

MRL-TN-522

AR-005-164



DTIC FILE COPY

DEPARTMENT OF DEFENCE  
DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION  
MATERIALS RESEARCH LABORATORIES

MELBOURNE, VICTORIA

TECHNICAL NOTE

MRL-TN-522

AD-A189 314

A DEFECT INVESTIGATION OF THUNDERFLASH MK N5 (NAVY)

DTIC  
ELECTE  
FEB 17 1988  
S D

Scott Murdoch

Approved for Public Release

DISTRIBUTION STATEMENT A  
Approved for public release  
Distribution Unlimited

DSTO  
MARIBYRNONG

C Commonwealth of Australia  
SEPTEMBER 1987

88 2 16 008

**DEPARTMENT OF DEFENCE  
MATERIALS RESEARCH LABORATORIES**

**TECHNICAL NOTE**

**MRL-TN-522**

**A DEFECT INVESTIGATION OF THUNDERFLASH MK N5 (NAVY)**

**Scott Murdoch**

**ABSTRACT**

✓ This technical note describes the examination of Thunderflash devices which had been stored in sealed metal ammunition boxes. The ammunition boxes had exhibited severe swelling during storage and this was found to be due to a reaction between the photoflash composition in the device and moisture. The result of this reaction was the pressurization of the boxes with hydrogen gas.  
↑

**Approved for Public Release**

---

**POSTAL ADDRESS: Director, Materials Research Laboratories  
P.O. Box 50, Ascot Vale, Victoria 3032, Australia**

---

# C O N T E N T S

|                     | <u>Page No.</u> |
|---------------------|-----------------|
| 1. INTRODUCTION     | 1               |
| 2. BACKGROUND       | 1               |
| 3. INVESTIGATIONS   | 2               |
| 4. CONCLUSION       | 3               |
| 5. ACKNOWLEDGEMENTS | 3               |
| 6. REFERENCES       | 4               |

|                    |                                     |
|--------------------|-------------------------------------|
| Accession For      |                                     |
| NTIS CRA&I         | <input checked="" type="checkbox"/> |
| DTIC TAB           | <input type="checkbox"/>            |
| Unannounced        | <input type="checkbox"/>            |
| Justification      |                                     |
| By                 |                                     |
| Distribution       |                                     |
| Availability Codes |                                     |
| Dist               | Avail and/or Special                |
| A-1                |                                     |



## A DEFECT INVESTIGATION OF THUNDERFLASH SMALL MK N5 (NAVY)

### 1. INTRODUCTION

MRL received a request from the Royal Australian Navy to investigate the swelling of metal ammunition boxes containing Thunderflashes, Small Mk N5. The Thunderflashes, manufactured to specification NOID 52204 at the Munitions Filling Factory, St Mary's between 1972-82, had been stored on both Australian naval vessels and in land based magazines. A number of the devices from some of the lots involved were examined at MRL. Evidence was found of a reaction between moisture and the magnesium in the pyrotechnic photoflash composition. A consequence of this reaction was the pressurization of the ammunition boxes with hydrogen gas.

### 2. BACKGROUND

The Thunderflash, Small Mk N5 (Fig.1) consists of a cylindrical cardboard tube, closed at one end by a cork plug. The cylinder is filled with the photoflash composition SR 801B which was developed in 1944 at the Royal Armament Research and Development Establishment, RARDE, Fort Halstead, UK. The composition contains 57% magnesium powder grade 4, 37% potassium perchlorate and 6% graphite. The devices are ignited by striking a match composition, located at the top of the cylinder. A length of safety fuse provides an interval which enables the device to be safely hand deployed. After a specified time, the fuse ignites the photoflash filling resulting in a loud explosion and a high intensity flash of light. The outer surface of the cardboard cylinder is weatherproofed with a coating of shellac and is fitted with an identification label. A protective rubber cap which covers the match composition is removed before use (Fig.2).

