D: Cambodia Mines

PMD-6 ANTI-PERSONNEL MINE

The original appearance of the PMD-6

A typical recovery site (mine 6)

None of the wood casing remains from mine 6. There is a clear break between the fuze and the TNT block (indicated by the red arrow); this was filled with mud.

Every PMD-6 mine recovered had a break between the fuze and the charge

Remnants of the wooden casing are visible once the TNT charge has been removed

The end of the TNT block, looking into the mouth of the detonator tube

The TNT block broken open to show the corroded detonator tube

The retaining pin of fuze 8 was almost rusted through, but the striker was seized

The retaining pin of fuze 6 was in relatively good condition

The mechanical components of fuze 6 might have been operational, but it is unlikely that the stab receptor would have functioned

PMD-6: SUMMARY OF FINDINGS

- The wooden case of every PMD-6 had rotted, with only small remnants found. Since the casing forms part of the initiation system (by pushing the retaining pin out to release the striker), these mines could no longer function as designed.
- The MUV-2 fuze components were intact, but were seized and had to be separated using force. The stab receptors were in poor condition and were probably not functional.
- The upper section of the aluminum detonator tube had corroded away, leaving a break of approximately 5-10 mm between the fuze and the main charge. This gap was filled with mud, which would probably have prevented the flash from the stab-receptor from initiating the detonator.
- Burning tests on two charges resulted in eventual detonation, indicating that the primary explosive within the detonator was still viable, and capable of initiating the main TNT charge.

CONCLUSIONS

- All of the PMD-6 mines examined showed multiple causes of failure, namely:
    - Absence of the casing as part of the initiation mechanism;
    - Seizure of mechanical fuze components;
    - Inactive stab-receptors (subject to confirmation);
    - Interruption of the initiation train.
- The combination of these effects would make it impossible for any of these mines to function as designed. Other PMD-6 mines buried in similar conditions for similar periods are also unlikely to function.

- The TNT charges are still hazardous, particularly since they contain embedded detonators with viable primary explosive. These could be initiated if set alight or subjected to substantial impact.

PMN ANTI-PERSONNEL MINE

The original appearance of the PMN

A typical recovery site (mine 12)

A close-up showing how the roots have grown around mine 12

The PMN with detonator removed; in some mines the detonator could not be extracted

Some of the rubber covers were damaged, allowing water to enter the mine body

In some cases, soil had almost filled the void beneath the pressure plate

Components of mine 13 with TNT charge still in place within the body. The mine may have been functional despite the striker spring being badly deteriorated

Strikers and springs showed substantial variation in the degree of degradation

Striker 12 was badly corroded and seized; this would have prevented operation

Most detonator capsules were functional, confirmed by explosive testing

PMN: SUMMARY OF FINDINGS

- The steel bands securing the rubber covers were badly rusted in all examples; many were at or near the point of failure. This is known to reduce the detection signature.
- Rubber covers had deteriorated and hardened; some, but not all, were breached. This does not prevent the mine from working, but does allow water into the fuze mechanism.
- The main effect of water inside the mine is to cause the springs to rust. The striker spring is most critical to failure; however, deterioration of the plunger spring could potentially lead to a decrease in operating pressure.
- As noted in the previous report, springs in contact with alloy strikers appear to deteriorate more quickly than those around steel strikers.
- Most strikers were in operational condition, but one had deteriorated badly and was seized into its channel. This would have caused the initiation mechanism to fail.
- TNT charges were in good condition and detonators appeared to be functional. Two detonator tests (using a PMN fuze mechanism in good condition) resulted in detonation.

CONCLUSIONS

- All of the PMN mines examined showed significant deterioration, but some still appeared to be functional while others clearly were not.
- The most common cause of failure is deterioration of the striker spring, which begins when water enters the mine and eventually results in disintegration. Other likely causes of failure include:
    - Degradation and seizing of the striker;
    - Prevention of operation due to silt build up in cavities.
- Explosive components appear to out-live the fuze mechanism.
- These findings are consistent with those from the first phase of the study.

