THE CONVENTION ON CERTAIN CONVENTIONAL WEAPONS: FINAL REPORT OF A STUDY OF THE TECHNOLOGICAL AND COST IMPLICATIONS OF RETROFITTING LANDMINES WITH FUSES INCORPORATING SELF DESTRUCT OR SELF NEUTRALIZING DEVICES

BY

SNC INDUSTRIAL TECHNOLOGIES INC.
LE GARDEUR, QUEBEC
CANADA

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INFORMATION STATEMENT

THE VIEWS EXPRESSED IN THIS REPORT ARE THOSE OF SNCIT AND DO NOT NECESSARILY REFLECT THOSE OF THE GOVERNMENT OF CANADA OR THE DEPARTMENTS OF NATIONAL DEFENCE OR FOREIGN AFFAIRS AND INTERNATIONAL TRADE .

EXECUTIVE SUMMARY

The 1980 United Nations Convention on Certain Conventional Weapons, also known as the CCW Convention, restricts the use of landmines which may be deemed to be causing undue suffering or having indiscriminate effects, especially on civilians. The proposed revision to the Convention may require all landmines to have self destruct or self neutralizing and possibly passive self deactivation features in the future.

SNC Industrial Technologies conducted a study of technological and cost implications of retrofitting landmines with fuses incorporating self destruct or self neutralizing devices for the Department of National Defence in order to assess the implications for Canada on the various options considered for the revision to the CCW Convention. During the course of the study the information obtained from Department of National Defence, international companies manufacturing landmines, Jane's Information Group and the information available within SNC Industrial Technologies was analyzed. The analysis of the worldwide situation on landmines is grouped under NATO countries, Former Warsaw Pact countries and other countries.

The study found that there are a wide variety of anti-personnel and anti-tank mines available worldwide. A few of the anti-personnel mines and some of the anti-tank mines have self destruct or self neutralizing devices.

A large majority of anti-personnel landmines are small devices and are activated with single impulse pressure fuses. Retrofitting these existing mines with self destruct or self neutralizing devices is not economically practical due to redesign of most of the components. The existing pull fused anti-personnel mines would also require redesign of most of the components to replace the fuse with self destruct or self neutralizing features and as such retrofitting of these mines is also not economically practical.

The single or double impulse pressure fused anti-tank mines can be retrofitted with electronic fuses containing self destruct or self neutralizing devices. The cost of such retrofitting would be more than half the original cost of the mine. The tilt rod fused anti-tank mines could be retrofitted with new electronic fusing. The cost of such a retrofit would be more than 70% of the original cost of mine due to replacement of the fuse and modifications to the mine components.

The new influence fused anti-tank mines are generally equipped with either self destruct or self neutralizing features. The passive self deactivation feature is included in some new generation of anti-tank mines.

Based on the information collected during this study and discussions with other international mine manufacturers, the recommendations are as follows:

- Replace existing anti-personnel mines with single impulse pressure fuse and pull fuse with new generation of anti-personnel mines having electronic fuses and self destruct capability. Retrofit of such mines is not economically justified.

- Retrofit existing pressure fused and tilt rod fused anti-tank mines with electronic fuses having either a self destruct or self neutralizing capability.

- Retrofit existing seismic, acoustic or magnetic influence fused anti-tank mines without any special features, with electronic fuses having either a self destruct or self neutralizing capability wherever economically justifiable.

- Consider replacement of these anti-tank mines currently incorporating seismic, acoustic or magnetic influence fuses but without any special features and where retrofitting is not cost effective, with new generation of mines incorporating a programmable self destruct of self neutralizing capability. Consider a passive self deactivation mechanism as an option on these mines.

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1.0 INTRODUCTION

1.1 General Background

In 1980 the United Nations (UN) concluded a "Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which may be deemed to be Excessively Injurious or to have Indiscriminate Effects", also known as the Certain Conventional Weapons or CCW Convention. The CCW convention and its three Protocols restrict or prohibit the use of certain conventional weapons which may be deemed to cause undue suffering or have indiscriminate effects, especially on civilians. One of the protocols of the CCW convention restricts the use of anti-personnel mines, anti-tank mines, remotely delivered mines, boobytraps and other devices.

Canada has ratified the 1980 CCW convention. The United Nations are currently engaged in negotiations to review and amend the 1980 CCW convention, which is likely to place further restrictions on the use of landmines. Canada, through the Department of Foreign Affairs and International Trade (DFAIT) is deeply involved in the United Nations initiative to review and amend the 1980 CCW convention.

The Department of National Defence (DND), because of the military nature of the convention and the potential impact of a revised convention on Canadian Forces activities and doctrine, is a major participant in the Canadian delegation. One of the most likely outcomes of the revision of the convention is that, in the future, all landmines will require relatively sophisticated fuses which will cause the mines to self destruct or self neutralize after a specified time. There is also a possibility of a provision incorporated in the revised convention which will require that all landmines have a passive self deactivation device, which will act as a fail safe backup to the self destruct or self neutralizing device. This will minimize potential danger to innocent civilians in the minefield areas.

Canada currently has no self destruct or self neutralizing landmines in its military inventory. In order to assess the implications for Canada on the various options being presented at the revision to the United Nations Convention, DND contracted SNC Industrial Technologies (SNCIT) a consultant study to investigate the technological and cost implications of retrofitting existing landmines without self destruct or self

neutralizing devices into more modern mines incorporating sophisticated fuses with self destruct or self neutralizing devices and passive self deactivation devices. This consultant study contract was issued by DND to SNCIT on 1 October 1994 with completion of the study and submission of final report on or before 15 December 1994.

SNC Industrial Technologies Inc. is the only manufacturer of military ammunition and landmines in Canada for the Department of National Defence. SNCIT is designated as the preferred source of supply in Canada and to be the center in Canada for the maintenance and further development of industrial defence capabilities in the production facilities, as well as the necessary technical knowledge, research and development relating to ammunition products for DND. The company has research and development capabilities with expertise in aeromechanics, energetic materials and materials engineering technologies. The company has manufacturing capabilities on diversified ammunition products. Because of its participation in a number of NATO projects and studies and manufacture of various types of ammunition products for DND, the company has established a close working relationship with a number of European and United States companies involved in the development and manufacture of defence products. SNCIT works closely with Canadian Defence Research Establishments on technology development projects and with DND on product development, technology transfer for new munitions and manufacture of military ammunition for DND. The company has extensive experience in the manufacture and assembly of conventional landmines. This experience together with its special business relationship with DND and contacts with international companies are used in the conduct of this study.

1.2 Scope of the Study

The scope of the study involved analysing the existing landmines in the Canadian Forces inventory and the landmines on a worldwide basis and document the technological challenges associated with retrofitting these mines with fusing mechanisms incorporating self destruct or self neutralizing mechanisms. In addition, the technological challenges associated with incorporation of passive self deactivation device, as a fail safe backup to the self destruct or self neutralizing device, are also analyzed. A rough order of magnitude costs associated with retrofitting the existing landmines with self destruct or self neutralizing devices are also included.

The following categories of mines are considered for this study:

- Anti-Personnel Mines

  - Single impulse pressure fused anti-personnel mines
  - Pull fused anti-personnel mines

- Anti-Tank Mines

  - Single or double impulse pressure fused anti-tank mines
  - Tilt rod fused anti-tank mines
  - Magnetic, acoustic or seismic influence fused anti-tank mines

- Remotely delivered mines

  These are mines delivered by artillery, mortar, missile, rocket, or similar means, or dropped from aircraft.

- Other devices

  These are mines emplaced by manual or mechanized means and are actuated by remote control or automatically after a lapse of time, such as off-route mines with anti-tank or anti-personnel capabilities.

1.3 Methodology

SNC Industrial Technologies through its working relationship with the Department of National Defence and through its business contacts with international companies involved with defence products acquired information on landmines from the following sources:

- Information from DND and DFAIT experts
- Information available at SNC Industrial Technologies
- Information from international companies associated with mines
- Information from Jane's Information Group

1.3.1 Information from DND and DFAIT Experts

At the beginning of the study, discussions were held with Director Military Engineering (DMILE) to review the strategy for conducting the study and to obtain information from DND experts. DMILE is also the contracting authority and the Project Officer responsible for all matters concerning the technical contents of the work. The technical reports and publications on landmines available at DND were accessed through Defence Science Information Services (DSIS) from the existing data base. Information on Canadian landmines and worldwide existing landmines was obtained through meetings with Director Ammunition Clothing and Materiel Engineering (DACME), Director Armament Operation Explosive Safety (DAOES) and DMILE.

Visits were made to Defence Research Establishment Valcartier (DREV) and Defence Research Establishment Suffield (DRES) to meet with scientists to discuss and gather information on landmines in general and fusing mechanisms in particular. During the visit to DRES, a meeting was held with representatives of the School of Military Engineering, Canadian Forces Base Chilliwack, to discuss the user perspective on the handling of landmines.

Information on the revisions to the CCW convention was obtained from the DFAIT experts by attending a workshop on Convention on Conventional Weapons: Verification, Confidence Building and Landmine Retrofitting, held in Ottawa in October, 1994.

1.3.2 Information available at SNCIT

SNCIT manufactured some of the landmines used by DND. Technical information data packages and the cost to manufacture these conventional landmines are available at SNCIT. In addition, SNCIT collected information on some sophisticated landmines with self destruct and self neutralizing devices through a marketing study conducted in 1990 to assist DND. The information available through this marketing study is also used.

1.3.3 Information from International Companies

Through the international business contacts of SNCIT, a list of major companies which manufacture mines and fuses, and a point of contact at each of these companies was established. A questionnaire on landmines to collect some key data, especially on fusing mechanisms, was prepared and sent to these companies. A copy of the questionnaire is enclosed in Annex A. This questionnaire also permitted to obtain some current trends in mine technologies. A summary of the replies from these companies is shown at Annex B. Following the reply from these companies, some were contacted for more details about the technical and cost implications of retrofitting existing landmines with self destruct, self neutralizing and passive self deactivation devices.

1.3.4 Information from Jane's Information Group

A short study contract was issued by SNCIT to Jane's Information Group in United Kingdom to provide a comprehensive data base on the landmines available worldwide. The findings of the study from Jane's Information Group are included at the end of this report.

2.0 DEFINITION OF TERMS

This section presents general definition of terms used in this report. Some of the definitions are from "Chairman's Rotating Text of the CCW Conference Held in Geneva in August 1994" and these are indicated by [CCW] at the end of the definition.

2.1 Landmine

"Mine" means a munition placed under, on or near the ground or other surface area and designed to be exploded by the presence, proximity or contact of a person or vehicle [CCW].

"Anti-Personnel Mine" means a mine designed to be exploded by the presence, proximity or contact of a person and that will incapacitate, injure or kill one or more persons [CCW].

"Anti-Tank Mine" means a mine designed to be exploded by the presence, proximity or contact of a tank or other vehicles and that will immobilize a tank or a vehicle by destroying the tracks or wheels or by penetrating the vehicle thereby causing death of the occupants.

"Remotely Delivered mine" means a mine not directly emplaced but delivered by artillery, missile, rocket, mortar or similar means, or dropped from an aircraft [CCW].

"Other Devices" means manually emplaced munitions and devices designed to kill, injure or damage and which are activated by remote control or automatically after a lapse of time [CCW].

"Minefield" is an area in which mines have been emplaced [CCW].

2.2 Kill Mechanism

"Kill Mechanism" means a mechanism used in a mine to kill or immobilize a person or vehicle. This is achieved by detonating a main explosive charge to create a blast or lethal fragments or project a metal slug or jet to penetrate the target.

"Explosive Train" means a sequence by which the initiation of a detonator is carried through the booster charge into the main explosive charge.

"Shaped Charge" means a cylinder of explosive with a hollow cavity at one end and a detonator at the opposite end. The hollow cavity is lined with a thin layer of metal, glass or ceramic in the form of a cone. The liner is accelerated as a jet at very high speed when the explosive charge is detonated.

"Explosively Formed Projectile" or "EFP" means a cylinder of explosive with a hollow cavity at one end and a detonator at the opposite end. The hollow cavity is lined with a thin layer of metal in the form of a dish. The liner is accelerated at high speed in the form of a projectile or metal slug when the explosive charge is detonated.

2.3 Fuse

"Fuse" means a device used to initiate the explosive train in the mine based on an external stimulus.

"Safe and Arming Mechanism" means a device which is part of the fuse and designed to arm the mine prior to its use. Usually, the mine is armed while laying in the minefield.

2.4 Anti-Handling Device

"Anti-Handling Device" means a device by which a mine will explode when an attempt is made to remove, neutralize or destroy the mine [CCW].

"Boobytrap" means any device or material which is designed, constructed or adapted to kill or injure, and which functions unexpectedly when a person disturbs or approaches an apparently harmless object or performs an apparently safe act [CCW].

2.5 Destruction, Neutralizing and Deactivation Mechanisms

"Self destruction mechanism" means an incorporated automatically functioning mechanism which secures the destruction of a munition [CCW].

"Self neutralizing mechanism" means an incorporated automatically functioning mechanism which renders a munition inoperable [CCW].

"Self deactivation" means automatically rendering a munition inoperable by means of the irreversible exhaustion of a component that is essential to the operation of the munition [CCW].

2.6 Generations of Mines

"The first generation" of mines are those having relatively simple mechanical fuses.

"The second generation" of mines are those having mechanical fuses with safe and arming mechanism.

"The third generation" of mines are those having electronic fuses which render them to incorporate self destruct or self neutralizing mechanisms.

3.0 LANDMINES AND FUNCTIONING MECHANISMS

The landmines considered in this study include anti-personnel mines, anti-tank mines, remotely delivered mines and other devices. The mines are traditionally used by organized military units as obstacles to the movement of troops and military vehicles.

Anti-personnel mines are designed to explode by the proximity or contact of a person and incapacitate, injure or kill one or more persons. The anti-personnel mines are effective based on either blast effects or projection of lethal fragments. The blast effects type of anti-personnel mines trigger the detonation of an explosive charge when a soldier steps on it, causing incapacitation or loss of life depending on the quantity of explosive. Fragmenting type of anti-personnel mines throw a spray of fragments like steel balls or pellets and are triggered by direct contact, pulling or severing a trip wire or command detonation.

Anti-tank mines are designed to immobilize a tank or other military vehicle by destroying the tracks or wheels or by penetrating inside the vehicle thereby incapacitating or killing the occupants. The anti-tank mines are effective based on blast effects caused by a large amount of explosive, or by projecting an explosively formed projectile (EFP) or a jet formed by a shaped charge. The anti-tank mines are mechanically fused to trigger upon contact with the vehicle and primarily incapacitate the vehicle by attack from underneath the vehicle. The new generation of anti-tank mines use magnetic, acoustic or seismic influence fuses.

The anti-personnel or anti-tank mines are laid in a minefield by hand or mechanized vehicles. These mines are either buried or scattered on the ground or in some cases are held above the ground on a support.

Remotely delivered mines are not laid by hand or mechanized vehicle, but are delivered by artillery, mortar, missile, rocket or dropped from an aircraft. These mines are scattered from the air as anti-personnel or anti-tank mines to control a specified area.

Other devices are placed either manually or through mechanized vehicle as anti-personnel or anti-tank mines and are normally activated by command detonation. These include off-route mines used against personnel or vehicles.

The fuse mechanism which will initiate a mine and cause it to explode can take various forms as shown in Figure 1. Some mechanisms require a physical contact between the target and the mine, and others do not as shown in Figure 2. The physical contact can be through pressure exerted on the mine by the target, or by pulling or severing a trip wire. Influence fused anti-tank mines use detection of the target by its magnetic, sound or vibrations signature.

The third generation of mines have electronic fuses with inert indicator, anti-handling facility, programmable laid life, electronic self destruct or self neutralizing capability, countermeasure immunity, remote on and off switching and automatic target selection capability.

A self destruct device in a mine is an automatic functioning mechanism which destroys the mine at the end of its active life. This can be achieved by aligning the detonator with the rest of the explosive train and initiating the detonator and the explosive charge.

A self neutralizing device is an automatically functioning mechanism which renders the mine inoperable and safe for recovery and reuse. This could be achieved be moving the detonator in a misaligned position with respect to the explosive train and initiating the detonator from a firing capacitor. The mine could be reused by refurbishing with a new detonator and reprogramming the sequence.

A passive self deactivation is a mechanism which is independent to the self destruct or self neutralizing device. The passive self deactivation mechanism is designed to automatically render a mine inoperable by means of an irreversible exhaustion of a component that is essential to the operation of the mine. One possible method could be by the battery decay through its shelf life or by accelerating the process through a built in short circuit mechanism.

4.0 ANALYSIS OF WORLDWIDE SITUATION ON LANDMINES

According to the report on international demining prepared by the Office of International Security Operations of United States Department of State, entitled "Hidden Killers-The Global Problem with Uncleared Landmines" published in 1993, there are more than 85 million uncleared landmines scattered in 62 countries and more are being laid each day. Many of these landmines, especially anti-personnel mines are extremely easy to lay but extremely difficult to detect and destroy.

Prior to assessing the technological implications of retrofitting the landmines with special features such as self destruct, self neutralizing or passive self deactivation devices, an analysis was conducted by SNCIT to evaluate the worldwide situation on landmines. The data base used for this analysis was taken from "MCIS", the Mine Countermine Informations System", USA, November 1993; other publications from the United States and Foreign Government documents; technical reports, manufacturers publications and publications in international magazines.

In addition, information obtained from the visits and discussions with Canadian Department of National Defence organizations such as Defence Research Establishments and Canadian Forces Bases was used in this analysis. Further, the replies to the questionnaire sent to manufacturers of landmines (see Annexes A and B) and follow up with some of these companies resulted in additional data that was used in this analysis.

The analysis of the worldwide situation on landmines is presented with respect to the countries grouped in the following three categories:

- NATO countries
- Former Warsaw Pact countries
- Other countries

For each country, the general characteristics of the mines in terms of type of mine, fuse functioning, kill mechanism, main charge explosive, type of casing, explosive weight, total weight, size and any special features are listed.

The general characteristics of landmines in NATO countries are listed in Annex C, in Former Warsaw Pact countries are listed in Annex D and in other countries are listed in Annex E. The percentage distribution of mines according to categories in different group of countries is presented in Table 1. The distribution relates to different types and not to the quantities held in these groups of countries. The number of types and the distribution is based on the information available during the conduct of this study.

For each category of mines in each group of countries, the percentage of each type of mines having special features such as self destruct, self neutralizing or passive self deactivation devices, in each category was calculated and is shown in Table 2.

A statistical analysis was also conducted to determine the percentage distribution of different types of fuse initiation mechanisms, kill mechanisms, main charge explosives, casing materials and special features. The analysis for each group of countries is presented below.

4.1 NATO Countries

Out of a total of 374 different types of mines analyzed in NATO countries, 44% are anti-personnel mines, 44% are anti-tank mines and 12% are other category of mines. The percentage distribution of different types of characteristics is shown in Annex F. The information on the size, total weight and explosive weight for landmines in NATO countries is shown in Table 3.

In general, the anti-personnel category of mines in NATO countries shows a wide variation in size and weight. Over 51% of the mines use non-metallic casings, making them difficult to detect. Fragmentation or blast are the primary kill mechanisms. The majority of these mines are pressure fused or pull fused and some are remote command fused. About 8% of different types of anti-personnel mines have self destruct or self neutralizing devices and few have passive self deactivation devices.

The anti-tank category of mines in NATO countries is larger in size and weight. Over 48% of these mines have non-metallic casings. These mines have blast, EFP or shaped charge as primary kill mechanisms. The majority of these mines are pressure or influence

fused. About 22% of the different types of anti-tank mines have self destruct or self neutralizing devices and a few have passive self deactivation devices.

4.2 Former Warsaw Pact Countries

Out of a total of 181 different types of mines analyzed out in Former Warsaw Pact countries, 45% are anti-personnel mines, 39% are anti-tank mines and 16% are other types of mines. The percentage distribution of different characteristics is shown in Annex F. The information on the size, total weight and explosive weight is shown in Table 4.

The anti-personnel category of mines in Former Warsaw Pact countries has a large variation in size and weight. Over 44% of these mines use non-metallic casings. Fragmentation or blast are the primary kill mechanisms. The majority of these mines are pressure fused or pull fused and some are remote command fused. About 11% of the different types of anti-personnel mines have self destruct devices and few have self neutralizing or passive self deactivation devices.

The anti-tank mines in Former Warsaw Pact countries are larger in size and weight. Over 50% of these mines use non-metallic casings. These mines use blast as a kill mechanism and some use shaped charge as the kill mechanism. The majority of these mines are pressure or pull fused. About 1% of these mines have self destruct devices and few have self neutralizing or passive self deactivation devices.

4.3 Other Countries

Out of a total of 238 different types of mines analyzed out in other countries, 63% are anti-personnel mines, 27% are anti-tank mines and 10% are other category of mines. The percentage distribution of different types of characteristics is shown in Annex F. The information on the size, total weight and explosive weight is shown in Table 5.

The anti-personnel category of mines in other countries has a large variation in size and weight. Over 35% of these mines use non-metallic casings. Fragmentation or blast are

the primary kill mechanisms. The majority of these mines are pressure or pull fused and some are remote command fused. Few of these mines have any special features.

Over 43% of the anti-tank mines in other countries use non-metallic casings. These mines use blast as the kill mechanism and some use a shaped charge as the kill mechanism. The majority of these mines are pressure fused but some are tilt rod or influence fused. About 3% of these mines have self neutralizing devices and a few have self destruct or passive self deactivation devices.

From the analysis of the available information, it may be noted that the percentage of different types of anti-personnel mines is significantly larger than the anti-tank mines in other countries.

5.0 TECHNOLOGICAL IMPLICATIONS OF RETROFITTING EXISTING LANDMINES IN CANADIAN FORCES INVENTORY

The Canadian Forces inventory of landmines consists of three types of anti-personnel mines and four types of anti-tank mines. All these mines have conventional fuses with no special features such as self destruct or self neutralizing or passive self deactivation devices. The landmines in Canadian Forces inventory are listed in Table 6. The anti-personnel mines C3/C3A1 and M18A1 and the anti-tank mine M21 were manufactured in Canada. The rest of the mines were purchased from either the United States, Germany or United Kingdom.

The technological implications of upgrading the existing fusing of the mines in the Canadian Forces inventory to incorporate self destruct, self neutralizing and passive self deactivation devices are presented in this section. A short description and functioning mechanisms of these mines are presented in order to provide necessary background for retrofitting these mines with special features. The information contained in the "Ammunition and Explosive Technical Information" manuals of Department of National Defence is used in the analysis.

Although the Canadian Forces inventory is used as the basis for retrofitting existing landmines, the generic types of mines indicate that the conclusions are relatively applicable to other similar mines in worldwide inventory.

5.1 Anti-Personnel Mines in Canadian Forces Inventory

The physical characteristics of anti-personnel mines in the Canadian Forces inventory are listed in Table 7.

5.1.1 Single Impulse Pressure fused Anti-Personnel Mine C3/C3A1

A single impulse pressure fused anti-personnel mine C3 is shown in Figure 3. The mine consists of a small shaped charge explosive activated by a pressure fuse and contained in a non-metallic casing. The C3 mine has a metal detector ring which is attached to the mine. A later version of this mine is designated as C3A1, where the metal detector ring can be removed during laying of the mine. The mine C3A1 is shown in Figure 4.

The functioning of the C3/C3A1 is shown in Figure 5. The fusing mechanism has a detonator, a firing pin holder, a cylindrical support, steel balls and a spring which are all contained in an upper and lower body casings. When a person steps on the mine, a force of 8 to 50 kg is applied to the top of the mine. This pushes the charge, the detonator holder and support down against the spring, thereby releasing the two steel balls which fall into the bottom of the casing. This allows the spring to reassert itself and forces the firing pin into the detonator which initiates the main charge. For training purposes, a practice mine C4 is used and is shown in Figure 6.

The size of the mine is small, about 5.1 cm in diameter and 7.6 cm in height. The retrofit of the C3/C3A1 mine with a self destruct or self neutralizing mechanism would require replacing the existing mechanical fuse which is smaller in diameter compared to its height, with an electronic fuse which has a totally different size configuration i.e large in diameter and relatively small in height. The electronic fusing mechanism adaptation would require a redesign of the main charge holder and upper body casing to include a safety and arming device and the lower body casing and the firing mechanism to include either a self destruct or self neutralizing device. All design modifications may lead to only one reusable component of the existing C3/C3A1 mine, which will be the explosive charge. At this time, no passive self deactivation devices are available on the market that would fit the C3/C3A1 mine. More space will have to be allocated if a passive self deactivation device is to be incorporated with a self destruct or self neutralizing device.

It would be possible to design new electronic fuses that are relatively smaller in diameter compared to the height, so that these fuses can be fitted in the configuration of existing anti-personnel mines. However, this will require extensive design and qualification of the new fuses and the retrofitted mine, which may not be an economically practical solution.

Based on the technology available at this time and from economical consideration, it would be more realistic to replace the existing C3/C3A1 anti-personnel mine with a new generation of single impulse pressure fused anti-personnel mine containing a built in self destruct device. Such mines are available on the world market.

5.1.2 Pull fused or Pressure fused Anti-Personnel Mine M16

The M16 anti-personnel mine is a jumping, fragmentation type mine which is pull fused or pressure fused, and is shown in Figure 7. The mine consists of an explosive charge contained in a cylindrical metal body which in turn is enclosed in an outer casing. A three prongs pressure fuse and trip wires are attached to the top of the mine. When a trip wire is pulled, the pull ring pulls the release pin outwards against its spring, thus bringing the large hole in line with the firing pin.

Similarly when a desired pressure is applied on any of the three prongs of the fuse, the pressure spring is compressed thereby forcing the trigger pin downward. The wedge shaped tip of the trigger pin forces the release pin thereby aligning the large hole with the firing pin. The firing pin spring forces the firing pin on to a primer, causing it to ignite the delay charge. This ignites the propelling charge which ejects the mine upwards and the wire attached between the body and outer casing of the mine initiates the detonator and therefore the main explosive charge. Figure 8 shows the pull fuse used on mine M16. Details of the anti-personnel mine M16A2 are shown in Figure 9.

The retrofit of the M16 anti-personnel mine with a self destruct or self neutralizing device would require changing the fusing mechanism in order to include a safety and arming device and a redesign to the inside body and outside casing to accommodate a misalignment mechanism. The misalignment mechanism will require modifications to the explosive train located in the inner body. Based on the discussions with other mine manufacturers, it could be possible to incorporate a self destruct device in the existing M16 mine with considerable modifications to the fuse and explosive train. Incorporating a self neutralizing or a passive self deactivation device would be a difficult task and may require a major redesign of the mine.

5.1.3 Remote Command fused Anti-Personnel Mine M18A1

The M18A1 Claymore anti-personnel mine is a directional fragmentation mine and is shown in Figure 10. The mine has a main explosive charge behind the steel balls enclosed in a plastic casing. The mine is deployed above the ground on a support. The mine is command detonated which involves the use of an electrical firing device actuated

by a soldier, that is a person in the loop. Actuation of the firing device provides sufficient electrical energy to the blasting cap which in turn detonates the explosive charge. The assembly of the mine is shown in Figure 11. A practice version of the mine is shown in Figure 12.

Since there is a person in the loop to initiate the explosive train, a self destruct or self neutralizing device is not necessary unless the mine can be boobytrapped. The boobytrapping will involve a pull fused device. In such a case, a self destruct or self neutralizing device can be incorporated to the pull fuse used for boobytrapping.

5.2 Anti-Tank Mines in Canadian Forces Inventory

The physical characteristics of the anti-tank mines in the Canadian Forces inventory are listed in Table 8.

5.2.1 Single Impulse Pressure fused Anti-Tank Mine Mk7A1

A single impulse pressure fused anti-tank mine Mk7 is shown in Figure 13. The mine consists of a large explosive charge contained in a casing and is initiated by a pressure fuse attached at the top of the casing. When a tank moves over the mine, the pressure plate is depressed, which in turn releases the exploder spring, which activates the firing pin and thereby the explosive train. A general explosive train mechanism is shown in Figure 14.

The retrofit of the Mk7 mine will involve replacing the pressure fuse with an electronic fuse containing a self destruct or self neutralizing device. The new electronic fuse could be fitted in the existing fuse well.

5.2.2 Single or Double Impulse Pressure fused Anti-Tank Mine M15

The M15 mines are originally provided with a double impulse pressure fuse which could also be turned into a single impulse pressure fuse by means of a mechanical nut crusher mechanism. Figure 15 shows a cross section of the M15 anti-tank mine. The pressure fuse is located on the centerline axis and slightly above the top of the mine, while the

explosive train is located under the pressure plate mechanism. When the shutter of the arming plug is in the armed position, a force applied on the pressure plate of the mine will depress the pressure plate and the fuse springs will snap into reverse driving the firing pin into the detonator which in turn initiates the booster and thereby the main charge.

Retrofitting of the M15 anti-tank mine will require replacing the pressure fuse with an electronic fuse having a self destruct or self neutralizing device. Intertek Laboratories Inc. in United States has done a mine modernization program by replacing the pressure fuse with a IL-115A mine fuse (Figure 16). The modified mine is shown in Figure 17. The pressure fuse is changed to a seismic/magnetic influence detection fuse which is directly adaptable to the M15 mine. The fuse is programmable with a self neutralization time. The mine is then field recoverable and reusable.

5.2.3 Tilt Rod fused Anti-Tank Mine M21

A cross section of the tilt rod fused anti-tank mine M21 is shown in Figure 18. The mine is fitted with a mechanical fusing which incorporates an expelling charge used to drive a firing pin, a delay in order to allow the tank to move further for a belly attack. The basic principles of a tilt rod mechanism are shown in Figure 19. The M21 tilt rod mechanism is located outside and above the mine casing, while the expelling charge, the delay and the booster are located on the centerline axis. The mine is equipped with a safety pin on the tilt rod mechanism to prevent accidental initiation. The tilt rod mechanism is no longer popular, since the rod is easy to locate from a distance.

The retrofit of the M21 mine would require a change to the tilt rod mechanism, the expelling charge and the explosive train. These modifications would lead to reusing only the main explosive charge and the mine body. The entire tilt rod fusing mechanism and firing train could be retrofitted with an electronic impulse pressure fuse or an electronic influence fuse with self destruct or self neutralizing devices.

5.2.4 Single Impulse Pressure fused Anti-Tank Mine DM21

A cross section of the pressure fused anti-tank mine DM21 is shown in Figure 20. A cross section of the fuse DM1001 used in the mine is shown in Figure 21 and details of the arming plug are shown in Figure 22.

The DM21 mine consists of an aluminum casing containing the explosive charge and the pressure fuse DM1001. The fuse is inserted into the mine casing immediately before laying the mine. The DM1001 is a mechanical pressure fuse equipped with an ignition chain interrupter regulated by a clockwork and a lock of the firing pin. When the arming lever is turned from position S to F, the clockwork starts to run and after approximately 5 minutes the detonator is aligned with the booster charge. When a pressure is applied by a tank or the tipping cover of the mine housing, the firing pin is released thereby initiating the explosive train.

The retrofitting of the DM21 mine would involve replacing the fuse and the explosive train with an electronic pressure fuse having a self destruct or self neutralizing device.

6.0 TECHNOLOGICAL IMPLICATIONS ASSOCIATED WITH RETROFITTING OF EXISTING LANDMINES WORLDWIDE

The following section describes the technological implications associated with retrofitting existing landmines worldwide with self destruct or self neutralizing devices and with incorporation of passive self deactivation device. Since the technological implications of replacing the existing fuse mechanisms on landmines in Canadian Forces inventory have been discussed on a specific item basis in section 5.0, only general technological challenges will be presented for worldwide landmine.

6.1 Anti-Personnel Mines

6.1.1 Single Impulse Pressure fused Anti-Personnel Mines

The single impulse pressure fused anti-personnel mines are classified as either ground emplaced or scatterable and are characterized as very small and relatively cheap devices which are used in large quantities. The first and second generation of anti-personnel mines have relatively simple mechanical fusing incorporated in mine body casings of relatively small diameter compared to their height. On the other hand, the third generation of anti-personnel mines are built with electronic components in the fusing mechanism which are much flatter as shown in Figure 23.

The analysis performed on the worldwide situation on landmines and presented in section 4.0 shows that the first and second generation of single impulse pressure fused anti-personnel mines worldwide have similar limitations like the C3/C3A1 mines. Retrofitting these mines with either a self destruct or self neutralizing device would require a major redesign of the mine thereby limiting the reuse of existing components. It would be more realistic to replace the existing first and second generation anti-personnel mines with a new generation of mines having self destruct devices.

In the case of the third generation electronic single impulse pressure fused anti-personnel ground emplaced or scatterable mines, the electronic fusing can be equipped with self destruct or self neutralizing devices as shown in Figure 24.

6.1.2 Pull fused Anti-Personnel Mines

The pull fused anti-personnel mines include both jumping and directional fragmentation mines. The first generation of jumping anti-personnel mines similar to the M16A1/A2 mines in Canadian inventory, were built in such a way that a load on one of the trip wires or a direct pressure on the fuse prongs would activate the fuse. Most of the latest generation of jumping anti-personnel mines are still built using exactly the same functioning principles and type of components (see Figure 25). The differences reside in new safety features, operational and functioning mechanisms that are added to improve such mines. For instance, some scatterable electronic jumping mines are now equipped with a safety and arming device, safety time of a few minutes needed to elapse before three trip wires will be automatically ejected by the fuse and a primer detonator misalignment in the fuse until the mine is activated. On activation, the primer train will first align followed by the initiation of the primer and ejection of the mine explosive body. Some electronic jumping mines are also provided with a programming active life time for self neutralization. When the pre-set life time is elapsed, the primer is fired in the misaligned or safe position, this causes an external steel belt to be released and a red band or marker to be displayed, thus indicating a state of neutralization from a distance. The electronic jumping mines are slightly larger in dimensions than first generation mines not equipped with safety and arming device, primer misalignment and self neutralizing devices (see Figure 26).

The retrofit of first generation of jumping anti-personnel landmines similar to the M16A1/A2, with a self destruct or self neutralizing device would require changing the fusing mechanism in order to include a safety and arming device and redesigning the outside and internal bodies to accommodate a misalignment mechanism. The misalignment mechanism will bring modifications on the explosive train located in the internal body while the self destruct or self neutralizing feature will be integrated into the fuse. In the case of a self neutralizing fuse, the display device will be controlled by the fuse but its mechanism will have to be built as part of the internal or outside body. These modifications will affect the entire mine design. Based on literature, no self destruct and/or passive self deactivation devices are available at this time for jumping anti-personnel mines but after discussions with landmine manufacturers, it is found that

some jumping anti-personnel mines could be provided with a self destruct rather than a self neutralizing device.

The directional fragmentation anti-personnel mines could either be pull fused or command detonated which involve the use of an electric detonator actuated by a soldier, i.e a person in the loop. This type of mine is used as anti-personnel and/or anti-vehicle based on the steel ball size and penetration performance. Based on the available literature, no manufacturers have equipped such directional fragmentation pull fused anti-personnel mines with a self destruct, self neutralizing and/or passive self deactivation devices. After discussions with landmine manufacturers, it is assessed that a self destruct or self neutralizing device could be designed and incorporated to such pull fused mines.

6.2 Anti-Tank Mines

6.2.1 Single and Double Impulse Pressure fused Anti-Tank Mines

The first and second generation of single or double impulse pressure fused anti-tank mines are equipped with a simple mechanical fusing mechanism such as the Mk7A1, M15 and DM21 mines used by the Canadian Forces. The third generation of landmines are equipped with a safety and arming device, a misalignment mechanism acting on the detonator in respect with the rest of the explosive train and a self destruct or self neutralizing device. Such impulse pressure fused anti-tank mine is shown in Figure 27.

This first generation fusing mechanism could be replaced by an electronic fuse incorporating a self destruct or self neutralizing device which could fit the available space since the electronics require less space than any mechanical impulse devices (see Figures 28 and 29). The retrofit would also require to design an adaptor in order to fit the new electronic fuse with the current casing and to redesign the explosive train to insure proper initiation of the main explosive charge. Such retrofit with electronic impulse pressure fuses would also mean these anti-tank landmines will still only be active on vehicle tracks or wheels. If an electronic fuse equipped with a self neutralizing device and an expelling charge for neutralization and position identification were used to retrofit first and second generation of landmines, the size of such fusing system would be more voluminous than

the actual mine fuse wells. This would lead to the use of an external electronic fusing mechanism.

Existing mechanical single or double impulse pressure fused anti-tank mines which have been retrofitted, are mainly equipped with magnetic influence fusing mechanism in order to be effective on a full width rather than on the vehicle tracks, as shown in Figure 30.

6.2.2 Tilt Rod fused Anti-Tank Mines

The tilt rod fused anti-tank mines are equipped with a mechanical fusing mechanism which incorporates an expelling charge used to drive a firing pin, a delay in order to provide the armoured vehicle to move further and perform a belly attack, a metallic casing, a booster and a main charge like the M21 mines in Canadian inventory. Today, such tilt rod fusing mechanisms are not manufactured anymore and from a tactical point of view, the rod is very easy to locate from a distance thereby revealing the exact position of the mine.

The whole mechanical tilt rod fusing mechanism could be retrofitted with an electronic impulse pressure or magnetic influence fuse and the explosive train would require to be redesigned accordingly in order to insure proper initiation of the main explosive charge. The electronic fuse selected would probably be slightly above the top surface of the mine body and would require to fit the existing fuse well threads.

6.2.3 Magnetic, Acoustic or Seismic Influence fused Anti-Tank Mines

The magnetic, acoustic and seismic influence fused anti-tank mines are mainly classified as the third generation of landmines since they are already equipped with electronic timers, clocks and discriminating pre-set values for influence signals (see Figures 31 and 32). The second generation of influence fused anti-tank mines were built to reply to one influence only while the third generation of mines are equipped with fuses incorporating dual influence signals which could either be magnetic and seismic or magnetic and acoustic in order to clearly discriminate the designated targets. Such influence fused anti-tank mine is shown in Figure 33.

Based on the fusing mechanism design, the retrofit of the second generation of influence fused mines with a self destruct or self neutralizing device, could either be feasible or almost impossible to achieve. In most cases, the retrofit would require many design modifications in order to incorporate the new electronic fuse and sensors, that it would be more realistic to buy a complete third generation influence fused mine. These landmines are also built in such a way that all the electronic components are integrated at different locations into the mine body which would probably require the redesign of the mine body. It would also be impossible to retrofit these landmines with new electronic fuses equipped with a self neutralizing device which indicates its neutralization and position by displaying or ejecting any visible marker because such new fusing mechanism would be larger in dimensions than the actual space available as shown in Figure 34.

It should be noted that some of the third generation of dual influence fused mines with a self neutralizing device are also equipped with a built in neutralization and position indicator (see Figures 35, 36 and 37).

6.3 Remotely Delivered Mines

Some of the anti-personnel and anti-tank mines are delivered by artillery, rocket or aircraft. For example, the Area Denial Artillery Ammunition (ADAM) is delivered from a 155 mm howitzer and contains 36 anti-personnel mines per projectile (see Figure 38). These mines have electronic circuits for self destruct timing. The Remote Anti-Armour Mine (RAAM) is delivered from a 155 mm howitzer and contains 9 mines per projectile. The AT2 anti-tank mine is used in the Light Artillery Rocket System (LARS) delivered from a 110 mm rocket and under development for use in the Multiple Launch Rocket System (MLRS). The AT2 anti-tank mine is shown in Figure 39.

The GATOR mine is carried in a dispenser on a fixed wing aircraft and contains both anti-personnel and anti-tank mines. These mines contain a self destruct selector switch.

6.4 Other Devices

The off-route mines and wide area mines can be classified under other devices. The off-route mines (see Figure 40) are equipped with wake up devices and tracking features.

The Wide Area Mine (WAM) has a ground sensor which detects and tracks a target. The mine is launched with a gas generator for a distance of up to 100 meters. The scanning sensor on the mine detects the target as it flies over it and then fires the top attack warhead (see Figure 2).

The retrofit of off-route mines with self destruct or self neutralizing devices would require to integrate such features to the existing fusing mechanism and to redesign the mine body in order to allocate more space. In some cases, the whole fusing mechanism may have to be replaced. Based on the available literature, no passive self deactivation or position and neutralization indicator or marker have been designed or are available with a self neutralizing device for such mines.

7.0 COST IMPLICATIONS OF RETROFITTING EXISTING LANDMINES

The cost implications of retrofitting existing landmines are based on the information available on landmines in Canadian Forces inventory, the cost of new electronic fuse to incorporate a self destruct or self neutralizing feature, the development cost associated with the upgrade of the existing mine and where possible the cost of a new replacement mine. The cost is based on a quantity of 5000 units. At this time, the cost implication associated with passive self deactivation device is not provided due to lack of information on such devices. All costs are expressed in 1994 Canadian dollars.

The cost estimates of retrofitting existing landmines include the cost of redesign and modifications to the existing mine components, the cost involved in the evaluation of the modification, the cost of new packaging and the cost of testing and qualification of the modified product. The cost of new electronic fuse is obtained from the electronic fuse manufacturers. The cost also includes the material and manufacturing required to upgrade the mine at the manufacturers' facilities.

7.1 Anti-Personnel Mines

7.1.1 Single Impulse Pressure fused Anti-Personnel Mines

The technological implications of retrofitting C3A1 anti-personnel mine are discussed in section 5.1.1. The retrofitting would involve redesign of all components except the main charge in order to integrate an electronic fusing mechanism with a self destruct or self neutralizing device. In addition the upgraded mine will have to be qualified for safety and suitability for service. The current cost of the C3A1 mine is about $40. It would be more realistic to replace the existing C3A1 mine with a new anti-personnel mine equipped with a self destruct device that will cost about $130.

7.1.2 Pull fused Anti-Personnel Mines

In the case of M16A1/A2 pull fused jumping anti-personnel mine, the retrofit would involve redesign of all components. It is advisable to replace the M16A1/A2 mines with a new generation of pull fused jumping anti-personnel mine equipped with a safety and

arming, misalignment of the detonator in the explosive train and a self destruct or self neutralizing device. Such a mine would cost about $260.

7.1.3 Remote Command fused Anti-Personnel Mines

The directional fragmentation M18A1 anti-personnel mine is mainly initiated with an electric detonator and initiated with remote command from an operator. These directional fragmentation anti-personnel mines can be boobytrapped using trip wires and pull fused mechanism.

The current cost for a kit containing M18A1 mine, M4 or M6 detonator with over 100 feet of electrical cable and a handheld pulse generator is approximately $350. The retrofit of the mine with a self destruct or self neutralizing device would involve an additional cost of $200 and a development cost of $1.2 million.

7.2 Anti-Tank Mines

7.2.1 Single or Double Impulse Pressure fused Anti-Tank Mines

Retrofitting of M15 anti-tank mine would involve replacing the pressure fuse with an electronic fuse having a self destruct or self neutralizing device. The fuse will be changed to magnetic influence fuse and will be programmable with a self destruct or self neutralization time. The cost of retrofit would involve $450 per mine and a development cost of $1.8 million.

The costs associated with the retrofit of Mk7 and DM21 anti-tank mines would be similar to that of M15.

7.2.2 Tilt Rod fused Anti-Tank Mines

The current cost of tilt rod fused anti-tank mine is about $350. The retrofit of this mine would require redesign to the explosive train and replacement of the mechanical fuse with an electronic fuse incorporating a self destruct or self neutralizing device. The cost of retrofit would be $400 per mine and a development cost of $1.4 million.

7.2.3 Magnetic, Acoustic or Seismic Influence fused Anti-Tank Mines

The second generation of influence fused anti-tank mines were designed to activate with only one influence signal, while the later generation contain a dual influence fusing mechanism with sensors set to predetermined values for better target discrimination.

The retrofit of influence fused anti-tank mines with a self destruct or self neutralizing device would be approximately $600. The cost of a new influence fused mine with a self destruct or self neutralizing device would be about $1200.

A summary of cost implication of retrofitting existing landmines is presented in Table 9. A cost of a new mine with a self destruct or self neutralizing device is also presented for comparison. These costs are budgetary and are based on limited information available at this time.

8.0 NEW GENERATION OF LANDMINES AND SPECIAL FEATURES

This section presents current trends in the new generation of landmines equipped with self destruct, self neutralizing and passive self deactivation devices. The new electronic mine fuses provide the capability for the mine to destruct, neutralize or passively deactivate itself in a given time period. Sometimes a combination of mechanical and programmable electronic devices are used in the fuse mechanism to achieve these special features.

8.1 Safety and Arming Devices

Almost all new generation of anti-personnel and anti-tank landmines are now equipped with a transportation safety pin and an arming lever that the operator must remove and rotate before starting the activation procedure. The transportation safety pin prevents accidental removing of the mine arming lever and allows on anti-tank mines a visual check of the mine status by an indicator. The status of the mine can also be checked electronically by means of a remote control equipment (status detector) receiving a particular signal sent from the mine (see Figure 41). The release of the safeties in a predetermined sequence is necessary to arm the mine, otherwise any different operational sequence will lock the mechanism.

The safety and arming device makes the mine safe in all operational conditions. When the mine is not armed, it maintains the explosive train misaligned and locks the contact barrier slide which keeps the firing electric lines of the electro-explosive actuators short circuited. This device is capable of preventing the detonation of the mine, even if the detonator is fired in a misaligned position. This allows the mine to be stored with the detonator inside and to be ready for deployment.

The power supply feeds the electronic circuit when the mine is in the armed position. The subsequent activation given with a programmer remote control device, starts in most fuse designs both an electronic delay and successively a mechanical arming delay. Such anti-personnel and anti-tank mines are radio programmable on a field basis and it is possible only when the mines are in a storage mode with safety on. The programming is mainly performed by induction on either a unitary basis, in the case of a manual laying, using a pocket size single mine programmer or a complete magazine or box of mines all

at one time using a mass programmer. The microprocessor continuously controls the integrity of the mine functioning and the efficiency of the battery which makes the mine fail safe. The electronics also deactivates the mine if any malfunction occurs. These mines can also be programmed with different anti-lifting and life times varying from 1 hour up to 365 days, depending on each fuse manufacturer features, in interval of 1 hour and the anti-removal life time length being always shorter or equal than the mine life time.

The change of the mine's status, from safe to arm conditions will only occur after the arming delay varying from 10 to 30 minutes is elapsed, which may be chosen when ordering the mine and depending on the manufacturers' specifications. Once the transportation safety pin and the arming lever have been removed and the mine activated by a remote control device or by the mine itself, both the mechanical and electronic safety devices still remain. Both these safety systems will be switched off after the arming delay.

The mechanical safety device consists of a shutter mechanism that maintains the detonator separated from the booster by a mechanical barrier while the electronic safety maintains the fire capacitors not charged during the arming delay and the neutralization phase if such option has been previously selected. The alignment occurs only when the mine, previously armed, is triggered by a valid target or, in case of a mine provided with a self destruct feature, at the end of its active life time. When the anti-removal life time is expired, the sensor will disable allowing the mine recovery only if the mine is equipped with a self neutralization device. The mine will self destruct or self neutralize at the end of its active life time according to the selected feature. This feature will have to be selected at the time of manufacture of the mine. The alignment system is composed of a sliding barrier, always kept in misaligned position until a short time before the detonator is fired. This mechanical device aligns the explosive train only if the mine has been properly armed and triggered.

8.2 Fuses

The fuse controls the life of the mine according to the programmed values entered in its memory. The electronic and electrical components are operated by lithium battery which

gives the power supply a shelf life of about 5 years and which could be easily substituted. This cell is capable of feeding all electrical and electronic circuits of the mine at least for the life time specified by the manufacturer. A self neutralized mine may be reused after having been reprogrammed, with or without the need for refurbishing based on the fusing mechanism used and after a battery check is performed. The mine is reusable if a self neutralization device has been selected and it can be recovered at the end of the pre-set life time having checked that it is in safe condition by means of a status detector and by checking the indicator position. The status detector and the mine communicate by radio and messages are coded to avoid jamming. Such mines provided with a self neutralizing mechanism are capable of safely switching off the mine, i.e misalignment of the explosive train and short circuit of the firing lines, without destroying it at the end of its programmed life time.

The main fusing mechanisms used for the third generation of anti-personnel landmines, except for directional fragmentation types, are pressure or pressure and pull (trip wire) activated while the anti-tank landmines could either be pressure or influence activated. Directional fragmentation mines are used as anti-personnel and/or anti-vehicle based on the size of the steel balls and penetration performances. In most cases, such directional fragmentation anti-personnel and anti-vehicle mines do not have any fusing mechanism since they are command detonated. However, some of them could be boobytrapped using trip wires. Such anti-personnel and anti-vehicle mines could also be equipped with a self destruct or self neutralizing device.

Only a few electronic ground emplaced or scatterable jumping anti-personnel mines are equipped with a safety time of about 10 minutes needed to elapse before three trip wires are automatically ejected by the fuse, with an explosive train alignment mechanism and with a self neutralizing device which become active when the active life time has expired. Such electronic jumping anti-personnel mine is shown in Figure 26. Upon self neutralizing activation, the primer is fired in misaligned position causing an external steel belt to be released and a red band to be displayed, thus evidencing neutralization from a distance.

Single or double impulse pressure activated anti-tank landmines are mainly designed to produce a mobility kill by destroying the tracks, the wheels and/or suspension gears of

armoured vehicle while influence fused mines are designed to produce a mobility or a complete kill since they have full width capacities. In the case of anti-tank influence fused mines, magnetic or a combination of magnetic and seismic or acoustic sensors are used. Pressure, magnetic, seismic or acoustic sensor signals are processed and compared with pre-fixed threshold values in order to discriminate targets and to perform maximum damage.

These new designs of anti-personnel and anti-tank landmines are all enclosed in a plastic casing and made of non-magnetic materials which make them water-proof and only detectable by the user and by means of a special detector. They are built to be absolutely insensitive to countermeasures such as steel rollers, explosion waves, Fuel Air Explosive (FAE) devices and magnetic detectors. They are also equipped with anti-shock feature to ensure safe handling and transport and to avoid explosion when accidentally dropped on the ground. Also, few self neutralized anti-personnel and anti-tank landmines are equipped with expelling or displaying mechanism using a red band or any other type of marker indicating neutralization and position as shown in Figures 36 and 37. A necessary feature that is missing in all third generation anti-personnel and anti-tank landmines, is the fact that once the life time of such laid mines has been set (up to a maximum of 365 days) and that for operational or any other reasons the minefield has to be neutralized, there is no way of using remotely controlled devices or other means of deactivation prior to completion of the preset values. In the future it would be possible to have activation and deactivation features which will be incorporated in existing electronic fuses.

Even if new fusing mechanisms are equipped with either a self destruct or self neutralizing device for both anti-personnel and anti-tank mines, it seems the self destruct mechanism is not the most suitable and viable option from an operational and environmental point of view. Such mines equipped with a self destruct mechanism could not be reused or redeployed and they also present a risk for soil contamination.

8.3 Passive Self Deactivation Devices

The passive self deactivation is a totally separate back up feature which is independent of the self destruct or self neutralizing mechanism. Passive deactivation features could

be developed and added to existing electronically built fusing mechanism including self destruct or self neutralizing devices. The activation of such additional features takes place after the short circuit of the capacitor firing lines used to initiate the detonator. One of these passive features could be to electrically feed supplementary capacitors or other devices in order to drain the battery power in a very short period of time. Another method could be to drain the battery power by overloading and destroying some of the electronic components contained in the fuse. It could also simply be natural battery life decay based on the battery shelf life. Passive self deactivation will automatically involve major refurbishing in a maintenance or manufacturing depot, unless the features are designed in such a way that dead battery, overturned electronic circuit board or exploded detonator could be easily substituted on site.

9.0 CONCLUSIONS

The conclusions from this study are as follows:

i) A wide variety of anti-personnel and anti-tank landmines are available on the market. The first generation of mines have simple mechanical fuses; the second generation of mines have mechanical fuses with safety and arming; and the third generation of mines have electronic fuses with programmable features and self destruct or self neutralizing capabilities.

ii) A large majority of anti-personnel landmines are small devices and are activated by single impulse pressure fuses. Retrofitting these existing mines with self destruct or self neutralizing features is not economically practical due to redesign of most of the components.

iii) The existing pull fused anti-personnel mines would also require redesign of most of the components to replace the fuse with self destruct or self neutralizing features. As such, retrofitting of these mines is not economically practical.

iv) The single or double impulse pressure fused anti-tank mines can be retrofitted with electronic fuses containing self destruct or self neutralizing devices. The cost of such retrofitting would roughly be more than half the original cost of mine.

v) The tilt rod fused anti-tank mines could be retrofitted with new electronic fusing. The cost of such a retrofit would be more than 70% of the original cost of the mine due to replacement of the fuse and modifications to the mine components.

vi) The new influence fused anti-tank mines are generally equipped with either self destruct or self neutralizing features.

vii) A passive self deactivation feature is included in some new generation of anti-tank mines.

10.0 RECOMMENDATIONS

Based on the information collected during this study and discussions held with other international mine manufacturers, SNCIT recommendations are as follows:

i) Replace the existing C3 and M16 anti-personnel mines in the Canadian Forces inventory with new generation of anti-personnel mines containing self destruct capabilities.

ii) No changes are required for the remote command fused anti-personnel mine M18, as long as unused mines are recovered after its intended use.

iii) Retrofit pressure fused anti-tank mines Mk7, M15 and DM21 with seismic or magnetic influence detection fuse having programmable self neutralization time.

iv) Retrofit tilt rod fused anti-tank mine M21 with an electronic impulse pressure fuse with a self destruct capability.

v) Retrofit existing seismic, acoustic or magnetic influence fused anti-tank mines without any special features, with electronic fuses having either a self destruct or self neutralizing capability wherever economically justifiable.

vi) Consider replacement of these anti-tank mines currently incorporating seismic, acoustic or magnetic influence fuses but without any special features and where retrofitting is not cost effective, with new generation of mines incorporating a programmable self destruct of self neutralizing capability. Consider a passive self deactivation mechanism as an option on these mines.

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"TS/50, VAR/40 and BM/85 Anti-personnel scatterable and jumping mines, MATS/2, TC/2.4, TC/6, MAT/5, MAT/6, TCE/3.6, TCE/6 and BAT/7 Anti-tank mines, TEC Programmable Igniter, MAL/17 and MAS/22 Anti-landing mines, EPR/2.5 Underwater mine", Tecnovar Technical Manual.

"UNPROFOR Engineer Mine Guide", Prepared by CANENGBAT (1CER) Info Cell.

"VS-MK2, VS-MK2-EL, VS-50, VS-APFM1, VS-SAPFM3, VS-JAP, VALMARA69 and VS-DAFM1 Anti-personnel scatterable and jumping mines, VS_DAFM3 and VS-DAFM6/7 Anti-vehicle mines, VS-16, VS-2.2/3.6, VS-AT4, VS-AT4-EL, VS-HCT2, VS-HCT4, VS-9.0 and VS SATM1 Anti-tank mines, VS-SS-22 Limpet mine, VS-N Igniter, VS-SD1 Status detector, VS-MP1, VS-SP1 and VS-SP2 Multipurpose and secondary programmer", Valsella Technical Manual.

