PROJECT FOR RESEARCH AND DEVELOPMENT OF DEMINING RELATED EQUIPMENT IN CAMBODIA

No 1

PERFORMANCE TEST

SWING TYPE MACHINE

4. NO 1: PERFORMANCE TEST

The aim of this test is to assess the performance of the system against mines without booster of various sizes and shapes which located in different depths and fueling consumption of machines. The test will be done at three conditions:

- Dry condition is selected when the ground moister is less than 25% or other word; there is no visual contact of water within its test site. On top of that the ground soil is hard and it less potential to get flooded.
- Light bush condition is selected when the area is grown by shrubs or mix wild vegetation whose diameter is less than 20 cm (tree that diameter is larger than 20 cm is manually removed).
- Wet condition is where the ground moister is over 25% or the ground is soft that it could represent Cambodia minefield in wet season. This condition poses a major constraint for heavy weight demining machinery.

4.1. PERFORMANCE TEST LOCATION

Performance test is conducted at Siem Reap province. Please find more detail information in the following page:

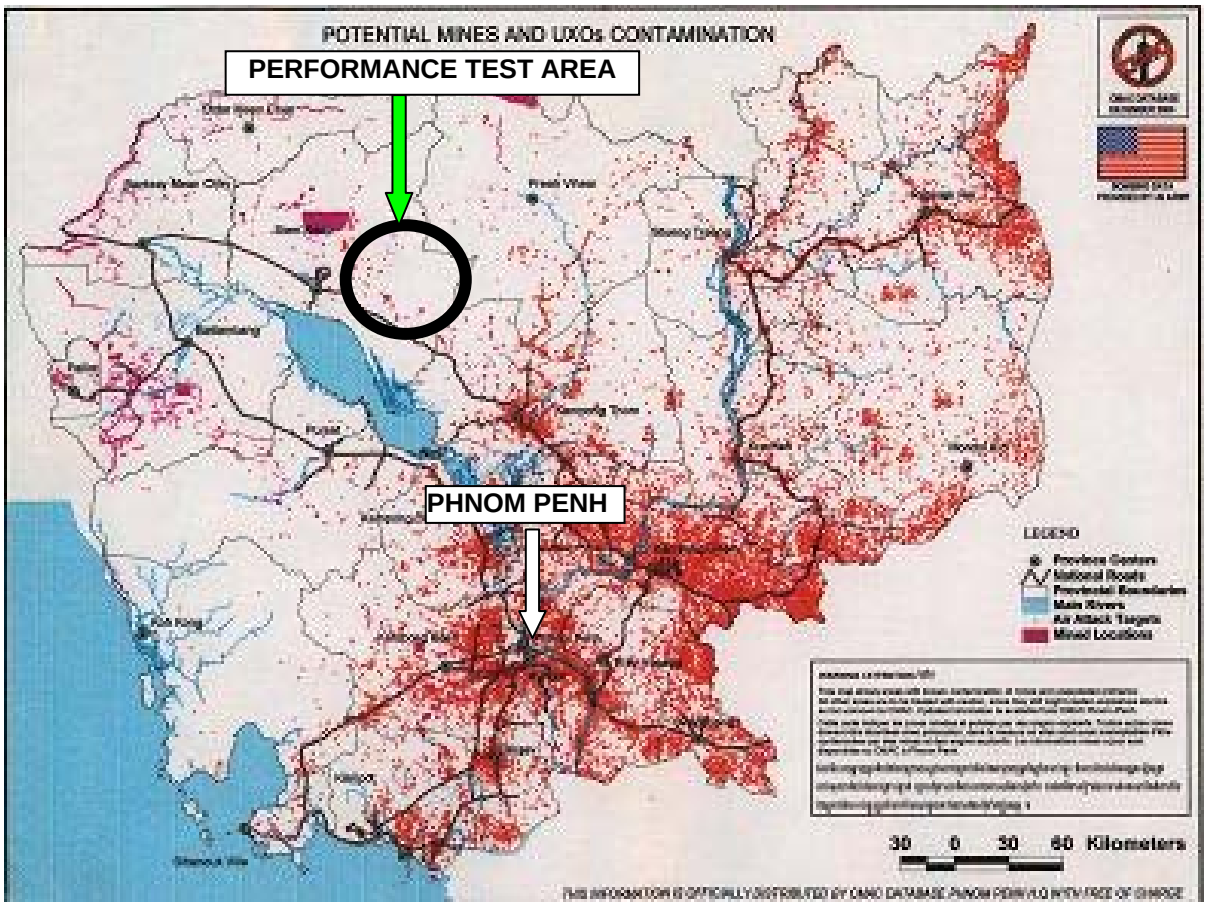


Figure 1: Performance test location in Cambodia

GENERAL INFORMATION OF TEST SITE TO CONDUCT PERFORMANCE TEST

1. Province: Siem Reap province
2. District: Sort Nikum
3. Commune: Porpel
4. Village: Porpel kandaal
5. Test site name: Light bush
6. Distant from Siem Reap town: approximately 60km
7. Distant from Phnom Penh city: approximately 300km
8. Distant from National road: 5km
9. Distant to nearest village: 1km
10. Evaluation in case of emergency: ambulance, helicopter
11. Test Size Compound: 650m x 360m
12. Landscape: flat
13. Land use: abandoned farm area
14. Soil type: Mix clay on top, laterite below
15. Potential flooding: Average
16. Potential mudding: High (in bulldozed area) average (in bush area)
17. Mine/UXO contamination within Test Site: NO
18. Mine/UXO contamination surrounding test site: NO
19. Mine/UXO explosion: Yes
20. Mine/UXO accident (kill or injured): No
21. Historical background during civil war: village
22. Mobile phone connection: Yes at some locations (poor network)
23. Running water: NO
24. Electricity: Generator
25. Recommended footwear: Boot
26. Rain coat recommended: Yes
27. Vegetation within test site area: Yes but already clear by bulldozer
28. Vegetation surrounding the test site area: Thick
29. Vegetation type: light bush (1m – 2.5m height)
30. Potential mosquitoes bite at day time: Low
31. Potential mosquitoes bite at night time: Average
32. Malaria infected level: unknown
33. Humidity: 55% - 80% (estimated)
34. Temperature during wet season: 30 degrees – 40 degree (direct sun light)
35. Recommendation:
    a. wear boot
    b. use anti-mosquitoes rappelling cream or spray
    c. use bottle water for drinking (can be bought at town)
    d. Report to superior or project staff in case of other issues arisen.

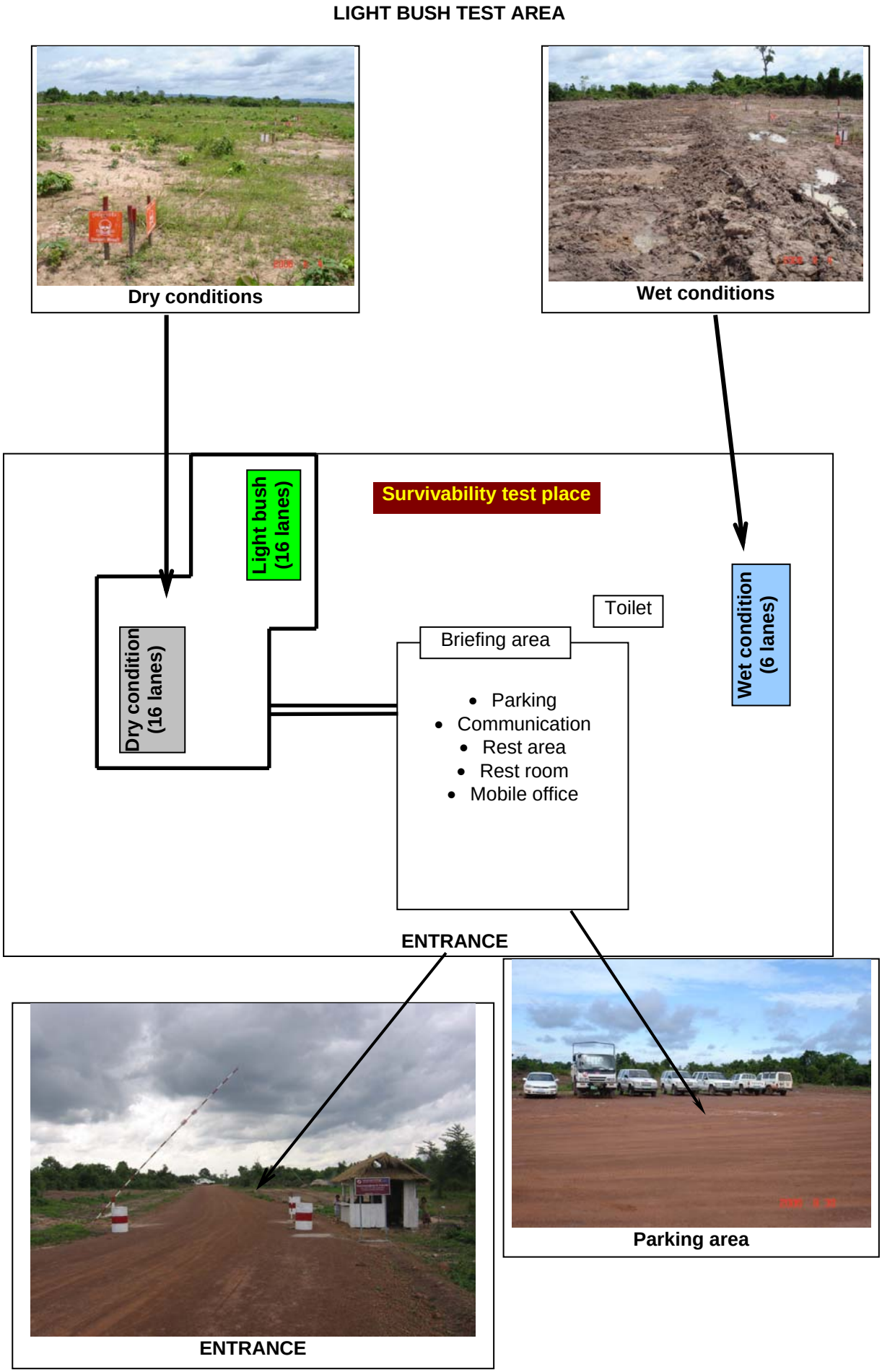


Figure 2: General view of light bush test area (performance & survivability test area)

4.2. TEST PARTICIPANTS

4.2.1. CAMBODIAN MINE ACTION CENTRE (CMAC)

To implement this project, CMAC had set up a project management team consists of existing CMAC staff, pool of CMAC Special Service Agreement (SSA) and an independent consultant to come and evaluate the performance of the demining machine. The structure of the project and the name of the staff could be shown bellows:

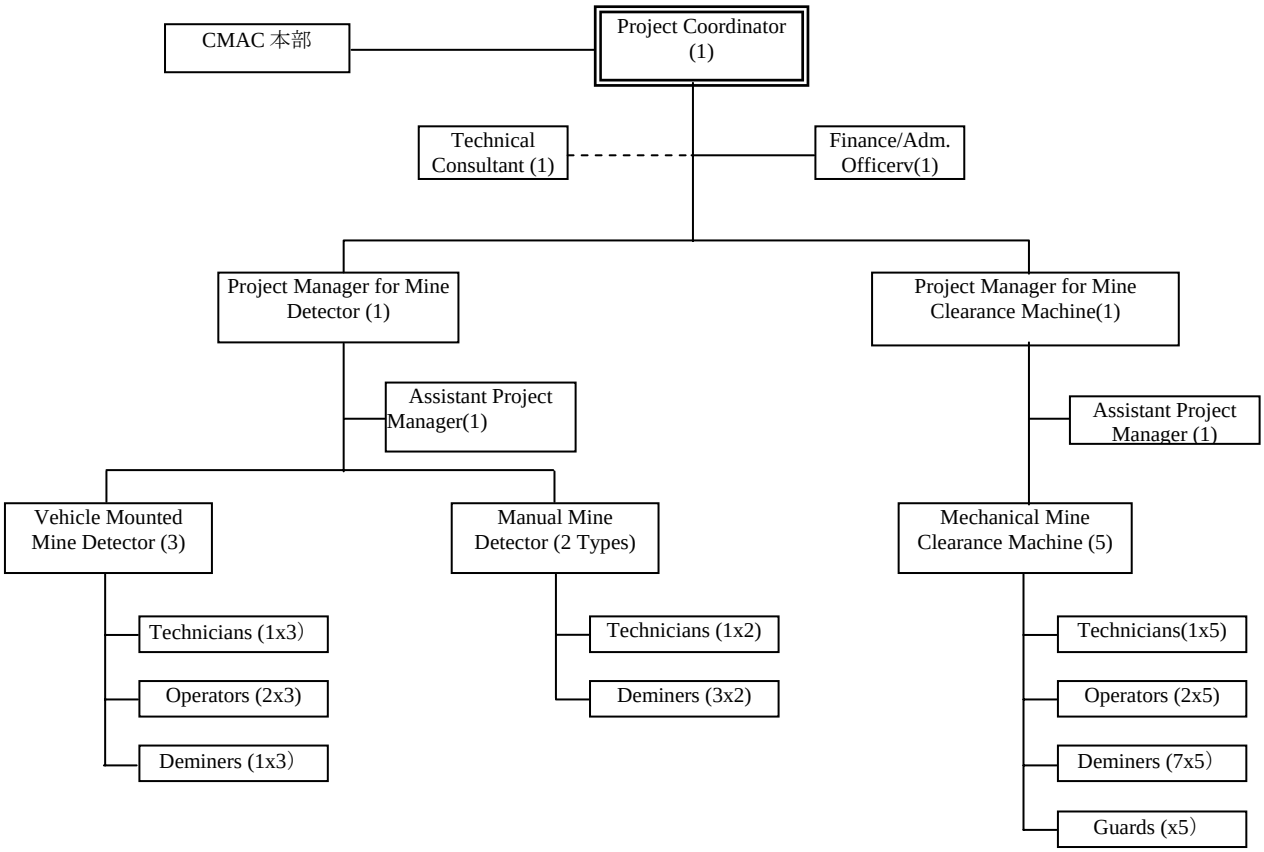


Figure 3: Structure of the project

Table1: Project Management Team

No.	Full Name	Organization	Position	Sex	Position
1	Oum Phumro	CMAC	Director of Planning & Operation	Male	Project Coordinator
2	Roath Kanith	Independent	Consultant	Male	Project Evaluator
3	Srey Rithisack	CMAC	Coordinator	Male	Project Manager
4	Chhin vibol	CMAC	EOD instructor	Male	Deputy Project Manager
5	Tep Sokha	CMAC	Finance	Male	Accountant
6	Chhea rithy	CMAC	Medic	Male	Medics
7	Keo Sreynoch	CMAC (SSA)	Driver	Male	Driver
8	Dav Sunly	CMAC (SSA)	Driver	Male	Truck driver
9	Kim Heang	CMAC (SSA)	Driver	Male	Driver
10	Ung Neth	CMAC (SSA)	Driver	Male	Driver
11	Soueng Sinaan	CMAC (SSA)	Driver	Male	Driver
12	Luy Suy	CMAC (SSA)	Driver	Male	Driver
13	Mr. Vuthy	CMAC (SSA)	Driver	Male	Driver
14	Mr. Heang	CMAC (SSA)	Driver	Male	Driver