Ten Thunderflash devices with one striker are supplied wrapped in waxed paper and sealed in a polythene envelope. Ten of these packages are stored in an M2A1 ammunition box which incorporates a rubber seal in the lid

(Fig.3). The free space in the box is packed with waxed paper to protect the contents against rough handling.

The Thunderflash devices have a recommended service life of four years, with a potential service life of ten years subject to routine periodic inspection and proof [1].

### 3. INVESTIGATIONS

Swelling due to internal pressure was observed in a number of M2A1 boxes each containing one hundred Thunderflash devices. Reports from the Naval Quality Assurance Representative (NQAR), Newington indicated that some of these boxes had been opened within the last twelve months yet, at the time of this initial inspection, no swelling was observed. It has been determined that the internal pressure required to swell the M2A1 boxes to the degree observed could be as high as 100 kPa [2], therefore ammunition boxes that exhibited deformation due to internal pressure were considered unsafe for transport. A number of Thunderflash devices from these boxes were repackaged and forwarded to MRL for examination. Samples of the photoflash composition were taken from devices under manufacturing Lots, 5 MY 3/72, 4 MY 3/72, 33 MY 3/79, 3 MY 6/82 and analysed for free magnesium content. The results are listed in Table 1.

TABLE 1

| Sample         | Year of Manufacture | Free Magnesium (%) |
|----------------|---------------------|--------------------|
| Lot 5 MY 3/72  | 1972                | 34.1               |
|                |                     | 37.9               |
|                |                     | 35.1               |
| Lot 4 MY 3/72  | 1972                | 38.0               |
|                |                     | 37.1               |
|                |                     | 38.2               |
| Lot 33 MY 3/79 | 1979                | 41.5               |
|                |                     | 47.7               |
|                |                     | 47.0               |
| Lot 3 MY 6/82  | 1982                | 55.0               |
|                |                     | 55.2               |

The free magnesium content was determined by the Eudiometric method [3]. The results show that the percentage of free magnesium decreases significantly with the age of the stores. Cackett [4] states that magnesium is one of the most reactive metals used in pyrotechnic compositions and will undergo deterioration in the presence of moisture. Magnesium reacts with water to produce magnesium hydroxide and hydrogen gas. The gas evolved can exert dangerously high pressures in hermetically sealed stores or containers.

The paper components in the Thunderflash contain moisture. It is therefore expected that the magnesium will react, liberating hydrogen gas. Should this reaction continue, a point will be reached where the device will fail to function due to insufficient free magnesium in the photoflash filling.

#### 4. CONCLUSION

MRL have examined the pyrotechnic filling from a number of Thunderflash, Small Mk N5 devices. The examination indicates a depletion of the free magnesium content in the filling caused by a reaction between the magnesium and moisture. A consequence of this reaction is the liberation of hydrogen gas. The volume of gas evolved is sufficient to generate a high pressure in sealed ammunition boxes. It is recommended on the basis of this investigation that the Thunderflash devices stored in boxes that exhibit swelling be destroyed.

To overcome the problem of excessive gas generation, a number of alternatives may be considered for a replacement device:-

- (i) the photoflash filling could be modified by developing a suitable coating for the magnesium, or
- (ii) aluminium is less readily attacked by water because of the continuous film of oxide formed on its surface, therefore it may be possible to replace the current filling with an aluminium fuelled photoflash composition, or
- (iii) the device could be redesigned using non-paper components in contact with the photoflash filling.

#### 5. ACKNOWLEDGEMENTS

The assistance of Mr W. Bracken, NOAR, Newington, Mrs S. Spencer of Explosives Research Group, MRL and Mr M. Wilson of Explosives Materials Group, MRL is gratefully acknowledged.

