

IMAS¹ and PPE Requirements

This paper explains the personal protective equipment (PPE) that a demining group must use in order to comply with the United Nation's International Mine Action Standards (IMAS). The author was an active member of the User Focus Group advising the Geneva International Centre for Humanitarian Demining (GICHD) when they made the current IMAS revision. He continues as an elected member of the IMAS Review Board. The author has also maintained a database of demining accidents for five years, and uses the evidence of real accidents to inform his views on protection needs.

by Andy Smith, AVS Mine Action Consultants

In June 2000, I published a paper in this journal under the title "The Facts on Protection Needs in Humanitarian Demining."² In that paper, I explained how the results of real accidents in demining could be used to assess protection needs. That paper was intended to provide a "reality check"—a balance against a few PPE manufacturers who had scented a market and thrown common sense aside in their pursuit of profit. Today, the pseudo-academic hysteria continues and a new generation of potential purchasers may benefit from reading the truth about protection needs.

My views in this paper are based on extensive field experience, the detailed investigations in the Database of Demining Accidents³ (DDAS) and on the many follow-up interviews of accident victims that I have undertaken. Statistics quoted in this paper are derived from the latest version of the database, including data not included in the United Nations Mine Action Service (UNMAS) version released through GICHD last year.⁴

Risk and Its Reduction

Anyone considering the risks in demining should be aware that demining accidents are rare. While I do not have all of the relevant data, I have been able to make a statistical study of the frequency of demining accidents for some theatres in some years. To make this study you must

have reliable information about the numbers of deminers and supervisors actually working in mined areas, the hours worked and the accidents suffered. My limited investigation showed that severely disabling accidents occur at the rate of one for each 30+ person-years of actual demining. I believe that this is a worst-case figure—and that accidents in most demining theatres are much rarer than this.

However rare they may be, explosive accidents can inflict very severe injuries. Because demining is a *humanitarian* activity, there is an obligation for employers to acknowledge a *duty of care* and take all reasonable measures to reduce the injuries that deminers may suffer as they work.

This can be pursued "procedurally" by seeking to reduce the number of accidents that occur. It can also be approached by seeking to reduce the severity of injury by using PPE. The distinction between these two approaches is important. While many accidents were caused by procedural errors or omissions and so could have been avoided, up to 25 percent of all accidents are deemed unavoidable. So while improvements in training, management and field supervision could prevent many accidents, some would still occur. The only way to reduce the impact of the unavoidable accidents is to reduce the severity of the injuries that result.

The Limits of PPE

A deminer cannot realistically be shielded against the effects of some mines and UXO. The worst possible accident

would kill a deminer wearing the best bomb-suit. This kind of accident has happened when moving unstable UXO in an unsafe manner, but is very rare indeed. The worst kind of accident that a deminer might reasonably expect is to detonate a bounding fragmentation mine or a submunition that is very close to him. Deminers have done this when wearing heavy frag-jackets, helmets and visors, and when wearing no protection at all. The results in terms of injury and death show that the PPE offered no significant protection. It may have given the wearer false confidence.

By far the most common activity at the time of an accident is when "excavating," digging or prodding to locate an AP blast mine. Fortunately, this is also the time when a deminer feels most vulnerable, and is most willing to accept the need to use protective equipment. The term "excavation" is used to cover the activity when a deminer is using a probe, prod, bayonet, scraper, pick-axe, hoe, trowel⁵ or any other hand-tool to investigate a suspicious area of ground. The investigation may follow a metal-detector reading, a dog-signal, a break in a perceivable pattern of mines or reliable information that a mine or other device is there. In almost all cases, the deminer will be squatting or kneeling as he does this.

The most common mine to be detonated while excavating is also the largest common AP blast mine—the PMN with a 240-g TNT main charge. A deminer can realistically be protected against the effects of this when it detonates 30 cm (12 in) from his knees.

International Mine Action Standards and PPE

Section 10.30 of the United Nations' IMAS has the title *Personal Protective Equipment*. Designed to be as all-embracing as possible, the standard covers the use of a range of equipment and working stances

■ A PMN mine.



that should make it easy for the IMAS to be adopted by military deminers as well as humanitarian deminers in all mined countries. Throughout the IMAS, the terms “should” and “shall” are used with a very different meaning. When they write that something “shall” be done, it is *obligatory*. If it is not done, the demining group cannot claim to be operating in accordance with the IMAS. When they write that something “should” be done, it indicates the authors’ “preference” and is not an obligation. If the term “may” is used, it is only “to indicate a possible method or course of action.”