Table2: Member for demining machine number 1

No.	Current Post.	Loc/Team.	ID#	Full Name	New Positions
1	Mechanic	CWS	933912	Sam Pisey	Technician/Truck Driver
2	Asst. BC. TL	DU#2-BC#T21	932156	Vong Yen	Operator

3	BC.Operator	DU#2-BC#T09	931530	Pum Phally	Operator
4	Sr.Member	HQ-CMC#T04	930589	Lay Ponloeuk	Team Leader
5	Section Cdr.	DU2-MPL107	931009	Proeung Soeung	Deputy team leader
6	Deminer	DU2-MPL107	930565	Rum Thip	Deminer
7	Deminer	DU2-MPL107	930632	Yin Hip	Deminer
8	Deminer	DU2-MPL107	931085	Prim Tek	Deminer
9	Deminer	DU2-MPL107	931743	Uk Sopheap	Deminer
10	Deminer	DU2-MPL107	931230	Thoun Thy	Deminer
11	Deminer	DU2-MPL107	931054	Som Bona	Deminer
12	Deminer	DU2-MPL137	930625	Duch Kong	Deminer

Table3: Member for demining machine number 2

No.	Current Post.	Loc/Team.	ID#	Full Name	New Positions
1	BC-Mechanic	CWS	934070	Heng Chanrith	Technician/Truck Driver
2	Spare Driver, No.3	Ex.FLAIL Project	933701	Eng Ton	Operator
3	BC.Operator	DU2-BC#12	933190	Kun Pov	Operator
4	Sr.Member	DU#2-CMC#05	931300	Khem Pach	Team leader
5	Section Cdr.	DU2-MPL115	930160	Chap Samnang	Deputy team leader
6	Deminer	DU2-MPL115	930638	Hul Horn	Deminer
7	Deminer	DU2-MPL115	930574	Um Sam.Oeun	Deminer
8	Deminer	DU2-MPL115	931365	Pov Choch	Deminer
9	Deminer	DU2-MPL115	932356	Kheav Penh	Deminer
10	Deminer	DU2-MPL115	932153	Lay Sarin	Deminer
11	Deminer	DU2-MPL115	931324	Khat Tha	Deminer
12	Deminer	DU2-MPL137	931128	Chan Khemara	Deminer

Table 4: Member for demining machine number 3

No.	Current Post.	Loc/Team.	ID#	Full Name	New Positions
1	Mechanic	CWS	933911	Ty Sarith	Technician/Truck Driver
2	BC. Operator	DU2-BC#03	932619	Ses Saroeun	Operator
3	BC. Operator	DU2-BC#09	933644	Lors Savoeun	Operator
4	Sr.Member	DU2-CMC#06	930035	Hin Bunthorn	Team leader
5	Section Cdr.	DU2-MPL116	931986	Lim Sophal	Deputy team leader
6	Deminer	DU2-MPL138	930660	Phan Loeum	Deminer
7	Deminer	DU2-MPL116	931321	Chhun Sarith	Deminer
8	Deminer	DU2-MPL116	931323	Kem Sarin	Deminer
9	Deminer	DU2-MPL138	930103	Sum Savoeun	Deminer
10	Deminer	DU2-MPL138	932947	Sarin Sam.arth	Deminer
11	Deminer	DU2-MPL116	931306	Chum Sear	Deminer
12	Deminer	DU2-MPL137	932630	Chhun Bona	Deminer

Table 5: Member for demining machine number 4

No.	Current Post.	Loc/Team.	ID#	Full Name	New Positions
1	Mechanic	CWS	933967	Ny Sinath	Technician/Truck Driver
2	BC. Operator	DU2-BC#17	932692	Lay Sarann	Operator
3	BC. Operator	TC-BC#02	932137	Dao Sunly	Operator
4	Sr.Member	DU2-CMC#07	932189	Tang Meang Heng	Team leader
5	Section Cdr.	DU2-MPL117	933080	Torn Chantha	Deputy team leader
6	Deminer	DU2-MPL117	931757	Phan Somantha	Deminer
7	Deminer	DU2-MPL117	932301	Chan Hoeum	Deminer
8	Deminer	DU2-MPL137	930683	Hun Map	Deminer
9	Deminer	DU2-MPL138	931341	Kong Ngoun	Deminer
10	Deminer	DU2-MPL138	931439	Nan Map	Deminer
11	Deminer	DU2-MPL138	932762	Kan Bunthorn	Deminer
12	Deminer	DU2-MPL137	930439	Chea Khoun	Deminer

4.2.2.JAPAN INTERNATIONAL COOPERATION SYSTEM (JICS)

JICS had designated one project staff Mr. Takefumi Mayumi to come and cooperate with CMAC to implemented this research/test demining machine.

4.2.3.HITACHI STAFF

There are seven YAMANASHI HITACHI staff participated in this test and evaluation:

1. Kotaro TOKUNO
2. Haruki KUDO
3. Makoto AMEMIYA
4. Kiyoshi AMEMIYA
5. Masashi NOSE
6. Kimio FUJIMAKI
7. Mitsuo IKEDA

4.2.4.HITACHI SWING TYPE MACHINE

Figure 4: Yamanashi swing type machine

- **SPECIFICATION SHEET**

Table 6: Demining machine swing type (Model V33)

No.	Specification	Performance	Remark
(a)	(b)	(c)	(d)
General Data			
1	Driving speed (=Travel Speed)	5.5/3.8 km/m	
2	Capacity for Vegetation Cutting in light and heavy vegetation	1400 m^2/h 1200 m^2/h 1200 m^2/h 1000 m^2/h	Light vegetation (By Flail) Heavy vegetation (By Flail) Light vegetation (By Rotary-cutting) Light vegetation (By Rotary-cutting)
3	Operating speed and clearance depth in varying terrain	1.5 km/h 20 cm 30 cm	Swing speed (=Max 11.8 rpm) Clearance depth by flail Clearance depth by Rotary-cutting
4	Controlling system		
5	Speed-control system		Travel speed: High /low 2-speed
6	Maximum and Minimum operating temperature	(+)50~(-)20 deg. Celsius	
7	Maximum operating range from remote control unit	100 m	
8	Maximum climb slope while operating	30 degrees	
9	Maximum descending slope while operating	30 degrees	
10	Maximum traversing slope while operating	15 degrees	
11	Height	3200 mm	
12	Weight	37,600 kg 39,200 kg	With Rotary-cutting With Flail-hammer
13	Daily service schedule	0.5 hours	Machine working hours: 8 hours/day

No.	Specification	Performance	Remark
(a)	(b)	(c)	(d)
14	Transportability		Short distance: By its own Long distance: By trailer Max. weight of transport units is 23.5 tom.
15	Documentation requirements		Service manual(existing) Operator's manual(existing) Spare part catalogues(existing)
16	Protection Machine survivability Crew survivability(where applicable)		Machine survivability: Bucket Cylinder Rod guard Boom Cylinder Rod guard Arm Cylinder Rod guard Under guard Hydraulic oil tank guard Horse guard etc. Crew survivability Special designed armored cabin with high-tension steel plate and anti-bullet glass.
17	Reliability The machine shall operated under load for minimum of 48 hours over a 6 consecutive days		Fuel consumption: to be closely examined and checked during trial test. Oil and coolant temperature during operation: Hydraulic oil: 50~70 deg. C Engine oil: 100~120 deg. C Coolant oil: 80~100 deg. C Spare parts:
Vehicle data			
18	Turning circle	6640 mm	Since the base machine is a shovel, the upper structure can make a swing freely.
19	Length	10970 mm	
20	Width	3290 mm	
21	Maximum fording depth	10500 mm	
22	Gap coverage	3000 mm	
23	Axle weights	----------	
24	Wheel spacing	----------	
25	Wheel/track footprint	700 × 4050 mm × mm	For each side
26	Ground bearing pressure	65 kpa	
27	Power requirement to drive the vehicle(if available)		
28	Engine power at the flywheel	240kw	
29	Fuel consumption under normal operation	28 liters	
30	Fuel tank capacity	560 liters	
Tool data			
31	Clearance width	8~10 m	
32	Maximum angle of depression	47 degrees	
33	Maximum angle of elevation	56 degrees	
34	Tool width	1200 mm 1600 mm	Rotary-cutting Flail-hammer
35	Beat pattern		Not measured yet
36	Power at the working tool	154kw	
37	Tool operating speed	400 rpm 540 rpm	For flail hammer For rotary-cutting

- **OBJECTIVE OF THE PROJECT OR THE MACHINE DEVELOPMENT**

YAMANASHI HITACHI aims to develop the mine clearance machine swing type with following characteristic:

1) To increase productivity of AP mine disposing as well as bush cutting capability.
2) To secure operator's safety, even if large size explosive blasted during machine operation.
3) To assure machine survivability against AP mine explosion and minimum machine damage against small size UXO explosion.
4) To keep simplicity of operation and maintenance of machine.
5) To show high cost-effectiveness.
6) To be applicable to other purpose than demining, such as farming.
7) To suit local transportation conditions.
8) To fulfill CMAC operational requirements, not limited to Essential but Desirable, if possible.
9) To be strong enough against bush and muddy ground.

- **CONCEPT OF DESIGN AND DEVELOPMENT**
  1) R/C &Swing-type F/h model BM307-V33 & Mobile Workshop BM307-EG40
  2) Bush cutting/AP mine disposing machine BM307-V33

- **CHARACTERISTIC OF BM307-V33**
  1) 33-ton class Hitachi hydraulic shovel adopted as base-machine.
  2) Easy replacement of attachments by quick-hitch device.
  3) Rotary-cutter attachment capable of cutting 40-cm trunk tree and other vegetation and also capable of ground excavation down to 30-cm depth.
  4) Rake-grapple mounted on front capable of collecting cut/fell trees and removing them to safe area.
  5) Flail-hammer attachment capable of cutting 20-cm trunk tree and other vegetation and also capable of ground excavation down to 20-cm depth. Slightest damage on flail attachment even in case large size mine exploded.
  6) Rake mounted on front capable of excavating ground down to 50-cm depth and capable of collecting cut/fell trees and removing them to safe area.
  7) Main body without attachments being compact and light enough for transportation.

- **SPECIFICATIONS OF THE MACHINE**

Total system

Model	BM307-V33
Total weight (W/F/H)	39,200 Kg
Total weight (W/R/C)	37,600 Kg

Engine

Type	ISUZU AA-6HK1X
Rated power/rpm	240Kw/ 1900rpm
Fuel tank capacity	560 L

Driving features

Travel speed	3.2Km~5.5 Km/h
Climbing ability	35 degrees
Ground pressure	65kpa(0.66kgf/cm^2)

Flail hammer attachment

Operating width	1600 mm
Excavation depth	200 mm
Number of chain	50 pieces
Drum revolution speed	400~600 rpm
Rake-grapple width	2042 mm
Weight	4,800 kg

Productivity

Bush Cutting	(Light bush)	1400 m2 /h
	Heavy bush	1200 m2 /h
Landmine disposing		1000 m2 /h

4.3. TEST PROCEDURE

4.3.1.RESOURCES: AP MINE USED IN THE TEST

There are two types of landmines which had been used to conduct this performance test. Both of them are anti-personnel, blast mine which were commonly found in Cambodia minefields. The first one is former-USSR made AP mine: PMN-2. The second one is Chinese made AP mine: T-72A. each of this explosive material is removed its booster to ensure that it does not pose grave danger to test participant but it still react to the pressure from demining machine by detonating it's detonator (pressure cap and firing pin remain intact).

Figure 5: AP PMN-2 mine

Figure 6: AP T-72A mine

Each AP mine used in this test is collected from the CMAC demining unit that had just been removed from the real minefields. Then at test site, it would be dismantled, analyzed to ensure that all function still functioning well then reassembled again, by CMAC specialist, before laid it in the test lane.

Figure 7: AP T-72A is dismantled

4.3.2.DEPTH OF AP MINE

Mine found in real minefield is in various depth. Some locates only a few centimeter from top soil, some stays very deep underground. To represent such various depth of landmine, three conditions of depth of landmine is used in this test: 10 cm, 15 cm and the maximum depth is 20 cm. The depth is measured from the top soil to the bottom of the mine.

