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Safety & occupational health - Demining worksite safety

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Foreword

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

The scope of these original standards has since been expanded to include the other components of mine action and to reflect changes to operational procedures, practices and norms. The standards were re-developed and renamed as International Mine Action Standards (IMAS) with the first edition produced in October 2001.

The United Nations has a general responsibility for enabling and encouraging the effective management of mine action programmes, including the development and maintenance of standards. UNMAS, therefore, is the office within the United Nations responsible for the development and maintenance of IMAS. IMAS are produced with the assistance of the Geneva International Centre for Humanitarian Demining.

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

Introduction

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

The provision of a safe working environment includes the design and layout of a demining worksite by fencing and marking hazardous areas, controlling the movement of deminers, visitors and the public, establishing and enforcing working distances, and providing effective medical cover and insurance. This requires National Mine Action Authorities (NMAA) and demining organisations to develop and maintain appropriate policy and procedures.

It is necessary to clarify the meaning of the term 'safe' in respect of mine action. To say that a situation is safe does not necessarily imply that all risk has been removed. It merely assumes that the risk has been reduced to a 'tolerable' level, i.e. '.... to a level which is accepted in a given context based on the current values of society'. (See ISO Guide 51.)

Given the wide range of operational settings and mine action activities, it is not possible to provide a precise and complete set of specifications or provisions that apply to all mine action worksites. However, it is possible to state that the greatest risk is faced by the deminers closest to the hazard, with those at a greater distance facing a smaller risk of secondary injury. Mine action organisations should develop and maintain management procedures and processes that will enable Safety and Occupational Health (S&OH) risks in the worksite to be identified, evaluated and reduced in a systematic and timely manner.

This standard provides NMAA and demining organisations with guidance on the development and implementation of policy and documented procedures for establishing and managing a safe worksite. The document is in three parts: clauses 1 to 3 define the scope, references and terms used in the standard; clauses 4 to 7 define the requirements, specifications and responsibilities; and the Annexes provide additional detailed information and guidance on how to apply the standard.

Safety & occupational health - Demining worksite safety

1. Scope

This standard provides specifications and guidance on the development and implementation of policy and documented procedures and practices that aim to establish and maintain a safe demining worksite.

2. References

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

3. Terms, definitions and abbreviations

A complete glossary of all the terms, definitions and abbreviations used in the IMAS series of standards is given in IMAS 04.10.

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

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

The term 'workplace' refers to all places where employees need to be or to go by reason of their work and which are under the direct or indirect control of the employer.

The term 'National Mine Action Authority (NMAA)' refers to the government entity, often an inter-ministerial committee, in a mine-affected country charged with the responsibility for the regulation, management and coordination of mine action.

Note: In the absence of a NMAA, it may be necessary and appropriate for the UN, or some other recognised international body, to assume some or all of the responsibilities, and fulfil some or all the functions, of a MAC or, less frequently, an NMAA.

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

The term 'demining worksite' refers to any workplace where **demining** activities are being undertaken.

Note 1: Demining worksites include workplaces where **technical survey, clearance** and **EOD** activities are undertaken including centralised disposal sites used for the destruction of mines and ERW, (including unexploded sub-munitions), identified and removed during clearance operations.

4. General requirements

The provision of a safe working environment includes the design and layout of a demining worksite by fencing and marking hazardous areas, controlling the movement of deminers, visitors and the local population, establishing and enforcing safety distances, and providing effective medical cover and casualty evacuation procedures. This requires NMAA and demining organisations to establish policies and develop and maintain procedures for worksite safety.

5. Demining worksite layout and procedures

5.1. General requirements

The demining worksite shall be designed to:

- d) provide a clearly visible separation of hazardous areas (including demolition danger areas), cleared areas and useable areas;
- e) ensure that approved working distances are maintained between individual deminers, machines or Mine Detection Dogs (MDD) and other staff on the demining worksite;
- f) control the movement of demining worksite staff and visitors (including members of the public) at the worksite;
- g) control the movement of demining machines and other vehicles;
- h) limit the number of demining worksite staff and visitors allowed into danger areas;
- i) take all reasonable precautions to exclude demining worksite staff, visitors and members of the local population from demolition danger areas during the controlled destruction of mines and Explosive Remnants of War (ERW), or provide suitable protection inside buildings, bunkers or mobile structures; and
- j) include measures to prevent structural and environmental damage.

Note: In the context of this IMAS a hazardous area is the immediate area in which explosive hazards are expected and a danger area, for a particular hazard, is the area within which fragmentation from an explosion of the expected hazard may cause injury. A danger area is greater than a hazard area for a particular hazard.

5.2. Marking of hazardous areas

Safe and hazardous areas within the worksite shall be separated by providing clear and consistent marking. (See IMAS 08.40 for details of hazard marking)

5.3. Demining working distances

Demining working distances are sometimes referred to as safety distances.

During demining, the greatest risk is borne by the deminers who undertake the clearance and are, by necessity, closest to the hazard. There is a secondary and smaller risk to others at the worksite. To reduce the risk of injury to others at a worksite to a tolerable level, demining organisations shall determine appropriate working distances between individual deminers, machines or MDD and other staff on a demining worksite.