"Worldwide Countermine Systems Database", Countermine Laboratory, Meradcom, 2nd Edition, Jan. 1983.

"XM84 Wide Area Side Penetrating Mine (WASP)", Motorola Inc., Publicity Pamphlet.

TABLES

TABLE 1 - PERCENTAGE DISTRIBUTION OF CATEGORY OF MINES IN DIFFERENT GROUP OF COUNTRIES

CATEGORY OF MINE	PERCENTAGE DISTRIBUTION		
	NATO COUNTRIES	FORMER WARSAW PACT COUNTRIES	OTHER COUNTRIES
Anti-Personnel Mines	44%	45%	63%
Anti-Tank Mines	44%	39%	27%
Others	12%	16%	10%
Total types of mines	374	181	238

TABLE 2 - PERCENTAGE OF TYPE OF MINES HAVING SPECIAL FEATURES IN EACH CATEGORY

CATEGORY OF MINE	PERCENTAGE OF TYPE OF MINES		
	NATO COUNTRIES	FORMER WARSAW PACT COUNTRIES	OTHER COUNTRIES
Anti-Personnel Mines	9%	11%	2%
Anti-Tank Mines	23%	1%	3%
Others	10%	24%	8%

TABLE 3 - INFORMATION ON SIZE, TOTAL WEIGHT AND EXPLOSIVE WEIGHT FOR LANDMINES IN NATO COUNTRIES

CHARACTERISTICS		ANTI-PERSONNEL MINES	ANTI-TANK MINES
SIZE	Average (cm)	11	19
	Variation (cm)	1 to 39	5 to 110
TOTAL WEIGHT	Average (kg)	1.77	6.79
	Variation (kg)	0.02 to 5.00	1.00 to 18.20
EXPLOSIVE WEIGHT	Average (kg)	0.35	4.71
	Variation (kg)	0.01 to 0.69	0.30 to 10.33

TABLE 4 - INFORMATION ON SIZE, TOTAL WEIGHT AND EXPLOSIVE WEIGHT FOR LANDMINES IN FORMER WARSAW PACT COUNTRIES

CHARACTERISTICS		ANTI-PERSONNEL MINES	ANTI-TANK MINES
SIZE	Average (cm)	10	22
	Variation (cm)	3 to 47	7 to 62
TOTAL WEIGHT	Average (kg)	1.57	7.54
	Variation (kg)	0.11 to 10.00	.60 to 15.00
EXPLOSIVE WEIGHT	Average (kg)	0.41	5.36
	Variation (kg)	0.08 to 4.80	0.50 to 7.50

TABLE 5 - INFORMATION ON SIZE, TOTAL WEIGHT AND EXPLOSIVE WEIGHT FOR LANDMINES IN OTHER COUNTRIES

CHARACTERISTICS		ANTI-PERSONNEL MINES	ANTI-TANK MINES
SIZE	Average (cm)	12	20
	Variation (cm)	1 to 40	4 to 38
TOTAL WEIGHT	Average (kg)	2.58	8.64
	Variation (kg)	0.01 to 6.00	2.50 to 14.00
EXPLOSIVE WEIGHT	Average (kg)	1.00	6.28
	Variation (kg)	0.01 to 4.20	1.50 to 10.00

TABLE 6 - LANDMINES IN CANADIAN FORCES INVENTORY

TYPE OF MINE	DESIGNATION	FUSE INITIATION	SOURCE OF SUPPLY
Anti-Personnel Mines	Elsie C3/C3A1 M16/A1/A2 Claymore M18A1	Pressure Pull or Pressure Remote Command or Pull	Canada United States Canada
Anti-Tank Mines	Mk7A1 M15 M21 DM21	Pressure Pressure Tilt Rod Pressure	United Kingdom United States Canada Germany

Notes: None of the above mines have self destruct, self neutralizing or passive self deactivation devices. Anti-Tank mines Mk7A1 and M15 are in very small quantities in Canadian Forces Inventory.

TABLE 7 - PHYSICAL CHARACTERISTICS OF ANTI-PERSONNEL LANDMINES IN CANADIAN FORCES INVENTORY

MINE DESIGNATION	C3/C3A1	M16/A1/A2	M18A1
Total weight (kg)	0.08	3.74/3.74/2.83	1.58
Size (cm)	7.6 (H) 5.1 (D)	19.8 (H) 10.2 (D)	10.6 (H) 22.0 (L) x 3.5 (W)
Fuse designation	-----	M605	-----
Fuse Initiation	Pressure	Pressure / Pull	Remote Command / Pull
Main charge	Tetryl	TNT	C4
Explosive weight (kg)	0.008	0.521/0.513/0.590	0.682
Casing	Plastic	Steel	Plastic
Kill mechanism	Blast	Fragmentation	Fragmentation
Self destruct or self neutralizing or passive self deactivation feature	None	None	None

TABLE 8 - PHYSICAL CHARACTERISTICS OF ANTI-TANK LANDMINES IN CANADIAN FORCES INVENTORY

MINE DESIGNATION	Mk 7A1	M15	M21	DM21
Total weight (kg)	13.6	14.3	7.9	9.26
Size (cm)	13.0 (H) 32.5 (D)	12.5 (H) 33.0 (D)	20.6 (H) 22.9 (D)	9.8 (H) 30.0 (D)
Fuse designation	-----	M603/M608	M607	DM1001
Fuse Initiation	Pressure	Pressure	Tilt Rod	Pressure
Main charge	TNT	Comp B	H6	TNT
Explosive weight (kg)	8.89	10.33	4.9	5.0
Casing	Steel	Metal	Metal	Aluminium
Kill mechanism	Blast	Blast	Blast	Blast
Self destruct or self neutralizing or passive self deactivation feature	None	None	None	None

TABLE 9 - COST IMPLICATION OF RETROFITTING EXISTING LANDMINES

MINE	CURRENT COST	RETROFITTING COST	ADDITIONAL DEVELOPMENT COST OF RETROFITTING	NEW MINE REPLACEMENT COST
C3A1 Single impulse pressure fused anti-personnel mine	$40	*	*	$130
M16A1/A2 Pull fused jumping anti-personnel mine	$60	*	*	$260
M18A1 Command fused directional fragmentation anti-personnel mine	$350	$200	$1.2M	N/A
M15 Pressure fused anti-tank mine	$650	$450	$1.8M	$1200
Mk7 Pressure fused anti-tank mine	$150	$450	$1.8M	$1200
DM21 Pressure fused anti-tank mine	$1100	$450	$1.8M	$1200
M21 Tilt rod fused anti-tank mine	$350	$400	$1.4M	$1200
Influence fused anti-tank mine	$1200	$600	$1.8M	$1200

Notes: The cost are budgetary in 1994 Canadian dollars.
Range costs for testing are not included in development cost.
* Retrofit is not economically justifiable.

FIGURES

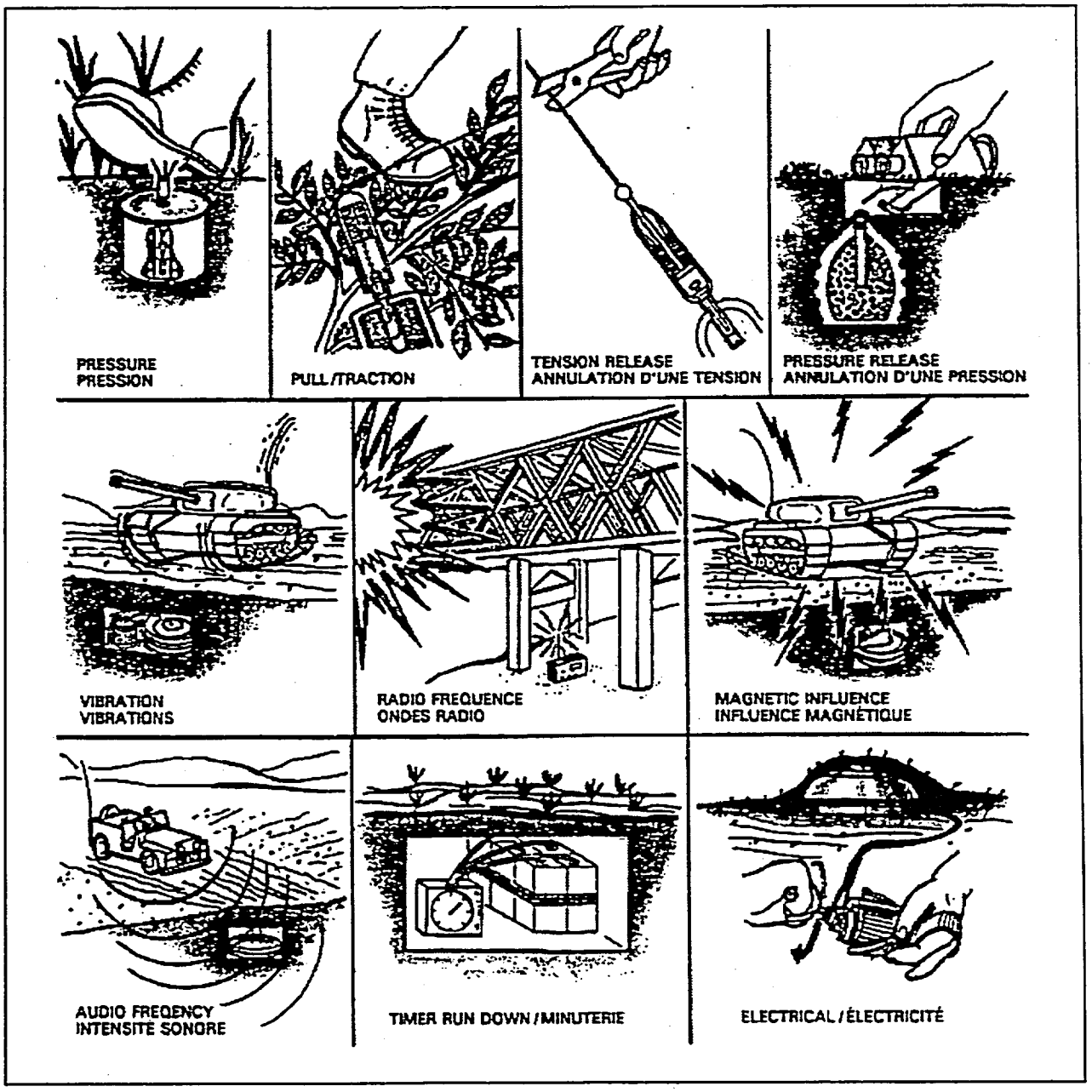


FIGURE 1 - DIFFERENT TYPES OF FUSE INITIATING ACTIONS FOR LANDMINES

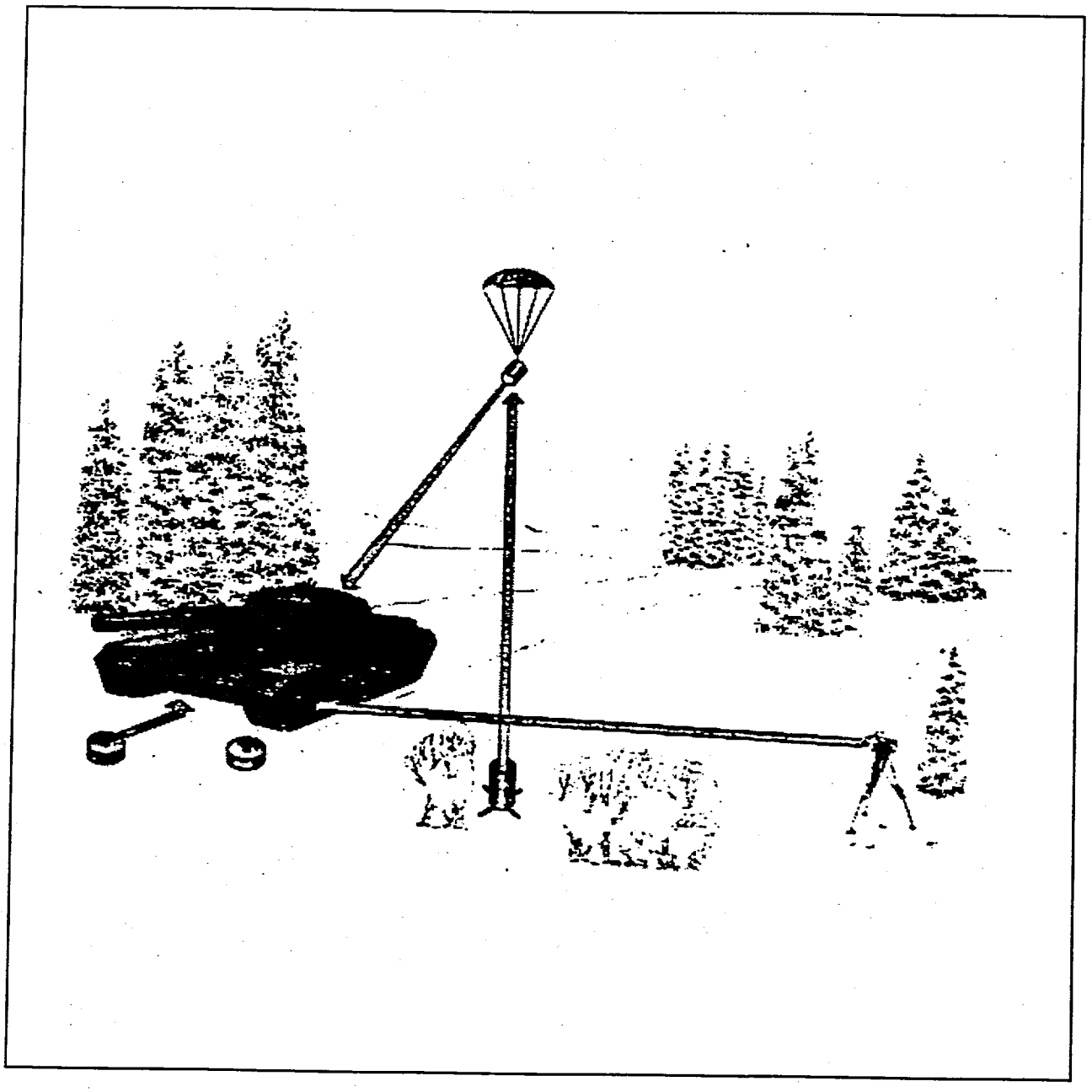


FIGURE 2 - ANTI-TANK OPTIONS: FULL-WIDTH ATTACK, TRACK-CUTTING, OVERHEAD TOP ATTACK, OFF-ROUTE SIDE ATTACK

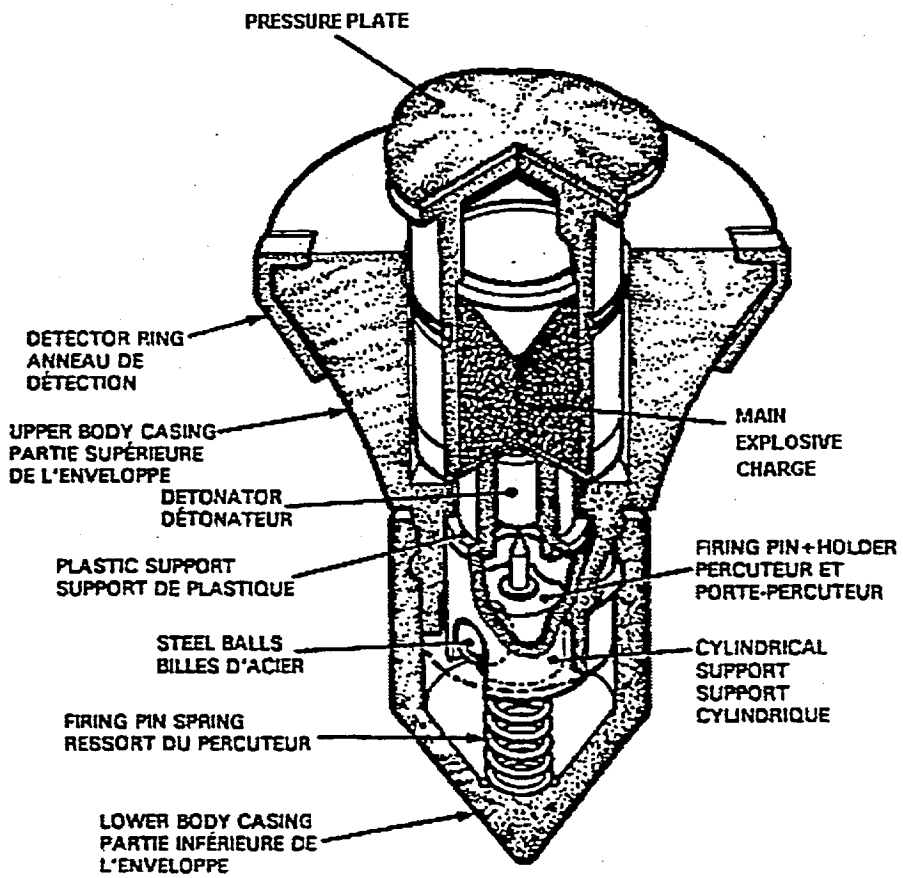


FIGURE 3 - ANTI-PERSONNEL MINE C3 - SECTIONAL VIEW WITH NON-METALLIC CASING

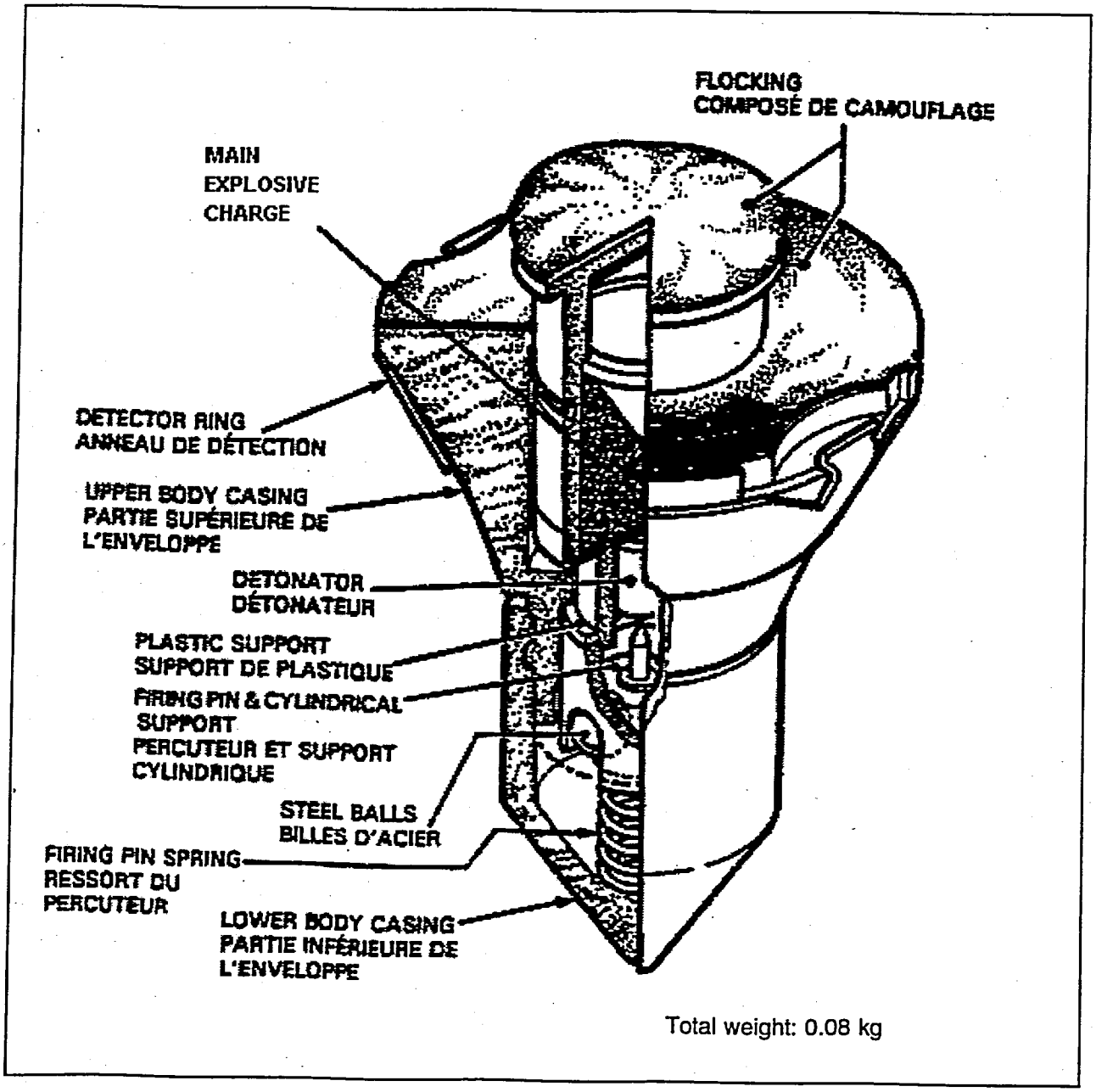


FIGURE 4 - ANTI-PERSONNEL NON-METALLIC MINE C3A1

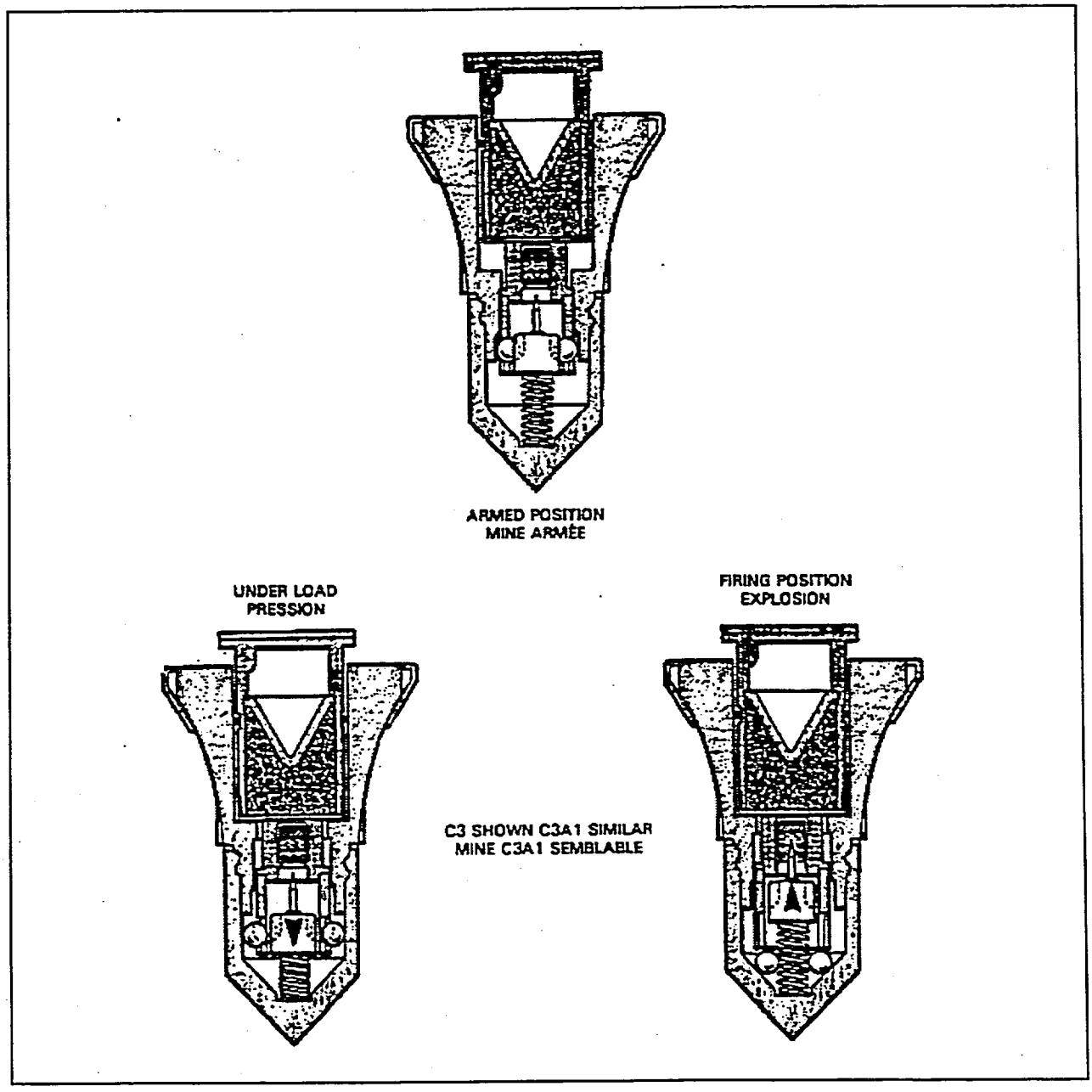


FIGURE 5 - FUNCTIONING OF ANTI-PERSONNEL MINE C3 AND C3A1

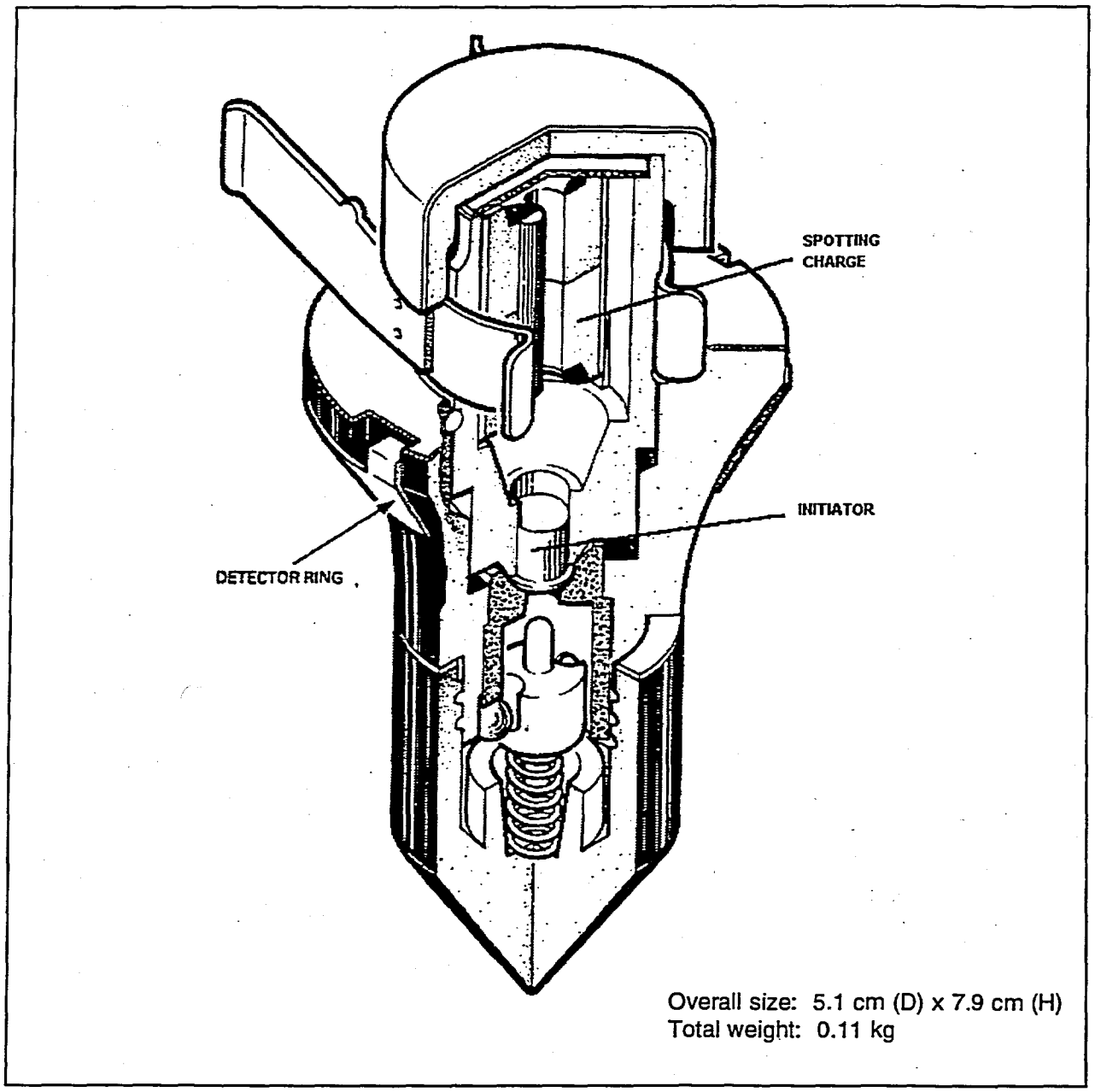
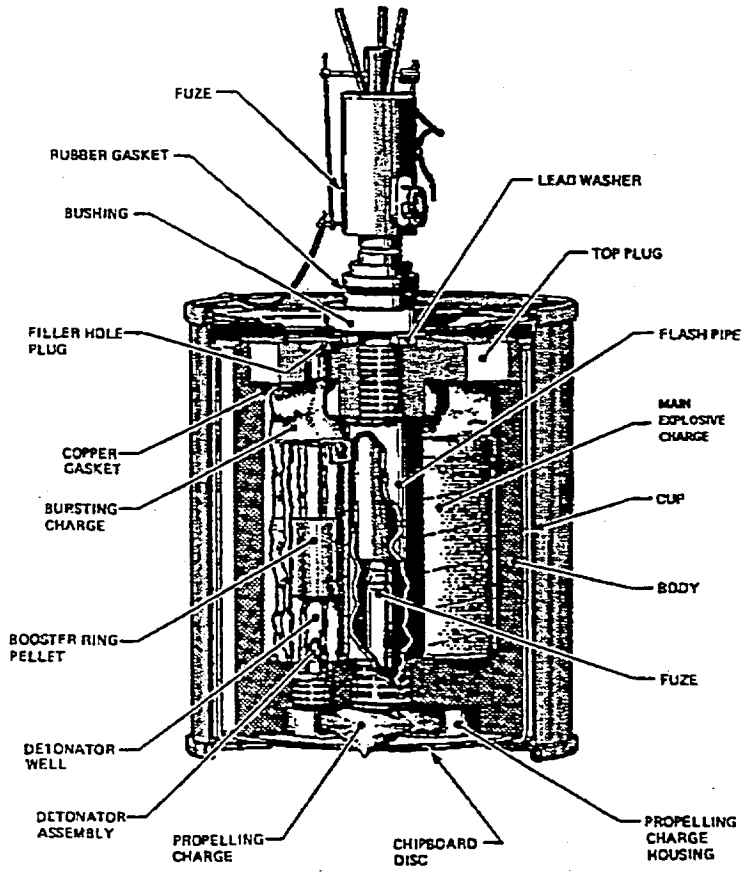


FIGURE 6 - ANTI-PERSONNEL NON-METALLIC PRACTICE MINE C4



Overall size: 10.2 cm (D) x 19.8 cm (H)
Total weight: 3.74 kg

FIGURE 7 - ANTI-PERSONNEL MINE M16 - SECTIONAL VIEW

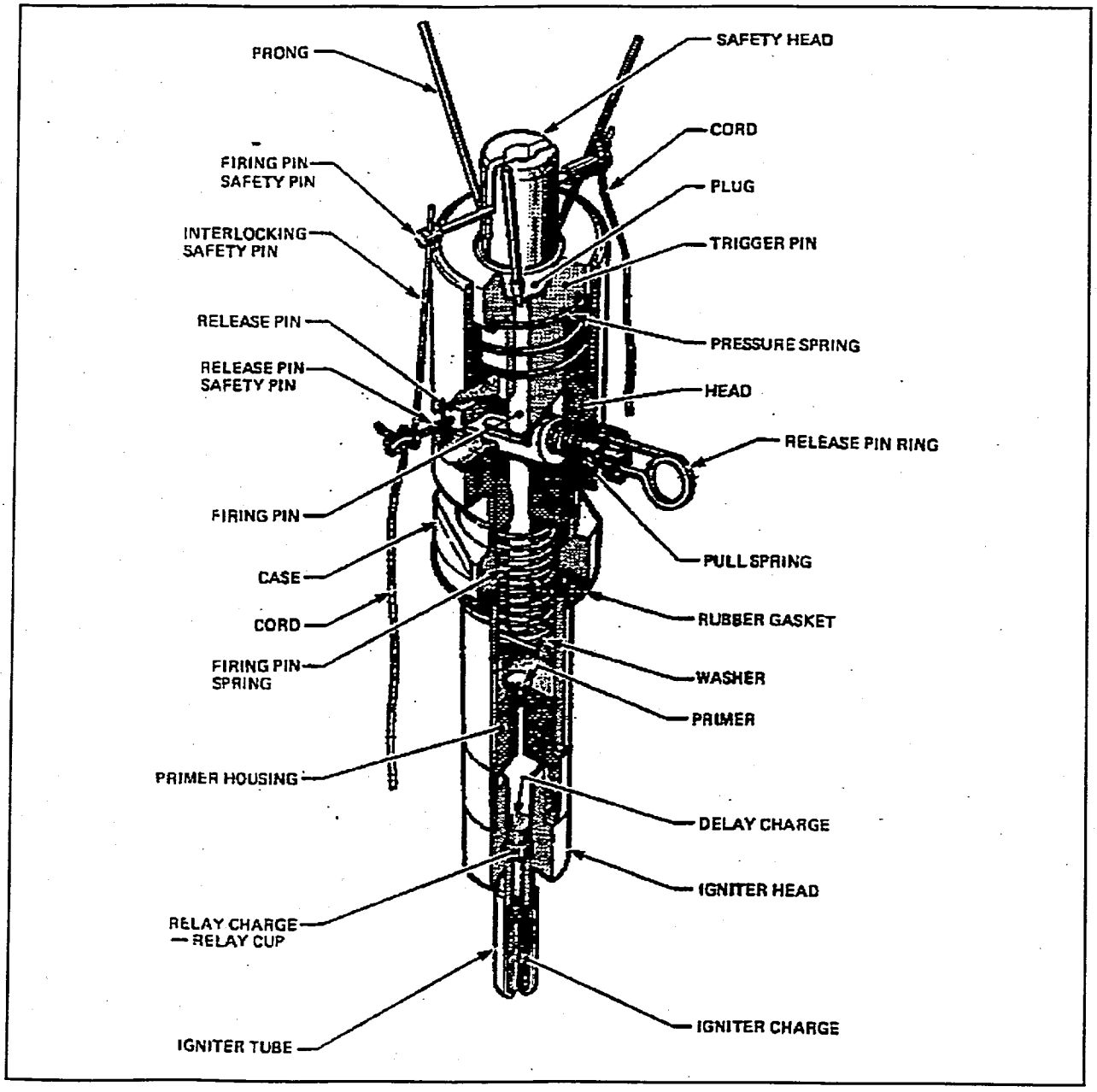


FIGURE 8 - PULL FUSE, M605, FOR ANTI-PERSONNEL MINE M16/M16A1/M16A2

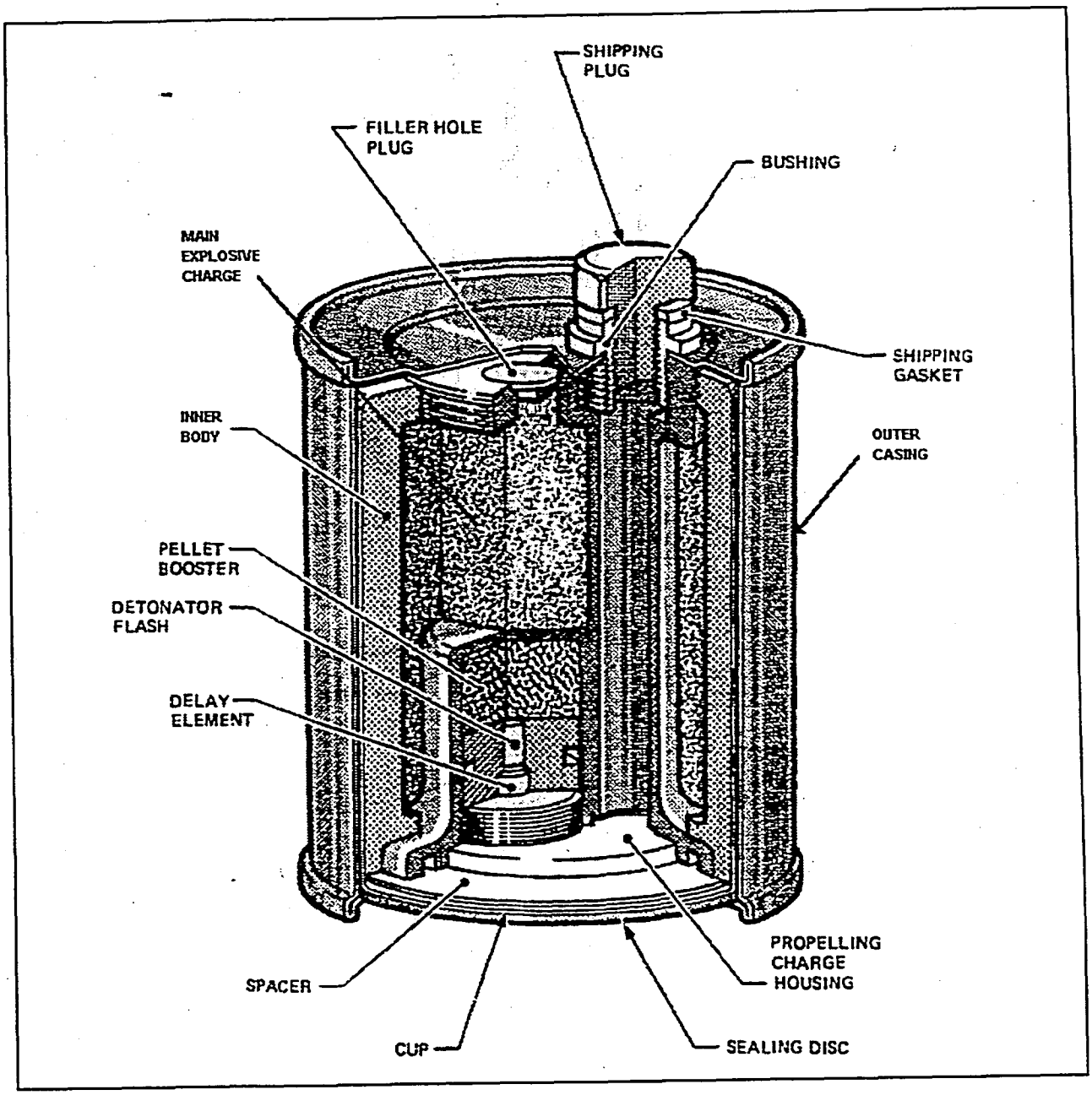


FIGURE 9 - ANTI-PERSONNEL MINE M16A2 SHOWN WITHOUT FUSE, M605

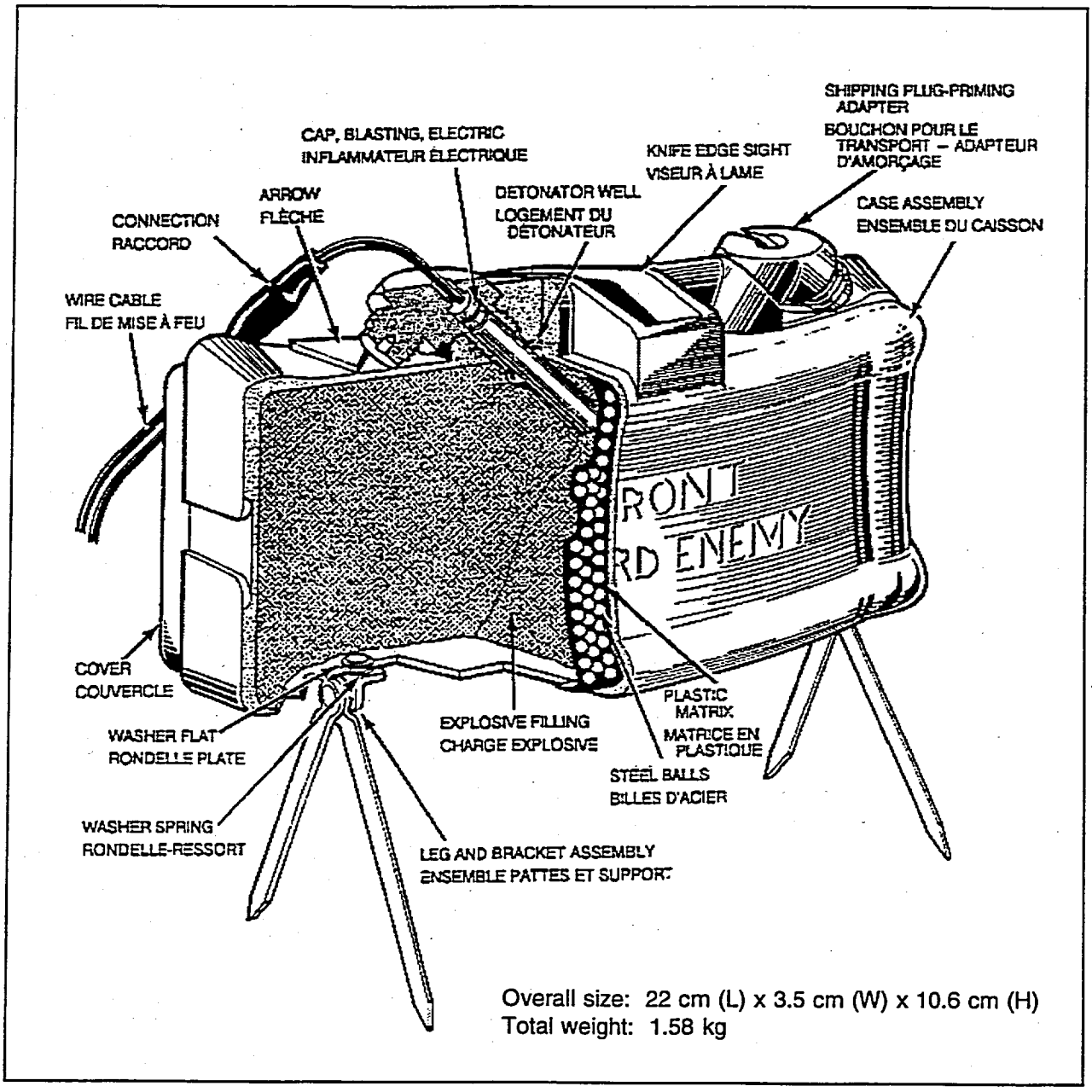
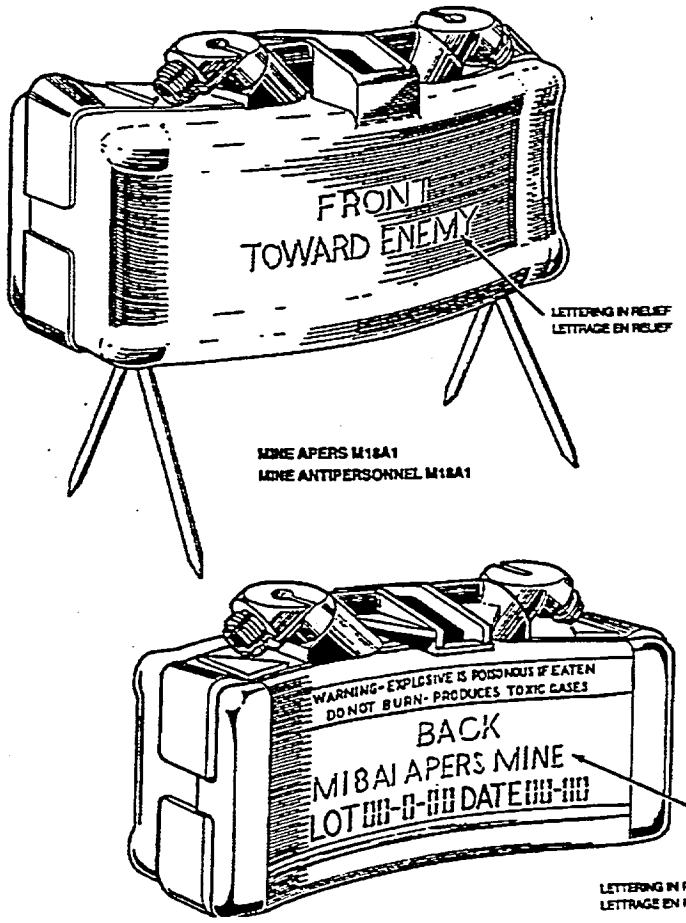
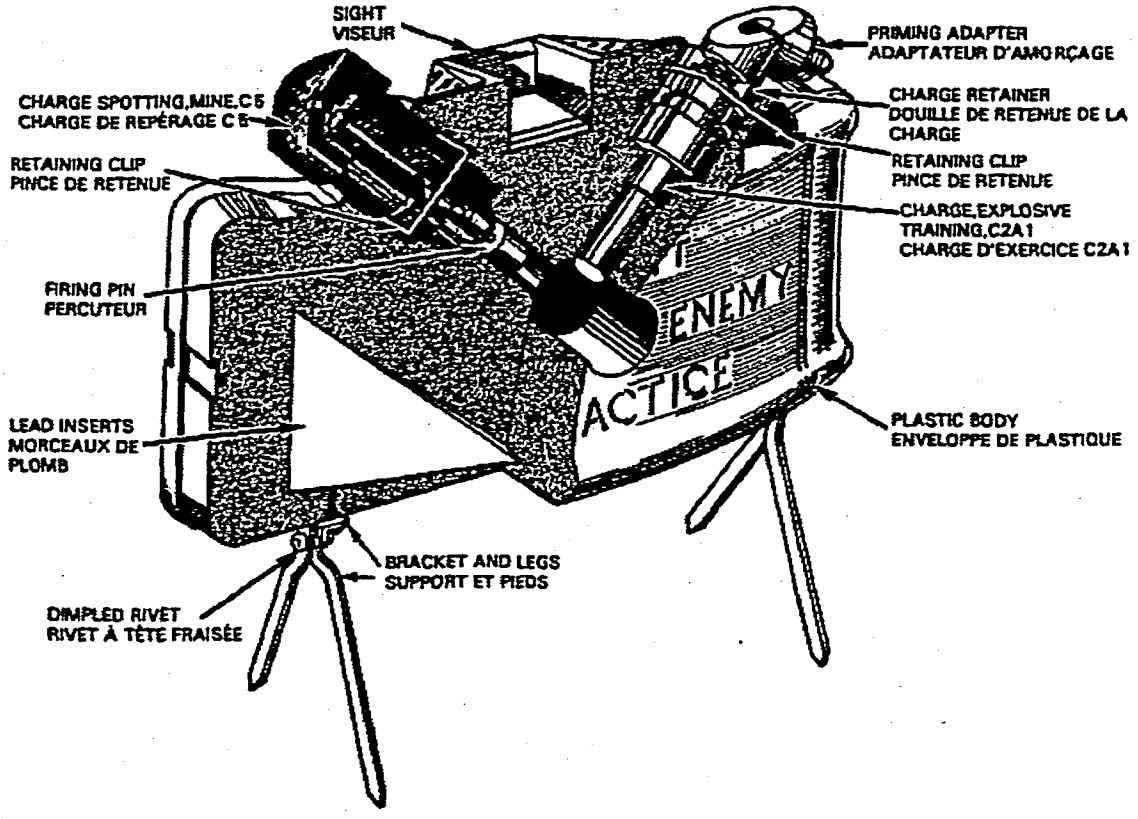


FIGURE 10 - ANTI-PERSONNEL MINE M18A1 - ASSEMBLY



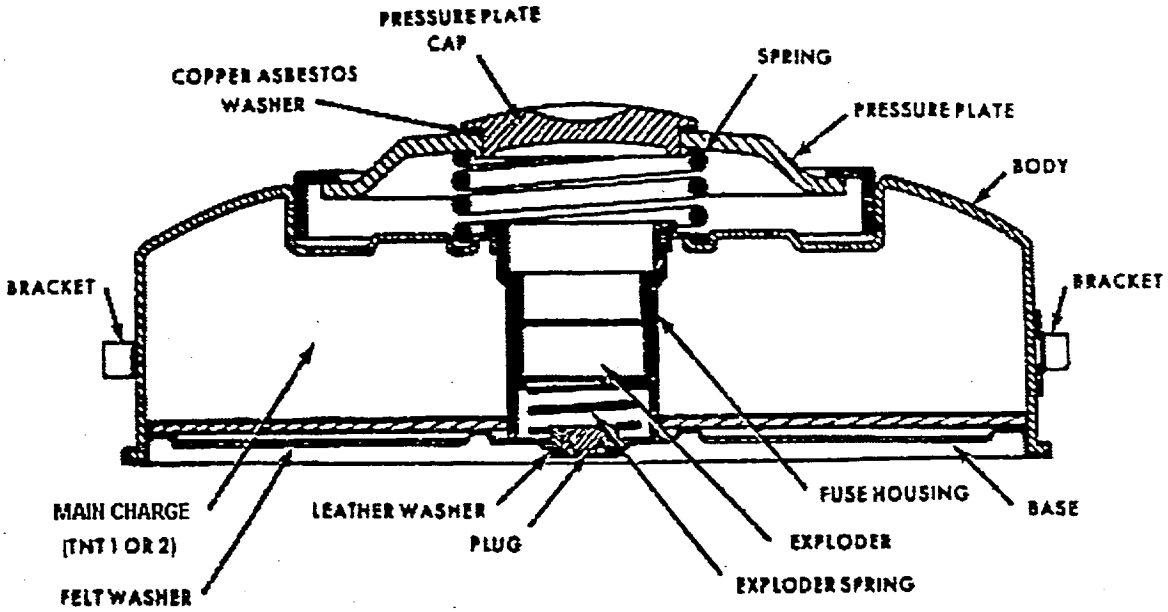
Overall size: 22 cm (L) 3.5 cm (W) x 10.6 cm (H)
Total weight: 1.58 kg

FIGURE 11 - ANTI-PERSONNEL MINE M18A1



Overall size: 22 cm (L) x 3.5 cm (W) x 10.6 cm (H)
Total weight: 1.58 kg

FIGURE 12 - ANTI-PERSONNEL PRACTICE MINE M18A1 - SECTIONAL VIEW



Overall size: 32.5 cm (D) x 13 cm (H)
Total weight: 13.6 kg

FIGURE 13 - ANTI-TANK MINE MARK 7

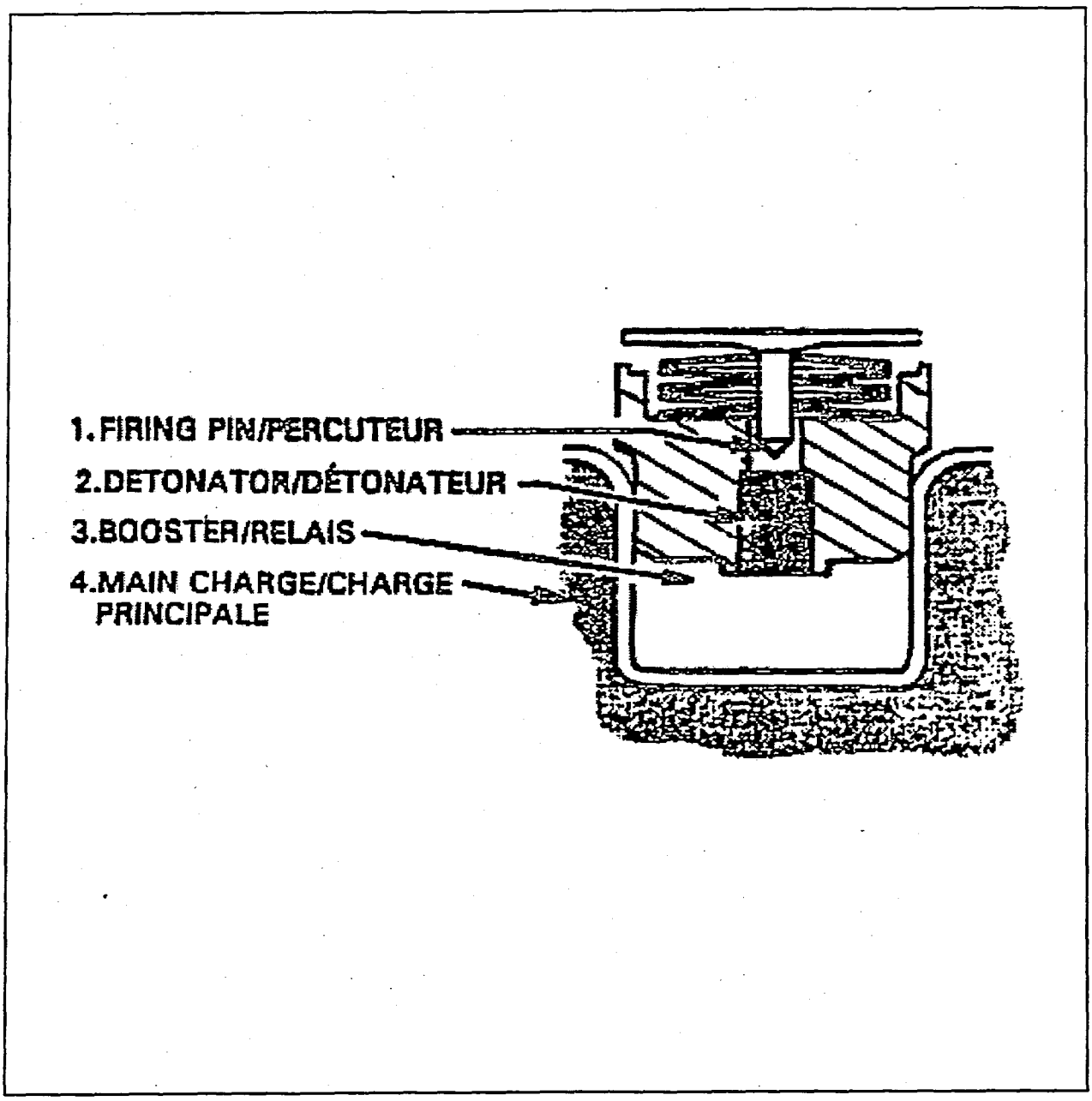
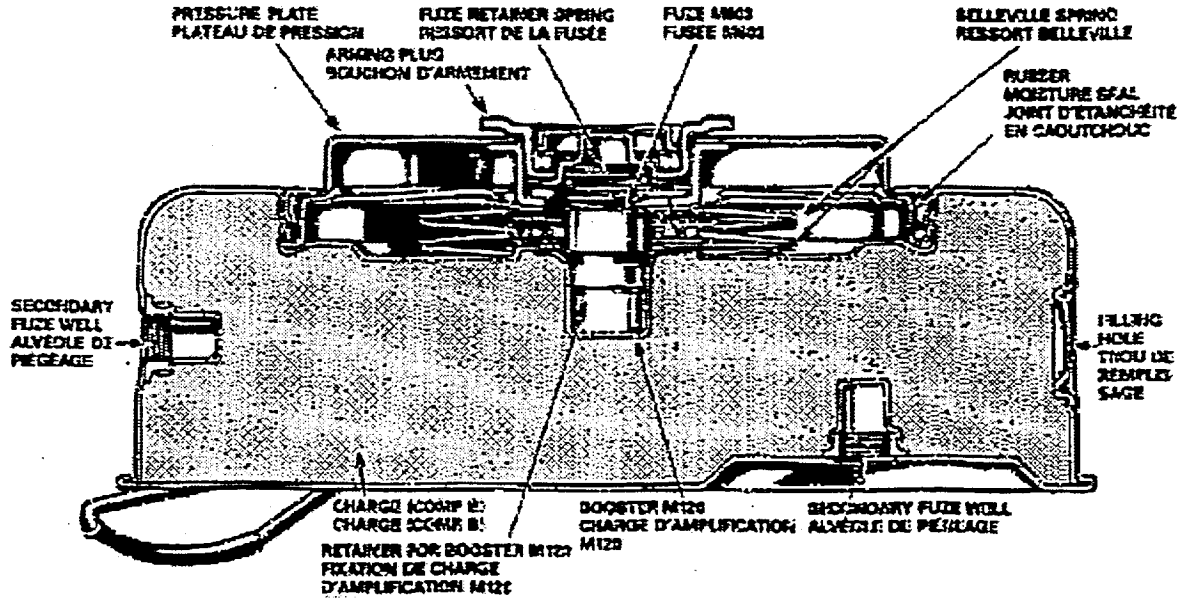
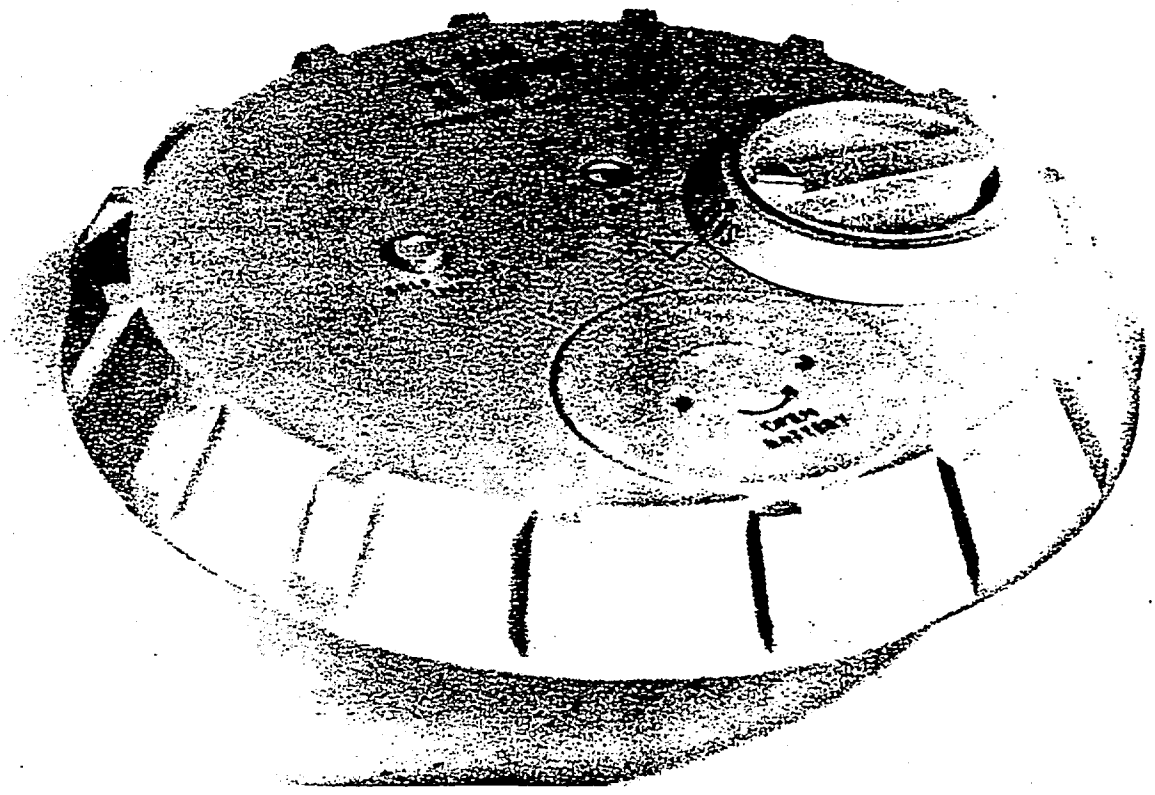


FIGURE 14 - GENERAL EXPLOSIVE TRAIN FOR ANTI-TANK MINE



Overall size: 33 cm (D) x 12.5 cm (H)
Total weight: 14.3 kg

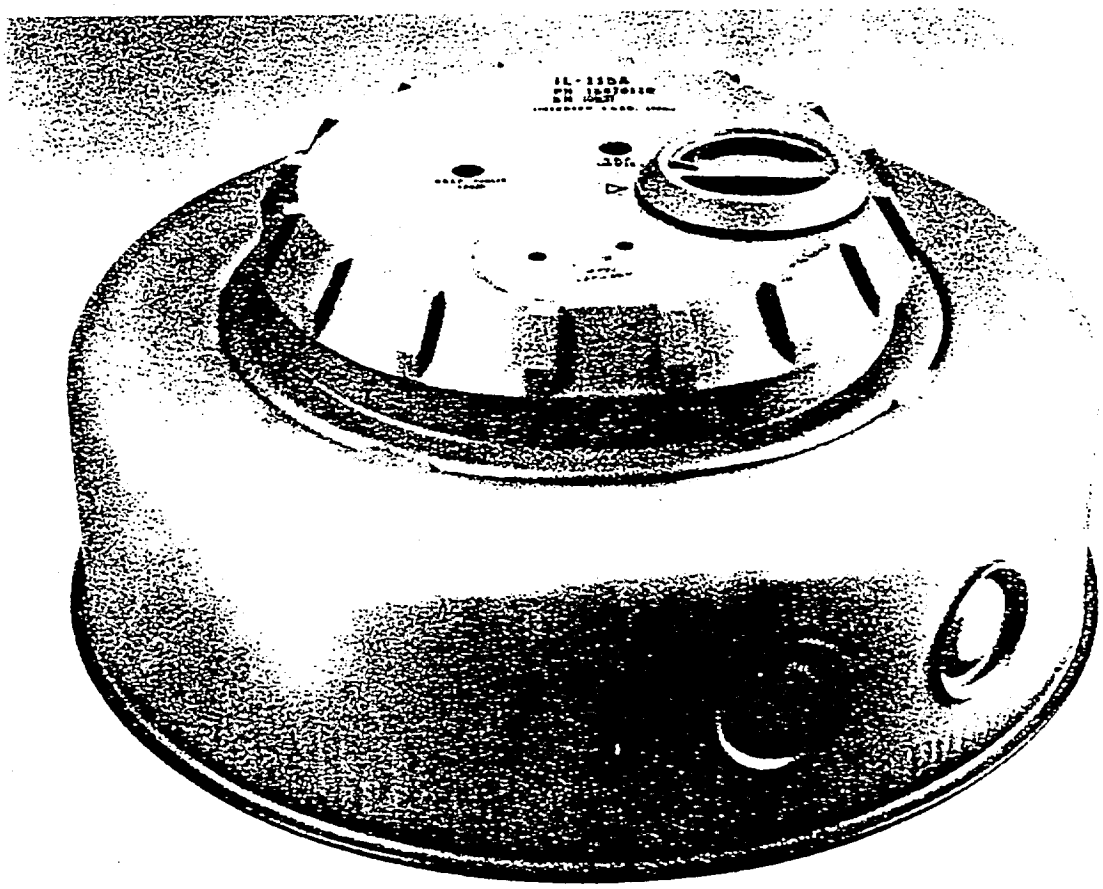
FIGURE 15 - ANTI-TANK MINE M15



Courtesy of Intertek Laboratories Inc.