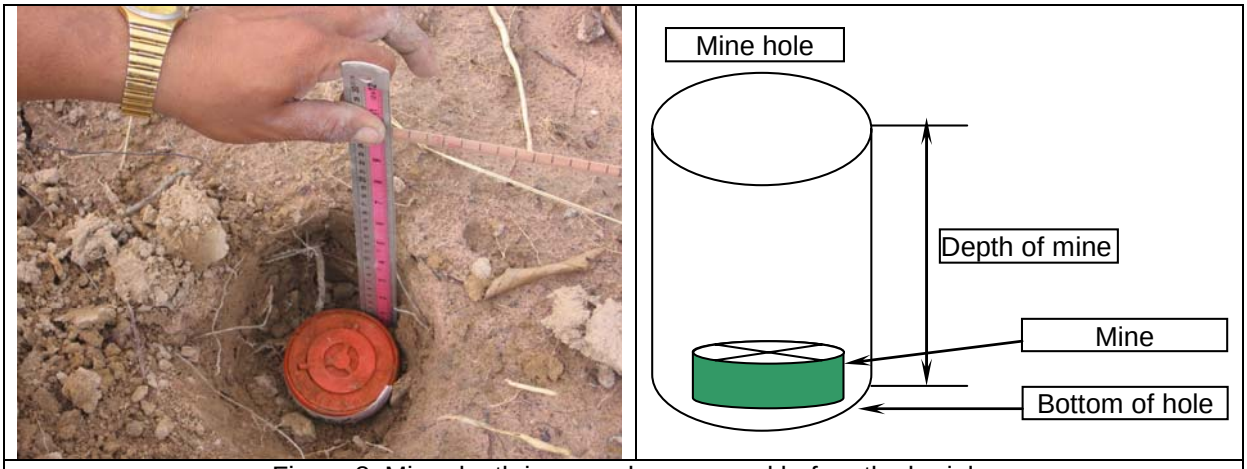


Figure 8: Mine depth is properly measured before the burial

4.3.3.TIME KEEPING

Time is very important for the test. Time will be recorded by CMAC staff by using chronometer and watch. There would be one time keeper for one machine. Time keeper is designated by project manager. Each time keeper use two chronometers (one for backup just in case the other one malfunction). Project Manager and CMAC evaluator will also closely monitor this activity strictly.

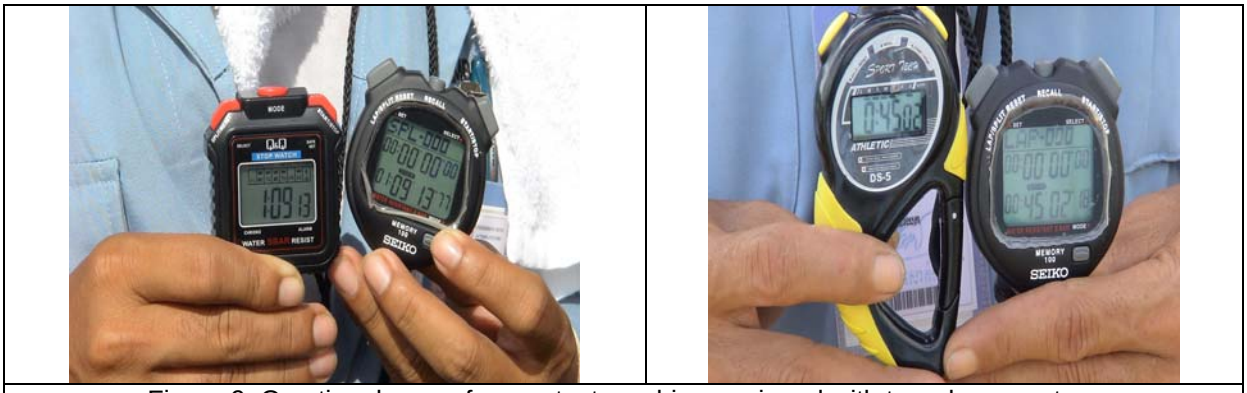


Figure 9: One time keeper for one test machine equipped with two chronometers

4.3.4.TEST START TIME AND END TIME OF TIME KEEPING

Star time is when the demining machine drum hit the ground and the project manager gave a signal to record the time. Time keeper will pressure the button of two chronometers at the same time. When the machine complete the it's mission, it will move back to the original start point, then the project manager will make a signal to end the record test time. Time will be recorded by project manager, by CMAC evaluator and this figure will be recorded by CMAC cameraman.

4.3.5.THE PATTERN & DIRECTION OF MINE CLEARANCE

CMAC give the priority to the manufacturer to select the best pattern for their machine to clear landmine. In this test, many manufacturer use "reverse mode" pattern. For SWING TYPE MACHINE, because of it's flail system rotating anti-clock movement at high speed, it kicks dirt and object from left to right, therefore, their preferred body movement direction is from right to left. In this movement

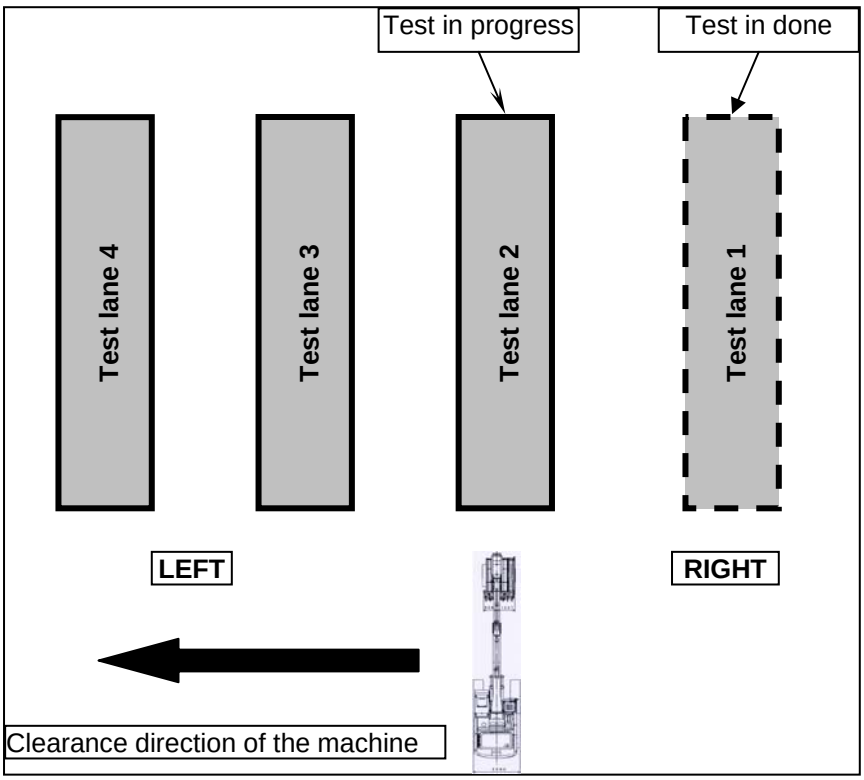


Figure 10: Clearance direction of the machine

4.3.6. FUEL CONSUMPTION

Fuel tank of the demining machine must be full before the start of each test lane. It will be refueling after the completion of each test lane. Fuel will be transported by CMAC and brought as close as to test site as possible. Refuel will be done by manufacturer with assistant from CMAC staff and supervised this process by CMAC evaluator and CMAC project manager. Fuel figure will be recorded.

Figure 11: Fuel is transported close to the test site

4.3.7. RE-ESTABLISH TEST LAND & LANDMINE POSITION

Soon after the completion of the test, mine is crushed into pieces/explode, move or push away from its original location. Therefore, the first task after the completion of the test by the machine, it is important to re-establish the position of all mines within its test lane. To be able to do so, CMAC adopt 5-step procedures[1] (each step has to be completed before moving into the next one) which could be mentioned as follows:

[1] Each step has to be completed before implementing the next step. Upon completion of each step, team member has to inform project manager for inspection. Only the project manager satisfy with the result, then the following step could be taken.

Step 1: Re-establish test lane boundary

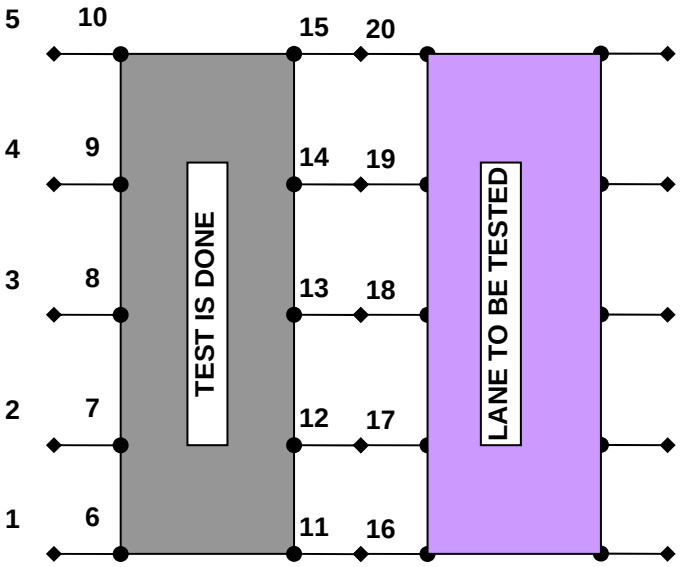


Figure 12: Re-establish test lane

- After the test, the boundary of the test is destroyed (from point 6 to point 15 is totally destroyed), Therefore, metal detector is used to detect metallic object (if found just mark and move forward). The detection will be done along point 6 to point 10 and from point 11 to point 15. The purpose of using metal detector is to ensure the safety of the deminer who walk along this just clear test lane.
- Because of point 1 to point 5 and point 16 to point 20 remain intact, existing position of point 6 to point 9 and from point 11 to point 15 could be easily relocated.
- Use metal detector to detect existing location of point 6 to point 15 to make sure that there is no metallic object present at that location (Because of the test lane is metal free, therefore, any metallic object is from mine fragment). If there is no present of metallic object, thus re-establish existing test land boundary by using stick and string.

Figure 13: CMAC deminer is using metal detector to re-establish the test lane boundary after the area is cleared by the machine

Figure 14: CMAC deminer is re-establish the test lane boundary

Step 2: Identify mine fragment

- Identify fragment and remaining explosive object by using metal detector.
- The deminer must detect the object up to the existing ground.
- Equipped with metal detector,
- Pile of earth which is more than 20cm height has to be removed and then use metal detector again for detection.
- Visual observation has to be done to look for piece of plastic or non-metallic object that could not be detected by metal detector machine.

Figure 15: Mine in good shape is marked with yellow stick with red note

Figure 16: Fragment of mine is marked with yellow stick and yellow note (safe)

- Marking the found object: mark yellow stick with red note for mine still in good shape or big pieces of mine where it is thought to still danger. Mark yellow stick with yellow note for piece of mine that it is thought to be safe.
- The detection must be made not only in the test lane vicinity, but it must extend up to the distant where mine or piece of mine is flown by the power of the demining machine.

Figure 17: CMAC deminer is detecting mine fragment nearby the test lane (in light bush)

Step 3: Identifying existing mine position

- By using mine laying map in each test lane, identify existing mine location by its coordinate
- Use metal detector to detect the present of mine
- If pile of earth is higher than 20cm (because of some demining machine generate high pile of earth behind), remove it manually and detect again. The detection must be made up to the existing ground.
- If mine is found, used round red stick
- If mine is disappeared (had been cleared or pushed away by machine) use yellow round stick

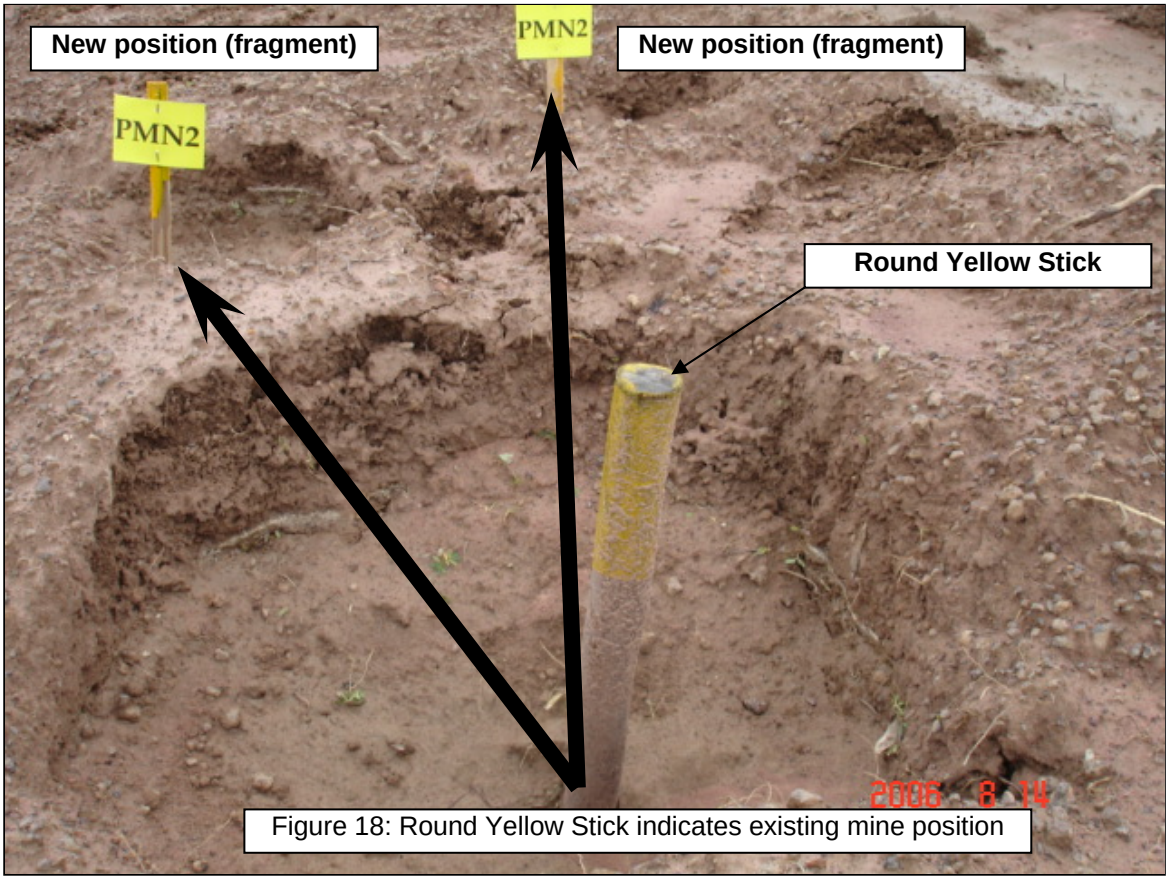


Figure 18: Round Yellow Stick indicates existing mine position

Step 4: Count mine

- Count mine and identify its original location
- If mine is lost, try to search the surrounding area (just in case mine is flown away) or use metal detector. Prodding is prohibited because of potential to detonate the mine.
- Pile of earth has to be carefully removed.
- The search could only be finished when all mines are accounted for

Step 5: Circle the whole contaminated area

- Mark the contaminated area up to the last scattered mine (which had been hit by the machine)
- Report to CMAC Evaluator for evaluation

4.3.8.THE CLASSIFICATION OF LANDMINE AFTER CLEARANCE

After the test is done, mine is hit by the demining machine and it fall into five categories:

Table 7: The classification of landmine damaged by the machine

Category	Mine	Initial sign given	Indication
1	Small piece or small fragment of mine scatter nearby previous mine location	Yellow	Mine had been destroyed by the machine during test.
2	Big piece of mine scatter nearby previous mine location	Yellow or red	Mine had been hit by the machine. This mine is subjected for checking
3	Mine in good shape but move from previous position	Red	Mine had been hit by the machine. This mine is subjected for checking
4	Mine is partially broken and is in previous position	Red	Mine had been hit by the machine but the machine does not have the sufficient digging depth. This mine is subjected for checking
5	Mine is in previous position and in good shape	Red	Machine did not touch mine due to insufficient digging depth. Mine still dangerous.