PMN-2 ANTI-PERSONNEL MINE

The original appearance of the PMN-2

A PMN-2 recovery site (mine 18)

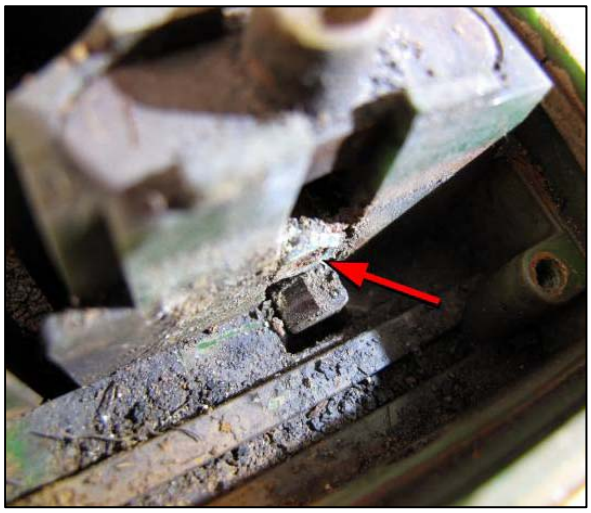
Deterioration of the rubber pressure plate cover

The mine's base, with booster plug and booster capsule removed

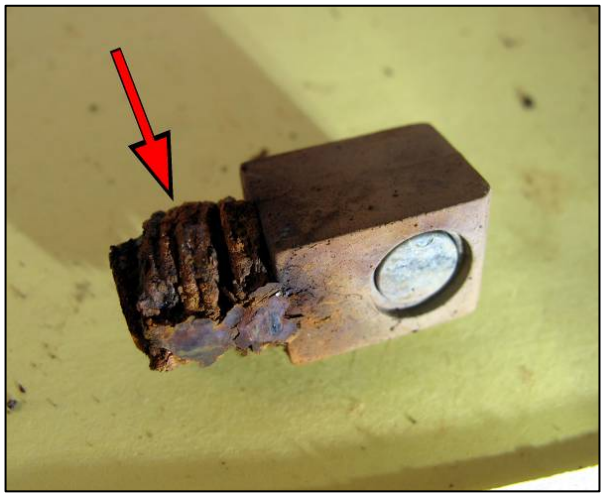
The mine cleaned to show the extent of the rubber and casing degradation

Removal of the securing ring reveals the penetration of soil and roots

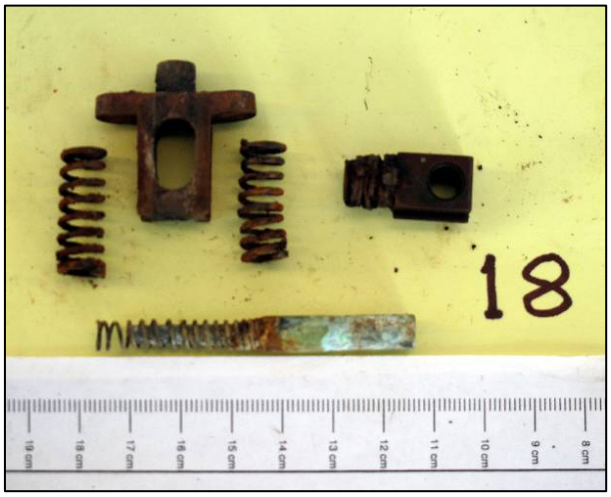
Top plate removed to show the main charge (to the left) which is in good condition. The fuze mechanism (to the right) has degraded



A close-up showing the end of the striker. The arrow indicates where the firing pin should be, but this has rusted away completely



The slider containing the detonator. The arrow indicates the spring, which should move the detonator into line with the striker as the mine is actuated; this spring is no longer functional



Components of the fuze mechanism, showing that all springs were badly rusted. The plunger (top left) and striker (below) were firmly seized into their channels

PMN-2: SUMMARY OF FINDINGS

- The rubber pressure plate covers were badly perished, with large sections missing. In several examples, the top edge of the plastic casing was also split. This damage would not prevent the mine from working, but does allow water into the fuze mechanism.
- The main effect of water inside the mine is to cause the springs to rust. The striker spring and detonator slider spring are both critical to operation and their deterioration can cause failure.

