longer function as designed

A.18
destroy (destruction) *in situ*
blow *in situ*

the **destruction** of any item of ordnance by **explosives** without moving the item from where it was found, normally by placing an **explosive** charge alongside

A.19
detonator
a device containing a sensitive **explosive** intended to produce a **detonation** wave

A.20
detonation
the rapid conversion of explosives into gaseous products by means of a shock wave passing through the explosive (c.f. deflagration. Typically, the velocity of such a shock wave is more than two orders of magnitude higher than a fast deflagration)

A.22
disarmament
the collection, control and disposal of small arms, ammunition, explosives, light and heavy weapons of combatants and often also of the civilian population. It includes the development of responsible arms management programmes

[4] Definition from NATO Maintenance and Supply Agency (NAMSA), Peter Courtney-Green, May 2000.

A.23
disposal (logistic)
The removal of ammunition and explosives from a stockpile by the utilization of a variety of methods (that may not necessarily involve destruction). Logistic disposal may or may not require the use of Render Safe Procedures.

Note: There are five traditional methods of disposal used by armed forces around the world, some of which are obviously not suitable for micro-disarmament programmes. These are; 1) sale; 2) gift; 3) increased use at training; 4) deep-sea dumping; and 5) destruction or demilitarization.[5]

A.24
disposal site
an area authorized for the destruction of **ammunition** and **explosives** by **detonation** and burning

A.25
equipment
a physical, mechanical, electrical and/or electronic system that is used to enhance human activities, procedures and practices

A.26
explosives
a substance or mixture of substances which, under external influences, is capable of rapidly releasing energy in the form of gases and heat

A.27
explosive materials
components or ancillary items used by **demining organizations,** which contain some **explosives**, or behave in an explosive manner, such as **detonators** and **primers**

A.28
explosive ordnance
all munitions containing **explosives**, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and small arms **ammunition**; all **mines**, torpedoes and depth charges; pyrotechnics; clusters and dispensers; cartridge and propellant actuated devices; electro-explosive devices; clandestine and improvised explosive devices; and all similar or related items or components explosive in nature.

A.29
explosive ordnance disposal (EOD)
"The detection, identification, evaluation, render safe, recovery and final disposal of unexploded explosive ordnance. It may also include the rendering-safe and/or disposal of such explosive ordnance, which have become hazardous by damage or deterioration, when the disposal of such explosive ordnance is beyond the capabilities of those personnel normally assigned the responsibility for routine disposal".[6]

[5] This is an obvious area where confusion can be caused due to the use of incorrect terminology or translation. One party may assume that when the other mentions disposal they are really talking about destruction. This may not be the case.

[6] IMAS 11.10, Guide for the destruction of stockpiled anti-personnel mines.

Note: The presence of ammunition and explosives during micro-disarmament operations will inevitably require some degree of EOD response. The level of this response will be dictated by the condition of the ammunition, its level of deterioration and the way that it is handled by the local community.

A.30
fragmentation hazard zone
for a given **explosive** item, explosive storage or **mine**/**UXO** contaminated area, the area that could be reached by fragmentation in the case of detonation

Note: Several factors should be considered when determining this zone; the amount of explosive, body construction, type of material, ground conditions etc. See also [**secondary fragmentation**].

A.31
fuze
a device that initiates an **explosive** train

A.32
harm
physical injury or damage to the health of people, or damage to property or the environment [ISO Guide 51:1999(E)]

A.33
hazard
potential source of **harm** [ISO Guide 51:1999(E)]

A.34
incident
an event that gives rise to an **accident** or has the potential to lead to an accident [ILO C155]

A.35
International Mine Action Standards (IMAS)
documents developed by the UN on behalf of the international community, which aim to improve safety and efficiency in **mine action** by providing guidance, by establishing principles and, in some cases, by defining international requirements and specifications

Note: They provide a frame of reference that encourages, and in some cases requires, the sponsors and managers of mine action programmes and projects to achieve and demonstrate agreed levels of effectiveness and **safety**.

Note: They provide a common language and recommend the formats and rules for handling data, which enable the free exchange of important information; this information exchange benefits other programmes and projects, and assists the mobilization, prioritization and management of resources.