Category 1:
Small piece or small fragment of mine

Figure 19: Mine is destroyed by the machine. In this category, mine is classified to be destroyed by the machine.

Category 2:
Big piece of mine scatter nearby previous mine location

Figure 20: Mine had been hit by the machine. This mine is subjected for checking

Category 3:
Mine in good condition and had been moved from previous location

Figure 21: Mine is hit and moved from its original location but still in good condition. This mine is in category three and is subjected for evaluation

Category 4:
Mine is partially broken and is in previous position

Figure 22: Mine had been hit by the machine but the machine does not have the sufficient digging depth. This mine is subjected for checking

Category 5:
Mine is in previous position and in good shape

Figure 23: Machine did not touch mine due to insufficient digging depth. Mine still dangerous. Round stick painted in yellow indicate previous mine position.

4.3.9.MINE EVALUATION TECHNIQUE

After the test is done and all mines are accounted for, mines that fall into category 2, 3, 4 and 5 will be subjected for evaluation to ensure that this mine is safe or already damaged by the destruction of the machine. The process of mine evaluation will be done as follows:

Step 1: Call for expert

CMAC deminer with Personal Protective Equipment arrived mine neutralized tool kits arrived. His role is to neutralize mine with red sign and to analyze its danger status.

Figure 24: CMAC deminer with PPE and visor walking to mine evaluation spot

Step 2: Neutralize mine

Mine is neutralized and every piece removed is carefully analyze whether it still in good condition and could perform its function according to its design or it had been destroyed by the demining machine.

Figure 25: Mine is neutralized before analyzing

Step 3: The analysis of mine mechanism

Case 1: Come of mine mechanism is bending because of the impact from demining machine (such as firing pin in these pictures). In this state, mine lose its function.

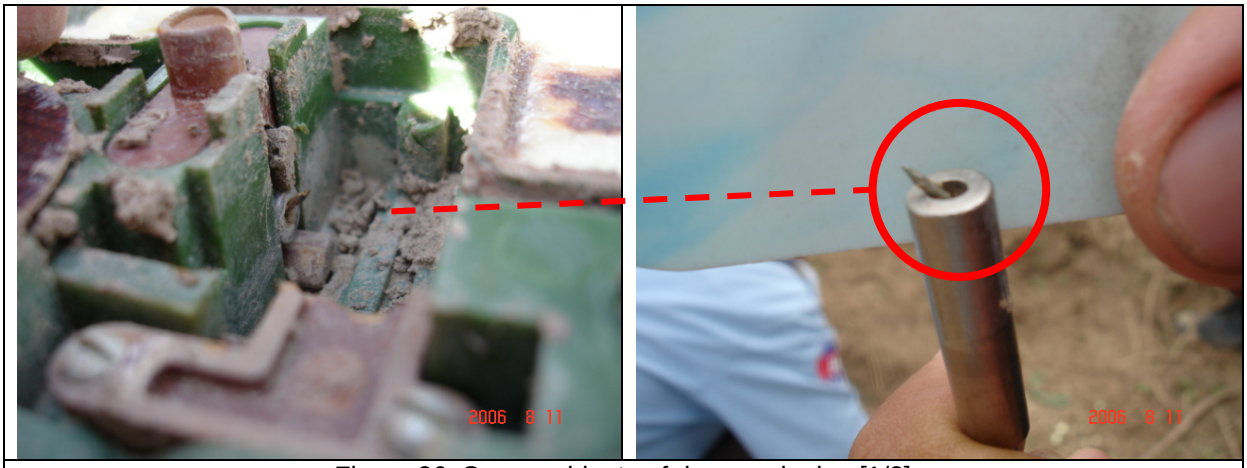


Figure 26: Some evidents of damaged mine [1/2]

Case 2: The power of the demining machine has cracked mine into pieces and earth has fill most of the crack and hole. After checking its mechanism, it is no longer function as it had been designed (mechanism had been jammed). In some other case, we found that even the mine is in good condition but actually its firing pin or pressure cap had been fired, thus mine is considered destroyed.

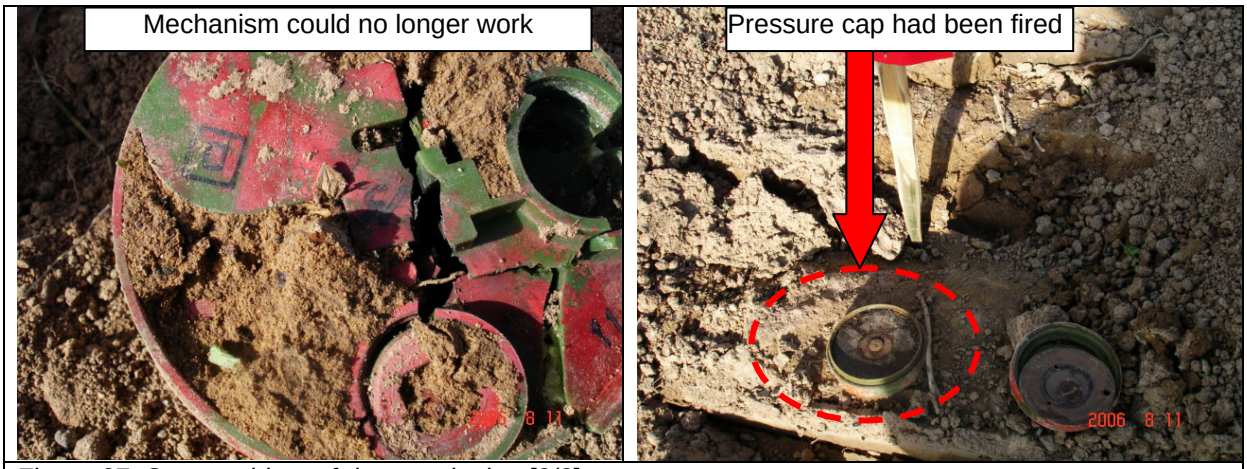


Figure 27: Some evident of damaged mine [2/2]

Case 3: If all mechanism still in good condition and it still functioning well, this mine is considered un-destroyed.

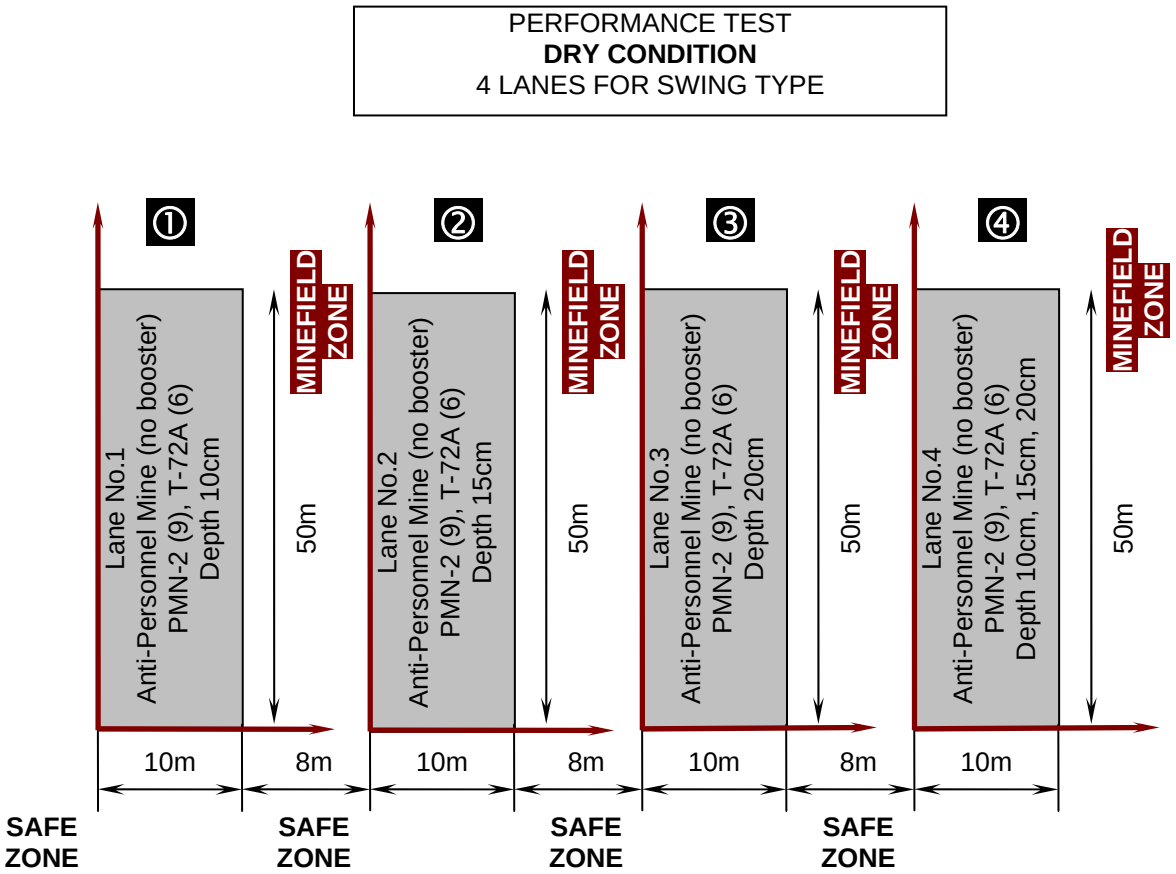
Step 4:

After finding out that mine is in case 1, case 2 of step 3, then warning sign is changed from red to yellow as shown bellows:

Figure 28: The change of mine status from live mine to damaged mine

4.4. TEST PREPARATION

4.4.1. THE PREPARATION OF DRY CONDITION TEST AREA



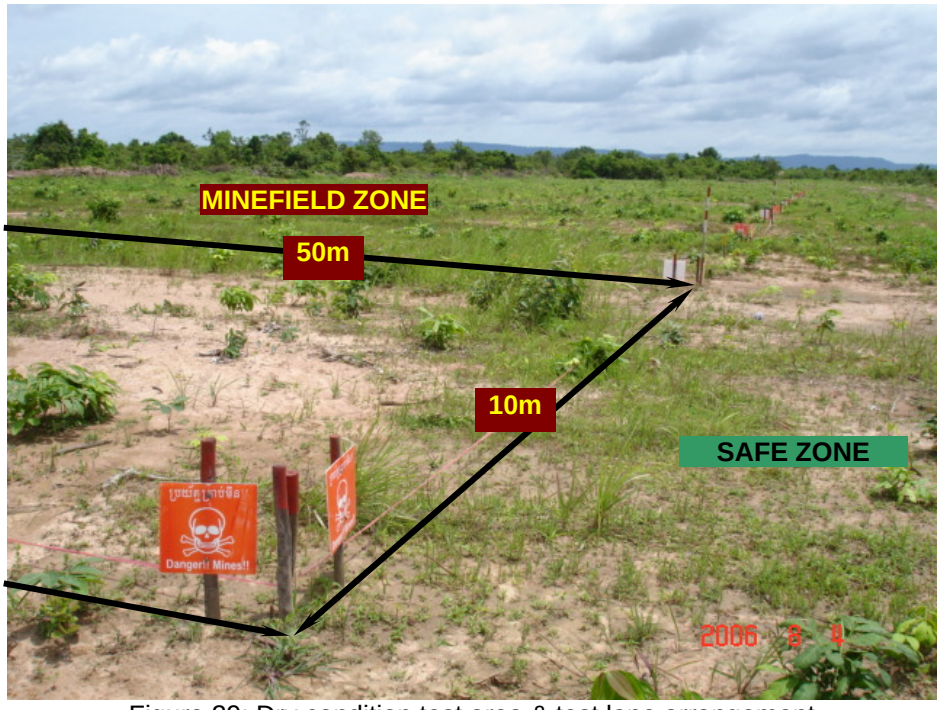


Figure 29: Dry condition test area & test lane arrangement

• Step 1: select the area within the test site area big enough to accommodate 16 test lanes. The selection is base on high ground (avoid flooding), and close to parking area. CMAC has prepared 4 lanes to be tested for each demining machine. Each lane is 10m x 50m. A distant from one lane to another is 8m apart.

