Technical Note 10.10 / 02

Issue 1.0 - 1 July 2004

Technical notes for mine action

TNMA

Safety Notes – General

Warning

This document is distributed for use by the mine action community, review and comment. Although in a similar format to the International Mine Action Standards (IMAS) it is not part of the IMAS Series. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation. Comments should be sent to technical@gichd.ch.

The contents of this document have been drawn from a range of open source information, and have been technically validated as far as reasonably possible. Users should be aware of this limitation when utilising the information contained within this document. **They should always remember that this is an advisory document only; it is not an authoritative directive.**

Contents

Foreword

Management practices and operational procedures for mine action are constantly evolving. Improvements are made, and changes are required, to enhance safety and productivity. Changes may come from the introduction of new technology, in response to a new mine or UXO threat, and from field experience and lessons learned in other mine action projects and programmes. This experience and lessons learned should be shared in a timely manner.

Technical Notes for Mine Action (TNMA) provide a forum to share experience and lessons learned by collecting, collating and publishing technical information on important, topical themes, particularly those relating to safety and productivity. Technical Notes complement the broader issues and principles addressed in International Mine Action Standards (IMAS).

The preparation of Technical Notes follows a rapid production and approval process. They draw on practical experience and publicly-available information. Over time, some Technical Notes may be 'promoted' to become full IMAS standards, while others may be withdrawn if no longer relevant or if superseded by more up-to-date information.

Technical Notes are neither legal documents nor IMAS. There is no legal requirement to accept the advice provided in a Technical Note. They are purely advisory and are designed solely to supplement technical knowledge or to provide further guidance on the application of IMAS.

Technical Notes are compiled by the Geneva International Centre for Humanitarian Demining (GICHD) at the request of the United Nations Mine Action Service (UNMAS) in support of the international mine action community. They are published on the James Madison University (JMU) website (http://www.hdic.jmu.edu/) and the GICHD website (http://www.gichd.ch/).

Introduction

IMAS 10 .60 gives guidance on how to investigate and report demining incidents. Information from these investigations should be widely disseminated so that others may learn from any lessons immediately apparent. In addition, all Mine Action Programmes have been requested to forward demining accident reports to the Database of Demining Accidents (DDAS) held, and maintained, by the Geneva International Centre for Humanitarian Demining (GICHD). The DDAS is introduced below.

With the flow of information immediately following an accident, or incident, in the demining work place, a number of general conclusions and lessons can be immediately obvious. UNMAS, as the central coordinating body for mine action, has a responsibility to disseminate lessons learnt to all other programmes and this TNMA is a means by which immediate safety lessons can be disseminated.

It is intended that this TNMA will be periodically updated with new issues including new information being extracted from demining accidents. Before information is published in this TNMA it will be discussed within the UN agencies concerned with mine action support (UNMAS, UNDP and UNOPS) and GICHD. The information will be supported by a notification to all mine action programmes and extracted abbreviated information will be posted on a safety page of the E_MINE Website, mineaction.org. At the same time the James Madison University Lessons Learnt database will extract and include relevant lessons.

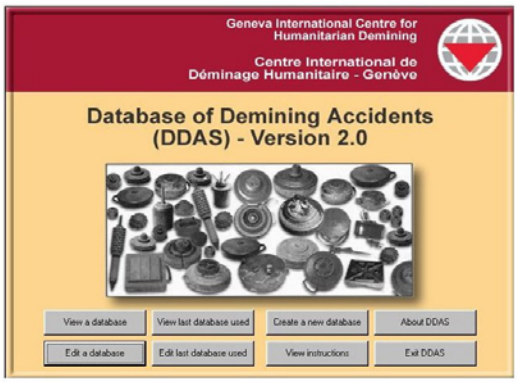
The dissemination of information from accident reports and incident investigations is not an exercise to apportion blame. The intention is only to pass on general lessons learnt and safety messages and the source of the information will not be published, nor will names of units or individuals.

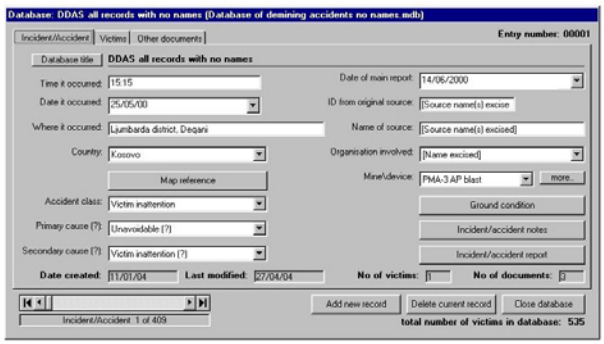
Safety issues considered relevant but not resulting from demining accidents or incidents should be sent to UNMAS or GICHD for possible inclusion in subsequent versions or updates of this TNMA and other lessons learnt databases.

