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SMALL CALIBER DE-ARMERS: AN ANSWER TO EXPLOSIVE ACQUISITION PROBLEMS

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Complete Mini De-Armer with de-bulleting kit, reloading kit and tool roll.
All graphics courtesy of author.

In many mine-affected countries, sourcing, transporting and reliably initiating explosives is one of the major obstacles for mine action operators. Consequently, finding a reliable method of destroying anti-personnel (AP) landmines and other explosive remnants of war (ERW) contamination that does not require the use of high explosives is of great interest to many in the industry.

While .50-caliber de-armers and disruptors are widely used in the world of explosive ordnance disposal (EOD), their use in landmine and unexploded ordnance (UXO) clearance is less common. Both de-armers and disruptors function by firing projectiles at ERW items. Whereas a de-armer uses a steel slug as the projectile, a disruptor uses the projectile motion of a water jet. These tools use de-bulleted and re-loaded cartridges fitted with electric matches that are loaded into a breech with the breech cap tightened down. A de-armer consists of a slug that is loaded into the threaded end of a barrel, which is then screwed onto a breech. Alternatively, a disruptor consists of a plastic slug that is loaded into the threaded end of a barrel, acting as a seal, as the barrel is screwed onto a breech. The disruptor is then positioned vertically, and water is poured into the barrel to within 10 mm of the top, which is then sealed with a close-fitting polystyrene plug.

De-armers and disruptors are positioned so that their barrels are within 25 mm of their targets. Both are initiated via an electric cable that is connected to a standard electronic blasting machine (i.e., an electric power source for initiating the detonation) that is a safe distance away as designated by the on-site EOD officer. The machine then sends a current to the electric match inside the cartridge, causing the cartridge to fire and propel the steel slug or water jet toward the target at a high velocity, de-arming or disrupting the firing chain, usually without initiating the main charge within the munitions or explosive device. It is the responsibility of the on-site EOD officer to decide whether the UXO can be moved safely, and whether the explosive charge can be removed for disposal.

Many operators find that in addition to their cost, the power cartridges used by these tools are often expensive and problematic to move due to restrictions on the transportation and importation of explosives. However, these challenges led The HALO Trust to pursue a collaborative project with Development Technology Workshop (DTW) to develop alternative clearance methods that could use locally sourced ammunition.

The DTW created a series of EOD tools and produced equipment for the following calibers: 7.62 x 39 mm, 12.7 x 108 mm, 14.5 x 114 mm (Russian) and 12.7 x 99 mm NATO. More than 80 of

Breakdown of the mini de-armer. From left to right: breech cap, de-bulleted 7.62 x 39 mm cartridge, breech, 14 mm steel slug, and barrel.

De-bulleted and re-loaded cartridges for three sizes of Mini De-Armers developed by DTW. From left to right: 7.62 x 39 mm, 12.7 x 108 mm (also available in 12.7 x 99 mm NATO), and 14.5 x 114 mm (Russian).

these tools were deployed in the field against live AP and anti-tank (AT) landmines and were used to remove fuzes from larger UXO safely for subsequent transport and disposal elsewhere. DTW also developed a rocket wrench (12.7 x 108 mm), nine of which were deployed. These use a pair of charges to unscrew the fuze from large UXO items (bombs and shells).

LOCALLY MANUFACTURED AMMUNITION

In the United Kingdom and United States, the high cost of a standard, commercial .50-caliber power cartridge (custom-made for de-armers) is one of the main deterrents to using disruptors for routine minefield demolitions. However, small-arms ammunition cartridges are widely available and much more affordable in many of the countries where demining takes place. DTW has developed **de-bulleting** kits that allow the use of ammunition manufactured or sourced in country, greatly reducing the costs of shipping and transportation.

These de-bulleting kits are supplied with each of their EOD de-armers/disruptors and require locally sourced ammunition and an electric match. The electric matches cost a mere 30 cents each, and an air courier can ship them as a normal package. Moreover, any standard electronic blasting machine can initiate these matches.

The de-bulleting process is straightforward and can be completed in five minutes. First, the bullet is pulled from the cartridge, and the propellant is poured into a container. Next, the percussion cap is struck and its brass housing removed. Then the electric match is inserted with its wires exiting through the hole where the percussion cap was originally. Thereafter the powder is poured back into the cartridge, which is crimped. Combined de-bulleting and crimping equipment is available and can be mounted on workshop benches to speed up the process considerably.[1]

HALO in Afghanistan now routinely uses the 12.7 x 108 mm disruptors to destroy AP mines in a role endorsed by the Mine Action Coordination Centre of Afghanistan. The use of de-bulleted cartridges avoids the need for demining personnel to transport explosives and detonators through areas with possible Taliban checkpoints, preventing the chance of diverting explosives into the wrong hands. Similarly, the devices were used in Cambodia to destroy mines along the Thai border, and negated the need to cause explosions in sensitive areas where the military and the local population prohibited the use of explosives.

PERFORMANCE: DEVELOPMENT OF THE MINI DE-ARMER

The 12.7 x 108 mm disruptor is an efficient tool, but engineers at DTW felt these cartridges were excessive when used to destroy plastic-bodied AP mines and de-arm other small ordnance such as 60 mm mortar bombs. The engineers believed they could harness sufficient power to destroy standard AP mines from a smaller cartridge. To this end, they experimented with the ubiquitous 7.62 x 39 mm round (the cartridge used by the AK-47).

Trial results on an indoor test range showed that a 14 mm steel slug driven by a de-bulleted 7.62 x 39 mm cartridge using the Mine De-Armer could penetrate a 4 mm mild steel witness plate.

A strike on a 60 mm mortar fuze with a 14 mm steel slug.

Figure 1 (left to right). Hard plastic 16 mm slug, 14 mm steel flat end, and chisel slug.

Figure 2. Mini De-Armer set up to destroy a PMN AP mine using the 16 mm, 2.4 g plastic slug. Note that a sandbag is placed on top of the tool before firing to dampen the recoil.

Figure 3. As a result of the strike, many parts of the mine were unrecoverable.

Figure 4. Mini De-Armer set up to destroy a PMN2 AP mine using a 14 mm, 27.2 g steel slug.

Figure 5. Result of the strike on the PMN2 with the 14mm steel slug.

Barrel length	Slug length	Slug diameter	Slug weight	Velocity	kj energy
70mm	16mm	16mm	2.4g	43m/s	0.0022kj
170mm	16mm	16mm	2.4g	54m/s	0.0034kj
250mm	16mm	16mm	2.4g	64m/s	0.0049kj

Table 1. K.E = ½mv2, where m = mass; v = velocity

Further experiments using a 16 mm hard plastic slug soon showed that the plastic slug was sufficiently energetic to destroy a range of plastic AP mines (including PMN, PMN2 and Type 72 mines). By using a plastic slug, engineers limit the amount of metal contamination to the surrounding area. Tests using a water projectile as described above were also conducted but showed that water added little extra value to the effect of the plastic slug in attacking AP mines. This contrasts with the larger 12.7 x 108 mm disruptor, which has proved very effective when used with the water projectile.

Trials of the 7.62 mm Mine De-Armer continue in Cambodia, but the system is capable of destroying most plastic AP mines. Field testing utilized a 14 mm diameter steel slug weighing 27.2 g with a barrel length of 135 mm and a 16 mm diameter hard plastic slug weighing 2.4 g with a barrel length of 175 mm. DTW engineers recognized that performance was dependent upon several factors:

1. Barrel length
2. Burn rate of the propellant, which depends on the grain size and is fixed by the reuse of existing propellant in this case
3. Projectile dimensions, including weight and diameter
4. Projectile fit to barrel; a tighter fit will result in a higher pressure buildup of propellant gasses and a higher velocity
5. Size of the charge, which is fixed by the size of the AK-47 cartridge.

Of these five factors, barrel length, projectile dimension and projectile fit were most easily modified, and hence offered the best opportunities for improving performance.

Based on the field test results, DTW decided to carry out ballistic testing using a chronograph on an indoor range in order to determine optimal dimensions for projectiles and barrels. The information in Table 1 relates specifically to the Mine De-Armer as part of DTW's research and development, and is not a guide for the energy required for the destruction of UXO. The plastic slug is made to be a tight fit and can be inserted by pushing it into the breech end of the barrel.

CONCLUSION

The results indicate the importance of barrel length when considering maximum output possibilities. Research and development will continue, but the current design of the Mine De-Armer destroys plastic-bodied AP mines and removes Bakelite fuzes from small mortar bombs. Furthermore, the current design is also suitable for use against improvised explosive devices.

The Mine De-Armer is a lightweight (3 kg), easily transportable system for use against lighter munitions. The use of de-armers and disruptors is a safe, economic way of rendering landmines and UXO of various kinds safe. All the equipment mentioned is cost-effective, especially in light of the limited budgets of many of the organizations involved in humanitarian clearance. Moreover, since the items are manufactured and exported directly from Cambodia, there are no delays associated with export license applications.

See endnotes page 67

Development Technology Workshop is a British-registered charity and an international nongovernmental organization (NGO) based in Cambodia that provides research, development, prototyping, and when required, manufacturing services to other NGOs and the local, private-sector industry. DTW is not a demining organization.

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