• Step 2: Remove all vegetation (by bulldozer) within that selected area in step 1.

Figure 30: All top vegetation is removed by machine (bulldozer)

• Step 3: Remove all fragment within bulldozed area by using metal detector MINELAB F1A4 to ensure that the entire test area is metal free. Metal free environment enable CMAC to recover the mines after the clearance test done by the demining machine easily.

Figure 31: Metallic object is removed from the test site

• Step 4: Making lane by using strip and stick. Each lane is 10m x 50m with 8m buffer lane. In the middle of buffer lane, mark a white stick as a benchmark so that when the boundary of test lane is destroyed by the machine, benchmark could be used to re-establish the boundary of the test lane again.

Figure 32: CMAC deminer is marking test lane

• Step 5: Color mine according to its quantity, type, and section (0m - 10m: orange, 10m-20m: yellow, 20m - 30m: black, 30m - 40m: white and 40m - 50m: red). By doing so, it enable CMAC to identify the original of its location, distant and performance of the machine.

Figure 33: Landmine is color before laid in the ground

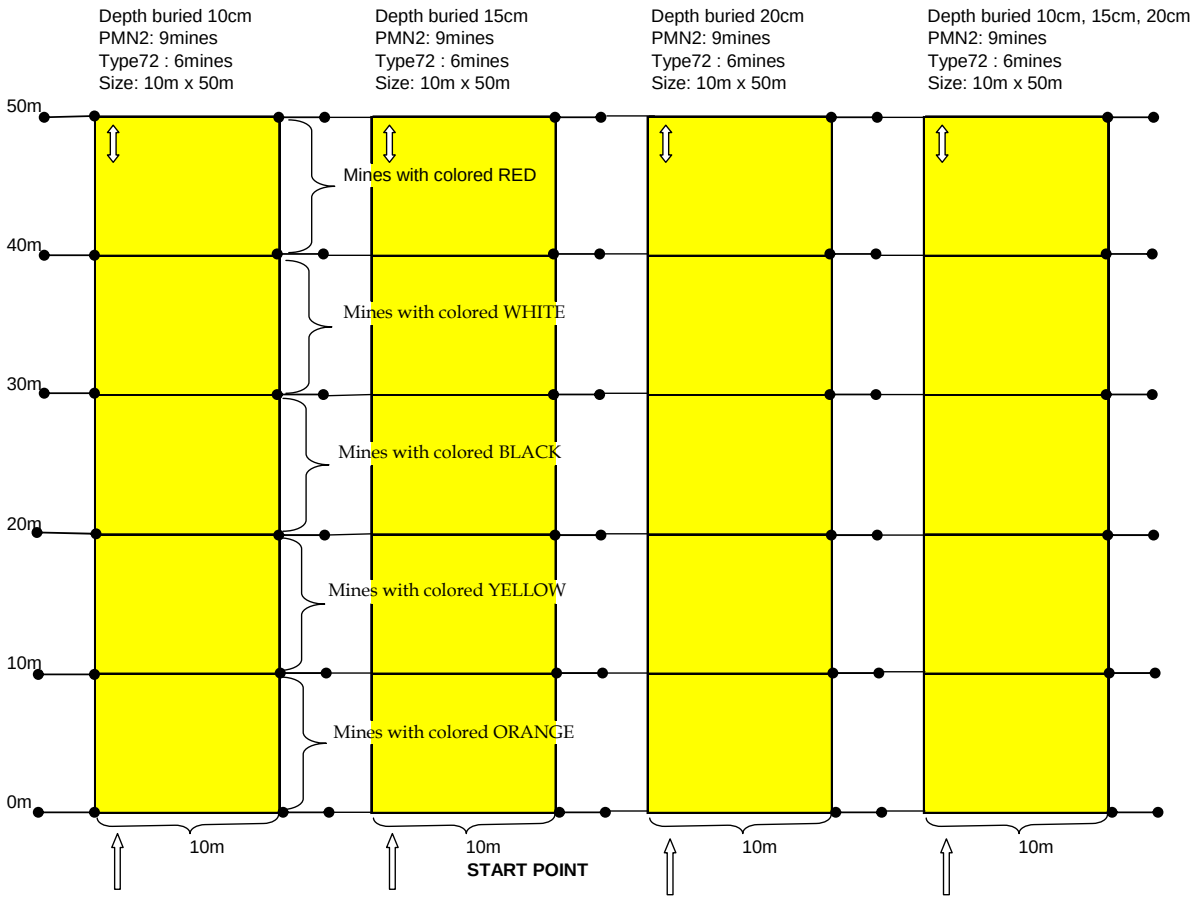


Figure 34: The pattern of laid mine in the test lane

- Step 6: Drill hole according to its lane, location, and depth.

Figure 35: Drill hole according to its designated position and depth to laid landmine

• Step 7: Laid landmine according to its color, section, depth and lane (see picture below). There are two type of landmines in each lane: PMN-2 (9 mines) and T-72A (6 mines). By lying landmine in this pattern, it ensure the maximum chance of the machine to encounter the mine during test.

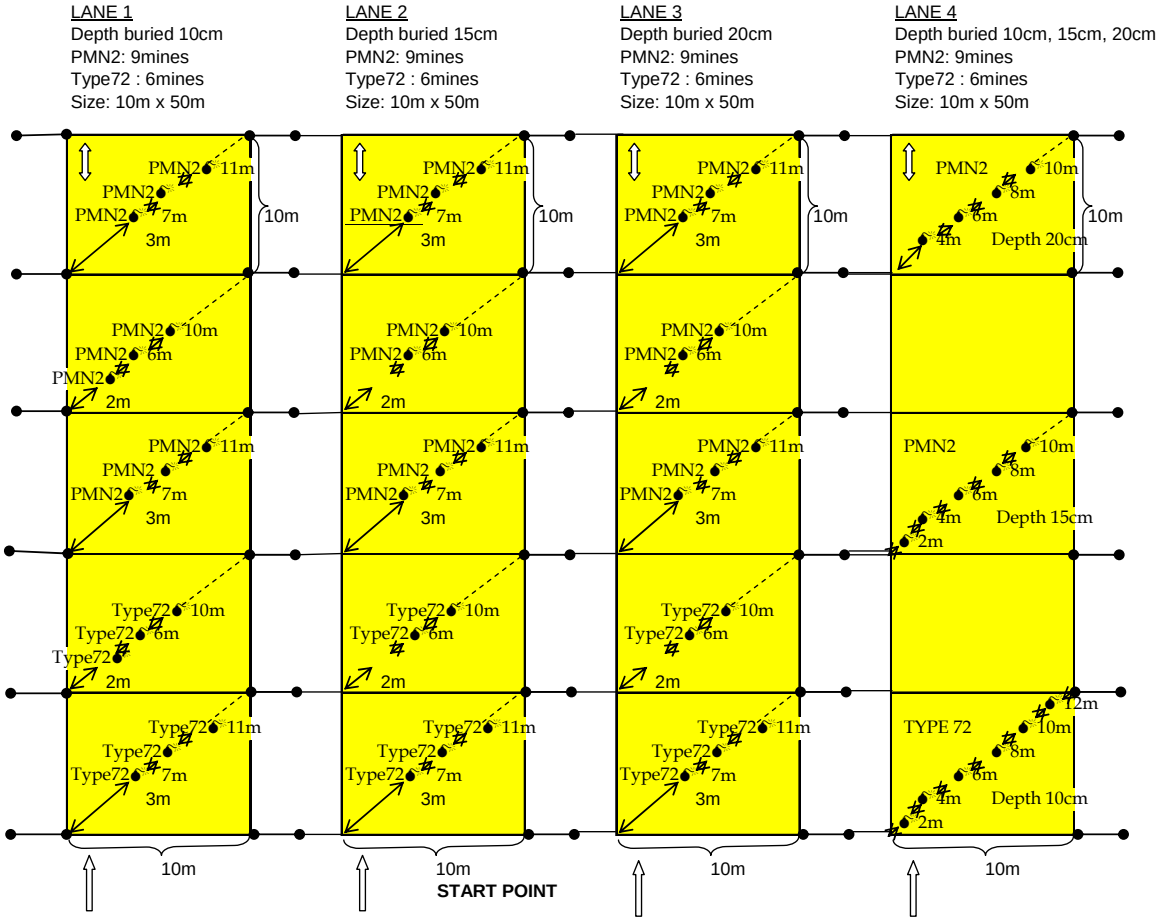


Figure 36: The location, depth, type and quantity of landmine

Table 8: Deployment pattern of landmine PMN-2 and T-72A at dry condition lane 1, 2 and 3

Distant from start point	Landmine type	Quantity
0m – 10m	T-72A	3 mines
10m – 20m	T-72A	3 mines
20m – 30m	PMN-2	3 mines
30m – 40m	PMN-2	3 mines
40m – 50m	PMN-2	3 mines
TOTAL		15 mines

Table 9: Deployment pattern of landmine PMN-2 and T-72A at dry condition lane 4

Distant from start point	Landmine type	Quantity
0m – 10m	T-72A	6 mines
10m – 20m	-	-
20m – 30m	PMN-2	5 mines
30m – 40m	-	-
40m – 50m	PMN-2	4 mines
TOTAL		15 mines

Table 10: summary of landmine at dry condition test lane 1, 2, 3 and lane 4

Test lane	Size	Depth bored	AP Landmine	
			PMN-2	T-72A
Lane 1	10m x 50m	10 cm	9 mines	6 mines
Lane 2	10m x 50m	15 cm	9 mines	6 mines
Lane 3	10m x 50m	20 cm	9 mines	6 mines
Lane 4	10m x 50m	Mix (10 cm, 15 cm, 20 cm)	9 mines	6 mines
Total			36 mines	24 mines

4.4.2.THE PREPARATION OF LIGHT BUSH CONDITION

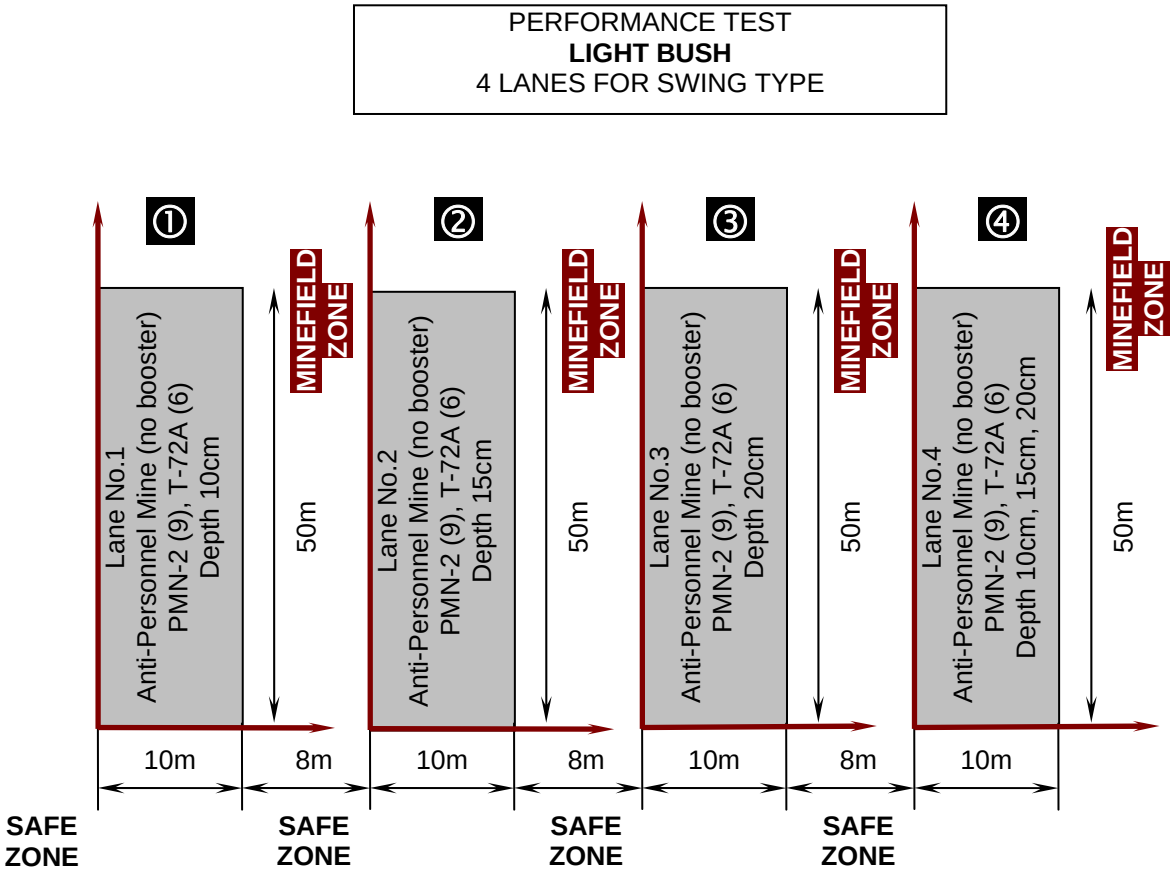


Figure 37: Light Bush test area & test lane arrangement

• Step 1: select the area within the test site area big enough to accommodate 16 test lanes. The selection is base on high ground (avoid flooding) with proximity to parking area so that assistant could be provided if the demining machine run into trouble. CMAC has prepared 4 lanes to be tested for each demining machine. Each lane is 10m x 50m. A distant from one lane to another is 8m apart.

• Step 2: Marking into lanes by using red-white stick and plastic string. Each lane is 10m x 50m. It locates 8m apart. Then bulldoze the buffer zone.