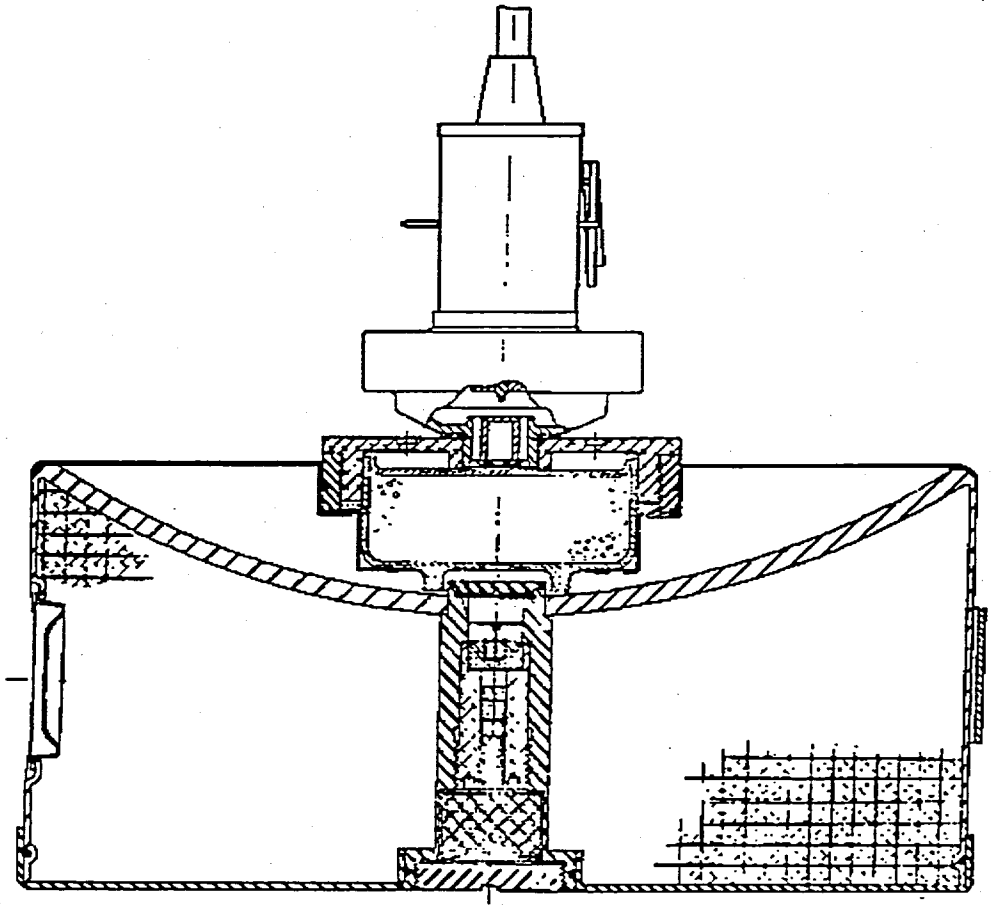
Overall size: 20 cm (D) x 7.8 cm (H)
Total weight: 1.3 kg

FIGURE 16 - IL-115A MAGNETIC FUSE FROM INTERTEK LABORATORIES INC.



Courtesy of Intertek Laboratories Inc.

FIGURE 17 - RETROFITTED M15/IL-115A ANTI-TANK MINE



Overall size: 22.9 cm (D) x 20.6 cm (H)
Total weight: 7.9 kg

FIGURE 18 - ANTI-TANK MINE M21 WITH TILT ROD FUSE

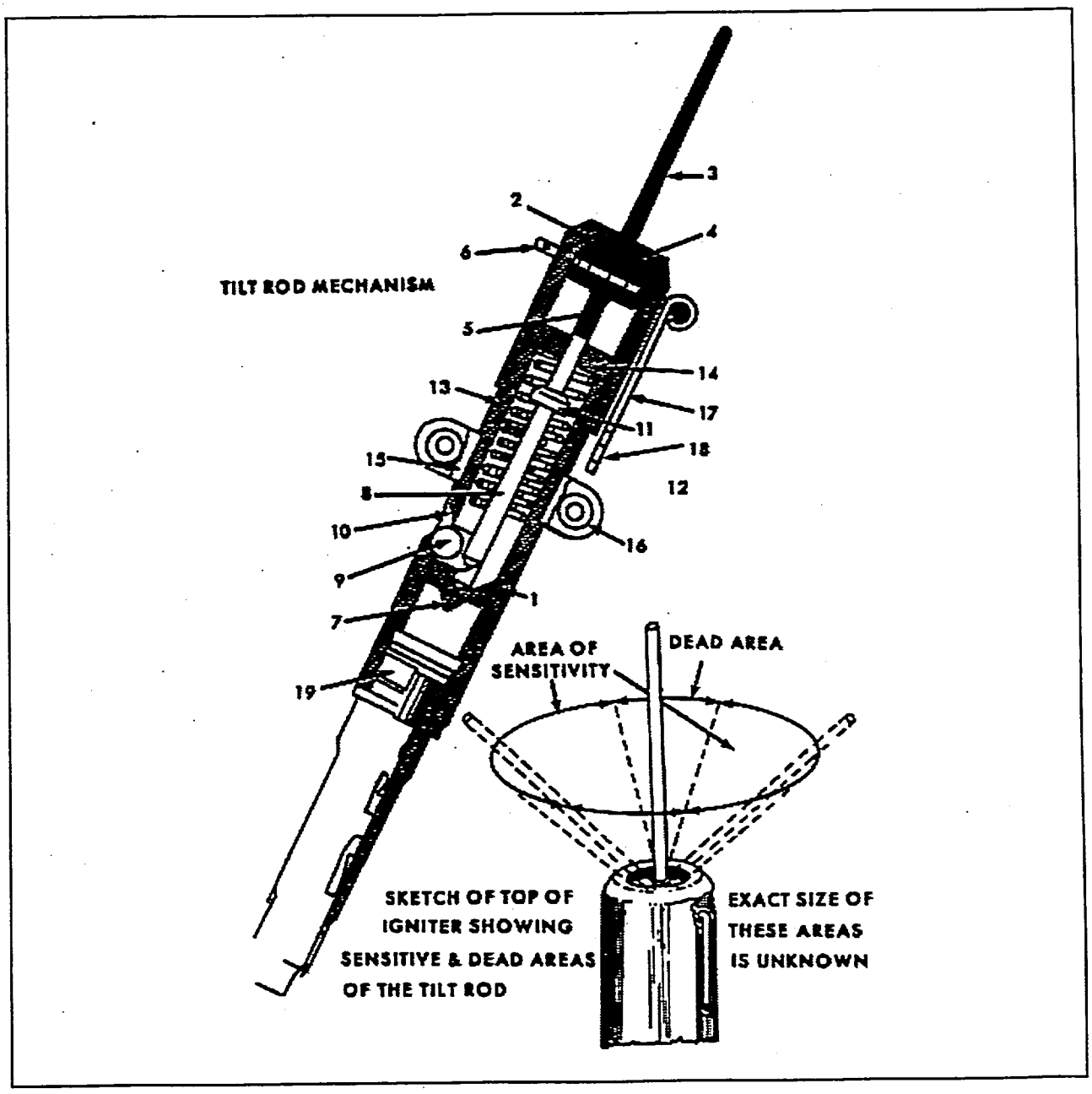
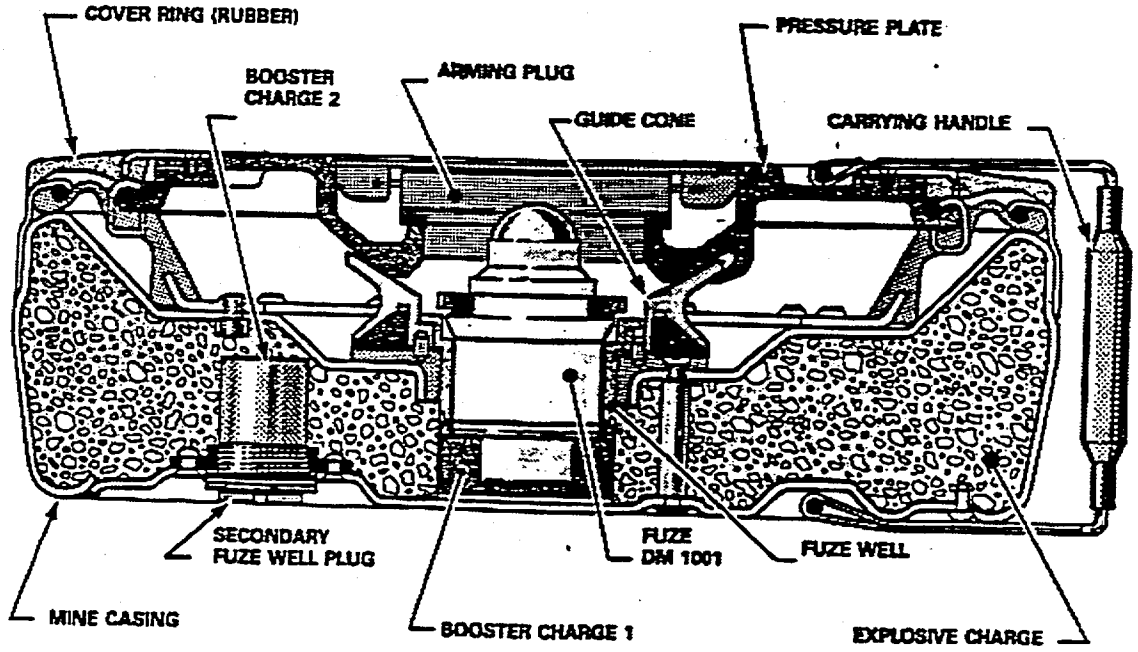


FIGURE 19 - BASIC PRINCIPLES OF A TILT ROD MECHANISM



Overall size: 30 cm (D) x 9.8 cm (H)
Total weight: 9.3 kg

FIGURE 20 - ANTI-TANK MINE DM21 - SECTIONAL VIEW

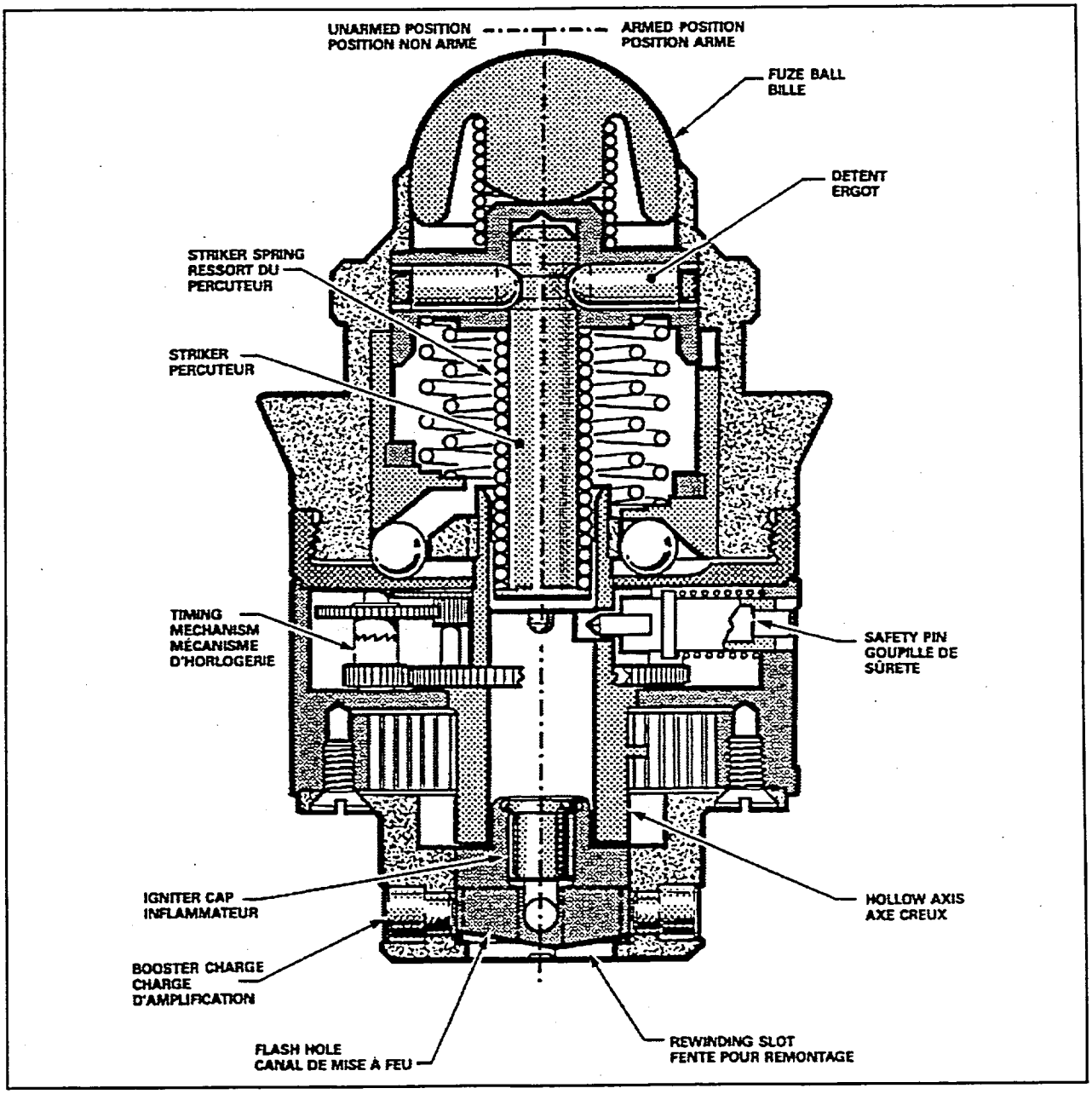


FIGURE 21 - SECTIONAL VIEW OF FUSE DM1001 USED IN ANTI-TANK MINE DM21

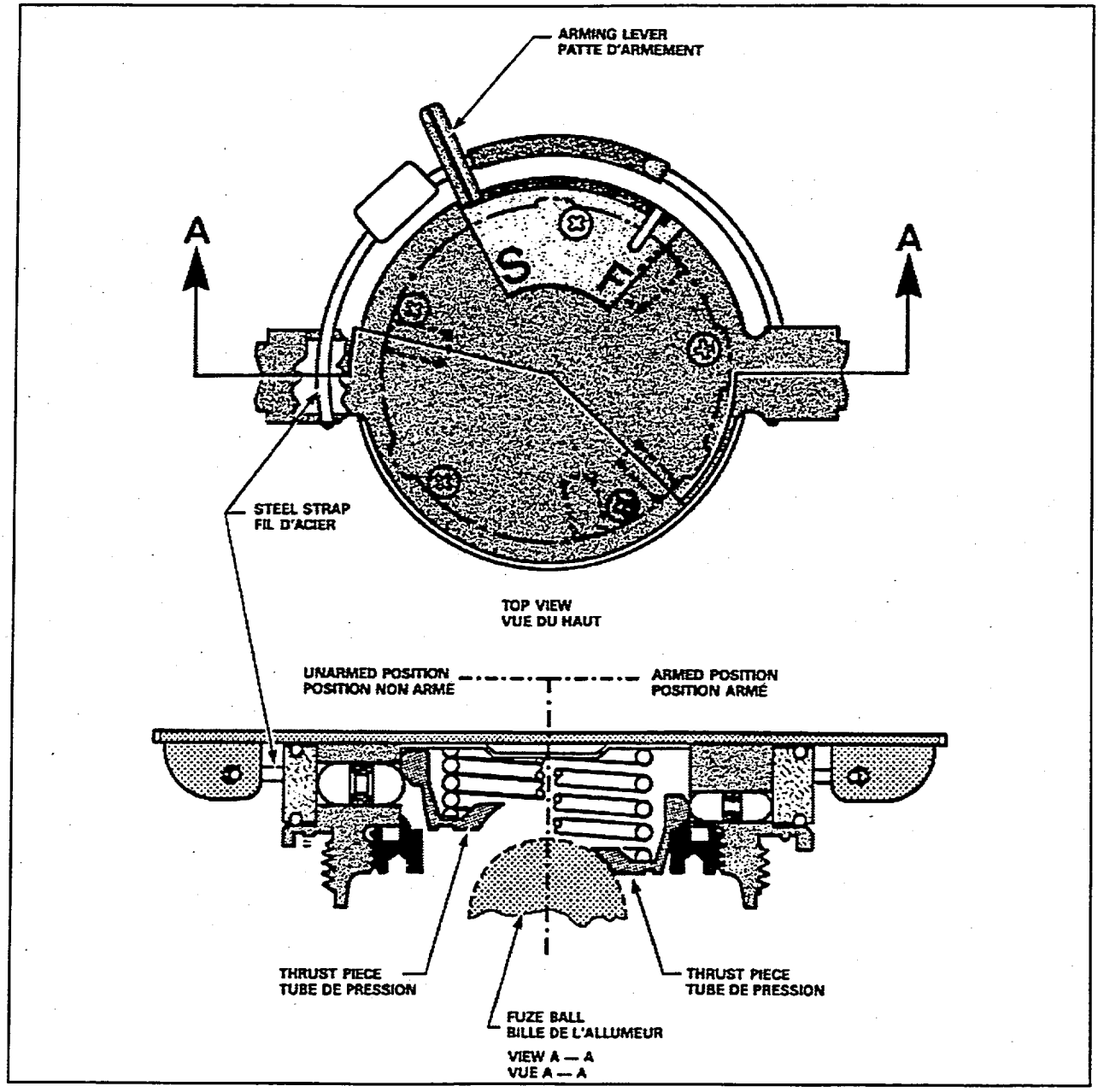
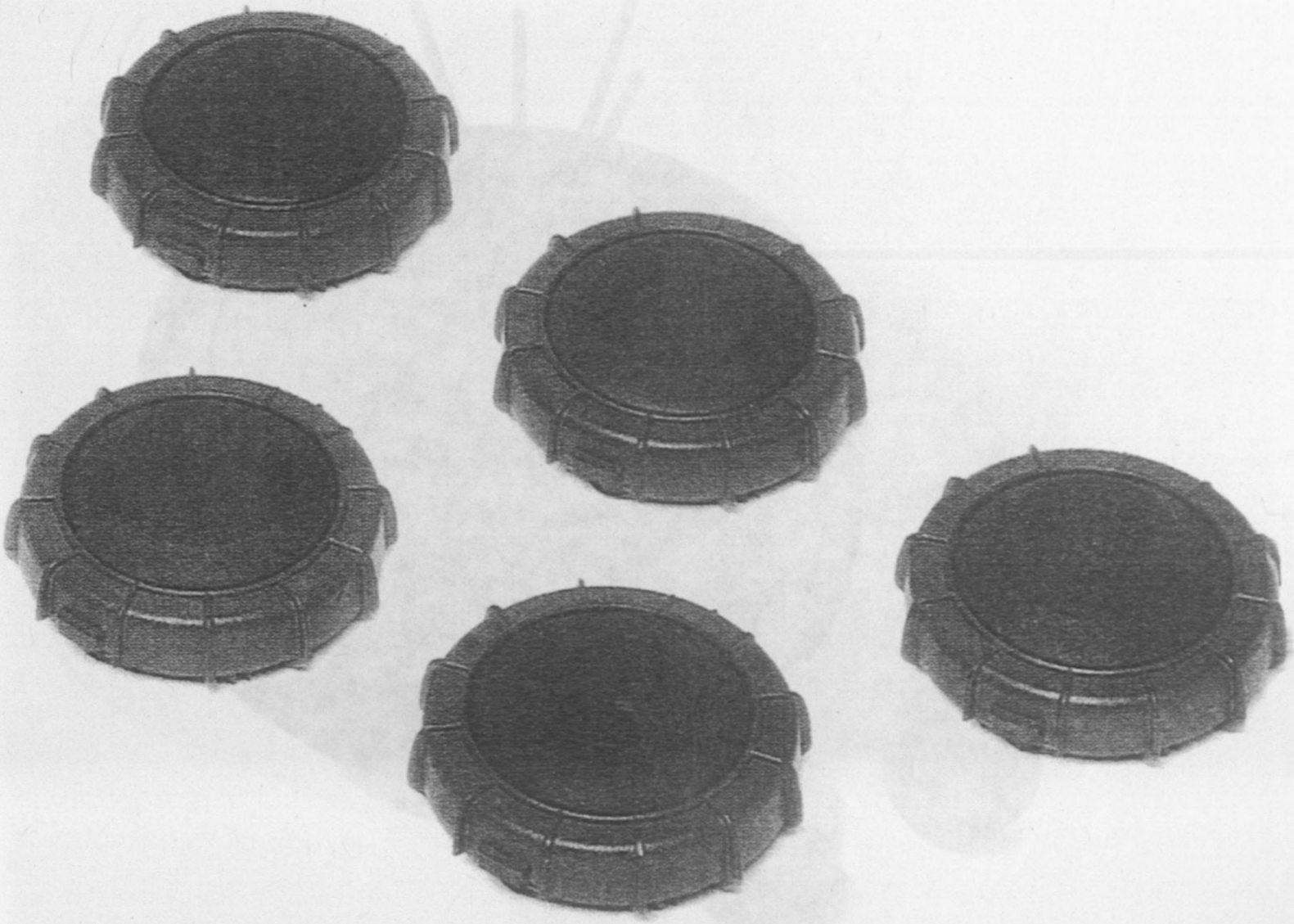


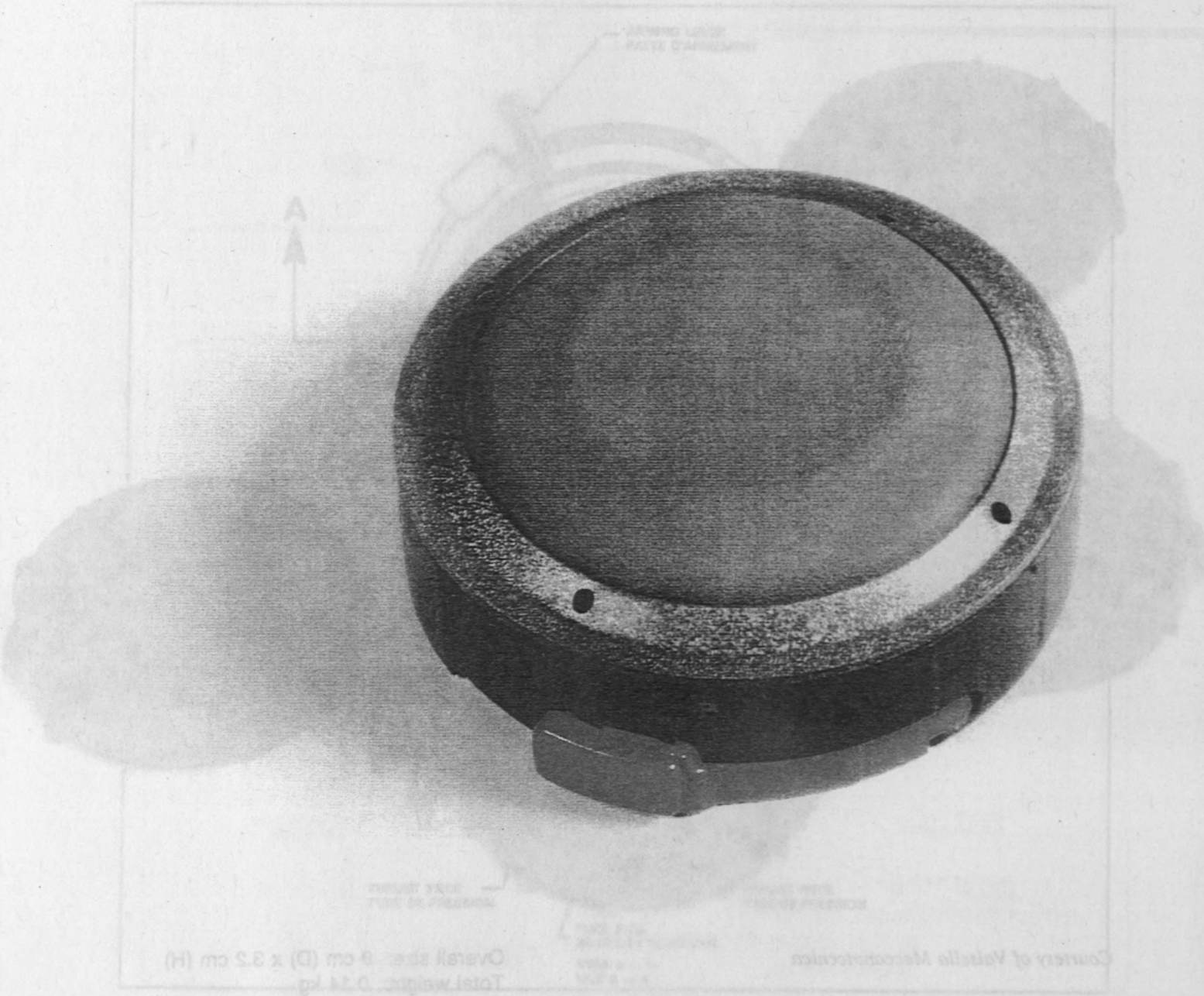
FIGURE 22 - ARMING PLUG FOR ANTI-TANK MINE DM21



Courtesy of Valsella Meccanotecnica

Overall size: 9 cm (D) x 3.2 cm (H)
Total weight: 0.14 kg

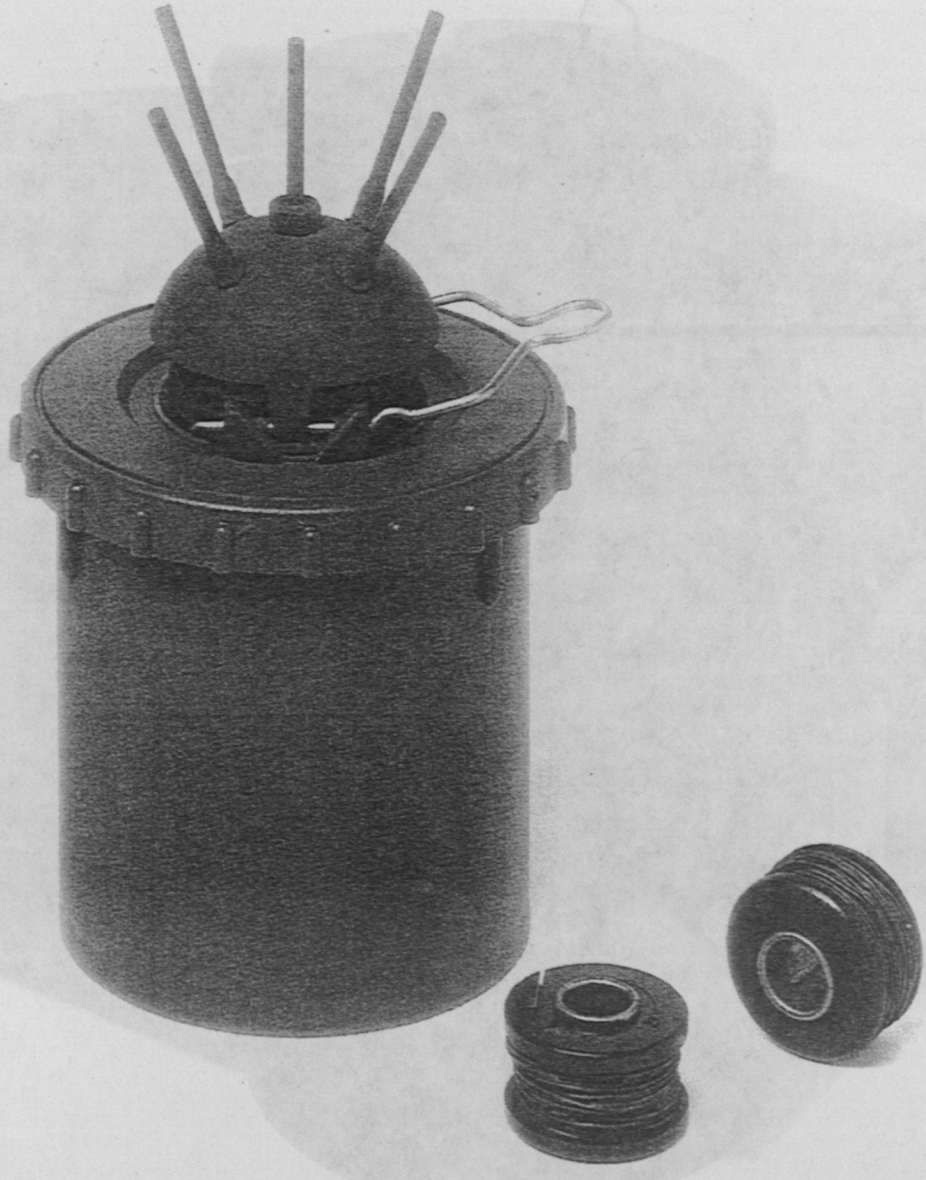
FIGURE 23 - VS-MK2 SINGLE IMPULSE PRESSURE FUSED ANTI-PERSONNEL SCATTERABLE MINES



Courtesy of Valsella Meccanotecnica

Overall size: 8.95 cm (D) x 3.5 cm (H)
Total weight: 0.2 kg

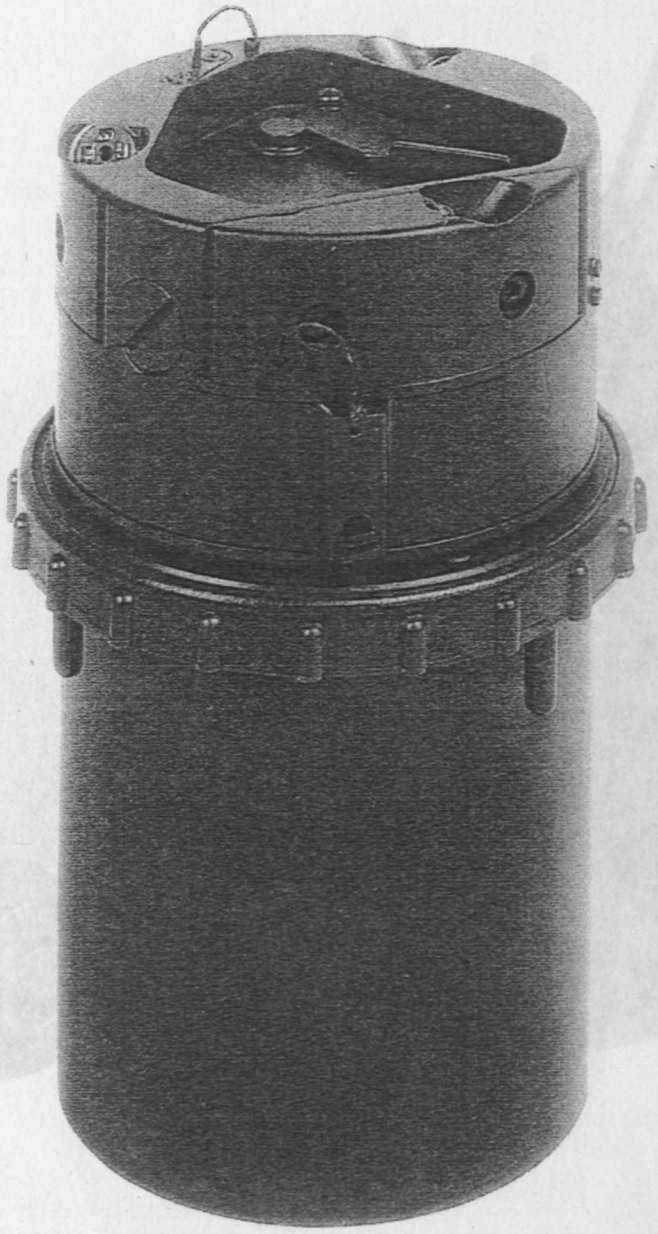
FIGURE 24 - VS-MK2-EL IMPULSE PRESSURE ANTI-PERSONNEL MINE



Courtesy of Valsella Meccanotechnica

Overall size: 13 cm (D) x 20.5 cm (H)
Total weight: 3.2 kg

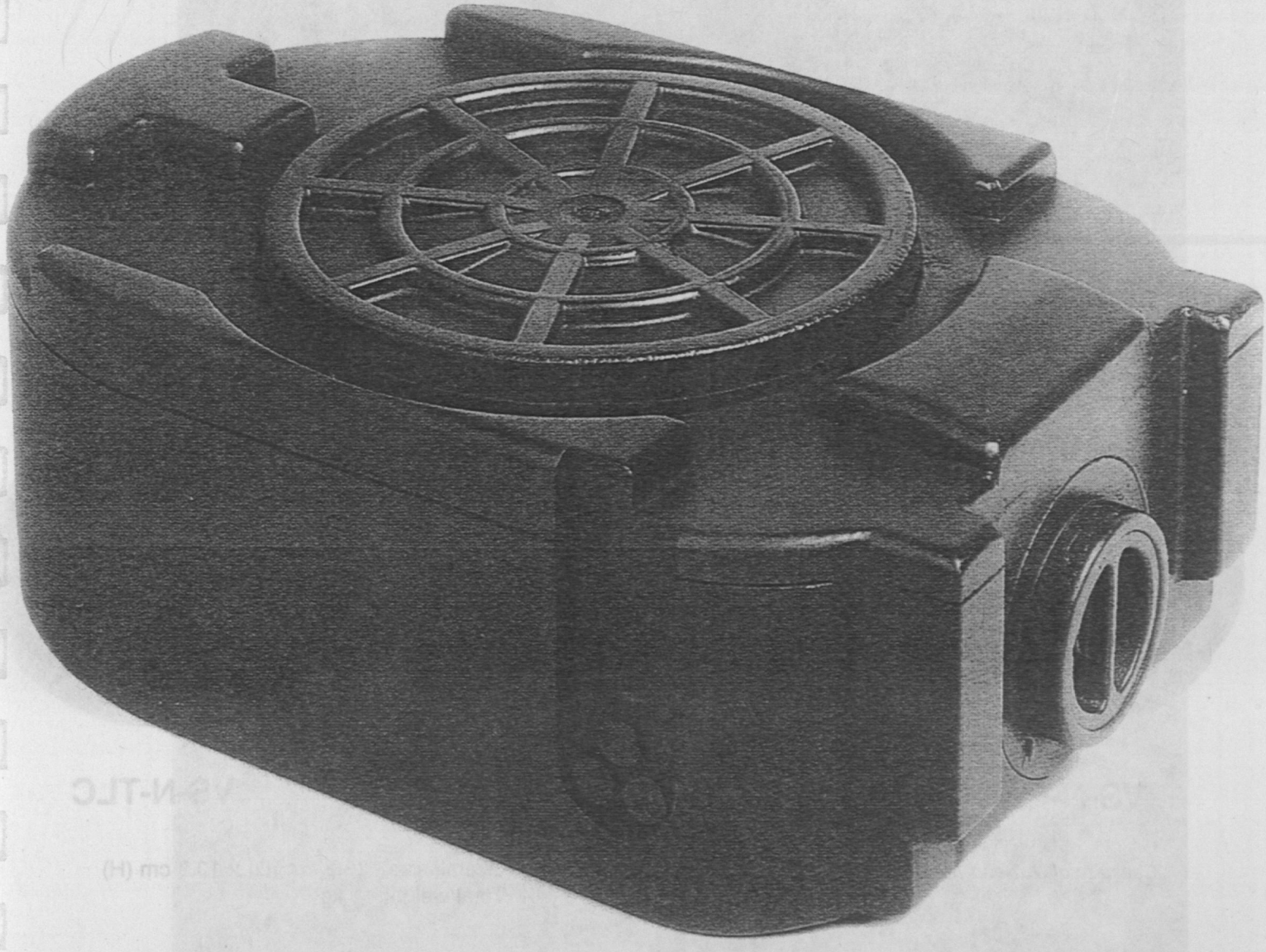
FIGURE 25 - VALMARA 69 PULL FUSED JUMPING ANTI-PERSONNEL MINE



Courtesy of Valsella Meccanotecnica

Overall size: 33 cm (D) x 19 cm (H)
Total weight: 3.5 kg

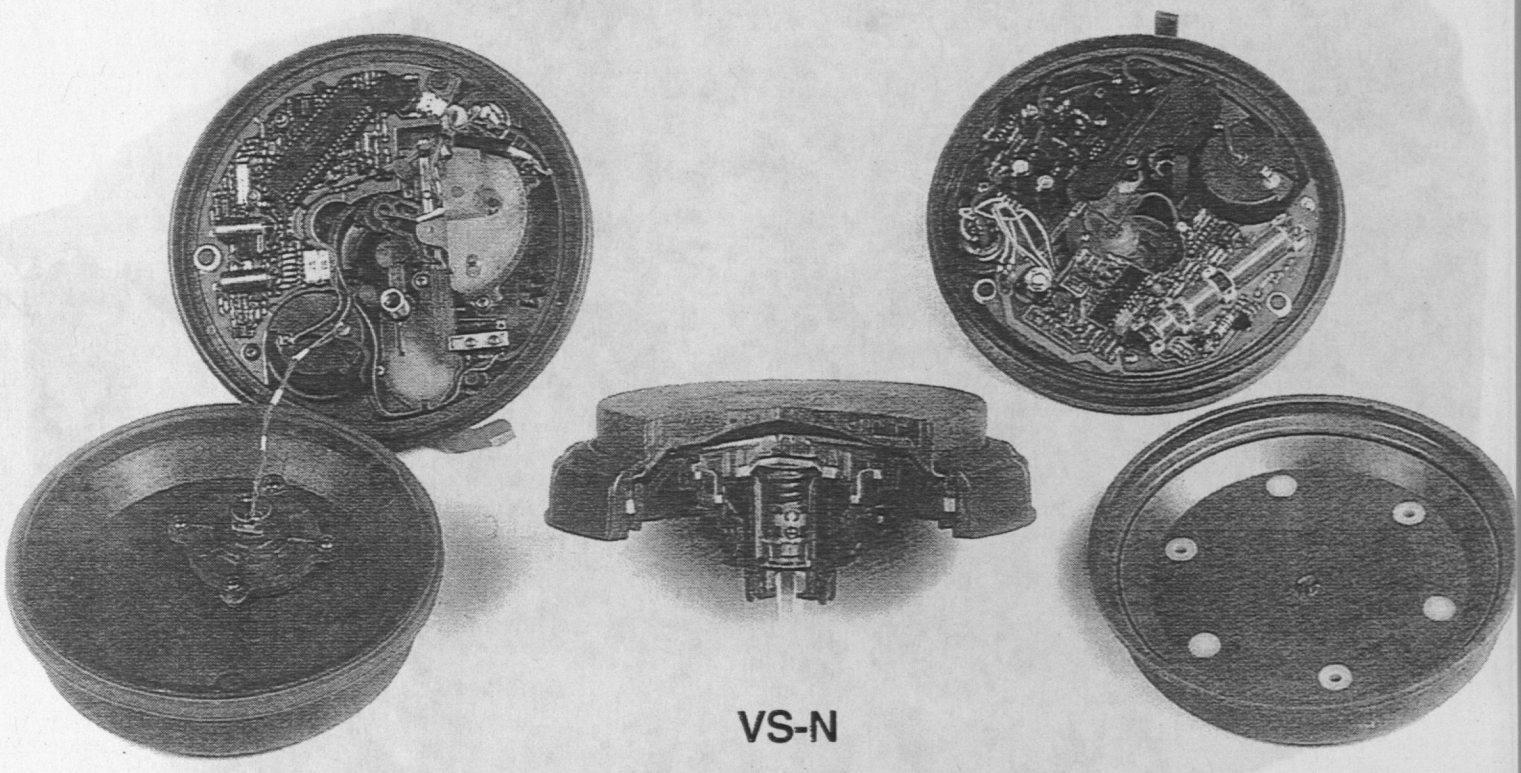
FIGURE 26 - VS-APFM1 JUMPING ANTI-PERSONNEL MINE



