

The Danger Area Marking Kit (DAM)

8 January 2007

US Humanitarian Demining Research and Development Program

1.0. Background. In order to meet a stated user requirement from the 2003 US Humanitarian Demining Research and Development Program (HD R&D) Requirements Workshop, HD R&D contracted CSIR Defencetek to support the design, testing and evaluation of a Danger Area Marking (DAM) for use by the international humanitarian demining community, as well as interested military forces.

At that time there was not a universally accepted method for the marking of minefields and hazardous areas. Demining practitioners such as NGOs and commercial entities were using (and still are) generically developed methods that suited their particular requirements. These methods vary from entity to entity and region to region. While most military entities do have formal marking systems and equipment, these are restricted to be used during military operations, such as the marking of breaches through minefields, and are not suitable for use in the humanitarian context. The DAM Kit was needed to mark suspect areas identified during initial area surveys as well as the final marking of areas after clearance and verification.

In order to understand marking practices in the field and refine the requirements for the DAM Kit a literature survey was conducted. A mined-area marking user focus group (UFG) was conducted in a two-day workshop in South Africa 24 - 25 June 2003. The workshop sought to provide a record of current practices in mined-area marking, and develop a reliable user requirement. Group members were drawn from commercial, United Nations and NGO demining groups, with additional selected consultants and representatives of the research and development community. The UFG members had recent humanitarian demining experience in Croatia, Iraq, Kurdish Iraq, Thailand, Cambodia, Angola, Mozambique, Democratic Republic of Congo, Afghanistan, Bosnia Herzegovina, Kosovo, Nicaragua, Somalia, Lebanon, Eritrea, and Ethiopia. The UFG served as the basis for establishing the contents and procedures for use of the DAM Kit.

2.0. Description. The DAM Kit provides tools and materials for the perimeter marking of suspect or identified danger areas containing explosive remnants of war (ERW), including mines. The marking of danger areas can be done by Mine Action Centers, non-governmental organizations (NGOs), commercial demining companies, military units and local police as part of a mine action program or as part of peacekeeping operations in post conflict situations. The DAM Kit is comprised of two separate kits, a Consumable Kit and a reusable Toolkit. A single DAM Kit has sufficient material to mark 400 meters of linear perimeter of a danger area. The cost for the Toolkit is \$US 327 and the cost for the Consumable Kit is \$US 332.

The DAM Kit was developed to facilitate perimeter marking by either painting natural objects such as trees and stones or man-made objects like buildings or stationary derelict vehicle wrecks. Where there are no natural or man-made objects located along the perimeter of the danger area, beacons can be manufactured to create the required marker points. The beacons are manufactured on the site of the marker point by loosening the soil and mixing it with the cement contained in the kit. When dry the beacon is able to withstand the effects of weather

3.0. Capability. A single kit has sufficient material to mark 400 meters of linear perimeter of a danger area as a minimum. The distance will depend on local terrain conditions.

4.0. The content of the DAM Kit. The DAM Kit consists of a Toolkit that is re-useable and a Consumable Kit that contains the materials required for the marking of the perimeter of the hazardous area.

4.1. Toolkit. A Hippo water roller, a barrel-shaped drum with a large screw-on cap and a clip-on steel handle, is used to transfer water from the closest water source to the site to mix and cast perimeter beacons as needed. Two persons can push or drag the roller containing up to 150 liters of water over rough terrain. Two plastic moulds are used for the casting of the beacons. The two moulds provide sufficient capacity to cast 8 to 10 beacons per day, depending on climatic conditions and associated drying time. A plastic bucket is used to measure the required amount of soil for the cement mix and to transfer water from the water roller to the soil/cement mix during mixing. A canvas carry-bag is used to carry the tools on foot along the perimeter. A metallic skull and crossbones stencil is used to emboss the skull and crossbones symbol onto the side of the beacon when the cement is fairly wet. This embossed symbol remains visible longer than a symbol painted onto a flat surface. The bow saw and “panga” or machete can be used for vegetation cutting and to clear sections of tree trunks to be painted as marker points along the perimeter. The pick is used to loosen the topsoil on site for the cement mix. The spade is used to mix the cement. The building trowel is used to smooth the outer surface of the beacon after de-moulding. The steel wire brush is used to clean the inside of the mould after de-moulding to provide a smooth inner surface for the next casting of the beacon. The stencil set (alpha-numeric) is used to write on the reference point marker board. A 100 meter measuring tape has been included in the Toolkit to assist with the mapping of the perimeter. A protractor stencil has also been included to assist with the mapping of the danger area.