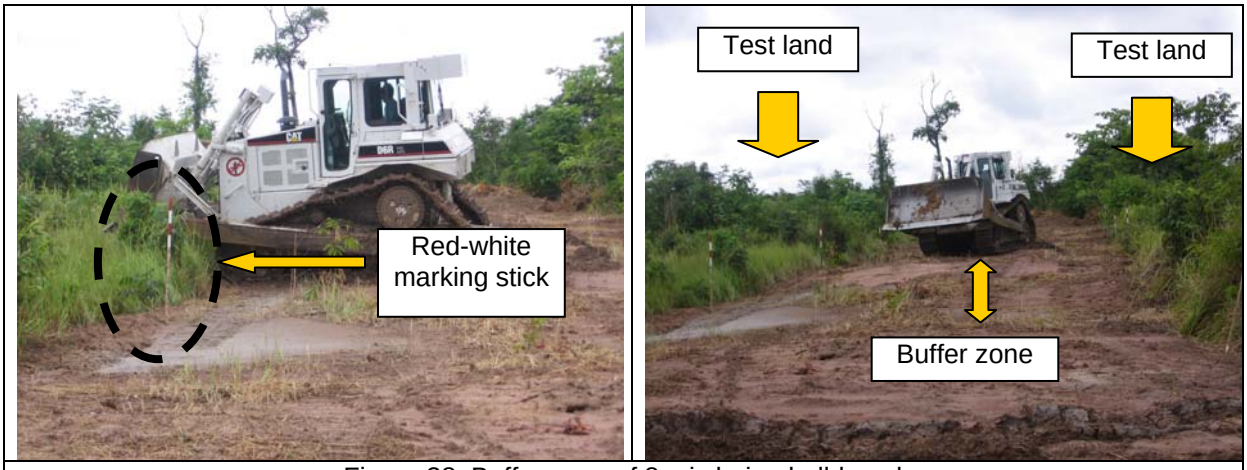


Figure 38: Buffer zone of 8m is being bulldozed

• Step 3: To ensure the standard of equality among test lanes, tree size, tree height and soil condition, CMAC has to be standardized. Any tree whose diameter is larger than 10cm will be cut and removed. Any tree which is taller than 2m will also be trimmed. Termite or ant hill will be leveled.

Figure 39: Tree top is being trimmed by CMAC deminer

Figure 40: Large tree (>20cm) is being removed

Figure 41: Termite hill is subjected to be identified and leveled.

• Step 4: Remove all fragment by using metal detector MINELAB F1A4 to ensure that the entire light bush test area is metal free. Metal free environment enable CMAC to recover the mines after the clearance test done by the demining machine more efficient.

Figure 42: CMAC deminer is setting up metal detector MINELAB F1A4 to be used to remove metallic object from light bush test area.

• Step 5: Color mine according to its quantity, type, and section (10m-orange, 20m-yellow, 30m-black, 40m-white and 50m-red). By doing so, it enable CMAC to identify the original of its location, distant and performance of the machine.

Figure 43: Landmine is color before laid in the ground

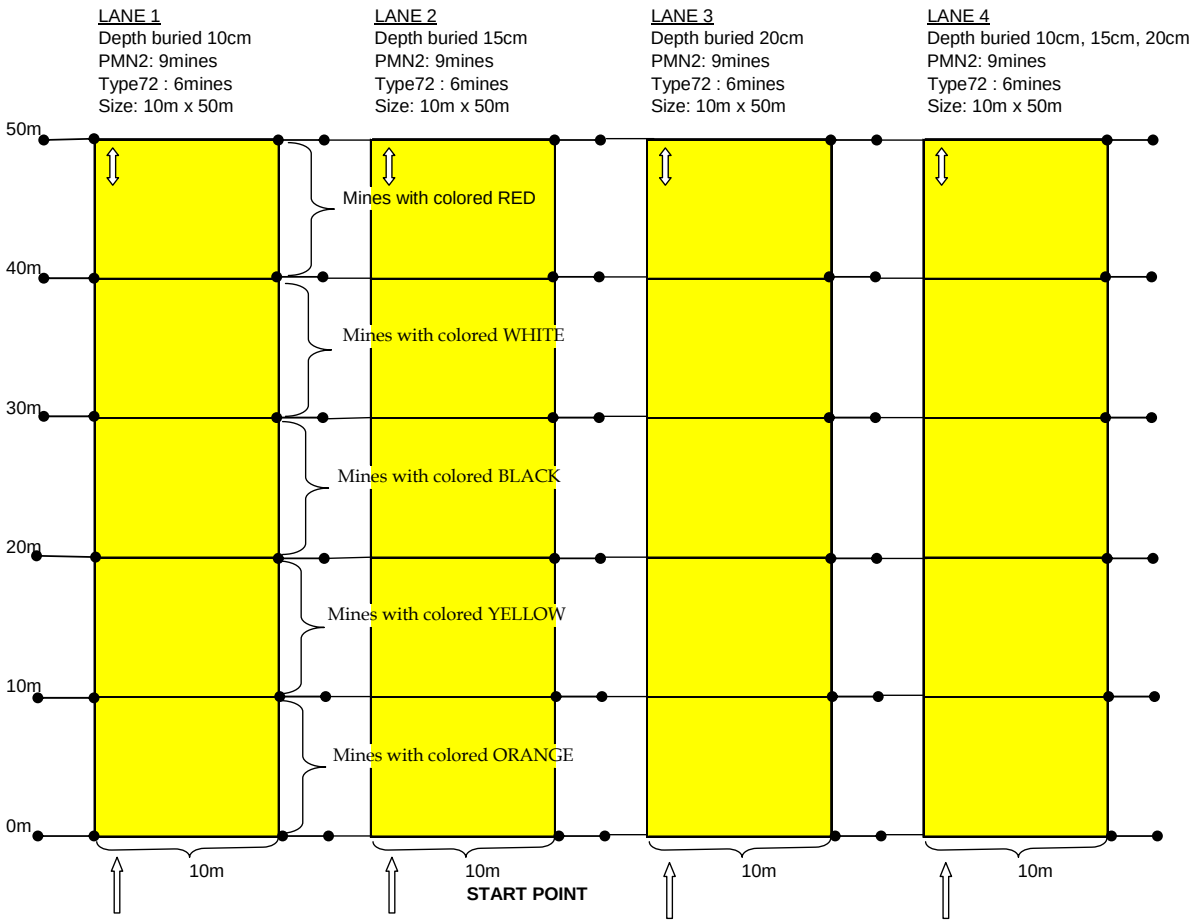


Figure 44: Landmine with its designated color will be laid according to the above pattern

- Step 6: Drill hole according to its lane, location, and depth.

Figure 45: After identifying the location, the hole is drilled up to the specified depth.

• Step 7: Laid landmine according to its color, section, depth and lane (see picture below). There are two type of landmines in each lane: PMN-2 (9 mines) and T-72A (6 mines). By lying landmine in this pattern, it ensure the maximum chance of the machine to encounter the mine during test.

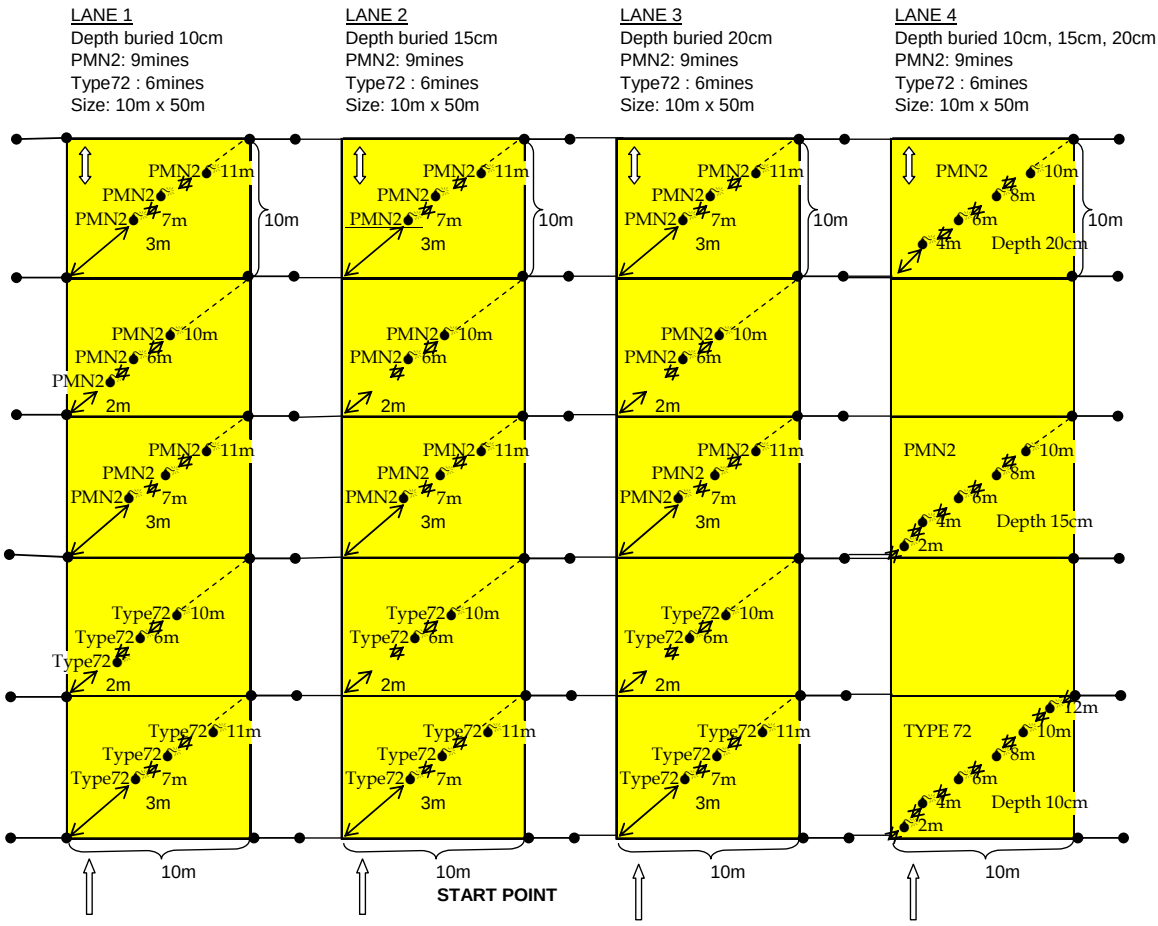


Figure 46: The location, depth, type and quantity of landmine

Table 11: Deployment pattern of landmine PMN-2 and T-72A at light bush condition lane 1, 2 and 3

Distant from start point	Landmine type	Quantity
0m – 10m	T-72A	3 mines
10m – 20m	T-72A	3 mines
20m – 30m	PMN-2	3 mines
30m – 40m	PMN-2	3 mines
40m – 50m	PMN-2	3 mines
TOTAL		15 mines

Table 12: Deployment pattern of landmine PMN-2 and T-72A at light bush condition lane 4

Distant from start point	Landmine type	Quantity
0m – 10m	T-72A	6 mines
10m – 20m	-	-
20m – 30m	PMN-2	5 mines
30m – 40m	-	-
40m – 50m	PMN-2	4 mines
TOTAL		15 mines

Table 13: summary of landmine at light bush condition test lane 1, 2, 3 and lane 4

Test lane	Size	Depth bored	AP Landmine	
			PMN-2	T-72A
Lane 1	10m x 50m	10 cm	9 mines	6 mines
Lane 2	10m x 50m	15 cm	9 mines	6 mines
Lane 3	10m x 50m	20 cm	9 mines	6 mines
Lane 4	10m x 50m	Mix (10 cm, 15 cm, 20 cm)	9 mines	6 mines
Total			36 mines	24 mines

4.4.3.THE PREPARATION OF WET CONDITION

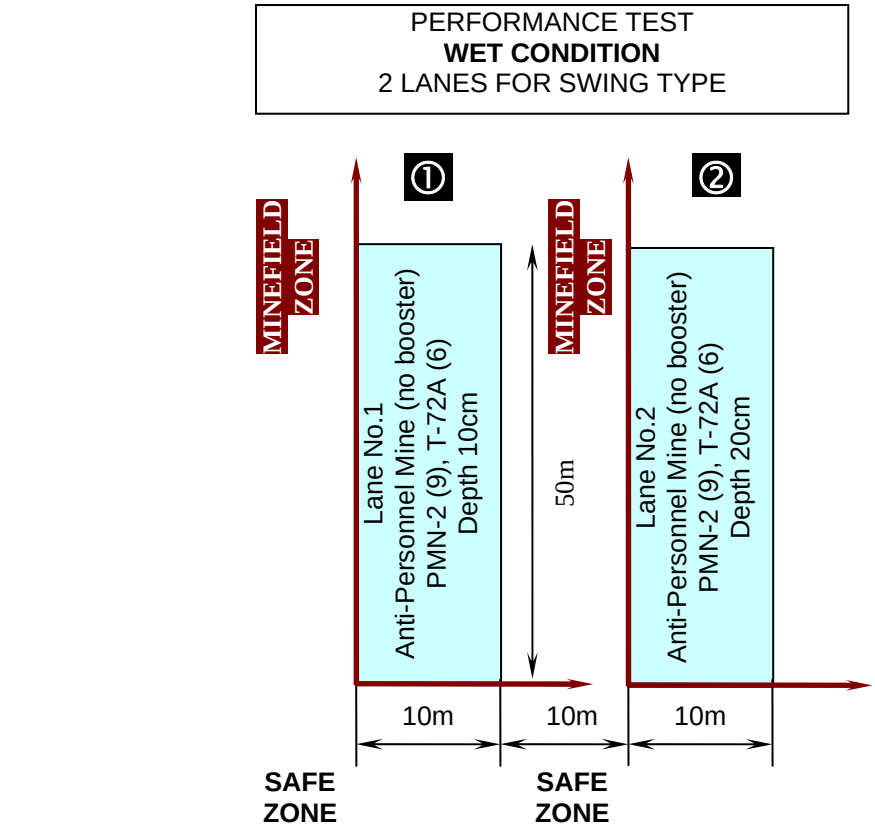


Figure 47: Wet condition test area & test lane arrangement

• Step 1: select the area within the test site area big enough to accommodate 6 test lanes. The selection is base on low and soft ground and close to parking area. This enable CMAC to recover the machine just in case it got stuck in the mud. CMAC has prepared 2 lanes to be tested for each demining machine. Each lane is 10m x 50m. A distant from one lane to another is 10m apart.