Courtesy of Valsella Meccanotecnica

Overall size: 28 cm (L) x 18.8 cm (W) x 10.4 cm (H)
Total weight: 5.7 kg

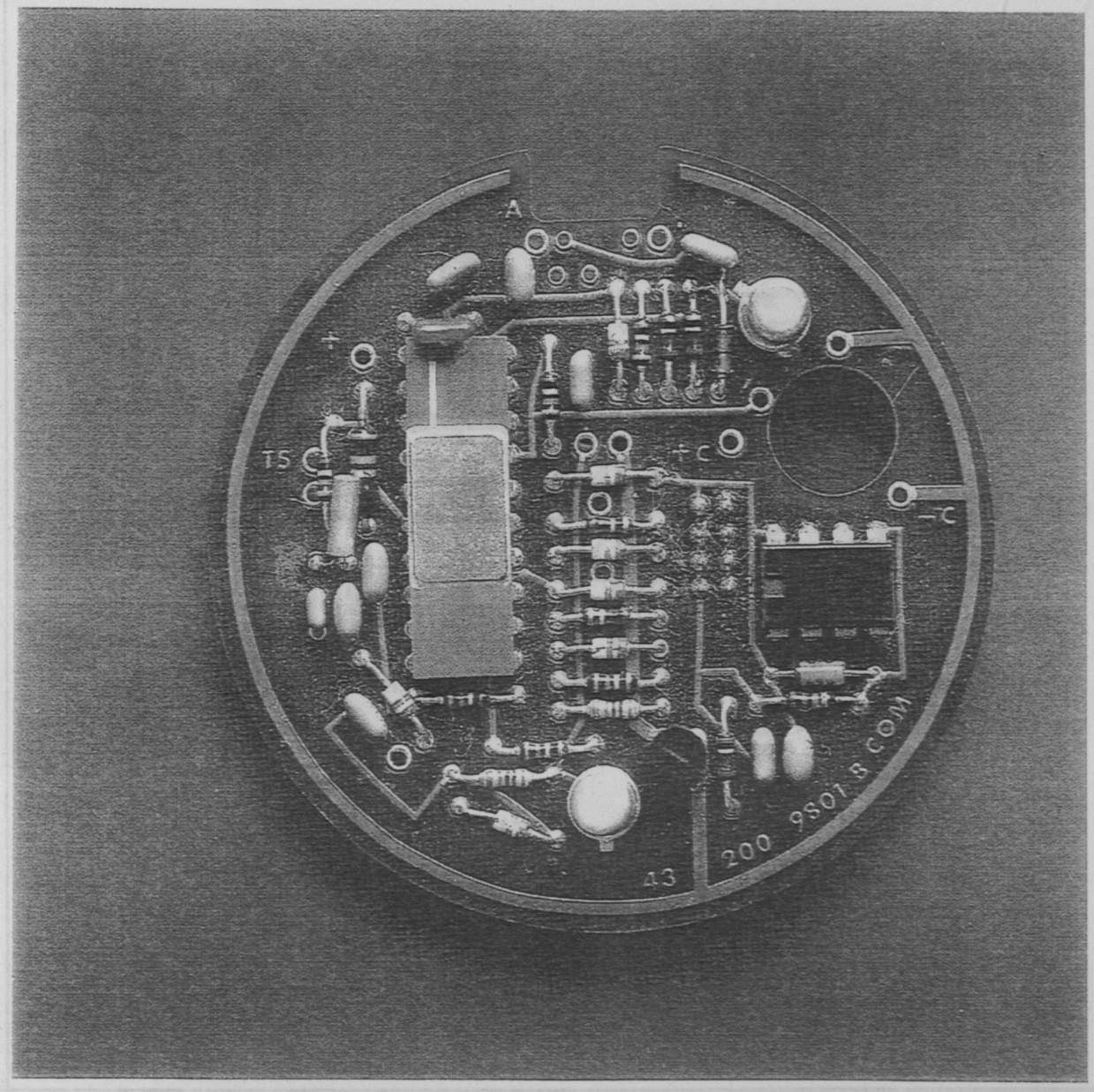
FIGURE 27 - VS-AT4 SINGLE IMPULSE PRESSURE FUSED ANTI-TANK MINE



Courtesy of Valsella Meccanotecnica

Overall size: 18.3 cm (D) x 10.8 cm (H)
Total weight: 1 kg

FIGURE 28 - VS-N SINGLE IMPULSE PRESSURE FUSES FOR ANTI-TANK MINES



Courtesy of Technovar Italiana

Overall size: 4.5 cm (D) x 0.7 cm (H)
Total weight: ~ 0.1 kg

FIGURE 29 - TEC PROGRAMMABLE ELECTRONIC IGNITER FOR PRESSURE ANTI-PERSONNEL AND ANTI-TANK MINES

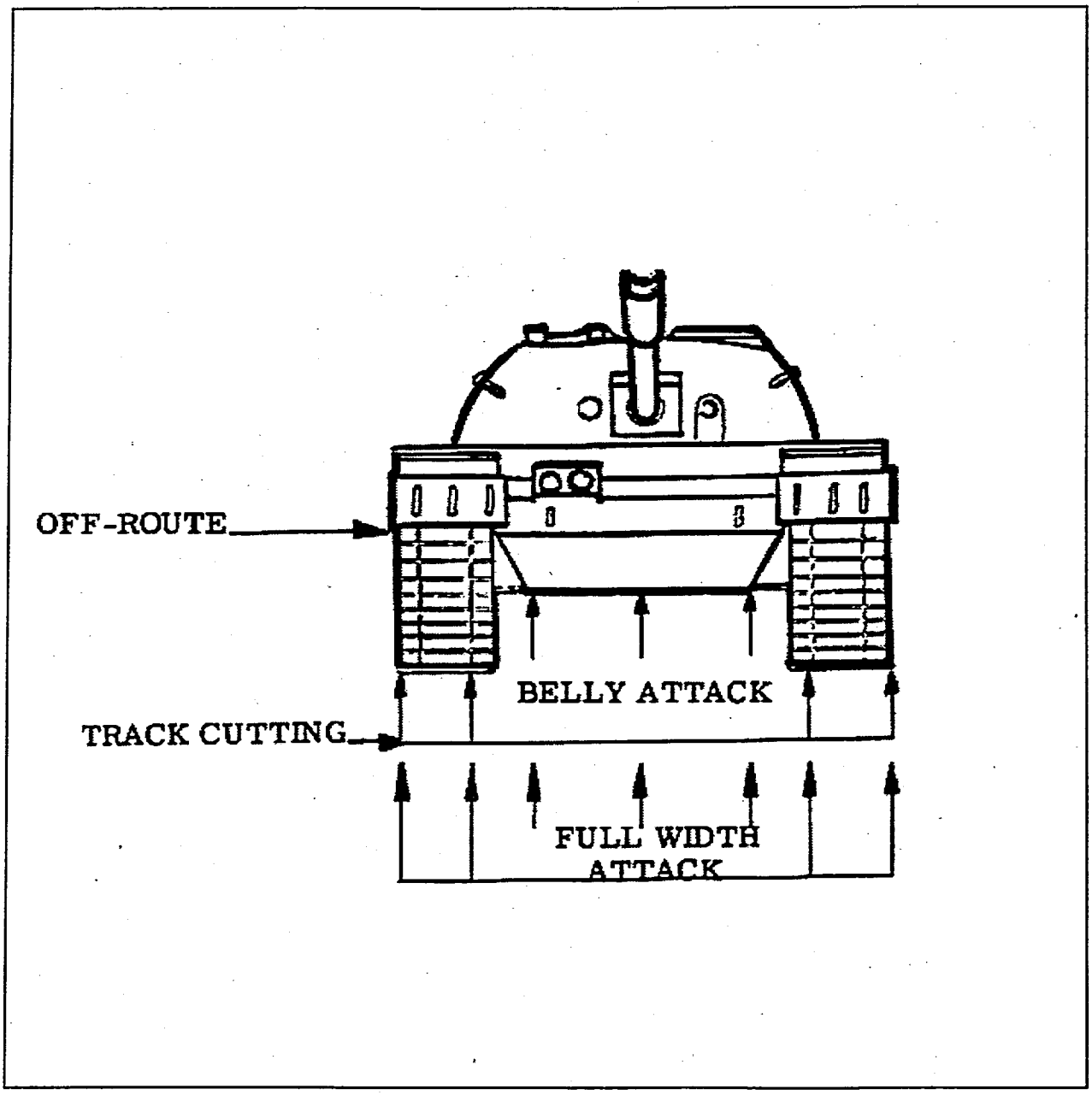


FIGURE 30 - TRACK, BELLY OFF-ROUTE AND FULL WIDTH ATTACKS

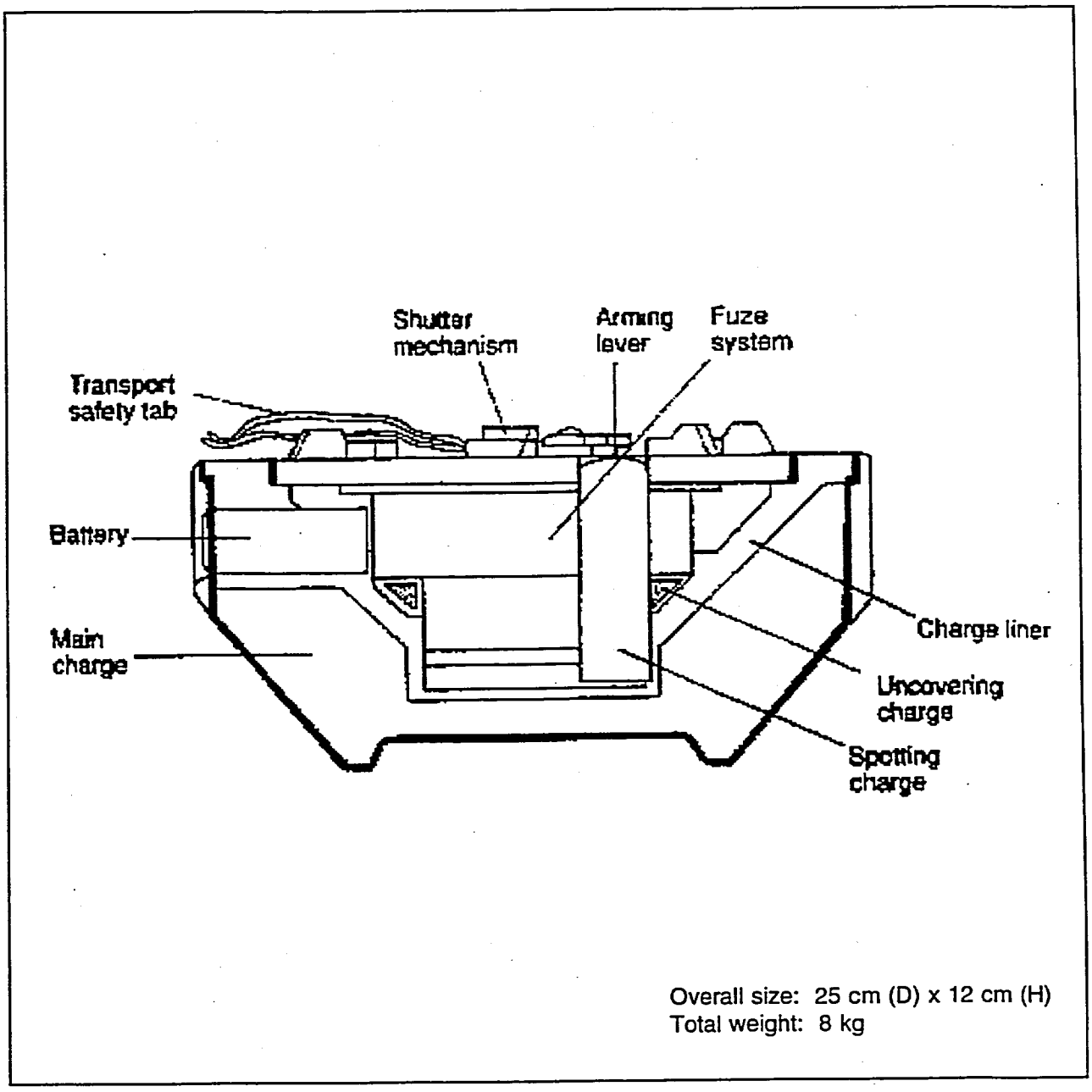
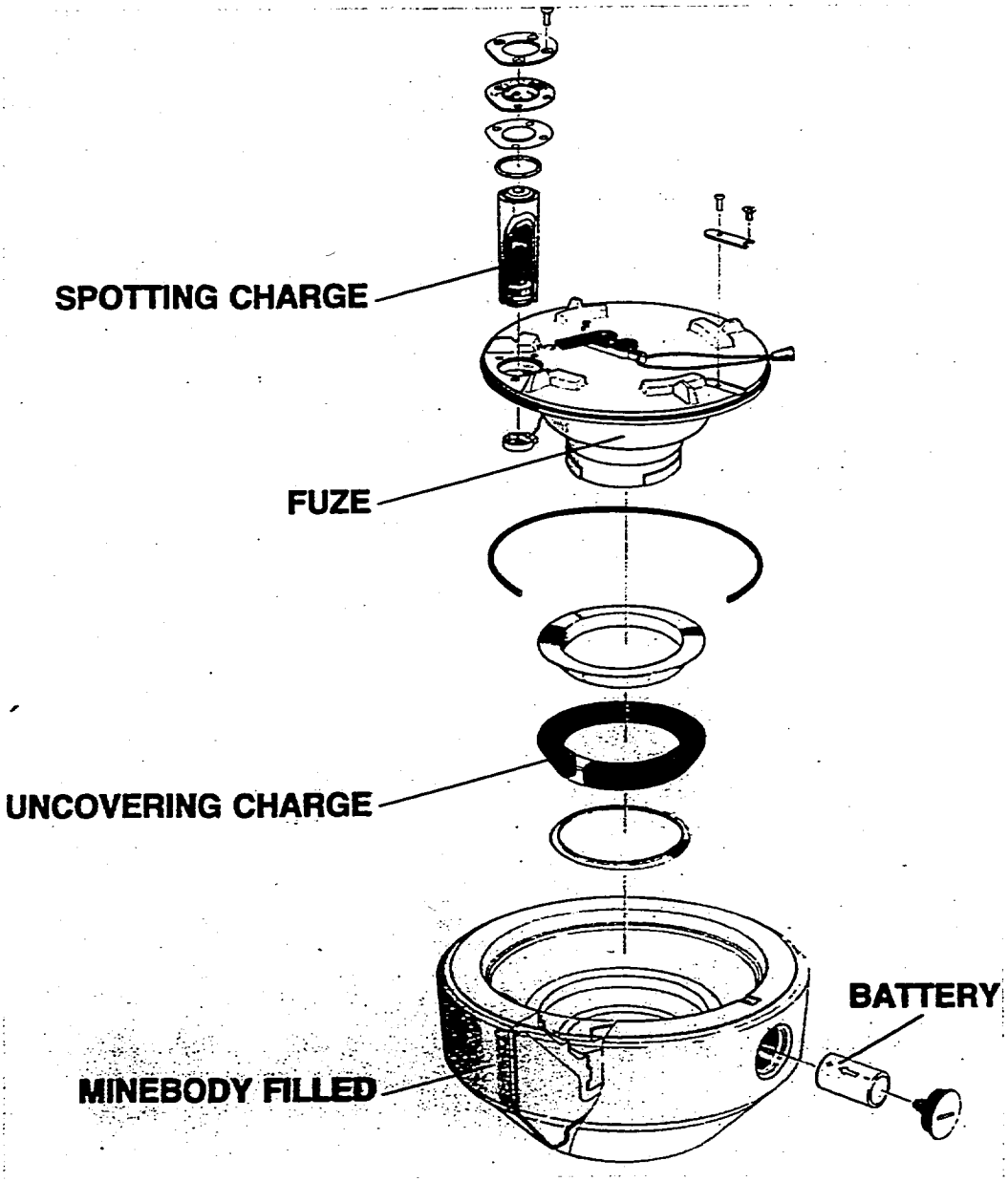


FIGURE 31 - FFV 028 DESIGN



Courtesy of Bofors

Overall size: 25 cm (D) x 12 cm (H)
Total weight: 8 kg

FIGURE 32 - FFV 028 MAIN PARTS OF A MAGNETIC INFLUENCE, SELF NEUTRALIZING ANTI-TANK MINE

Courtesy of Valsella Meccanotecnica

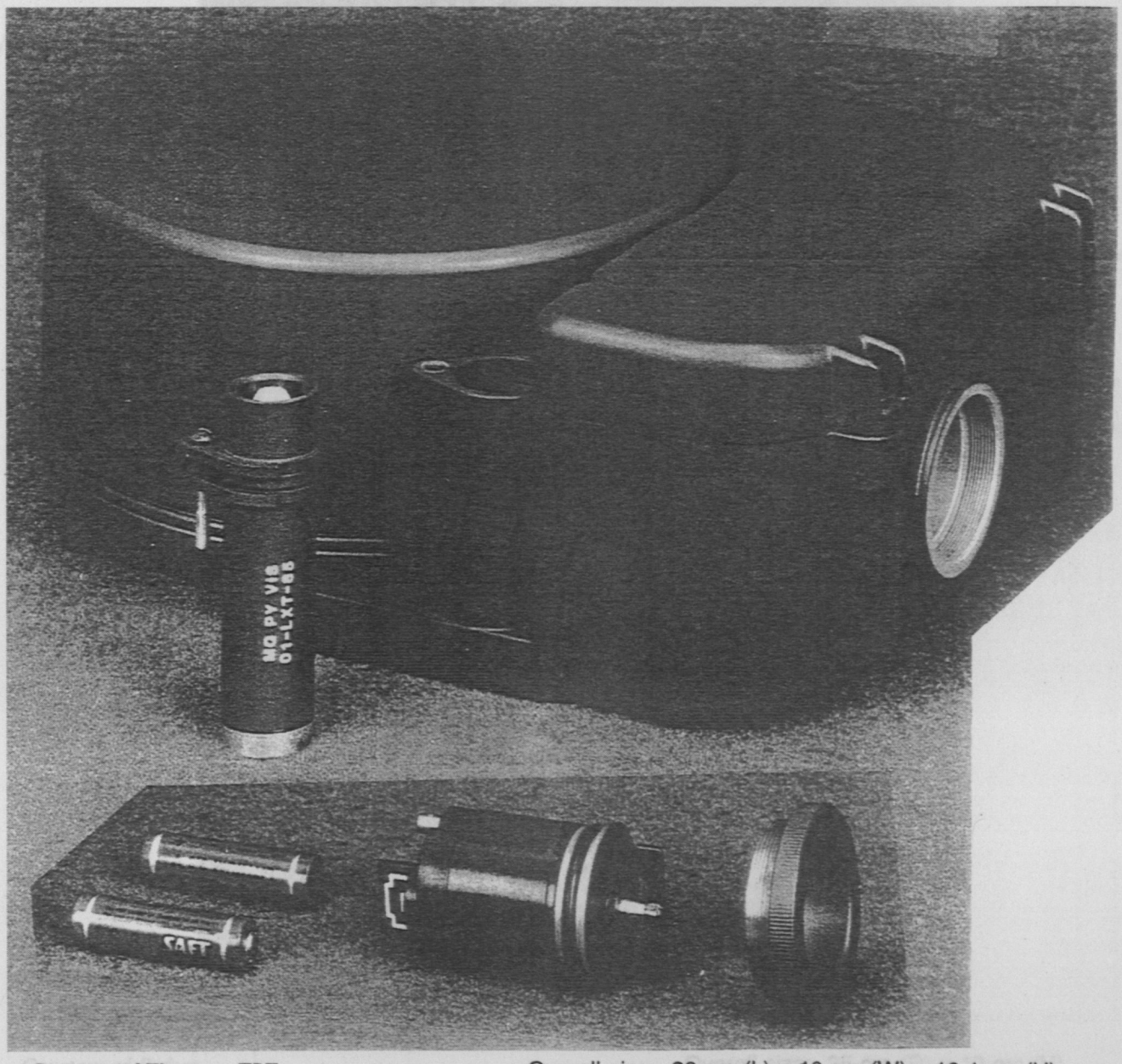
Overall size: 28 cm (L) x 18.8 cm (W) x 10.4 cm (H)
Total weight: 5.5 kg

FIGURE 33 - VS-HCT4 INFLUENCE FUSED ANTI-TANK MINE

Courtesy of Thomson-TRT

Overall size: 28 cm (L) x 19 cm (W) x 10.4 cm (H)
Total weight: 7 kg

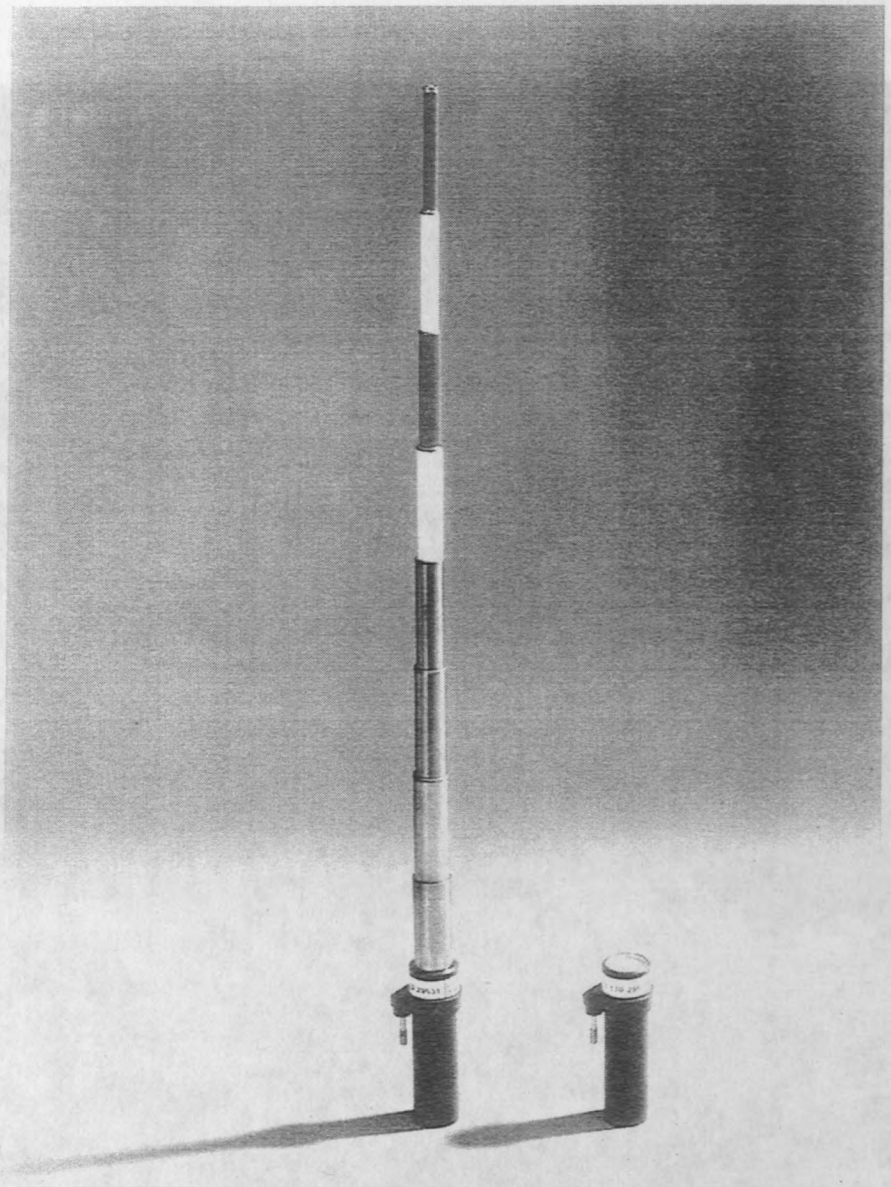
FIGURE 34 - HPD F2 MAGNETIC INFLUENCE ANTI-TANK MINE



Courtesy of Thomson-TRT

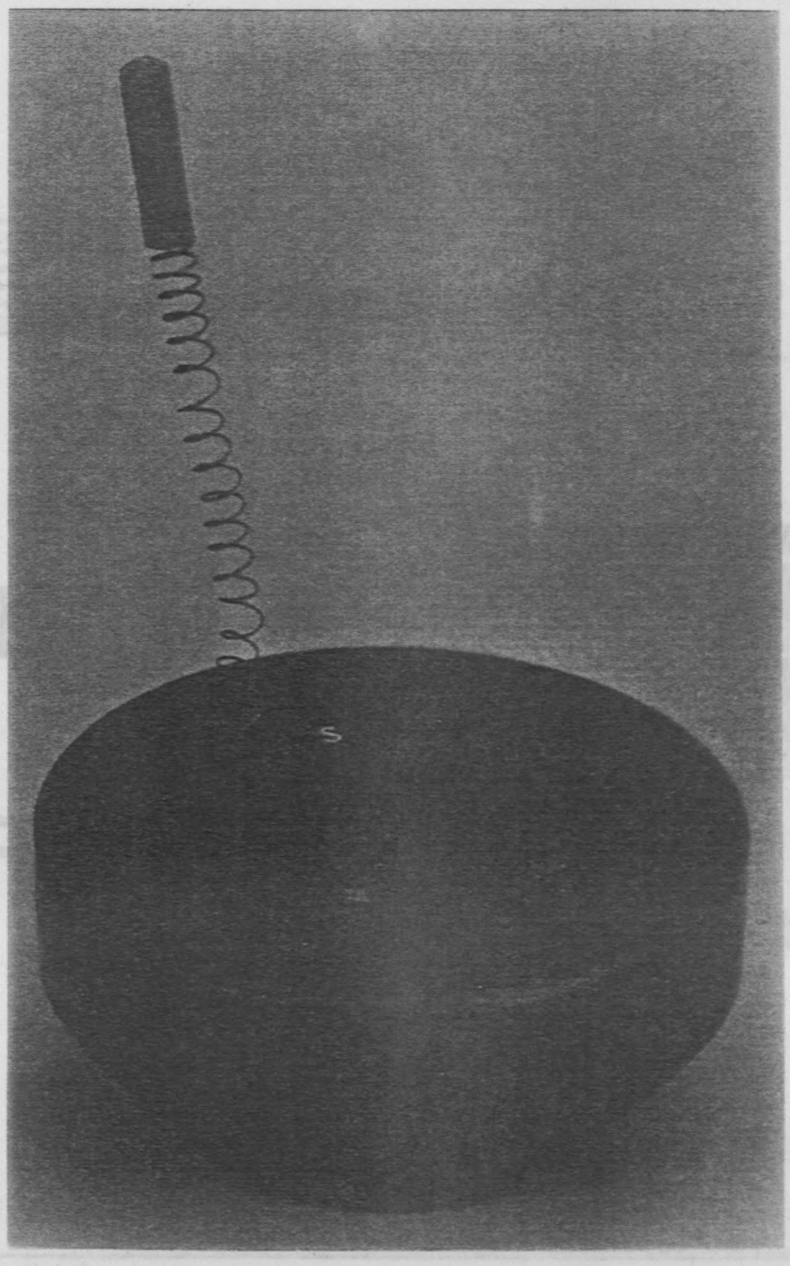
Overall size: 28 cm (L) x 19 cm (W) x 10.4 cm (H)
Total weight: 7 kg

FIGURE 35 - HPD F2 ANTI-TANK MINE EQUIPPED WITH A NEUTRALIZATION AND POSITION MARKER



Courtesy of Thomson-TRT

FIGURE 36 - HPD F2 NEUTRALIZATION AND POSITION MARKER



Courtesy of Bofors

Overall size: 25 cm (D) x 12 cm (H)
Total weight: 8 kg

FIGURE 37 - FFV 028 ANTI-TANK MINE EQUIPPED WITH A NEUTRALIZATION AND POSITION INDICATOR

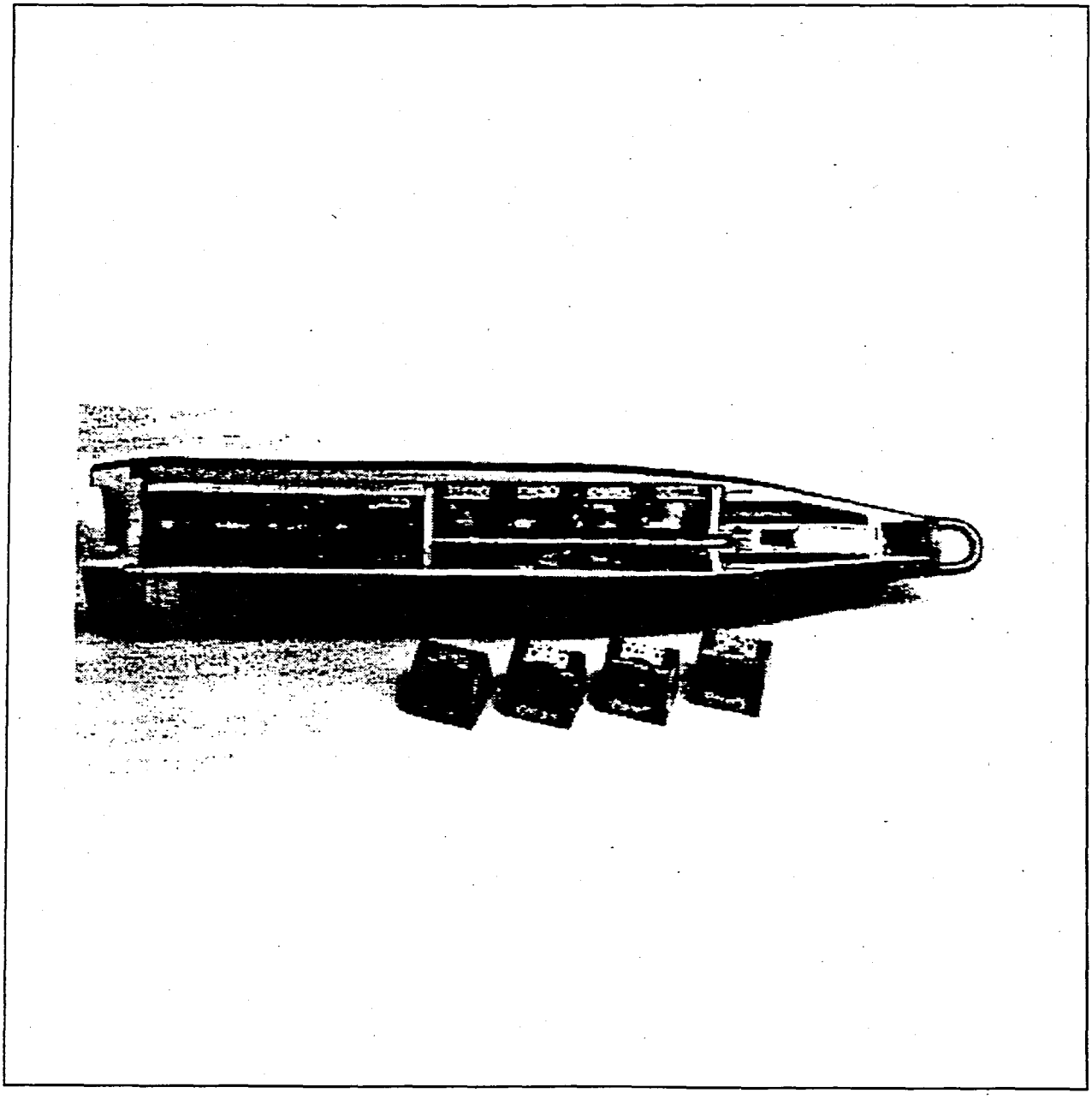
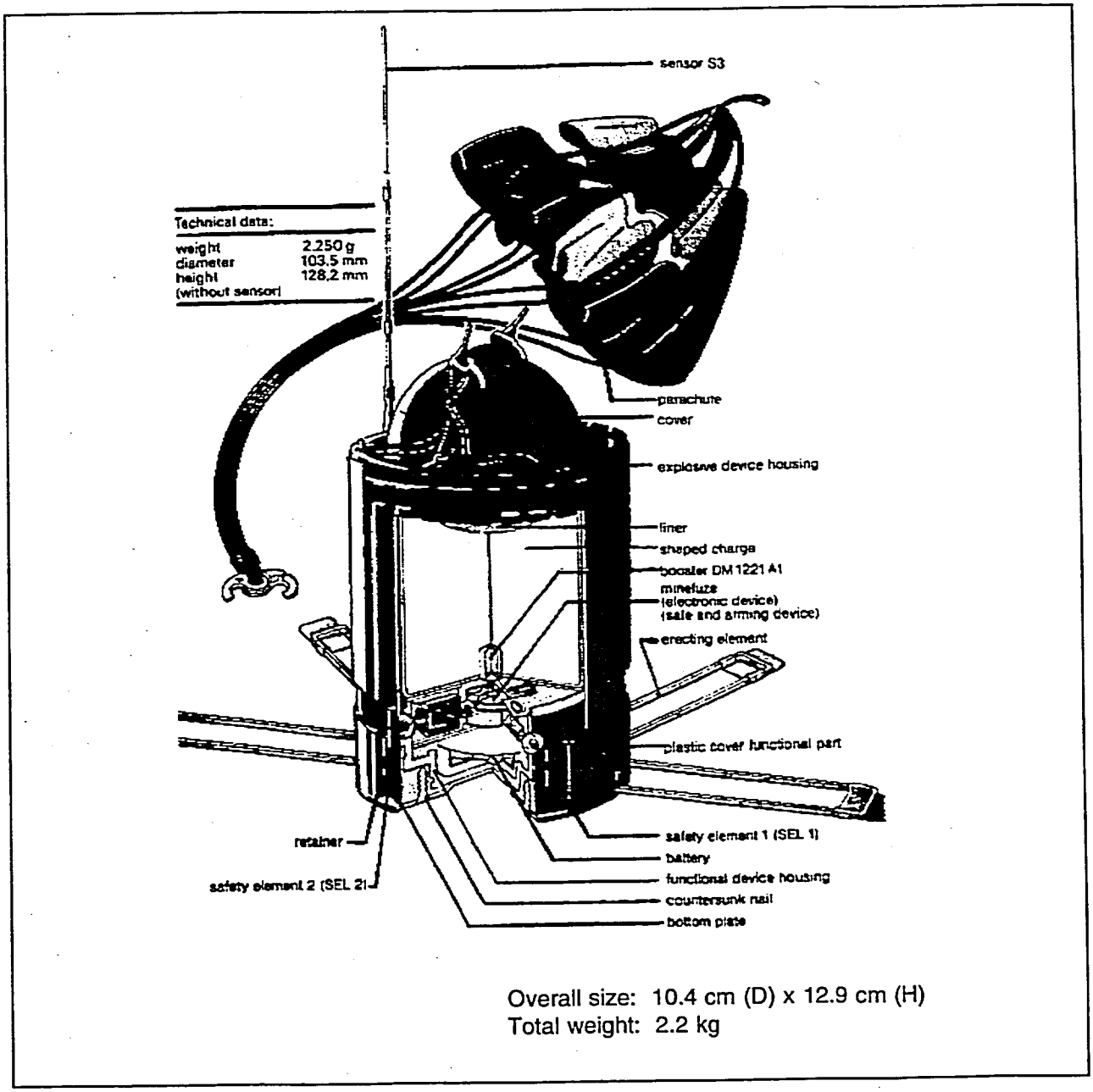
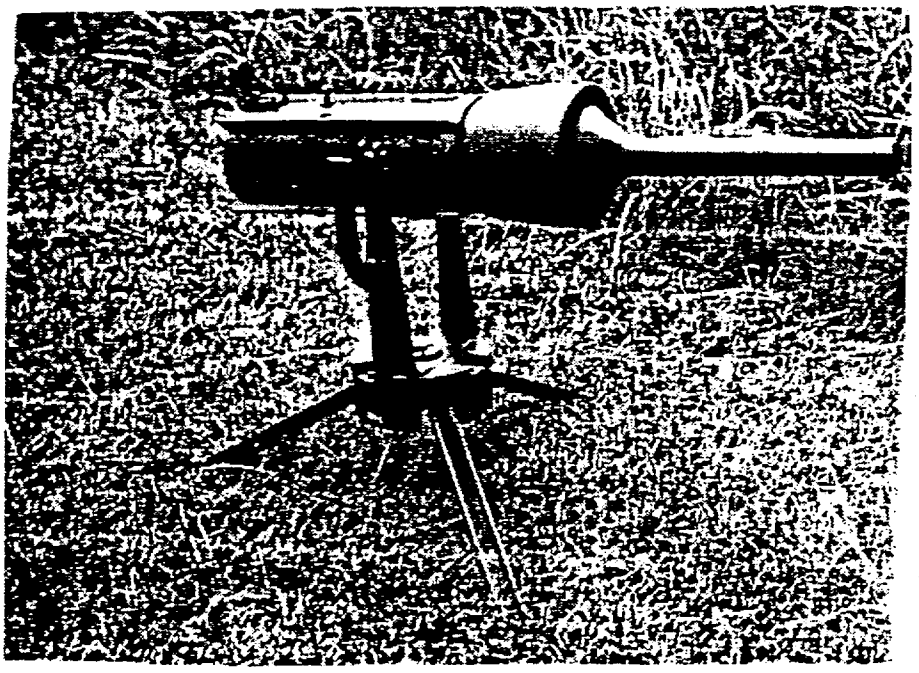


FIGURE 38 - AREA DENIAL ARTILLERY MUNITION (ADAM)



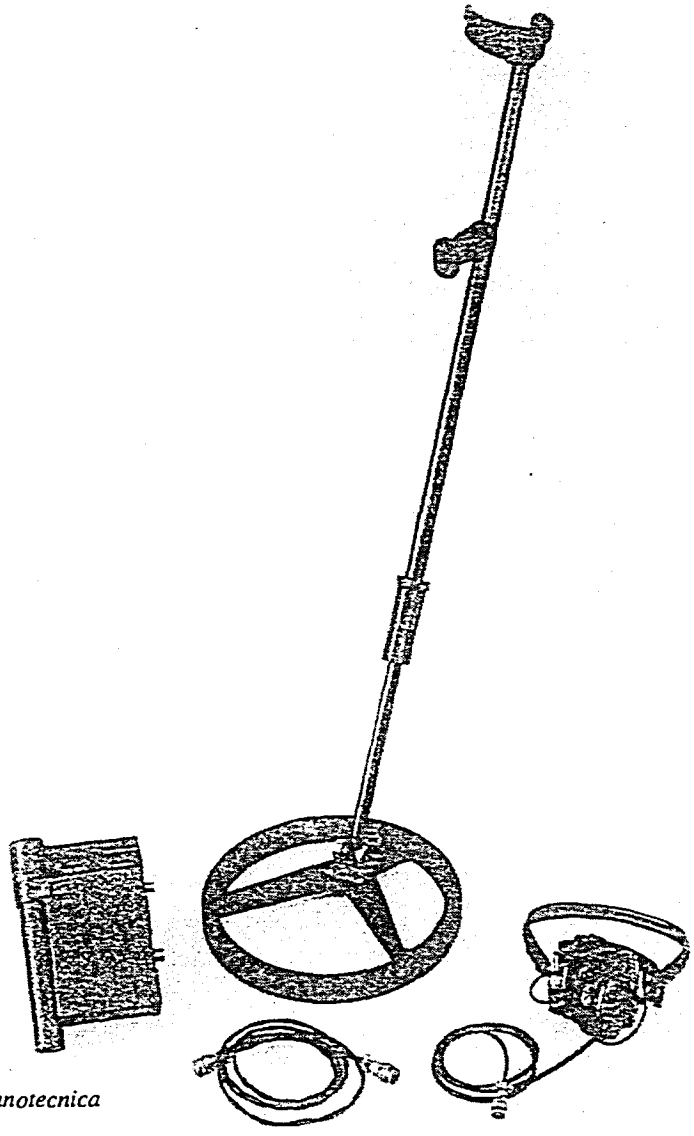
Courtesy of Dynamit Nobel

FIGURE 39 - REMOTELY DELIVERED MINE



Total weight: 10 kg

FIGURE 40 - OFF-ROUTE MINE



Courtesy of Valsella Meccanotecnica

FIGURE 41 - VS-SD1 STATUS DETECTOR

ANNEX A

QUESTIONNAIRE ON LANDMINES AND SPECIAL FEATURES AND A LIST OF COMPANIES

COMPANY NAME: _____

QUESTIONNAIRE

1. *What landmines do you presently manufacture?*

- ☐ Single impulse pressure fused anti-personnel mines
- ☐ Single impulse pressure fused antit-tank mines
- ☐ Pull fused anti-personnel mines
- ☐ Tilt rod fused anti-tank mines
- ☐ Magnetic influence fused anti-tank mines
- ☐ Acoustic fused anti-tank mines
- ☐ Double impulse pressure fused anti-tank mines
- ☐ Seismic fused anti-tank mines
- ☐ Any other applicably fused mines
- ☐ We do not manufacture landmines

2. *These landmines are they presently equipped with the following devices?*

Self destruct devices	Yes ☐	No ☐
Self neutralizing devices	Yes ☐	No ☐
Self deactivation devices	Yes ☐	No ☐

3. *Could these devices be used to retrofit conventional mines that are already equipped with such devices?*

Anti-personnel mine	Yes ☐	No ☐
Anti-tank mines	Yes ☐	No ☐

QUESTIONNAIRE

4. *If you answered yes to one of the items in question #2, would you please describe the basic functioning mechanism involved in such devices (any attach technical data that you can provide).*

_____
_____
_____
_____
_____

5. *Do you presently conduct research and/or development on the following features?*

Self destruct devices	Yes ☐	No ☐
Self neutralizing devices	Yes ☐	No ☐
Self deactivation devices	Yes ☐	No ☐

6. *Would you please specify a point of contact for further information.*

_____ Name

_____ Title

_____ Telephone

If you have any questions regarding this questionnaire, do not hesitate to contact me.
Answers to this questionnaire could be sent back to me by fax or mail.

Bruno Blouin
Specialist Engineer
Research & Development
Phone: (514) 581-3080 ext. 8358
Fax: (514) 581-0275

INTERNATIONAL COMPANIES

NAME	COUNTRY
Australian Defence Industries Ltd, Corp.	AUSTRALIA
Hirtenburger Patronen	AUSTRIA
British Aerospace, plc/Naval	ENGLAND
Ferranti Instrumentation Limited	ENGLAND
Marconi Radar & Control Systems	ENGLAND
Royal Ordnance Marketing Services	ENGLAND
Thors Emi Electronics Ltd Defence Systems	ENGLAND
ECA	FRANCE
GIAT Industries	FRANCE
Thompson Armament / Demu	FRANCE
Deuthch Aerospace	GERMANY
Dynamit Nobel AG	GERMANY
Technovar Italiana SpA	ITALY
Valsella SpA	ITALY
Israel Military Industries Ltd (IMI)	ISRAEL
Sociedade Portuguesa de Explovisos, SA	PORTUGAL
Chartered Industries of Singapore	SINGAPORE
Explosivos Alaveses SA (Expal)	SPAIN
AB Bofors Ordnance Division	SWEDEN
Makina ve Kimya	TURKEY
AAI Corporation	USA
Action Mfg Co.	USA
Aerojet Ordnance Division	USA
Alliant Techsystems Inc.	USA
Almet	USA
Bulova	USA
Motorola	USA
Pan Metal Corp.	USA
Texas Instruments	USA
Textron Defense Systems	USA
Thiokol Corporation (Ordnance Operations)	USA

ANNEX B

SUMMARY OF REPLIES TO THE QUESTIONNAIRE

SUMMARY OF REPLIES TO THE QUESTIONNAIRE

COMPANY	LANDMINE TYPE	FUSING MECHANISM	SPECIAL FEATURE	SPECIAL MECHANISM
HIRTENBERGER, AUSTRIA	Anti-Tank	Magnetic	No	No
MARCONI, ENGLAND	Anti-Tank	Magnetic	SN	Electronic Circuitry
GIAT, FRANCE	Anti-Tank	Magnetic and Acoustic	SD, SN, PSD	Clock Mechanism
THOMSON BRANDT, FRANCE	Anti-Tank	Magnetic and Seismic	SD, SN, PSD	Electronic Timer
DYNAMIT NOBEL, GERMANY	Anti-Tank	N/A	SD	No
TASS, ISRAEL	None	None	No	No
TECHNOVAR, ITALY	Anti-Personnel Anti-Tank	Single Impulse Pressure Single Impulse Pressure and Magnetic	SD, SN SD, SN	Electronic Circuitry Electronic Circuitry
VALSELLA, ITALY	Anti-Personnel Anti-Tank Anti-Vehicle	Single Impulse Pressure and Pull Single Impulse Pressure and Magnetic Command Detonated	SD, SN SD, SN No	Electronic Electronic No
EXPAL, SPAIN	Anti-Tank Anti-Personnel	Single Impulse Pressure Single and Double Impulse pressure, magnetic ans seismic	SD, SN, PSD SD, SN, PSD	Electronic Circuitry Electronic Circuitry
BOFORS, SWEDEN	Anti-Tank Anti-Tank	Single Impulse Pressure and Magnetic Tilt Rod	SN, PSD No	Electronic Timer No
MAKINA VE KINYA, TURKEY	None	None	No	No
ALLIANT TECH SYSTEMS, USA	Anti-Personnel Anti-Tank Other	Pull Magnetic Infrared	SD, SN SD, SN No	Electronic Clock Electronic Clock No
BULOVA, USA	Anti-Tank	Magnetic	SD	Electronic Timer
OLIN, USA	None	None	No	No
TEXAS INSTRUMENTS, USA	None	None	No	No
THIOKOL, USA	Anti-Personnel	Pull	No	No

(SD: Self Destruct SN: Self Neutralization PSD: Passive Self Deactivation)

ANNEX C

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechaniam	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Belgium	Anti-Personnel	NR 257		Blast	TNT	0.10	0.16	Metal-Plastic	3.9			6.5	
Belgium	Anti-Personnel	PRB M409	Pressure	Blast	Trialene	0.08	0.18	Plastic	2.8			8.2	No
Belgium	Anti-Personnel	NR 409		Blast	Trialene	0.08	0.18	Plastic	2.8			8.2	
Belgium	Anti-Personnel	NR 413	Pull	Fragmentation	Comp B	0.10	0.64	Metal-Plastic	23.0			4.6	No
Belgium	Anti-Personnel	NR 442		Fragmentation	TNT	0.56	4.50	Metal	24.5			10.5	
Belgium	Anti-Personnel	PRB BAC		Blast-Fragmentation	Trialene		0.15	Plastic	2.8			7.9	
Belgium	Anti-Personnel	PRB-M35	Pressure	Blast	TNT	0.10	0.16	Plastic	6.0			6.5	No
Belgium	Anti-Personnel	U/1	Pressure	Blast	TNT	0.06	0.136	Plastic	6.5			5.7	No
Belgium	Anti-Tank	NR 141	Percussion	Blast	Trialene	6.00	6.8		23.0	23.0	13.0		
Belgium	Anti-Tank	NR 201	Percussion	Blast			6.60		13.0	23.0	23.0		
Belgium	Anti-Tank	NR 408	Pressure-Pull	Blast	Brisance	3.60	4.13	Plastic	9.8	21.5	21.5		No
Belgium	Anti-Tank	PRB M3	Pressure	Blast	Trialene	6.00	6.80	Polyethene	13.0	23.0	23.0		No
Belgium	Anti-Tank	PRV IV	Pressure		TNT-RDX	9.00	9.20	TNT	9.9			22.0	No
Canada	Anti-Personnel	C3A1	Pressure	Blast	Tetryl	0.01	0.08	Plastic	7.6			5.1	No
Canada	Anti-Personnel	C3A2	Pressure	Blast	Comp A5	0.01	0.08	Plastic	7.6			5.1	No
Denmark	Anti-Personnel	AIPD-51											No
Denmark	Anti-Personnel	M 47-1	Pressure	Blast	TNT	0.20	0.40	Wood	13.0	15.5	7.5		
Denmark	Anti-Personnel	M14		Blast	Tetryl	0.03	0.09	Plastic	4.0			5.6	
Denmark	Anti-Personnel	M16	Pressure-Pull	Fragmentation	TNT	0.52	3.75	Steel	19.9			10.3	
Denmark	Anti-Tank	Barmine	Pressure-Tilt rod-DI	Blast	RDX-TNT	8.40	10.40	Non-metal	8.1	10.8	120.0		
Denmark	Anti-Tank	M47-1	Pressure	Blast	TNT	6.5	9.9	Metal	9.3			31.5	No
Denmark	Anti-Tank	M52	Pressure-Tilt rod	Blast	TNT	8.40	10.80	Plastic	13.0			30.0	No
Denmark	Anti-Tank	M 52/53	Pressure	Blast	TNT	8.6	11.00	Plastic	13.8			30.7	No
Denmark	Anti-Tank	M47-2	Pressure	Blast	TNT	5.4	7.2	Metal					No
Denmark	Anti-Tank	M/88			TNT/RDX	0.01	0.84	Plastic	5.4			21.8	SN
France	Anti-Personnel	Directed Fragmentation	Command Detonated	Fragmentation	Melinite	10.00	21.40	Metal	12.2	31.5	31.5		No
France	Anti-Personnel	DV-56	Pressure	Blast	Tolite	0.08	0.16	Plastic	8.0			7.2	No
France	Anti-Personnel	Fragmentation Plate Charge	Friction	EFP									
France	Anti-Personnel	M 1948 SCHU	Pull	Blast	TNT or ANFO	0.17	0.59	Tar	6.4	10.0	10.7		No
France	Anti-Personnel	M 1951		Blast	PETN	0.05	0.09	Plastic	5.0			6.9	No
France	Anti-Personnel	M 51	Pressure-Tilt rod	Fragmentation				Steel					
France	Anti-Personnel	M 51/55	Pressure-Pull	Fragmentation	Tolite	0.36	4.00	Metal	16.0			10.0	
France	Anti-Personnel	M 59	Pressure	Blast	TNT	0.06	0.13	Plastic	5.5			6.2	No
France	Anti-Personnel	M1951/1955	Pull-Tilt rod	Fragmentation	Pitric Acid	0.408	4.5		15.8	9.7	9.7		SD

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
France	Anti-Personnel	M-1956	Pressure	Blast	Tolite	0.08	0.16	Plastic	6.0			7.2	No
France	Anti-Personnel	MAPED F1	Pressure	Fragmentation	Plastic Explosive		1.00	Metal	22.0	18.0	6.0		No
France	Anti-Personnel	MIAPMB 51/55		Fragmentation	TNT		4.00	Metal	13.5			10.0	No
France	Anti-Personnel	Mk 61	Pressure-Pull	Fragmentation	TNT	0.06	0.13	Plastic	27.0			3.5	No
France	Anti-Personnel	Mk 63	Pressure	Fragmentation	Tetryl	0.03	0.10	Plastic	27.0			3.5	No
France	Anti-Tank	ACPM		Blast		4.70	6.40	Plastic	10.5	18.5	28.0		
France	Anti-Tank	ACPM Type LXT 542L		Blast		6.00	8.50	Plastic	10.5	25.2	28.0		
France	Anti-Tank	ACPR		Blast		4.00	5.00	Plastic	10.5	18.5	26.0		
France	Anti-Tank	Antitank Plate Charge		EFP	Melinite	7.30	13.00	Steel	12.0			28.0	
France	Anti-Tank	APILAS-Mine		Off-route			12.00		110.0			28.0	
France	Anti-Tank	ARGES		Blast									
France	Anti-Tank	HPD	Magnetic-Seismic	Shaped Charge	Comp B	6.00	7.00	Plastic	10.5	18.5	28.0		SD
France	Anti-Tank	HPD 1A	Magnetic-Seismic	Shaped Charge	Comp B	3.30	7.00	Plastic	10.5	18.5	28.0		SN
France	Anti-Tank	HPD 3	Magnetic-Seismic	Shaped Charge			7.00	Plastic	10.5	18.5	28.0		SN
France	Anti-Tank	HPD F1	Magnetic-Seismic	Shaped Charge	Comp B	2.30	6.10	Plastic	10.3	19.0	28.0		
France	Anti-Tank	HPD F2	Magnetic-Seismic	Shaped Charge	Comp B		7.00	Plastic	10.5	18.5	28.0		SN
France	Anti-Tank	Lance Mine	Magnetic	Shaped Charge		0.70	2.34					13.9	
France	Anti-Tank	M 1947	Pressure	Blast	TNT	5.40	11.00	Plastic	11.0			34.0	No
France	Anti-Tank	M 1948	Pressure-Tilt rod	Blast	TNT	5.00	8.98	Metal	8.8			32.0	
France	Anti-Tank	M 1948, Plate Charge	Pressure-Tilt rod	EFP	Picric Acid-TNT	7.28		Metal	13.5			27.5	No
France	Anti-Tank	M 1948T		EFP				Steel					
France	Anti-Tank	M 1951	Pressure-Tilt rod	EFP	TNT	6.48	7.00		9.5			30.0	No
France	Anti-Tank	M 1951 (Grille)	Pressure	Blast	PETN			Plastic	15.0	24.2	24.2		
France	Anti-Tank	M 1951 Metallic		Shaped Charge				Metal					
France	Anti-Tank	M 1952	Pressure-Tilt rod	Blast	TNT	6.48	9.00	TNT	12.0			30.0	No
France	Anti-Tank	M 1953	Pressure	Shaped Charge		0.30	1.90	Metal	28.0			7.3	No
France	Anti-Tank	M 1954	Tilt rod	Shaped Charge		0.30	1.20	Metal	26.0			14.6	No
France	Anti-Tank	M 1956	Magnetic-Tilt rod	Shaped Charge				Metal					
France	Anti-Tank	M 48/55	Magnetic	EFP				Metal					
France	Anti-Tank	M 51	Pressure-Tilt rod	Blast	PETN	7.50	8.32	Plastic	15.0			24.2	
France	Anti-Tank	MACIPE	Pressure	Blast		3.5	5.00	Plastic	10.5	28.0	18.0		No
France	Anti-Tank	MAZAC	Seismic	EFP						28.0	18.0		
France	Anti-Tank/Off-Route	MIACAH F1	Infrared	Shaped Charge		5.00	12.00	Metal	12.5			20.0	No
France	Anti-Tank	Minotaur AT		Shaped Charge									

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
France	Anti-Tank	Mitral AT Mine		Blast	RDX		2.60		10.0	30.0	10.0		
France	Anti-Tank	Model 1951 Plastic		Shaped Charge				Plastic					
France	Anti-Tank	MI AC DIS F1	Magnetic		Hexal	0.60	2.30						SD
France	Anti-Tank/Personnel	Belouga Bomblet					1.30	Steel	15.0			6.5	
France	Anti-Vehicle	Antivehicle Plate Charge		EFP	Melinite	11.10	18.00	Steel	10.0			38.0	
France	Influence	TSM 3510											
France	Influence	TSM 3530											
France	Off-Route	ACL 89		Off-route		0.80	2.20						
Germany	Anti-Armor	KB 44		Shaped Charge									
Germany	Anti-Lift	DM-39A1											
Germany	Anti-Material	DYNAMINE Anit-Material		Shaped Charge			2.22					103.5	
Germany	Anti-Personnel	Butterfly Bomb											
Germany	Anti-Personnel	DM-11	Pressure	Blast	TNT	0.12	0.23	Plastic	3.4			8.2	
Germany	Anti-Personnel	DM-31	Pull	Blast-Fragmentation	TNT	0.54	4.00	Steel	13.6			10.2	No
Germany	Anti-Personnel	DM-39	Lift	Blast	TNT-RDX	0.30	0.48	Plastic-Metal	4.0			10.0	
Germany	Anti-Personnel	Dragon Seed "LARS"											
Germany	Anti-Personnel	DYNAMINE Anti-Personnel		Fragmentation			2.22					103.5	
Germany	Anti-Personnel	K2	Pressure-Pull	Fragmentation	Nitro Penta	3.00	5.00	Plastic	25.0			10.0	No
Germany	Anti-Personnel	MUSA		Fragmentation					11.3			12.2	
Germany	Anti-Personnel	MUSPA	Audio Frequency	Fragmentation			4.50		11.3			12.2	
Germany	Anti-Personnel	PMP 71/2	Pressure	Blast	TNT	0.10	1.50	Plastic	11.0			12.2	No
Germany	Anti-Personnel	PPM-2	Pressure	Blast	TNT	0.11	0.37	Plastic	6.3			12.5	No
Germany	Anti-Personnel	Ration-Can Mine		Fragmentation		0.10		Aluminum					
Germany	Anti-Personnel	Remote Bounding		Fragmentation									
Germany	Anti-Personnel	Remote Controlled AP Mine	Command Detonated	Fragmentation									No
Germany	Anti-Personnel	S-Mine 35	Pressure-Pull	Fragmentation	TNT	0.3118		Steel	12.7			10.1	
Germany	Anti-Personnel	SD-2	Pressure-Pull	Blast-Fragmentation	TNT	0.21	2.04						
Germany	Anti-Personnel	SM-70	Pull-Command detonated	Fragmentation	TNT		0.2	Plastic-Steel	8.3			10.1	
Germany	Anti-Personnel	Truppmina 11		Fragmentation		0.55	4.0	Steel	13.6			10.2	
Germany	Anti-Personnel	W-1		Blast				Aluminum					
Germany	Anti-Tank	Aluminum AT Mine	Pressure	Blast	Cheddite	4.7	7.5	Aluminum	12.0			32.0	
Germany	Anti-Tank	AT-I	Pressure	Blast		1.3	2.0	Metal	33.0			5.5	SD
Germany	Anti-Tank	AT-II (Medusa)	Pressure-Electric	Shaped Charge	Hexogen	0.8			13.0	10.0	10.0		SD
Germany	Anti-Tank	AT2		Shaped Charge	RDX	0.85	2.25	Metal	12.8			10.35	SD-PSD

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Germany	Anti-Tank	DM-11	Pressure	Blast	TNT	7.0	7.4	TNT-Polyester	9.5			30.0	No
Germany	Anti-Tank	DM-24	Pressure	Blast	TNT-RDX	5.17	9.16	Aluminum	13.3			30.5	
Germany	Anti-Tank	DT-21		Blast		4.8	9.0	Aluminum	9.8			30.0	
Germany	Anti-Tank	K-1	Pressure		TNT	7.00	11.00	Plastic	15.0			25.0	No
Germany	Anti-Tank	Light Antitank Mine	Pressure	Blast		2.27	4.09	Steel	6.0			26.0	
Germany	Anti-Tank	MIFF	Magnetic-Seismic	Shaped Charge			3.4					12.2	No
Germany	Anti-Tank	No 3			TNT-RDX	4.0		Plastic	10.8			24.0	
Germany	Anti-Tank	PARM 1	Pull-Influence	Off-route		1.5	10.0	Metal	39.0			25.6	
Germany	Anti-Tank	PZ-MI-2 (Panzermine)	Pressure	Shaped Charge	TNT-RDX	5.6	10.2	Metal	12.8			30.0	No
Germany	Anti-Tank	R.MI.43	Pressure	Blast	TNT	4.0	9.32	Steel	9.0	9.5	81.0		
Germany	Anti-Tank	R.MI.44	Pressure	Blast	TNT	4.0		Steel					
Germany	Anti-Tank	SPR.R.MI	Pressure	Blast	TNT	8.0	9.1	Steel	8.5	10.0	84.0		
Germany	Anti-Tank	Tellermine 29	Pressure-Pull	Blast	TNT	4.5	5.9	Zinc	6.4			25.4	
Germany	Anti-Tank	Tellermine 35	Pressure	Blast	TNT-Amatol								
Germany	Anti-Tank	Tellermine 35 (Steel)	Pressure	Blast	TNT	5.00	8.70	Steel	8.3			30.3	
Germany	Anti-Tank	Tellermine 42	Pressure	Blast	TNT	5.45	8.6	Steel	10.1			32.2	
Germany	Anti-Tank	Tellermine 43(P)	Pressure	Blast	TNT	5.79	8.2	Steel	10.0			31.0	
Germany	Anti-Vehicle	Bottle Type Ice Mine	Pressure-Electric	Blast	Gelatine donarit	1.8	2.5	Glass	27.0			10.2	No
Germany	Anti-Tank	DM-21	Pressure	Blast	TNT	5.00	9.26	Aluminum	10.0			30.0	
Germany	Dual Purpose	PM-60	Pressure	Blast	TNT	7.50	11.35	Plastic	11.7			32.0	No
Germany	Influence	FGI											
Germany	Runway Cratering	STABO					16.00		60.3				
Germany	Shallow-Water	DYNAMINE Shallow Water		Shaped Charge			2.215		26.2			103.5	
Italy	Anti-Landing Craft	MALT/17	Pressure	Blast	TNT	17.00	22.00		24.0			38.0	No
Italy	Anti-Landing Craft	MAL/17	Tilt rod	Blast	TNT	17.00	22.00		63.0			38.0	No
Italy	Anti-Landing Craft	MANTA	Magnetic-Seismic	Blast	TNT-HBX-3	140.00	220.00	Plastic	49.0			98.0	SN
Italy	Anti-Landing Craft	MAS/22	Pressure-Tilt rod	Blast	TNT	18.00	22.00		37.0			32.0	No
Italy	Anti-Landing Craft	VS-RM-30	Magnetic-Command detonated	Blast		30.00	40.00		20.0			50.0	No
Italy	Anti-Personnel	Anti-personnel Mine (SCHU)		Fragmentation	TNT	0.149	0.4535	Plastic-Wood	3.7	13.9	6.2		
Italy	Anti-Personnel	Anti-personnel Mine R	Pull	Fragmentation	TNT	0.15		Wood	4.5	8.3	14.9		
Italy	Anti-Personnel	AUPS	Pressure-Pull	Blast-Fragmentation	Comp B	0.109	0.3	Plastic	3.6			10.2	No
Italy	Anti-Personnel	AUS 50/5	Pressure-Pull	Fragmentation	TNT-Comp B	0.147	1.423	Plastic	9.86			13.0	No
Italy	Anti-Personnel	B-4		Blast	TNT	0.1134		Steel	12.9			6.8	