A.36
International Organization for Standardization (ISO)

Note: A worldwide federation of national bodies from over 130 countries. Its work results in international agreements that are published as ISO **standards** and **guides**. ISO is an NGO and the standards it develops are voluntary, although some (mainly those concerned with health, **safety** and environmental aspects) have been adopted by many countries as part of their regulatory framework. ISO deals with the full spectrum of human activities and many of the tasks and processes that contribute to **mine action** have a relevant standard. A list of ISO standards and guides is given in the ISO Catalogue [www.iso.ch/infoe/catinfo/html].

Note: The revised mine action standards have been developed to be compatible with ISO standards and guides. Adopting the ISO format and language provides some significant advantages including consistency of layout, use of internationally recognized terminology, and a greater acceptance by international, national and regional organizations that are accustomed to the ISO series of standards and guides,

A.37
lachrymatory ammunition

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

A.38
mine

munition designed to be placed under, on or near the ground or other surface area and to be exploded by the presence, proximity or contact of a person or a vehicle. [Mine-Ban Convention]

A.39
munition

a complete device charged with **explosives**, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations, including **demolitions**

Note: In common usage, "munitions" (plural) can be military weapons, ammunition and equipment.

A.40
neutralize

the act of replacing safety devices such as pins or rods into an explosive item to prevent the fuze or igniters from functioning

Note: It does not make an item completely safe as removal of the safety devices will immediately make the item active again (c.f. **disarm**)

Note: A mine is said to be neutralized when it has been rendered, by external means, incapable of firing on passage of a target, although it may remain dangerous to handle.

A.41
render safe procedure (RSP)

"The application of special explosive ordnance disposal methods and tools to provide for the interruption of functions or separation of essential components to prevent an unacceptable detonation".[7]

A.42
reintegration

assistance measures provided to former combatants that would increase the potential for their and their families' economic and social reintegration into civil society

[7] Definition from NATO Maintenance and Supply Agency.

Note: Reintegration programmes could include cash assistance, or compensation in kind, as well as vocational training, income-generating activities and participation in sustainable development programmes.

A.43
risk
combination of the probability of occurrence of **harm** and the severity of that **harm**
[ISO Guide 51:1999(E)]

A.44
risk analysis
systematic use of available information to identify **hazards** and to estimate the **risk**
[ISO Guide 51:1999(E)]

A.45
risk assessment
overall process comprising a **risk analysis** and a **risk evaluation**
[ISO Guide 51:1999(E)]

A.46
risk evaluation
process based on **risk analysis** to determine whether the **tolerable risk** has been achieved [ISO Guide 51:1999(E)]

A.47
risk reduction
actions taken to lessen the probability, negative consequences or both, associated with a particular **risk**

A.48
safe
the absence of risk; normally the term **tolerable risk** is more appropriate and accurate

A.49
safety
the reduction of risk to a tolerable level [ISO Guide 51:1999(E)]

A.50
secondary fragmentation
in an explosive event, fragmentation that was not originally part of the mine/UXO

A.51
small arms and light weapons (SALW) [8]

[8] Examples of SALW include pistols, rifles, assault rifles, machine guns, light support weapons, grenade launchers, cannon (>37mm), light mortars, light anti-tank weapons, shoulder launched surface-to-air missiles (SAM), high explosive (HE) grenades, anti-personnel mines (APM), anti-tank mines (A/Tk) and small arms ammunition (SAA).

Note: There are a variety of definitions for SALW circulating and international consensus on a "correct" definition has yet to be agreed. For the purposes of this Handbook the following definition will be used:

"Broadly speaking, small arms are those weapons designed for personal use, and light weapons are those designed for use by several persons serving as a crew. The category of small arms includes revolvers and self-loading pistols, rifles and carbines, sub-machine guns, assault rifles and light machine-guns. Light weapons include heavy machine-guns, hand-held under-barrel and mounted grenade launchers, portable anti-aircraft guns, portable anti-tank guns, recoilless rifles, portable launchers of anti-tank missile and rocket systems, portable launchers of anti-aircraft missile systems, and mortars of calibres of less than 100 mm".[9]

A.52
standing operating procedures (SOPs)
standard operating procedures

instructions that define the preferred or currently established method of conducting an operational task or activity

Note: Their purpose is to promote recognizable and measurable degrees of discipline, uniformity, consistency and commonality within an organization, with the aim of improving operational effectiveness and safety. SOPs should reflect local requirements and circumstances.

