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Safety and occupational health - demining worksite safety

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Foreword

In July 1996, international standards for humanitarian mine clearance programmes were proposed by working groups at a conference in Denmark. Criteria were prescribed for all aspects of mine clearance, 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 into *International Standards for Humanitarian Mine Clearance Operations*. A first edition of these standards was issued by the UN Mine Action Service (UNMAS) in March 1997.

This second edition reflects changes to operational procedures, practices and norms that have occurred over the past three years. The scope of these standards has been expanded to include the other components of mine action, in particular those of mine risk education and victim assistance.

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 is the office within the United Nations Secretariat responsible for the development and maintenance of international mine action standards (IMAS).

The work of preparing, reviewing and revising these standards 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 www.mineactionstandards.org. IMAS will be 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 (see IMAS 07.10). 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, enforcing safety distances, and providing effective medical cover and insurance. This requires national mine action authorities 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. Thus, 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 national mine action authorities 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 and 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 which aim to establish and maintain a safe demining worksite

2 References

A list of normative 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 and definitions

A list of terms and definitions used in this standard is given in Annex B. A complete glossary of all the terms and definitions 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 'worksite' refers to the location where demining activities take place, and which is under the direct control of the demining organisation.

The term 'national mine action authority or authorities' refers to the government department(s), organisation(s) or institution(s) in each mine-affected country charged with the regulation, management and co-ordination of mine action. In most cases the national mine action centre (MAC) or its equivalent will act as, or on behalf of, the 'national mine action authority'.

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.

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, enforcing safety distances, and providing effective medical cover and casualty evacuation procedures. This requires national mine action authorities 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:

- a) provide a clearly visible separation of hazardous areas including fragmentation zones, cleared areas, useable areas and unknown areas of and around the worksite;
- b) control the movement of deminers and visitors (including members of the public) at the worksite;
- c) limit the number of deminers and visitors allowed into the blast and fragmentation hazard zones;
- d) during the controlled destruction of mines and UXO, take all reasonable precautions to exclude deminers, visitors and members of the local population from the blast and fragmentation hazard zones, or provide suitable protection inside buildings, bunkers or mobile structures; and
- e) include measures to prevent structural and environmental damage.

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)

5.3 Control of entry into blast hazard or fragmentation hazard zones

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 mined areas, onto the demining worksite and into blast and fragmentation hazard zones. This should be achieved by:

- a) informing the local population, demining workers and demining worksite visitors of the extent of the worksite, and the blast and fragmentation hazard zones; and
- b) physically controlling entry into the hazard zones during the mine or UXO hazard destruction processes by warning signs and positioning sentries (See Annex B for specifications and recommendations on the development of standards and SOPs for blast and fragmentation hazard zone safety distances).

Note: Warning systems should include the following.

- Warning signs on approach routes (roads, tracks or paths) informing people that they are entering a fragmentation zone. Signs should include information on the nature and extent of the fragmentation zone.
- Risk reduction education through briefings or signs or information sheets to people 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 mine or UXO hazards and hazardous material.
- Risk reduction education, including site dangers, and the implications of ignoring the directions of demining workers appointed to control access into fragmentation zones.

- Documented standards and SOPs should include the use of sentries to control entry into fragmentation zones, warning signs and audible signals to be used during the destruction process.

Planning and execution of demining operations should minimize disruption to the local population, which may need to move through blast and fragmentation hazard zones if they are to subsist or survive. It is unrealistic to expect that the public can be prevented from entering associated blast and fragmentation hazard zones of whole demining worksites for the duration of the clearance task. On the other hand it is important to reduce to tolerable levels the risk of harm to the public. The following example may provide guidance on the development of a reasonable and workable compromise.

- a) the extent of the fragmentation zone should be equivalent to the fragmentation hazard of the likely mine/UXO contamination in the worksite;
- b) the public, having been given appropriate warnings as set out above, should be allowed to pass on marked routes through the fragmentation zone, EXCEPT when demolitions are taking place. When a demolition is taking place the demining organisation shall establish a cordon with sentries on routes at the entry points of the fragmentation hazard zone to prevent entry into the hazard zone. It may also be necessary to restrict entry when particular munitions with a large fragmentation radius, such as bounding mines, are being cleared; and
- c) an inner safety distance should also be identified. For example, a radius equivalent to the blast zone from the likely mine/UXO contamination, demining lane separation, or RF detonator hazard (whichever is greater). The minimum radius of such a distance should be 25m. The public should not be allowed to enter this safety zone at any time when demining is being undertaken on the worksite.

Where the location of the worksite means that this inner safety distance cuts a frequently used road or path, an alternative solution should be considered. If the worksite is small enough, the demining unit should phase operations in such a way to minimize disruption to the public. If the worksite is large, the demining organisation should seek the assistance of the local administration, police or other appropriate emergency services or the military to identify, mark and possibly supervise the creation of a suitable diversion route. If no such diversion route is feasible, the demining unit should consider using protective works.