Evidence from the DDAS was used to help determine the obligatory requirements. The only obligatory articles of PPE are frontal body protection and a long visor. Other “optional” equipment is mentioned. This inclusion was either as a result of pressure from “interested” bodies who advised the IMAS User Focus Group, or because there were differences of opinion between group members and those who were canvassed during “outreach” in the field. The optional equipment includes: a) advice on when it would be appropriate to wear helmets; b) a preference for handtools to be properly designed as protective equipment; and c) an invitation that a reader “may” like to assess the use of blast-resistant boots.

Body Protection

To comply with IMAS, deminers must wear “frontal protection, appropriate to the activity, capable of protecting against the blast effects of 240 gm of TNT at 30 cm [12”].” Notice that there is no standard

agreement (STANAG) v50 cited. This is not fragmentation armour, but blast armour. Good blast armour will always provide some fragmentation protection, but it does not *have* to meet the (NATO) North Atlantic Treaty Organization STANAG v50 of 450 metres a second. Under Section 4.3 “Fragmentation protection,” the requirement is extended with the additional

preference that body armour with a STANAG v50 of 450 m/s is used, but this is not an obligation. This is because the authors recognised that fragmentation mines had defeated the best PPE being used, so they decided that the risk from them should be minimised “procedurally” rather than by imposing an inflexible requirement for onerous PPE that would be resisted in the field. The procedural approach involves promoting appropriate training, field discipline and the extended use of armoured machines for area preparation when fragmentation mines are expected.

What this means to the end-user is that a demining group can wear armour with a v50 lower than 450 m/s—as long as that armour protects fully against the blast and environmental fragmentation associated with a PMN AP blast mine at 30 cm. I know two internationally respected groups that do this—and having tested their armour, I can say with confidence that it performs better against blast than many other designs with a much higher fragmentation specification. It has also been performed without any problem in at least 35 real accidents to date. The NATO STANAG fragmentation test was not devised to simulate a mine detonation, and a “pass” does not prove that the armour will give suitable protection. But there is no other test standard to use at this time, so the IMAS compromise makes sense.

Visors

The obligatory IMAS requirements for visors is “eye protection capable of retaining integrity against the blast effects of 240 gm

of TNT at 60 cm, providing full frontal coverage of face and throat as part of the specified frontal protection ensemble.” Five-mm thick polycarbonate visors have been widely used to do this since the mid-1990s.

If I had been given my way, the IMAS would state that, as a general rule, a visor in regular use shall be replaced every six months or sooner if vision through the visor is restricted. Others disagreed, so this requirement was not included. There is, however, a requirement for all protection to be regularly inspected to ensure that it is fit for use. Users should remember that polycarbonate is hardened by UV exposure and scratches very easily. To maintain protection and to ensure clear vision, they should be replaced frequently.

Hand-Tools as PPE

It is a credit to those at GICHD⁶ who drafted the IMAS that the available facts informed the requirements. However, other opinions and beliefs had to be respected, especially when persuasive evidence was available. When opinions differed, the suggested PPE could only be included as a *preference*, not a *requirement*. This happened with my own opinion on the need for long and blast-resistant tools. I believed that there was enough evidence to make them a requirement, but there were contrary opinions and the safer hand tools became “preferred” instead of obligatory.

On handtools, IMAS now reads:

“Hand tools *should* be constructed in such a way that their separation or fragmentation resulting from the detonation of an AP blast-mine incident is reduced to a minimum. Hand tools *should* be designed to be used at a low angle to the ground and should provide adequate stand-off from an anticipated point of detonation.”

The use of “should” instead of “shall” was a disappointment. But everyone’s views had to be combined and the end result is a workable compromise. For more information on blast-resistant handtools, see the article “Safer Demining Handtools in Zimbabwe”⁷ in Vol 6.2 of this journal.

