

## **(Extracted from report entitled) Testing Demining Technology Innovations (2001)**

Testing was conducted under the direction of the Lead Consultant, Col. J.T. Theyse of Namibia on behalf of SADC (Southern Africa Development Community) with European Union (EU) funding support.

### **Visitors**

Visitors include those not directly involved in the trial and its execution but exclude the technicians preparing the site, guards, medics etc.

### **Zimbabwe**

At the Zimbabwe trial, the follow people were present:

**Consultants:** Col. J.T. Theyse of Namibia (Lead Consultant), Maj. G. Chimanga of Zimbabwe, (Assistant Consultant)

**Zimbabwean National Army:** Lt. Col. T. Munongwa, Director – Zimbabwe Army Engineers; Lt. Col. Ngube, Commander – Zimbabwe Army School of Engineers; Capt. P. Moyo, Safety Officer

**Innovators:** Mr. Trevor Thomsen, Security Devices (Pty) Harare; Mr. Byron Hove, Biku Business Services (Pty) Ltd

**Technical Experts:** Brig. T. Kanganga; Mr. Keith Byng; Mr. C. Wanyamba

**Observers:** H.E. Mr. J.M. Ndjoze, High Commissioner of the Republic of Namibia to Zimbabwe; Dr. J.M.Ndlovu, Project Manager, SADC Demining Program; Mr. P. Makumbe and Maj. Nhidza, Mine Clearance International, Harare.

### **Mozambique**

At the Mozambique trial, the following people were present:

**Consultants:** Col. J.T. Theyse of Namibia (Lead Consultant)  
Maj. G. Chimanga of Zimbabwe (Assistant consultant)

#### **SADC Mine Action Committee:**

Dr. J. M. Ndlovu, Project Manager, SADC Demining Program  
Mr. F. J. Nuvunga, IND, Mozambique  
Mr L. Sapalo, INAROOEE, Angola  
Major F. Kotokeni, Defence Forces, Namibia  
Mr N. Reynard, Foreign Affairs, South Africa  
Lt. Col. T. Munongwa, Director Army Engineers, Zimbabwe  
Mr M. F. Selemane, Foreign Affairs, Mozambique

#### **Innovators:**

Mr. Trevor Thomsen, Security Devices (Pty), Harare, Zimbabwe  
Ms Fiona McKay, Security Devices (Pty), Harare, Zimbabwe  
Mr B. Hove, Biku Business Services (Pty), Harare, Zimbabwe  
Mr C. Vhazhure, Biku Business Services (Pty), Harare, Zimbabwe  
Mr T Bande, Biku Business Services (Pty), Harare, Zimbabwe

#### **Technical Experts:**

Mr A. Domingus, IND Mozambique  
Mr T. Alexander, IND Mozambique

Mr A.F.Marie, IND Mozambique  
Mr D. Van Lawersberg, Mozambique  
Mr D. Constantino, Mozambique  
Mr C. Chitatango, Mozambique  
Mr J. Jeremias, Mozambique

**Observers:**

Mr. A. J. Soul, Municipality President of Chimoio, Mozambique  
Mr J. De Amelda, ADP, Mozambique  
Mr E. Lavario, Mozambique  
Mr D. Assa, Mozambique  
Mrs S. Mangujo, Mozambique  
Mr. J. Graca, Provincial Director of Chimoio, Mozambique  
Mr D. T. Jaquetta, Mozambique  
Mr F. Lubanga, Mozambique  
Brigadier J. P. Machakaire, Zimbabwe  
Major J. Nhidza, Zimbabwe  
Mr P. Makumbe, Zimbabwe  
Mr B. Van Stroten, Zimbabwe

**Namibia**

At the Namibia trial, the following people were present:

**Consultants:** Col. J.T. Theyse of Namibia (Lead Consultant)

**Namibian explosives police:** Safety Officer

**Innovators:** Mr. Trevor Thomsen, Security Devices (Pty) Harare; Ms. Fiona McKay Security Devices (Pty) Harare

**Technical Experts:**

Mr S. Smith, (TechMech), Namibia  
Mr A.V.Smith (demining safety specialist), UK

**Observers:** Mr D. Radmore, explosives specialist, Namibia

**Trial equipment**

The trials of PPE involved the use of a frame (or “dummy”) on which to arrange the equipment when presented to a mine blast. Security Devices had such a frame and it was used in the first two trials. In the third trial a prototype of an improved frame made in Namibia was used with some success.

The picture on the right shows the Namibia frame adjusted to match a demining position. The improved frame was made using mild steel with some size-adjustment capability built in. The Namibia frame needs further work (see recommendations).



## Stores

The mines used for the testing were PMN AP blast mines, R2M2 AP blast mines and PMD-6 AP blast mines. Because of the legal difficulties in transferring AP mines within the region, the mines were provided by partners within the test country. The age and condition of the mines varied, and some difficulties were encountered when mines failed to detonate as designed or only partly detonated. The variations in blast-wave forces that resulted were undesirable (although probably reflected the varied performance of real mines as they might be encountered). Given the limited number of tests that could be conducted, it was decided that in future it would be better to use mines of a known condition. The well-stored and unused PMN AP blast mines that were used for the last testing in Namibia (shown on the right) are an example of mines in a "known condition" that could be expected to detonate in a predictable way.



Detonators and electrical initiation systems were also provided by the authorities within the country where the testing took place.

## Trial procedure

Blast trials of the PPE involved setting up the ensembles in front of an AP blast mine at measured distances, then detonating the AP mines from a safe distance.

After the first two tests, the damage to the PPE was visually assessed in the field. After the third test in Namibia, the PPE was taken apart and the damage and method of manufacture assessed. The picture on the right shows the SD Mk4 apron being cut apart and the internal damage assessed as minimal.