A.53
stockpile
in the context of mine action, the term refers to a large accumulated stock of explosive ordnance (EO).

A.54
stockpile destruction
the physical destructive procedure towards a continual reduction of the national **stockpile**

A.55
submunition
any **munition** that, to perform its task, separates from a parent **munition**
mines or **munitions** that form part of a **cluster bomb**, artillery shell or missile payload.

A.56
tolerable risk
risk that is accepted in a given context based on current values of society
[ISO Guide 51:1999(E)]

A.57
Unexploded Ordnance (UXO)
"explosive ordnance which has been primed, fuzed, armed or otherwise prepared for action, and which has been dropped, fired, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel or material and remains unexploded either by malfunction or design or for any other cause".[10]

[9] Report of the Secretary-General on small arms, A/54/258, 19 August 1999.

[10] Definition from NATO Maintenance and Supply Agency.

Note: The distinction between anti-personnel mine (APM) and UXO should be explained at this stage. UXO, by definition, is ammunition that has failed to function as intended yet still presents a dangerous hazard to individuals. In contrast, APMs are a (generally) hidden explosive danger waiting to be initiated by the victim. They have not yet failed and therefore can not be defined as UXO, although similar techniques are required to render them safe.

A.58
voluntary surrender
the physical return by an individual(s) or community of small arms and light weapons to the legal government or an international organization with no further penalty

A.59
weapons in exchange for development
the indirect linkage between the voluntary surrender of small arms and light weapons by the community as a whole in exchange for the provision of sustainable infrastructure development by the legal government, an international organization or NGO

A.60
workplace
all places where employees need to be or to go to by reason of their work and which are under the direct or indirect control of the employer [ILO R164]

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Annex C
Summary of small arms destruction techniques

SER	TECHNIQUE / TECHNOLOGY	EXPLANATION	EXAMPLE COUNTRY	ADVANTAGES	DISADVANTAGES
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
1	Band saw	The use of industrial band saws to cut SALW into unusable pieces.		❑ Limited training. ❑ Simple.	❑ Labour-intensive. ❑ Minimum of 3 cuts per weapon, dependent on type. ❑ Inefficient.
2	Burning	The destruction of SALW by open burning using kerosene.	Mali Nicaragua	❑ Cheap and simple. ❑ Highly visible and symbolic. ❑ Limited training requirements.	❑ Labour-intensive. ❑ Environmental pollution. ❑ Not particularly efficient. ❑ Visual inspection essential, but difficult.
3	Cement	Cast weapons into cement blocks.		❑ Cheap and simple. ❑ Limited training.	❑ Recovery possible, but very labour intensive to achieve. ❑ High landfill requirements. ❑ High transport requirements to landfill. ❑ Final accounting difficult.
4	Crushing by armoured fighting vehicles (AFV)	The use of AFVs to run over and crush the SALW.	Yugoslavia	❑ Cheap and simple. ❑ Highly visible and symbolic. ❑ Limited training requirements.	❑ Not particularly efficient. ❑ Visual inspection essential.

SER	TECHNIQUE / TECHNOLOGY	EXPLANATION	EXAMPLE COUNTRY	ADVANTAGES	DISADVANTAGES
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
5	Cutting by oxy-acetylene or plasma	The use of high temperature cutting technology to render the SALW inoperable.		❑ Established and proven method. ❑ Cheap and simple. ❑ Limited training requirements. ❑ Equipment available worldwide. ❑ Maintenance free.	❑ Labour-intensive. (One operative can process 40 weapons per hour). ❑ Risk of small functioning components (Bolts etc) not being destroyed.
6	Cutting using hydro-abrasive technology	The use of hydro-abrasive cutting technology.		❑ Limited training requirements. ❑ Technology readily available. ❑ High production levels possible using automation. ❑ Environment-ally benign.	❑ Medium initial capital costs. ❑ Equipment requires transporting to affected country.