Blast-Boots as PPE

Blast-boots or mine-boots are

awarded the lowest IMAS requirement—one that says that a user of the IMAS “may” like to consider their use. Even that low level of requirement is made conditional on there being new evidence that they are effective. On blast-resistant footwear, the IMAS reads:

“[D]emining organisations may consider providing blastproof boots for the protection of feet and lower limbs, where there is a significant risk that cannot be reduced by SOPs alone, provided that the blast boots being considered are proven to be effective in reducing that risk.

Note: The effectiveness and operational benefits of mine boots is still a contentious issue within the mine clearance community. To date, only one independent trial (U.S. State Department sponsored) has been conducted, which identified that the cost of provision and replacement is high, whilst the benefits are unproven. There is currently a danger that they offer ‘false security.’...”

In the tests referred to,⁸ one well-known supplier failed to provide enough samples for a meaningful conclusion to be reached. When assessing the rest, there was some evidence that injury *might* be reduced if a wearer stepped on mines with a main charge of 28 g of high explosive, but there was still a real risk of a subsequent surgical amputation (especially in countries with poor medical facilities). Very few of the mines that deminers step on contain as little as 28 g of high explosive. Since the most effective blast-boots rely on lifting the foot away from the initiation, they are all clumsy to wear and work in—especially when moving on rough ground and when standing and kneeling continually. In my opinion, they are uncomfortable and impractical, and offer only a false sense of security. A deminer should never miss a mine and then step on it. If he does, there is something wrong with the procedures being used, and further accidents should be prevented by addressing those failings.

Canvassing by those with a commercial interest in selling boots had occurred—and might have led to blast-boots becoming an IMAS requirement if it were not for the independent research in the (USAISR LEAP) United States Army Institute of Surgical Research

(USAISR) Lower Extremity Assessment Programme (LEAP) study, so the independent study has been very useful. Because blast-boots are still being offered by manufacturers, I would like the LEAP testing to be repeated with a greater number of tests and a wider range of boots as soon as possible.

Helmets as PPE

The IMAS states that users “should” consider the use of a helmet if they believe they have a 360° risk. I agree that this would be preferable if there really is a risk to the head from behind. However, safety distances and safe working practices in fragmentation mine areas should mean that a deminer never has a 360° risk, and the available evidence suggests that this is really the case.

In 60 percent of recorded accidents, the deminers involved had been issued blast visors (they were not always worn). In 68 percent of these, the visor was attached to a helmet. There are no examples in the database where wearing a helmet reduced injury in any significant way. By a “significant reduction” I mean a reduction in the range of recorded injuries. For example, it is likely that a few fragments were deflected by the helmet pictured on the next page, but that did not prevent the wearer suffering very severe head injuries. He died, but it was not considered of much importance to decide whether he died from his head wounds or from the extensive body penetrations that he also suffered, despite his frag-jacket. There was even some argument over whether the helmet was being worn (or worn properly) at the time, but the in-and-out damage tells us that this was irrelevant to the outcome for the victim.

It is important that a visor should be held steady on the wearer’s head, and a helmet can be used to do this. This can also be achieved using one of many of the open head-frames that are used to support visors and are preferred by demining groups like MineTech, HALO Trust, Menschen gegen Minen (MGM—in

■ Some hand-tools that have injured their users.



English, People Against Landmines), the UN Accelerated Demining Programme (UNADP), the Danish Demining Group (DDG) and Norwegian Peoples Aid (NPA). There is no evidence to support the claim that it is necessary to strap the visor to the head with a chin-strap. Indeed there is some evidence that, when worn loosely, such a chin-strap can increase injury. An unsecured visor tends to be torn away as the blast-front passes. To an observer, this can look as though the visor has failed. In fact, at 60 cm from any anti-personnel blast-mine, the fragments of soil, stone, roots, and plastic mine casing are moving ahead of the blastfront. They hit the visor first, and the passing blast front then takes the visor with it, meaning that the wearer’s face and eyes are protected at the critical time.

In most accidents when excavating an AP blast mine in which the victim was wearing a visor without a helmet, the visor was torn away by the passage of the blast front. In many accidents when the victim was wearing a helmet and visor and the helmet was not secured, the helmet and visor were also torn away. The victims only suffered eye injuries if their visors were

■ A blast-boot after the wearer stepped on a PMA-3 with 35 g high explosive.



raised at the time of the blast.