• Step 2: Remove all vegetation (by bulldozer) within that selected area in step 1.

• Step 3: Remove all fragment within bulldozed area by using metal detector MINELAB F1A4 to ensure that the entire test area is metal free. Metal free environment enable the CMAC deminer to recover the mines after the clearance test done by the demining machine easily.

• Step 4: Making lane by using strip and stick

Figure 48: CMAC deminer is marking test lane at wet condition area

• Step 5: Color mine according to its quantity, type, and section (10m-orange, 20m-yellow,30m-black, 40m-white and 50m-red)

• Step 6: Drill hole according to its lane, location, and depth.

• Step 7: Laid landmine according to its color, section, depth and lane (see picture below). There are two types of landmines in each lane: PMN-2 (9 mines) and T-72A (6 mines).

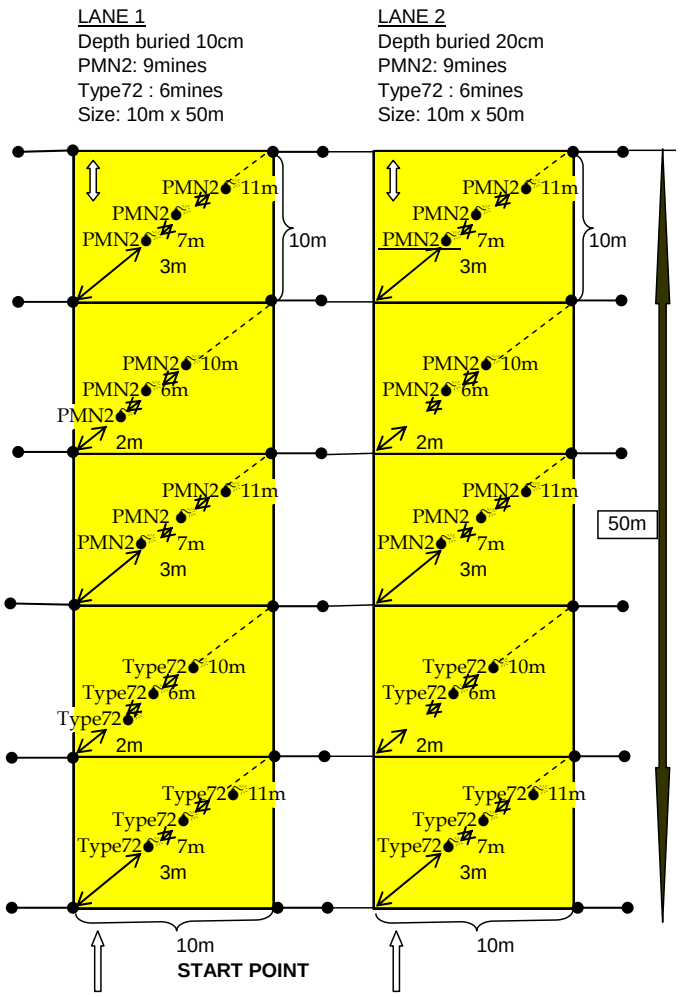


Figure 49: Landmine pattern at wet condition

Table 14: Deployment pattern of landmine PMN-2 and T-72A at Wet condition lane 1, 2

Distant from start point	Landmine type	Quantity
0m – 10m	T-72A	3 mines
10m – 20m	T-72A	3 mines
20m – 30m	PMN-2	3 mines
30m – 40m	PMN-2	3 mines
40m – 50m	PMN-2	3 mines
TOTAL		15 mines

Table 15: summary of landmine at wet condition test lane 1 and test lane 2

Test lane	Size	Depth bored	AP Landmine	
			PMN-2	T-72A
Lane 1	10m x 50m	10 cm	9 mines	6 mines
Lane 2	10m x 50m	20 cm	9 mines	6 mines
Total			18 mines	12 mines

4.5. TEST SCHEDULE

4.5.1. TEST SCHEDULE AT DRY CONDITION

Table 16: Test schedule of swing demining machine in dry condition

Lane	Test date	Start time	Temperature	Humidity	Other
Lane 1	16 August 2006	11 AM	29.6 Celsius	78.2%	Could clear only 200m^2
Lane 2	15 August 2006	2:20 PM	32.2 Celsius	71.9%	Test completed successfully
Lane 3	17 August 2006	1:50 PM	35.8 Celsius	60.7%	Could clear only 300m^2
Lane 4	17 August 2006	10 AM	48.6 Celsius	30.4%	Test completed successfully

Note: on the 09 August 2006, swing conducted the test at dry condition. The machine bogged down. Test data is canceled due to can not obtain the fuel consumption (the machine required to refill after the completion of two test lanes. Because of this incident, the refuel procedure is changed to refuel soon after the completion of each test lane.)

4.5.2. TEST SCHEDULE AT LIGHT BUSH CONDITION

Table 17: Test schedule of swing demining machine in Light Bush condition

Lane	Test date	Start time	Temperature	Humidity	Other
Lane 1	16 August 2006	1:50 PM	31.9 Celsius	66.5%	Test completed successfully
Lane 2	15 August 2006	11:15 PM	32.2 Celsius	65.5%	Test completed successfully
Lane 3	14 August 2006	2:55 PM	32.1 Celsius	69.2%	Test completed successfully
Lane 4	14 August 2006	9:17 AM	34.6 Celsius	68.4%	Test completed successfully

4.5.3. TEST SCHEDULE AT WET CONDITION

Table 18 : Test schedule of swing demining machine in wet condition

Lane	Test date	Start time	Temperature	Humidity	Other
Lane 1	18 August 2006	2:29 PM	36.2 Celsius	75.7%	Test completed successfully
Lane 2	18 August 2006	10:30 AM	36.5 Celsius	69.8%	Test completed successfully

4.6. TEST NO 1: PERFORMANCE TEST RESULT

4.6.1. POTENTIAL POLLUTION BY MINE CLEARANCE MACHINE

During mine clearance operation, Hitachi – BM307-V33 rotate its flail system at high speed in an anti-clock direction. Its hammer smash earth and mine at high velocity and spread it to nearby area. Some object has been seen flying at great distant.

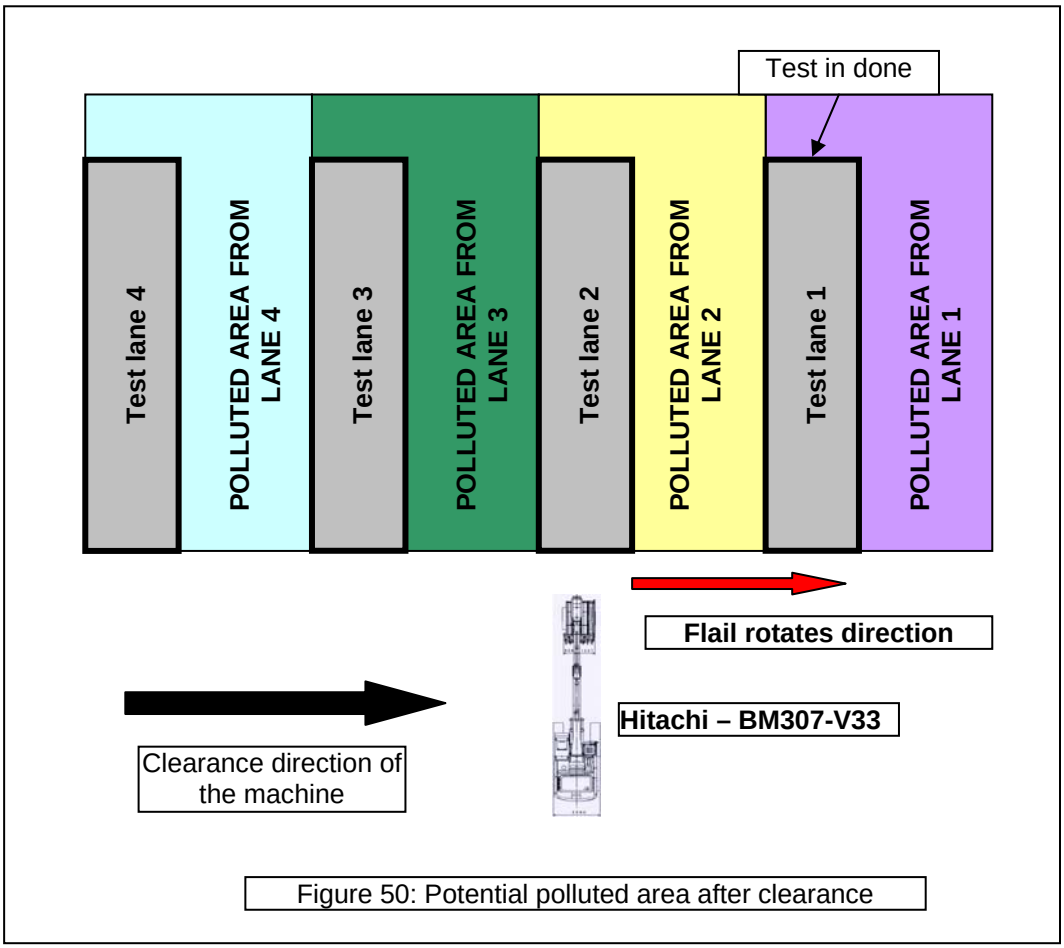


Figure 50: Potential polluted area after clearance

Figure 51: Nearby trees are hit by earth and fragment from swing operation

Figure 52: CMAC deminer are looking for fragment/mine in nearby area

4.6.2.TEST RESULT AT DRY CONDITION

There are four test lanes in dry condition test area. The test had been conducted and successfully completed at lane number two and four. Initially, swing conducted the test at test lane number 1 successfully and when it conducts the test lane number 2, it was bogged down. A recover had been made but it destroyed all the evident of the test. Because of the destruction of test lane and the complication of measuring fuel consumption, CMAC management team decided to create other test lanes (1 and 2) for re-test. At test lane number 3, the ground was too soft to allow the machine to move forward. The operator decided to stop the test after clearance 300m^2. The following is the test result at wet condition:

Table 19: Summary Test result at Dry condition

Test lane	Clearance duration	True Clearance	bored mine	Destroyed mine	Un-Destroyed mine (live mine)	Fuel, Liters
Lane 1	0h25mn00s	200 m^2	6 Mines	6 Mines	0	14 Liters
Lane 2	01h6mn42s	500 m^2	15 Mines	12 Mines	3 Mines	35 Liters
Lane 3	0h37mn30s	300 m^2	9 Mines	8 Mines	1 Mine	22 Liters
Lane 4	1h05mn27s	500 m^2	15 Mines	13 Mines	2 Mines	38 Liters
TOTAL		**1500 m^2**	**45 Mines**	**39 Mines**	**6 Mines**	**109 Liters**

Table 20: Distant of flying fragment from original location in Dry condition

Test lane	0-10m	10m - 20m	20m - 30m	30m - 40m	40m - 50m	**Average**
lane 1	15.2 m	24.45 m				**19.825 m**
lane 2	12 m	23.55 m	8.8 m	17.7 m	19.5 m	**16.31 m**
lane 3	14.5 m	10.7 m	25.5 m			**16.9 m**
lane 4	23 m		13.5 m		14.65 m	**17.05 m**

Table 21: Potential mine to be broken up by the SWING TYPE MACHINE during performance test

Test lane	Fragments in test lane	Fragments out of test lane	sub-Total
lane 1	1 Fragments	6 Fragments	7 Fragments
lane 2	15 Fragments	50 Fragments	65 Fragments
lane 3	11 Fragments	21 Fragments	32 Fragments
lane 4	6 Fragments	36 Fragments	42 Fragments
TOTAL	**33 Fragments**	**113 Fragments**	**146 Fragments**

Table 22: Fragment position in dry condition area after the performance test by SWING TYPE MACHINE

Test lane	Total Fragments	Total mine used in test lane	Break up ratio
lane 1	7 Fragments	6 Mines	1.2 Fragments/mine
lane 2	65 Fragments	15 Mines	4.3 Fragments/mine
lane 3	32 Fragments	9 Mines	3.6 Fragments/mine
lane 4	42 Fragments	15 Mines	2.8 Fragments/mine
TOTAL	**146 Fragments**	**45 Mines**	**3.2 Fragments/mine**

TEST LANE – 1 (DRY CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	16 August 2006
3	Mine depth	:	10 cm
4	Condition	:	Dry condition
5	Temperature	:	29.6 Celsius
6	Humidity	:	78.2%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	11PM
10	Duration	:	25 mn (unable to continue operation due to soft ground)
11	Clearance size	:	200 m^2
12	Fuel consumption	:	14 liter

Mine is hit and its fragment scattered at the following distant:

Table 23: mine fragment scattered at dry condition, test lane 1

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 15.20 m	1 fragment	2 fragment
10m – 20m	+ 24.45 m	0	4 fragment
20m – 30m	X	X	X
30m – 40m	X	X	X
40m – 50m	X	X	X
TOTAL		**1 fragment**	**6 fragment**

LANE 1 (DRY CONDITION)

TOTAL MINE: 6 MINES
DESTROYED MINE: 6 MINES
LIVE MINE: 0 MINES

TEST LANE – 2 (DRY CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	15 August 2006
3	Mine depth	:	15 cm
4	Condition	:	Dry condition
5	Temperature	:	32.2 Celsius
6	Humidity	:	71.9%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	2:20 PM
10	Duration	:	1h06mn42s
11	Clearance size	:	500 m^2
12	Fuel consumption	:	35 liters

Mine is hit and its fragment scattered at the following distant:

Table 24: mine fragment scattered at dry condition, test lane 2

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 12 m	1 live mine 1 live mine	5 fragments
10m – 20m	+ 23.55 m	6 fragments	8 fragments
20m – 30m	+ 8.8 m	1 fragment 1 live mine	6 fragments 1 live mine
30m – 40m	+ 17.7 m	4 fragments	12 fragments
40m – 50m	+ 19.5 m	2 fragments	18 fragment
TOTAL		**13 fragments 2 live mines**	**49 fragments 1 live mine**

Note about live mine: There are 3 live mines left after the clearance. One AP T-72A mine and one PMN-2 are in good shape and apparently remain at the same position. This is resulted from insufficient digging depth of the machine. Another live mine had been smashed by the machine and dispersed about 8.8m forward from the previous position.