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Italy	Anti-Personnel	BM/85	Pressure-Pull-Command detonated	Fragmentation	Comp B	0.45	2.00		20.0			12.0	No
Italy	Anti-Personnel	Dual Purpose ICM	Impact	Shaped Charge		0.035	0.198		8.1			3.8	
Italy	Anti-Personnel	IT-S-AP		Blast		0.034	0.135		3.2			9.0	No
Italy	Anti-Personnel	LORY	Pressure	Blast	Tetryl	0.082	0.25	Plastic	4.0			11.5	No
Italy	Anti-Personnel	M 51		Fragmentation	TNT	0.23	2.9	Plastic	14.0			11.7	No
Italy	Anti-Personnel	M-59		Fragmentation	Comp B	0.54	3.1	Metal	16.8			10.5	No
Italy	Anti-Personnel	Maus	Pressure	Blast	Tetryl	.02	.277	Plastic-Neoprene-Steel	4.6			8.9	No
Italy	Anti-Personnel	Maus-1	Pressure	Blast	4% Phlegmetized T4	0.0155	0.267	Plastic-Neoprene-Steel	4.6			8.9	
Italy	Anti-Personnel	Minelba Type A	Pressure	Blast			0.17	Plastic	3.1			10.6	
Italy	Anti-Personnel	Minelba Type B	Pressure	Blast			0.17	Plastic	3.1			10.8	
Italy	Anti-Personnel	Model R		Fragmentation	TNT	0.15	0.451	Wood	4.6	6.6	15.0		
Italy	Anti-Personnel	Model V	Pull	Fragmentation	TNT	0.091	0.9	Iron	39.0			3.6	No
Italy	Anti-Personnel	P-25	Pull	Fragmentation	TNT	0.14	0.7	Plastic	18.0			7.5	No
Italy	Anti-Personnel	P-40	Pressure-Pull	Fragmentation	TNT	0.48	1.5	Plastic	20.0			9.0	No
Italy	Anti-Personnel	Picket Mine		Blast		0.099		Metal	19.0			3.7	
Italy	Anti-Personnel	PMC	Pressure	Blast					1.2	10.1	10.1		
Italy	Anti-Personnel	RM	Pull		TNT	0.15	0.451	Wood	4.6	8.4	15.0		
Italy	Anti-Personnel	SB-33	Pressure	Blast	Comp A3	0.035	0.14	Plastic	3.2			8.8	No
Italy	Anti-Personnel	Thermos Bottle Mine			TNT	0.6	4.00						
Italy	Anti-Personnel	TS-50	Pressure	Blast	T4	0.05	0.186	Plastic	4.5			9.0	No
Italy	Anti-Personnel	T/79	Pressure	Blast	T4	0.05	0.186	Plastic	4.5			9.0	No
Italy	Anti-Personnel	VALMARA		Fragmentation	Comp B	0.544	3.6	Plastic-Metal	20.1			10.4	
Italy	Anti-Personnel	Valmara 59	Pressure-Pull	Fragmentation	Comp B	0.55	3.20	Steel	19.6			10.2	No
Italy	Anti-Personnel	Valmara 69	Pressure-Tilt rod	Fragmentation	Comp B	0.42	3.2	Plastic	13.0			20.5	No
Italy	Anti-Personnel	VAR/100	Pressure	Blast	T4	0.10	0.17	Plastic	5.7			7.2	No
Italy	Anti-Personnel	VAR/100/SP	Pressure-Pull	Fragmentation		0.10	1.77	Iron	13.8			12.0	No
Italy	Anti-Personnel	VAR/40	Pressure	Blast	T4	0.04	0.11	Plastic	4.5			7.8	No
Italy	Anti-Personnel	VS 50	Pressure	Blast	TNT-RDX	0.04	0.19	Plastic	4.5			9.0	No
Italy	Anti-Personnel	VS-APFM1	Pull	Fragmentation	Comp B	0.5	3.50	Plastic	19.0			13.0	SN
Italy	Anti-Personnel	VS-ER-83	Pressure	Fragmentation		0.70	4.35		34.5			11.3	SN-SD
Italy	Anti-Personnel	VS-Mk2	Pressure	Blast	RDX	0.03	0.135	Plastic	3.2			9.0	No
Italy	Anti-Personnel	VS-Mk2-E	Pressure	Blast	RDX	0.02	0.14	Non-metal	3.2			9.0	SN-SD
Italy	Anti-Personnel	Scatterable	Pressure	Blast		0.034	0.135		3.2			9.0	No

Special Features:

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Italy	Anti-Tank	Antitank Mine Type II				3.63		Plastic	13.9			29.9	
Italy	Anti-Tank	ATIS		Shaped Charge				Plastic					
Italy	Anti-Tank	B2			TNT	3.18		Wood	21.5	19.0	87.6		
Italy	Anti-Tank	B-2	Pressure	Blast		2.72		Metal					
Italy	Anti-Tank	BAT/7	Magnetic	EFP		3.60	5.60	Plastic	16.0			27.0	No
Italy	Anti-Tank	CC 48	Pressure	Shaped Charge	TNT	1.81	4.00	Wood	13.9	12.9	28.4		
Italy	Anti-Tank	CS 42/2	Pressure	Blast	TNT	4.99	7.80	Wood-Metal	16.0	34.0	28.0		No
Italy	Anti-Tank	CS 42/3	Pressure	Blast	TNT	5.00	6.99	Wood	14.5	24.0	28.0		No
Italy	Anti-Tank	FIROS-25	Magnetic-Seismic	Shaped Charge								11.6	SD
Italy	Anti-Tank	FSA-ATM											No
Italy	Anti-Tank	G50	Pressure	Shaped Charge	TNT	4.00	7.30	Plastic	29.0			22.0	
Italy	Anti-Tank	Hydraulic Antitank Mine	Pressure	Blast	TNT	3.80	9.30	Aluminum	90.0			8.7	
Italy	Anti-Tank	MAT/5	Pressure	Blast	Comp B	5.00	7.00	Non-metal	10.8			29.0	No
Italy	Anti-Tank	MAT/6	Pressure	Blast		6.30	7.10	Resin	14.2			27.0	No
Italy	Anti-Tank	MATS/2	Pressure	Blast	T4-Comp B	2.6	4.0	Plastic	9.0			26.0	SN
Italy	Anti-Tank	MATS/2.6	Pressure	Blast	T4-Comp B	2.40	5.00	Plastic	9.0			26.0	
Italy	Anti-Tank	P-1	Pressure	Blast	TNT	6.99	9.40	Plastic	14.0			33.5	
Italy	Anti-Tank	P-2	Pressure		TNT	4.99	7.00	Plastic	12.7			33.0	
Italy	Anti-Tank	SACI 54/5	Pressure	Blast	TNT	5.00	6.23	Plastic	16.0			28.2	
Italy	Anti-Tank	SACI 54/7	Pressure	Blast	TNT	7.00	8.23	Plastic	20.5			28.2	No
Italy	Anti-Tank	SACI 54/7 (HEAVY)		Blast	TNT		10.20	Non-metal	18.8			27.6	No
Italy	Anti-Tank	SACI 54/7 (LIGHT)	Pressure	Blast	TNT		6.21	Metal-Plastic	15.4			27.6	No
Italy	Anti-Tank	SACI 54/9	Pressure	Blast	TNT	9.00	10.23	Plastic	19.1			28.2	
Italy	Anti-Tank	SACI IMAC-10	Pressure	Blast	TNT	10.00	12.00	Plastic	16.0			29.0	
Italy	Anti-Tank	SACI IMAC-5	Pressure	Blast	TNT	5.50	7.00	Plastic	13.0			27.5	
Italy	Anti-Tank	SACI IMAC-7	Pressure	Blast	TNT	7.00	8.70	Plastic	13.0			29.0	
Italy	Anti-Tank	SATM	Magnetic	Shaped Charge		0.40	1.40	Metal	10.6			9.6	SD
Italy	Anti-Tank	SB-81	Pressure	Blast	Comp B	2.00	3.2	Plastic	9.0			22.3	SD-SN
Italy	Anti-Tank	SB-MV/1	Magnetic	Shaped Charge	Comp B	2.6	5.00	Plastic	10.1			23.6	SN
Italy	Anti-Tank	SBP-04	Pressure	Blast		4.00	5.00	Plastic	11.0			25.0	SN
Italy	Anti-Tank	SBP-07	Pressure	Blast		7.00	8.20	Plastic	13.0			30.0	SN
Italy	Anti-Tank	SH-55	Pressure	Blast	Comp B	5.50	7.30	Resin	12.2			28.0	No
Italy	Anti-Tank	TC/2.4	Pressure	Blast	Comp B	2.40	3.30	Non-metal	10.8			20.4	
Italy	Anti-Tank	TCE/6	Pressure	Blast	Comp B	6.00	9.60	Plastic	18.5			27.0	No

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Italy	Anti-Tank	TCE/3.6	Pressure	Blast	Comp B	3.60	6.80	Plastic	14.5			27.0	No
Italy	Anti-Tank	Type 9				5.44		Wood	13.3	22.8	99.0		
Italy	Anti-Tank	Type I		EFP		3.63		Plastic	13.0			29.5	
Italy	Anti-Tank	V-3 and N-5	Pressure	Blast		2.72		Metal	6.8	6.2	114.3		
Italy	Anti-Tank	VS 1.6	Pressure	Blast		1.85	3.00	Plastic	9.2			22.2	No
Italy	Anti-Tank	VS 2.2	Pressure	Blast	Comp B	2.13	3.50	Plastic	12.0			24.0	No
Italy	Anti-Tank	VS 3.6	Pressure	Blast	Comp B	4.00	5.00	Plastic	11.5			24.8	No
Italy	Anti-Tank	VS-HCL	Magnetic	Shaped Charge								11.6	
Italy	Anti-Tank	VS-HCT	Magnetic-Seismic	Shaped Charge	Comp B	5.00	7.00	Plastic	10.8			29.0	SN-PSD
Italy	Anti-Tank	VS-HCT2	Magnetic-Seismic	Shaped Charge	Comp B	2.30	6.80	Plastic	12.6	26.0	26.0		SD-SN
Italy	Anti-Tank	VS-HCT4	Magnetic-Seismic	Blast-Shaped Charge	Comp B	2.30	5.50	Plastic	10.4	18.8	28.0		SD-SN
Italy	Limpet Mine	EPR/2.5		Blast		2.50	5.00	Plastic	9.0			26.0	No
Italy	Limpet Mine	VS-SS-22	Blast			10.00	20.00	Plastic					
Italy	Shallow-Water	Type IO		Contact	Torpex	193.00	354.00	Steel	246.0			45.7	
Italy	Anti-Tank	VS-SATM1	Magnetic	EFP	Comp B	0.8	2.3	Plastic	11.3			12.8	SN-SD
Italy	Anti-Tank	SB-MV1	Magnetic-Seismic	EFP	Comp B	2.4	5.00	Plastic	11.3			23.6	SN
Italy	Anti-Tank	VS-AT4-EL	Pressure	Blast		4.5	6.00	Plastic	104.0	18.8	28.0		SN-SD
Italy	Anti-Personnel	VS-MK2-EL	Pressure	Blast		0.015	0.2	Plastic	3.5			8.95	SN-SD
Italy	Anti-Personnel	VS-SAPFM3	Pull	Fragmentation	Comp B	0.45	2.3	Plastic	10.5	12.8			SN
Italy	Anti-Personnel	VS-DAFM1	Pull-Command detonated	Fragmentation			3.6	Plastic	16.8	34.2			No
Italy	Anti-Vehicle	VS-DAFM3	Pull-Command detonated			2.00	4.00	Plastic	19.0	33.0			No
Italy	Anti-Personnel/Vehicle	VS-DAFM8	Pull-Command detonated	Fragmentation			18.2	Plastic	27.0	53.0			No
Italy	Anti-Personnel/Vehicle	VS-DAFM7	Pull-Command detonated	Fragmentation			10.7	Plastic	17.0	19.0			No
Italy	Anti-Personnel	VS-JAP	Pressure-Pull	Fragmentation		0.5	2.8	Plastic	19.0			13.0	No
Italy	Anti-Tank	VS-9.0	Magnetic	Blast		9.00	11.00	Plastic	13.5			33.5	No
Italy	Anti-Tank	VS-AT4	Pressure	Blast	Comp B	4.00	5.7	Plastic	10.4	18.8	28.0		No
Netherlands	Anti-Personnel	AP 23		Fragmentation	Comp B	0.50	4.50	Steel	18.5			20.0	
Netherlands	Anti-Personnel	Model 15	Pressure	Blast	TNT	0.18	0.79	Plastic	6.7	10.0	11.3		No
Netherlands	Anti-Personnel	Model 22	Pressure		TNT	0.04	0.09	Plastic	5.0			7.2	
Netherlands	Anti-Tank	Model NR 22C1			TNT	0.06	0.13	Plastic	5.4			6.2	No
Netherlands	Anti-Tank	26C1		Blast	TNT	9.00	9.00	TNT-Glass Fiber	12.0	30.0			
Netherlands	Anti-Tank	Model 25	Pressure	Blast	TNT	9.00	12.97	Steel	12.8			30.5	No
Netherlands	Anti-Tank	Model 26	Pressure	Blast	TNT	9.00	9.00		11.3	11.3	30.0		
Netherlands	Anti-Tank	T 40	Pressure	Blast	TNT	4.08	6.00	Metal	9.0			26.0	No

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Portugal	Anti-Personnel	m/966	Pressure	Fragmentation									
Portugal	Anti-Personnel	m/966		Fragmentation				Metal					
Portugal	Anti-Personnel	M432	Pull	Fragmentation	TNT	0.60	3.90		13.1			10.5	
Portugal	Anti-Personnel	MAPS		Blast	TNT	0.09	0.18	Non-metal	3.5			6.8	
Spain	Anti-Personnel	CP-X02	Pressure			0.04	0.058	Plastic	3.4			7.2	No
Spain	Anti-Personnel	FAMA	Pressure	Blast	TNT or Tetryl	0.05	0.09	Plastic	3.8			7.0	
Spain	Anti-Personnel	H-1	Pressure						11.8	11.8	11.8		
Spain	Anti-Personnel	M45B											
Spain	Anti-Personnel	P-4	Pressure	Blast	TNT		0.15	Plastic	3.6			7.0	
Spain	Anti-Personnel	P-4-A	Pressure	Blast	TNT	0.10	0.21	Plastic	5.5			7.2	
Spain	Anti-Personnel	P-S-1	Pull	Fragmentation	TNT	0.45	3.78	Steel	12.7			9.6	No
Spain	Anti-Tank	C-3	Pressure	Blast	TNT		5.20	Plastic	8.5			27.0	No
Spain	Anti-Tank	C-3-A	Pressure	Blast	TNT	5.00	5.90	Plastic	11.5			28.5	No
Spain	Anti-Tank	CETME	Pressure	Blast	TNT	5.22	9.98	Plastic	15.3			46.0	No
Turkey	Anti-Tank	4 SKG	Pressure	Blast	TNT	4.49	6.48	Metal	7.6			25.4	No
United Kingdom	Anti-Landing Craft	Dragonfish											
United Kingdom	Anti-Personnel	DORIS	Pressure	Blast-Shaped Charge	Tetryl	0.014	0.14	Plastic	10.2			7.8	No
United Kingdom	Anti-Personnel	L10A2		Blast	RDX-Wax		7.70	Plastic	3.2			6.2	
United Kingdom	Anti-Personnel	Mark 1 "Dingbat", No. 7		Blast			13.00		3.5			6.4	No
United Kingdom	Anti-Personnel	Mk 1 Model											
United Kingdom	Anti-Personnel	MARK 2		Fragmentation		0.45	4.45	Metal	15.2			15.0	
United Kingdom	Anti-Personnel	No. 5	Pressure	Blast		0.20	0.23	Cardboard	8.9			5.1	
United Kingdom	Anti-Personnel	No. 6	Pressure	Blast		0.14	0.23	Plastic	20.3			4.5	
United Kingdom	Anti-Personnel	No. 7	Pressure	Blast		0.04	0.11	Metal	3.5			6.4	
United Kingdom	Anti-Personnel	Ointment Box	Pressure		TNT	0.09	0.23						
United Kingdom	Anti-Personnel	PADMINE		Fragmentation			1.28		12.0	20.5	5.5		
United Kingdom	Anti-Personnel	Ranger EMI Mine System	Pressure	Blast	RDX	0.01	7.7		3.2	6.2	6.2		
United Kingdom	Anti-Tank	Barmine L18A1	Pressure-Tilt rod-DI	Blast	RDX-TNT	7.20	10.40	Plastic	8.1	10.8	120.0		No
United Kingdom	Anti-Tank	Infantry Mine Project	Influence	Shaped Charge			1.00	Plastic	5.5	9.2	16.0		
United Kingdom	Anti-Tank	L14A1	Infrared-Command Detonated	Shaped Charge	Hexalite	5.00	12.00	Metal	26.0			20.0	
United Kingdom	Anti-Tank	L3A1	Pressure	Blast	TNT	6.00	7.70	Plastic	14.5			26.6	
United Kingdom	Anti-Tank	LAWMINE		Off-route									
United Kingdom	Anti-Tank	MARK 5	Pressure	Blast	TNT	3.60	5.67	Metal	10.0			20.0	No
United Kingdom	Anti-Tank	MARK 7	Pressure-Tilt rod-DI	Shaped Charge	TNT	8.89	13.60	Steel	13.0			32.5	No

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
United Kingdom	Anti-Tank	MK2	Pressure	Blast	TNT	1.814	3.175	Metal	7.2			19.0	
United Kingdom	Aera Denial	HB 876		Fragmentation			2.50	Metal-Plastic	15.0			10.0	
United Kingdom	Influence	Sea Urchin	Influence										
United Kingdom	Limpet Mine	Rigid Limpet Assault Mine	Delay	Blast		1.20		Brass	6.5	6.5	21.1		
United Kingdom	Off-Route	Adder	Command Detonated	Off-route			9.00		150.0			18.8	
United Kingdom	Off-Route	Addermine	Pull	Off-route			9.00		150.0			18.8	
United Kingdom	Off-Route	Addermine/Ajax	Influence	Off-route			9.00		150.0			18.8	
United Kingdom	Anti-Tank	MK 2	Pressure	Blast	TNT	1.814	3.175	Metal	7.2			190.0	
United States	Anti-Armor	SLAM		EFP									
United States	Anti-Armor	WAM		EFP									SD
United States	Anti-Helicopter	AHM	Acoustic	EFP			10.00				33.5	18.0	SD-SN
United States	Anti-Helicopter	Anti-Helicopter Demo Mine		EFP									
United States	Anti-Helicopter	Anti-Helicopter Mine		EFP			18.14						
United States	Anti-Material/Armor	BLU 77/B Bomblet		Fragmentation			0.45	Steel	22.4			4.0	
United States	Anti-Personnel	ADAM		Fragmentation	Comp A5	0.02	0.55	Metal	6.4			12.7	
United States	Anti-Personnel	BLU 61A/B Bomblet		Fragmentation			1.2	Steel-Plastic				6.4	
United States	Anti-Personnel	BLU 92/B	Pull	Fragmentation	Comp B	0.4	1.98	Metal	6.6	14.6	12.7		SD
United States	Anti-Personnel	BLU-42		Fragmentation	Comp B	0.12						6.4	
United States	Anti-Personnel	BLU-43	Pressure	Blast			0.02						
United States	Anti-Personnel	BLU-43B	Pressure	Blast	Liquid Explosive	0.009	0.02		1.3	7.6	6.4		SD
United States	Anti-Personnel	BLU-44		Blast			0.02						
United States	Anti-Personnel	BLU-54 (BLU-42/B)	Pull	Blast-Fragmentation	Comp B	0.065					6.4		No
United States	Anti-Personnel	BLU-61A (BLU-61/B)		Fragmentation		0.065	1.2	Steel-Plastic				6.4	
United States	Anti-Personnel	BLU-63B (BLU-86/B)		Fragmentation		0.065	0.45	Steel				7.6	
United States	Anti-Personnel	BLU-92/B		Fragmentation	Comp B	0.4	1.68		6.6	14.6	12.7		
United States	Anti-Personnel	Daneye		Fragmentation									No
United States	Anti-Personnel	M1											
United States	Anti-Personnel	M1 One Gallon Mine											
United States	Anti-Personnel	M14	Pressure	Blast	Tetryl	0.029	0.099	Plastic	4.0			5.6	No
United States	Anti-Personnel	M16	Pressure-Pull	Fragmentation	TNT	0.521	3.75	Steel	19.86			10.3	No
United States	Anti-Personnel	M16A1	Pressure-Pull	Fragmentation	TNT	0.513	3.57	Steel	20.3			10.3	No
United States	Anti-Personnel	M16A2	Pressure-Pull	Fragmentation	TNT	0.59	2.83	Metal	19.9			10.3	No
United States	Anti-Personnel	M18A1	Pull-Command detonated	Fragmentation	C4	0.685	1.58	Plastic	8.3	21.6	3.5		No
United States	Anti-Personnel	M25	Pressure	Blast	Tetryl	0.024	0.9	Plastic-Metal	9.2			2.5	No

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
United States	Anti-Personnel	M26	Pressure-Pull	Fragmentation	Comp B	0.17	1.00	Aluminum	14.48			7.88	No
United States	Anti-Personnel	M2A3B2											
United States	Anti-Personnel	M2A4	Pull	Fragmentation	TNT	0.1542	2.948	Steel	24.4			10.4	No
United States	Anti-Personnel	M3	Pressure-Pull	Fragmentation	TNT	0.4075	4.68	Iron	22.0	8.9	8.9		No
United States	Anti-Personnel	M510	Pull	Fragmentation			0.5		14.0	9.0	3.0		
United States	Anti-Personnel	M692 & M731 (bombiets)	Pull	Fragmentation	Liquid Explosive			Plastic	6.5	7.0	5.5		SD
United States	Anti-Personnel	M74	Pull	Fragmentation	Comp B	0.545	1.4	Metal	8.604			12.06	No
United States	Anti-Personnal	M86		Fragmentation	Comp A5		0.545	Metal	6.35			15.24	
United States	Anti-Personnel	MDH C-40	Command Detonated	Fragmentation	TNT	0.8	1.66	Metal	22.6	7.9	3.8		
United States	Anti-Personnel	MLU/54-E	Command Detonated	Fragmentation	Astrolite G		9.00	Metal	92.0			14.2	No
United States	Anti-Personnel	XM-37											
United States	Anti-Personnel	XM-55											
United States	Anti-Personnel	XM131	Magnetic	Fragmentation	RDX-Comp B		1.65	Metal	12.065			13.208	No
United States	Anti-Personnel	XM27											No
United States	Anti-Personnel	XM41		Blast									No
United States	Anti-Personnel	XM65		Blast									
United States	Anti-Personnel	PDM (M86)					0.45						SD-PSD
United States		XM84											SD
United States	Anti-Tank	BLU 31/B		Blast-Fragmentation			341.00	Steel					
United States	Anti-Tank	BLU 94/B	Magnetic-Seismic					Metal					No
United States	Anti-Tank	BLU-45		Shaped Charge			9.1						
United States	Anti-Tank	BLU-91/B	Magnetic	EFP	RDX-ESTANE	0.7	1.95	Metal	6.6	12.7	14.6		SD
United States	Anti-Tank	M15	Pressure-Tilt rod	Blast	Comp B	10.33	14.3	Steel	12.47			33.656	No
United States	Anti-Tank	M15	Magnetic-Seismic	Blast	Comp B	10.33	14.3	Steel	12.47			33.656	SN
United States	Anti-Tank	M21	Pressure-Tilt rod-Magnetic	Blast	Comp H-6	4.9	7.955	Steel	20.64			22.86	No
United States	Anti-Personnel	M2A3	Pressure	Fragmentation									
United States	Anti-Tank	M58 (XM-34)	Pressure	Blast	Comp H-8	1.364	2.682	Aluminum	25.4			11.684	SD
United States	Anti-Tank	M66	Infrared-Seismic	Dif-routa	Comp B	0.853	18.18	Metal	59.82			11.684	No
United States	Anti-Tank	M6A2	Pressure	Blast	TNT	5.4	9.5	Metal	8.2			30.3	
United States	Anti-Tank	M714	Magnetic	EFP	RDX		2.26	Metal	6.0			13.0	SD
United States	Anti-Tank	M718	Magnetic	EFP	RDX		2.28	Metal	6.0			13.0	SD
United States	Anti-Tank	M75	Electrical	EFP	RDX-ESTANE	0.545	1.82	Metal	6.604			12.06	SD
United States	Anti-Tank	M80											
United States	Anti-Tank	M87											

Special Features:

SD: Self Destruct
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PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
United States	Anti-Tank	MLU 10/B	Multi-Influence		Destex		347.00	Steel					
United States	Anti-Tank	MK36											
United States	Anti-Tank	MK40											
United States	Anti-Tank	Plastic Bag Mine					5.44	Plastic					
United States	Anti-Tank	RAAM	Magnetic	EFP	PBX	0.591	1.73	Metal	6.604			12.066	
United States	Anti-Tank	STORM											
United States	Anti-Tank	T-18											
United States	Anti-Tank	XM131		Misznay-Schardin	RDX-ESTANE-CompB		1.65	Metal	12.065			13.208	
United States	Anti-Tank	XM70 (bomblets)	Magnetic	EFP	RDX		2.26	Metal	6.0			13.0	SD
United States	Anti-Tank	XM73 (bomblets)	Magnetic	EFP	RDX		2.26	Metal	6.0			13.0	SD
United States	Anti-Tank	XM75	Magnetic	EFP	RDX-Estane		1.68	Metal	6.5	6.5	12.0		SD
United States	Anti-Tank/Personnel	XM132	Magnetic	Blast-Fragmentation	RDX-ESTANE-CompB		1.65	Metal	6.0			13.0	No
United States	Anti-Tank/Personnel	XM78	Magnetic	Blast-Fragmentation	RDX-ESTANE-CompB		1.65	Metal	6.0			15.0	No
United States	Anti-Tank	XM84		Off-route					30.0	30.0	30.0		No
United States	Anti-Tank/Off-Route	M24	Pull	Off-route	Comp B	0.853	8.18	Plastic-Metal	60.0			15.0	No
United States	Anti-Tank/Personnel	M23	Pressure	Blast	VX Agent	4.76	10.376	Metal	12.7			33.0	No
United States	Anti-Tank/Vehicle	M19	Pressure	Blast	Comp B	9.53	12.582	Plastic	9.398	33.25	33.25		No
United States	Anti-Vehicle	M 177											
United States	Anti-Vehicle	M 117											
United States	Anti-Vehicle	M515					0.5						
United States	Anti-Personnel	M7A2	Pressure	Blast	Tetrytol	1.6	2.2	Metal	6.4	11.4	17.8		
United States	Bomblet	BLU 97B *		Shaped Charge			1.6	Steel	6.4			2.5	
United States	Bomblet	MK 118		Shaped Charge			0.6	Steel	34.0			6.0	
United States	Dual Purpose	DST MK 36 Mod 0/Mod 3		Blast	H6	87.27	261.82		225.0			0.4	
United States	Dual Purpose	DST MK 36 Mod 4		Blast	H6	87.27	261.82		225.0			0.4	
United States	Dual Purpose	DST MK 36 Mod 5		Blast	H6	87.27	261.82		225.0			0.4	
United States	Dual Purpose	DST MK 40 Mod 0/Mod 3		Blast	H6	202.27	482.27		286.0			0.57	
United States	Dual Purpose	DST MK 40 Mod 4		Blast	H6	202.27	482.27		286.0			0.57	
United States	Dual Purpose	DST MK 40 Mod 5		Blast	H6	202.27	482.27		286.0			0.57	
United States	Dual Purpose	DST MK 41 Mod 0/Mod 3		Blast	H6	429.55	928.64	Steel	383.0			0.624	
United States	Dual Purpose	DST MK 41 Mod 4/Mod 5		Blast	H6	429.55	923.18		383.0			0.63	
United States	Dual Purpose	M3		Shaped Charge	CompB-Pentolite	13.61	18.14	Metal					
United States	Off-Route	WASPM		Blast			15.87		38.1	22.86	27.9		
United States	Anti-tank/Off-Route	ORATMS	Influence	Off-route			15.9		33.0			33.0	No

Special Features:

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GENERAL INFORMATION ON LANDMINES IN NATO COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
United States	Torpedo-Like Vehicle	MOWAM					19.7		60.8			20.3	
United States		Astrolite liquid mine		Blast									
United States	Anti-Personnel	M2	Pressure	Fragmentation	PETN-TNT	4.54							No
United States		T-23		Shaped Charge									
United States		T-28		Shaped Charge									
United States	Anti-Tank	T7	Pressure		Tetrytol			Steel					

Special Features:

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ANNEX D

GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Bulgaria	Anti-Personnel	PSM-1	Pressure-Pull-Command	Fragmentation	Hexogene	0.17	2.69	Metal	13.5			7.5	
Bulgaria	Anti-Personnel	PSM-10b					2.10	Metal	11.5			7.5	
Bulgaria	Anti-Personnel	PM-79											
Bulgaria	Anti-Tank	PTM-80P	Pressure			7.50	8.93	Plastic	12.8			32.0	
Czechoslovakia	Anti-Personnel	PP-MI-Ba		Blast	TNT	0.20	0.34	Plastic	6.0			15.0	
Czechoslovakia	Anti-Personnel	PP-MI-D	Pressure-Pull	Blast	TNT	0.20	0.50	Wood	5.5	10.5	13.5		No
Czechoslovakia	Anti-Personnel	PP-MI-Sb	Pressure-Pull	Fragmentation	TNT	0.08	2.10	Metal-Concrete	14.0			7.5	No
Czechoslovakia	Anti-Personnel	PPM2	Pressure	Blast	TNT	0.11	0.345	Plastic	6.0		12.0	12.0	No
Czechoslovakia	Anti-Personnel	PP-MI-Sk	Pull	Fragmentation	TNT	0.08	1.60	Iron	13.7			6.0	No
Czechoslovakia	Anti-Personnel	PP-MI-Sr	Pressure-Pull	Fragmentation	TNT	0.36	3.20	Steel-Plastic	15.2			10.2	No
Czechoslovakia	Anti-Personnel	PP-MI-ST-46	Pressure-Pull	Fragmentation	TNT	0.075	1.60	Metal	17.3			7.0	No
Czechoslovakia	Anti-Tank	Shaped Charge Mine		EFP	TNT-RDX	5.7	9.5	Metal	23.0	24.0	24.0		No
Czechoslovakia	Anti-Tank	PT-MI-Ba	Pressure	Blast	TNT	6.00	7.83	Plastic	11.5			32.4	No
Czechoslovakia	Anti-Tank	PT-MI-Ba-53	Pressure	Blast	TNT	5.6	7.6	Plastic	10.2			32.2	No
Czechoslovakia	Anti-Tank	PT-MI-Ba-II		Blast	TNT	6.00	9.60	Plastic	13.5	23.0	39.5		No
Czechoslovakia	Anti-Tank	PT-MI-Ba-III	Pressure	Blast	TNT	7.23	9.90	Plastic	10.8			33.0	No
Czechoslovakia	Anti-Tank	PT-MI-D	Pressure-Pull	Blast	TNT	6.20	9.00	Wood	14.0	23.0	32.0		No
Czechoslovakia	Anti-Tank	PT-MI-K	Pressure	Blast	TNT	4.90	7.20	Steel	10.2			30.0	No
Czechoslovakia	Anti-Tank	PT-MI-P	Pressure	Shaped Charge	TNT-RDX		9.50	Metal	23.0			24.0	
Czechoslovakia	Anti-Tank	TQ-MI	Pressure	Blast	TNT	5.21	10.00	Wood	15.0			56.0	
Czechoslovakia	Limpet Mine	M1		Shaped Charge		0.55	6.30	Metal	25.8			9.0	
Czechoslovakia	Limpet Mine	M2		Shaped Charge		3.50	14.30	Metal	48.3			18.7	
Czechoslovakia	Anti-Tank/Personnel	NA-MI-BA	Pressure-Pull	Blast	Tritol-TNT	2.40	10.00	Plastic	24.7			18.6	No
Czechoslovakia	Anti-Parsonnel	PPM2	Pressure	Blast	TNT	0.110	0.375	Plastic	6.0			12.0	No
Hungary	Anti-Personnel	Bounding Anti-Personnel Mine	Pull	Fragmentation	TRI-11	0.77	3.63	Metal	30.0			12.0	
Hungary	Anti-Personnel	Gyata-64	Pressure	Blast-Fragmentation	TNT		0.45	Plastic-Metal-Rubber	6.1			10.6	No
Hungary	Anti-Personnel	M49	Pull	Blast	TNT	0.075	0.33	Wood	5.8	5.1	18.5		No
Hungary	Anti-Personnel	M62	Pull	Blast	TNT	0.075	0.32	Plastic	6.5	5.0	18.7		No
Hungary	Anti-Personnel	RAMP	Pull	Blast	TNT	0.82	1.36	Metal	3.0	5.0	47.5		No
Hungary	Anti-Tank	EFP	Command Detonated	EFP	PETN		5.7	Aluminum-Steel	6.0			38.0	No
Hungary	Anti-Tank	Shaped Charge	Pressure	Shaped Charge	TNT		5.7	Cardboard-Wood	14.2			30.0	No
Hungary	Anti-Tank	UKA-63	Tilt rod	Shaped Charge			8.00	Metal	12.0			29.6	No
Hungary	Dual Purpose	CVP-1	Pressure-Pull	Blast	TNT	1.6	3.6	Steel-Brass	7.6			20.3	

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GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Poland	Anti-Personnel	Plastic Anti-Personnel Mine		Fragmentation			0.25	Plastic	5.1	14.0	7.0		No
Poland	Anti-Tank	MN-121	Magnetic	EFP									
Poland	Anti-Tank	Plastic Anti-Tank Mine		Blast			0.60	Plastic	8.0			31.5	No
Romania	Anti-Personnel	Directional AP Mine		Fragmentation	TNT	12.00	19.00		26.0	40.0	10.0		
Romania	Anti-Personnel	Lightweight AP Mine		Blast	TNT-RDX	0.05	0.11	Plastic	4.5			7.0	
Romania	Anti-Personnel	MS-3	Pressure			0.31	0.63		8.5			11.0	
Romania	Anti-Tank	MAT-62B	Pressure	Blast	TNT	7.20	9.80	Plastic	13.4			34.0	
Romania	Anti-Tank	MC-71	Pressure	Shaped Charge	TNT	5.33	8.20	Metal	30.0			28.0	
USSR	Anti-Landing Craft	PDM-1M	Tilt rod	Blast	TNT	10.00	21.00	Metal-Concrete	100.0				SD-SN
USSR	Anti-Landing Craft	PDM-2	Tilt rod	Blast	TNT	15.00	100.00	Metal	140.0				SD-SN
USSR	Anti-Landing Craft	PDM-6	Tilt rod	Blast	TNT-PETN	28.00	47.5	Metal	250.0	100.0	100.0		SD-SN
USSR	Anti-Personnel	KhF-1	Command Detonated	Chemical	Toluol-Melinite	0.01	15.00	Metal	24.5			15.0	No
USSR	Anti-Personnel	KhF-2	Command Detonated	Chemical	Toluol-Melinite	0.01	15.00	Metal	28.0			28.0	No
USSR	Anti-Personnel	MON-100	Pull-Seismic-Command	Fragmentation	TNT	2.00	5.4	Steel	8.0			24.0	SD
USSR	Anti-Personnel	MON-200	Pull-Seismic	Fragmentation	TNT	12.00	25.00	Steel	13.0			45.0	SD
USSR	Anti-Personnel	MON-50	Pull-Seismic-Command	Fragmentation	Plastic Explosive	0.715	1.96	Plastic	10.5	4.5	22.0		SD
USSR	Anti-Personnel	MON-90	Pull-Seismic-Command	Fragmentation	Plastic Explosive	2.00	10.00	Plastic	10.5	4.5	22.0		No
USSR	Anti-Personnel	MS-3	Pressure			0.31	0.63						No
USSR	Anti-Personnel	MZ	Pressure-Pull	Fragmentation	TNT	1.8	10.00	Steel	25.4			12.7	
USSR	Anti-Personnel	OZM-160	Command Detonated	Fragmentation	TNT	4.8	8.5	Metal					SD
USSR	Anti-Personnel	OZM-3	Pull-Seismic-Command	Fragmentation	TNT	0.075	3.00	Iron	12.0			7.5	SD
USSR	Anti-Personnel	OZM-4	Command Detonated	Fragmentation		1.7	5.00	Iron					SD
USSR	Anti-Personnel	OZM-72	Pull-Command	Fragmentation		0.7	5.00	Steel	15.0			10.7	SD
USSR	Anti-Personnel	PFM-1	Pressure	Blast	Liquid Plastic	0.037	0.0738	Plastic	6.096			10.7	No
USSR	Anti-Personnel	PFM-1S	Pressure	Blast	Liquid Plastic	0.037	0.0736	Plastic	6.096			10.7	SD
USSR	Anti-Personnel	PMD-56	Pull	Blast	TNT			Wood					
USSR	Anti-Personnel	PMD-57	Pull	Blast	TNT	0.2		Wood					No
USSR	Anti-Personnel	PMD-6 (PDM-6M)	Pull	Blast	TNT	0.2	0.4	Wood	5.0	8.7	19.6		No
USSR	Anti-Personnel	PMD-7	Pull	Blast	TNT	0.075	0.3	Wood	5.1	7.6	15.2		No
USSR	Anti-Personnel	PMD-7ts	Pull	Blast	TNT	0.075	0.3	Wood	5.8	7.4	18.5		No
USSR	Anti-Personnel	PMK-40	Pressure	Blast	TNT	0.048	0.09	Cardboard	3.8			7.0	No
USSR	Anti-Personnel	PMM-3	Pressure	Blast	TNT	0.05		Metal	3.7			10.0	
USSR	Anti-Personnel	PMM-5	Pressure	Blast-Fragmentation	TNT	0.2		Metal	5.0	8.0	15.0		
USSR	Anti-Personnel	PMN	Pressure	Blast	TNT	0.2	0.55	Plastic	5.6			11.2	No

Special Features:

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GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
USSR	Anti-Personnel	PMN-2	Electrical	Blast		0.115	0.45	Plastic	5.4			12.5	No
USSR	Anti-Personnel	PMN-6			TNT	0.196	0.6	Plastic	5.6			11.2	No
USSR	Anti-Personnel	PMP	Pressure	Projectile				Metal					
USSR	Anti-Personnel	PMP 71/1	Pressure	Blast-Fragmentation	TNT	0.1	1.5	Plastic	11.5			20.0	
USSR	Anti-Personnel	PMZ-4											
USSR	Anti-Personnel	POM 2S	Pull	Fragmentation				Metal	15.0			6.0	SD
USSR	Anti-Personnel	POMZ-2	Pressure-Pull-Tilt rod	Fragmentation	TNT	0.075	2.3	Iron	13.5			6.4	No
USSR	Anti-Personnel	POMZ-2M	Pressure-Pull-Tilt rod	Fragmentation	TNT	0.075	1.77	Iron	11.1			6.4	No
USSR	Anti-Personnel	Unknown											
USSR	Anti-Tank	ADM-8			TNT	12.00	24.2		54.0			22.0	
USSR	Anti-Tank	AKS	Tilt rod	Blast	TNT	6.8	9.00	Metal	11.5	21.5	21.5		No
USSR	Anti-Tank	Cake tin mine		Blast	TNT			Plastic					
USSR	Anti-Tank	Dog mine	Pull	Blast	TNT	12.00		Metal					
USSR	Anti-Tank	PGMDM	Pressure	Blast	Liquid Explosive	1.5	1.7	Plastic	31.0	6.5			SD
USSR	Anti-Tank	T-IV	Pull	Blast	TNT	2.8	4.3	Metal	7.0	21.0	21.0		
USSR	Anti-Tank	TM-35	Pull	Blast	TNT	2.8	5.2	Metal	8.5	22.0	22.9		No
USSR	Anti-Tank	TM-38	Pressure-Pull	Blast	TNT	3.6	4.75	Metal	8.0	22.0	22.0		No
USSR	Anti-Tank	TM-39	Pressure-Pull	Blast	TNT	3.4	5.2	Metal	10.2	14.0	60.0		No
USSR	Anti-Tank	TM-41	Pressure	Blast	TNT-amatol	3.8	5.4	Metal	14.5			25.5	No
USSR	Anti-Tank	TM-44		Blast	TNT-Amatol	5.4	7.2	Metal					
USSR	Anti-Tank	TM-46	Pressure-Pull-Tilt rod	Blast	TNT	5.7	8.6	Metal	10.8			30.5	No
USSR	Anti-Tank	TM-56		Blast	TNT			Metal					
USSR	Anti-Tank	TM-57	Pressure-Tilt rod	Blast	TNT	6.34	8.47	Steel	11.5			31.572	No
USSR	Anti-Tank	TM-60	Pressure	Blast	TNT	7.5	11.35	Plastic	11.7			32.0	No
USSR	Anti-Tank	TM-62B	Pressure-Seismic-Magnetic	Blast	TNT	5.5	7.00						
USSR	Anti-Tank	TM-62D	Pressure-Magnetic	Blast		7.00		Wood	17.8	34.0	29.5		
USSR	Anti-Tank	TM-62M	Pressure-Seismic-Magnetic	Blast	RDX-Aluminum Powder	7.2	8.5	Steel	10.2			32.0	No
USSR	Anti-Tank	TM-62P	Pressure-Pull-Seismic-Magnetic	Blast	TNT	6.2	9.2	Plastic	8.4			30.8	No
USSR	Anti-Tank	TMB-1	Pressure	Blast	TNT	5.00	6.6	Cardboard	13.0			27.0	No
USSR	Anti-Tank	TMB-2	Pressure	Blast	TNT	5.00	7.00	Cardboard	15.2			27.0	No
USSR	Anti-Tank	TMD-40	Pull	Blast	TNT	3.2	5.00	Wood	10.0	14.0	60.0		
USSR	Anti-Tank	TMD-41	Pull	Blast	TNT	5.6	7.7	Wood	9.3	47.7	19.4		No
USSR	Anti-Tank	TMD-44 (TMD_B)	Pressure	Blast	TNT	6.00	10.00	Wood-Plastic	15.8	28.0	31.5		No

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GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
USSR	Anti-Tank	TMK-2	Tilt rod	EFP	TNT	6.5	12.5	Steel	26.2			30.2	No
USSR	Anti-Tank	TMN-46	Pressure-Pull-Tilt rod	Blast	TNT	5.7	8.6	Steel	10.8			30.5	No
USSR	Anti-Tank	TMSB	Pressure	Blast	TNT	5.9	8.00	Cardboard	16.764			28.7	No
USSR	Anti-Tank	TQ-MI	Pressure-Chemical	Blast	TNT	5.2	10.00	Cardboard	15.5	27.0	27.0		
USSR	Anti-Tank	YaM-10		Blast	TNT	10.00	11.8	Wood	19.6	21.6	62.0		No
USSR	Anti-Tank	YaM-5	Pull	Blast	TNT	5.00	7.7	Wood	9.3	19.4	47.7		
USSR	Anti-Tank	YAM-5K		Blast	TNT		7.2	Wood	16.5	17.5	60.0		
USSR	Anti-Tank	YAM-5M		Blast	TNT		7.2	Wood	16.5	19.5	48.5		
USSR	Anti-Tank	YAM-5U		Blast	TNT		6.3	Wood	16.5	19.5	51.0		
USSR	Anti-Tank	YaRM		Blast		3.00	15.00	Metal	30.0			90.0	
USSR	Anti-Tank/Personnel	PMZ-40	Pressure	Blast	TNT	3.6	9.00	Steel	10.2			24.0	
USSR	Anti-Tank/Personnel	TMD-B	Pressure	Blast	Amatol	5.00	7.7	Wood	16.0	28.0	31.5		No
USSR	Anti-Vehicle	DM	Vibration	Blast	TNT	1.2	1.8	Wood	13.0	15.5	15.5		
USSR	Anti-Vehicle	LMG	Pull	Shaped Charge	TNT	3.83	9.9	Metal		15.5	15.5		No
USSR	Anti-Vehicle	MDM		Blast		0.9		Bronze	10.2	30.5	20.3		
USSR	Anti-Vehicle	MZD-10	Vibration-Electric delay	Blast	TNT	0.4	3.00	Wood	11.4	20.9	18.4		No
USSR	Anti-Vehicle	MZD-2	Electric delay	Blast	TNT	0.8	5.00	Wood	11.4	21.4	21.5		No
USSR	Anti-Vehicle	MZD-3	Electric delay-Vibration	Blast	TNT	0.8	5.00	Wood	11.4	21.4	21.5		No
USSR	Anti-Vehicle	MZD-35	Electric delay	Blast	TNT			Wood	12.0	6.9	26.1		No
USSR	Anti-Vehicle	MZD-4	Electric delay-Vibration	Blast	TNT	0.8	5.00	Wood	10.1	13.9	17.78		No
USSR	Anti-Vehicle	MZD-5	Electric delay-Vibration	Blast	TNT	0.4	3.00	Wood	10.1	13.9	17.78		No
USSR	Anti-Vehicle	AMS	Pull-Electric delay	Blast	TNT	0.4		Wood	7.6	12.1	17.1		
USSR	Anti-Tank/Vehicle	BMZ-1	Striker	Blast				Steel	6.6	12.1	17.1		
USSR	Anti-Tank/Vehicle	NV-41	Pressure	Blast	TNT	6.1	7.95	Wood	18.4	19.7	24.8		
USSR	Anti-Personnel/Vehicle	OZM	Propellant	Fragmentation	TNT		3.00	Metal	12.0			7.7	No
USSR	Dual Purpose	MZD-1		Blast	TNT	4.50	8.00	Wood	10.0	190.0	24.1		
USSR	Dual Purpose	VMG	Pressure	Blast	TNT	3.00	10.00	Wood	23.0	12.0	47.5		
USSR	Dual Purpose	VMG	Pressure	Blast	TNT	7.50	10.00	Wood	23.0	12.0	47.5		
USSR	Dual Purpose	VMG (VARIANT)	Pull-Tension	Blast	TNT	7.70	10.00	Wood	23.0	12.0	47.5		
USSR	General Purpose	PMS	Electrical	Blast	TNT	0.45		Wood	6.3	14.0	16.5		
USSR	Limpet Mine	BPM-2			Tritanol	3.00	6.60	Aluminum	11.5	14.0	16.5		
USSR	Limpet Mine	MPM	Pressure	Blast		0.32	0.73		4.5	7.2	14.6		No
USSR	Limpet Mine	Plastic Limpet Mine		Blast	TNT		2.70	Plastic	27.0			11.5	
USSR	Limpet Mine	Turtle Limpet Mine			TNT	3.00	6.80		18.0			30.0	

Special Features:

SD: Self Destruct
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GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
USSR	Shallow-Water	MKB			TNT	229.52	446.33	Steel	126.0			87.6	
USSR	Shallow-Water	PDM-1	Tilt rod	Blast	TNT	10.00	29.00	Metal-Concrete		100.0	100.0		No
USSR	Under Ice	APM	Pressure	Fragmentation	TNT			Metal					
USSR	Unknown	MZD-5m	Pressure	Fragmentation	TNT			Metal					
USSR	Unknown	MZD-60	Pressure	Fragmentation	TNT			Metal					
USSR	Anti-Personnel	9B17											
USSR	Aera Defence	POM-K	Pressure		TNT	0.25	0.85		12.4			21.8	SD
Yugoslavia	Anti-Lift	Antilift Device	Pressure	Detonator									
Yugoslavia	Anti-Personnel	MRUD	Pull-Command	Fragmentation	Plastic explosive	0.90	1.50	Plastic	8.9	23.1	4.6		No
Yugoslavia	Anti-Personnal	PMA-1	Pressure	Blast	TNT	0.20	0.40	Wood	8.4	8.9	19.1		No
Yugoslavia	Anti-Personnel	PMA-1A	Pressure	Blast	TNT	0.20	0.40	Plastic	31.0	6.8	14.0		No
Yugoslavia	Anti-Personnel	PMA-2	Pressure	Blast	TNT	0.10	0.14	Plastic	6.1			6.8	No
Yugoslavia	Anti-Personnel	PMA-3	Pressure	Blast	TNT	0.04	0.18	Plastic-rubber	4.0			11.1	No
Yugoslavia	Anti-Personnel	PMD-1	Pressure	Blast	TNT	0.20	0.50	Wood	4.0	10.0	12.0		No
Yugoslavia	Anti-Personnel	PMR-1	Pull	Fragmentation	TNT	0.08	2.20	Iron	12.0			8.0	No
Yugoslavia	Anti-Personnel	PMR-2	Pull	Fragmentation	TNT	0.10	2.20	Metal-concrete	12.0			8.0	No
Yugoslavia	Anti-Personnel	PMR-2A	Pull	Fragmentation	TNT	0.10	1.70	Steel	13.2			6.6	No
Yugoslavia	Anti-Personnel	PMR-2AS	Pull	Fragmentation	TNT	0.10	1.70	Steel	13.2			6.6	
Yugoslavia	Anti-Personnel	PMR-3	Pull	Fragmentation	TNT	0.41	3.00	Steel	13.4			7.8	No
Yugoslavia	Anti-Personnel	PMRS	Pull	Fragmentation	TNT	0.2	3.00	Steel	13.4			7.8	No
Yugoslavia	Anti-Personnel	PP-56	Pressure		TNT		3.90	Plastic					No
Yugoslavia	Anti-Personnel	PROM-1	Pressure-Pull	Fragmentation	Tritol-hexolite	0.43	3.00	Steel	47.0			7.5	No
Yugoslavia	Anti-Personnel	Rocochet, Expanding Mine	Pressure	Fragmentation	Trinitrotoluol	0.20		Metal					
Yugoslavia	Anti-Personnel	TM-200	Pressure-Pull	Blast		0.20		Plastic	10.9	3.2	5.9		
Yugoslavia	Anti-Personnel	UDAR (Heavy)	Command detonated	Blast	Propylene oxide	20.00	40.00	Steel					No
Yugoslavia	Anti-Personnel	UDAR (Light)	Command detonated	Blast	Propylene oxide	10.00	20.00	Steel					No
Yugoslavia	Anti-Personnel	YU-S-AP											No
Yugoslavia	Anti-Personnel	TM-100	Pressure	Blast			0.130		10.8			3.2	No
Yugoslavia	Anti-Personnel	TM-500	Pressure	Blast			0.8		5.7	6.9	10.8		
Yugoslavia	Anti-Tank	ABABEL	Magnetic	Shaped Charge								11.8	No
Yugoslavia	Anti-Tank	PT-56	Pressure	Blast	TNT	5.40	10.00						No
Yugoslavia	Anti-Tank	TMA-1	Pressure	Blast	Trotyl	5.00	6.5	Plastic	10.5			30.0	No
Yugoslavia	Anti-Tank	TMA-1A	Pressure	Blast	TNT	5.40	6.50	Plastic	10.0			31.5	
Yugoslavia	Anti-Tank	TMA-2	Pressure	Blast	Trotyl	6.50	7.50	Plastic	14.0	20.0	26.0		No

Special Features:

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GENERAL INFORMATION ON LANDMINES IN FORMER WARSAW PACT COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Yugoslavia	Anti-Tank	TMA-2A		Blast	Trotyl	5.5	6.50		14.0	20.0	26.0		
Yugoslavia	Anti-Tank	TMA-3	Pressure	Blast	TNT	6.5	7.00	Plastic	8.0			26.5	No
Yugoslavia	Anti-Tank	TMA-4	Pressure	Blast	Trotyl	5.50	6.30	Plastic	9.9			28.4	No
Yugoslavia	Anti-Tank	TMA-5	Pressure	Blast	TNT	5.50	6.60	Plastic-rubber	11.3	27.5	31.2		No
Yugoslavia	Anti-Tank	TMA-5A	Pressure	Blast	TNT	5.50	6.60	Plastic	11.3	27.5	31.2		
Yugoslavia	Anti-Tank	TMD-1	Pressure	Blast	TNT	5.50	7.50	Wood	14.0	28.0	32.0		No
Yugoslavia	Anti-Tank	TMM-1	Pressure	Blast	TNT	5.60	8.60	Metal	10.0			31.0	No
Yugoslavia	Anti-Tank	TMRP-6	Pressure-Tilt rod	EFP	TNT	5.1	7.2	Plastic	13.2			29.0	No
Yugoslavia	Anti-Tank	Metal Pot Type Mine	Pressure	Blast		2.5							
Yugoslavia	Anti-Tank	Topfmine A 4531											
Yugoslavia	Anti-Personnel	TM 100	Pressure	Blast			0.13		10.6			3.2	
Yugoslavia	Anti-Personnel	TM 500	Pressure	Blast			0.6		5.7	6.9	10.6		
Yugoslavia	Anti-Personnel	TM 200	Pressure-Pull	Blast		0.2		Plastic	10.9	3.2	5.9		

Special Features:

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ANNEX E

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Argentina	Anti-Personnel	FMK-1	Pressure	Blast		0.152	0.250	Non-Metal	4.67			8.2	
Argentina	Anti-Personnel	MAPG	Pressure-Pull	Shaped Charge	TNT	0.4	2.6	Metal					
Argentina	Anti-Personnel	MAPPG	Pressure-Pull	Fragmentation	TNT	0.4	2.6						
Argentina	Anti-Tank	FMK-3					6.5	Plastic	9.2	24.4	24.4		
Argentina	Anti-Tank	MAA-1	Pressure	Blast	TNT			TNT&7-% Cotton					
Argentina	Anti-Tank	Ministry of the Navy		Shaped Charge	TNT	5.5							
Austria	Anti-Personnel	APM-1		Blast	Comp B	0.36	1.00		8.0	4.0	14.0		
Austria	Anti-Personnel	APM-2	Command Detonated	Fragmentation	Comp B	1.3	2.95	Plastic	15.5	31.5	4.0		
Austria	Anti-Personnel	APM-3		Fragmentation	Comp B	1.2	3.00	Plastic	14.0	28.0	2.3		
Austria	Anti-Personnel	ARGES M80		Fragmentation	PETN	1.3	3.00	Plastic	13.0	7.5	25.0		
Austria	Anti-Personnel	ARGES M80A1		Fragmentation	Comp B	1.3	2.9	Plastic	15.5	4.0	31.5		
Austria	Anti-Personnel	ARGES M89		Fragmentation	PETN	2.3	4.00	Plastic	15.5	5.5	3.15		
Austria	Anti-Personnel	DNW HM 1000		EFP			2.4	Plastic	13.0	3.0	29.0		
Austria	Anti-Personnel	SMI 21/11C		Fragmentation	Comp B	11.5	20.00	Plastic	23.5	56.0			
Austria	Anti-Personnel	SMI 21/3C		Fragmentation	Comp B	4.2	6.2	Plastic	18.0	24.0			
Austria	Anti-Personnel	SpM75		Fragmentation	PETN	0.5	6.00	Plastic	17.0			12.5	
Austria	Anti-Personnel	SMI 20/1C		Fragmentation	Comp B	0.9	1.9	Plastic	11.0	26.0			
Austria	Anti-Personnel	ATM 2000E				1.9	6.5	Plastic	25.1	25.1	13.0		SN
Austria	Anti-Tank	ATM-6		Fragmentation	Comp B	7.2	13.00	Steel	32.0	25.1	13.0		
Austria	Anti-Tank	ATM-7		EFP		9.00	14.00	Steel	32.0	25.1	13.0		
Austria	Anti-Tank	Panzermine 75	Pressure-Tilt rod	Blast		7.4	8.2	Plastic	12.0	12.0	28.0		No
Austria	Anti-Tank	PM 83	Tilt rod	Blast-Shaped Charge		4.00	7.5		14.0	28.0	28.0		
Austria	Anti-Tank	SMI 22/7C	Command detonated	Shaped Charge	Comp B	7.00	13.5		29.0	28.0	28.0		SN
Austria	Anti-Tank	SMI 17/4C	Command detonated	Fragmentation	Comp B	5.00	8.00		15.0	28.0	28.0		
Austria	Anti-Tank	DNW PM 3000											
Brazil	Anti-Personnel	Min AP NM AE T1		Blast	Pentolite		0.42	Plastic	9.5			8.5	
Brazil	Anti-Personnel	T-AB-1	Pressure	Blast	Pentolite	0.062	0.125	Non-Metal	6.1			6.0	
Brazil	Anti-Tank	Min AC NM AE T1	Pressure	Blast	Trotyl	7.00	8.00	Plastic	15.5	25.5	25.5		
Brazil	Anti-Tank	T-AB-1		EFP-Blast	TNT	5.2	5.9		13.8	24.3	24.3		
Chile	Anti-Personnel	AP Mine		Blast		2.6	5.8	Metal	6.0	24.0	24.0		
Chile	Anti-Personnel	AP Mine II	Pressure	Blast	Moxatol C	0.37	0.8		8.0				No
Chile	Anti-Personnel	M-18		Fragmentation		0.5	1.6		14.0	6.0	22.0		
Chile	Anti-Personnel	Directional Anti-Personnel Mine		Fragmentation									