Working distances shall be established based on a detailed and documented risk assessment taking into account the hazards associated with the site, the topography of the site and the protection provided to staff by equipment. Annex B describes how to make a detailed risk assessment to determine appropriate working distances to use during manual demining. TNMA 10.20-02/2009 provides guidance on how to conduct an informed Field Risk Assessment. The

principles used to determine working distances appropriate for manual demining may also be used when determining appropriate distances between MDD or machines.

5.4. Demolition safety distances

IMAS 09.30 provides guidance on the safe conduct of EOD operations.

The Danger Area Support Tool included with the IMAS CD, and available on the IMAS website (under IMAS support tools see TNMA 10.20 - estimation of explosion danger areas), provides danger area radii based on the 'all up weight' of mines/ERW being disposed of. This tool may be used to determine safety distances for the controlled demolition of large single item mines or ERW (over 1kg) or for bulk disposal operations. It is not applicable when determining working distances during survey and clearance operations.

The explosion consequence analysis (ECA) tool included with the IATG CD, available from UN ODA, may be used to assess hazards and explosion danger areas in more complex situations, (for example during the EOD clearance after an undesirable explosion within an ammunition storage area). Further details of the principles behind, and development of, an ECA may be found in IATG 02.10 Introduction to risk management principles.

5.5. Determination of danger areas

The extent of the danger area radius should reflect the fragmentation hazard radius of the likely mine/ERW contamination in the worksite. The extent of the danger area should initially be measured from the known outer edges of the hazardous area, but may be moved as demining progresses and the actual locations of mines/ERW is learned.

5.6. Control of entry into danger areas

Demining often proves to be an attractive event for the local population, especially children. Procedures shall be developed for controlling the entry of unauthorised persons into hazardous areas, onto the demining worksite and into danger areas. This should be achieved by:

- a) informing the local population, demining workers and demining worksite visitors of the extent of the worksite, hazardous areas and danger areas;
- b) physically controlling entry into danger areas during the mine or ERW destruction processes by warning signs and positioning sentries; and
- c) marking of hazardous and danger areas. (See IMAS 08.40).

Warning systems should include the following:

- d) warning signs on approach routes (roads, tracks or paths) informing men, women and children that they are entering a hazardous or danger area. Signs should include information on the nature of the hazard or danger and the extent of the area. Signs should also remind demining staff of any need to be wearing Personal Protective Equipment (PPE) whilst inside any danger area;
- e) risk reduction education through briefings or signs or information sheets to men, women and children living or working near a demining worksite, and to the local authorities in the area. The briefings and/or information sheets should include information on the audible warning methods used to advise workers and the local public of the demolition of mines or ERW;
- f) risk reduction education, including site dangers, and the implications of ignoring the directions of demining workers appointed to control access into danger areas; and

- g) documented standards and Standard Operating Procedures (SOPs) should include the use of sentries to control entry into danger areas, warning signs and audible signals to be used during the destruction process.

Planning and execution of demining operations should minimise disruption to the local population, which may need to move through danger areas if they are to subsist or survive. It is unrealistic to expect that the public can be prevented from entering danger areas of whole demining worksites for the duration of the clearance task.

Where the location of a worksite means that the danger area cuts a frequently used road or path the following measures should be considered to ensure access for local populations:

- h) if the worksite is small enough, the demining unit should phase operations in such a way to minimise disruption to the public;
- i) if the worksite is large, the demining organisation should consider the creation of a suitable diversion route; and
- j) if no such diversion route is feasible, the demining unit should consider using protective works.

5.6.1. Traffic control

Where any trafficked road or track passes within a danger area for a demining worksite, traffic should either be diverted through a known safe area or manned traffic control points should be established at all access points. Traffic control points may involve the positioning of physical barriers and signs. Personnel manning traffic control points should have communications with the Demining Worksite Supervisor controlling the demining.

Local authorities should be advised of any requirement for traffic control during demining and their advice and assistance should be sought.

Demining Worksite Supervisors should establish systems to allow demining operations to continue close to trafficked roads and tracks. However, such systems should not jeopardise the safety of demining personnel and the public, and should cause as little disruption as practicable.

5.7. Use of Personal Protective Equipment (PPE)

All personnel required to enter demining worksite danger areas whilst demining is ongoing shall wear PPE that is compliant with the requirements of IMAS 10.30. If demining operations are stopped then use of PPE may be relaxed at the discretion of the Demining Worksite Supervisor.

5.8. Radio Frequency (RF) hazards

On demining worksites where the hazards are assessed as including electrically initiated ordnance, precautions should be taken against RF hazards. These include:

- a) vehicles with radios mounted shall remain outside the boundary of any un-cleared hazardous areas. If vehicles have to move inside, radios shall be switched off; and
- b) staff that are required to carry communication equipment shall turn their communication equipment off if they have to approach electrically initiated UXO or any unidentified UXO.

Communications equipment should not be used in proximity to any electrically initiated detonators used for destruction of mines or ERW unless the detonators are stored separately from explosives in a manner that prevents their initiation.

5.9. Control areas

Effective control of the worksite requires the establishment and clear marking of a number of areas for safety and administration. Such areas shall be outside the relevant danger areas from clearance or demolition activity and explosive storage.

5.9.1. Vehicle parking areas

Vehicle parking areas shall be used or cleared areas large enough to provide safe parking for demining unit and visitor's vehicles. Separate areas may also be required for the unloading/loading of machines.

The boundary of the parking area shall be clearly marked and sign posted. The parking area sign posting should indicate directions to the demining worksite and visitor reporting area. Where appropriate these directions should include a map that indicates any mine or ERW hazards in close proximity to the parking area or the route from the vehicle parking area to the visitor reporting area of the demining worksite.

5.9.2. Visitor reporting and briefing area

The visitor reporting area and briefing area shall be a clearly marked and identifiable area that visitors are required to report to on arrival on a demining worksite. See Annex D for guidance on dealing with visitors to demining worksites.

Any mines, UXO or other components of munitions held on a demining worksite for the purpose of display to visitors shall be strictly managed in accordance with the requirements of IMAS 10.50. Visitors shall be cautioned about touching any objects that may be lying on the ground.

5.9.3. Helicopter Landing Site (HLS)

In the event that helicopter casualty evacuation is an available option a HLS shall be established prior to demining operations commencing on the site. The size of the HLS and cleared air approaches shall be established in accordance with the requirements of the organisation providing the air casualty evacuation service. The HLS should not be located adjacent to potential hazard areas. Consideration shall be given to air approaches and the risk from tilt-rod, tripwire and prong initiation through rotor downwash and 'foreign object' dispersal. The demining site number, HLS grid reference and description (including marking features) shall be provided to the organisation providing the air casualty evacuation service.

The HLS shall be marked with an easily visible marker (preferably fluorescent) of a minimum size of 2m x 2m, firmly secured to the ground (the organisation providing the air casualty evacuation service should provide guidance on securing arrangements). It should also be clearly marked and signposted from all the demining worksites it serves. All loose material shall be removed from the site and out to a radius stipulated by the organisation providing the air casualty evacuation service. The HLS should not be used as a car park or administration area.

5.9.4. Safety lanes

The demining organisation shall establish safety lanes, which are confirmed as clear of hazards, to provide access to and around the demining worksite. Safety lanes shall be marked and documented as specified in IMAS and NMAA standards. Safety lanes shall be wide enough to provide safe access for personnel and equipment to the worksite. Safety lanes for victim evacuation shall be wide enough for the safe execution of the demining accident response plan. Safety lanes should be not less than 2.0m wide.

5.9.5. First aid

Each demining worksite shall include a first aid post, organised and equipped as recommended in IMAS 10.40. The first aid post shall:

- a) be identifiable and clearly marked;
- b) be equipped with appropriate first aid and medical supplies and equipment;
- c) where appropriate, be attended by suitably qualified and experienced male and female medical or Para-medical staff; and
- d) provide easy access to the clearance area of the worksite and easy access for ambulances.

5.9.6. Rest areas

The worksite shall include clearly identifiable and marked rest areas for deminers. Rest areas shall be located outside the danger area if demining continues during rest periods, and should be equipped to provide staff with protection from adverse or extreme weather conditions. Separated areas for men and women shall be available, if needed.

5.9.7. Explosive storage area(s)

Explosives, mines or ERW may be stored on a demining worksite. Explosives used in the demining process should be stored in a container approved for the type and quantity of explosive being stored. (See IMAS 10.50 for standards for the construction of storage boxes and magazines for explosive materials used in the demining process). Where provision of this standard of container storage is impracticable, the demining organisation shall be responsible for providing adequate safety measures (protective works, safety distances, physical security etc.) and should include protection against environmental factors in accordance with explosive manufacturers' instructions. Such storage should be considered as a temporary measure only. Detailed guidance on the temporary or field storage of ammunition and explosives may be found in IATG 04.10 Field and temporary storage.

6. Demining incident

Procedures for the response to a demining incident shall be established and formally documented as SOPs. The SOPs should include:

- a) the organisation and capabilities needed to respond to a demining incident, including the procedures, training, equipment and material (see IMAS 10.40); and
- b) procedures for the investigation, analysis and corrective action to be taken following a demining incident (see IMAS 10.60).

7. Responsibilities

7.1. National Mine Action Authority (NMAA)

The NMAA shall develop a policy and establish and maintain documented procedures for S&OH on demining worksites. These should include:

- a) minimum requirements for the establishment of demining worksites;
- b) procedures for the establishment of working distances based on a risk assessment;
- c) standards for emergency response and casualty evacuation procedures on demining worksites; and
- d) procedures for the reporting and investigation of demining incidents.

7.2. Demining organisation

The demining organisation shall establish and maintain documented SOPs that comply with the provisions of IMAS, the NMAA standards and other relevant standards or regulations.

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

- a) issue, maintain and update their own regulations, codes of practice, SOPs and other suitable provisions on worksite safety;
- b) co-operate with other demining organizations in the same country to ensure consistency of standards of safety on worksites; and
- c) support the host nation, during the establishment of a NMAA, with assistance in framing national S&OH regulations and codes of practice for worksite safety.

7.3. Demining employees

Demining employees shall:

- a) take all reasonable care for their own safety and that of other persons on the worksite;
- b) comply with instructions given for their own conduct and safety, especially those contained in SOPs;
- c) comply with national instructions and regulations on conduct and safety on worksites; and
- d) report forthwith to their superior any situation which they have reason to believe could present a worksite hazard which they cannot themselves correct.