- Deterioration of the plunger springs could potentially lead to a decrease in operating pressure, but appears to be offset by seizing of the plunger itself.
- In every PMN-2 examined, the striker was seized into its channel; this appears to be caused by a build-up of corrosion, leading to expansion beneath the metallic plating.
- In several examples, the steel firing pin (which is inset into the end of the alloy striker) had rusted away completely, leaving the striker with a flat end.
- In all examples, the explosive charges (RDX/TNT) and boosters were in good condition and detonators appeared to be functional. However, the detonator is held out of line until the mine is actuated, and relies on the slider spring to bring it into line.

CONCLUSIONS

- All of the PMN-2 mines examined showed significant deterioration and none appeared to be capable of functioning.
- The most common cause of failure is seizing of the striker into its channel. However, some mines showed multiple points of failure, including:
    - Absence of the firing pin;
    - Seizure of the detonator slider and spring;
    - Seizure of the plunger.
- Explosive components appear to be stable and functional.
- These findings are consistent with those from the first phase of the study.

TYPE 72 ANTI-PERSONNEL MINE

The appearance of the Type 72 when new

A typical recovery site (mine 2)

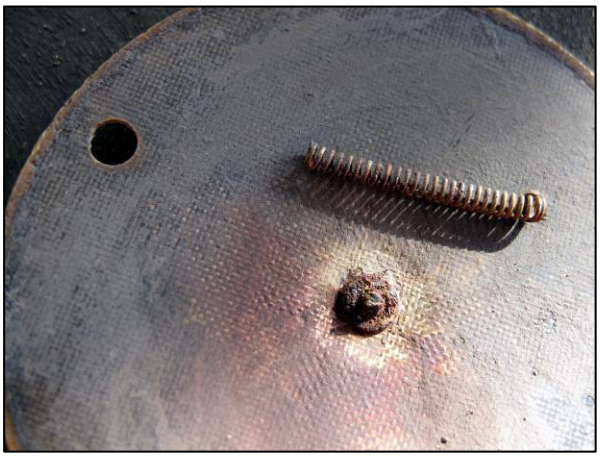
A closer view of the recovery site, with the edge of mine 2 just visible

The soil type, burial depth and appearance of the mine are typical of the Type 72s recovered

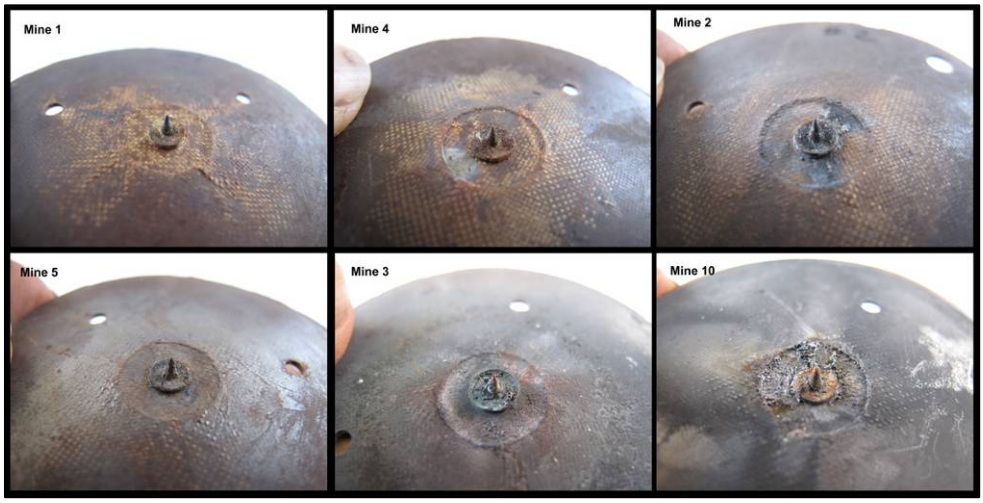
Mine 3 was unusual because it was found buried upside down