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GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Chile	Anti-Personnel	FAMAE											
Chile	Anti-Tank	Anti-Tank Mine	Pressure	Blast	Pentolite	9.50	14.00	Metal	15.0			38.0	No
Chile	Anti-Tank	MAT.84-F5	Pressure	Blast	Pentolite	9.30	10.30	Plastic					
Chile	Anti-Tank	MP-APVL 83-F4		Blast-Fragmentation	TNT	2.00	6.75	Plastic-Steel					
China	Anti-Personnel	AP Shrapnel Mine	Pull	Fragmentation	TNT	1.17	1.40	Iron	10.5			6.0	No
China	Anti-Personnel	Directional Steel Fragmentation Mine	Pull	Fragmentation				Metal					No
China	Anti-Personnel	PMD-6	Pressure-Pull	Blast	TNT-Grenade	0.20	0.40	Wood	6.4	8.9	19.1		No
China	Anti-Personnel	Portable Bounding		Fragmentation		0.46	2.80		10.9			13.5	
China	Anti-Personnel	Type 58		Blast	TNT	0.20	0.60	Plastic					
China	Anti-Personnel	Type 69	Pressure-Pull	Fragmentation	TNT	0.11	1.35	Steel	11.4			6.1	No
China	Anti-Personnel	Type 72	Pressure	Blast	TNT-RDX	0.03	0.15	Plastic	3.7			7.8	SD
China	Anti-Tank	Anti-Tank	Pressure	Blast	Amatol	3.80	5.40	Metal	14.5			25.2	No
China	Anti-Tank	Antitank Mine	Pressure-Pull		TNT		5.00	Steel	7.3			20.0	
China	Anti-Tank	CH-MRL-AT											
China	Anti-Tank	Type 51	Pressure	Blast	TNT	6.27	8.00	Wood	14.0	34.0	28.0		No
China	Anti-Tank	Type 72B	Pressure-Impulse-DI	Blast	TNT-RDX	5.00	8.00	Metal	9.3			27.9	
China	Anti-Tank	Type 72 Non-Metallic	Pressure-Impulse-DI	Blast	TNT-RDX	5.40	6.50	Plastic	10.0			27.0	
China	Anti-Tank	Type 81						Plastic					
China	Anti-Tank	Type 84						Steel					
China	Anti-Vehicle	(Anti-Tank) Mine		Blast			1.6	Metal	15.4			25.0	
China	Dual Purpose	No. 4	Pressure-Pull	Blast	TNT	2.27	7.27	Steel	10.2			22.9	
China	Dual Purpose	No. 8		Blast		2.27			10.1			45.6	
Cyprus	Anti-Personnel	Unknown	Pull-Command	Fragmentation									
Egypt	Anti-Personnel	Claymore	Pull-Command	Fragmentation		1.00	2.00		10.5	20.0	4.5		No
Egypt	Anti-Landing Craft	MAL-17	Tilt rod	Blast		18.00	22.00					38.0	No
Egypt	Anti-Landing Craft	MOORED		Blast		18.00						38.0	
Egypt	Anti-Personnel	Bounding Mine	Pressure-Pull	Fragmentation									No
Egypt	Anti-Personnel	Jumping Mine	Pressure-Pull	Fragmentation	TNT-RDX				16.5			5.4	
Egypt	Anti-Personnel	T/78		Blast	TNT	0.19	0.27	Plastic	4.1	6.8	13.5		
Egypt	Anti-Personnel	Unknown SCHU	Pressure	Blast	TNT	0.17	0.35	Non-Metal	4.927	6.705	13.36		
Egypt	Anti-Tank	M/71		Blast	TNT-Amatol	5.70	8.60	Metal	10.8			30.5	
Egypt	Anti-Personnel	M/78	Pressure	Blast		0.19	0.27		4.1	6.8	13.5	30.5	No
Egypt	Anti-Tank	M/80		Blast	TNT-RDX	2.40	3.50	Plastic	10.8			20.4	

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GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Egypt	Anti-Tank	SACI	Pressure	Blast	TNT	7.00		Plastic	20.5			28.0	No
Egypt	Anti-Tank	SAKR-30 (bomblets)		Shaped Charge									No
Egypt	Anti-Tank	STORM		Off-route									
Egypt	Anti-Tank	TC/6	Pressure	Blast	Comp B	6.00	8.60	Plastic	18.5			27.0	
Egypt	Anti-Tank	TM-46	Pressure-Tilt rod	Blast		5.7	8.6		10.8			30.5	
El Salvador	Anti-Personnel	Claymore-Type Mine	Command Detonated	Fragmentation	Chlorate-Al			Wood					No
India	Anti-Personnel	M14	Pressure	Blast	Tetryl	0.0284	0.0946	Plastic	3.969			5.556	
India	Anti-Personnel	M16A1	Pressure-Pull	Fragmentation	TNT	0.521	3.75	Steel	19.86			10.28	
India	Anti-Tank	1A	Pressure-Tilt rod	Blast	TNT	6.75	7.3	Plastic	15.2			28.0	
India	Anti-Tank	3A		Blast			11.00	Plastic	8.1	10.8	121.0		
International	Anti-Tank	ACEATM		Off-route									
International	Anti-Tank	APAJAX		Off-route		1.50	12.00						
Iraq	Anti-Landing Craft	AL-MUTHENA/35	Tilt rod-Command detonated	Blast		35.00	190.00		61.0			55.0	No
Iraq	Anti-Landing Craft	AL-MUTHENA/45	Tilt rod-Command detonated	Blast		45.00	200.00		66.0			55.5	No
Iraq	Anti-Landing Craft	SIGEEL/400	Magnetic	Blast		400.00	535.00		61.0			98.0	SN
Iraq	Anti-Tank	Cast Explosive Mine		Blast					8.0			32.0	
Iraq/Yugoslavia	Anti-Personnel	Dual Purpose ICM	Impact	Shaped Charge		0.035	0.198		8.1			3.8	
Israel	Anti-Personnel	No. 10	Pressure	Blast	TNT	0.05	0.12	Plastic	7.5			7.0	No
Israel	Anti-Personnel	No. 12	Pressure-Pull	Fragmentation	TNT	0.26	3.5	Metal	24.0			10.2	No
Israel	Anti-Personnel	No. 4	Pressure	Blast	TNT	0.2	0.35	Plastic	5.5	7.0	16.0		No
Israel	Unknown	Directional Fragmentation Mine	Pull-Command	Fragmentation									
Israel	Anti-Tank	No. 25	Pressure-Friction	Blast	TNT	6.98	7.26						No
Israel	Anti-Tank	No. 26	Pressure	Blast	TNT	7.00	8.98	Non-Metal					No
Israel	Anti-Tank	No. 6	Pressure	Blast	TNT	6.00	9.00	Metal	11.0			30.5	
Japan	Anti-Armor	Type 99	Pressure	Blast	TNT-RDX	0.68		Canvas	3.7			12.0	
Japan	Anti-Personnel	M-67											No
Japan	Anti-Personnel	Model 63		Fragmentation				Plastic					No
Japan	Anti-Personnel	Scatterable AP Mine											
Japan	Anti-Tank	Type 63	Pressure	Blast	Comp B	11.00	14.52	Plastic	21.6			30.5	
Japan	Anti-Tank	Magnetic Influence Mine	Magnetic										
Japan	Anti-Vehicle	Type 93	Pressure	Blast	Picric Acid	0.91		Metal	4.4			15.5	
Korea	Anti-Personnel	Unknown		Fragmentation			0.94	Plastic	12.6				
Korea	Anti-Personnel	K440	Pressure-Pull	Fragmentation	C4	0.63	1.58	Plastic	10.4	4.0	17.8		

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GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Korea	Anti-Personnel	Model 15	Pull	Blast	TNT	0.08	2.60	Iron	10.7			6.0	
Korea	Anti-Personnel	PMD Mortar Mine	Pull	Blast				Wood	7.6	5.0	15.2		
Korea	Anti-Personnel	Metal Anti-Personnel Mine			TNT	0.08	1.2	Metal	10.0			6.0	
Korea	Anti-Personnel	Shrapnel AP Mine	Pull	Fragmentation		0.17		Metal	14.0			6.4	
Korea	Anti-Personnel	Wooden AP Mine	Pull	Blast		0.23		Wood	4.4	8.8	19.7		
Korea	Anti-Vehicle	Sheet Metal AT Mine		Blast			159.10	Metal	12.7			25.4	
Mexico	Anti-Personnel	MIN AP NM AE T1	Pressure	Blast			0.42	Plastic	9.5			8.5	No
Pakistan	Anti-Personnel	P2 Mk2	Pressure	Blast	TNT	0.06	0.14	Plastic	3.8			7.0	No
Pakistan	Anti-Personnel	P3 Mk2		Fragmentation	Black Powder	0.49		Metal					
Pakistan	Anti-Personnel	P4 MK1	Pressure	Blast	Tetryl	0.03	0.21	Plastic	1.5			7.2	No
Pakistan	Anti-Personnel	P5 MK 1	Pull	Fragmentation		0.90	1.60	Plastic	9.0	23.0	5.0		No
Pakistan	Anti-Personnel	P7 Mk1	Pressure-Pull	Fragmentation		0.15	2.95		25.0			9.7	No
Pakistan	Anti-Tank	P2 MK3	Pressure	Blast	TNT	6.33	7.50	Plastic	12.0	27.0	27.0		No
Pakistan	Anti-Tank	P3 Mk1	Pressure	Blast	TNT	6.50	7.36	Non-metal	11.7			30.6	
Singapore	Anti-Tank	STM-1	Pressure	Blast			7.00	Non-metal	9.5			30.0	
South Africa	Anti-Personnel	A/P HE	Pressure	Blast-Fragmentation	RDX-Wax	0.06	0.13	Plastic					
South Africa	Anti-Personnel	Shrapnel Mine No. 2	Command Detonated	Fragmentation	Plastic Explosive	0.68	1.58	Plastic					
South Africa	Anti-Tank	No. 8	Pressure	Blast	TNT-RDX	7.00	7.40	Plastic					
South Africa	Off-Route	ATR-5		Off-route									SD
South Korea	Anti-Personnel	M18A1	Pull-Command	Fragmentation	C4	0.68	1.59	Plastic	8.3	21.6	3.5		No
South Korea	Anti-Tank	M19	Pressure	Blast	Comp B	9.53	12.58	Plastic	9.4	33.3	33.3		No
Sweden	Anti-Personnel	AIRFIELD	Pull	Blast				Wood					No
Sweden	Anti-Personnel	AP12		Fragmentation			1.40		9.0	16.0			
Sweden	Anti-Personnel	FFV 013	Command Detonated	Fragmentation			20.00	Fiberglass	25.0	42.0			No
Sweden	Anti-Personnel	LI-11 (M-10)	Pressure	Blast	TNT	0.11	0.23	Plastic	3.5			8.0	No
Sweden	Anti-Personnel	LI-12	Pull-Electrical	Fragmentation	Hexotol		1.40		10.0	17.0			
Sweden	Anti-Personnel	M-11	Pressure-Pull	Fragmentation		0.5	4.00	Metal	19.0			10.0	No
Sweden	Anti-Personnel	M-12	Command Detonated	Fragmentation					9.0	16.0			
Sweden	Anti-Personnel	M-46	Pull	Blast			0.05	Cardboard	10.0				No
Sweden	Anti-Personnel	M/41	Pull	Blast	TNT	0.15	0.40	Wood	5.0	20.0	8.0		No
Sweden	Anti-Personnel	M/43	Pull	Blast	Nitrolite	0.13	0.48	Cardboard	4.0	10.5	10.5		
Sweden	Anti-Personnel	M/43 T	Pull	Blast	TNT	0.12	0.23	Cardboard	4.0	10.5	10.5		No
Sweden	Anti-Personnel	M/48	Pull	Fragmentation	TNT	0.23	2.90	Metal	18.0			8.0	No
Sweden	Anti-Personnel	M/49	Pressure	Blast	TNT	0.18	0.24	Cardboard	5.5			7.5	No

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Sweden	Anti-Personnel	M/49 B	Pressure	Blast	TNT	0.18	0.24	Cardboard	3.8			11.0	No
Sweden	Anti-Personnel	M43 (47 mm)	Pressure	Fragmentation	TNT	0.11	0.68		19.5			4.8	No
Sweden	Anti-Personnel	M43 (80 mm)	Pull	Fragmentation	Nitrolite	0.30	5.30		21.8			8.0	No
Sweden	Anti-Personnel	M43T (10 cm)	Pressure	Fragmentation		1.50	10.50		39.7			10.0	No
Sweden	Anti-Personnel	Model 43 and 43(T)	Pull	Fragmentation	Nitrolite-Trotyl	0.59	5.80	Metal-Concrete	23.0			10.6	No
Sweden	Anti-Personnel	TRUPPMINA 9	Pull	Fragmentation	TNT	0.13	0.71	Steel	18.8			3.7	No
Sweden	Anti-Tank	FFV 028	Magnetic	Shaped Charge	TNT-RDX	5.00	9.00	Steel	12.0			25.0	SN
Sweden	Anti-Tank	FFV 028 RU	Magnetic	Shaped Charge	TNT-RDX	3.50	7.50		11.0			25.0	
Sweden	Anti-Tank	M-14				1.6	2.5					16.0	
Sweden	Anti-Tank	M/14-47											
Sweden	Anti-Tank	M/43											
Sweden	Anti-Tank	M/47 (B-C)	Pressure	Blast	TNT	5.50	9.50	Steel	10.0			35.0	
Sweden	Anti-Tank	M/47-52B	Pressure	Blast	TNT			Steel					
Sweden	Anti-Tank	M/52	Pressure-Tilt rod	Blast	TNT	7.48	8.98	Plywood	7.7			34.3	No
Sweden	Anti-Tank	M/52 B	Pressure	Blast	TNT	7.50	9.50	Plywood	7.7			34.3	
Sweden	Anti-Tank	M47, b, c, d	Pressure	Blast	TNT	5.50	9.00	Metal	10.0			35.0	No
Sweden	Anti-Tank	M5	Pressure-Tilt rod	Blast	TNT-RDX	10.00	10.00	TNT	3.7			16.7	No
Sweden	Anti-Tank	MI 101	Pressure-Tilt rod	Blast	TNT-Hexotol	12.00	12.50	Fiberglass-TNT	7.2			37.0	No
Sweden	Anti-Tank	MI 102	Pressure-Tilt rod	Blast	TNT-Hexotol	7.52	8.00	Fibarglass-TNT	7.2			30.5	No
Sweden	Anti-Tank	MI 103	Pressure-Tilt rod	Blast	TNT-Hexotol	9.50	10.00	Fiberglass-TNT	7.7			33.2	No
Sweden	Off-Route	FFV 015		Off-route			2.60						
Sweden	Off-Route	FFV 016		EFP			2.6						
Switzerland	Anti-Personnel	Model 43	Pull	Blast	TNT	0.20	0.42	Wood-Bakelite	4.0	8.5	19.0		No
Switzerland	Anti-Personnel	Model 49	Pull	Blast	TNT	0.49	8.62	Metal-Concrete	22.4			15.0	No
Switzerland	Anti-Personnel	Model 49	Pull	Fragmentation	TNT	0.50	8.60	Steel-Concrete				15.2	
Switzerland	Anti-Personnel	Model 64		Fragmentation	TNT	0.48	4.59	Steel	29.0			9.8	
Switzerland	Anti-Personnel	Model M3	Pressure	Blast	TNT	0.07	0.10	Plastic	1.8			8.0	No
Switzerland	Anti-Personnel	P 59	Pressure	Blast	TNT	0.06		Plastic	5.4			7.2	No
Switzerland	Anti-Personnel	Plastic AP Mine		Blast	PETN	0.01	0.01	Plastic	1.5			4.5	
Switzerland	Anti-Tank	Model 37	Pressure	Blast				Metal					No
Switzerland	Anti-Tank	Model 42	Pressure	Blast									No
Switzerland	Anti-Tank	Model 49	Pressure	Blast	TNT	4.00	7.12	Steel	12.5			30.0	No
Switzerland	Anti-Tank	Model 53		EFP	TNT			Metal					No
Taiwan	Anti-Tank	M6A1	Pressure-Pull	Blast	TNT	5.44	9.07	Metal	8.6			33.0	

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Venezuela	Anti-Personnel	M6	Pull-Friction	Blast					7.9			14.0	No
Vietnam	Anti-Personnel	Anti-personnel Mine	Pressure-Pull	Blast	Black Powder		0.91	Steel	11.4			5.1	No
Vietnam	Anti-Personnel	Bangalore Torpedo			TNT-Picric Acid			Metal					
Vietnam	Anti-Personnel	Bounding Fragmentation		Fragmentation	TNT		2.27	Wood	20.3			6.4	
Vietnam	Anti-Personnel	Cast Iron Fragmentation	Command Detonated	Fragmentation	TNT-Melinite		5.44	Iron	22.9			12.7	
Vietnam	Anti-Personnel	Coconut Type Mine	Pull-Friction	Blast	Black Powder			Coconut					
Vietnam	Anti-Personnel	Concrete Fragmentation	Command Detonated	Fragmentation	TNT		5.90	Concrete	15.2	17.8	25.4		
Vietnam	Anti-Personnel	Concrete Mound Mine			TNT		5.90	Concrete	35.6			14.0	
Vietnam	Anti-Personnel	Cone Mine		Blast	TNT	4.08	6.80	Steel	20.3			22.9	
Vietnam	Anti-Personnel	DH-10	Command Detonated	Fragmentation	TNT	4.50	9.00	Metal	10.2			45.8	No
Vietnam	Anti-Personnel	DH-3 (Circular or Saucer)	Command Detonated	Fragmentation	Comp H6	1.80	5.50	Metal	2.4			6.4	No
Vietnam	Anti-Personnel	DH-3 (Rectangular)	Command Detonated	Fragmentation	Comp H6/Tritonal	0.27	0.80	Metal	2.6	5.2	6.8		No
Vietnam	Anti-Personnel	DH-5 (Circular or Saucer Shaped)	Command Detonated	Fragmentation	TNT-RDX	0.27	0.80	Metal	4.9			11.5	No
Vietnam	Anti-Personnel	Fixed Directional Mine	Command Detonated	Fragmentation	TNT	1.14	3.41	Metal	22.0	12.5	6.3		
Vietnam	Anti-Personnel	Flying Mine	Command Detonated		TNT	1.60	55.00						No
Vietnam	Anti-Personnel	Hollow Bamboo Mine	Pull-Command	Fragmentation	Black Powder			Bamboo	73.7			10.2	
Vietnam	Anti-Personnel	Improvised Claymore		Fragmentation	Plastic Explosive				45.7	15.2	10.2		
Vietnam	Anti-Personnel	Large Shaped Charge Mine		Shaped Charge	TNT	6.12	9.98	Metal	27.9			22.9	
Vietnam	Anti-Personnel	MD 82B		Blast		0.03		Plastic	5.5			5.5	
Vietnam	Anti-Personnel	MDH	Command Detonated	Fragmentation	TNT	1.40	1.80	Metal	8.6	23.0	34.0		No
Vietnam	Anti-Personnel	MDH-10K		Fragmentation	TNT		16.30	Metal	7.0			39.5	
Vietnam	Anti-Personnel	MDH-2		Fragmentation	TNT	1.20		Metal	19.0	12.0	5.4		
Vietnam	Anti-Personnel	MDH-4K		Fragmentation	TNT	3.90	7.90	Metal	7.3			24.5	
Vietnam	Anti-Personnel	MDH-6K		Fragmentation	TNT	6.10	10.70	Metal	7.0			29.9	
Vietnam	Anti-Personnel	MDH-7		Fragmentation	TNT	1.60	3.80	Metal	5.1			19.8	No
Vietnam	Anti-Personnel	MDH-8K		Fragmentation	TNT	7.30	13.40	Metal	7.0			32.5	
Vietnam	Anti-Personnel	MIN	Pull	Fragmentation	TNT		1.00	Iron	16.5			5.1	No
Vietnam	Anti-Personnel	Mud Ball Mine		Blast	TNT			Mud				15.2	
Vietnam	Anti-Personnel	Oil Drum Charge Mine	Timer	Blast				Metal					
Vietnam	Anti-Personnel	Pipe or Shell Casing Mine	Pressure	Blast	Fulminate		5.67	Metal	53.3			15.2	No
Vietnam	Anti-Personnel	Pole Charge Mine		Nonelectric charge	Potassium Chlorate		5.9	Tarpaulin					
Vietnam	Anti-Personnel	Satchel Charge Mine	Pressure		Potassium Chlorate			Waterproof Cloth					
Vietnam	Anti-Personnel	Shotgun Shell AP Mine	Pressure	Blast	Shotgun Explosive			Shotgun Shell					

Special Features:

SD: Self Destruct
SN: Self Neutralize
PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Vietnam	Anti-Personnel	Skyhorse	Pull-Command	Fragmentation				Metal	60.96			5.08	No
Vietnam	Anti-Personnel	Small Shaped Charge Mine		Shaped charge	Melinite	4.99	7.94	Metal	21.59			22.86	
Vietnam	Anti-Personnel	Tin Can AP Mine	Pull	Blast	TNT		0.91	Metal	15.24			7.62	No
Vietnam	Anti-Personnel	Toe Popper	Pressure	Blast-Fragmentation	Black Powder			Metal					
Vietnam	Anti-Personnel	Turtle Charge Mine		Blast	TNT-Melinite	3.41	9.07	Metal	13.97	22.86	10.16		
Vietnam	Anti-Personnel	Unknown (Apple)			Fragmentation			Steel					
Vietnam	Anti-Personnel	VC Flying MDH Mine	Command Detonated	Blast				Metal					
Vietnam	Anti-Personnel	Viet Cong AP Mine	Pressure	Blast-Fragmentation	Black Powder			Aluminum	13.0			5.7	
Vietnam	Anti-Personnel	Viet Cong Pipe Mine	Pressure	Blast	Black Powder	0.151	3.18	Metal	38.1			5.08	
Vietnam	Anti-Personnel	Volume Mine	Pressure-Pull-Command	Blast-Fragmentation	TNT	6.00	6.8	Metal	43.0			11.5	
Vietnam	Anti-Personnel	100 mm	Pressure	Shaped Charge	TNT	1.58	2.27	Metal	31.0			10.0	No
Vietnam	Anti-Personnel	150 mm	Pressure	Shaped Charge	TNT	3.99	6.12	Metal	36.0			15.0	No
Vietnam	Anti-Personnel	200 mm	Pressure	Shaped Charge	TNT	7.48	12.00	Metal	43.0			20.0	No
Vietnam	Anti-Personnel	B-40	Pull	Shaped Charge	TNT-RDX	0.54	1.2		26.0			7.8	No
Vietnam	Anti-Personnel	Dud Shell Mine			TNT			Mortar shell					
Vietnam	Anti-Personnel	MCX-7A	Pressure	Blast	TNT	7.89	8.89	Metal	8.4			27.8	No
Vietnam	Anti-Personnel	Bounding Baxomine Mine		Shaped Charge	Melinite		2.00	Metal	24.89	17.018			
Vietnam	Anti-Personnel	Antivehicular Mine	Pressure		TNT	2.00	5.00	Metal	11.5			21.4	
Vietnam	Anti-Personnel	Turtle Mine	Pressure	Blast	TNT		5.9	Wood	22.86			25.4	
Vietnam	Anti-Personnel	Amunition Box Mine	Command Detonated		TNT	9.00	12.00						
Vietnam	Anti-Personnel	Betal Mine	Command Detonated	Blast	TNT		5.9	Concrete	17.78			20.32	
Vietnam	Anti-Personnel	Shaped Charge Mine	Delay	Shaped Charge				Metal					
Vietnam	Dual Purpose	VC Modified Fougasse	Command Detonated	Shaped Charge	Black Powder	3.5	7.43	Metal	50.8			26.03	
Vietnam	Limpet Mine	Limpet Mine	Delay	Blast	TNT	1.14	4.54	Plastic	11.43			25.4	
Vietnam	Road Mine	FT40	Command Detonated	Blast	Melinite	38.00	55.00	Steel					
Vietnam	Shallow-Water	Bevelled Top Water Mine	Command Detonated	Blast	TNT		12.25	Metal	30.48			27.94	
Vietnam	Shallow-Water	Bouyant Shaped Box Mine	Command Detonated	Shaped Charge	TNT	195.05	213.19	Metal					
Vietnam	Shallow-Water	Floating Contact Mine	Contact	Blast-Fragmentation	Projectiles	2.5	27.22	Iron	27.9			30.5	
Vietnam	Shallow-Water	Floating Moored Mine	Contact-Command				56.7	Metal				55.88	
Vietnam	Shallow-Water	Large Viet Cong Water Mine	Command Detonated	Blast-Shaped Charge	TNT	18.6	37.65	Metal	63.5			43.18	
Vietnam	Shallow-Water	Metal Box Floating Mine	Command Detonated		Comp C4	36.29		Metal	29.21	36.83	53.34		
Vietnam	Shallow-Water	Pressure Influence Mine											
Vietnam	Shallow-Water	Segmented Water Mine	Pressure		TNT	130.00	146.00		45.7	28.4	121.0		
Vietnam	Shallow-Water	Twin Can Floating Mine	Delay		TNT	62.14		Metal-wood	38.1	38.1	152.4		

Special Features:

SD: Self Destruct
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PSD: Passive Self Deactivation

GENERAL INFORMATION ON LANDMINES IN OTHER COUNTRIES

Country	Mine Type	Designation	Fuse Initiation	Kill mechanism	Main Charge, Explosive	Explosive Weight (kg)	Total Weight (kg)	Casing	Height (cm)	Width (cm)	Length (cm)	Diameter (cm)	Special Features
Vietnam	Unknown	Improvised Mine	Pressure		TNT			Metal					
Vietnam	Unknown	Pyramid Shaped Mine	Command detonated	Blast	TNT			Steel					
Vietnem	Veries	Locally Fabricated Mines	Command detonated	Varies	TNT			Varies					
Vietnam	Water Mine	Magnetic-Acoustic Mine		Blast		219.99	385.55		188.0			44.5	

Special Features:

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ANNEX F

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF CHARACTERISTICS FOR LANDMINES IN NATO, FORMER WARSAW PACT AND OTHER COUNTRIES

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF CHARACTERISTICS FOR LANDMINES IN NATO COUNTRIES

CHARACTERISTICS	TYPE	ANTI-PERSONNEL MINE	ANTI-TANK MINE	OTHER DEVICES
FUSE INITIATION	Pressure	50%	56%	10%
	Pull	17%	0%	10%
	Tilt rod	0%	0%	0%
	Pressure-Pull	17%	2%	0%
	Magnetic Influence	0%	19%	30%
	Command detonated	5%	0%	5%
	Multiple	8%	13%	25%
	Others	3%	10%	20%
KILL MECHANISM	Fragmentation	53%	0%	12%
	Blast	41%	60%	26%
	Blast-Fragmentation	4%	1%	0%
	EFP	0%	13%	21%
	Shaped Charge	1%	22%	18%
	Multiple	1%	0%	0%
	Others	0%	4%	23%
MAIN CHARGE	TNT	41%	47%	33%
	Comp B	15%	22%	22%
	Tetryl	7%	0%	0%
	RDX	3%	6%	0%
	Multiple	8%	13%	11%
	Others	26%	12%	34%
CASING	Plastic	47%	45%	27%
	Metal	33%	39%	40%
	Wood	4%	3%	0%
	Multiple	10%	3%	13%
	Others	6%	10%	20%
SPECIAL FEATURES	Self-Destruct	5%	12%	4%
	Self-Neutralization	3%	10%	6%
	Passive Self Deactivation	1%	1%	0%
	None	91%	77%	90%

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF CHARACTERISTICS FOR LANDMINES IN FORMER WARSAW PACT COUNTRIES

CHARACTERISTICS	TYPE	ANTI-PERSONNEL MINE	ANTI-TANK MINE	OTHER DEVICES
FUSE INITIATION	Pressure	36%	54%	27%
	Pull	26%	12%	5%
	Tilt rod	0%	6%	18%
	Pressure-Pull	12%	6%	0%
	Magnetic Influence	8%	12%	0%
	Command detonated	9%	2%	0%
	Multiple	8%	8%	5%
	Others	1%	0%	45%
KILL MECHANISM	Fragmentation	44%	0%	15%
	Blast	47%	84%	69%
	Blast-Fragmentation	4%	0%	0%
	EFP	0%	8%	0%
	Shaped Charge	0%	8%	12%
	Multiple	0%	0%	0%
	Others	5%	0%	4%
MAIN CHARGE	TNT	77%	81%	91%
	Comp B	0%	0%	0%
	Tetryl	0%	0%	0%
	RDX	0%	0%	0%
	Multiple	0%	9%	4%
	Others	23%	10%	5%
CASING	Plastic	31%	31%	4%
	Metal	47%	36%	42%
	Wood	13%	19%	38%
	Multiple	0%	0%	8%
	Others	9%	14%	8%
SPECIAL FEATURES	Self-Destruct	11%	1%	14%
	Self-Neutralization	0%	0%	10%
	Passive Self Deactivation	0%	0%	0%
	None	89%	99%	76%

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF CHARACTERISTICS FOR LANDMINES IN OTHER COUNTRIES

CHARACTERISTICS	TYPE	ANTI-PERSONNEL MINE	ANTI-TANK MINE	OTHER DEVICES
FUSE INITIATION	Pressure	35%	60%	9%
	Pull	23%	0%	5%
	Tilt rod	0%	3%	5%
	Pressure-Pull	12%	4%	0%
	Magnetic Influence	0%	7%	5%
	Command detonated	18%	4%	41%
	Multiple	11%	22%	22%
	Others	1%	0%	18%
KILL MECHANISM	Fragmentation	49%	4%	5%
	Blast	39%	72%	50%
	Blast-Fragmentation	2%	2%	0%
	EFP	1%	4%	5%
	Shaped Charge	7%	9%	10%
	Multiple	0%	2%	0%
	Others	2%	7%	30%
MAIN CHARGE	TNT	57%	50%	64%
	Comp B	7%	14%	0%
	Tetryl	2%	0%	0%
	RDX	1%	0%	0%
	Multiple	8%	26%	7%
	Others	25%	10%	29%
CASING	Plastic	28%	36%	7%
	Metal	40%	39%	73%
	Wood	7%	7%	0%
	Multiple	3%	11%	7%
	Others	22%	7%	13%
SPECIAL FEATURES	Self-Destruct	1%	0%	4%
	Self-Neutralization	1%	3%	4%
	Passive Self Deactivation	0%	0%	0%
	None	98%	97%	92%

ANNEX G

JANE'S INFORMATION GROUP STUDY

LANDMINES IN WORLD SERVICE

A STUDY FOR

SNC INDUSTRIAL TECHNOLOGIES

30 November 1994.

LANDMINES IN WORLD SERVICE

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LANDMINES IN WORLD SERVICE

EXECUTIVE OVERVIEW

Despite opinions to the contrary, landmines are probably one of the major battlefield "force multipliers" and will almost certainly continue to be a significant battlefield asset - at least for the next century. The defence of any nation with credible military forces is arguably enhanced by the continuing research and planning for the use of landmines in an emergency, and to lose, or have this capability reduced because of the political unacceptability of certain categories of mines could have very serious consequence. We believe that with a little technological ingenuity and a certain amount of forethought, the capability can certainly be retained, operational effectiveness improved, and landmines continue to remain an acceptable weapon of modern warfare.

However, the mine warfare arena is changing fast and the minefield of the future will almost certainly be an intelligent entity, sensing the direction and type of threat, switching itself "on" and "off" as necessary and employing its own ECM defences to ensure survivability against countermine operations. No longer will it be necessary to drive across, or step on a mine to activate the charge. The US Army is already moving towards an Advanced Intelligent Minefield (IMF) concept linked into an overall "Intelligent Battlefield". In this intelligent battlefield a continuous loop of real time digitised information is both collected and distributed throughout the system.

As a part of this Intelligent Minefield requirement there have been considerable recent advances in the electronic systems with which mines are equipped. The available technology has provided opportunities for electronic enhancements almost undreamt of a few years ago and some extremely sophisticated mines are already on offer. During this study we have identified 32 mines/systems that include some form of self destruct/neutralisation/deactivation and by the end of the century this figure is set to double. In general, these mines currently appear in four major geographical clusters - France, Italy, US and Russia (CIS). At some stage (probably in the not too distant future) a self destruct/deactivation device will be standard on all mines in the inventories of Western nations.

Just as the armed helicopter has changed battlefield priorities, the reductions in numbers of main battle tanks will reduce the emphasis on mines to counter heavy armour. We expect to see a steady shift towards anti helicopter defences, and during the next ten years or so our estimate is that up to about one million anti-helicopter mines could be produced - 300,000 in the US,

300,000 in Europe and possibly another 300,000 in the rest of the world. The potential long term market in this area is immense and we wish our client to be aware of this fact.

We would recommend a close reading of the extract from the Readers Digest article at Annex A to this report. The civilian world views the whole concept of mine warfare with revulsion, and there are growing international pressures for the "outlawing" of the trade in landmines - especially those of the anti-personnel variety. Our experience tells us that any such moves would result in a massive covert trade in these weapons, and that the influence of the more responsible North Atlantic and Western European nations would no longer be applicable. The long term message is that any new generation of mines will, of necessity, have to incorporate technology such as "self destruct," if these weapons are to continue to be acceptable in the current moral climate.

Readers may be interested to learn that Jane's Information Group is to produce a handbook in late 1995 entitled ***Jane's Mine Identification Handbook***. This handbook will be suitable for use in the field and will cover all mines that are a threat both to the military and civil populations in theatres of operations today. Photographs, drawings and full descriptions will be provided.

C.G. Le Mesurier - Special Studies Editor 30 November 1994

LANDMINES IN WORLD SERVICE

PART 1 - OVERVIEW

1.1. The Current Situation

There have been very considerable changes in the types of land mines available in the world market during the past 20 years. Advances in electronics and the impact of miniaturisation have resulted in the availability of very different mines from the Elsie & Ranger (AP) types, or the Bar Mine (ATK) currently in service with the British Army. It is now possible to buy mines of both types "off the shelf" incorporating either all, or some of the following characteristics:-

(1) Electronic inert indicator.
(2) Electronic anti-lift facility.
(3) Programmable laid life.
(4) Electronic self destruct capability.
(5) Countermeasures immunity.
(6) Remote "on/off"switching.
(7) Automatic target selection.

In the short space of 20 years technology has driven mines from an almost totally mechanical mode of operation, to becoming highly sophisticated weapons with a high electronic content, and an ability to select and destroy high value battlefield targets such as tanks and helicopters.

However, there is a cost penalty for the purchase of mines with a sophisticated electronic content which will almost inevitably result in a reduced overall quantity being purchased. The cost multiple of an advanced electronic mine may be in the ratio of 5:1 over the older less technologically advanced systems, and this cost increase will almost certainly lead defence planning agencies towards a radical review of the Tactical Doctrine to be employed in the emplacement of such systems.

In short, fewer mines in the operational stocks will mean that mines will probably be emplaced when their use is highly probable, and that mines will move from being weapon systems that are positioned well in advance of the enemy's intentions being known, to a system which is used as a last resort measure directly in the path of an enemy advance. There are strong arguments both for and against the use of high technology in land mines, and these are examined in detail in the report. At the end of the day a mine has to be small enough to facilitate logistics, emplacement and prevent immediate discovery and neutralisation. However, a mine also needs explosive content and the smaller the mine the less the destructive effect. This reality is the base line for

all future land mine design.

In addition, some very significant changes in the future battlefield will almost certainly alter the staff officer's perception of mines and mine warfare. The advent of large numbers of battlefield helicopters, and smaller more flexible forces with greater areas to cover, could conceivably result in a far greater importance for mines than has hitherto been awarded in peace. In war, these weapons are always of the highest importance - what may be about to happen is that the in the future they become a much higher priority. The mines now available on the world market fall into the following broad categories:

a. Anti-Personnel mines
b. Anti-Tank Mines
c. Anti-Helicopter Mines
d. Area-Denial Mines

1.2. Emplacement Systems

The success of mines in the new, more fluid battlefield environment depends largely on the type of system employed for emplacement. These systems , the vast majority of which are manufactured in Europe or the US can be broadly categorised under the following headings:-

a. Ground based scatterable systems.
b. Air Delivered Systems (heliborne and fixed wing).
c. Artillery Cargo Rounds.

1.3. Countermine

There have been a number of significant developments in the area of countermine operations which have to be taken into account when looking at any future mine developments. In general terms it is probably only necessary to be aware that the detection of mines and neutralisation of mines has been a high profile programme during the last ten years, and considerable advances have been made in the following areas:-

a. Enhanced hand held detection devices.
b. Satellite and airborne imagery.
c. Improvements to individual personal protection.
d. Chemical neutralisation
e. Electronic counter measures.
f. Line charge technology.
g. Ploughs and Flails.

Future mine systems will be vulnerable to countermine operations, and as a general rule, the longer a minefield is in place, the greater its vulnerability to countermine operations.

1.4. The Broad Requirement

There appears to be a broad common requirement for all four categories of mine that a army of the first military division may need in the future. This requirement linking AP, ATK, AH and AD mines can probably be summarised as followed:

a. A necessity to follow the guidelines for minefield emplacement as given in the Geneva and various other international protocols. In this area there is clearly a conflict between conforming to international legal obligations, and bringing into service a weapon system that is capable of fulfilling the required role in war. However, the vast majority of future mines will most probably be fitted with a self destruct device that should serve to meet these requirements.

b. Anti-armour minefields will continue to require protection from enemy force interference by the emplacement of anti-personnel mines, certainly at the forward edge of the minefield and if time allows throughout the whole minefield. However, in the longer term the importance of large, preplanned anti-armour minefields may well be diminishing as the numbers of armoured vehicles in service are reduced and heliborne operations become more common.

c. In the future, as manpower levels fall and the area of the potential battlefield increases, all arms could become more dependent on minefields of various types for local protection. During the next five years the numbers of personnel on active duty is set to decline markedly throughout Europe and the United States. As a result, the manpower intensive tasks such as covering likely enemy approaches in both the vicinity of the Forward Edge of the Battle Area (FEBA) and rear logistic areas will become more difficult. The US Army intends to use semi-intelligent mines to assist in protecting areas where manpower cover is thin, and we believe that this trend will be reflected throughout the armies of the European members of NATO.

d. The old maxim that "minefields must be covered by fire or observation" may need to be examined in the light of current technology and declining force levels. In the future covering a minefield by observation may mean that instead of a human observer, sensor systems or TV cameras may be employed to monitor a mined area, allowing remote observers to call for mortar or artillery fire onto a area believed to be threatened.

e. To be effective mines currently need to be laid in quantity, but quantity has a cost variable that depends on the scale of the technology employed. While large numbers of low technology mines (average cost US$50-US$200) were formerly within the reach of most of the NATO armies, large numbers of modern "state of the art" mines employing the latest technology (average cost US$250-US$1,000+) may be difficult to fund, especially during the present financial climate.

Anti-helicopter mines are believed to cost about US$10,000 each. Armies will have to make some hard choices when determining the type of mine that will eventually be taken into service.

f. The minefield of the future will probably be an intelligent entity, sensing the direction and type of threat, switching itself "on" and "off" as necessary and employing its own ECM defences to ensure survivability against countermine operations. No longer will it be necessary to drive across, or step on a mine to activate the charge. The US Army has already launched a four-year Advanced Technology Demonstration (ATD) of its Intelligent Mine Field (IMF) programme, which is intended to provide a two-way link between manoeuvre commanders and mine-fields that can respond to targets in a co-ordinated manner. This will permit the best use of the available weapons, in order to maximise overall lethality. If this initial effort is successful, it will be followed by development of a demonstrator during the period FY97-99.

The ATD is intended to result in a prototype IMF, formerly known as the Advanced Intelligent Minefield Management System, by the end of Fiscal Year 1996. The US Army's Armament Research, Development and Engineering Centre (ARDEC) at Picatinny Arsenal has awarded initial contracts to Alliant Techsystems (US$985,000) and Textron Defence Systems (US$800,000). These values could later rise to US$6.7 million and US$6.8 million respectively.

IMF will use a management station, about the size of a mine, that incorporates a communications transceiver and may have its own sensors. This station, or gateway, will be deployed at the same time as the mines themselves, which may include both in-service types and future smart weapons such as the XM93 WAM (Wide Area Mine) under development by Textron Defence Systems.

1.5. Future Mines - Possible Requirement

The requirement for a future mine will probably resemble the following:-

* Built in self destruct device.
* Programmable laid life.
* Electronic switch on and switch off facility.
* Resistance to ECM.
* Contain enough explosive to remain a deterrent.
* Remain small enough for general military requirements.
* Capable of either hand emplacement or deployment by scatterable launcher, helicopter or cargo round.
* Contain an anti-lift device.
* Capable of operation during all types of weather.
* Have some means of inert indication.

Our observations on these possible requirements are as follows:-

a. Built in Self Destruct Device - This will probably be an essential requirement of any new mine system and the inclusion of a self destruct device will bring the mine inside the requirements of the Geneva Convention. The technology behind self destruct is not difficult, and could be as simple as self destruct when the battery life reaches a certain level.

b. Programmable Laid Life - A very attractive option is one that leaves a mine in place at the end of a predetermined/programmable laid life. In theory mines could then be recovered and used again where necessary. In reality the recovery of mines is a manpower intensive task which would take some considerable time, and is made all the more difficult by the natural suspicion on the part of the troops recovering the mines, as to the armed state of the weapons being recovered. In addition there cannot be a 100% rate at which there are no failures. At some stage there would be an accident during mine recovery, and confidence in the system would be lost. We therefore believe that programmable laid life although an attractive option may not in the end prove cost effective.

c. Electronic switch on and switch off facility - A highly desirable innovation that would allow the passage of friendly troops through a minefield at a crucial period in the battle. However, the passage of troops and armour through a minefield could easily damage mines, or press them deep enough into the soil to render them ineffective. In addition the technology to achieve this function would be expensive, and there will always be the possibility that the enemy has access to the electronic key to turn the minefield off. We therefore believe that a switch on and off facility, while once again being an attractive option is not absolutely necessary and has possible significant drawbacks.

d. Resistance to ECM - If programmable laid life or a switch on and switch off facility are to be incorporated into an anti-personnel mine system there will have to be some built in resistance to ECM. Such a resistance will have to be extensively tested and could prove very expensive in the longer term. In addition, advances in technology could render the resistant mechanism obsolete within a relatively short time and the complete stock of operational mines would then have to be re-engineered to the latest specifications.

e. Contain enough explosive to remain a deterrent - As mines become more sophisticated there may be a "trade off" between the amount of explosive contained and the size of the electronic mechanism. To remain a deterrent a mine must contain enough explosive to cause severe damage/injury if disturbed.

f. Remain small enough for general military requirements - Despite some astonishing advances in miniaturisation during the past ten years, packing higher technology into a mine generally results in some increase in weight and size. Even small increases in size make a considerable difference in the ability to conceal mines, especially if they are to be hand emplaced

just below the surface. In addition and probably far more important is the extra requirement on the logistical lift, especially during airportable or heliborne operations. The following examples of different types of mines illustrate the problem:-

Anti-Personnel Mines	**Weight**	**Diameter**
Elsie (Low Tech)	78 gms	51mm
Valsella VS-MK2-EL (High Tech)	200 gms	89.5mm

Anti-Tank Mines	**Weight**	**Diameter**
Mark 7 (Low Tech)	13.6kg	130mm
FFV 028 (High Tech)	8.4kg	250mm

g. Capable of either hand emplacement or deployment by scatterable launcher - Any future mine procured should almost certainly be capable of emplacement by both methods, and probably capable of being laid from helicopters or artillery cargo rounds.

h. Contain an anti-lift device - We believe that at least 20% to 30% of mines laid should contain an anti-lift device to assist in delaying breaching/neutralisation. However it may be possible to include an anti-lift device in 100% of mines at very little extra cost and in the interests of commonalty. Very simple electronic devices can be built into the self destruct device, that is almost certain to be included in the mine chosen in any future procurement. At the bottom line, a mine with a self destruct device already carries a significant psychological anti-lift device for sappers tasked with clearance. There will be considerable unease clearing mines that may self destruct at any time.

i. Capable of operation during all types of weather - Mines could be laid in all types of climatic conditions from arctic, through cold wet weather to desert conditions. If possible all types of mine should be capable of operation under water.

j. Have some means of inert indication - An inert indicator is not considered a good idea. Any soldier engaged in mine clearance would have to treat a mine lying on the battlefield as live, even if it is displaying an inert indication. We cannot believe that any experienced combat engineer would act otherwise.

1.6. Anti-Personnel Mines

a. General

Anti-personnel mines have been an extremely important battlefield weapon for many years and their future is assured - the mines themselves may change dramatically, but the requirement will remain. We cannot see a time when there will not be infantry on the battlefield and believe that anti-personnel mines of some sort laid in the close proximity of vital areas will be an ongoing

requirement. At the bottom line, anti-personnel mines have a future as weapons to defend anti-tank mines, area denial mines and anti-helicopter mines.

In the past anti-personnel mines have been relatively simple devices, with a pressure point acting upon a detonator which triggers an explosion. The current generation of anti-personnel mines has moved on, and the latest mines illustrates this trend.

b. Current Generation Anti-personnel Mines

The Italian company Valsella's VS-MK2 AP non-metallic mine was designed for scatter-laying from helicopters. It can also be scattered from vehicles or by hand. It is noon magnetic and fully waterproof. The VS-Mk2 has a disc shaped resin based plastic case available in various camouflage colours and is activated by pressure applied to both the pressure plate on the mines top surface and on its bottom face.

The mine is provided with a double anti-shock device operating mechanically and pneumatically. The anti-shock device prevents the mine from being triggered when an impulse load is applied onto the pressure plate caused by an accidental drop, when scattered by helicopter dispenser, by the explosion of a nearby or suspended charge, or by the action of fuel air explosive mineclearing systems. A model fitted with an electrical anti-lift device is known as the VS-Mk2-E. An electronic model with anti-lift and independently programmed active life time is also available. This model, known as the VS-Mk2-EL has a detonating train which is kept out of alignment until firing.

The US Pursuit Deterrent Munition (PDM), designation M86, has been added to the list of available weapons at the US Army's Armament Research, Development & Engineering Centre and illustrates a different approach. The PDM is a fragmentation, anti-personnel, area-denial mine which is an adaptation of the 155mm howitzer submunition. the mine uses a system of seven self-deploying trip wires, each 6m long, which trigger the 0.45kg mine. Upon detonation, the mine "bounces" some 1m to 2m in the air, exploding and discharging its anti-personnel fragments. A safety mechanism self-destructs the mine if it fails to go off after a certain length of time. The PDM also features an external arming system. The PDMs are issued in sets of two in a bandolier and were believed to have been carried by UK Special Forces during the Gulf War.

c. Anti-personnel Mines in the Future

The future for the anti-personnel mine family is probably centred around the following:

1) Protection of high value systems such as ATK Mines, AD Mines and AH Mines.
2) Personnel Area denial.
3) Protection of vulnerable points.

Protection of high value systems is already catered for and some extremely effective systems are

available, especially in the scatterable and helicopter distribution systems. Area Denial is the sector that probably has the scope for the greatest changes and we believe that there is increased scope for emplaced fuel air anti-personnel mines in the future. Fuel air systems are covered later in this report.

Much R&D effort has been spent during the last 15 years on trying to develop a system that can cover a wider area than conventional pressure mines using a smaller number of mines equipped with influence fuzes. This concept of deploying fewer mines per metre of front is very attractive and in theory has cost attractions. Influence fuzed mines generally require the following:-

1) Some form of discriminatory sensing or influence fuze, or
2) A "self deploying" series of trip wire devices, and
3) A shaped or directional charge probably incorporating a fragmenting jacket, P-charges or pre-formed fragments.

However, conventional pressure initiated mines work and are proven in service. There appear to be considerable disadvantages to influence fuzed anti-personnel mines some of which are commented upon as follows:-

1) "People sensors" can be triggered by other means, livestock, wild animals etc.

2) The detonic effects from one activated device might intrude into the zone of influence of a nearby mine thereby setting off a chain of sympathetic initiation.

3) US experience has shown that trap wires (often fabric based) and their ejection system, are bulky and have varying reliability. Once deployed the trap wire pattern is seldom consistent with maximum ground area coverage.

4) For maximum effect the more sophisticated and probably larger mine would be difficult to deploy by a remote scattering method, as the conventional random pattern obtained is unlikely to achieve the optimum mine - target - mine distance ratio.

5) Bulkier influence fuzed mines would be more difficult to store, transport and deploy than "conventional" smaller pressure operated mines.

6) Location and clearance procedures covering active influence fuzed anti-personnel mines would probably be more hazardous than for mines similar to Ranger or Elsie.

d. Conclusions

It would be wise to inject a few words of caution on the subject of anti-personnel mines. Their use has become an extremely emotive subject and large numbers of international organisations are quite rightly concerned about their indiscriminate use, especially in the third world. In some

parts of Africa there are quite astonishing numbers of civilians who have been severely disable by mines left from previous conflicts.

The majority of Western Governments are under some pressure from a number of quarters both national and international to ban the sale of anti-personnel mines in the export market. In the longer term, some governments could come under pressure to ban the manufacture of anti-personnel mines.

Some of the social aspects relating to mine warfare are outlined in a Readers Digest magazine article reproduced at Annex A. It provides evidence of the horror with which civilians view the whole area of anti-personnel mines. It would be wise to be wholly aware of the external pressures that might be applied to the inclusion of anti-personnel mines in the national military inventory in the future.

1.7. Anti-Tank Mines

a. General

The anti-tank mine has been an extremely important battlefield asset for over 70 years. An anti-tank mine employs one of the three classic tank attack modes with surface laid mines generally attacking the tank running gear (by cutting the track or blowing off the wheels) or attacking the belly plate. Off-route mines generally attack the sides of a tank and modern technology also offers the top attack option.

Older mechanical anti-tank mines were relatively simple weapons requiring at least 3kg of explosive (but normally two or three times that amount) to damage a tank's running gear using a blast effect. Surprisingly, a belly attack mine requires much less explosive (possibly only 1 kg) when it employs the shaped charge or Miznay Schardin effect. However, belly attack mines require more complicated fuzes than running gear mines. The belly attack mine can be set off by vertical rods that are broken or bent by the tank hull, or by small wires or hozes spread horizontally on the ground and set off when two of them are pressurised by tank tracks. These mines are not easily concealed but this can be achieved if the more advanced influence mines operating on the heat, sound, seismic or magnetic effects of the tank are used to set them off.

For the past fifty years countermine technology has forced anti-tank mine development along a path designed to:

a. Penetrate significant enhancements in tank armour.
b. Defeat countermine systems such as detectors, flails, ploughs and explosive hoses.

We have now reached the stage in anti-tank mine development whereby a modern, relatively state of the art system such as the Technovar/Ferranti ATIS incorporates the following features:

1) Centre belly detonation independent of target speed.
2) Warhead (K) kill capability.
3) Advanced intelligent influence fuze (I2F)
4) Hand emplaced or scatterable.
5) Full width attacks capability.
6) Anti-handling devices to prevent removal or manual disruption.

It is envisaged that future mines could be switched on and off to allow the passage of friendly forces through the minefield, and there is a perceived requirement for a capability to exactly determine the position of each mine electronically.

The elimination of the massed armour threat from the Warsaw Pact and the reduction of armour on the battlefield of the future, probably indicates a halt in the development of what we know as conventional anti-tank mine technology. In the future funding will be more difficult to obtain, as both defence budgets shrink and anti-tank warfare assumes a lower priority. We would see the majority of work in this area as being related to the upgrading of electronic fuzes designed to prolong the life of older mines.

1.8. Area Denial Mines

a. General

All mines are in fact area denial weapons. For the purposes of this study we have grouped off route systems, with both anti-tank and anti-personnel capabilities, together with mines that are obviously intended to cover target areas and not individual systems or personnel. Broadly speaking the following are good in-service examples of this type of mine.

APILAS Autonomous Off-Route Mine	ATK Mine	France
Apajax Aimed Controlled Effect Anti-tank System I Ajax Off-Route Anti-tank Mine Sensor System	ATK Mine	International
DRAGON Electronic Fuze System for Off-route Anti-tank Mines	ATK Mine	Austria
Dynamit Nobel DYNAMINE Family of Mines	Family	Germany
GEMSS Mines	Family	USA
Horizontal Action Anti-tank Mine F1 with Infra-red Radiation Sensor IRMAH Mle F1	ATK Mine	France
M24 and M66 Off-route Anti-tank Mines	ATK Mine	USA

MAPS Anti-personnel Mine	AP Mine	Portugal
MINX	Family	UK
PARM DM 12 Off-route Anti-tank Mine	ATK Mine	Germany
PDM-1, PDM-1M, PDM-2 and PDM-6	AD Mine	CIS
Pakistan Ordnance Factories Directional Mine P5 Mark 1	AD Mine	Pakistan
Panzerfaust 3 Off-route Mine with SIRA	ATK Mine	Germany
SMI Directional Fragmentation Mines	AD Mine	Austria
SMI 22/7C Off-route Anti-tank Mine	ATK Mine	Austria
TM-83 Off-route Mine	ATK Mine	Russia
Valsella VS-DAFM 6 and VS-DAFM 7	AD Mine	Italy
Directional Anti-material Mines XM93 Wide Area Mine (WAM)	AD Mine	USA

b. First Generation

The majority of these ADM have evolved from some extremely simple devices such as the French Horizontal Action Mine Mark 1 (MIACAH) which consisted of a cylindrical drum pivot mounted upon a circular frame. The drum contained a shaped charge warhead, that could penetrate 50mm of armour at a range of 80 meters with an angle of impact of 0 degrees, or 50mm of armour at at range of 40 meters with an angle of impact of 30 degrees. The mine was normally anchored to the ground, camouflaged and pointed across the tank's expected route. A wire was stretched out in line with the mine and when a tank crossed the wire the mine operates and the shaped charge penetrates the side armour of the tank. The Mark 1 mine was improved in the 1970s to F1 standard by fitting an infra red radiation sensor capable of not only target detection but selection of the first, second or third tank.

c. Second Generation

The German PARM Off-route Anti-tank Mine is a good example of the next generation of off-route mines. PARM was developed as a private venture by MBB, which claims it can engage both stationary and moving targets with a high hit and kill probability. It is laid manually, is ready to fire after a five-minute delay and can remain operational for up to 40 days. Power for the circuits is provided by a lithium battery with a shelf life of 10 years. Using the Active Relief Sensor (ARES) the range of PARM is 100 meters. ARES operates in two modes, rest and awake. An acoustic warning sensor activates the transition from rest to wake, after which a four channel infra-red and optical firing sensor locks onto the target. Data signals are then processed and the mine fired at the optimum instant. If necessary the mine can be detonated by an observer at a remote location. The manufacturers claim that the penetration capability is over 600 meters at 40 meters.