LANE 2 (DRY CONDITION)

TOTAL MINE: 15 MINES
DESTROYED MINE: 12 MINES
LIVE MINE: 3 MINES

TEST LANE – 3 (DRY CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	17 August 2006
3	Mine depth	:	20cm
4	Condition	:	Dry condition
5	Temperature	:	35.8 Celsius
6	Humidity	:	60.7%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	1:50PM
10	Duration	:	37mn30s
11	Clearance size	:	300 m^2
12	Fuel consumption	:	22 liters

Mine is hit and its fragment scattered at the following distant:

Table 25: mine fragment scattered at dry condition, test lane 3

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 14.50 m	0	4 fragments
10m – 20m	+ 10.70 m	1 live mine	5 fragments
20m – 30m	+ 25.50 m	10 fragments	12 fragments
30m – 40m			
40m – 50m			
TOTAL		**10 fragments 1 live mine**	**21 fragments**

LANE 3 (DRY CONDITION)

TOTAL MINE: 9 MINES
DESTROYED MINE: 8 MINES
LIVE MINE: 1 MINE

TEST LANE – 4 (DRY CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	17 August 2006
3	Mine depth	:	Mix (10cm, 15cm & 20cm)
4	Condition	:	Dry condition
5	Temperature	:	48.6 Celsius
6	Humidity	:	30.4%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	10AM
10	Duration	:	1h05mn27s
11	Clearance size	:	500 m^2
12	Fuel consumption	:	38 liters

Mine is hit and its fragment scattered at the following distant:

Table 26: mine fragment scattered at dry condition, test lane 4

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 23 m	0	12 fragments
10m – 20m			
20m – 30m	+ 13.5 m	4 fragments 1 live mine	11 fragments
30m – 40m			
40m – 50m	+ 14.65 m	1 live mine	13 fragments
TOTAL		**4 fragments 2 live mines**	**36 fragments**

LANE 4 (DRY CONDITION)

TOTAL MINE: 15 MINES
DESTROYED MINE: 13 MINES
LIVE MINE: 2 MINES

4.6.3.TEST RESULT AT LIGHT BUSH CONDITION

Table 27: Summary Test result at light bush condition

Test lane	Clearance duration	True Clearance	bored mine	Destroyed mine	Un-Destroyed mine (live mine)	Fuel, Liters
Lane 1	1h9mn33s	500 m^2	15 mines	14 mines	**1** mine	42 Liters
Lane 2	1h34mn09s	500 m^2	15 mines	14 mines	**1** mine	54 Liters
Lane 3	1h44mn52s	500 m^2	15 mines	15 mines	**0**	57 Liters
Lane 4	1h42mn00s	500 m^2	15 mines	9 mines	**6** mines	57 Liters
TOTAL		**2000 m^2**	**60 mines**	**52**	**8 mines**	**210 Liters**

Table 28: Distant of flying fragment from original location in Light Bush condition

Test lane	0-10m	10m - 20m	20m - 30m	30m - 40m	40m - 50m	**Average**
lane 1	23.1 m	15.65 m	15.55 m	24.95 m	25.85 m	**21.02 m**
lane 2	21 m	22.5 m	22.15 m	19.6 m	19.2 m	**20.89 m**
lane 3	10.6 m	23 m	33.3 m	29.7 m	30.6 m	**25.44 m**
lane 4	32.5 m		20.3 m		27.8 m	**26.87 m**

Table 29: Potential mine to be broken up by the SWING TYPE MACHINE during performance test

Test lane	Fragments in test lane	Fragments out of test lane	sub-Total
lane 1	21 Fragments	41 Fragments	62 Fragments
lane 2	2 Fragments	32 Fragments	34 Fragments
lane 3	9 Fragments	31 Fragments	40 Fragments
lane 4	2 Fragments	18 Fragments	20 Fragments
TOTAL	**34 Fragments**	**122 Fragments**	**156 Fragments**

Table 30: Fragment position in Light Bush condition area after the performance test by SWING TYPE MACHINE

Test lane	Total Fragments	Total mine used in test lane	Break up ratio
lane 1	62 Fragments	15 Mines	4.1 Fragments/mine
lane 2	34 Fragments	15 Mines	2.3 Fragments/mine
lane 3	40 Fragments	15 Mines	2.7 Fragments/mine
lane 4	20 Fragments	15 Mines	1.3 Fragments/mine
TOTAL	**156 Fragments**	**60 Mines**	**2.6 Fragments/mine**

TEST LANE – 1 (LIGHT BUSH CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	16 August 2006
3	Mine depth	:	10 cm
4	Condition	:	Light bush
5	Vegetation height	:	2m
6	Temperature	:	31.9 Celsius
7	Humidity	:	66.5 %
8	Operation mode	:	Manual
9	Clearance mode	:	Reverse
10	Start time	:	1:50PM
11	Duration	:	1h9mn33s
12	Clearance size	:	500 m^2
13	Fuel consumption	:	42.2 liters

Mine is hit and its fragment scattered at the following distant:

Table 31: mine fragment scattered at light bush condition, test lane 1

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 23.10 m	3 fragments	4 fragments
10m – 20m	+ 15.65 m	5 fragments	1 fragment
20m – 30m	+ 15.55 m	9 fragments	13 fragments
30m – 40m	+ 24.95 m	4 fragments	7 fragments **1 live mine**
40m – 50m	+ 25.85 m	0 fragment	14 fragments **1 live mine**
TOTAL		**21 fragments**	**39 fragments 2 live mines**

LANE 1 (LIGHT BUSH)

TOTAL MINE: 15 MINES
DESTROYED MINE: 13 MINES
LIVE MINE: 2 MINES

TEST LANE – 2 (LIGHT BUSH CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	15 August 2006
3	Mine depth	:	15 cm
4	Condition	:	Light bush
5	Vegetation height	:	2m
6	Temperature	:	32.2 Celsius
7	Humidity	:	65.5%
8	Operation mode	:	Manual
9	Clearance mode	:	Reverse
10	Start time	:	11:15 AM
11	Duration	:	1h34mn09s
12	Clearance size	:	500 m^2
13	Fuel consumption	:	54 liters

Mine is hit and its fragment scattered at the following distant:

Table 32: mine fragment scattered at light bush condition, test lane 2

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 21.0 m	2 fragments	3 fragments
10m – 20m	+ 22.5 m	0	5 fragments
20m – 30m	+ 22.15 m	0	8 fragments
30m – 40m	+ 19.60 m	0	6 fragments **1 live mine**
40m – 50m	+ 19.20 m	0	9 fragments
TOTAL		**2 fragments**	**31 fragments 1 live mine**

Note: broke 2 chains, bending 1 holder and many more chain need replacement (almost broken)

LANE 2 (LIGHT BUSH)

TOTAL MINE: 15 MINES
DESTROYED MINE: 14 MINES
LIVE MINE: 1 MINES

TEST LANE – 3 (LIGHT BUSH CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	14 August 2006
3	Mine depth	:	20 cm
4	Condition	:	Light bush
5	Vegetation height	:	2m
6	Temperature	:	32.1 Celsius
7	Humidity	:	69.2%
8	Operation mode	:	Manual
9	Clearance mode	:	Reverse
10	Start time	:	2:55PM
11	Duration	:	1h44mn52s
12	Clearance size	:	500 m^2
13	Fuel consumption	:	57 liters

Mine is hit and its fragment scattered at the following distant:

Table 33: mine fragment scattered at light bush condition, test lane 3

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 10.6 m	0	4 fragments
10m – 20m	+ 23 m	0	2 fragments
20m – 30m	+ 33.3 m	3 fragments	9 fragments
30m – 40m	+ 29.7 m	3 fragments	7 fragments
40m – 50m	+ 30.6 m	3 fragments	9 fragments
TOTAL		**9 fragments**	**31 fragments**

LANE 3 (LIGHT BUSH)

TOTAL MINE: 15 MINES
DESTROYED MINE: 15 MINES
LIVE MINE: 0 MINES

TEST LANE – 4 (LIGHT BUSH CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	14 August 2006
3	Mine depth	:	Mix (10cm, 15cm and 20cm)
4	Condition	:	Light bush
5	Vegetation height	:	2m
6	Temperature	:	34.6 Celsius
7	Humidity	:	68.4%
8	Operation mode	:	Manual
9	Clearance mode	:	Reverse
10	Start time	:	9:17 AM
11	Duration	:	1h42mn00s
12	Clearance size	:	500 m^2
13	Fuel consumption	:	57 liters

Mine is hit and its fragment scattered at the following distant:

Table 34: mine fragment scattered at light bush condition, test lane 4

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 32.5 m	1 fragment 1 live mine	6 fragments
10m – 20m			
20m – 30m	+ 20.3 m	1 fragment	6 fragments 2 live mines
30m – 40m			
40m – 50m	+ 27.8 m	2 live mines	3 fragments 1 live mines
TOTAL		**2 fragments 3 live mines**	**15 fragments 3 live mines**

Note about live mine: There are 6 AP live mines remain in test lane. After investigation, we found that 3 of them remain at the same position and had no physical contact with the demining machine (insufficient digging depth). 3 other mines had been smashed and flown over 20m forward from its previous position and still remain active.

LANE 4 (LIGHT BUSH)

TOTAL MINE: 15 MINES
DESTROYED MINE: 9 MINES
LIVE MINE: 6 MINES

4.6.4.TEST RESULT AT WET CONDITION

There are two test lanes in wet condition test area. The test had been conducted and successfully completed. The following is the test result at wet condition:

Table 35: Summary Test result at Wet condition

Test lane	Clearance duration	True Clearance	bored mine	Destroyed mine	Un-Destroyed mine (live mine)	Fuel, Liter
Lane 1	1h26mn39s	500 m^2	15 mines	15 mines	0 mine	55 liters
Lane 2	1h44mn07s	500 m^2	15 mines	14 mines	1 mine	61 liters
TOTAL		**1000 m^2**	**30 mines**	**29 mines**	**1 mine**	**116 liters**

Table 36: Distant of flying fragment from original location in Wet condition

Test lane	0-10m	10m - 20m	20m - 30m	30m - 40m	40m - 50m	**Average**
lane 1	17.45 m	19.3 m	22.4 m	19 m	25.75 m	**20.78 m**
lane 2	22.6 m	22.9 m	15.65 m	22.95 m	23 m	**21.42 m**

Table 37: Potential mine to be broken up by the SWING TYPE MACHINE during performance test

Test lane	Fragments in test lane	Fragments out of test lane	sub-Total
lane 1	3 Fragments	29 Fragments	32 Fragments
lane 2	8 Fragments	33 Fragments	41 Fragments
TOTAL	**11 Fragments**	**62 Fragments**	**73 Fragments**

Table 38: Fragment position in Wet condition area after the performance test by SWING TYPE MACHINE

Test lane	Total Fragments	Total mine used in test lane	Break up ratio
lane 1	32 Fragments	15 mines	2.1 Fragments/mine
lane 2	41 Fragments	15 mines	2.7 Fragments/mine
TOTAL	**73 Fragments**	**30 mines**	**2.4 Fragments/mine**

TEST LANE – 1 (WET CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	18 August 2006
3	Mine depth	:	10 cm
4	Condition	:	Wet
5	Temperature	:	36.2 Celsius
6	Humidity	:	75.7%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	2:29 PM
10	Duration	:	1h26mn39s
11	Clearance size	:	$500m^2$
12	Fuel consumption	:	55 liters

Mine is hit and its fragment scattered at the following distant:

Table 39: mine fragment scattered at wet condition, test lane 1

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 17.45 m	0	4 fragments
10m – 20m	+ 19.30 m	0	3 fragments
20m – 30m	+ 22.40 m	0	3 fragments
30m – 40m	+ 19.0 m	1 fragment	5 fragments
40m – 50m	+ 25.75 m	2 fragments	14 fragments
TOTAL		**3 fragments**	**29 fragments**

LANE 1 (WET CONDITION)

TOTAL MINE: 15 MINES
DESTROYED MINE: 15 MINES
LIVE MINE: 0 MINES

TEST LANE – 2 (WET CONDITION)

No.	Description		Detail information
1	Machine type	:	Hitachi – BM307-V33
2	Test date	:	18 August 2006
3	Mine depth	:	20 cm
4	Condition	:	Wet
5	Temperature	:	36.5 Celsius
6	Humidity	:	69.8%
7	Operation mode	:	Manual
8	Clearance mode	:	Reverse
9	Start time	:	10:30 AM
10	Duration	:	1h44mn07s
11	Clearance size	:	500 m^2
12	Fuel consumption	:	61 Liters

Mine is hit and its fragment scattered at the following distant:

Table 40: mine fragment scattered at wet condition, test lane 2

Mine locate at	Distant (Scattered)	Fragment In test lane	Fragment Outside test lane
0m – 10m	+ 22.60 m	1 fragment	5 fragments
10m – 20m	+ 22.90 m	1 fragment	8 fragments and 1 live mine
20m – 30m	+ 15.65 m	2 fragments	2 fragments
30m – 40m	+ 22.95 m	2 fragments	3 fragments
40m – 50m	+ 23 m	2 fragments	14 fragments
TOTAL		**8 fragments**	**32 fragments and 1 live mine**

LANE 2 (WET CONDITION)

TOTAL MINE: 15 MINES
DESTROYED MINE: 14 MINES
LIVE MINE: 1 MINE