Figure 4.1. DAM Toolkit

4.2. Consumable Kit. A metallic marker board (900 x 600 millimeters) is used to mark the reference point of the danger area. Two 1-metre sections of galvanized water piping (25 millimeter in diameter) joined by a socket are fixed to the board with four U-bolts to support the marker board. Thirty paintbrushes (15 - 25 millimeter and 15 - 50 millimeter brushes) are used for the painting of the beacons and natural and man-made objects along the perimeter as well as the lettering on the marker board. Glass beads are sprinkled over the painted surface of a manufactured beacon while the paint is still wet. The beads create a reflective surface that enhances the visibility of the beacon. Eight liters of road paint (3 liters red and 5 liters white) are included in the kit. The road paint is used for the painting of beacons, rocks and man-made objects not consisting of fibrous material. Six liters of tree paint (3 liters red and 3 liters white) are used for the painting of tree-trunks, branches and other vegetation to mark the perimeter. The red and white colors are used to distinguish between the danger and safe sides of the perimeter according to standards and practice used in a specific region. The tree paint was developed for use in the forestry industry where marked trees must remain visible for periods exceeding one year under adverse climatic conditions. Two empty tins (1 liter) are included in the kit for the mixing of the tree paint. A roll of barrier tape (100 meters) is included in the kit to facilitate emergency, short term marking of the perimeter. Ten packets of quick-dry cement facilitate the manufacture of at least ten beacons. Additional packets of cement can be obtained locally. The mass of the Consumable Kit is approximately 100 kilograms with package included.



Figure 4.2. DAM Consumable kit

5.0. Guidelines for the use of the DAM Kit. The use of the DAM Kit should not contravene the principles and guidelines established in the International Mine Action Standards (IMAS) for the marking of mine and UXO hazards. (IMAS 08.40).

5.1. Local involvement. It is important to involve members from the local community within the affected area. The marking of the perimeter of the danger area should be conducted in conjunction with an appropriate mine risk education program where the function and purpose of the marking system are explained to the members of the local population. Ultimate success is achieved when members of the local community accept responsibility for the marking of the danger areas as well as the maintenance of the marked perimeter.

5.2. Spacing of markers. The spacing of markers along the perimeter of the danger area will depend on the terrain conditions, most notably vegetation growth that impedes visibility. The perimeter should be visible from at least ten metres out when approaching the danger area. More than one marker should be visible from this distance. Adjacent markers in both directions from the position of a specific marker along the perimeter should be visible.

5.3. Painting of trees and shrubs to establish marker points. Trees and shrubs are natural objects that can act as marker points along the perimeter of a danger area. If a particular tree or shrub is chosen as a marking point, surrounding branches and secondary growth along the trunk should be removed to enhance visibility of the trunk prior to painting. The trunk should be painted in two colours, red and white to indicate the danger and safe sides of the perimeter according to conventions used in the region. The height at which the trunk should be painted should be higher than the surrounding vegetation to enhance visibility. It should not be painted lower than one metre from the ground. A single or forked trunk can be painted as illustrated in Figures 5.1 and 5.2.



Figure 5.1. Single trunk



Figure 5.2. Forked trunk

The tree paint provided in the kit should be used to paint trees and shrubs. This specially developed paint penetrates into the wood and does not easily fade or dry out the outer bark allowing it to fall off. This paint lasts up to a year under adverse weather conditions.

5.4. Painting of other natural or man-made objects. Other natural objects such as rocks or stones located along the perimeter of the danger area can also be painted to establish marker points as indicated in Figure 5.3. Man-made objects such as derelict

buildings, stationary vehicles, existing posts and pylons can also be painted to establish marker points along the perimeter, as depicted in Figure 5.4.



Figure 5.3. Painted rocks



Figure 5.4. Painted derelict building

5.5. Manufacture of beacons. Where no natural or man-made objects are located along the perimeter of the danger area, beacons have to be manufactured to create the required marker points. The beacons are manufactured on the site of the marker point by loosening the soil and mixing it with the cement contained in the kit. The recommended ratio of is one part cement to 20 parts soil. If the ground on the site consists of shale or rock, loose soil can be obtained from another position and carted to the site with the aid of the canvas carry-bag. Water is added to the mix to provide a stiff cement mix. The cement mix is transferred into the mould and compacted with a stick as shown in Figure 5.5.