The German Army ordered 50,000 PARM off-route mines from MBB in a deal believed to be worth over $128 million, with the unit cost per mine believed to be approximately US$2,500. The first 25,000 were delivered between 1991 and 1994.

d. Third Generation - ACEATM

In early 1988 France, Germany and the UK agreed joint requirements for the ACEATM (Aimed Controlled-Effect Anti-Tank Munition) off-route mine and a joint development programme. Four tri-national consortia, each led by a French company (France having been named prime contractor nation), were formed to bid for ACEATM development programme.

1) Aerospatiale with Marconi or Thorn EMI (or both) and MBB.
2) GIAT with Hunting Engineering, Dynamit Nobel and Honeywell Sondertechnik.
3) Matra Manurhin Defence with SERAT, British Aerospace and RHM.
4) TRT with Plessey, Shorts and Diehl.

The first three teams proposed systems with a passive IR sensor, while the fourth (TRT) offered a system with a dual-mode (IR/millimetric-wave) sensor.

The original proposal was for the ACEATM to be laid between 300mm and 700mm above the ground, and a planned effective range of some 100m was required. The mine was to be capable of destroying future main battle tanks from any angle. ACEATM was also required to be able to choose its target in a column of vehicles, and the hit probability was to better than that of guided anti-tank missiles. Remote control was an additional area of the specification but each country decided to keep the option of using radio control to activate a minefield.

The mine's sensor was to be capable of determining the target's size, speed and range before initiating the firing mechanism and the ACEATM round was expected to be made up of a rocket of at least 140mm calibre, fitted with a tandem dual hollow charge warhead. Development of ACEATM was to be financed in equal parts by the three countries concerned and total tri-national requirements for ACEATM mine are estimated at some 100,000 units. Original costs were projected at US$3,000-4,000 per mine and the in-service date was envisaged as 1996.

The project, which grew out of a NATO Staff Target drawn up in 1980, was delayed in late 1988 by funding problems in the UK Ministry of Defence. The UK MoD being reluctant to fund another anti-armour system, particularly as the projected timetable for ACEATM coincides with that of TRIGAT, the third generation anti-tank missile also being jointly developed by the UK, France and West Germany.

As late as February of 1988, the UK was considering not signing the ACEATM MoU, and did not finally agree to join the programme until April of that year under pressure from a meeting of the Independent European Programme Group held in Rome. Reports in 1988 suggested that the UK requirement would be for 20,000 mines, the French requirement 30,000 and the German

50,000. Development costs of US$22.5 million were to be shared between the three nations. In May 1991 a fixed price contract worth US$25.8 million for development of the ACETAM off-route anti-tank mine system was awarded to GIAT Industries, Dynamit Nobel, Honeywell Regelsysteme and Hunting Engineering. The contract was divided into two phases: a 12-month project definition phase and a 20-month full-scale development phase. The selected system is known as the ARGES (Automatic Rocket Guardian with Electronic Sensor), or ACEATM in the UK. GIAT Industries of France was responsible for project management and integration of the overall system (through SERAT, its common subsidiary with Aerospatiale). Dynamit Nobel was involved in the warhead, projectile design and attack system integration, much of which was derived from the Panzerfaust 3 programme, Hunting Engineering provided components and technology from the LAW80 programme and was also responsible for the design of the HEAT warhead. Honeywell had the responsibility for the sensor and shared some of the development work with GIAT Industries.

By late 1992, with a relaxation in tension between NATO and the East and with the first sub-phase of 12 months coming to an end, it was evident that the production target for the three countries involved in the programme would not exceed 50,000 systems - 25,000 for Germany, 15,000 for France and 10,000 for Great Britain - in comparison with the original requirement for as many as 100,000 mines.

The system evaluation should last 12 to 18 months, between 1994 and, at the latest, mid 1995; this will be followed, about two years later, by the industrialisation phase. We would now expect a production decision in late 1996/1997 and an in-service date of 1998/99. The ACEATM system will complement current mine systems and be used to cover gaps and block roadways. The system is fitted with a combination of sensors to give complete target discrimination and ensure a high kill probability against MBT side armour.

According to its official specifications, ACEATM must be able to destroy modern heavy MBTs travelling at speeds up to 60km/h, regardless of their direction of travel relative to the mine, up to a range of 75m (100m desired), by day or night, in all weathers. Weighing less than 20kg (15kg desired), the system must be proof against re-use or redirection by the enemy. It must have a programmable active life which can be increased by increments of three hours up to 96 hours, and subsequently day by day up to 40 or even 60 days.

ACETAM will have the ability to ignore dismounted personnel and wheeled vehicles weighing less than 3 tons and being less than 4m long. Its computer memory will allow it to be programmed to select the first, second or third heavy target that passes. It should also be capable of operating with a narrow field-of-view (25deg maximum). Friendly forces will be able to resite an ACETAM (with a fully charged power supply), up to five times within the overall endurance limit of 40 or 60 days.

ACETAM should be inconspicuous, easy to camouflage and capable of deployment by one man

in five minutes by day, or ten minutes by night. It will have three main components:

1) A stand, which can be used on concrete surfaces, and has a fine-adjustment mechanism to allow accurate siting.

2) A countermeasures-resistant target detection and fire control sensor.

3) An attack system with safety and arming devices, a warhead and a launcher. In addition, ACETAM should be capable of initiation by remote control.

e. European Area Defence Weapon (ADW)

France was the lead country in the European Area-Defence Weapon (ADW) program being worked on by a NATO Project Group involving France, Germany, Canada Spain, Italy and the UK. Discussions started on the definition phase in 1991.

Plans were for a passive sensor (to save power), an acoustic/seismic targeting sensor and at least one (but probably two or more) sub-munitions which could be fired in succession. These included top attack munitions with an initial ballistic trajectory, or stabilised anti-tank grenade which would be fired when the sub-munition is over the target after a circular search phase. (The search and firing of this type of munition probably involved an infra-red sensor or millimetre radar - or both.

ADW's range was believed to have been between 200 and 250m, implying a detection range of some 300 to 400m. Ideally, it would have operated even when there is no direct line of sight to the target (a fast moving tank for example); some thought was also given to linking groups of mines in networks, allowing minefield ambushes to be set up (in which a group of mines "permits" a packet of vehicles to enter a minefield before detonating).

The ADW programme ran into difficulty. Spain, Italy and the UK withdrew from the programme and at the end of 1993 the project appeared to have been placed into suspended animation.

f. Russian Off Route Mines

Off-route mines have never been a significant item in Russian anti-armour inventories. Until the arrival of the TM-83 in 1993, most Russian off-route mines were improvised devices. They were usually created by placing metal sheets over the face of conventional anti-tank mines which were then laid on their sides and aimed towards the attacker. Detonation was normally by some form of remote or photo-electric device.

The TM-83 produces a self-forging fragment (SSF) warhead for the attack of the side armour of main battle tanks, armoured personnel carriers and similar vehicles. The dished-shaped body of the mine appears to have similarities with the anti-personnel/anti-material MON-200, but the visual similarities are superficial.

Two target sensors are employed by the TM-83. They are mounted side by side on top of the body of the mine. The smaller sensor is seismic while the larger is infra-red (IR) operated. If normal practice is followed, the seismic sensor is used to alert and activate the IR sensor as a potential target approaches. The IR sensor can then detect and track the target in order to detonate the mine when the target in order to detonate the mine when the target is within range. The effective range is given as 50 m. If required, the mine may be detonated by remote control via a 100 m long cable. In either case, the actual performance of the high-velocity SSF should be sufficient to penetrate approximately 200 mm of armour.

g. Miscellaneous Off Route Mines

While an armour threat persists there are isolated programmes ongoing world wide to develop off-route mines. The South African ATR-5 derivative is a good example of these programmes. In early 1993, Somchem of South Africa announced the development of an off-route mine based on the FT5 shoulder-launched light anti-tank weapon.

Designated ATR-5, it comprises a tripod-mounted FT5 round surmounted by a fire-control system module. The latter has a microprocessor to calculate target speed and direction, based on inputs from acoustic and infrared sensors which serve to acquire and identify the target. The system weighs 17kg, light enough to be carried and set up in minutes by one man, who enters the parameters of intended targets via a keypad. The mine can thus be set to engage targets with speeds varying from 3 to 80km/h, over distances of 5 to 80m, moving left or right (or in either direction). The fire-control system has a counter, enabling a specific vehicle within a convoy to be attacked (up to eight vehicles). The weapon self-destructs after 90 days, or if tampered with.

h. Conclusions

These Off-route or Area Denial Mines are significant systems where a high armour threat exists. However, they are extremely expensive and emplacement appears to be highly manpower intensive operation. In the longer term, as the tank threat decreases we would expect mines of this type to assume a much lower priority. Off-route anti-armour mines have probably reached the end of their current development cycle.

1.9. Anti-Helicopter Mines

a. General

The trend towards airmobile forces is accelerating and within a relatively short period the attack helicopter could become the dominant system on the battlefield. Some analysts believe that there are already 35 nations with over 100 military helicopters in their inventory and numbers in service could easily rise by 100% during the next ten years.

The requirement for anti-helicopter mines is examined elsewhere in this report but broadly

speaking it can probably be summed up as follows:

1) Force the enemy above Nap of the Earth (NOE) into the low level (LLAD) coverage where they can be engaged by, for example, Javelin and Rapier missiles.

2) AHM Minefields are used to deny the enemy FARP (Foward Arming and Refuelling Points) Landing Zones, penetration routes on perimeters, flanks, and in gaps.

3) Place enemy helicopters at risk anywhere on the battlefield and inflict attrition if the mined areas are ignored. Reduce aircrew and helicopter passenger morale by a significant amount.

4) Allow safe passage of friendly forces.

5) AHM should be capable of emplacement by remote or scatterable delivery systems.

There appear to be two approaches to the anti-helicopter mine problem. The first approach is to manufacture a mine specifically designed to destroy an approaching helicopter with a Wide Field Panoramic (WFP) warhead. This approach is best illustrated by the Ferranti and Texton AHM currently involved in the US army AHM requirement. A second approach is to fit a specially designed electronic fuze to an existing heavy fragmentation mine. The Austrian firm Hirtenberger have an excellent example of this type of fuze.

b. Current World Market Situation

The United States began development of an anti-helicopter mine (AHM) capable of destroying low-flying helicopters in July 1989 when seven companies - Ferranti, Textron, Honeywell, Lockheed, Hughes, Texas Instruments and General Dynamics - presented the results of a six-month concept definition study to officials at the US Army Armament Research, Development and Engineering Center, Picatinny Arsenal. The original concept was for mines designed to force helicopters to operate at higher altitudes, making them vulnerable to air defence weapons. Options studied include an autonomous point air defence weapon based on a missile such as Stinger, which could attack a helicopter at a range of several kms, and 'smart' munitions which would scatter terminally guided bomblets or wire entanglements as helicopter approached. One of the most difficult aspects of the programme was to develop a system of distinguishing between friendly and hostile helicopters. Acoustic sensors which could discriminate between the noise patterns of different helicopters was an path considered worth following.

By late 1989 the decision was taken to push ahead with development of an anti-helicopter mine with the offer of proof of principle (POP) contracts to Textron, Texas Instruments and Ferranti. The three were chosen from the original group of seven companies, which each carried out concept definition studies into possible system configurations. Work was due to start in September 1991 the POP phase having been programmed to last for 24 months.

In December 1991 Textron Defense Systems and Ferranti-Alliant Techsystems Inc were finally awarded parallel US$12.5 million, 24-month proof-of-principle (POP) development contracts for anti-helicopter mines following down-selection earlier in 1991 (Texas Instruments were the losing contractor).

The competing firms are taking different technical approaches.
Textron's contender borrows from its XM93 Wide Area Mine (WAM), and is claimed to have an effective range of 400m. It can variously be deployed by MLRS, Army TACMS, the Volcano helicopter-borne mine dispenser, or be hand-emplaced. The 40lb (18kg) weapon uses a passive acoustic-array groundsensor and a dual-mode sublet sensor. The warhead is of a focused, multiple explosively-formed projectile (EFP) element design. The Ferranti-Alliant Techsystems unit is designed to counter hostile helicopters flying at speeds up to 350km/h and at altitudes varying from NOE to more than 100m. It uses a dual-mode acoustic/IR fusing system. It too has a multiple EFP warhead. It should be noted that until now no EFP warhead has been type classified.

The US DOD is now carrying out selection of both of these mines with a view to full scale development. Should the US Army opt for the Ferranti-designed AHM (which the British company had earlier been developing under contract to ARPA) for full-scale development, Alliant Techsystems will become prime US contractor.

c. Ferranti - Alliant Techsystems AHM
The Ferranti - Alliant Techsystems solution to the AHM problem is a one man portable system weighing 10kg and compatible with current scatterable and remote deployment systems. Once deployed it is autonomous in operation,and may incorporate a Command and Control (C2) module to facilitate remote arming and disarming. For additional operational flexibility the Ferranti-Alliant AHM incorporates non-co-operative Identification Friend or Foe (IFF), ensuring the safe passage of friendly forces. The dual-mode acoustic/infra-red fusing system is highly resistant to countermeasures, and ensures accurate aiming of the multiple Explosively Formed Projectiles (EFP) prior to detonation. The system is designed to counter hostile helicopters flying at speeds of up to 350 kph and at altitudes from NOE to 100 m+.

d. Textron Defence Systems AHM
The Textron Defence Systems reply to the AHM problem is a mine with high component commonalty to the existing WAM (Wide Area Mine) and has a weight of about 18 kgs. The system has a remote turn on and off provided by secure, two way communications and a passive acoustic array detects, classifies and tracks in a multiple target environment. There is a redundant Friend or Foe (IFF) classification.

The mine has a variable trajectory launch that permits operation in forests and other restricted areas and there is a dual mode sensor for accurate aiming. There is a 360 degree coverage and the extended range and altitude performance envelope provides an NOE attack capability. Textron

claim that the focused multi-EFP warhead element yields a high kill probability.

There is little doubt that these AHM are very much the weapons of the next decade. The situation is such that they are the only really effective counter to the helicopter flying at just over NOE and the world market potential is very large. We would not be surprised to see a very large number (more that 1 million?) of these mines sold in the world market during the next ten years at an approximate cost of US$10,000 each.

e. Hirtenberger - HELKIR Electronic Fuze System for Anti-Helicopter Mines.

Hirtenberger's electronic fuze system is intended for use against low flying helicopters within a range of 150m and was designed to be adapted to a range of heavy fragmentation mines. The system can be used to cover a pre-selected area for a pre-determined time selected by the user and at the end of that time, if the system and mine have not been activated, the system can be returned to a safe condition, with the condition indicated.

Once the correct characteristics and sound level of the target is detected the infra-red sensor is activated. The sensor scans the area covered by the fragment spread of the mine and if a target appears in that area the mine is initiated. If the infra-red sensor cannot locate the target, the system will return to the standby mode. The system has a range from between 5 to 150 m and can be triggered by target speeds of up to 250 kph.

This system is obviously not as effective against individual targets as the dedicated Ferranti/Textron AHM. However it is a much cheaper option and large numbers of existing heavy fragmentation mines could be utilised/adapted for the role. Large numbers of mines fitted with these fuzes would certainly degrade heliborne operations.

f. Conclusions

In the longer term AHMs such as these will almost certainly form a core element of the intelligent minefield systems described earlier. This area has the potential for real market growth during the next ten years.

LANDMINES IN WORLD SERVICE

PART 2 - MINES IN WORLD SERVICE

2.1. Complete Listing of Mines by Country

In this section we have identified mines with either Self Destruct (SD), Self Neutralisation (SN) or Passive Self Deactivation (PSD) capabilities. In the next section (2.2.) we provide a considerable amount of detail on each of these mines.

Abbreviations:

AD Mine	-	Area Defence Mine
AH Mine	-	Anti Helicopter Mine
AP Mine	-	Anti Personnel Mine
ATK Mine	-	Anti Tank Mine
Family	-	Part of a mine family that may include systems of different types.
Fuze	-	We list a small number of fuzes.

Country	Type	Model	SD	SN	PSD
Argentina	AP Mine	FMK-1			
Argentina	ATK Mine	FMK-3			
Austria	AP Mine	DNW HM 1000			
Austria	ATK Mine	DNW PM3000			
Austria	ATK Mine	ATM 2000E	No	Yes	No
Austria	AD Mine	SMI Directional			
Austria	ATK Mine	SMI 22/7C	No	Yes	No
Austria	AP Mine	APM-1			
Austria	AP Mine	APM-2			
Austria	ATK Mine	DRAGON			
Austria	AH Mine	HELKIR			
Brazil	AP Mine	AP NM AE AE T1			
Brazil	AP Mine	T-AB-1			
Brazil	ATK Mine	T-AB-1			
Brazil	ATK Mine	Min AC NM AE T1			
Bulgaria	AP Mine	PM-79			
Bulgaria	AP Mine	PSM-1			
Bulgaria	ATK Mine	PTM-80P			
Canada	AP Mine	C3A2			
Chile	AP Mine	FAMAE			

Chile	ATK Mine	AMAE MP-APVL 83			
Chile	ATK Mine	FAMAE MAT.84-F5			
China PRC	AP mine	Type 72	Yes	No	No
China PRC	AP Mine	Shrapnel Mine			
China PRC	AP Mine	Type 69			

Country	**Type**	**Model**	**SD**	**SN**	**PSD**
China PRC	AP Mine	Bounding			
CIS	AP Mine	PMN			
CIS	AP Mine	POMZ-2			
CIS	AP Mine	POMZ-2M			
CIS	DAP Mine	POMK	Yes	No	No
CIS	AP Mine	PDM-6 to PDM7ts			
CIS	AP Mine	PMD-57			
CIS	AP Mine	MON-50 to MON-200			
CIS	AP Mine	MON-90			
CIS	AP Mine	PFM-1/S	Yes	No	No
CIS	AP Mine	OSM & OSM-3			
CIS	AP Mine	OZM-4			
CIS	AP Mine	OZM-72			
CIS	AP Mine	OZM-160			
CIS	ATK Mine	PGMDM	Yes	No	No
CIS	ATK Mine	TM-72			
CIS	ATK Mine	TM-62			
CIS	ATK Mine	TM-57			
CIS	ATK Mine	TM-46			
CIS	ATK Mine	TMN-46			
CIS	ATK Mine	TMD-B			
CIS	ATK Mine	TMD-44			
CIS	ATK Mine	TMK-2			
CIS	AD Mine	PDM-1/-1M/-2/P-6	Yes	Yes	No
CIS	AD Mine	PMK-1			
Czech	AP Mine	PP-Mi-Ba			
Czech	AP Mine	PP-Mi-D			
Czech	AP Mine	PP-Mi-Sb			
Czech	AP Mine	PP-Mi-Sk			
Czech	AP mine	PP-Mi-Sr			
Czech	ATK Mine	PT-Mi-Ba			
Czech	ATK Mine	PT-Mi-Ba-II			
Czech	ATK Mine	PT-Mi-Ba-III			
Czech	ATK Mine	PT-Mi-K			
Czech	ATK Mine	PT-Mi-D/1/11			

Czech	ATK Mine	PT-Mi-P			
Czech	ATK Mine	Na-Mi-Ba			
Czech	ATK Mine	TQ-Mi			
Denmark	ATK Mine	M/88	No	Yes	No
Egypt	AP Mine	AP Mine Series			
Egypt	AP Mine	T/78			
Egypt	AP Mine	Bounding			
Egypt	TK Mine	M/71			
EgypT	ATK Mine	M/80			
Egypt	ATK Mine	ATK Mine Series			
France	AP Mine	MAPED F1			
France	AP Mine	M 61 and M 63			
France	AP Mine	M 59			

Country	**Type**	**Model**	**SD**	**SN**	**PSD**
France	AP Mine	Model 1951/1955	Yes	No	No
France	AP Mine	Model 1951			
France	ATK Mine	Mine Mle F1			
France	ATK Mine	IRMAH Mle F1			
France	ATK Mine	ALSETEX	Yes	No	No
France	Fuze	ALSETEX Igniter	Yes	Yes	No
France	ATK Mine	HPD 1			
France	ATK Mine	HPD 2	No	Yes	No
France	ATK Mine	HPD-1A	No	Yes	No
France	ATK Mine	ACPR Type F2			
France	ATK Mine	ACPR			
France	ATK Mine	Models 1953/54			
France	ATK Mine	M 51/M 52			
France	ATK Mine	APILAS			
France	ATK Mine	MI AC DIS F1	Yes	No	No
Germany	AP Mine	PPM-2			
Germany	ATK Mine	PM-60 (or K-1)			
Germany	Family	DYNAMINE			
Germany	AP Mine	DM 11 (AP)			
Germany	ATK Mine	DM 11 (AT)			
Germany	ATK Mine	DM 21			
Germany	ATK Mine	PARM DM 12			
Germany	ATK Mine	Panzerfaust			
Germany	ATK Mine	AT2	Yes	No	Yes
Hungary	AP Mine	Gyata-64			
Hungary	AP Mine	M62			
Hungary	AP Mine	M49			

Hungary	ATK Mine	UKA-63			
India	AP Mine	AP Mine Series			
India	ATK Mine	1A			
India	ATK Mine	3A			
International	ATK Mine	Apajax			
International	ATK Mine	ATIS			
Israel	AP Mine	No 4			
Israel	AP Mine	No 10			
Israel	AP Mine	No 12			
Israel	ATK Mine	No 6			
Italy	AP Mine	VS-50			
Italy	AP Mine	VS-Mk 2			
Italy	AP Mine	VS-Mk 2-EL	Yes	Yes	No
Italy	AP Mine	TS-50			
Italy	AP Mine	BPD SB-33			
Italy	AP Mine	Maus-1			
Italy	AP Mine	VAR/40			
Italy	AP Mine	VAR/100			
Italy	AP Mine	VAR/100/SP			
Italy	AP Mine	BM/85			
Italy	AP Mine	Valmara 69			

Country	**Type**	**Model**	**SD**	**SN**	**PSD**
Italy	AP Mine	VS-JAP			
Italy	AP Mine	VS-APFM1	No	Yes	No
Italy	AP Mine	BPD P-25			
Italy	AP Mine	BPD P-40			
Italy	AP Mine	VS-SAPFM3			
Italy	AP Mine	VS-DAFM 1			
Italy	AD Mine	VS-DAFM6/VS-DAFM			
Italy	ATK Mine	SATM	Yes	No	No
Italy	ATK Mine	VS-SATM1	Yes	Yes	No
Italy	ATK Mine	VS-1.6			
Italy	ATK Mine	BPD SB-81	Yes	Yes	No
Italy	ATK Mine	VS-3.6			
Italy	ATK Mine	VS-2.2			
Italy	ATK Mine	VS-AT4-EL	Yes	Yes	No
Italy	ATK Mine	VS-HCT	No	Yes	Yes
Italy	ATK Mine	VS-HCT2	Yes	Yes	No
Italy	ATK Mine	VS-HCT4	Yes	Yes	No
Italy	ATK Mine	BPD SB-MV/1	No	Yes	No
Italy	ATK Mine	TC/2.4			

Italy	ATK Mine	MATS/2.6			
Italy	ATK Mine	TC/3.6/TCE/3.6			
Italy	ATK Mine	MAT/5			
Italy	ATK Mine	MAT/6			
Italy	ATK Mine	TC/6 and TCE/6			
Italy	ATK Mine	BAT/7			
Italy	ATK Mine	SBP-04/SBP-07	No	Yes	No
Japan	ATK Mine	Type 63			
Korea N	AP Mine	Model 15			
Korea S	AP Mine	M18A1			
Korea S	AP Mine	K440			
Korea S	ATK Mine	M19			
Netherlands	AP Mine	Model 15			
Netherlands	AP Mine	Model 22			
Netherlands	ATK Mine	26C1			
Netherlands	ATK Mine	Type 2-T40			
Netherlands	ATK Mine	Model 25			
Pakistan	AP Mine	AP Series			
Pakistan	AP Mine	Bounding Series			
Pakistan	AD Mine	P5 Mark 1			
Pakistan	ATK Mine	P2 and P3			
Peru	AP Mine	MGP-30			
Poland	ATK Mine	MPP-B			
Portugal	AP Mine	MAPS			
Portugal	AP Mine	m/966			
Portugal	AP Mine	M432			
Romania	AP Mine	Ap Series			
Romania	AP Mine	MS-3			
Romania	AP Mine	AP Series			

Country	**Type**	**Model**	**SD**	**SN**	**PSD**
Romania	ATK Mine	MAT-62B			
Romania	ATK Mine	MC-71			
Romania	AP Mine	AP Series			
Russia	ATK Mine	PGTMDM			
Russia	ATK Mine	TM-83			
Serbia	AP Mine	UDAR			
Serbia	AP Mine	PMA-3			
Serbia	AP Mine	PMA-2			
Serbia	AP Mine	PMA-1/PMA-1A			
Serbia	AP Mine	PROM-1			
Serbia	AP Mine	PRM-2A			

Serbia	AP Mine	MRUD			
Serbia	AP Mine	PMR-1/PMR-2			
Serbia	ATK Mine	TMA-5/TMA-5A			
Serbia	ATK Mine	TMA-4			
Serbia	ATK Mine	TMA-3			
Serbia	ATK Mine	TMA-2			
Serbia	ATK Mine	TMA-1A			
Serbia	ATK Mine	TMM-1			
Serbia	ATK Mine	TMRP-6			
South Africa	AP Mine	APHE			
South Africa	AP Mine	Shrapnel No 2			
South Africa	ATK Mine	Mine No 8			
South Africa	ATK Mine	ATR-5	Yes	No	No
Spain	AP Mine	FAMA			
Spain	AP Mine	P-S-1			
Spain	ATK Mine	C-3-A			
Sweden	AP Mine	LI-11			
Sweden	AP Mine	FFV 013			
Sweden	ATK Mine	FFV 016			
Sweden	ATK Mine	FFV 028	No	Yes	No
Sweden	ATK Mine	Models 41-47			
Sweden	ATK Mine	Models 52/52B			
Sweden	ATK Fuze	Mine Fuze 15			
Sweden	ATK Fuze	Mine Fuze 16			
Switzerland	AP Mine	P59			
Switzerland	AP Mine	Model 49			
UK	Family	MINX			
UK	ATK Mine	Bar Mine			
UK	ATK Mine	FWAM			
UK	ATK Mine	Mark 7			
UK	AH Mine	Development			
USA	AP Mine	M18A1			
USA	AP Mine	Min M26			
USA	AP Mine	M16, M16A			
USA	AP Mine	M14			
USA	AP Mine	M2A4			
USA	AH Mine	AHM	Yes	Yes	No

Country	**Type**	**Model**	**SD**	**SN**	**PSD**
USA	Family	GEMSS Mines	Yes	No	Yes
USA	AD Mine	SM93 (WAM)	Yes	No	No
USA	AP Mine	PDM	Yes	No	Yes

USA	ATK Mine	M21
USA	ATK Mine	M24 and M66
USA	ATK Mine	M19
USA	ATK Mine	M15
Vietnam	AP Mine	AP Series
Vietnam	AP Mine	New AP Series

2.2. Mines With Self Destruct/Self Neutralisation Devices

Entry No 1

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Austria
Model : ATM 2000E Anti-tank Mine

Comment :

The ATM 2000E (Anti-Tank Mine 2000 Electronic), also known as the PzMi 88, is an advanced plastic-bodied mine utilising the latest available electronic technology and containing a minimum of metal components. A microprocessor-based sensor system inside the mine is able to carry out a number of independent sensor checks together with a number of manual controls for a very flexible range of operational sequences.

Commencing with the method of laying, either hand or mechanical methods may be used. For the latter the ATM 2000E can be mechanically laid using the Intertechnik AID 2000 minelayer. In either case the mine circuits will not auto-activate for 10 minutes after laying. The circuits can be manually deactivated at any time and at no risk to the operator. After deactivation the mine can be lifted and is then ready for immediate re-use if required. An automatic deactivation facility is included in the circuitry and the timing may be varied in accordance with customer preference.

The mine may be laid either on or below the surface. Once activated the sensor uses a combination of acoustic and magnetic sensors to locate a target, and the microprocessor system can discriminate between types of target. The normal pressure plate facility is retained. When called upon to detonate, a small clearing charge removes earth or other covering from the main warhead. The fuzing circuits allow the mine to be used against targets travelling at speeds between 0.5 and 60 km/h and the self-forging fragment warhead can penetrate up to 300 mm of monobloc armour or 100 mm of armour-plated steel plus six 10 mm witness plates. In addition to the above features the ATM 2000E can be detonated remotely by a conventional exploder

device and there is a manual switch that can be used to engage an anti-handling device if required. Inert training versions are available while another training variant can be supplied with only the electronic components in an operable state.

Associated with the ATM 2000E is the DEAK 2000 deactivation device. This can be used to locate buried ATM 2000E mines and can indicate the position and operating condition of the buried equipment. It can also be used to deactivate the mine electronics.

Specifications :

Weight: 6.5 kg
Weight of explosive: 1.5 kg
Dimensions: 251 x 251 x 130 mm
Penetration:
(monobloc steel) 300 mm
(armour-plated steel) 100 mm plus 6 x 10 mm witness plates
Main Charge Type - NK
Weight of Main Charge - NK
Method of Laying - Hand or Mechanical
Remote Laying Capability - Nil
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - Nk
Unit Price Estimate - US$600
Status : In production. In service with the Austrian Army.
Manufacturers :

Intertechnik Techn. Produktionen-GmbH,
A-4040 Linz,
Industrielle 56,
PO Box 100, Austria.
Tel: (0732) 78 92-0.
Telex: 221522.
Fax: (0732) 78 92-13.

Entry No 2

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Austria
Model : SMI 22/7C Off-route Anti-tank Mine

Comment :

The SMI 22/7C off-route anti-tank mine is aimed by the integral sight along a predetermined line across an important road or passage and the sensor is placed as required and then connected to the mine. The mine can be fitted with a self-neutralisation device if required. The main charge when detonated forms a projectile with a very high penetrating power. The mine also has an integral electronics unit with two sensors that can differentiate between various types of vehicle. The maximum distance that the mine can be positioned off the route is 50 m. It is also fitted with a self-deactivation device which operates after a predetermined time. Inert training mines are available.

Specifications :

Weight: 13.5 kg
Length: 290 mm
Diameter: 180 mm
Weight of main charge: 7 kg
Type of main charge: Composition B
Maximum effective range: 50 m
Armour penetration:
(30 m) 80 mm steel
(50 m) 70 mm steel
Penetration diameter: 80 mm
Deviation from flight path: 0.5x
Battery life: (operational) 3 months
Method of Laying - Hand
Remote Laying Capability - Nil
Logic Systems
Self Destruct - No
Self Neutralisation- Yes
Passive Self Deactivation - No
Inert Indications - NK
Unit Price Estimate - US$2,000
Status : Trials.
Manufacturers :

SMI, Military Defence Products, Sudsteirische Metall-industrie GmbH,
A-8430 Leibnitz,
Austria.
Tel: 03452 2101.
Telex: 034405 assmann a.
Fax: 03452 2297.

Entry No 3

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : China, People's Republic
Model : Type 72 Anti-personnel Mine Series

Comment :

All the Type 72 anti-personnel mines are visually identical, being small low metallic content cylindrical mines with a slightly domed upper surface. Each mine is only 78 mm in diameter and 37 mm high. The weight is 150 g of which 34 g is explosive. The mines are pressure-activated by a pressure of between 3 and 7 kg. However, the Type 72B and 72C use electronic circuitry on a printed circuit board to delay arming and also have ananti-handling device which detonates the mine if the body is tilted more than 10x. The Type 72C also has a self-destruct capability. Externally all three are visually identical, having a light green top cover and a green body. Once emplaced all three mines are outwardly identical. However, the Type 72A has a safety pin with a round end. On the Type 72B it is triangular while the end of the safety pin for the Type C is reported to be rectangular.

With the Type 72A, removal of the safety pin will permit the pressure plate under the sealed rubber top cover to descend to activate the mine when pressure is applied. When the safety pin is in place three spring-loaded detents block any pressure plate movement. Once the pin has been removed the pressure plate is free to move down against a domed fibre-reinforced plastic plate which, once enough pressure has been applied, will flip downwards to permit a striker pin in its centre to contact the detonator. On the Type 72B removal of the safety pin will not only release the pressure plate to move downwards when pressure is applied but it will also permit an internal switch plate to turn and switch on the electronic circuitry. After a short delay the electronics will assume that the position assumed by the mine is a fixed datum point. Thereafter any movement of 10-12x from that datum will cause the mine to detonate. Pressure on the pressure plate will also detonate the mine.

Specifications :

Weight - 150gms
Diameter - 78mm
Height - 37mm
Main Charge Type - NK
Weight of Main Charge - 34gms
Method of Laying - Hand
Remote Laying Capability - Nil
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - NK
Unit Price Estimate - US$30 (at US manufacturing prices)
Status : In service with the Chinese armed forces. Encountered throughout South-east Asia.
Manufacturers :
State factories.

Entry No 4

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : CIS/Russia
Model : POM-K Scatterable Anti-personnel Mine

Comment:
Designed for delivery from helicopters, low flying aircraft and rocket launchers, in contrast with most other Soviet-designed land mines, the POM-K operates in a set sequence that relies on a number of automatic stages being carried out correctly and without error. The sequence commences with a 143 mm diameter canister in which the mines are transported and from which they are ultimately dispensed. Each one of these canisters, marked VP-09S, is enclosed by a lid. Each canister contains four mine units. Each canister lid is connected to the base of another canister. As the canister is dispensed a small explosive charge blows off the lid and the four mine units fall free. As the canister lid flies off a loaded spring at the top of each mine body forces off yet another lid to allow four fabric drogues to deploy and ensure that the mine unit falls to the ground base first. As the mine hits the ground an internal inertia fuze is actuated to blow off the top of the mine body along with the now-redundant drogues. The same action releases six base-hinged stabiliser legs which deploy under spring pressure to hold the mine upright. When deployed the legs create an overall diameter of 265 mm while the mine body

diameter is approximately 58 mm; the mine stands about 124 mm high and weighs 850 g. The inertia fuze also initiates a pyrotechnic chain which eventually blows off a cruciform-shaped alloy casting from the top of the mine body -- up to this point the casting is held in place by two spring-loading pins. The removal of the casting allows four L-shaped spacers to fall away to reveal four wells at the top of the mine body.

Each of these wells contains a coiled spring and a length of thin coiled wire. Once the L-shaped spacers have fallen away the coiled springs propel themselves and the coiled wire away from the mine body to a distance of about 8 m. The mine is then ready to operate with the entire arming sequence after landing lasting little more than a second. Once deployed, the coiled wires are ready to act as trip wires, although the term contact wires might be more appropriate. The wire used is very thin and almost impossible to spot amongst foliage or even against level surfaces. The four wires are actually joined together in two pairs with each junction being made at a plastic ball, one each side and located about 20 mm from the top of the mine body. Any movement of the trip wires will thus cause at least one plastic ball to move slightly. From each plastic ball a further short length of wire leads into the top of the mine body via a carefully-angled channel which ensures that any movement of either of the plastic balls will result in an amlified horizontal movement of a rotating metal arm located inside the top of the mine body. The rotating arm needs to move only about 15 degree to 20 degree before the firing sequence commences - the movement requires a pressure of as little as 500 g on any of the trip wires. The rotating arm is directly connected to an internal striker tube which is also rotated to a point where two internal steel bearings come into alignment with clearance spaces. The bearings move into the clearance spaces and a spring-loaded striker is then free to move and initiate the main charge.

The main charge is 252 g of TNT which causes the mine's steel body to fragment over a lethal radius of 10 m. A POM-K minefield created by a salvo of 220 mm rockets is likely to contain large numbers of mines with their trip wires all jumbled together to form an almost impenetrable barrier to movement - the detonation of even one POM-K could cause significant damage to any soft-skinned vehicle.

Self-Destruction

To add to the hazards posed by the POM-K it also has a self-destruct function. The sequence involved commences as the top of the mine unit is blown off by the inertia fuze on landing. As the top blows off, along with the drogues, a blocking/safety pin is allowed to rise from the centre of the top of the mine body. The blocking/safety pin releases pressure on an internal compressed spring located around the striker mechanism, but the spring is not completely free to expand immediately. It is held compressed by a mass of an elastic silicone substance which retards the release of the spring. Thus the spring can only expand slowly, driving a piston as it does so. Eventually the piston will reach a point where the internal striker tube, normally actuated by the rotating arm connected to the trip wires, comes into play. The piston operates yet another spring to move the striker tube vertically to a position where two further clearance spaces are brought

into alignment with the striker pin steel bearings. The bearings move into the clearance spaces and allow the spring-loaded striker to move and initiate the main charge as normal. The self-destruct sequence mentioned here takes approximately 23 hours but it is likely that other self-destruct times could be set.

Quality Control

The operating sequences of the POM-K may seem complex but the devices do work. The arming and other stages all depend on a number of mechanical operations being carried out in a precise sequence, so any one failure will cause the rest to fail. This apparent drawback is overcome by two factors, one being the large numbers in which the mines are normally dispensed. Thus a few failures amongst many will still create a barrier to movement that will be difficult and time-consuming to overcome. The second factor is that the quality control employed during the production of these mines is very high. Observers of Soviet mines are normally used to rough but serviceable production standards, but with the POM-K the contrast with former quality acceptance levels is most marked. Because of the high quality of manufacture the unit costs of each mine must be accordingly high which makes some observers wonder if the device is cost-efficient. Such considerations have to be set aside when one considers that the instantly-created and non-permanent barriers to movement formed by number of POM-K scatterable mines could have considerable tactical value during any conflict.

Specifications :

Weight - 850gms
Diameter - 265mm (overall) 58mm body
Height - 124mm
Main Charge Type - TNT
Weight of Main Charge - 252gms
Trigger Pressure - 500gms
Method of Laying - Scatterable
Remote Laying Capability - Aircraft/Rockets
Logic Systems
    Self Destruct - Yes
    Self Neutralisation - No
      Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$75-100 (At US prices)
Status : In Production
Manufacturers : Russian/CIS State Factories.

Entry No 5

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : Commonwealth of Independent States
Model : PFM-1/1S Anti-personnel Mine/Bomblet

Comment :

The PFM-1 anti-personnel mine/bomblet was first used during the Israeli-Syrian conflict in October 1973 and was employed in large numbers in Afghanistan. It has been marked as the PFM-1 (anti-personnel high explosive mine) or PMZ (area denial mine). The PFM-1 is a small air-delivered plastic weapon with a low metallic signature containing 35 to 40 g of liquid explosive. The liquid explosive has four components and has a density of 1.57 g/ml. The device is designed to maim rather than kill and has no self-destruct or neutralising capability. The PFM-1 has an irregularly shaped bulbous body containing the liquid explosive in its lower part which is flexible to a limited degree. The casing, which weighs approximately 12 g, is manufactured from a high density polyethylene. In the firmer centre are the delayed arming and initiation systems. The rest of the body is a flat section that acts as a form of stabiliser while the weapon is dropped from an aircraft. The material used for the body is very low density polythene and may be coloured green, sand or white. In Afghanistan PFM-1 mines were sown by Mi-8 Hip or similar helicopters with each helicopter usually carrying two 144-mine scattering units. Each unit comprises six 12-mine packets and the units are suspended from the helicopter's load-carrying points with one portion remaining on the hard point after launch. For launching the two solid side-covers of the unit are pushed apart mechanically by piston-like levers operated by springs and hydraulic pressure. When each of the six 12-mine packets is released the mines are scattered randomly by the airflow or on impact with the ground. The packets are made of a very thin foil and have dimensions of approximately 250 x 250 x 250 mm.

The PFM-1 mines can also be scattered from 240 mm mortar bombs fired to a range of between 12000 to 15000 m. With this system the mines are packed into units that look like green plastic bags, each containing about 20 mines. Each unit measures approximately 200 x 200 x 100 mm, and the unit scatters the mines by exploding an internal charge in the middle of the bag upon impact with the ground. The mines are then scattered over a radius of between 100 and 200 m.

When released from fixed or aimable containers carried on fixed-wing aircraft or helicopters a safety/arming plug is released from one side of the central part of the body. As the mine falls to the ground a piston is then allowed to travel under spring pressure through a silicon-based viscous liquid. This provides an arming delay that does not arm the weapon until after it is on the ground. Thereafter any distortion of the plastic body will cause the striker to hit the detonator. This distortion may be from a single movement produced by stepping on or kicking the mine but the mine may also be detonated by an accumulation of light pressures such as those produced by handling.

The fuze employed is the MVDM although it is sometimes marked as the VGM-572. The PFM-1 was named the 'Green Parrot' by Afghan tribesmen and this name has been used in some Western references. The PFM-1S is a variant of the basic PFM-1 but with an added self-destruct feature.

Specifications :

Weight: 70 g
Width over wings: 112 mm
Height central body: 60 mm
Thickness of body: 15 mm
Weight of charge: 35-40 g
Type of charge: liquid explosive
Method of Laying - Scatterable
Remote Laying Capability - Bombs, rockets and aircraft
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$25-40 (At US prices)
Status : In Production
Manufacturers : Soviet/CIS State Foctories

Entry No 6

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Commonwealth of Independent States
Model : PGMDM Scatterable Anti-tank Mine

Comment :

The PGMDM scatterable anti-tank mine may be dispensed from aircraft or helicopters and has the same triangular bar-mine shape and appearance as the German AT-1 (which did not enter service) and the French Mitral scatterable anti-tank mines.The PGMDM differs in that it uses a liquid explosive charge contained in a thin flexible plastic cover. The PGMDM uses the same MVDM pressure-operated fuze employed on the PFM-1 anti-personnel mine. This fuze may be operated by a single pressure or an accumulation of slight pressures, for example by handling, and is electrically activated on release - after a 30 second delay all operations are mechanical. The mine is reported to be spongy to the touch as the plastic casing is very thin. The mine has an overall length of 300 mm and a height of 75 mm; the base measures 65 mm. The circular

metal fuze is set at one end of the body and has a diameter of approximately 55 mm; the fuze protrudes 20 mm from the mine body. These dimensions put the weight between 1.4 kg and 2 kg. Since most of the weight is made up of the liquid explosive filling this is enough to damage a tank track or vehicle wheel. The PGMDM has a clockwork self-destruct timer that can be preset to any one of 12 settings, with the maximum setting understood to be 20 hours.

Specifications:
Weight - 1.4 to 2kg
Length - 300mm
Height - 75mm
Main Charge Type - Liquid Explosive
Weight of Main Charge - .8kg (approx)
Method of Laying - Scatterable
Remote Laying Capability - Aircraft & helicopters
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$175
Status : In Production
Manufacturers : Russian/CIS State Factories

Entry No 7

Equipment Type : River-Bottom Mine (AD Mine)
Country : Commonwealth of Independent States
Model : PDM-1, PDM-1M, PDM-2 and PDM-6 River-bottom Mines

Comment :

The PDM anti-landing mines were designed to disable and damage landing craft and amphibious vehicles and would be used in rivers or lakes with a maximum velocity of 1.5 m/s. They can also be used on the sea shore in depths of water ranging from
1 to 5 m.

PDM-1
This is similar to the PDM-1M but lacks a booster in the firing chain.

PDM-1M
This consists of a hemispherical case resting on a steel and concrete base and is normally used in water 1 to 2 m deep. The mine is detonated when the VPDM-1M tilt-rod fuze is struck. Two men can lay and arm the mine in 10 to 20 minutes.

PDM-2
This mine is also spherical and rests on a concrete base. It has a VPDM-2 tilt-rod fuze and is normally used in water from 2.4 to 3.8 m deep.

PDM-6
This is similar to the PDM-1M but has four fuze wells, one ofwhich is in the bottom of the mine and is used as an anti-disturbance device. Each of the three fuze wells in the top of the mine has a tilt-rod fuze which can be adjusted so that the mine will detonate immediately on contact, or so that a rod deflection will trigger the mine.

Specifications :

Model	PDM-1M	PDM-2	PDM-6
Weight	21 kg(1)	100 kg(2)	47.5 kg(4)
Height	1 m	1.4 m(3)	2.5 m(5)
Diameter	-	270 mm	500 mm
Base diameter	-	-	1 m
Main charge type	TNT	TNT or Ammonite	TNT or PETN
Weight of main charge	10 kg	15 kg	28 kg
Operating force	18-26 kg	40-50 kg	n/a

(1) Without concrete base which weighs 24-29 kg
(2) On low stand, 135 kg on high stand
(3) Range from 1.1-2.7 m depending on type of stand
(4) With base plate
(5) Mine body only, between 550-1050 mm with fuze

Two updated variants, the PDM-1B and the PDM-2B, have been developed. The 60 kg PDM-1B (below left) retains the hemispherical case of the original PDM-1M, is anchored on the river or sea bottom by a steel or concrete collar, and contains about 10 kg of explosive, probably TNT. It is installed under about 1.1 to 2 m of water with a tilt mast sensor threaded into the central fuze well. The PDM-1B differs from earlier models in that the operating mechanism contains an electronic proximity fuze, with the tilt mast electro-mechanical element acting as a back-up. The proximity/electro-mechanical fuze combination can be programmed to self-destruct or neutralize after periods of up to

45 days. Programming from the 'safe' to the operational mode can be selected up to five times before the mechanism becomes inoperable.

The latest version of the heavier PDM-2 series, the PDM-2B weighs 110 kg of which 15 kg is the explosive charge inside a cylindrical casing. The PDM-2B has an electronic proximity fuze which supplements the electro-mechanical element so that the mine can be emplaced under 2.5 to 10 m of water. It has the same neutralize or self-destruct fuze programming option as the PDM-1B.

Method of Laying - Hand
Remote Laying Capability - Nil
Logic Systems
Self Destruct - Yes
Self Neutralisation -Yes
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - NK
Status : In Production
Manufacturers : Russian/CIS State Factories

Entry No 8

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Denmark
Model : Anti-tank Mine Fuze M/88

Comment :

The electronic Anti-tank Mine Fuze M/88 was developed in co-operation with the Royal Danish Army Material Command. It is offered as a cost-effective alternative retrofit solution for existing non-metallic mines. This fuze is licence-produced by Royal Ordnance as the RO 150. The M/88 can provide most existing non-metallic mines with a full width capability and can be fitted to the Bar Mine using two plastic straps with snap locks and without using tools. On other types of mine fitting is carried out using various interfaces integrated into the bottom of the mine fuze. The fuze has an advanced electronic sensor which ensures correct functioning regardless of target speed. The sensor can be preset to disregard light targets and the fuze has a built-in anti-tilt device. It is also protected against electronic mineclearing measures. The 7.8 g transfer charge of TNT/RDX 45:55 is integrated into the fuze bottom and can be fitted without having to open the fuze. The fuze case is waterproof to a depth of 2 m in salt and fresh water and is manufactured using modified polycarbonate materials in a green colour although various shades of brown can be produced.

The M/88 has a 15 minute arming delay and will self-neutralise after 90 days. Burying depth is up to 150 mm in earth. It can be used with mechanical minelayers. Minimum shelf life is 10 years although the battery may have to be changed after 5 years. Weight of the M/88 is 835 g including the battery. Dimensions are 218 x 97 x 54 mm. The operating temperature range is from -3 to +58xC.

Specifications:
Weight - 835 gms
Diameter - 218mm
Height - 54mm
Main Charge Type - TNT/RDX 45:55
Weight of Main Charge - 7.8 gms (transfer charge)
Method of Laying - hand
Remote Laying Capability - N/a
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$150
Status : In production. In service with the Royal Danish Army.
Licence-produced in the United Kingdom by Royal Ordnance.

Manufacturers :

Nea-Lindberg A/S,
Industriparken 39-43,
PO Box 226,
DK-2750 Ballerup,
Denmark.
Tel: 42 97 22 00.
Telex: 35 338 nealin dk.
Fax: 42 65 61 38.

Entry No 9

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : France
Model : Anti-personnel Bounding Mine Model 1951/1955

Comment :

This mine consists of a cylindrical metal case which acts as a mortar, and a canister which contains the main charge, integral fuze, steel shrapnel, and is closed by a cap which contains the main, central and self-destruction fuze well plug. The mine can be activated by a tilt of the rod or downward pressure on the rod when the mine is fitted with a tilt-rod fuze, or a pull on the tripwire when the mine is fitted with a pull fuze. This initiates the fuze and fires the delay train and the propelling charge. The expanding gases project the canister into the air. The canister has a cord attached to its lower end and when it reaches a height of 1.5 m (the full length of the cord), it pulls out the retaining pin of the canister fuze. This releases the striker-retaining balls which escape and free the spring-driven striker. This initiates the firing chain which consists of a percussion cap, detonator and the main charge which hurls shrapnel in all directions up to a radius of 45 m.

Specifications :

Weight: 4.49 kg
Diameter: 97 mm
Height: 158 mm
Main charge type: picric acid
Weight of main charge: 408 g
Operating force: 3 kg
Fuze: Model 1952 tilt-rod
Method of Laying: Hand
Remote Laying Capability: Nil
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - Nil
Unit Price Estimate - US$100

Status : In service with the French Army but no longer in production.

Entry No 10

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : France
Model : ALSETEX Mitral Scatterable Anti-tank Mine

Comment :

The ALSETEX Mitral scatterable anti-tank mine was designed to be distributed in a number of ways and is intended as a tank track destruction mine. It can be scattered from an aircraft or helicopter munitions dispenser, by a rocket or similar vehicle, or from a ground-based launcher. The Mitral anti-tank mine is of the small bar type and has three sides so that at any one instant one face of the mine with its centrally located fuze is always pointing upwards. It has a clockwork igniter delay device that starts to operate as soon as the mine is released or fired. This device completes the alignment of the pyrotechnical chain after a given time, and the same device also self-destructs after a pre-arranged period.

The edges of the mine are provided with flexible shock dampers to soften the shock of landing. The mines can be scattered from an aircraft or helicopter munitions dispenser in clusters, and may even be dispensed individually from helicopters. Rockets could carry from 6 to 12 mines and ground-based launchers could fire the mines using a small explosive charge - these ground-based launchers could be static or mounted on a vehicle.

Specifications :
Weight: 2.6 kg
Length: 300 mm
Edge: 100 mm
Type of charge: RDX based
Method of Laying : Scatterable
Remote Laying Capability: Aircraft, rockets or ground based launchers.
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - Nil
Unit Price Estimate - US$400

Status : Development.

Manufacturers :

ALSETEX SAE,
35 rue Tronchet,
F-75009 Paris,
France.
Tel: (1) 42 65 50 16.
Telex: 280 384 f alexplo.
Fax: (1) 42 65 24 87.

Entry No 11

Equipment Type : Mine Fuze
Country : France
Model : ALSETEX Programmable Igniter

Comment :

The Alsetex Programmable Igniter is used for the electrical and mechanical ignition of various explosive devices including mines. The igniter will actuate the device on receipt of signals from a range of sensor devices which can include tripwires, infra-red sensors, acoustic devices and so on, or in a time programmed mode. The time programmes can be set in periods from 0 to 96 hours, or in 1 hour increments, or in one day increments. At the end of the preprogrammed period the igniter will either cause the explosive device to self destruct or return to a safe condition; in the latter case the igniter can be recovered and reused.

The igniter is contained inside a sealed case and can be used over a temperature of from -40 degrees C to +63 degrees C. Power is supplied by two lithium cells. The igniter may be used with tripwires up to 100m long. An anti-lifting device is incorporated.

A version of this igniter intended for use with the off-route MIACAH F1 weighs 1kg, is 70mm high and has a diameter of 185mm.

Specifications
Weight - 1kg
Diameter -185mm
Height - 70mm
Method of Laying - Hand
Remote Laying Capability - Nil
Logic Systems
Self Destruct - Yes
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$150

Status : Believed to be in production.

Manufacturers :

ALSETEX SAE,
35 rue Tronchet,

F-75009 Paris,
France.
Tel: (1) 42 65 50 16.
Telex: 280 384 f alexplo.
Fax: (1) 42 65 24 87.

Entry No 12

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : France
Model : HPD 2 Anti-tank Mine

Comment :

The HPD 2 anti-tank mine has been referred to as the HPD F2 and is a development of the original HPD. It is described as a second-generation high-power mine which can produce explosively formed fragments to penetrate tank belly armour up to 100 mm thick across the width of a tank. The HPD 2 has been ordered by the French Army plus Belgium (contract worth $53 million), Norway and Switzerland. The Swiss contract was worth SF 342 million, with deliveries scheduled between 1991 and 1994. Designed to be used with existing minelaying systems the HPD 2 consists of two modular subassemblies. One is the fuze section which contains the magnetic induction sensors, the laying safety, the self-neutralising system, the power supplies, a pyrotechnic safety, and the arming devices. The other section contains the clearing charge to blow away any covering earth or snow and the main shaped charge. It can be laid in up to 1.5 m of water and is highly resistant to mechanical, explosive and magnetic countermeasures. The self-neutralisation system is such that if the mine is not used during a preset length of time it can be lifted and re-used. The mine is provided with a visual self-neutralising indicator.

Specifications :

Weight: 7 kg
Length: 280 mm
Width: 185 mm
Height: 105 mm
Temperature range: -35 to +63xC
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - No

Inert Indications - Yes
Unit Price Estimate - US$800

Status : In production for Belgium, France, Norway and Switzerland.

Manufacturers :

Thomson-TRT Defense,
Ammunition Electronics Activity,
533 avenue du General de Gaulle,
F-92140 Clamart,
France.
Tel: (1) 46 01 25 00.
Fax: (1) 46 30 35 42.

Entry No 13

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : France
Model : Anti-tank Mine HPD-1A

Comment :

This mine was designed to be laid or buried by the mechanical laying devices of the HPD family. It is fitted with an influence fuze capable of operating across the width of vehicles weighing 8000 kg and above. When laid on the surface the mine is capable of penetrating 200 mm of armoured vehicle belly plate from a stand-off distance of 0.5 m. If it is buried under 150 mm of earth it can penetrate 50 mm of belly armour from the same stand-off distance. The HPD-1A can be fitted with an earth-clearing blasting charge which allows a buried mine to have the same perforating performance as a mine laid on the surface. It will also destroy tank tracks. Arming is initiated after a 10 minute delay and the mine can be set for self-neutralisation after one month.