The PPE ensembles were also assessed for ease of use, maintenance, comfort and apparent durability.

## Trial location(s)

Trials took place in three countries at the following sites:

- Chimoio Military Shooting Range, Mozambique
- Pamona Barracks Army Training Centre, Harare, Zimbabwe
- Otjisase mine tailings site, Windhoek, Namibia

The picture on the right shows an army engineer in Zimbabwe preparing the SD Mk4 PPE ensemble for the blast test. The frame used to support the ensemble was provided by Security Devices for this and the following test in Mozambique.



## Trial programme

Blast testing was carried out on the following dates:

- Mozambique from 17-19<sup>th</sup> April, 2001
- Zimbabwe on March 6<sup>th</sup>, 2001
- Namibia on September 3<sup>rd</sup> 2001

Preparations and finalisation occurred before, between and after those dates.

## Climatic conditions encountered

The weather was dry in all three countries. Soil conditions were not measured and varied significantly. The ground conditions in Namibia were hard and the soil largely mica. In Mozambique the soil was dry and fibrous. In Zimbabwe the ground was wet and fibrous. It was decided that, for future testing, a weather station was needed to record ambient conditions, and that a soil-hardness tester should be used prior to laying the mine. (See recommendations.)

## Description of tests

Testing in terms of the suitability of the equipment for its design purpose was carried out by canvassing opinion from a range of experts invited to attend the blast testing, and by the Lead Consultant in a prolonged assessment.

Testing of the blast protection offered was by presenting the equipment to real blast mines in environments resembling real mined areas.



The tests are described in detail in: ANNEX A Zimbabwe, ANNEX B Mozambique, ANNEX C Namibia.

The PPE ensembles were presented to blast mines at measured distances and after the blast the PPE was examined and damage recorded. Where it was felt that the product could be improved, suggestions were made to the manufacturer and any revisions he made were then assessed in the next test. The manufacturer made revisions to the SD Mk4 apron between each test, so indicating that the criticisms were helpful and valued.

## Trial results for Blast testing

The **SD Mk1 apron** performed well. The material from which the apron is made was found to be capable of withstanding the blast and fragments associated with large anti-personnel blast mines without sustaining serious damage.

The **SD Mk4 apron** was found to have manufacturing flaws that were addressed as the trials progressed. The revised SD Mk4 performed well. The material from which the apron is made was found to be capable of withstanding the blast and fragments associated with large anti-personnel blast mines without sustaining serious damage.

The **SD Blast Visor** performed well. In two tests the visor broke down the left hand side with a single fracture line. [It is believed that the method of presenting the visor held rigid to the frame was the cause. Visors do break in accidents, but rarely.]

## Product Evaluation

All equipment was subjected to continuous evaluation by the invited specialists and experts present at the blast trials.

The appraisal parameters for the PPE were:

- Does the equipment provide valuable protection to a wearer against an anti-personnel blast mines at close quarters?
- Is it light and relatively cool to wear in hot climates?
- Is it relatively quick to put on and easy to adjust?
- Does it impose only minor restrictions on movement and vision?

- Is it durable and easy to maintain?

The consensus was that the PPE was found to meet the above parameters, with some reservations over the visor's comfort, durability and ease of maintenance.

## Conclusions

### SD Mk1 armour apron

The SD Mk1 armour apron performed remarkably well against a range of blast mine threats. The fragments of mine casing and of the ground associated with an anti-personnel blast mine detonation struck the apron body in all the tests. No fragments penetrated and no fragments came close to penetrating. Despite having a NATO STANAG 2920 fragmentation V50 lower than that recommended in the new IMAS standards for Humanitarian Demining, the general view was that the protection offered had proven more than capable of stopping all blast and mine casing or ground fragmentation associated with anti-personnel blast mines.

When assessing the SD MK1, the experts also assessed the manufacturer's claims that the armour was:

- light and cool to wear in hot climates,
- quick to put on and easy to adjust,
- minimises restrictions of movement and vision
- durable and easy to maintain.

In the opinion of the experts, the above is an accurate description of the SD Mk1 apron.

### SD Mk4 armour apron

The revised version of the SD Mk4 body armour apron was found to be appropriate for protection against blast-mine threats.

In an unscheduled test of a SD Mk4 ensemble that had already survived a PMN test, the ensemble faced a common fragmentation mine threat. It was found that the SD Mk4 gave significant protection against the detonation of a POMZ-2M fragmentation mine at 1.5 meters.

The picture on the right shows the SD Mk4 facing a POMZ-2M.

When assessing the SD MK4, the experts also assessed the manufacturer's claims that the armour was:

- light and cool to wear in hot climates,
- quick to put on and easy to adjust,
- minimises restrictions of movement and vision
- durable and easy to maintain.

In the opinion of the experts, the above is an accurate description of the SD Mk4 apron.



### SD 5mm full-face polycarbonate blast visor

The SD full-face 5mm polycarbonate visor has been manufactured and sold for several years. It has been tested regularly and featured in more than 20 real blast incidents and not failed, so it provided a measure of the realism of the simulated accidents in the blast testing

When assessing the SD blast visor, the experts assessed the manufacturer's claims that the visor was:

- light and cool to wear in hot climates,
- quick to put on and easy to adjust,
- minimises restrictions of movement and vision
- durable and easy to maintain.

In the opinion of the experts, no visor meets the above description. Like all polycarbonate blast visors, the material is not known for its durability or its ease of maintenance. Also, most deminers do not consider visors to be light and cool to wear. That said, the experts agreed that:

- the SD blast visor was well designed to provide good protection,
- the scratch guard was an improvement over most other visors
- the fact that the visor is locked down improved safety,
- the head-frame was unusually comfortable compared to hard plastic versions.