The rubber cover on mine 3 was better preserved than most

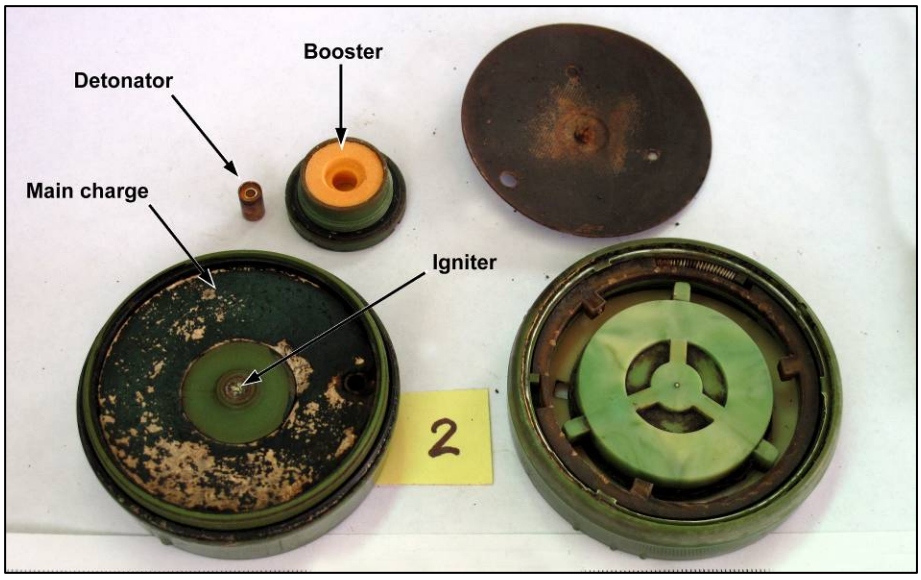
With the rubber cover missing, the Type 72 is penetrated by water and soil



The tip of this firing pin has rusted away, leaving the mine unable to function



Most of the mines recovered had firing pins in reasonable condition, though superficial rusting had rounded off the ends, making them less likely to fire the igniter



The main charge, booster and detonator appeared to be functional in most of the mines recovered. However, some of the igniters had deteriorated.

Function tests using firing pins in good condition confirmed that some igniters were no longer operational

TYPE 72: SUMMARY OF FINDINGS

- The rubber pressure plate cover was badly perished or absent in all of the mines examined. In every case, this had allowed water and soil to penetrate the mine body.
- Without the smooth green rubber cover, the appearance of aged Type 72 mines is quite different, and may not be recognizable to people who have only seen it in new condition.
- The primary effect of water inside the mine is to rust the mild steel firing pin. Initially, this causes the tip to become rounded and therefore shorter, which makes it far less likely to fire the igniter.
- The likelihood of initiation continues to fall as the mass of steel within the firing pin decreases further. This, combined with rusting of the helical arming spring, may also make the mine difficult or impossible to locate using a metal detector.
- Most of the Type 72 mines examined had fuzes that were already actuated (shown primarily by the inversion of the Belleville spring), but the mines had not detonated.
- Most explosive components remained in reasonable condition and appeared to be functional. However, some of the stab-sensitive igniters were no longer operational.

CONCLUSIONS

- Breaching of the thin rubber cover means that all Type 72s examined had significant levels of deterioration. However, some still appeared to be capable of functioning.
- The most common cause of failure is rusting of the firing pin. Degradation of the igniter may also cause failure, particularly in conjunction with a short, rounded firing pin.

- With the rubber cover missing, the mine can be difficult to recognize; this has important implications for mine risk education and deminer training.
- Older mines with minimal metallic content may require alternative means of detection.
- A complete explosive train (detonator, booster and main charge) may remain even when the fuze is non-functional. This means the mine is still hazardous.
- These findings are consistent with those from the first phase of the study.