Figure 5.5. Pouring cement mix into mould

After compaction of the cement mix, a wooden stake can be inserted into the top of the mould to enhance the visibility of the beacon. The mixture is allowed to dry for one to two hours depending on climatic conditions before the mould is removed by carefully pulling it from the beacon. The sides are smoothed over with the building trowel and the skull and crossbones embossed into the side of the mould as depicted in Figure 5.6.



Figure 5.6. Embossing the skull and crossbones

The completed beacon is allowed to dry for at least one day prior to painting with the road paint supplied in the kit. The completed beacon is depicted in Figure 5.7.



Figure 5.7. Completed beacon

When dry, the beacon is able to withstand the effects of the weather. However, the recommended cement-soil mixture ratio is not strong enough to withstand any handling or shifting. The beacon will crumble and break up if handled. This prevents the beacon from being removed and used for other purposes and does not pose problems in areas where agricultural activities have to resume within the area after removal of the ERW threat.

5.6. Seasonal vegetation growth. The effects of seasonal vegetation growth regarding visibility should be borne in mind when establishing the positions of markers along the perimeter of a danger area. The visibility of markers can be reduced dramatically by the abundant growth of the surrounding vegetation. Beacons constructed and erected to mark the perimeter in typical grassland during winter, may be visible from distances as far as fifty metres. This distance may be reduced to less than five meters during summer after the grass has grown to a height of more than one meter.

5.7. Use of barrier tape. The use of the barrier tape included in the kit should be restricted to short-term or emergency marking only. Short strips on this tape can be tied to branches or placed under rocks to establish the perimeter of a danger area quickly. However, once a more permanent form of marking has taken place, these strips should be

removed and burned. Experience has shown that the tape deteriorates rapidly (within weeks in certain regions) and the wind scatters these pieces throughout the area. This can lead to confusion regarding the position of the perimeter.

5.8. Maintenance of the marked perimeter. Members of the local community should be made responsible for the maintenance of the marked perimeter. This includes vegetation clearance as well as repainting when required. They should also report the condition of the marked perimeter to the local authorities on a regular basis. Inspections by the local authorities should be conducted on a regular basis. Footpaths could be established along the safe side of the perimeter to allow the safe conduct of the local population around the danger areas. Footpaths will enhance the visibility of the perimeter as well.

6.0. Initial Testing and Operational Field Evaluation. Initial testing of the DAM Kit and its contents was held at Paardefontein Explosive Range, South Africa by CSIR. The area was surveyed and marked using items from a single DAM-Kit. A survey was conducted 14 - 15 October 2003 and a linear perimeter of 729 meters was marked to designate the danger area. Maximum use was made of natural objects (trees, termite hills, adobe ruins and other structures) as turn points along the perimeter. Beacons were manufactured on site and positioned along the perimeter where no natural or man-made objects could be identified as perimeter turn points. The perimeter markings were inspected on a monthly basis from mid-October 2003 to mid-February 2004 with no evident visible deterioration.

Changes made as a result of this initial testing resulted in the final DAM Kit that was deployed to Mozambique for use by the Mozambique Accelerated Demining Program (ADP). ADP conducted a training session for all of its survey teams at Moamba near Maputo from 6 to 12 January 2004. CSIR deployed five DAM Kits to Moamba and introduced the kits to the survey teams during this period. One of the kits was used during this introduction and a perimeter of a fictitious danger area was marked as part of the introduction. This marked perimeter was used for ageing tests. The four remaining kits were given to the survey teams for use in actual technical surveys.

All the items included in the kit proved useful, adding value to the marking activities and enhancing the visibility of danger area markings. The personnel were very enthusiastic about the quality of the paint and the ease of use of the Hippo roller as well as the cement mould.

7.0. Conclusions. The DAM Kit was developed as a result of an identified user requirement, focus group feedback and a field trial prior to deployment to Mozambique. The result was a portable, low cost, useful system for marking danger areas with demonstrated utility during its operational field deployment. The DAM Kit proved to be an unqualified success due in large part to continuous consultation with, and acceptance of, users from the initial concept through deployment to the field.