While many of these safety messages included below may seem obvious they have all been highlighted as a result of recent accidents or have been extracted from a large number of accidents and so should be shared. Section 1 contains observations extracted from recent accidents and Section 2 contains recommendations taken from the Database of Demining Accidents. In this case hard evidence, extracted from several accident investigation reports, has indicated trends and so the recommendations should be taken most seriously.

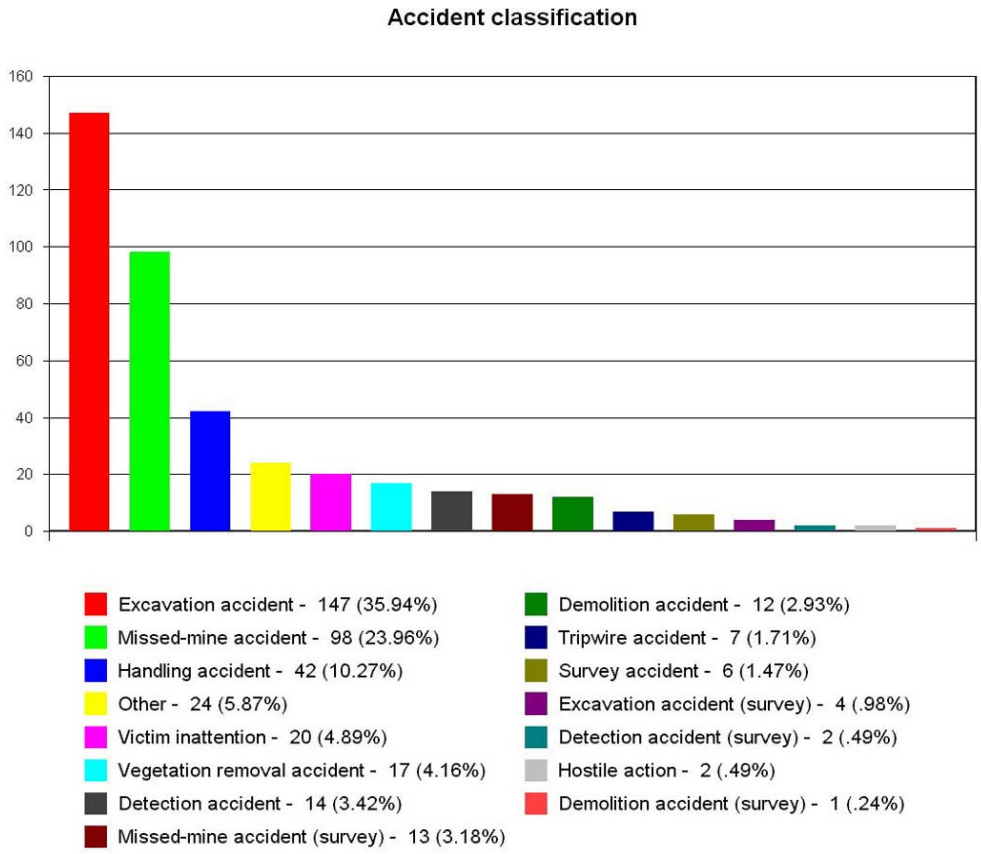
What is the DDAS?

The DDAS is a collection of demining accident reports held in a specially designed database. As at June 2004, there are 410 accidents recorded, involving 535 injuries, from 12 countries. Complete Board of Inquiry reports are duplicated inside the database, along with medical reports and related documents (names of individuals and organisations are removed.) This allows complex searching and querying. Results are then checked against the original Board of Inquiry reports before inferences are drawn.





While complex queries require some knowledge of the database structure, simple queries can generate graphical reports like that shown below.



The more records there are in the database, the more confidence we can have about lessons derived from it. When a significant percentage of accidents share a common feature, general inferences can be legitimately derived and the general lessons resulting can be compelling.

Safety Notes - General

1. Scope

This Technical Note highlights immediate lessons learnt from the initial reports of demining accidents and incidents as well as recommendations from an analysis of the Database of Demining Accidents (DDAS). It aims to disseminate the information to all concerned, as soon as possible, so that many may learn from the experiences of a few.