Annex A (Normative) References

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

- a) IATG 02.10 Introduction to risk management principles;
- b) IATG 04.10 Field and temporary storage;
- c) IMAS 04.10 Glossary of mine action terms, definitions and abbreviations;
- d) IMAS 08.40 Marking mine and UXO hazards;
- e) IMAS 09.11 Battle Area Clearance (BAC);
- f) IMAS 09.30 Explosive ordnance disposal;
- g) IMAS 10.10 S&OH - General requirements;
- h) IMAS 10.30 S&OH - Personal protective equipment;
- i) IMAS 10.40 S&OH - Medical support to demining operations;
- j) IMAS 10.50 S&OH - Storage, transportation and handling of explosives; and
- k) IMAS 10.60 S&OH - Reporting and investigation of demining incidents.

Informative references:

- l) Database of Demining Accidents, www.ddasonline.com;
- m) TNMA 10.20 – 01/2001 Estimation of Explosion Danger Areas; and
- n) TNMA 10.20 – 02/2009 Field Risk Assessment.

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

Annex B (Normative) **Determining working distances for manual demining**

B.1. General

This Annex provides guidance on the determination of demining working distances to be enforced between deminers during demining activity at a demining worksite. Sometimes referred to as safety distances, working distances are the distance between working deminers at a worksite. A similar process may be used to make a working distance assessment for UXO or Battle Area Clearance (BAC) operations.

The adoption of safety distances deemed appropriate for demolition tasks is not appropriate during other manual demining procedures. This is because no manual demining procedure other than demolition involves the deliberate initiation of mines. A table of suggested safety distances appropriate for demolition tasks is given in Clause B.8.

The imposition of a working distance is intended to prevent *severe or disabling* injury to other demining staff whom are within the danger area when a deminer causes an unintended detonation. These are sometimes referred to as secondary injuries. The working distance adopted must not compromise worksite safety by reducing the opportunity for supervisory oversight or by limiting necessary communications.

A working distance should not be thought of as a safe distance because it does not reduce the risk of secondary injury to zero. Demining working distances must ensure that the risk of secondary injury from an unintended detonation is reduced to a tolerable level. The imposition of working distances that reduce all risk of secondary injury to zero would not be practical. While no risk of severe injury should ever be tolerated, a small risk of minor injuries that do not result in disability is considered unavoidable.

B.2. Mine and ERW hazards

The most common injuries to deminers are caused by the damaging effect of the blast wave from unintended detonations of AP blast mines. The front of the blast-wave decelerates rapidly, so limiting its range. The range is directly related to the size of the mine's high explosive content. The danger area presented by the blast-wave of the largest AP blast mines extends to less than 10 metres. However, the risk of ruptured tympanic membranes (ear-drums) from a blast-wave extends to a greater distance, and may approach 25 metres. Tympanic membrane injury is usually minor and temporary, with little or no permanent hearing loss. Permanent hearing loss will occur when the blast over-pressure exceeds 34.5kPa; the appropriate formula to calculate this over-pressure for a specific quantity of explosive is contained within the IATG CD.

Deminers who are a metre away from an unintended detonation of an AP blast mine and are wearing approved PPE often escape severe blast injury. However, the blast-debris associated with AP blast mines can present a danger area up to 10 metres. Consequently, there is a small risk of secondary fragmentation injuries to other worksite staff when an AP blast mine is initiated up to 10 metres away. The blast hazard and blast-debris danger area associated with large AT blast mines can be far more extensive.

The danger area associated with AP fragmentation mines extends to the limit of the fragmentation that they spread. This varies with different mines, and is generally related to the mine's design, the amount and type of its explosive content and its position relative to the ground when it detonates. The fragmentation associated with most fragmentation mines generally spreads in a 360° radius from the point of detonation and slows over distance. The speed of the fragments from the same mine varies considerably. The risk of being hit by a high-speed fragment is reduced both by distance and by the spread of the fragments.

With a fragmentation mine, both blast and fragmentation present a serious hazard to the deminer who initiates it. Fragmentation mines that are designed to “bound” and detonate in the air typically cause most demining staff fatalities. The spreading of fragmentation also presents a varying degree of danger to other staff at distances up to 50 metres. The greater the distance between the mine and the deminer, the less likely any injury is to be severe.

The variety of threat posed by ERW devices is too great to summarise. However, only when it is possible that the ERW could be unintentionally detonated using the procedures and tools that will be used, should the hazard associated with its detonation be considered in the risk assessment. When the hazards in an area do not include mines, IMAS 09.11 BAC should be applied. During BAC there is generally no minimum working distance as long as hazardous items are not touched.

B.3. Assessment of risk

All assessments of risk must be continually reviewed as conditions change. As demining on a particular site progresses the information on which the first risk assessment was based will alter. Risk assessments must be reviewed on a regular basis to keep pace with these changes.

A risk assessment for the determination of working distances for known mines and ERW involves an assessment of the following:

- a) the likelihood of an unintended detonation; and
- b) the likelihood of severe injury resulting from an unintended detonation.

These are discussed in more detail below.

B.4. Likelihood of unintended detonation

Some factors that can affect the likelihood of an unintended detonation of a mine or ERW occurring are described below.