So the IMAS once again reflects what can be derived from the accident record as a well-informed level of minimum protection needs. Effectively if a demining group wants to wear a helmet, they can, and if they want to use an open head-frame, they can. But they *must* wear a visor that provides “full frontal coverage of face and throat.” Almost all the visors made to fit combat helmets are short and provide no throat protection at all. This means that *almost all helmet visors do not reach the minimum PPE requirement for a visor as stated in IMAS*. In a few cases, lower jaw and throat injuries have occurred when the victim was wearing a short helmet visor that did not connect with or overlap the collar on the body protection.

A Sensible Minimum

Section 10.30 of the International Mine Action Standards—entitled *Personal Protective Equipment* deserves close study. If you read it carefully, paying attention to the difference between obligations and preferences, you will find that the obligatory requirements are both sensible and practical. They can be applied without hardship and have been applied by some groups for many years. The requirements are the “minimum”—and any group can take additional measures, but every demining group working to IMAS standards *must* wear frontal blast armour and a long visor when engaged in manual demining.

The IMAS include the disclaimer that “although this standard lays down distances at which the PPE must be effective it must be emphasised that this does NOT imply to deminers that they will be safe at such distances.” Given the unpredictable nature of blast events, this is wise. Also, the wearer’s arms are exposed and can be at a high risk if he is using an inappropriate tool as he works.

The IMAS PPE requirements were informed by the accident record but took other things into account, such as deminer acceptability. Deminers do not want to wear protection that they believe is unnecessary, which is probably why the PPE requirements in the earlier issue of IMAS were widely ignored. If a group can afford it and would feel safer using PPE with a higher specification, they should do so—as long as the increased weight and discomfort do not lead to the PPE being discarded as soon as the supervisor’s back is turned.

I recommend that any excess money in the budget is used to replace the visors regularly—because they do get easily scratched and IMAS state “equipment *shall* be examined on a regular basis to ensure that it is suitable for use.” If this had been done, I know of more than 50 blind deminers who would probably have benefited. Further excess funds should be used to purchase hand tools that have been designed to protect the user’s hands and arms. ■

**All photos courtesy of the author.*

About the Author

Andy Smith has been a hands-on demining researcher for the past eight years. His work has taken him into hundreds of mined areas in Angola, Mozambique, Cambodia, Zimbabwe, Namibia and Afghanistan—and less extensively in Kosovo, Croatia and Bosnia-Herzegovina. He has devised and implemented equipment tests in several countries, developed new equipment and overseen its technology transfer to developing countries, and been employed as a “subject matter specialist” by research programmes, universities and many of the major players in humanitarian demining. Recent work has included producing country-specific training materials for deminers, surveyors and the general public. He began the DDA in 1998 and is currently negotiating its upkeep for the UNMAS.

References

1. International Mine Action Standards (IMAS), <http://www.mineclearancestandards.org/links.htm>.
2. *Journal of Mine Action*, Issue 4.2: The Facts on Protection Needs in Humanitarian Demining. <http://maic.jmu.edu/journal/4.2/focus/PN/protectneeds.htm>.
3. *Journal of Mine Action*, Issue 6.2: “What Use is a Database of Demining Accidents?” <http://maic.jmu.edu/journal/6.2/notes/andysmith/andysmith.htm>.
4. For a free copy, please contact Paul Ellis at GICHD p.ellis@gichd.ch.
5. All these tools are widely used and have featured in accidents.
6. In particular, Alistair McAslan and Alan Bryden.
7. *Journal of Mine Action*, Issue 6.2: “Developing Safer Demining Handtools in Zimbabwe.” <http://maic.jmu.edu/journal/6.2/focus/andysmith/andysmith.htm>.
8. Lower Extremity Assessment Programme (LEAP 99-2) US ARMY CECOM NVESD, Fort Belvoir; US Army Institute of Surgical Research, et al: Project No.8-EI-495-BPF-001: Report No. ATC-8199.

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■ (Left to Right) The kind of visor/collar interface that is recommended in IMAS. The long visor is obligatory. The wearer detonated a PROM-1 while cutting vegetation: he died. (The damage was all caused by fragmentation.)