2. References

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

3. Terms and definitions

In the Technical Notes series, the words 'should' and 'may' are used to indicate the intended degree of compliance. This use is consistent with the language used in International Mine Action Standards (IMAS), and guides.

a) 'should' is used to indicate the preferred requirements, methods or specifications; and

b) 'may' is used to indicate a possible method or course of action.

SECTION 1 – Issues arising from recent accidents

4. Standing Operating Procedures

SOPs are written for the safety of individuals and to provide clear instructions for processes. They are based on wide experience. It is an indisputable fact that the majority of accidents could have been avoided and were caused by a breach of one or more SOPs. There can only be one simple rule for SOPs – WORK ACCORDING TO APPROVED SOPs

Some ideas to keep SOPs relevant:

1) Discuss SOPs at regular intervals;

2) Listen to deminers who make suggestions to change SOPs;

3) Select one SOP daily to concentrate on it – compliance, review, amendment;

4) Remain flexible – Managers should be prepared to change SOPs if required.

5. Mine models and displays

As a general rule, all mines/UXO should be destroyed in situ. In this way there would never be the need to “lift” mines/UXO. However, for many reasons it may sometimes be necessary to lift and remove mines. IMAS gives guidance on when this is acceptable and this should only ever be done by approved personnel. Certain mines/UXO are generally considered unsafe to disarm, such as the Israeli No 4A and PMN-2 mine and the KB-1 sub-munition. National standards and SOPs should make specific reference to such items where applicable.

Although it may seem obvious to state that any mine/UXO that has been removed from a minefield, or removed from storage, for the purposes of displays, exhibitions, training or testing of equipment, should always be made free from explosive (FFE) by an expert, accidents have happened through the handling of mines and UXO that were still live and in a dangerous state.

Some simple rules should be adhered to when mines and UXO are used for any public display or training. They include:

1) All mine/UXO display and training items should be FFE. Items manufactured as training items may already be FFE but, surprisingly, this is not always the case - CHECK!

2) All mine/UXO display and training items should be certified and clearly identified as FFE, and marked with a unique reference number;

3) All mine/UXO display and training items should be recorded in a Register;

4) The Register should clearly state who rendered the mine/UXO FFE and when;

5) CHECK YOUR DISPLAY AND TRAINING ITEMS NOW. CHECK THEM REGULARLY. Make someone responsible for the process.

6. Accident Reporting and Investigations

All accidents and incidents should be reported in accordance with IMAS 10.60. Relevant information should be disseminated through UNMAS who will make the information available through the most suitable means. This TNMA is such a method of dissemination. The JMU Lessons Learnt database is an additional method of making lessons learnt known to others.

Investigations should be conducted by appropriately qualified and experienced 3rd party personnel. To avoid allegations of influence, or conflict of interest, consideration should be given to requesting a totally independent, possibly international, investigating body. Assistance and advice can be provide through UNMAS if required.

Mine Action Investigations are intended to derive lessons and not to apportion blame. However, if at any time it is inferred or there is sufficient reason to believe that a criminal charge may result, the situation should be handed over to the national police authorities as soon as possible. Where possible, a parallel investigation to derive mine action lessons should be continued.

7. Working on- and off-duty

Deminers should be reminded that if approached when off-duty with a request for help, they should not forget on-duty SOPs nor should they reduce safety standards to solve an immediate problem. Reducing safety standards at any time risks lives. Demining is a team activity, and always requires the presence of a supervisor, a medic, a safety vehicle and communications.

When off-duty:

1) Report requests for assistance to your supervisor, if possible, before you do anything;

2) Mark, warn local inhabitants and report items reported to you;

3) Do not approach mines or UXO without standard on-duty personal protection and medical backup;

4) Never reduce normal standards when "working" or acting in a helpful manner off duty;

5) Always tell someone what you are going to do - even if acting off-duty.

8. Hearing and Listening

Deminers rely heavily on their hearing to be able to detect mines and UXO. Good hearing can detect small changes in detector signals - bad hearing can miss them. Loud background noise or interference can also distract deminers. Most organisations check technical equipment regularly but how often do they check the hearing of the deminers?

Some points to consider;

1) Deminers should have proven good hearing and it should be checked annually;

2) Loud interference such as strong wind and road noise can reduce the ability to hear;

3) Consider stopping work in high winds;

4) Listen to a deminer when he says he cannot hear the metal detector signals.