B.4.1. Condition of the mine or ERW

A few mines and ERW have very sensitive fuzes, or initiation systems that are more readily triggered in one way than another. Knowing the anticipated devices and the way they operate is essential in order to avoid approaching them in an inappropriate manner.

With all mines and ERW, the condition of the device and its fuzing system can make accidental initiation more or less likely. If it is known that a device or its fuze has decayed in such a way that it is no longer capable of detonating, the hazard posed by that device may be ignored in the risk assessment. Conversely, if it is known that a device has been damaged or decayed in such a way that the fuze mechanism is unstable, it should be presumed that there may be a higher risk of initiation. To reduce the increased risk of injury that this implies, the use of demining procedures that increase the distance between the deminer and the hazard should be considered. Using mechanical demining processes that prepare the ground and initiate unstable hazards may be appropriate.

B.4.2. The demining worksite

When the hazards and their condition are known, the risk they represent must be reviewed in relation to their context. The ground conditions at the worksite may increase or reduce the risk of an unintended detonation. For example, if the ground is unusually hard there may be a higher risk that excavation with a particular procedure or tool will cause an initiation. Undergrowth or other obstructions that restrict the vision of supervisors may require a variation in the procedures that would be used elsewhere.

B.4.3. Demining procedures and tools

In any given situation, some demining procedures and tools may pose a greater risk of an unintended detonation than others. The use of long-reach vegetation cutting tools in an area where tripwires or functional tilt-fuzes are anticipated is an example.

The demining procedures and tools that are appropriate at a particular worksite should be determined with reference to the hazard, its condition, and its context.

B.4.4. Other factors

Worksite climate, weather and the risk of disease can make it more likely that deminers are uncomfortable, unwell or simply tired any of which may increase the risk of an unintended detonation.. Demining staff shall be appropriately clothed, fed and rested, and shall have their health checked at appropriate intervals. The global variation between worksite conditions means that appropriate intervals should be determined for the local context and reviewed regularly enough to give confidence that no deminer works when unwell or when tired enough to lose concentration. Every effort should be made to keep deminers motivated and alert.

B.5. Likelihood of severe injury

An injury may be considered *minor* when it does not result in any loss of function or in disability. All injuries that result in loss of function or disability are considered *severe*. The risk of severe injury faced by the deminer who initiates an unintended detonation is, however, far greater than that faced by other demining staff at the worksite.

According to accident records, unintended detonations that cause severe or disabling injury during manual demining are rare. The likelihood of severe or disabling injury occurring is reduced to the lowest possible level by good training, using appropriate demining procedures and by the provision of disciplined supervision.

The likelihood of severe injury should also be assessed with reference to the procedures and tools that will be used, the PPE that is issued and the working distances that will be enforced.

B.5.1. Procedures and tools

Accident records show that demining procedures and tools used at a worksite can increase the risk of severe injury in an unintended detonation by:

- a) positioning the deminer closer to the device than necessary;
- b) encouraging the use of excessive or imprecise force when exposing a device; and
- c) the disintegration of the tool causing additional injury.

To keep the likelihood of severe injury to a minimum, procedures and tools that avoid these failings should be used.

B.5.2. PPE

After the application of supervised procedures and tools designed to prevent an unintended detonation occurring, there remains a small risk of an explosive accident. The main purpose of PPE is to provide practical protection to the men or women most at risk of causing an unintended detonation. The secondary purpose of PPE is to protect against the risk of secondary injuries resulting from an unintended detonation initiated by other demining staff within the danger area.

Because PPE is a secondary safeguard, the PPE selected should never restrict movement, comfort or concentration in a manner that makes an unintended detonation more likely to occur.

The choice of appropriate PPE to reduce the risk of primary and secondary injury to a tolerable level shall be determined by reference to IMAS 10.30 S&OH Personal protective equipment.

B.5.3. Working distances

Working distances do not provide any protection to the deminer who initiates the unintended detonation. The assessment of appropriate working distances should be concerned to reduce the risk of severe secondary injury to the minimum acceptable level. The attempt to remove all risk of minor secondary injury would generally involve imposing impractical procedures, PPE and working distances, so should be avoided.

The range of the blast hazard and the fragmentation danger area presented by other ERW should be assessed on a case by case basis. Clause B.2. discusses factors and hazard properties that should be taken into consideration when defining appropriate working distances.

B.6. Methodology for risk assessment

The risk assessment is essential in order to determine appropriate working distances at a demining worksite. In some cases, working distances may vary between different parts of the same worksite. When this occurs, the variation shall be clearly signed so that demining staff are always aware of which working distances apply where they are. The risk assessment for a demining worksite should be updated regularly as more information becomes available. The methodology to determine appropriate working distance is discussed in the detail below.

B.6.1. Determination of the mine or ERW that poses the greatest hazard

The first step in a risk assessment is the identification of the mine or ERW that poses the greatest hazard at a worksite. When the type or condition of the devices likely to be encountered is unknown or uncertain, a worst-case scenario should be presumed and the risk assessment reviewed when more information becomes available.