5.4 Control areas

Effective control of the worksite will be achieved by establishing and clearly marking a number of areas for safety and administration. Such areas shall be outside the relevant safety distances from all contaminated areas, clearance activity and explosive storage.

5.4.1 Vehicle parking area

The vehicle parking area shall be a used area or cleared area large enough to provide safe parking for demining unit and visitor's vehicles.

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

5.4.2 Helicopter landing site

In the event that helicopter casevac is an available option a helicopter landing site (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 casevac service. The HLS should not be located adjacent to potential hazard areas; consideration shall be given to air approaches and the threat 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 casevac 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 casevac service should provide guidance on securing arrangements). It shall also be clearly marked and signposted from all 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 casevac service. The HLS should not be used as a car park or administration area.

5.4.3 Visitor reporting and briefing area

The visitor reporting area and briefing area shall be a clearly marked and identifiable area that is outside the fragmentation zone of the demining worksite.

5.4.4 Safety lanes

The demining organisation shall establish cleared safety lanes to provide access to and around the demining worksite. Cleared safety lanes shall be marked and documented as specified in IMAS and national mine action authority standards. Cleared safety lanes shall be wide enough to provide safe access for personnel and equipment to the worksite. Safety lanes cleared for medevac shall be wide enough for the safe execution of documented medevac procedures. Safety lanes should be not less than 2.0m wide

5.4.5 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 medical or para-medical staff; and
- d) provide easy access to the clearance area of the worksite and easy access for ambulances.

5.4.6 Rest areas

The worksite shall include clearly identifiable and marked rest areas for deminers. Rest areas shall be located outside the fragmentation zone and should be equipped to provide staff with protection from adverse or extreme weather conditions.

5.4.7 Explosive storage area(s)

Explosives or mine and/or UXO hazardous material 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, which will be located outside the fragmentation zone of the demining worksite (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.

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 and obligations

7.1 National mine action authority

The national mine action authority shall develop a policy and establish and maintain documented procedures for safety and occupational health on demining worksites. The documented procedures should include:

- a) standards for safety markings to be used on demining vehicles;
- b) standards for an emergency response and casualty evacuation procedures on demining worksites; and
- c) 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 national mine action authority standards and other relevant standards or regulations.

In the absence of a national mine action authority 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 employees in the same country to ensure consistency of standards of safety on worksites; and
- c) support the host nation, during the establishment of a national mine action authority, with assistance in framing national S&OH regulations and codes of practice for worksite safety.

7.3 Deminers

Demining workers 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) IMAS 10.10 S&OH – General requirements IMAS 10.30 S&OH – Personal protective equipment; and
- b) IMAS 10.50 S&OH – Storage, transportation and handling of explosives.

The latest version/edition of these references should be used. GICHD hold copies of all 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). National mine action authorities, employers and other interested bodies and organisations should obtain copies before commencing mine action programmes.

Annex B **(Informative)** **Terms and definitions**

B.1.1

briefing area

in mine clearance operations; a clearly identifiable control point intended to be the first point of entry to a demining worksite. The briefing area contains a plan of the minefield and its current level of clearance, at a scale large enough for briefing purposes, showing the location of control points (car park, first aid point, explosive storage areas, the areas where mine clearance work is progressing and distances), and where safety equipment is issued to visitors.

B.1.2

control point

control area

all points or areas used to control the movements of visitors and staff in a demining worksite.

B.1.3

demolition

(dml)

destruction of structures, facilities or material by use of fire, water, explosives, mechanical or other means

B.1.4

deminer

a person qualified and employed to undertake demining activities or work on a demining worksite.

B.1.5

demining worksite

all workplaces where demining activities are being undertaken

Note: Demining worksites include workplaces where survey, clearance, inspection, sampling and EOD activities are undertaken including centralised disposal sites used for the destruction of mines and UXO identified and removed during clearance operations.

Note: Survey, in relation to a demining worksite includes general survey undertaken to identify mine and UXO hazards and hazardous areas,

B.1.6

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.

B.1.7

mine clearance

the clearance of mines and UXO from a specified area to a predefined standard.

B.1.8

risk

combination of the probability of occurrence of **harm** and the severity of that **harm**.

B.1.9

risk analysis

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

B.1.10

risk assessment

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

B.1.11

risk evaluation

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

B.1.12

secondary fragmentation

in an explosive event, fragmentation which was not originally part of the mine/UXO.

B.1.13

visitor

for the purposes of this standard, a person who is neither a member of the demining organisation, nor a demining worker accredited by the national demining authority.

Note: In circumstances where the national mine action authority does not have an accreditation system the demining organisation should determine the status of non-employees.

B.1.14

workplace

all places where workers need to be or to go by reason of their work and which are under the direct or indirect control of the employer.

Annex C

(Normative)

Safety distances for blast and fragmentation hazard zones

C.1 General

Hazard distance calculations can be extremely complex requiring consideration of a range of factors including:

- a) the hazard division and compatibility classification of the mine or UXO hazards that may be on the demining worksite;
- b) the protective measures included in the documented SOPs;
- c) protection offered by vegetation, topography or structures surrounding the worksite and available to the demining workers, visitors and the public; and
- d) climatic conditions.