9. Tiredness kills!

We can all accept that driving cars too long can be dangerous, so too can listening to a metal detector for too long. Local SOPs will state the length of time a deminer should operate and this is set for a reason.

Some points to emphasize;

1) Do not work longer periods than expected in SOPs;

2) Do not make “arrangements” with colleagues when working in pairs if it means changing work periods;

3) If tired, or unwell, deminers should tell their Supervisors who should make a decision on whether they should continue work;

4) Deminers should take breaks as directed. There should be no work in a break;

5) Shorten commuting distances to work by moving field camps if necessary.

10. Clearing Pattern Minefields

Minefield records can provide a great deal of information about what may be in the minefield and where. Do not ignore this information and pay attention to patterns that are either expected or apparent once demining has started. If there is a gap in the sequence, or a missing mine, deminers should STOP and EVALUATE. They should report, and not ignore, until an explanation for the absence has been found or the missing mine has been located. Accidents have a occurred through ignoring an apparently “missing” mine in a pattern.

Some thoughts for the Supervisors and Deminers;

1) Watch the pattern;

2) Place markers where mines have been found to highlight the pattern;

3) Think ahead;

4) Investigate anomalies;

5) But, always remember, the record may not be 100% accurate.

SECTION 2 – Issues arising from DDAS analysis

11. Visors

11.1. The effects of sunlight on visors

Users should be aware that the polycarbonate material from which blast-visors are made is adversely affected by prolonged exposure to sunlight (Ultra Violet light: UV). The effect of sunlight is to create hardened areas from which a crack may propagate. Visors have "shattered" is some recorded accidents, and a follow-up indicates that these visors had been in use for several years. The number of hours and the intensity of the UV to which they were exposed cannot be reliably estimated.

A visor that shatters in an anti-personnel mine blast event can add to the wearer's injuries. Eye loss has resulted.

Polycarbonate can be chemically treated during manufacture to provide a measure of UV resistance. The effectiveness of the various UV treatments is not known but some lead to a reduction in the optical clarity of the material. Visors manufactured with UV resistant properties should be subjected to NATO STANAG 2920 V50 fragmentation testing to ensure that the level of fragmentation resistance is not lower than that achieved with untreated polycarbonate and should also be checked for optical properties before purchase.

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) visors manufactured from untreated polycarbonate are replaced annually or every 225 days of use in order to minimise risks of degraded protection as a result of UV exposure;
2) visors are marked with identifiers so that their use can be recorded and audited and replacement made at timely intervals.

These recommendations do not necessarily apply to the visor's mounting, frame or helmet, which may have a longer service life.

11.2. Using visors attached to helmets

IMAS 10.30 requires that:

"eye protection …. providing full frontal coverage of face and throat as part of the specified frontal protection ensemble" be provided.

Users are advised that many short visors attached to helmets do not provide full frontal coverage of the face and throat and it is not only the lower face and throat that are at greater risk as a result.

The DDAS has records of more than a dozen accidents where the victims were wearing helmets and visors with the visor "down", but they had tilted the helmet back and looked out beneath the bottom edge of the visor. This provided a direct line of flight for fragments from a detonation to enter their eyes and eye loss has resulted.

Visors attached to helmets that were designed for military use often stand some distance from the face and flare towards the bottom. This allows good ventilation, but was not designed to protect against a threat that comes predominantly from below (the most common demining accident occurs while prodding/excavating).

This helmet and visor were used in an accident involving an eye injury

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) short visors attached to helmets are replaced by longer versions that provide “full frontal coverage of face and throat”;
2) helmet visors are always used in a fully closed position;
3) purchasers consider replacing combat helmets with alternatives that provide ventilation while allowing the visor to be closer to the wearer’s face;
4) purchasers consider buying visors that do not have hinges that allow them to be raised.

11.3. Visor maintenance

Polycarbonate visors are easily scratched, especially in dusty environments. Once scratched vision is impaired.

Users are advised that polycarbonate is porous and the use of chemical polishes and abrasives on a visor face may have unpredictable results on the protective properties of the material. The use of abrasives will reduce the thickness of the material and should be avoided.