The largest or most potentially damaging mine or ERW device will not always present the greatest risk of secondary injury or the greatest danger area. For example, when working in a mixed AP and AT minefield, there may be no reason to expect that an AT mine could be unintentionally detonated during any of the procedures used. In this case, the AP mines might present the greatest danger-area and AP mine working distances should be applied.

Note: Consideration should be given to the possibility of sympathetic detonation. If local ground conditions or the condition of the hazard gives cause for concern, this should be reflected in the risk assessment..

If functional AP fragmentation mines are present at a worksite, they may present the greatest risk of secondary injury to demining staff. However, when AP fragmentation mines are in a condition such that no tripwires remain or their fuze system is reliably inoperative, there may be no reason to expect that an AP fragmentation mine could be unintentionally detonated during any of the procedures used. In this case, the working distance for the danger area associated with the next greatest hazard should be applied.

If functional and movement-sensitive submunitions are present at a demining worksite, they may present the greatest risk of secondary injury to demining staff. However, when submunitions are known not to have armed or not to include movement-sensitive fuze mechanisms, there may be no reason to expect that a submunition could be unintentionally detonated during any of the procedures used. In this case, the working distance for the danger area associated with the next greatest hazard should be applied.

B.6.2. Assessment of the risk of an unintended detonation occurring

The second step in the risk assessment process is an assessment of the likelihood of an unintended detonation occurring at the worksite.

The risk of an unintended detonation occurring is assessed as high, increased or normal, as defined here.

- a) high risk. The *condition of the hazard* is such that it could be initiated during the correct application of standard manual demining procedures.
- b) increased risk. The *worksite conditions* complicate the application of standard manual demining procedures in a way that could be predicted to result in an unintended detonation.
- c) normal risk. There is no reason to believe that the application of standard manual demining procedures will result in an unintended detonation.

B.6.3. Assessment of the risk of an unintended detonation causing severe injury

When the risk of an unintended detonation occurring has been assessed, the risk of severe injury resulting from any unintended detonation must be determined and minimised.

The likelihood of severe injury occurring depends on the distance between that detonation and the demining staff. The required distance varies with the mine or ERW that presents the hazard. In all cases, a deminer within a metre of the unintended detonation is at an unacceptable risk of sustaining severe injury.

When the risk of an unintended detonation of any mine or other ERW is high, the risk of severe injury to any deminer conducting demining procedures at close quarters is unacceptable because the primary protection for all deminers is the application of procedures and tools that make an unintended detonation unlikely.

If there is a *high risk* of an unintended detonation, manual demining at close quarters shall not be conducted until the risk of an unintended detonation has been reduced to *increased* or *normal*. Equipment, procedures and tools should be selected that will reduce the risk of an unintended detonation. Mechanical demining that results in the planned detonation or disruption of the high risk hazards should be considered.

If there is an *increased risk* of an unintended detonation, attempts should be made to change the worksite conditions such that the risk of an unintended detonation is reduced to *normal*. It may be appropriate to use demining machines to prepare the area. When the worksite conditions cannot be improved, the use of manual demining procedures and tools that increase the distance between the deminer and the hazard to reduce the risk of the deminer suffering severe injury should be considered.

Demining may be conducted when there is an *increased risk* of an unintended detonation but demining shall only be conducted at a demining worksite when the risk assessment determines that, using the procedures, tools and PPE selected, there is a tolerably low risk of severe injury from any unintended detonation.

A *normal risk* of an unintended detonation is the normal situation at a demining worksite. A *normal risk* of an unintended detonation automatically means that there is a low risk of severe injury to all demining staff because there is a low risk of any injury at all. The risk of severe secondary injury occurring is then very low indeed, and the working distances required to make this residual risk tolerable need to be balanced against the need for communication, supervision and efficiency.

The preliminary risk assessment shall be reviewed and updated as work progresses so that all information about the hazards, their condition and their context can be reflected in the choice of equipment, procedures and tools that are used, and in the safety distances applied.

B.6.4. In the event of an unintended detonation

If an unintended detonation occurs, any temptation to respond immediately by making major changes to working distances, procedures and tools should be resisted without a clear and objective review of the worksite risk assessment and the decisions based on it. The risk assessment shall be reviewed in the light of the full circumstances surrounding the unintended detonation.

If the unintended detonation could have been avoided, this may lead to a revision of the procedures and tools being used. If no one was injured in the unintended detonation, this may be seen as a justification of the conclusions in the original risk assessment and the choice of demining procedures, tools and PPE that was made. In this case, the review of the risk assessment may result in no changes.

Even when a deminer is injured, there is usually no reason to revise the working distances unless there are secondary injuries. Even if this occurs, the revision of working distances should not be automatic. It should be based on an assessment of the likelihood of the circumstances surrounding the accident being repeated and any changes to the demining procedures and tools that will be implemented to prevent recurrence.

B.7. Minimum distances between working deminers

Table 1 shows minimum recommended working distances between demining staff at a worksite where mines present the greatest hazard. Greater working distances should be considered when it is possible to use them without reducing efficiency.

If any of the following apply, the distances shown under the heading “Increased risk” in Table 1 should be applied as the minimum:

- a) hazards are in an unknown or unpredictable condition;
- b) there is reason to believe that hazards may be booby trapped or have anti-lift devices fitted;
- c) the procedures in use have not been proven in a similar context; and/or
- d) the likelihood of an unintended detonation has been assessed as increased.