Specifications :

Weight: 7 kg
Length: 280 mm
Height: 103 mm
Width: 187 mm
Weight of main charge: 3.3 kg

Power supply: 2 rechargeable lithium batteries
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$800

Status : Development.

Manufacturers :

Centre de Bourges.
Enquiries to Giat Industries,
13 route de la Miniere,
F-78034 Versailles Cedex,
France.
Tel: 30 97 37 37.
Fax: 30 97 39 00.

Entry No 14

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : France
Model : MI AC DIS F1 anti-tank mine

Comment :

The MI AC DIS F1 anti-tank mine is housed in a rigid impact-resistant elastomer frame whose external casing is elastic with two metal lugs designed to prevent the mine from being laid sideways. It comprises a detection and ignition module with a magnetic sensor providing detection and a chronometric logic circuit as well as a warhead composed of two opposite half-charges of compressed explosive contianing an electronic fuze and a primer.

The mine is of 200mm calibre with the lugs unfolded (190mm for the carrier-projectile version). It is 89mm high and weighs 2.3kg, including 0.6kg of hexavyl-type explosive. When it explodes, the entire charge operates in one direction so that, at a distance of 50cm, this mine can penetrate 80mm of armour at zero obligity, 50mm of armour at an incidence angle of 45deg and 40mm of armour at an angle of 60deg.

The activity time of the MI AC DIS F1 can be programmed between one hour and 48 hours before launch in increments of one hour. It self-destructs at the end of its activity time.

Specifications:

Calibre : (with lugs unfolded) - 200mm
(carrier-projectile version) - 190mm
(with lugs folded) - 139mm
(carrier-projectile version) - 130mm
Height - 89mm
Weight - 2.3kg
Main Charge Type: Hexal
Weight of Main Charge: 0.6kg
Method of Laying: Scatterable
Remote Laying Capability: Carrier/Dispenser
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$300

Manufacturer :

Giat Industries,
13 route de la Miniere,
F-78034 Versailles Cedex,
France.
Tel: 30 97 37 37.
Fax: 30 97 39 00.

Entry No 15

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Germany
Model : AT2 Anti-tank Mine

Comment :

The AT2 (DM 1233) anti-tank mine has been in production since 1980, originally for use with the German 110 mm Light Artillery Rocket System. The AT2 was further developed for use in

the scatterable anti-tank mine rockets fired by the LTV 227 mm Multiple Launch Rocket System. The mine is also used with the German Skorpion minelaying system. In addition the AT2 is used as the basis for the private venture DYNAMINE family of mines by Dynamit Nobel AG. With LARS the AT2 has been known as the AT2 Medusa. Production of AT2 for LARS ceased during 1985 after 300,000 (DM1234) mines had been produced. Production of 640,000 AT2s (DM 1274), packed into 20-round magazines (with four tubes of five mines each) for the Skorpion minelaying system, is continuing. During 1992 production commenced of approximately 350,000 AT2 mines (DM 1399) for MLRS (for Germany and the United Kingdom).

Description

The AT2 has two main sub-assemblies, the warhead and the safe and arm assembly. The warhead comprises a parachute that is deployed when the mine is used with LARS or MLRS and reduces impact with the ground; a warhead case to protect the shaped charge against damage; a cover to protect the stand-off above the shaped charge; the S3 target sensor which causes the mine to detonate with an appropriate delay when any part of a target vehicle contacts it; and the shaped charge which produces an optimised behind armour effect. The safe and arm (S & A) assembly housing accommodates and protects the complete assembly comprising the electronic elements, the mechanical elements and the power supply.

There is also an erection mechanism that orientates the mine in its operating position, an electronic fuze assembly to control the functional process and evaluate the sensor signals, and the mechanical fuze assembly. The sensors pass on signals to the electronic fuze assembly if there is an attempt to handle or move the mine or if a vehicle passes over the mine. Power is derived from a battery which is activated by a pyrotechnic element just before the mine is emplaced. The AT2 is effective across the full width of a target vehicle and can be set for six different self-destruct times. An anti-handling device prevents the mine from being lifted and it is resistant to rapid clearing means such as line charges or other explosives. The mine is not affected by electromagnetic radiation or pulses. For manual laying AT2 mines can be delivered packed in shipping containers each holding five mines and weighing 12 kg. The five mines can be emplaced manually in 1 minute. The AT2 has a shelf life of 10 years.

Specifications :

Weight: 2.22 to 2.25 kg, depending on version
Diameter: 103.5 mm
Height: (without sensor) 128 mm
Penetration: (against rolled homogenous armour) up to 140 mm
Main Charge Type: Shaped Charge
Weight of Main Charge: Nk
Method of Laying: Hand/Mechanical
Remote Laying Capability: Rockets and Armoured Launchers
Logic Systems

Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - Yes
Inert Indications: No
Unit Price Estimate: US$325

Status : In production. In service with the German Army and under consideration by several NATO nations.

Manufacturers :

Dynamit Nobel AG,
Defence Technology Division,
D-5210 Troisdorf,
Federal Republic of Germany.
Tel: 2241 89-0.
Telex: 885 666 dn d.
Fax: 2241 89 1669.

Dynamit Nobel DYNAMINE Family of Mines

Comment :

The DYNAMINE family of mines is a private development by Dynamit Nobel AG to produce a range of mines based on the technology used for the AT2 anti-tank mine described in the previous entry. Details are as follows:

Description

The DYNAMINE family of mines is based on, and includes, the AT2 anti-tank mine and shares the same handling, shipping and storage safeties and a 10-year shelf life. All the mines have a body diameter of 103.5 mm and weigh between 2.2 and 2.7 kg.
Details of the different mines are as follows:

Anti-personnel Mine AP2

The warhead of the AP2 consists of a fragmentation casing lined internally with heavy metal balls. After emplacement and orientation the mine ejects three tripwires, each with a length of approximately 13 m, which will activate the mine on tension. The radius of penetration of 1.5 mm steel with more than 2 fragments/m{2} is more than 20 m.

Anti-materiel (AM) mine

The warhead of this mine is basically the same as the AP2 anti-personnel mine but the casing forms larger projectiles that are explosively formed to spread laterally at high velocity to produce a high degree of penetration against light armour to a range of approximately 100 m (where projectile fragments are able to penetrate 20 mm of mild steel). The AT2 shaped charge is retained and detonation will also result in a large number of fragments with anti-personnel effects. The mine is activated by the S3 sensor of the AT2 mine.

Signal mine (S-mine)

These mines may be emplaced either individually or in a mix with other types. When the noise of approaching enemy units is detected and filtered by acoustic sensors the mine is activated. A rocket motor then lifts the mine vertically to release the transmission antenna and transmit coded signals on a pre-programmed frequency.

Shallow water mine (SW-mine)

Intended for the protection of shore lines and shallow water, the shallow water mine has a flotation air bag which replaces the shaped charge cover and parachute of the basic AT2 mine and there is no erection mechanism. The shaped charge is retained to make the mine effective against landing craft and amphibious vehicles.

Entry No 16

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : Italy
Model : Valsella VS-Mk 2-EL Anti-personnel Scatter Drop Mine

Comment :

The VS-Mk 2-EL is an anti-personnel, blast effect, electronic programmable mine with a pressure sensitive fuze and an anti-lift device. The VS-Mk 2-EL is a general purpose mine which can be laid manually both on the surface and buried, scattered by the Istrice land mine scattering system or the manportable GRILLO 90 system, or dropped by the VS-MDH helicopter dispenser.

The mine is disc-shaped and is provided with a microprocessor for the identification, discrimination and selection of signals received by the pressure-sensitive fuze. The microprocessor also controls and governs all mine functions in all possible modes, neutralising the mine when any malfunction occurs. The mine is provided with a safety and arming device

which renders the mine safe under all conditions, thereby allowing its 'ready for use' state during storage and transport.

After arming the mine goes through the programmed modes, including self-neutralising or self-destruct, according to choice, at the end of the programmed life. The active life and anti-lift times for the mine are separately programmable in intervals of one hour up to one year. The mine detonates when a valid pressure is applied to the pressure-sensitive fuze during the active life period or when an attempt is made to lift the mine during the anti-lift period. The mine can cause serious injuries to personnel and can damage the wheels of light vehicles. It can operate even when laid upside down or below 1 m of water, and is difficult to detect by sight or by metal detectors.

The mine has a high immunity to clearance measures such as suspended charges, bangalore torpedoes or fuel-air devices. It will not respond to the detonation of another mine nearby. The VS-Mk 2-EL is provided with a complete set of electronic accessories. These include a VS-MP1 main programmer intended for officer-level use; a pocket-sized VS-SP1 secondary programmer intended for use by sappers; a bench-size VS-SP-2 secondary programmer for the mass programming of complete tubes or boxes of mines; and a manportable VS-DS-1 status detector for the detection and interrogation of deployed mines. The VS-Mk 2-EL complies with all the latest NATO and FINABEL standards. Practice and training versions are available.

Specifications :

Weight: 200 g
Max diameter: 89.5 mm
Height: 35 mm
Main charge type: HE
Main charge weight: 15 g
Active life time: 0 to 365 days in 1 h increments
Anti-lift time: 0 to 365 days in 1 h increments
Arming delay: 10 min
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Scatterable
Remote Laying Capability: Aircraft and Vehicle Launchers
Logic Systems
Self Destruct- Yes
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - No
Unit Price Estimate - US$60

Status : In production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 273 2621.
Telex: 300495 emmeti i.
Fax: 30 273 1687.

Entry No 17

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : Italy
Model : Valsella VS-APFM1 Anti-personnel Bounding Mine

Comment :

The Valsella VS-APFM1 anti-personnel bounding mine is an improved version of the Valmara 69 anti-personnel bounding mine with an advanced electronic fuze. The warhead is derived from the Valmara 69 model and includes some modifications to increase effectiveness. The mine is armed by the combined movement of an arming lever and a release button. After a safety delay of 10 min from arming, three tripwires are automatically ejected by the fuze. A traction load of about 500 g on one tripwire activates the fuze. The priming train is first aligned and then the ejection sequence of the warhead is initiated, terminating in the warhead activation. Both the primer in the fuze and the detonator in the warhead are kept in the SAFE position until activation. The fuze includes a self-neutralisation feature which can be electrically set in the field using a pocket-sized electronic programmer. Practice and training versions are available.

Specifications :

Weight: approx 3.5 kg
Diameter: 130 mm
Height: 190 mm
Weight of main charge: 500 g
Activation: by automatically extended tripwires
Activation load: approx 500 g
Arming delay: 10 min

Self-neutralising delay: 0 to 365 days in increments of 1 h
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Hand
Remote Laying Capability: Nil
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - No
Inert Indications - Yes
Unit Price Estimate - US$80

Status : Development complete.

Manufacturers :
Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 18

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella SATM Scatterable Anti-tank Mine

Comment :

The SATM scatterable anti-tank mine is provided with a single liner shaped charge plus an influence fuze and can be launched from the Valsella Istrice land mine scattering system. The SATM has a cylindrical body and is fitted with deployable fins which provide stabilisation during flight and maintain the correct orientation for landing. Once in position the SATM can use its shaped charge to attack the belly armour of a target MBT. There is a dual-action inertial safety arming device. The SATM dual-sensor integral fuze features target discrimination combined with a high immunity to mineclearing countermeasures. The mine also has a self-destruct capability which is electrically programmed at launch.

Specifications :

Weight: 1.4 kg
Diameter:
(maximum) 114 mm
(minimum) 96 mm
Height: (total) 106 mm
Weight of main charge: 0.4 kg
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Scatterable
Remote Laying Capability: Istrice Minelayer
Logic Systems
Self Destruct - Yes
Self Neutralisation - No
Passive Self Deactivation - No
Inert Indications: Nk
Unit Price Estimate: US$180
Status : In production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 19

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella VS-SATM1 Scatterable Anti-tank Mine

Comment :

The Valsella VS-SATM1 is a scatterable, full width, anti-tank mine provided with a dual sensor influence electronic fuze with an active life programmable in the field prior to scattering. The VS-SATM1 is intended for use with the Istrice mine scattering system, the manportable GRILLO

128 single-tube launcher and the VS-MDH helicopter system. It may also be hand emplaced. The VS-SATM1 uses an explosively formed projectile which is effective against MBTs and APCs, both wheeled and tracked. The mine can produced a complete kill when fired against belly armour or a mobility kill when fired under tracks or wheels. Advantages claimed for the mine include good target discrimination, virtually independent of target speed; zero false activations; high warhead effectiveness against
current and future MBTs; and a self-destruct or self-neutralisation capability at the end of the electronically preset active life period. The choice between the two latter alternatives is made prior to manufacture.

The VS-SATM1 is visually identical to the VS-SAPFM3 scatterable anti-personnel mine, and thus has a cylindrical body surrounded by lateral support springs and with a closed cover. The mine is provided with a safety and arming device which renders the mine safe under all conditions, allowing its 'ready for use' state during transport and storage. The mine is resistant to countermeasures, and is capable of selecting only the correct firing stimuli. The warhead can penetrate 100 mm of rolled homogeneous armour (RHA) and is designed to obtain the maximum behind-armour effects by using spall fragment projection and the generation of an over-pressure inside the target. It is effective even when submerged under water. The VS-SATM1 is provided with a complete set of electronic accessories. These include a VS-MP1 main programmer intended for officer-level use; a pocket-sized VS-SP1 secondary programmer intended for use by sappers; a bench-size VS-SP-2 secondary programmer for the mass programming of complete tubes or boxes of mines; and a manportable VS-DS-1 status detector for the detection and interrogation of deployed mines. The VS-SATM1 complies with the latest NATO STANAGs and MIL-STDs. Practice and training versions are available.

Specifications :

Weight: 2.5 kg
Height: 105 mm
Diameter: 128 mm
Weight of explosive charge: 800 g
Arming delay: 10 min
Active life: programmable between 0 and 365 days in increments of 1 h
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Scatterable
Remote Laying Capability: Istrice Minelayer
Logic Systems:
Self Destruct - Yes
Self Neutralisation - Yes
Passive Self Deactivation - No

Inert Indications: No
Unit Price Estimate: US$320
Status : Production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 20

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : BPD SB-81 Scatterable Anti-tank Mine

Comment :

The BPD SB-81 can be scattered from helicopters with the BPD SY-AT system, or laid manually. It can be buried in the ground to a maximum depth of 100 mm. Air-dropping does not impede its ability to destroy tank tracks or irreparably damage tank running gear. The mine is circular and has a plastic case available in any colour. It is pressure-activated and will function whether it lands on its top or its bottom. The SB-81 is waterproof, will not float, is maintenance-free and has a shelf life of ten years. The explosive content of the mine can be removed and stored separately. The magazine is used for carrying and storing the mine as well as being used in conjunction with the SY-AT scattering system. The detonator can be inserted into the mine even when it is stored in the magazine.

Other versions of the mine are available including a model with an electronic anti-removal and self-neutralising device, and another with an electronic anti-removal device and a self-destruction device, which both operate at pre-determined times. In appearance these are identical to the standard mines. Smoke and inert models are available for training purposes.

The SB-81 is produced in Spain (as the EXPAL SB-81).

Specifications :

Weight: 3.2 kg
Diameter: 232 mm
Height: 90 mm
Main charge type: HE
Weight of main charge: 2 kg
Operating force: 150-310 kg
Packaging: magazine containing 5 weighs 19.5 kg
Method of Laying: Hand/Scatterable
Remote Laying Capability: Helicopter
Logic Systems
Self Destruct : Yes
Self Neutralisation : Yes
Passive Self Deactivation : No
Inert Indications: No
Unit Price Estimate: US$300

Status : In production. In service in Argentina, Italy and Spain (for Spanish Army).

Manufacturers :

BPD Difesa e Spazio srl, Corso Garibaldi 20-22, I-00034 Colleferro (Rome),
Italy.
Tel: 06 97891.
Telex: 611434 bpd cf 1.

Explosivos Alaveses SA, Orense 68, 10th Floor, E-28020 Madrid, Spain.
Tel: 5715599. Telex: 43 484 xpal e.
Fax: 2797914.

Entry No 21

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella VS-AT4-EL Anti-tank Mine

Comment :

The Valsella VS-AT4-EL anti-tank mine is a general purpose, electronic mine with a pressure sensitive fuze which can be electronically programmed in the field. It is provided with an anti-lift device and a target counting capability enabling it to select an individual target in a column of vehicles. The mine is effective against the wheels and tracks of modernarmoured vehicles and is capable of producing a mobility kill. It may be used with mechanised minelaying equipments but may be surface-laid or emplaced manually. The anti-lift and active life times of the VS-AT4-EL are programmable in the field between 0 and 365 days in increments of one hour. At the end of its active life the mine will either self-neutralise or self-destruct; this feature is selected prior to manufacture.

The fuze contains a safety and arming device which conforms to the latest NATO and FINABEL standards, allowing a 'ready to use' state for storage and transport. The fuze can discriminate the correct firing stimuli among other influences such as battlefield disturbances, electromagnetic radiations and mechanical or explosive clearing systems. The VS-AT4-EL is provided with a complete set of electronic accessories. These include a VS-MP1 main programmer intended for officer-level use; a pocket-sized VS-SP1 secondary programmer intended for use by sappers; a bench-size VS-SP-2 secondary programmer for the mass programming of complete tubes or boxes of mines; and a manportable VS-DS-1 status detector for the detection and interrogation of deployed mines. The VS-AT4-EL complies with the latest NATO STANAGs and MIL-STDs. Practice and training versions are available.

Specifications :

Weight: approx 6 kg
Length: 280 mm
Height: 188 mm
Width: 104 mm
Weight of main charge: 4.5 kg
Active life: programmable between 1 h and 365 days in increments of 1 h
Anti-lift feature: programmable between 0 and 365 days in increments of 1 h
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct: Yes
Self Neutralisation: Yes
Passive Self Deactivation: No

Inert Indications: Nil
Unit Price Estimate: US$500

Status : In production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 22

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella VS-HCT Anti-tank Mine

Comment :

The Valsella VS-HCT anti-tank mine was developed to meet a specification issued for a full width mine by the Italian Army and entered series production in 1979. The VS-HCT anti-tank mine is fitted with a high-performance shaped charge and a dual-sensor electronic influence fuze that is effective across the full width of an armoured vehicle. The blast effect is used to damage the tracks and the shaped charge can penetrate the belly armour to a depth of more than 175 mm. The VS-HCT can be laid manually or mechanically to a maximum depth of 100 mm. A number of safety features are incorporated for use during storage, transporting and laying. These include a removable composite detonator and interruption of the detonating train when in the safe, mechanical and electronic arming delay states. The VS-HCT is cylindrical and has a plastic watertight casing.

The fuze is powered by a replaceable military-grade lithium battery pack. In operation a magnetic sensor inside the VS-HCT detects the change in the local magnetic field when a tank approaches. The sensor's signal is processed by an electronic circuit for optimum discrimination of the target and for correct timing of the firing pulse. The explosive train is primed by an electrical device which initiates a composite percussion detonator. The detonator includes a first stage to ignite the clearing charge and a delayed detonator, the delay being determined by the degree to which uncovering is required. It is claimed that the effectiveness of the VS-HCT is such that one mine

can be as effective as three normal pressure mines but with a much greater chance of obtaining a tank 'kill' rather than merely disabling the target. The mine is provided with a built-in timer for self-neutralisation and 10 self-neutralising time periods can be selected at the moment of laying - these vary from 1 to 128 days. The VS-HCT can also be fitted with an anti-lift device and a status indicator that can be checked remotely with a special detector device.

Specifications :

Weight: approx 4 kg
Diameter: 222 mm
Height: 110 mm
Weight of main charge: approx 2.05 kg
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct - No
Self Neutralisation - Yes
Passive Self Deactivation - Yes
Inert Indications: Yes
Unit Price Estimate: US$400

Status : In production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 23

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella VS-HCT2 Full width Anti-tank Mine

Comment :

The Valsella VS-HCT2 anti-tank mine is fitted with electronic combined dual-sensors, and a shaped charge providing a full width 'kill' capability against any type of MBT or APC. When fired under the tracks of a target the mine cuts the tracks and causes severe damage to the suspension. When fired between the tracks the mine perforates the belly armour and internal plates and creates a peak increase of the internal pressure which is well above the crew survival level.

The main features of the VS-HCT2 are optimised full width effectiveness, good target discrimination (independent of speed), a dual-safety arming device which interrupts the pyrotechnic and detonating trains, self-neutralising (or self-destruct) and anti-lift capabilities which are electrically programmable in the field, and a high immunity against mineclearing countermeasures. The mine is also provided with a target counting feature for the selection of an individual target in a column of vehicles.

The VS-HCT2 can be buried either manually or mechanically using a chute minelayer. The self-neutralisation time is accurately preset just before laying using a portable electronic programmer. The programmed value may be altered any number of times. For extra safety the exact status of a mine can be checked using a special stand-off detector before a self-neutralised mine is recovered. The VS-HCT2 was developed according to Italian Army specifications and meets NATO and FINABEL requirements. In tests the VS-HCT2 has penetrated a 50 mm plate set 500 mm above the mine and a further five 25 mm thick witness plates. The fuze can be supplied either with a self-neutralising or self-destruct capability. A practice version (with smoke effect) and a training model are available. The training model can be stripped down into the main component parts.

Specifications :
Weight: 6.8 kg
Length: 260 mm
Width: 260 mm
Height: 128 mm
Weight of main charge: 2.3 kg
Type of main charge: Composition B
Arming delay: 15 mins, mechanical and electronic
Self-neutralisation and anti-lift delay: electrically programmable in steps of 1 h up to 365 days
Waterproofing: tested under 0.1 kg/sq.cm
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Hand/Mechanical
Remote Laying Capability: Mil

Logic Systems
Self Destruct: Yes
Self Neutralisation: Yes
Passive Self Deactivation: No
Inert Indications: Yes
Unit Price Estimate: US$700
Status : In production.

Manufacturers :
Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 24

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : Valsella VS-HCT4 Full width Anti-tank Mine

Comment :

The Valsella VS-HCT4 anti-tank mine is fitted with an electronic combined magnetic and seismic influence fuze, and a shaped charge providing a full width 'kill' capability against any type of MBT or APC. When fired under the tracks of a target the mine cuts the tracks and causes severe damage to the suspension. When fired between the tracks the mine perforates the belly armour and internal plates and creates a peak increase of the internal pressure which is well above the crew survival level.

The main features of the VS-HCT4 are optimised full width effectiveness, good target discrimination (independent of speed), a dual-safety arming device which interrupts the pyrotechnic and detonating trains, self-neutralising (or self-destruct) and anti-lifting capabilities which are electrically programmable in the field, and a high immunity against mineclearing countermeasures. The VS-HCT4 can be buried either manually or mechanically using a fully automatic mine burier. The self-neutralisation time is accurately preset just before laying using a portable electronic programmer; this operation is performed automatically on the mechanical minelayer. The programmed value may be altered any number of times. The VS-HCT4 was

developed according to Italian Army specifications and meets NATO and FINABEL requirements. In tests the VS-HCT4 has penetrated a 50 mm plate set 500 mm above the mine and a further five 25 mm thick witness plates.

The fuze can be supplied either with a self-neutralising or self-destruct capability. A practice version (with smoke effect) and a training model are available. The training model can be stripped down into the main component parts.

Specifications :
Weight: 6.5 kg
Length: 280 mm
Width: 188 mm
Height: 104 mm
Weight of main charge: 2.3 kg
Type of main charge: Composition B
Target speed range: 1 to 70 km/h
Arming delay: 10 min
Self-neutralisation and anti-lift delay: programmable in increments of 1 h up to 365 days
Waterproofing: tested under 0.1 kg/cm{2}
Operating temperature range: -32 to +60xC
Storage temperature range: -40 to +70xC
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct: Yes
Self Neutralisation: Yes
Passive Self Deactivation: No
Inert Indications: No
Unit Price Estimate: US$700 Approx

Status : In production.

Manufacturers :

Valsella Meccanotecnica SpA,
I-25014 Castenedolo,
Brescia,
Italy.
Tel: 30 2732621.
Telex: 300495 emmeti i.
Fax: 30 2731687.

Entry No 25

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : BPD SB-MV/1 Anti-tank Mine

Comment :

The SB-MV/1 anti-tank mine is a development of the SB-MV/T anti-tank mine that entered series production in early 1979. The SB-MV/1 is circular and has a plastic casing which is available in a variety of colours. It is of the hollow charge type and has an influence fuze. BPD claims that it is three times more effective than conventional anti-tank mines as it acts against the belly armour of the tank as well as its tracks. The mine will penetrate up to 150 mm of steel armour and cause serious damage to the interior of the tank, immobilising it.

The mine can be laid by hand or mechanically and is normally buried to a maximum depth of 100 mm. If the arming lever is rotated and the detonator inserted after the lever has passed the arming delay, a safety circuit that stops the mine igniting comes into operation. When in its packing case, the mine cannot be activated as the arming lever cannot be moved from its safety position. A delayed mechanical arming is incorporated in the mine so that it does not become fully active until after the external arming lever has been operated.

The mine operates as follows: the approach of a tank towards the mine is accompanied by vibrations in the ground which are detected by the seismic transducer and the electronic amplification and discrimination circuit of the fuzing system. This alerts the magnetic sensor part of the system which locates the tank by detecting the change in the magnetic field of the earth caused by the metallic mass of the tank and, when it is over the mine, transmits a signal to the firing circuit. This operates both the ignition cap of the uncovering charge - which blows off the upper part of the mine and any camouflage over it to leave the liner of the bursting charge unobstructed - and the detonator. The detonator has a time-lag built-in to delay the firing of the booster charge and the main charge. The delay is determined by the uncovering time.

Only two-thirds the number of SB-MV/1 anti-tank mines are needed to provide the same obstructive capability as Second World War type mines. They also require a third of the time and need fewer personnel to lay. The mines are packed in magazines of five, and the detonators can be inserted into the mines without removing the mines from the magazine. The mines can be quickly removed from the magazine for manual laying and the magazine is also used when the mines are being laid mechanically. The mine is fitted with an anti-lifting device designed to operate the detonator if any change in trim of the mine is detected and a self-neutralisation device which is programmed to operate after a preset period.

Specifications :
Weight: 5 kg
Diameter: 236 mm
Height: 113 mm
Main charge type: melted CB
Weight of main charge: 2.4 kg
Booster charge type: compressed RDX
Uncovering charge type: propelling powder
Power supply: replaceable lithium batteries
Method of Laying: Hand/Mechanical
Remote Laying Capability: Nil
Logic Systems
Self Destruct: No
Self Neutralisation: Yes
Passive Self Deactivation: No
Inert Indications: No
Unit Price Estimate: US$450-US$550

Status : In production. Ordered by Australia.

Manufacturers :

BPD Difesa e Spazio srl,
Corso Garibaldi 20--22,
I-00034 Colleferro (Rome),
Italy.
Tel: 06 97891.
Telex: 611434 bpd cf 1.

Entry No 26

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Italy
Model : BPD SBP-04 and SBP-07 Anti-tank Mines

Comment :

Both these mines were designed for hand laying and are identical in design and operating characteristics, differing only in their dimensions and weight of high explosive. The mines have the same firing pressure type device which can easily be removed for arming. When activated the mines have sufficient explosive to break the tracks of a tank or damage its suspension. The

mines are non-magnetic and have a plastic case which is available in any colour. They are also waterproof, will not float, are maintenance-free and have a shelf life of 10 years. A smoke-producing model is available for training.

The SBP-04 and SBP-07 mines can be fitted with a SAT igniter that has countermeasures against fuel-air explosive sweeping techniques. A version known as the SAT-TL is externally identical to the basic SAT but can be programmable and remote-controlled. A version fitted with an anti-lift and programmable self-neutralisation device is designated SAT/QZ. It is also physically identical to the basic SAT. The SAT can be retrofitted to numerous older models of anti-tank mine.

Specifications :

Mine	**SBP-04**	**SBP-07**
Weight	5 kg	8.2 kg
Diameter	250 mm	300 mm
Height	110 mm	130 mm
Main charge type	HE	HE
Weight main charge	4 kg	7 kg
Operating force	150-310 kg	150-310 kg

Igniter	**SAT**	**SAT/TL**	**SAT/QZ**
Weight	700 g	950 g	1 kg
Diameter	182 mm	182 mm	182 mm
Height	76 mm	76 mm	76 mm

Status : In production. All three igniter types are in production.

Method of Laying: Hand
Remote Laying Capability: Nil
Logic Systems
Self Destruct: No
Self Neutralisation: Yes (QZ)
Passive Self Deactivation: No
Inert Indications: No
Unit Price Estimate: US$475 - US$600

Manufacturers :

BPD Difesa e Spazio srl,
Corso Garibaldi 20-22,

I-00034 Colleferro (Rome),
Italy.
Tel: 06 97891.
Telex: 611434 bpd cf 1.

Entry No 27

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : South Africa
Model : ATR-5 Anti-tank mine

Comment :

Somchem of South Africa is developing an off-route mine based on the FT5 shoulder-launched light anti-tank weapon. Designated ATR-5, it comprises a tripod-mounted FT5 round surmounted by a fire-control system module. The latter has a microprocessor to calculate target speed and direction, based on inputs from acoustic and infrared sensors which serve to acquire and identify the target. The system weights 17kg, light enough to be carried and set up in munutes by one man, who enters the parameters of intended targets via a keypad. The mine can thus be set to engage targets with speeds varying from 3--80km/h, over distances of 5--80m, moving left or right (or in either direction). The fire-control system has a counter, enabling a specific vehicle within a convoy to be attacked (up to eight vehicles). The weapon self-destructs after 90 days, or if tampered with.

Specifications :
Weight - 17Kg
Target speed - 3--80km/h
Target distance - 5-80mm
Method of Laying: Hand
Remote Laying Capability: Nil
Logic Systems
Self Destruct: Yes
Self Neutralisation: No
Passive Self Deactivation: No
Inert Indications: No
Unit Price Estimate: US$1,200

Manufacturer :

Somchen
South Africa

Entry No 28

Equipment Type : Anti-Tank Mine (ATK Mine)
Country : Sweden
Model : Anti-tank Mine FFV 028

Comment :

In the second half of the 1960s studies were made in Sweden to find new and more effective anti-tank mines. The main requirements were the ability to kill the tank, rather than immobilise it temporarily, and that the mine should permit a reduction of the mine density in the minefield without reducing the probability of a mine being activated. Full scale development of the mine began in the early 1970s and in early 1978 the mine was at the pre-production stage. The FFV 028 was ordered by the Swedish armed forces in 1982, and by the German armed forces in 1985. The 1985 contract was placed by the then West German Ministry for Armament and Procurement and was initiated by the delivery of a trials batch of 200 mines. The full contract was for 125,200 FFV 028 SN D-31 mines at a cost of DM 141.2 million with German participation in production expected to reach a level of 35 per cent. In December 1985 the Netherlands Ministry of Defence placed an order worth SKr 365 million for FFV 028 mines and their associated minelayers. A further order worth SKr 200 million was placed during September 1989.

Description :
The mine, known as the Stridsvagnsmina 6 by the Swedish armed forces, consists of two main components, the body and the fuze. The body contains the hollow charge with the liner and the battery housing. The battery is a standard single-cell type and maintains its performance even at low temperatures. It has a shelf life of more than 10 years and can be replaced from the outside of the mine. The hollow charge of the mine is
contained in a non-magnetic housing.

The FFV 028 can be laid by hand or by the FFV mechanical minelayer which was developed specifically for use with this mine. When laying the mine, the transport safety is removed and the arming lever is pressed down and turned 90x. This connects the battery and the electric time circuit starts. The shutter is released and its time mechanism starts. When the time delay has expired, the shutter turns to the armed position, the explosive train is aligned and the electric detonator is connected to the electronic unit. At this time the electronic safety also ceases and the mine is armed.

The mine is effective against the whole width of the tank and operates as follows: when a vehicle passes over the mine its fuze senses the disturbances in the terrestial magnetic field, the electronic unit processes the signal and, when the conditions for initiation have been met, it emits an initiation pulse to the electric detonator. The uncovering charge blows off the upper part of the fuze and any camouflage over the mine. Thus the hollow charge jet is unobstructed when the

bursting charge detonates after a certain delay. The mine will penetrate the belly armour of any tank and causes considerable damage by blast and fragments. As there is a trend to stow all ammunition in a tank below the turret ring, it is highly probable that the ammunition of the tank will explode. The mine is insensitive to shock waves caused by artillery fire or nuclear explosions.

The FFV 028 has a considerably higher probability of being actuated than a conventional mine: 2.5 to 3 times as many conventional mines as FFV 028 mines are required to attain the same probability of a mine being actuated in a minefield. The FFV 028 SN has a self-neutralisation mechanism that operates after a selected period of between 30 and 180 days. The mine can be manufactured with an arming delay of up to 60 minutes.

Specifications :

Weight: 8.4 kg
Diameter: 250 mm
Height: 120 mm
Main charge type: RDX/TNT
Weight of main charge: 4 kg
Operational life: preselected, from 30 to 180 days
Anti-lift device: yes
Method of Laying: Hand/Mechanical
Remote Laying Capability: No
Logic Systems
Self Destruct: No
Self Neutralisation: Yes
Passive Self Deactivation: No
Inert Indications: No
Unit Price Estimate: US$1,200

Status : In production. In service with the Dutch, Swedish and German armed forces.

Manufacturers :

Bofors AB,
S-69 180 Karlskoga,
Sweden.
Tel: 46 586 81 000.
Telex: 73210.
Fax: 46 586 58 145.

Entry No 29

Equipment Type : Anti-Helicopter Mine (AH Mine)
Country : United States of America
Model : Anti-helicopter Mine (AHM)

Comment :

The US Army has a requirement for an anti-helicopter mine (AHM) that will be both scatterable or manually laid. The intention is that the AHM will be able to detect and attack low-flying helicopters, forcing them to fly at higher altitudes where other air defence weapons can engage them. It is intended that the mine will incorporate a passive identification system to distinguish friendly helicopters from those of an enemy. It is understood that the various options studied included an autonomous air defence weapon based on a ground-to-air missile such as Stinger, and 'smart' munitions that would scatter terminally guided bomblets or wire entanglements as a helicopter approached.

Following a six-month concept definition study, seven companies made submissions to the US Army Armament Research, Development and Engineering Center at Picatinny Arsenal, New Jersey. The seven companies were Ferranti International, Textron, Honeywell, Lockheed, Hughes, Texas Instruments and General Dynamics. From these, three companies were selected for further development contracts awarded in June 1989. The contracts were awarded by the US Armament Research and Development Command, also based at Picatinny Arsenal. Textron Defense Systems of Wilmington, Massachusetts, was awarded a $1 million increment as part of a $16,202,030 cost-plus-fixed-fee contract. Their submission weighs 18.1 kg, can be turned on and off by secure communication links and provides a full 360x azimuth coverage. The general configuration of the Textron AHM follows that of the Wide Area Mine (WAM). Texas Instruments, Defense Systems and Electronics Group of Dallas, Texas, was also awarded a $1 million increment as part of an $8,362,486 cost-plus-fixed-fee contract. The third contract was awarded to Ferranti International of the United Kingdom and was worth $8,380,421.

Work on the advanced munition, which incorporates state-of-the-art sensor and warhead technologies, together with non co-operative IFF, was carried out by Ferranti Aerospace Components based at Moston, Manchester. Their development and (if successful) production stages will be bid in conjunction with Alliant Techsystems. The Ferranti/Alliant Techsystems AHM is compatible with scattering and remote deployment systems and once deployed is autonomous in operation. It employs a multiple explosively formed projectile (EFP) warhead and may incorporate a command and control module to facilitate remote arming and disarming.

The first part of these contracts, which resulted in brassboard models of the AHM to prove the concepts and technologies involved, was completed in July 1991 following a series of 'shoot-off' trials. These resulted in the selection of two contractors, Ferranti and Textron, to continue into

the second phase. The second phase, due to be completed during late 1994, will be the development of a form, fit and function version for field demonstration. The outline specifications provided relate to the Ferranti/Alliant Techsystems AHM. The mine is believed to have a self destruct capability,

Specifications :

(Ferranti/Alliant Techsystems)
Weight: 10 kg
Diameter: 180 mm
Length: 335 mm
Target speed: 0-350 km/h
Target altitude: 0-100 m plus
Coverage: 360x azimuth
IFF: non-cooperative
Sensors: passive acoustic and infra-red
Warhead: multiple EFP
Method of Laying: Hand/Scatterable
Remote Laying Capability: Likely
Logic Systems
Self Destruct: Yes (possibly)
Self Neutralisation: Yes (switch on and off)
Passive Self Deactivation: No
Inert Indications:Nk
Unit Price Estimate:Nk - probably region $3,000

Status : Development

Manufacturers :

Ferranti Aerospace Components,
St Mary's Road, Moston, Manchester M10 0BE, UK.
Tel: 061 681 2071. Fax: 061 682 2500.

Textron Defense Systems,
201 Lowell Street, Wilmington, Massachusetts 01887, USA.
Tel: (617) 657 5111. Telex: 947488.
Fax: (617) 657 2138.

Entry No 30

Equipment Type : Wide-Area Mine (AD Mine)
Country : United States of America
Model : XM93 Wide Area Mine (WAM)

Comment :

The XM93 Wide Area Mine (WAM) was designed to meet a US Army requirement for an improved counter-mobility weapon. Unlike conventional mines that require a target vehicle to run directly over them for warhead activation, the WAM is capable of attacking and destroying any tank, tracked vehicle or heavy truck that moves within a 360°x 100 m radius. Each WAM consists of a ground launcher, erected and supported by spring-loaded legs, and a sublet (similar to the Skeet munition employed by the US Air Force SFW cluster bomb) which is launched by a gas generator in a rapidly spinning and coning motion over the target.

The ground launcher contains seismic and acoustic sensors that detect, classify, track and engage targets as they move in the mine's vicinity. If all attack criteria are satisfied, the launcher swivels in azimuth and tilts in elevation to aim the sublet's trajectory. An infra-red sensor on the sublet searches the ground in a near circular pattern looking for the target. When pre-established target detection and aimpoint criteria have been satisfied, the sublet's microcomputer initiates the explosively formed penetrator warhead which fires a high velocity, heavy metal slug (450 g of tantalum) at the target; it is capable of defeating a target's top armour.

In August 1987, competitive Proof-of-Principle programme awards were made to Honeywell Defense Systems (now Alliant Techsystems) and Textron Defense Systems, a division of Textron Inc, for the advanced development of a WAM. Both contractors conducted extensive component, subsystem and system tests until mid-1989. In April 1990, Textron was awarded a $69.4 million full scale development for a Hand Emplaced Wide Area Mine. Textron were also awarded a contract modification to incorporate an improved secure, two-way mine communication system to permit on/off control and recovery of minefield activity data. Initial issue is scheduled to be during the fourth quarter of FY94.

The mine under current development is hand-emplaced, and can be activated remotely over a one-way data link by the M131 Modular Mine Pack System remote-control unit. Future delivery variants include the M139 Volcano multiple mine delivery system the Multiple Launch Rocket System (MLRS), and the Army Tactical Missile System (ATACMS). The mine is believed to have 1 preset self-destruct time.

Status : Development continues.

Manufacturers :

Textron Defense Systems,
201 Lowell Street,
Wilmington,
Massachusetts 01887, USA.
Tel: (617) 657 5111.
Telex: 947488.
Fax: (617) 657 2138.

Entry No 31

Equipment Type : GEMSS Mine (Family)
Country : United States of America
Model : GEMSS Mines

Comment :
As an integral part of the US FASCAM System two mines are used with the Ground Emplaced Mine Scattering System (GEMSS) M128 vehicle towed mine dispenser (the Frisbee Flinger) and the M138 Flipper portable minelaying device; the M74 anti-personnel mine and the M75 anti-tank mine. Both mines have the same dimensions but the M74 is a fragmenting blast mine actuated by automatically deployed tripwires while the M75 is intended to attack tank belly armour and tracks using a magnetic influence fuze. The M75 is also used with the Remote Anti-Armor Mine System (RAAMS). Both types of mine are delivered for M128 use packed in shipping containers each holding 40 mines packed in sleeves of five. A shipping container holding M74 anti-personnel mines weighs 88.45 kg and a container holding M75 anti-tank mines weighs 97.5 kg. An inert practice mine is known as the M79.

Both mines have two alternative self destruct settings and when battery life falls to a certain level the mines automatically self destruct.

Specifications :

Model	**M74**	**M75**
Employment	anti-personnel	anti-tank
Weight	1.4 kg	1.678 kg
Diameter	119 mm	119 mm
Height	66 mm	66 mm

Method of Laying: Mechanical/Scatterable
Remote Laying Capability: No
Logic Systems

Self Destruct: Yes
Self Neutralisation:No
Passive Self Deactivation: Yes
Inert Indications: No
Unit Price Estimate: US$275-US$500

Status : In production. In service with the US Army and some other armies.

Entry No 32

Equipment Type : Anti-Personnel Mine (AP Mine)
Country : United States of America
Model : PDM (Pursuit Deterrent Munition)

Comment :

Also part of the FASCAM System, the Pursuit Deterrent Munition (PDM), designation M86, has been added to the list of available weapons at the US Army's Armament Research, Development & Engineering Center. The PDM is a fragmentation, anti-personnel, area-denial mine which is an adaption of the 155mm howitzer submunition. The mine uses a system of seven self-deploying trip wires, each 6m long, which trigger the 0.45kg mine. Upon detonation, the mine "bounces" some 1m to 2m in the air, exploding and charging its anti-personnel fragments. A safety mechanism dependent upon battery life self-destructs the mine if it fails to go off after a certain length of time. The PDM also features an external arming system. The PDMs are issued in sets of two in a bandolier and the production of 9,500 mines by Thiokol Corporation at the Louisiana Army Ammunition Plant began in January of 1991.

Specification :

Weight: 0.45kg
Trip Wire Length: 6.0m
Method of Laying: Hand
Remote Laying Capability: Nil
Logic Systems
Self Destruct: Yes
Self Neutralisation: No
Passive Self Deactivation: Yes
Inert Indications: No
Unit Price Estimate: US$150

Status: In production and in Service with the US and UK Special Forces.

Entry No 33

US FASCAM System Notes

a. FASCAM Technology

A major effort in the FASCAM programme has been to improve the system designs with features such as hybrid micro-circuitry and electrically programmed integrated sensors and microcomputers. When these features are developed for a particular mine, the technology is thereby applicable to the whole or a significant portion of the family. The electronics of these systems are powered by an ammonia or lithium battery and the safe and arming devices have to be tailored to the requirements of each type of mine, but all share a common electro-explosive device.

The MOPMS and GATOR safe and arming devices are identical, and are similar to those used in the GEMSS safe and arming mechanism. All of the FASCAM mines share a common clearing charge design. Four of the mines (ADAM, MOPMS, GEMSS and GATOR) use tripline detonation systems that have substantial commonalty. Also many of the mines share common individual parts which have substantially reduced tooling costs.

b. US FASCAM Family (Deployment Matrix)

The following matrix indicates how the FASCAM concept is deployed on the battlefield. For clarity we have included anti armour weapons and delivery modes.

Delivery Mode	**Delivery Mechanism**	**Anti Armour Mines**	**Anti-personnel Mines**
Artillery Projectile	155mm Howitzer	RAAM M718/M741	ADAM M692/M731
Ground Vehicle	Towed M128	M75 GEMSS	M74 GEMSS
	Flipper M138	M75 GEMSS	M74 GEMSS
	Volcano M139	BLU-91B GATOR	BLU-92B GATOR
Aircraft	GATOR Dispenser	BLU-91B GATOR	BLU-92B GATOR
Helicopter	SUU-13 Dispenser	M56	None
	Volcano M139	BLU-91B GATOR	BLU-92B GATOR
Soldier Hand	4 x Man Hand	M131 MOPMS	M132 MOPMS

Carry	Carry 1 x Man Hand Carry	WASPM XM84 WAM	PDM XM86

All of the above mines have between 1 and 4 programmable self destruct times and they all appear to have the common characteristic of passive self deactivation when the battery life reaches a certain level.

LANDMINES IN WORLD SERVICE

ANNEX A: NO DEFENCE FOR LAND-MINES

by Rudolph Chelminski

Extract From Reader's Digest - April 1994

Farmer Luis Upeme lay on the floor of a stinking, fly-infested ward in the Josina Machel Hospital in Launda, Angola. Despite a shortage of anaesthetics and antibiotics, doctors had just amputated his left leg above the knee. Upeme had stepped on one of the nine million land-mines that were planted by rebels and government forces who deliberately targeted civilians in Angola's brutal civil war.

This is just one victim of the most treacherous, cruel and indiscriminate weapon of modern warfare: the anti-personnel land-mine. In Angola there are at least 20,000 land-mine amputees. Cambodia has around 35,000, many also blinded. In Afghanistan, mines sown after the Soviet Union's 1979 invasion have killed or wounded tens of thousands of people - many of them children. Somalia's former dictator Siad Barre terror-mined the country's break-away northern province, planting the devices in water-holes, prime pasture land, even civilian homes. In all, more than 600 people are killed or injured by mines every month around the world - adding up to perhaps a million mine deaths since the start of the Second World War. And the toll is accelerating. It is estimated that 100 million anti-personnel mines are strewn around the world, primed and ready to explode. "Mines kill for decades and decades, long after the soldiers have gone home," says Rae McGrath, a founding director of Britain's non-profit, humanitarian Mines Advisory Group (MAG).

The destructive capability of land-mines has escalated fearfully since the Second World War, when planners and manufacturers came to a chiling conclusion: it can be more effective to maim than to kil. As the author of Ammunition of the Land Battle (Brassey's, £25.50), Lieutenant Colonel Courtney-Green, explains: "A wounded soldier will be more morale-sapping for his comrades than a dead one, and a burden to his own side's medical and logistical services."

From this cruel truth was born the modern anti-personnel mine. It can be as small and light as a cake of bath soap (three-quarters of an ounce of TNT is plenty to take off a foot), simple to construct and easy to stock and transport. Land-mines don't even require shrapnel: the blast alone is enough to make a new amputee. Mines are also cheap. The Chinese Type 72 costs about £2. Mines may sell on the black market for even less. Worldwide, mines represent a market of death worth £33.5 million to £134 million a year, involving at least 78 manufacturers in 44 countries - from Austria to China, Pakistan to the United States. Britain no longer exports mines.

Demand for land-mines comes largely from the Third World, where revolutionary-style "people's wars" drag civilians into conflicts between ragtag armies led by unscrupulous commanders. In these murderous conflicts, mines - historically used as defensive weapons - take on an entirely new offensive character. Placed in roads, paths and wells, these hidden seeds of death may lead enemies into clever traps, but they also guarnatee years of terror for villages.

If a leader decides that a whole community is hostile, he may carry the logic one step further, targeting agricultural and grazing grounds to bring starvation. That's what Saddam Hussein did in his 1988 "Anfal" campaign against Iraq's own ancient area of Kurdistan. His troops bombed villages and bulldozed the ruins, then mined the rubble that remained, aiming to make the land uninhabitable for all time.

The worst of Africa's tyrants are not far behind Saddam. An esitmated 18 million to 30 million mines lie in 18 African states. In Sudan, where Muslim northerners are waging a genocidal war against Christians and others in the south, minefields have been used to "deliberately cut off populations from food and water", says David Gowdey, a former US State Department official. "This is pure terror-mining".

In Afghanistan the Red Army staged what was probably the largest single mining operation of all time - dropping millions of "scatterable" mines from helicopters and planes. The most notorious was the PFM-1 "green parrot", a winged, plastic mine about the size of a pack of cards, which fluttered to the ground like a lethal butterfly. Deceptively toylike, the PFM-1 will be maiming children dozens of years from now.

"In places like Afghanistan, Cambodia, Kurdistan and Mozambique, the impact of mines is as important as famine", MAG's McGrath explains. "Kids as young as seven or eight are being forced to make decisions about whether it's worth the risk of getting blown up to graze their sheep".

At 45, a burly, bearded ex-soldier whose salt-and-pepper hair is still trimmed in a neat military crew cut, McGrath went into humanitarian work after serving in the British Army for nearly 18 years. In 1990, with the help of his wife Debbie, he founded MAG - dedicated to helping restore mined land to safety.

Funded by a variety of organizations, which include the EC, and headquartered in Cockermouth, Cumbria, MAG counts nearly 500 de-miners and support staff, and is the world's top non-governmental agency for mine clearance. MAG experts, most of them former military engineers, teach local people how to find and clear minefields. In October 1993 a MAG crew visited Suay Geath, a Cambodian village that had been the scene of heavy fighting between Vietnamese and Cambodian forces. The team found mines everwhere.

Phlork Kob, chief of the village, described how the battles that had swept Suay Geath in years

past had changed village life. The children no longer went into the fields and woods the way young people used to, he said. Farmers had abandoned about a third of the good rice-growing land because of mines, so there was less food to go round. Four men and one woman had lost legs so far.

Only a mile or so down the rickety railway line, the village of Beng Veng was being de-mined by a 32-man MAG team of Cambodian specialists directed by Scotsman Russell Bedford, 35, a retired captain of the Royal Engineers. Outfitted in green overalls, the de-miners carried metal detectors and wore ballistic jackets and blast helmets with high-impact visors. Standing within mine-free corridors marked by tape, half the men watched while the others carefully clipped away at underbrush with garden shears.

"Underbrush is the enemy of all mine clearers," Bedford said. "The only way you can be sure an area is clear is to clip it down to the ground and then hunt out the mines. The teams always work in twos: one to de-mine and one to observe him and get him out if he gets hurt." It is slow work. Says Bedford, "I reckon it'll take about 50 years to clear Cambodia."

Further down the line, where the underbrush had been cleared, other men were on hands and knees, probing into the ground ahead of them with blue-handled instruments that resembled hunting knives. Gently but firmly, they shoved the long blades forward at a slight angle, searching fo the tell-tale tap of plastic that meant they had hit the side of a mine. Inch by inch, they moved forward, slowly widening the cleared corridor.

"Mine-clearing is boring, soul-destroying work," says McGrath. And dangerous. MAG has not suffered a single death, but two team members have been seriously injured. Following the Second World War nearly 200 men were killed clearing the many thousands of mines our own forces had laid on Britain's beaches. From 1945 to 1977, some 15 million Second World War mines were cleared from Poland. Several Poles are killed each year from leftover Second World War ordnance.

Clearance work on the 30,000 or so Argentine mines left on the Falklands maimed three British soldiers before the Ministry of Defence suspended operations. After Operation Desert Storm, at least 190 people were killed or injured clearing Iraqi mines left in Kuwait.

A de-miner may work for months without incident, but then forget his vigilance - probing too hard or becoming impatient. There is also the constant danger of booby traps - a second mine buried under the first, designed to explode when the de-miner lifts the top one. Or a mine may be deliberately set sideways, so its pressure plate faces the probe of any advancing de-miner. One thrust too hard, and it is all over.

Adding to the danger is the increasing fiendishness of mine design: chemical fuzes and plastic parts that are "invisible" to metal detectors; switches that cause detonation if the mine is moved

just ten degrees.

"These undetectable or unremovable mines are mostly useful to insurgent armies that want to break up a country's infrastructure," says Paul Jefferson, a world-respected mine expert who served as commander of diposal operations in the Falklands twice between 1985 and 1987. "They see non-detectability as a selling-point. It kills lots of people."

Jefferson is blind and one-legged, the results of injuries he sustained in 1991 while walking in a supposedly mine-clear area in Kuwait. He stepped on a Russian PMN mine and became a living object-lesson in the savagery of mines and the impossibility of clearing them 100 per cent.

The carnage is now so immense that thoughtful people have finally come together to try to stop it. Alarmed by a flood of reports from demoralized field surgeons, the International Committee of the Red Cross in Geneva has become involved in the effort. At an April 1993 ICRC-sponsored symposium in Switzerland, Ferruccio Petracco, an Italian economic journalist, told of how the Italian company Valsella Meccanotecnica - half-owned by the car maker Fiat - sold nine million mines to Iraq from 1983 to 1985.

Valsella's commerce soon became painfuly familiar to thousands of Iranian schoolchildren. During Iran's 1980-88 war with Iraq, entire classes of boys were brought to the front as "scouts" and sent forward over enemy minefields. Tehran had previously used sheep, but decided that even children were to be involved in the war effort. Besides, their mission being "sacred", the youngsters were guaranteed direct access to heaven if they died. Survivors who merely lost limbs got wooden legs.

When Valsella could not obtain export licences to ship directly from Italy, the company, through a newly founded corporation, shifted production to Singapore - eventually earning £139 million from the deal. "It is impossible to believe that the Italian government, and event less the Italian secret service, was not well aware of these sales," Petracco said.

Combining first-rate research and development with aggressive marketing, Valsella has built itself into one of the world's largest producers of mines. Valsella leads the way in diabolically clever design: custom-coloured mines that blend into any background; booby-trapping mechanisms; plastic undetectables resistant to all countermeasures. Such is the high-quality craftmanship of Valsella products that arms-trade insiders nicknamed one of its products "the Gucci."

Although Britain still manufactures mines for the Army, the Ministry of Defence says that none have been exported for more than a decade. Last September, the US Senate voted unanimously to extend by three more years the moratorium on exports of US-made anti-personnel mines, giving the campaign a much-needed boost. France announced last year that it also had stopped exports of anti-personnel mines. The European Parliament has issued a resolution calling on its members to impose a five-year moratorium.

Currently the only international law restricting land-mines is Protocol II of a 1980 UN convention. Ratified by a mere 40 nations - Britain isn't one of them - it applies solely to international wars, not internal conflicts. "As things stand, you can do anything you want to your own people." says Toni Pfanner, chief of the ICRC's Juridical Division in Geneva. "It is obvious that this treaty must be revised or replaced."

To combat the growing menace of land-mines, the international community should agree to these steps:

1. Undetectable, metal-free mines and devices that target de-miners must be outlawed. These have no military use - their only purpose is indiscriminate killing and maiming, mostly of civilians.

2. Newly manufactured mines must be equipped with self-destruct mechanisms to make them inert after a brief time. New mines produced in Britain and the US are already equipped with such mechanisms.

3. Mapping and marking of mine-fields must be legally obligatory.

4. Funding must be stepped up for research into improved detection and removal techniques. It is absurd that de-mining has not progressed beyond hands and knees and garden tools.

A new international agreement can provide the undisputed legal and moral principles that no state or armed group can ignore without incurring pariah status among civilized nations. Violators should face soberingly serious consequences.

Last December the United Nations passed resolutions calling for a worldwide ban on the export of anti-personnel mines, a measure which the British Government opposes. Says General Sir Hugh Beach, vice-chairman of the Council for Arms Control, "It is a matter of shame that our Government should be dragging its feet on a worldwide ban. The forthcoming review of the UN Inhumane Weapons Convention provides the ideal opportunity."

Rae McGrath believes responsibility lies with all of us. "Debate in the UN in fine," he says, "and I favour it. But finally the answer has to come from average people in the street who will pressure their governments to do something about these disgusting killers. If you haven't been to Cambodia or Kurdistan, you can't understand the people's misery. If you know it is wrong, you've got to stand up and try to stop it ".