It is recommended that:

1) the only polish applied to untreated polycarbonate should be a high-quality, smooth toothpaste. The cloth used should be should be dust and grit free: the soft lint material used for cleaning spectacles is usually suitable;
2) a regime of visor maintenance by washing with clean soapy water and storing in soft, dust free bags (with a strong outer) should be enforced; (note: use soap not detergent! Hand soap is ideal and liquid detergents are not a substitute.);
3) appropriate means of protecting visors in transit should be devised;
4) visors should be checked regularly and replaced whenever their condition restricts visibility and compromises safety.

Polycarbonate can have its outer surfaced hardened. This makes the material a little more resistant to the light scratching that is common, but less flexible because the outer surface is hard. Generally, visors with a hardened outer surface must be thicker and heavier in order to provide the same level of blast protection as an untreated example. The hardened surface of a treated visor should only be polished using methods and materials recommended by the manufacturer.

11.4. Wearing visors down or “closed”

In almost a quarter of all accidents recorded in the DDAS, a visor was issued but either not worn or not worn in a “closed” position. In more than half of these, severe eye injury or eye-loss has occurred. In some cases the condition of the visor was such that the victim raised the visor on finding a mine because he wanted to see it clearly. In others the visor was worn partly

raised as an apparent habit. Accident investigators and senior demining staff are frequently photographed in the mined area without visors or with visors raised and have submitted these photographs as part of their reports, apparently without being aware of the example they are setting.

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) supervisors and visitors to the field are reminded to consider safety and that they must set an example by wearing visors in accordance with SOPs at all times;
2) when selecting visors, make sure that they fit properly and are held securely at an appropriate angle.
3) purchasers should consider buying visors that are fixed in a down position;
4) SOPs regarding the use of visors in a “closed” position when excavating/prodding should be enforced.

12. Long hand tools

The use of tools designed specifically for demining is spreading. Using varied designs and materials, one feature that almost all have in common is increased length. This allows the user’s hand to be further from any accidental detonation.

The Velocity of Detonation of a small device is usually high enough to cause severe hand injury or loss when the hand is directly above or within 15cm of the detonation. There are exceptions, but a study of accidents in the DDAS shows that severe injury is very common. The speed of the advancing blast front decreases dramatically with distance, and this is especially apparent with small devices such as anti-personnel blast mines. At 30cm distance from the largest anti-personnel blast mine, and to one side, the evidence in the DDAS indicates that it is reasonable to expect severe hand injury to be avoided. That said, if the hand is directly above the mine, it is likely to be severely injured by fragments of mine casing, earth and stones regardless of the increased distance.

In the past, it has been argued that tools of a 30cm blade length are unwieldy and difficult to use. Demining organisations using the tools do not report this problem, although it may be true when the tool is unusually heavy.

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) excavation and prodding tools are designed so that the user’s hands are at least 30cm from the possible point of initiation;
2) SOPs covering the angle of approach (30° or less) should be reinforced.
3) that awareness training on the use and design of tools and blast effects is enforced.

13. Prodding and excavation tools

The inquiries into several accidents that have occurred during prodding/excavation have concluded that the victim did not have adequate tools for the task. In some the deminer only had a prodder, and in some he only had a trowel. It was widely felt that more than one tool was needed in order to both prod and move spoil safely aside.

Other accidents have occurred while using light pickaxes, mattocks and hoes for excavation. Usually these are used from one side to shave the face of an excavation in order to get close to an indication. When used in area-excavation, they are used after the ground has been investigated with a prodder. The accidents have occurred when the victim has struck an anti-

personnel blast mine with the blade of the tool. The tools have frequently broken and the parts of the wooden handles caused injury.

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) demining organisations ensure that deminers are equipped with suitable tools for prodding/excavation, which are (as a minimum) a thin prodder and a trowel or other tool designed for spoil removal;
2) demining organisations using pickaxes, mattocks or hoes for excavation should use tools that are designed to stay in one piece in the event of an accident. This may involve welding the tool-head to a thin metal pipe or constructing the tool from a single piece of metal stock.

14. Supervisors and handling of devices

One in five recorded accidents in the DDAS involved a person in a supervisory role. Generally, the ratio of deminers to supervisors is greater than one in five, from which it can be inferred that a supervisor is at a slightly higher risk of suffering an accident than a deminer. This may not be surprising because supervisors often have to set charges and deal with tasks such as "handling" devices. What may be surprising is that in 50% of accidents involving supervisors, the supervisor was not wearing the PPE approved by his/her demining organisation.

Also, in 45% of all handling accidents recorded in the DDAS the victim was a supervisor, and in a quarter of those, there was more than one victim. From this is can be inferred that the supervisors were not enforcing the appropriate safety distances.