C.2 Calculating safety distances

The national mine action authority and demining organisations should seek the advice of a suitably qualified EOD expert to calculate safety distances appropriate for the mine and UXO hazard risk.

Calculations should be based on the following standard methods of making hazard distance calculations:

C.2.1 Blast hazard zone

The safety distance for blast hazards shall be calculated to reduce risk of temporary hearing loss. The calculation of a blast hazard zone should be based on the methodology and calculations of "Kingerey and Bulmarsh".

Note: This can be found in "Airblast Parameters from TNT Spherical Air Burst & Hemispherical Surface Burst" by Charles N Kingerey & Gerald Bulmarsh, US Technical Report ARBRL-TR-02555 dated April 1984.

This methodology calculates the blast over-pressure in KPa at varying ranges from the source explosive. It is accepted that eardrum rupture occurs at approximately 24.5 KPa, therefore the imposed danger area should be calculated to be that range at which the expected blast overpressure is significantly less than 24.5 KPa. An Explosion Consequence Analysis (ECA) will have to be conducted to establish this range. This ECA should be conducted by an appropriately qualified EOD operator. It is likely that the fragmentation danger area will be greater than the blast danger area in most cases, however for light cased munitions, where there is minimal fragmentation hazard, a blast danger area will usually suffice.

C.2.2 Fragmentation hazard zone

The fragmentation zone safety distance shall be calculated to reduce the risk of harm from fragmentation to those working on the worksite and the local population. Where necessary, protective works should be used to reduce the extent of fragmentation hazard zones.

The calculation of fragmentation hazard zone areas is a more complex operation than that for blast hazard zone. Various methodologies can be used, but it is accepted that the use of the “Gurney Equation” to calculate the initial worst case fragment velocity, when combined with the “Fragment Slowdown Equation”, “Ballistic Range Equation” and a simple “Pythagoras Equation and Launch Angle Calculation”, will produce an acceptable danger area. An alternative is to use the USA Conventional Weapons Effects (CONWEP) equation. Again, this part of an Explosion Consequence Analysis (ECA) should only be conducted by an appropriately qualified EOD operator.

An alternative approach to the calculation of fragmentation hazard zones is to use simplified equations based on experimental results combined with “Gurney Equation” predictions. These formulae utilise the all-up-weight of the munition to calculate an estimated hazard zone. They have not been reproduced here, as only a suitably qualified EOD operator should use these equations; various assumptions have to be made that are not applicable to all scenarios.

C.3 Default safety distances

In the absence of a detailed risk assessment and calculations based on the above the safety distances provided in the following table shall apply.

C.3.1 Default safety distances on demining worksites”.

Activity	Metres apart
More than one working section	25
Deminers working in the same lane	25
Access route and safety areas	25
Vehicle park, medical teams and active mine clearance sites	100
Note: Distances in this table should be applied to worksites assessed as having an AP blast mine hazard. Safety distances for fragmentation hazards should be considerably greater, depending on the nature of the risk.	
Note: See IMAS 07.50 for distances to applied to storage of explosives on site	

Figure 1. Demining worksite AP blast mine safety distances

C.3.2 Safety distances for the destruction of mines and UXO

Demolition minimum safety distances	
Type of munition	(Open area – metres)
AP mine – Blast	100
AP mine – Fragmentation/bounding/directional	300/500
AT mine – Blast	500/1,000
AT mine - Shaped charge (A shaped charge jet can travel up to 1800m in free air.)	1,800
Off route mine	1,000
Mortar up to 82 mm	500
Shell up to 80 mm	500
Shell up to 160 mm	800
Shell above 160 mm	1,000
Rocket up to 88 mm	500
Hand and rifle grenade	300

Note:	Buried boosted charges estimated at 10 kilograms have a safety distance of 500 metres. 100 metres should be added for each additional 10 kilogram charge.
Note:	Organisations shall seek the advice of qualified EOD specialists to determine safety distances for all munitions other than those detailed above. All safety distances shall be specified in documented SOPs.
Note:	Protective measures should be used to allow distances to be reduced.

Figure 2. Demolition minimum safety distances

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 SOPs

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

- a) procedures for establishing and maintaining signs that:
 - provide warning that the visitor or public are approaching or entering a demining worksite blast hazard or fragmentation hazard zone;
 - direct visitors to a safe vehicle parking area; and
 - direct visitors to a reporting area.
- b) safety briefing including information on:
 - 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) and the use of other electronic equipment or cameras;
 - the requirements to wear PPE; and
 - action to be taken in the event of a demining incident or accident.
- c) liabilities in case of 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 legally drafted disclaimer or waiver indicating:

- a) that the visitor has been briefed on the risks and threat;
- b) that the visitor accepts personal responsibility for an undesired event to their person whilst visiting the site; and
- c) the visitor absolves the demining organisation of any legal responsibility for any damage, injury or fatality to the visitor, should the visitor fail to comply with instructions or directions.