SER	TECHNIQUE / TECHNOLOGY	EXPLANATION	EXAMPLE COUNTRY	ADVANTAGES	DISADVANTAGES
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
7	Cutting by hydraulic shears	The use of hydraulic cutting and crushing systems.	Australia Canada South Africa	❑ Limited training requirements. ❑ Technology readily available. ❑ High production levels possible using automation. ❑ Environment-ally benign.	❑ Medium initial capital costs. ❑ Equipment requires transporting to affected country.
8	Deep-sea dumping	The dumping at sea in deep ocean trenches of SALW.		❑ Traditional technique. ❑ Efficient.	❑ Constraints of Oslo Convention. ❑ More environmentally benign than many other techniques.
9	Detonation	The destruction of SALW by detonation using donor high explosives.		❑ Highly visible and symbolic. ❑ Destruction guaranteed if sufficient donor explosive used.	❑ Labour-intensive. ❑ Environmental pollution. ❑ Requires highly trained personnel. ❑ Expensive in terms of donor explosive.

SER	TECHNIQUE / TECHNOLOGY	EXPLANATION	EXAMPLE COUNTRY	ADVANTAGES	DISADVANTAGES
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
10	Dismantling and recycling	The use of industrial process to dismantle and then recover raw materials.	Germany	❑ Destruction guaranteed. ❑ Some costs recovered by sale of scrap. ❑ High maintenance requirements.	❑ High initial capital costs to develop facility. ❑ Only cost-effective for large quantities of SALW in developed countries.
11	Shredding	The use of industrial metal shredding technology.	Australia Canada	❑ Highly efficient. ❑ Limited training requirements. ❑ Technology readily available. ❑ High production levels possible using automation. ❑ Environmen-tally benign.	❑ High initial capital costs. ❑ Equipment requires transporting to affected country.

SER	TECHNIQUE / TECHNOLOGY	EXPLANATION	EXAMPLE COUNTRY	ADVANTAGES	DISADVANTAGES
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
12	Safe storage	The storage of recovered weapons in secure accommodation.	Albania	❑ Cheap and simple. ❑ SALW move under direct control of national government or international organization.	❑ Potential for proliferation in the future exists if there is a significant political change of circumstances.

Annex D
Equipment manufacturers and suppliers

The following list is intended to be representative only; it is hoped that manufacturers and distributors will make themselves known to the United Nations Department for Disarmament Affairs, so that periodic updates of this annex can be issued.

Crushing Machines
MORMAK Equipment Ltd.
8140 Highway 97, Vernon, BC,
Canada V1B 3V3.
Tel. (250) 542-7350
Fax. (250) 542-0571
http://www.mormak.com/about.html

Hydraulic Shears/Presses
Birim Makina Sanayi ve Ticaret Ltd, Sti.
4. Sanayi Sitesi, 129/4 sok. No:30
Izmir, Turkey
Tel. +90 (232) 375 58 10
Fax. +90 (232) 375 57 05
http://www.birimmakina.com.tr/location.htm

NuGen Machineries Ltd.
16,17,18 Changodar Industrial Estate,
Sarkhej-Bawla Highway, Changodar 382 2.1 Ta,
Sanand District, Ahmedabad,
Gujarat, India
Tel. 91-2717-50963
Fax. 91-2717-50310
http://www.nugenindia.com/

Oxy-Acetylene Cutting
Welding Tool Supplies,
Business and Technology Centre,
Bessemer Drive, Stevenage, Herts,
England SG1 2DX
Tel. 0438 310090
Fax. 0438 350022
http://www.genet.demon.co.uk/wts_acet.htm

Macdermid & Co., Inc.
Pelham Manor, New York 10803
USA
Tel. 1-800-505-3687
Henrob2000@yahoo.com

American Welding Society
550 NW LeJeune Road
Miami, FL 33126
Tel. (305) 443-9353
Fax. (305) 443-7559
E-mail. webmaster@aws.org
http://www.aws.org

Oxy-Gasoline Cutting
Petrogen Inc.
P.O.Box 1778,
San Leandro, CA 94577
USA
Tel. (510) 569-7877
Fax. (510) 569-8070
http://www.petrogen.com/welcome.html

Rotary Kilns
El Dorado Inc.,
2964 West-4700 South,
Suite 109, Salt Lake City,
Utah 84118, USA

Explosive De-canting
Federal State Unitary Enterprise
“SRPE – BAZALT”
105058 Moscow, Russia
Tel: (095) 369-0122
Fax: (095) 369-2418
http://www.bazalt.ru

Pre-Used Equipment
Machine Net Pty Ltd.,
118 Canarvon St.,
Silverwater, New South Wales,
Australia 2141
Tel. 61-2-97379597
Fax. 61-2-97379707
http://www.machinenet.com.au