When the risk assessment determines that ERW present the greatest hazard, working distances appropriate for the risk of an unintended detonation of the ERW hazard should be determined and applied.

When there is no reason to believe that the procedures and tools in use could cause an unintended detonation of any of the hazards present, the working distances appropriate for the normal risk associated with the smallest AP blast mine should be adopted.

Having determined which mine presents the greatest hazard with regard to its type, condition and context, the working distances shown in the table below shall be applied as a *minimum*. Any further reduction shall be documented in the risk assessment with reasons for the variation stated in writing. Greater distances should be used when a demining group’s own risk assessment determines that greater distances are desirable.

Mine Type	Minimum distance between demining personnel (distance in metres)	
	Normal risk	Increased risk
AP blast, HE up to 200 gm.	10	15
AP blast, HE more than 200 gm.	15	20

AP fragmentation mines.	20	25
AP Bounding or Directional fragmentation mines.	25	30
AT mines.	15	50
<p>Notes to table:</p> <ol style="list-style-type: none"> 1. Recommended <i>minimum</i> distances are for demining staff wearing IMAS 10.30 compliant PPE. 2. The type of mine selected to determine the minimum working distance should be the most hazardous functional mine that could be initiated using the demining tools and processes that will be used. 3. The risk assessment used to determine the minimum working distance shall be reviewed if any of the information used in the assessment changes. 4. If devices presenting a greater hazard than expected are discovered, the appropriate working distance for the increased hazard shall be adopted unless there is no reason to anticipate the presence of more of those devices in the area. 5. These distances should not be applied during demolitions or any other procedure during which mines are deliberately detonated (such as mechanical demining). 6. Generally, working distances do not apply to those supervising deminers while they work. It is a safety requirement that supervisors may approach any working deminer as part of their task. Supervisors should not approach closer than three metres while the deminer is working. 		

Table 1: Range of recommended working distances during manual demining

The constraints listed above generally mean that the working distances at a demining worksite will be one of those listed under "Increased risk" until an assessment of the hazard presented by the mines and ERW that are present has been made.

B.8. Recommended minimum safety distances during demolitions

Table 2 below shows minimum recommended safety distances for the explosive demolition of mines. Safety distances during explosive demolition are greater than working distances during clearance procedures because there is a deliberate intent to cause a detonation, and because there should be no need for other demining work to be conducted while the demolition takes place.

Mine Type (a single mine and minimum demolition charges is presumed)	Minimum safety distance (distance in metres)	
	Demolition staff	Other staff
AP blast, all types.	25	60
AP fragmentation mines (all types).	60	100
AT mines	200	300
<p>Notes to table:</p> <ol style="list-style-type: none"> 1. Recommended <i>minimum</i> distances are for demolition staff wearing IMAS 10.30 compliant PPE. Other staff not wearing PPE should be out of line of sight from the demolition at the time of detonation. Ear protection should be provided to demolition staff at the time of demolition when the risk appears high at the minimum distance above. 2. The distances shown are between the site of the detonation and the position of staff at the time of demolition not distances between demining staff. The safety distances may be reduced if there is a safe place with adequate protection available in the area for example, inside a bunker or behind a hillside. 3. When using protective works while destroying mines by explosive demolition, the required 		

safety distance should be assessed by appropriately qualified staff and may be reduced to reflect the reduced risk.

4. When multiple mines are being destroyed in a single demolition, the all-up weight of the high explosive involved should be considered and an appropriate safety distance should be determined and applied. The Danger Area Support Tool included with the IMAS CD, and available on the IMAS website (under IMAS support tools see TNMA 10.20 - Estimation of Explosion Danger Areas), provides danger area radii based on the 'all up weight' of mines/ERW being disposed of.

Table 2: Range of recommended minimum safety distances during explosive demolition

Greater distances should be considered when there would be no reduction in operational efficiency by using them or when a demining group's own risk assessment determines that greater distances are desirable.

Explosive demolition distances do not necessarily apply to other means of destroying mines. The safety distance required when burning mine bodies separately from their fuzes, for example, is generally greatly reduced because there is limited danger of a high order detonation during the process.

Annex D (Informative) **Dealing with visitors to demining worksites**

D.1. General

Demining activities attract a range of visitors from the donor community, government and other officials and the media. These visitors should not be discouraged from visiting demining sites as they can assist in much needed advocacy and resource mobilisation for the mine action sector.

D.2. Standard Operating Procedures (SOPs)

The demining organisation shall develop and maintain documented procedures for dealing with visitors to demining worksites. These SOPs should include:

- a) procedures for establishing and maintaining signs that;
 - (1) provide warning that the visitor or public are approaching or entering a demining worksite danger area;
 - (2) direct visitors to a safe vehicle parking area;
 - (3) direct visitors to a reporting area;
- b) safety briefing including information on;
 - (1) the site layout, safety marking system and any restrictions. This may include restriction on movement, the use of equipment that may be an RF hazard (mobile telephones, radios etc), smoking or fire restrictions and the use of other electronic equipment or cameras;
 - (2) the requirements to wear PPE;
 - (3) action to be taken in the event of a demining incident or accident;
 - (4) the restriction on touching any object lying on the ground; and
- c) liabilities in case of an accident.

D.3. Insurance

The demining organisation should have third party liability insurance to cover risk of harm to visitors to demining worksites. This should cover liability not only of the demining organisation, but also of its employees. Insurance for employees of the demining organisation is covered in IMAS 10.10 (S&OH general requirements).

An alternative is for the demining organisation to ensure that the visitor signs a disclaimer or waiver, drafted with legal advice indicating:

- a) that the visitor has been briefed on the hazards and the risks;
- b) that the visitor accepts personal responsibility for an undesired event to their person whilst visiting the site;
- c) that the visitor authorises the demining worksite personnel to provide whatever medical treatment and evacuation necessary to sustain life and to minimise further injury; and

- d) the visitor absolves the demining organisation of any legal responsibility for any injury or fatality that occurs to the visitor, or for any damage to the visitor's equipment, during the visit or arising from the visit.

Amendment record

Management of IMAS amendments

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

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

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

The most recently amended IMAS will be the versions that are posted on the IMAS website at www.mineactionstandards.org.

Number	Date	Amendment Details
1	01 Dec 2004	<ol style="list-style-type: none"> 1. Formatting changes. 2. Minor text editing changes. 3. Changes to terms, definitions and abbreviations where necessary to ensure that this IMAS is consistent with IMAS 04.10. 4. Substantive changes: Annex D clause D3. Inclusion of new sub clause 'c' and text changes to sub clause 'd' (previously 'c').
2	23 Jul 2005	<ol style="list-style-type: none"> 1. Clause 5.1. Inclusion of a new sub clause b) concerning maintaining safe working distances. Inclusion of a new sub clause d) concerning control of demining machines and vehicles. Removal of the word 'deminers' in sub clauses c), e) and f) and replacement with the term 'demining worksite staff'. 2. Clause 5.3, new clause inserted on demining safety distances. 3. Clause 5.4, second paragraph, sub clause c), third sentence, change the word 'minimum' to 'default'. 4. Clause 5.5, last sentence, removal of reference to contaminated areas. 5. Clause 5.5.1, first paragraph, inclusion of a new sentence concerning areas for unloading and loading of machines. 6. Clause 5.5.3, inclusion of a new paragraph concerning display mines/UXO held on demining worksites for viewing by visitors and cautioning visitors about touching objects on the ground. 7. Annex C, clause C.2, C.2.1, C.2.2 and C.3.2 (second note to table 2), replacement of the words 'EOD expert' and 'EOD specialists' with a single term 'qualified and experienced EOD operator' (4 times). 8. Annex C, clause C.3, removal of reference to calculations and change of a 'shall' to a 'should'. 9. Annex C, second note to table 2, change of a 'shall' to a 'should'. 10. Annex D, clause D.2, sub clause b), inclusion of new sub clause (4).
3	01 Aug 06	<ol style="list-style-type: none"> 1. Minor changes/additions to the first and second paragraph of the foreword. 2. Introduction, text change to the second paragraph. 3. Clause 4, text change. 4. Clauses 5.1, 5.6, 5.9, 5.96 and 5.97, removal of the term(s) 'blast' and 'fragmentation' 'hazard zones' and replaced with the term 'danger areas'. 5. Clause 5.3, text changes. 6. Clause 5.4, new clause on 'Demolition safety distances'. 7. Clause 5.5, new clause on 'Determination of danger areas'. 8. Clause 5.6, text changes to second and third paragraphs. 9. Clause 5.6.1, new clause on 'Traffic control'. 10. Clause 5.7, new clause on 'Use of Personal Protective Equipment (PPE)'. 11. Clause 5.8, new clause on 'Radio Frequency (RF) hazards'. 12. Clause 5.9.2, text change to last paragraph. 13. Clause 7.1, changes to the responsibilities of the NMAA. 14. Inclusion of the term 'mines and ERW'. 15. Removal of the term 'hazard' from throughout the IMAS. 16. Annex C, old annex removed and draft annex entitled 'Risk assessment for the determination of demining safety distances' included.

Number	Date	Amendment Details
4	12 Nov 08	<ol style="list-style-type: none"> 1. Minor changes throughout. 2. Distinction between “Working distances” and “Safety distances” introduced. 3. Addition of “Danger area” and Hazard area” to definitions in Annex B. 4. Draft Annex C replaced by new annex entitled ‘Determining working distances for manual demining’. 5. Clause C8, Annex C - table removed due to an error in Nov 08, revised, approved and included in Feb 2009.
5	01 Mar 2010	<ol style="list-style-type: none"> 1. Updated definition of NMAA. 2. Updated UNMAS address 3. Removal Annex B from the IMAS series and its reference from clause 3. 4. Renamed Annex C to B and its references in the body of IMAS. 5. Minor addition throughout to include cluster munitions and gender issues. 6. Inclusion of a normative reference to TNMA - FRA in the body and in Annex A.
6	01 Aug 2012	<ol style="list-style-type: none"> 1. Clause 5.4, new text on IATG ECA. 2. Clause 5.9.7, new text on IATG 04.10 Field and temporary storage. 3. Annex B, Clause B.2, new text on permanent hearing damage blast over-pressure levels. 4. Addition of IATG 02.10 and IATG 04.10 to normative references. 5. Minor typographical amendments.