#### 6. REFERENCES

1. "Director of Naval Ordnance Inspection Orders" Vol 2 No. 4.9.6.1 (issued 24th February 1986).
2. Wilson, M. and Bird, R. (1986). "Defect Investigation of Cartridge Illuminating 1-1/2 inch", MRL-TN-501, Materials Research Laboratories, Maribyrnong, Australia.
3. Davidson, R.G. (1972). "Chemical Analysis of Flash Composition". DSL-TN-254, Defence Standards Labs (now Materials Research Laboratories.), Maribyrnong, Victoria.
4. Cackett, J.C. (1965). "Monograph on Pyrotechnic Composition". Special RARDE publication. RESTRICTED

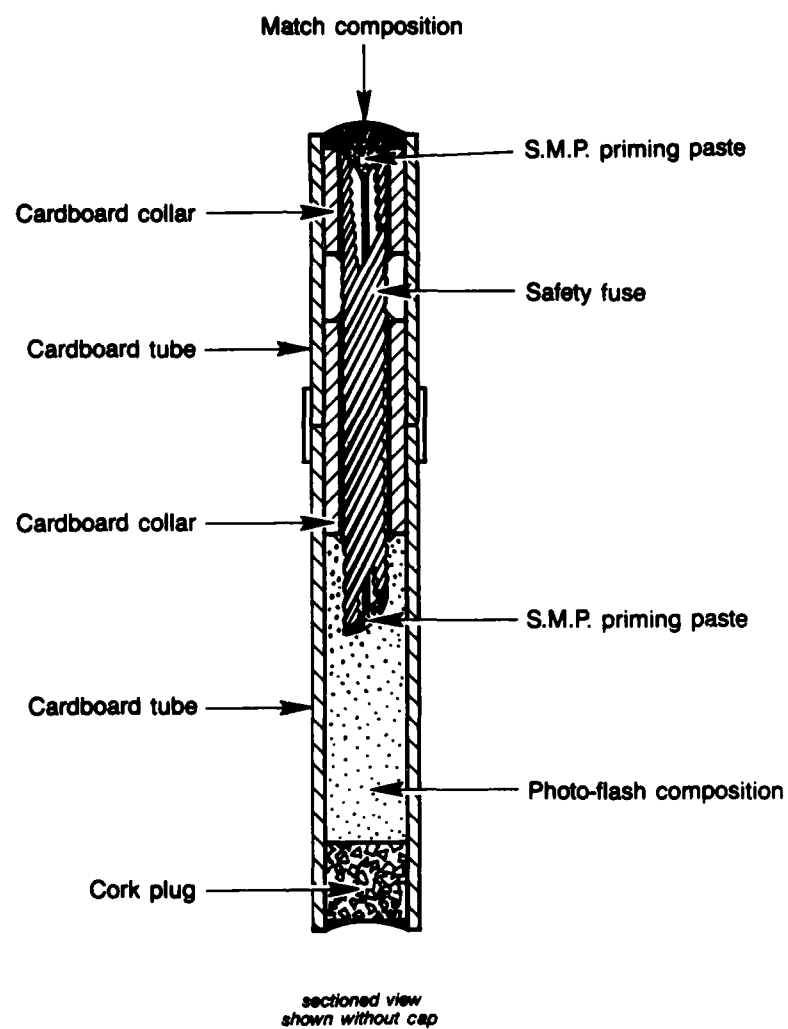


FIGURE 1 Thunderflash, Small Mk N5.