Drawing inferences from the available evidence in the DDAS, it is recommended that:

1) supervisors, managers, senior staff and advisors should be reminded that safety distances and all SOPs also apply to them;
2) safety distances between a person handling a device and other individuals should be rigidly enforced;
3) supervisors should be reminded to refrain from "showing" others what they do outside a training environment;
4) supervisors should be reminded that they must wear the appropriate PPE for the task, even if their SOP does not require them to wear full PPE when outside the working lanes.

15. Responsibilities

15.1. National mine action authorities

It is the responsibility of the National Mine Action Authority to ensure that the managers of all local demining teams, NGOs or commercial companies are aware of the existence of this Technical Note.

15.2. Demining organisations

It is the responsibility of the management of local demining teams, NGOs or commercial companies to pay attention to this Technical Note, and incorporate the recommendations into SOPs where appropriate. If no National Mine Action Authority exists, it is their responsibility to ensure that all demining teams are aware of the recommendations in this Technical Note.

15.3. Demining personnel

It is the responsibility of all field staff, whether deminers or EOD, to adhere to SOPs, to carry out the recommendations in this Technical Note to the best of their ability, and to inform their management if compliance with the recommendations cannot be achieved.

Annex A
(Normative)
References

The following documents, when referred to in the text of this Technical Guide, form part of the provisions of this guide.

a) IMAS 04.10. Glossary of demining terms; and

b) IMAS 10.60 Accident investigation and reporting.

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

The latest version/edition of the Technical Notes can be read on the GICHD web site: (http://www.gichd.ch/) or www.mineactionstandards.org .

Annex B
(Informative)
Terms and definitions

1.1. accident

an undesired event which results in harm

Note: modified from definition in OHSAS 18001:1999

1.2. deminer

a person, including public servant, qualified and employed to undertake **demining** activities or work on a **demining worksite**

1.3. demining accident

an accident at a demining workplace involving a mine or UXO hazard (c.f. mine accident)

1.4. demining incident

an incident a demining workplace involving a mine or UXO hazard (c.f. mine incident)

1.5. demining

the survey and subsequent **clearance** of contaminated land by the **detection**, removal or **destruction** of all **mine** and **UXO hazards**. Demining may be carried out by different types of organisations, such as NGOs, commercial companies, national mine action teams or military units. Demining may be emergency-based or developmental.

1.6. demining organisation

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

1.7. demining workplace

workplace where demining activities are undertaken.

Note: Includes sites where survey, clearance and EOD activities are undertaken including centralised disposal sites used for the destruction of mines and UXO identified and removed during clearance operations.

1.8. 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. [AAP-6]

1.9. explosive ordnance disposal (EOD)
the **detection**, identification, evaluation, **render safe**, recovery and **disposal** of **UXO**. EOD may be undertaken:

a) as a routine part of mine **clearance** operations, upon discovery of the UXO.

b) to dispose of UXO discovered outside **mined areas**, (this may be a single UXO, or a larger number inside a specific area).

c) to dispose of **explosive ordnance** which has become **hazardous** by damage or attempted destruction.

1.10. incident

an event that gives rise to an accident or has the potential to lead to an accident [ILO C155]

1.11. mine accident

an accident away from the demining workplace involving a mine or UXO hazard (c.f. demining accident)

1.12. mine incident

an incident away from the demining workplace involving a mine or UXO hazard (c.f. demining incident)

1.13. personal protective equipment (PPE)

all equipment and clothing designed to provide protection, which is intended to be worn or held by a employee at work and which protects him/her against one or more **risks** to his/her safety or health.

1.14. standing operating procedures (SOPs)

standing operating procedures are instructions which define the preferred or currently established method of conducting an operational task or activity. Their purpose is to promote recognisable and measurable degrees of discipline, uniformity, consistency and commonality within an organisation, with the aim of improving operational effectiveness and safety. SOPs should reflect local requirements and circumstances.

1.15. unexploded ordnance (UXO)

explosive ordnance that has been primed, fuzed, armed or otherwise prepared for use or used. It may have been fired, dropped, launched or projected yet remains unexploded either through malfunction or design or for any other reason.

1.16. United Nations Mine Action Service (UNMAS)

the focal point within the UN system for all mine-related activities. UNMAS is the office within the UN Secretariat responsible to the international community for the development and maintenance of International Mine Action Standards (IMAS)