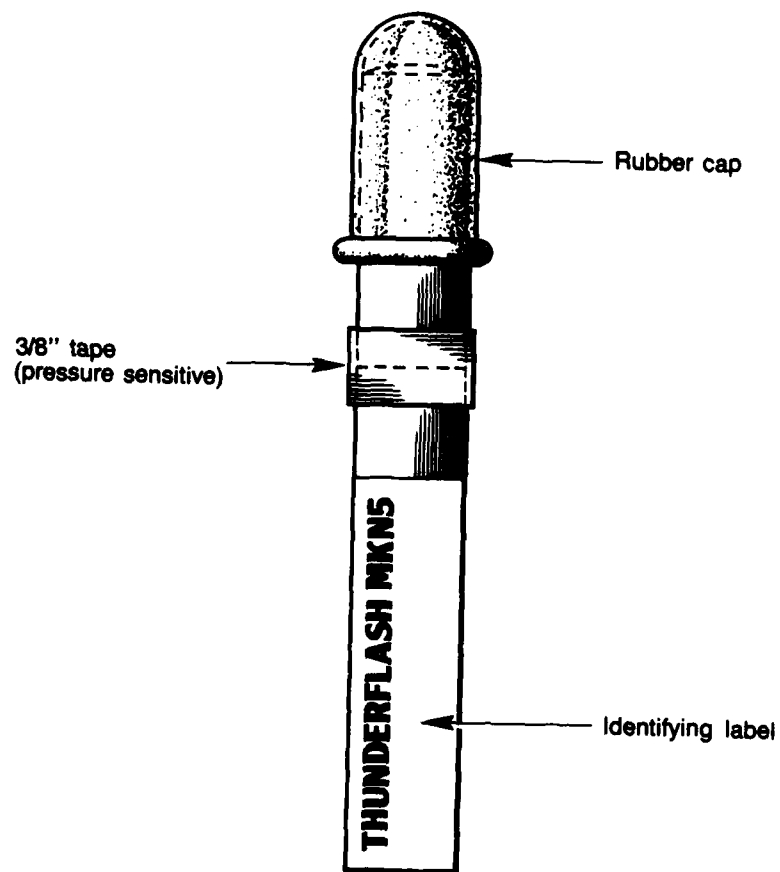


FIGURE 2 Thunderflash, Small Mk N5.

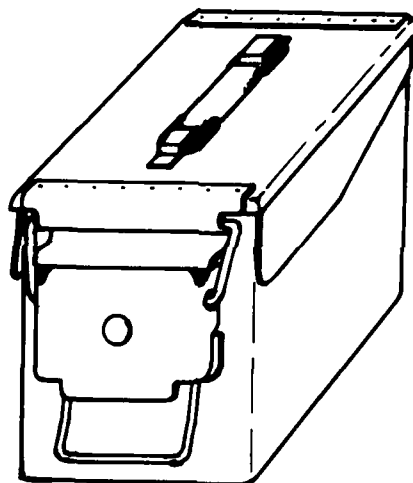


FIGURE 3 M2A1 Ammunition box

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

## DOCUMENT CONTROL DATA SHEET

REPORT NO.  
MRL-TN-522AR NO.  
AR-005-164REPORT SECURITY CLASSIFICATION  
Unclassified

## TITLE

A defect investigation of thunderflash MK N5 (Navy)

## AUTHOR(S)

Scott Murdoch

## CORPORATE AUTHOR

Materials Research Laboratories  
PO Box 50,  
Ascot Vale, Victoria 3032

## REPORT DATE

September 1987

## TASK NO.

NAV 146/85

## SPONSOR

Navy

## FILE NO.

G6/4/8-3313

## REFERENCES

4

## PAGES

10

## CLASSIFICATION/LIMITATION REVIEW DATE

September 1990

## CLASSIFICATION/RELEASE AUTHORITY

Superintendent, MRL  
Physical Chemistry Division

## SECONDARY DISTRIBUTION

Approved for Public Release

## ANNOUNCEMENT

Announcement of this report is unlimited.

## KEYWORDS

Photoflash  
Ammunition  
ThunderflashAmmunition  
ContainersPyrotechnics  
StorageSwelling  
Hydrogen

SUBJECT GROUPS 0079A

## ABSTRACT

This technical note describes the examination of Thunderflash devices which had been stored in sealed metal ammunition boxes. The ammunition boxes had exhibited severe swelling during storage and this was found to be due to a reaction between the photoflash composition in the device and moisture. The result of this reaction was the pressurization of the boxes with hydrogen gas.

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED