Metal detector

A U.S. Army soldier uses a metal detector to search for weapons and ammunition in Iraq
Metal detectors use electromagnetic induction to detect metal. Uses include de-mining (the detection of land mines), the detection of weapons such as knives and guns, especially at airports, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food, and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

In its simplest form, a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces an alternating magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.

○

History and development

The first detectors

Towards the end of the 19th century, many scientists and engineers used their growing knowledge of electrical theory in an attempt to devise a machine which would pinpoint metal. The use of such a device to find ore-bearing rocks would give a huge advantage to any miner who employed it. The German physicist Heinrich Wilhelm Dove invented the induction balance system, which was incorporated into metal detectors a hundred years later. Early machines were crude, used a lot of battery power, and worked only to a very limited degree. Physicist Alexander Graham Bell used such a device to attempt to locate a bullet lodged in the chest of American President James Garfield in 1881; the attempt was unsuccessful because the metal bed Garfield was lying on confused the detector.[citation needed]

Modern developments

The modern development of the metal detector began in the 1930s. Gerhard Fisher had developed a system of radio direction-finding, which was to be used for accurate navigation. The system worked extremely well, but Fisher noticed that there were anomalies in areas where the terrain contained ore-bearing rocks. He reasoned that if a radio beam could be distorted by metal, then it should be possible to design a machine which would detect metal, using a search coil resonating at a radio frequency. In 1937, he applied for, and was granted, the first patent for a metal detector. His designs were soon put to the test in a practical way, as they were used as mine detectors during World War II. They were heavy, ran on vacuum tubes, and needed separate battery packs, but they worked. After the war, there were plenty of surplus mine detectors on the market; they were bought up by relic hunters who used them for fun and profit. This helped to form metal detecting into a hobby.

Further refinements

Many manufacturers of these new devices brought their own ideas to the market. Whites Electronics of California began in the 50's by building a machine called the Oremaster Geiger Counter. Another leader in detector technology was Charles Garrett, who pioneered the BFO (Beat Frequency Oscillator) machine. With the invention and development of the transistor in the 50's and 60's, metal detector manufacturers and designers made smaller lighter machines with improved circuitry, running on small battery packs. The metal detector was reduced to a size that even a child could use - and use them they did. Fabulous finds were made; prehistoric gold ornaments, chests of Roman coins, jewelled daggers, arrow heads- all types of metal artifacts were coming out of the ground. Suddenly, there was a huge demand for those early electronic magic wands

which might make a man rich overnight. Companies sprang up all over the USA and Britain who wished to supply the growing demand.
Larger portable metal detectors are used by archaeologists and treasure hunters to locate metallic items, such as jewelry, coins, bullets, and other various artifacts buried shallowly underground.

Discriminators

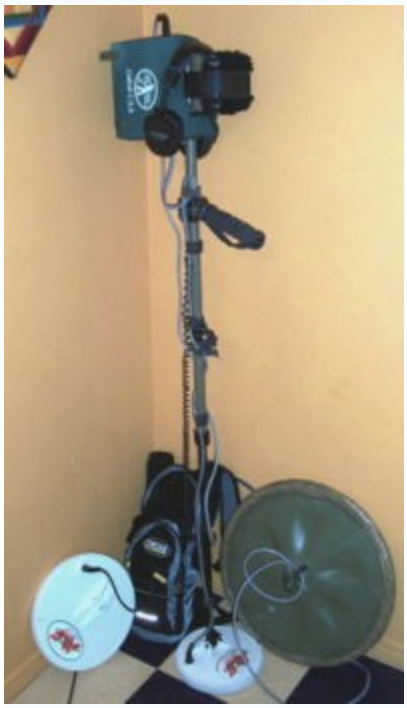
Technological changes were taking place at a rapid rate too, and very few of the smaller companies managed to stay in competition with the big outfits. GOLDAK, METROTECH, IGWT, TEC, and, quite recently, ARADO ceased production of hobby machines. Some devotees of metal detecting still treasure their Arado machines, which had a reputation for being difficult to set up, but were reputed to be the deepest-seeking hobby detectors ever made. The biggest technical change in detectors was the development of the induction-balance system, where two coils are set up in an electrical equilibrium to produce a 'null' or zero balance. Introducing metal to the vicinity of the coils caused them to unbalance, producing a change of tone in the machine's speaker. Scientists had long known that every metal has a specific response to stimulation by alternating current. Each metal produces a time lag or 'phase angle' in its induced current, in relation to the drive current. This meant that detectors could now be set up to ignore unwanted phase angles, and respond positively only to desired metals. But there was also a downside to the development of the 'discriminator' detectors. Introducing discrimination always had the effect of reducing the sensitivity of the machine, so it was less able to find deep objects. In addition, there was the fact that some desirable metals were quite near the area of unwanted metals, such as iron. Gold, particularly in alloy form, was quite close to tinfoil in the overall spectrum, so the discrimination control had to be used carefully. The price to be paid for setting up a detector to ignore iron and tinfoil was the possibility that, sooner or later, the user would scan over, and ignore, a valuable find - perhaps a diamond engagement ring on a beach.

New coil designs

Coil designers also tried out innovative designs. The original Induction Balance coil system consisted of two identical coils placed on top of one another. Compass Electronics produced a new design; the two coils were made in a D shape, and were mounted back-to-back to form a circle. This system was widely used in the 1970s, and both concentric and D type (or Widescan as they became known) had their fans. Another development was the invention of detectors which could cancel out the effect of mineralization in the ground. This gave greater depth, but was a non-discriminate mode. It worked best at lower frequencies than those used before, and frequencies of 3 to 20 kHz were found to produce the best results. Many detectors in the 1970s had a switch which enabled the user to switch between the discriminate mode and the non-discriminate mode. Later developments switched electronically between both modes. The development of

the Induction Balance detector would ultimately result in the Motion detector, which constantly checked and balanced the background mineralization.

Pulse induction



A pulse induction metal detector with an array of coils

At the same time, developers were looking at using a completely different type of technology in metal detectors. This was the process known as Pulse Induction. Unlike the Beat Frequency Oscillator or the Induction Balance machines which both used a uniform alternating current at a low radio frequency, the pulse induction machine simply fired a high-voltage pulse of signal into the ground. In the absence of metal, the 'spike' decayed at a uniform rate, and the time it took to fall to zero volts could be accurately measured. However, if metal was present when the machine fired, a small current would flow in the metal, and the time for the voltage to drop to zero would be increased. These time differences were minute, but the improvement in electronics made it possible to measure them accurately and identify the presence of metal at a reasonable distance. These new machines had one major advantage: they were completely impervious to the effects of mineralization, and rings and other jewelery could now be located even under highly-mineralized 'black sand'. They had one major disadvantage too: there was no way to incorporate discrimination into a Pulse induction detector. At least, that was the perceived wisdom of scientists and engineers until Eric Foster, who had run Location Technology in Ireland for many years, started a new company in Britain and produced the Goldscan, the first Pulse Induction detector which had the apparent ability to differentiate between metals. This was a new

type of 'junk eliminator' circuit, which relied on the size of the target as well as its metallic response to give a control that would show positive for a gold ring and negative for a copper coin. Its ability to differentiate between non-ferrous metals was not an exact science, but gave unparalleled depth on mineralized soil or sand. Pulse Induction detectors are now widely used in the construction industry; the Whites PI-150 is an industrial machine which can detect large objects to 10 feet, using a 12 or 15 inch coil.

Future detectors

Modern top models are fully computerized, using microchip technology to allow the user to set sensitivity, discrimination, track speed, threshold volume, notch filters, etc., and hold these parameters in memory for future use. Compared to just a decade ago, detectors are lighter, deeper-seeking, use less battery power, and discriminate better.
New genres of metal detector have made their appearance. BB (Beat Balance) and CCO (Coil Coupled Operation) were unveiled by the electronics press in 2004. Both were invented by electronics writer and designer Thomas Scarborough and combine unprecedented simplicity with good sensitivity.

Uses of metal detectors

Metal detectors in archeology

In England and Wales metal detecting is legal provided permission is granted by the landowner, and the area is not a Scheduled Ancient Monument or covered by elements of the Countryside Stewardship Scheme. Voluntary reporting of finds to the Portable Antiquities Scheme or the UK Detector Finds Database is encouraged. These schemes have their critics, however, including some archaeologists and metal detectorists. The situation in Scotland is very different. Under the Scots law principle of bona vacantia[1], the Crown has claim over any object of any material where the original owner cannot be traced. There is also no 300 year limit to Scottish finds. Any artifact found, whether by metal detector survey or from an archaeological excavation, must be reported to the Crown through the Treasure Trove Advisory Panel at the National Museums of Scotland. The Panel then determines what will happen to the artifacts. Reporting is not voluntary, and failure to report the discovery of historic artifacts is a criminal offense in Scotland.

Archeology is beginning to recognize the contribution responsible metal detecting provides in adding to the knowledge of our past. One example is utilizing the skilled use of the metal detector to examine wide areas such as battlefield sites where surface scatters of metal objects may be all that survives. This has recently been demonstrated during archaeological work conducted at Antietam National Battlefield in the United States.[citation needed]

As a hobby

This 156 ounce nugget was found by an individual prospector in the Southern California Desert using a metal detector.

Many people use consumer metal detectors to look for coins on the beach. Most metal detectors are good to detect metal only within a foot or so below the

ground. The detection depth depends on the type of metal detector, type of metal in the buried object, size of buried object, type of metals in the ground, and other objects in the ground.

There are five major types of hobbyist activities involving metal detectors:

- Coin shooting is looking for coins after an event involving many people, like a baseball game, or simply looking for any old coins. Serious coin shooters will spend hours, days and months doing historical research to locate long lost sites that have the potential to give up historical and collectible coins.
- Prospecting is looking for valuable metal like gold and silver.
- Relic hunting is very similar to coin shooting except that the relic hunter is after any type of historical artifact, relic hunters are usually very determined and dedicated not only to the research and hunting that they do but also to preserving historical artifacts. Coins, Minié balls, buttons, axe heads, and buckles are just a few of the items that are commonly found by relic hunters.
- Treasure hunting is looking for valuable items in general.
- Beach combing is hunting for lost coins or jewelery lost on a beach. Beach hunting can be as simple or as complicated as one wishes to make it. Many dedicated beach hunters also familiarize themselves with tide movements and beach erosion.

Coin shooting

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Prospecting

Prospecting is the physical search for minerals, fossils, precious metals or mineral specimens, and is also known as fossicking.

Prospecting is synonymous in some ways with mineral exploration which is an organised, large scale and at least semi-scientific effort undertaken by mineral resource companies to find commercially viable ore deposits. To actually be considered a prospector you must become registered as a professional prospector. This process is easy but necessary if you wish to work in mineral exploration.

Prospecting is quite intensive physical labor, involving a considerable amount of traversing (traditionally on foot or on horseback), panning, sifting and outcrop investigation, looking for tell-tale signs of mineralisation. A prospector must also make claims, meaning they must erect posts with the appropriate plackards on all four corners of a desired land they wish to prospect and register this claim before they may take samples.

Old prospecting methods

The traditional methods of prospecting involved carefully and intensely combing through the countryside, often through creek beds and along ridgelines and hilltops, often on hands and knees looking for signs of mineralisation in the outcrop. In the case of gold, all streams in an area would be panned at the appropriate trap sites looking for a show of 'colour' or gold in the tail.

Once a small occurrence or show was found, it was then necessary to intensively work the area with pick and shovel, and often via the addition of some simple machinery such as a sluice box, races and winnows, to work the loose soil and rock looking for the appropriate materials (in this case, gold). For most base metal shows, the rock would have been mined by hand and crushed on site,the ore separated from the gangue by hand.

Often, these shows were short-lived, exhausted abandoned quite soon, requiring the prospector to move onwards to the next and hopefully bigger and better show. Occasionally, though, the prospector would strike it rich and be joined by other prospectors and larger-scale mining would take place.

note although these are referred to as "old prospecting methods", these techniques are still used very frequently today but usually in

coupling with other more advanced techniques such as magnetic surveying and gravimetric analysis.

In most countries in the 19th and early 20th century, it was very unlikely that a prospector would retire rich even if he was the one who found the greatest of lodes. For instance Patrick (Paddy) Hannan, who discovered the Golden Mile, Kalgoorlie, died without receiving anywhere near a fraction of the value of the gold contained in the lodes, the same story repeated at Bendigo, Ballarat, Klondike and California.

The Gold Rushes

In the United States and Canada prospectors were lured by the promise of gold, silver, and other precious metals. They travelled across the mountains of the American West, carrying picks, shovels, gold pans, and whatever else they would need. Other prospectors searched canyons and mountain peaks, hardly leaving a rock unturned while looking for wealth. The majority of early prospectors had no training and relied mainly on luck to discover deposits.

Other gold rushes occurred in Papua New Guinea, Australia at least four times, and in South Africa and South America. In all cases, the gold rush was sparked by idle prospecting for gold and minerals which, when the prospector was rarely but spectacularly successful, generated 'gold fever' and saw a wave of prospectors comb the countryside.

Modern prospecting

Modern prospectors today rely on training, the study of geology, and prospecting technology.

Knowledge of previous prospecting in an area helps in determining location of new prospective areas. Prospecting includes geological mapping, rock assay analysis, and sometimes the intuition of the prospector.

Metal detecting

Metal detectors are invaluable for gold prospectors, as they are quite effective at detecting gold nuggets within the soil down to, depending on the acuity of the operator's hearing and knack, perhaps 3 feet.

Magnetic separators may be useful in separating the magnetic fraction of a heavy mineral sand from the nonmagnetic fraction, which may assist in the panning or sieving of gold from the soil or stream.

TREASURE HUNTING

Treasure hunting is the search for real treasure which has been a notable human activity for millennia.

Gems may be found by treasure hunters.

Background

In recent times, the early stages of the development of archaeology included a significant aspect of treasure hunt; Heinrich Schliemann's excavations at Troy, and later at Mycenae, both turned up significant finds of golden artifacts. Early work in Egyptology also included a similar motive.

Some people hunt for treasure on sunken galleons of the Spanish treasure fleet.

Some people hunt for treasure on sunken galleons of the Spanish treasure fleet.

More recently, most serious treasure hunters have started working underwater, where modern technology allows access to wrecks containing valuables which were previously inaccessible. Starting with the diving suit, and moving on through Scuba and later to ROVs, each new generation of technology has made more wrecks accessible. Many of these wrecks have resulted in the treasure salvage of many fascinating artifacts from Spanish treasure fleets as well as many others. Unfortunately, in their search for valuable artifacts, treasure hunters destroy forever unique archaeological sites. For this reason, treasure hunting is illegal in most developed countries.

Additionally with the advent of affordable, state of the art satellite imaging from companies such as GlobeXplorer, GeoEye and others, the average income household can now contact a satellite imaging company and pay to have a specified area scanned. This has made it infinitely easier for treasure hunters to do extensive research previously impossible to do without physically going to the specific point of interest, and saved the real life treasure hunters much time and money, even providing for a new level of safety to be incorporated in to treasure hunting expeditions.

In fact, even companies such as Google with their Google Maps and Google Earth products, have given the ability to virtually anyone to have eyes across the globe and conduct research into specific points of interest before launching a treasure hunting expedition. In 2005, a treasure hunter found the remains of an ancient Roman villa when he browsed Google Earth maps showing satellite images of his local area.[1]

Famous treasure hunters

Treasure hunter Heinrich Schliemann.

*** Capt. Martin Bayerle located the shipwreck of RMS Republic in 1981.**

*** Mel Fisher (discoverer of the Spanish galleon Nuestra Señora de Atocha)**

*** Mike Hatcher (discoverer of the "Nanking Cargo")**

*** Dr. E. Lee Spence (pioneer underwater archaeologist, author of real life adventure articles and former editor for a number of magazines.)**

*** Robert F. Marx (underwater archaeologist, author)**

*** Ponce de Leon (searched the new world for gold and the Fountain of Youth)**

*** Robert Stenuit (underwater archaeologist, author)**

*** Heinrich Schliemann (grocer turned treasure hunter, considered father of historical archaeology, discoverer of lost city of Troy)**

*** Odyssey Marine Exploration has extracted treasure from the shipwreck of the SS Republic in 2003 worth approximately 75 million USD.**

Beachcombing

Beachcombing or Beachcomber is a term with multiple but related meanings which have evolved over time.

The origins of the term are unknown but the first appearance in print was in Herman Melville's Omoo (1847).[1] It described a population of Europeans who lived in South Pacific islands, such as drifters, ex-sailors or criminals on the run, who had given up on civilization and "gone native" with the Polynesian peoples of the region. Unlike the modern term "comb" which means to "sift through", the term "comber" was originally related to the long breaking waves the Pacific is famous for, known as "combers". There had always been a small number of castaways since the earliest Spanish explorers, but the numbers increased dramatically in the early 19th century with the start of regular commercial enterprises. It is estimated that in 1850 there were over 2000 beachcombers throughout Polynesia and Micronesia.[2] Ultimately they became cultural mediators for the native inhabitants, able to speak the language and understand the customs of both sides of the colonial experience, they fulfilled an important function.[3]

Beachcombing today more often refers to the act of scavenging (or literally, combing through debris) along beaches or in wharf areas for items of perceived value that are floating in the water (flotsam) or that have washed up on shore (jetsam). A beachcomber is one who practices beachcombing.

The term beachcomber may sometimes refer to people who practice beachcombing as their sole means of support in life. In addition to searching for items that have value, a beachcomber may become totally dependent upon coastal fishing of fish and shellfish, and may abandon his or her original culture and set of values.

In Uruguay, the term has been naturalized into the Spanish form Bichicóme, and refers to poor or lower-class people. The Spanish form also draws on the similarities to the Spanish bicho (small animal) and comer (eat), making it difficult for Uruguayans to see the word's Anglo origin.

In archaeology the beachcombing lifestyle is associated with coastal shell-middens, that sometimes accumulate over many hundreds if not thousands of years. Evidence at Klasies River Caves in South Africa, and Zuli Gulf in Eritrea, show that a beachcombing option is one of the earliest activities separating anatomically modern human Homo sapiens from the ancestral subspecies of Homo erectus.

In a general sense and in modern times, however, the most common use of the term "beachcombing" is as a descriptive word for the

recreational activity of looking for and finding various curiosities that have washed in with the tide. These items include seashells, sea beans (drift seeds), sea glass (beach glass), driftwood, lumber, plastics, and all manner of things lost or discarded by seagoing vessels and fishing activities. Books have been written to aide the identification of these occasionally strange and well-traveled items. [4] Sophisticated recreational beachcombers use knowledge of how storms, geography, ocean currents, and seasonal events determine the arrival and exposure of rare finds.

Both the recreational and utilitarian aspects of beachcombing or "wrecking" were celebrated in the film "The Wrecking Season," an award-winning film that portrays playwright Nick Darke's passion for beachcombing the coast of Cornwall, UK.

A popular Canadian family television drama, The Beachcombers, focused on the work of beachcombers in late-twentieth-century British Columbia.

Security screening

Metal detectors at an airport

The first industrial metal detectors were developed in the 1960s and were used extensively for mining and other industrial applications. A series of aircraft hijackings led the Finnish company Outokumpu to adapt mining metal detectors, still housed in a large cylindrical pipe, to the purpose of screening airline passengers as they walked through. The development of these systems continued in a spin off company and systems branded as Metor Metal Detectors evolved in the form of the rectangular gantry now standard in airports. In common with the developments in other uses of metal detectors both alternating current and pulse systems are used, and the design of the coils and the electronics has moved forward to improve the discrimination of these systems. In 1995 systems such as the Metor 200 appeared with the ability to indicate the approximate height of the metal object above the ground, enabling security personnel to more rapidly locate the source of the signal. Smaller hand held metal detectors are also used to locate a metal object on a person more precisely.

Safety

Contamination of food by metal shards from broken processing machinery during manufacture is a major safety issue in the food industry. Metal detectors for this purpose are widely used and integrated in the production line.

Introduction

Metal Detector, device that uses electricity electricity and magnetism to detect metals buried in the ground or hidden from view. A metal detector produces electromagnetic fields by passing an electric current through a coil of wire. The current creates an associated magnetic field around the coil. When the magnetic field passes over a nearby metal object, the field induces a current within the metal (see Induction). As a result, the current in the metal creates its own magnetic field. The detector senses the induced magnetic field and registers the presence of metal. A metal detector can sense the induced magnetic field of a metallic object even if the object is hidden inside a coat, buried underground, or lost on the bottom of the sea.

Metal detectors are commonly used for security, in industry, and for recreation. Walk-through and smaller, handheld metal detectors are used to detect hidden weapons at airports and social events. Metal detectors are useful in mining, where they can guide miners along the path of a gold-ore vein in rock. In food processing, they are used to detect small pieces of metal contaminants in food. Detectors are also used to locate underground pipes, sunken ships, and lost or buried treasure. Hobbyist treasure hunters use metal detectors to search for lost valuables at beaches and parks, and archaeologists use metal detectors at excavation sites to find buried artifacts.

II How Metal Detectors Work

Metal detectors are able to sense metallic items through dirt, rock, water, wood, concrete, and almost any nonmetallic barrier. However, if the area being searched contains high levels of minerals, like salt or iron, the minerals can shield metallic objects from some detectors. There are three types of metal detectors in current use: induction-balance detectors, pulse induction detectors, and magnetometers.

Induction-balance metal detectors use a power source and two coils of tightly wound wire to detect the presence of metal. One coil is the send coil, and the

other is the receive coil. A current of electricity is sent through the send coil, creating a magnetic field around the coil. The field induces a current in the receive coil. The receive coil is adjusted to read null, or zero, on a meter. When a metallic object comes within the magnetized field of the send coil, a small electric current is induced in the metal. The induced current produces a magnetic field, which alters the null reading of the receive coil. The detector registers the change and signals the presence of metal. American inventor Alexander Graham Bell, better known for his work on the telephone, devised an early form of induction-balance metal detector. In 1881 Bell was summoned to go to the White House with his detector to search for a bullet lodged in the back of President James Garfield.

A more recent type of metal detector is the pulse induction detector, which uses a different electronic principle. Instead of relying on a balanced electromagnetic field, the pulse induction detector generates a rapid pulse of electricity, creating a magnetic field that penetrates the area being searched. The pulse rate can be as high as 5,000 pulses per second. Each pulse is followed by an equally short nonpulse period. When the pulse comes into contact with a metallic object, the coil detects the induced magnetic field during the nonpulse interval. Pulse induction detectors are popular for deep-sea exploration, because they ignore the limiting effects of salt water, which contains minerals and carries a charge that can thwart induction-balance detectors.

The third type of metal detector is the magnetometer. Instead of creating an electromagnetic field itself, a magnetometer passively monitors the naturally occurring magnetic field of Earth. Magnetic lines of force, called flux lines, circle Earth in parallel lines. Metallic items disturb these parallel lines of magnetic force, and the magnetometer measures this disturbance. Minerals in the ground do not affect magnetometers as much as induction-balance detectors. Nevertheless, magnetometers are less stable and less sensitive than the other types of detectors.

III Applications

Metal detectors are very popular for treasure hunting. A hobbyist may spend up to $1,000 for an induction-balance metal detector that can detect coins, jewelry, and other lost valuables. These devices can detect objects buried to a depth of about 30 cm (about 12 in), depending on the size of the object and the mineral content of the ground. Handheld metal detectors, both pulse induction and induction-balance, are used by scuba divers to search the underwater sites of sunken ships.

Detecting the presence of underground utility lines is another important use of metal detectors. Although most utility lines, including highly explosive gas lines, are indicated on underground maps, many lines go unnoticed until struck by digging equipment. Before even beginning to dig in urban areas, repair crews can use pipe-locating metal detectors to find the exact locations of underground lines.

In order to ensure food safety, metal detectors are often used to detect small metallic particles that may have contaminated food products. During food preparation, such as the sawing or cutting of fresh meats, small metallic pieces—for example, saw teeth—can break off and become mixed with the food. By running the food product through a metal detector, food suppliers make sure that small pieces of metal do not find their way into the food supply.

Definition:

instrument that senses explosive mines: an instrument used for finding explosive mines hidden under the ground or in water

Land Mine Detectors

In many countries of the world, land mines threaten the population and hinder reconstruction and fast, efficient utilization of large areas of the mined land in the aftermath of military conflicts.

The extremely efficient FOERSTER land mine detectors and metal detectors "MINEX 2FD" for use on land and in shallow water help to locate the threat in wasteland which can be accessed only at the risk of lethal injury. The active detectors operate with the modern two-frequency method and allow optimum possible pinpointing thanks to the clear change in signal tone as they pass over a metallic object.

Mine detector system

A mine detector system that utilizes an explosive comparator to increase sensitivity and selectivity. The system utilizes a generator to transmit a signal simultaneously toward the area to be scanned for mines and towards a sample of the explosive sought. Detectors are positioned within the device to receive the reflected signals from both the area to be scanned and the sample explosive. The outputs from both detectors are fed to preferably a null type comparator for correlation. When the two signals correlate, mine presence is indicated.

Uses of metal detector?

Uses of metal detector include de-mining (the detection of land mines), the detection of weapons such as knives and guns especially at airports, malls, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

Types of metal detector-

Door frame metal detector or walk through detectors are ideal for Building entrances, malls, airports, market or factory entries. For added security hand held detectors are used. Hand held detector can also be used in internal premises. Door frame detectors are designed to withstand external climate- hot humid or rains.

Feature to look for in Door frame metal detectors

- Water proof
- Rugged yet aesthetically designed
- In- built Rechargable maintenance free battery
- Detect both ferrous and non ferrous metals
- Sensitivity control knob for precised setting at desired levels
- Base should be covered with synthetic carpet for durability
- Our product- Sentry series door frame detectors

Feature to look for in Handheld metal detectors

- Sensitivity control knob for precised setting at desired levels
- Detect bothferrous and non ferrous metals
- Sensitive, rugged and dependable metal detector
- Our product- Metaprobe 02

Features

Sentry 03 walk through metal detector

High ‘Q’ tuned resonant circuit

Lockable Single set control knob for initial setting with respect to

immediate vicinity and environmental conditions

Linear sensitivity control knob for precise setting at desired levels

Three level visual indication of metal detection through 10mm LED

Bar graph display shows real time signal level strength

Audio alarm through Piezo-electric transducer with volume control on

detection

Detect all metals even when concealed in Ferrite container

Demining is the process of removing landmines or naval mines from an area. There are two distinct types of mine detection and removal: military and humanitarian.

Colombian soldier minesweeping.
Colombia has the highest rate of victims by mines

Mine clearing system Keiler of the German Army in Butmir/Bosnia-Herzegowina(1997)

Mine clearance

In the combat zone, the process is referred to as mine clearance. The priority is to breach the minefield quickly to create a safe path for troops or ships. Speed is vital, both for tactical reasons and because units attempting to breach the minefield may be under enemy fire. In this situation, it is accepted that mine clearance will be imperfect and there may be casualties from undiscovered mines. Correspondingly, in these mine clearance operations, the methods that are applied for detection and removal are quicker, but not exact. These methods include those that detect and remove in a single action, such as mechanical demining, carpet bombing, burning of the land or the use of Bangalore Torpedoes. According to the doctrine of the U.S. and other armies, mine clearance is carried out by combat engineers and demining is carried out by Explosive Ordnance Disposal units.

Humanitarian Demining

In times of relative peace, the process of mine removal is referred to as demining. This is a thorough, time-intensive process that seeks to locate all mines so that the land or sea area may be safely returned to normal use. It is vital that this process is exhaustive. Even if only a small handful of mines remain undiscovered, then demining can actually lead to an increase in civilian mine casualties as local people re-occupy an area they previously avoided in the belief that it has been made safe. In this context demining is one of the tools of mine action. Coordinated by Mine Action Coordination Centers run by the United Nations or a host government, civilian mine clearance agencies are tasked with the demining. In post-conflict areas, minefields are often contaminated with a mixture of explosive remnants of war (ERW) that includes unexploded ordnance as well as landmines. In that context the humanitarian clearance effort is often referred to as battle area clearance.

It is estimated that US$1 billion per year would be sufficient to completely demine globally, but in 2000, only about US$400 million was donated. It takes one to two million US$ to clear a square kilometer of land in most environments. Often, clearing landmines is a necessary condition before other humanitarian programs can be implemented.[1] A large-scale international effort has been made to test and evaluate existing and new technologies for humanitarian demining, notably by the EU, US, Canadian and Japanese governments and by the Mine Action Centres of affected countries. [1],[2].

Current humanitarian demining methods

The main methods used for humanitarian demining on land are manual detection using metal detectors and prodders, detection by specially trained mine detection dogs, and mechanical clearance using armoured vehicles fitted with flails, tiller or similar devices. In many circumstances, the only method that meets the United Nations' requirements for effective humanitarian demining, the International Mine Action Standards (IMAS), [3] is manual detection and disarmament.[2] The process is typically slow, expensive and dangerous, although demining can be safer than construction work if procedures are followed rigorously. [3] New technologies may provide effective alternatives.

Manual detection with a metal detector

Foerster Minex 2FD 4.500 Metal detector used by the French army.

The first step in manual demining is to scan the area with metal detectors, [4] which are sensitive enough to pick up most mines but which also yield about one thousand false positives for every mine,[2] and cannot detect landmines with very low metal content. (While some mines have significant metallic content and are fairly easy to detect with metal detectors, many anti-personnel mines and some anti-tank mines have a very low metal content and are much more challenging to locate). Areas where metal is detected are carefully probed to determine if a mine is present, and must continue until the object that set off the metal detector is found.

Dogs

Well-trained dogs can sniff out explosive chemicals like TNT in landmines, and are used in several countries.[4]

Mechanical clearance

Special machines effectively combine mine detection and removal into one operation. These machines are applied in both mine clearance and demining. In demining they can be used to verify land that is not expected to be contaminated or as an extra layer of security after an area has cleared by another method,

such as dogs. The machines consist of a special vehicle that is driven through the minefield, deliberately detonating the mines it drives over. These vehicles are designed to withstand the explosions with little damage. Some are operated directly with armour to protect the driver; some are operated under remote control.

* Mine rollers and mine flails. The roller method originated during World War I and the flail method during World War II but both are still used. Neither system is completely reliable and both will leave undetonated mines, requiring the minefield to be rechecked by another method. Mine flails may only be 80% effective; often good enough for military mine clearance, but well below the 99.6% standard set by the United Nations for humanitarian demining.[2]
* Mine plows
* Modified long-armed demining bulldozers are being used in a number of countries. It has the capability to remove vegetation before demining and can withstand antipersonnel and antitank landmines. Its long arm gives it the benefit of reducing damage to the main body, especially the operating seat, and 3.5 inch (9 cm) thick bulletproof glass protects the operator from directional mines.[5][6][7]


Hydrema mine clearing vehicle


MineWolf demining machine deployed in Sudan

tiller-based


Digger Mini Flail for mine clearance


World War II Sherman Crab mine-flail tank under test, 27th April 1944

Personal Protective Equipment

Deminers may be issued with personal protective equipment (PPE) such as helmets, visors, armoured gloves, vests and boots, in an attempt to protect them if a mine is set off by accident. IMAS specifies standards for such equipment but draws attention to its limitations and states that at close quarters, antipersonnel fragmentation mines and antitank mines overmatch PPE currently available. [5] PPE can afford significant protection against antipersonnel blast mines, and these are more common.

Related technologies that have been developed to improve safety include large, pillow-like pads strapped to the bottoms of shoes that distribute weight and dull

the impact of footsteps, as very slight disturbances of the ground can tip off old, unstable, or intentionally sensitive mine triggers.[citation needed]
Shoes of protective clothing
Shoes of protective clothing

Removal methods

Removal methods in demining

In demining, once an object has been detected it is removed by one of the following methods:

* Manual disarmament.
* Remote burning of the explosive. Where possible it is better to burn the explosive without detonation. Diethylene triamine (a close relative of ethylenediamine) reacts with TNT to generate heat. The compound that results from this reaction can then be combusted without detonation.[8] It has been reported that this amine is hypergolic with TNT, Tetryl, Composition B and other TNT based explosives. But it does not react in this way with RDX or PETN-based explosives in the same way. Other nitrogen-containing organic ligands (eg pyridine, diethylamine and pyrole) are known to be hypergolic with TNT.[9]
* Setting the mine on fire while avoiding high-order detonation. This can be done by cutting holes in the mine without detonating its contents[10]


Shoes of protective clothing

Removal methods in mine clearance

Some removal methods that are not applied in humanitarian demining, but are common in mine clearance include:

* The Bangalore Torpedo that clears a path through a minefield. This can also be done using the Antipersonnel Obstacle Breaching System or Giant Viper, a hose-pipe filled with explosives and carried across a minefield by a rocket.[11]
* Helicopters dragging a plow to overturn or detonate mines. This has the problem of bringing down the helicopter when the plow snags onto objects such as large rocks, but has been corrected by use of pressure-sensitive plow rakes

which release when over-pressured. This does, however, affect its effectiveness as mines planted in hard ground or near rocks will not be detonated.

Case study

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Along the China-Vietnam border were numerous minefields. These are the legacy of the border clashes in the 80's. The mines are mainly anti-personnel, and have kept large areas of arable land from use by local farmers. A typical demining process deployed by the Chinese is as below. Firebreaks are dug around the minefield to be cleared. Then engineers would set the minefield on fire with flamethrowers. Key factors of this burning process are: thick vegetation covering the minefields; most anti-personnel mines are buried very close to the ground level; the mines are made of mostly either wood, thin metal or plastic. This burning process would usually destroy about 90% of the mines, as the mines are either detonated or melted. Mines which have trip wires would have these wires burned off. Demining teams then would plow the area with mine detectors. When the teams have cleared the mines, they would walk over the field hand in hand themselves to show to the locals that all the mines have been cleared.

Detection methods under development

Advanced Electromagnetic Methods

Ground Penetrating Radar

Conventional metal detectors rely on electromagnetic signals with frequencies of the order of 10-100kHz, which are not sensitive to plastic or wooden mine bodies and the high explosive block itself. The only part of a low-metal mine that they may be able to detect is the detonator. Much higher frequency signals (of the order of 1GHz) are employed in Ground Penetrating Radar (GPR) and these signals are also sensitive to the non-metallic parts of the mine. Unfortunately, they are also affected by innocuous objects such as tree-roots and stones and by local changes in soil moisture, it is difficult to distinguish a mine on a GPR image.

Dual-sensor

A hybrid approach employing both GPR and metal detector sensors in a single instrument has been developed by several companies and research organisations.

Biological detection

Honey bees

Recent research by the University of Montana has revealed that honey bees can, with minimal training, be used to detect landmines with a far greater accuracy and far higher clearance rate than dogs or rats.[12]

Rodents

Recent experiments with the Gambian giant pouched rat have indicated that it has the required sensitivity to smell, can be trained reliably with food-reward incentives, and is typically too small to set off the mines.[13]

Additionally, experiments with electrode-guided rats suggest that demining could one day be accomplished by guiding "ratbots" into areas that humans are unable to reach.[14]

Plants

The mustard Arabidopsis thaliana, one of the best studied plants in the world, normally turns red under harsh conditions, but using a combination of natural mutations and genetic manipulation scientists from Danish biotechnology company Aresa Biodetection, created a strain that only changes color in response to the nitrous oxide that leaks from landmines and other explosives. Because nitrous oxide can also be formed by denitrifying bacteria, there is some risk of false positives using this technique, and researchers are attempting to make the plant less sensitive. The plants would aid demining by indicating the presence of mines through color change, and could either be sown from aircraft or by people walking through demined corridors in minefields. As of February 2005, no studies have been conducted with actual landmines, though successful studies have been done in greenhouses. In order to prevent the spread of this genetically modified organism into the wild, the plants have been further modified so that they will only sprout when provided with an external growth factor.[15]

Bacteria

A bacterium has been genetically engineered to fluoresce under ultraviolet light in the presence of TNT. Tests involving spraying such bacteria over a simulated minefield successfully located mines. In the field, this method could allow for searching hundreds of acres in a few hours, which is much faster than other techniques, and could be used on a variety of terrain types. While there are some false positives (especially near plants and water drainage), even three ounces of TNT were detectable using these bacteria. Unfortunately, there is no strain of bacteria capable of detecting RDX, another common explosive, and the bacteria

may not be visible under desert conditions. Also, well-constructed munitions that have not had time to corrode may be undetectable using this method.[16]

Marine mammals

The U.S. Navy Marine Mammal Program uses sea lions and dolphins, among other species, in the detection of seamines.[17]

Nuclear detection

The vast majority of explosives used in land mines are very nitrogen rich when compared with other materials. It is possible by elemental analysis by neutrons to detect nitrogen by means of the reaction

$$^{14}N + n \rightarrow {}^{14}C + p + \gamma\ (10.8\ MeV)$$

The system works by subjecting the mine to thermal neutrons while searching for the very rare and high energy gamma photons; these photons will only be observed when an object containing nitrogen is being subjected to the neutron irradiation.[18] One possible neutron source is californium-252 which undergoes spontaneous fission. A better neutron source is to use a sealed tube electrostatic D-T neutron generation tube, this has the advantage that the tritium is much less radiotoxic than the californium so in the event of an accident such as an explosion the nuclear mine detection equipment would pose a smaller threat to humans. This type of explosive detection has been proposed for use in airport security and for the detection of explosives in trucks coming into military bases.[19][20][21]

Acoustic detection

It is possible to detect land mines by directing sound waves at the area to be demined, which causes the land mines to vibrate, and then using a laser to search for vibrations on the surface by means of the Doppler shift - this technique is termed Scanning Laser Doppler Vibrometry. Such devices have been constructed e.g. at the University of Mississippi,[22] at MIT[23] and by the Keyser-Threde Company[24] .

Bomb disposal

Bomb disposal is the process by which hazardous explosive devices are rendered safe. "Bomb disposal" is an all encompassing term to describe the separate, but interrelated functions in the following fields:

* military – Explosive Ordnance Disposal (EOD)
* public safety – Public Safety Bomb Disposal (PSBD), Bomb Squad
* civilian – Unexploded Ordnance (UXO)

History

World War I and the interwar period

Bomb Disposal became a formalised practise in the first World War. The swift mass production of munitions led to many manufacturing defects, and a large proportion of shells fired by both sides were found to be "duds".[1] These were hazardous to attacker and defender alike. In response, the British dedicated a section of Ordnance Examiners from the Royal Army Service Corps (latterly the RAOC) to handle the growing problem.

In 1918, the Germans developed a delayed-action fuse that would later develop into more sophisticated weaponry during the 1930s, as Nazi Germany began its secret course of arms development. These tests led to the development of UXBs (unexploded bombs), pioneered by Herbert Ruehlemann of Rheinmetall, and first employed during the Spanish Civil War of 1936-37. Such delayed-action bombs provoked terror because of the uncertainty of time. The Germans saw that unexploded bombs caused far more chaos and disruption than bombs that exploded immediately. This caused them to increase their use of delayed-action bombs later in World War II. The Germans were also the first to develop and use proximity sensitive fusing on air dropped bombs. Allied UXO specialists, unaware that movement on or around the fuse caused detonation, took a number of casualties. They believed these fuses were set at varying time increments in order to cause unpredictable destruction. Allies began calling these proximity devices Variable Time or VT fuses.[citation needed] This label is still used on many proximity fuzes today.

Bomb disposal staff would soon face munitions designed to kill civilians and ultimately, themselves. Initially there were no specialised tools, training, or core knowledge available, and as Ammunition Technicians learned how to safely neutralize one variant of munition, the enemy would add or change parts to make neutralization efforts more hazardous. This trend of cat-and-mouse extends even to the present day, and the techniques used to defuse munitions are held to high standards of secrecy.

World War II

Modern EOD Technicians across the world can trace their heritage to the Blitz, when the United Kingdom's cities were subjected to extensive bombing raids by Nazi Germany. In addition to conventional air raids, unexploded bombs (UXBs) also took their toll on population and morale, paralyzing vital services and communications. These delayed-action explosives provoked terror and uncertainty, with complex fuses equipped with anti-tampering devices. Troops responded on the ground by devising methods to inert and remove deadly bombs and anti-personnel mines.

United States EOD history

The United States War Department felt the British Bomb Disposal experience could be a valuable asset, based on reports from U.S. Army, Navy, and Marine Corps observers at Melksham Royal Air Force Base at Wiltshire, England in 1940. The next year, the Office of Civilian Defense (OCD) and War Department both sponsored a Bomb Disposal program, which gradually fell under military governance due to security and technical reasons. OCD personnel continued to train in UXB reconnaissance throughout the war. After Pearl Harbor, the British sent instructors to Aberdeen Proving Ground, where the U.S. Army would inaugurate a formal Bomb Disposal school under the Ordnance Corps.

Lt. Col. Geoffrey Yates (RE) and his British colleagues also helped establish the USN Mine Disposal School at the Naval Gun Factory, Washington, DC. Not to be outdone, the US Navy, under the command of Lieutenant Commander Draper L. Kauffman (who would go on to found the Underwater Demolition Teams -- better known as UDTs or the U.S. Navy Frogmen), created the USN Bomb Disposal School at University Campus, Washington, D.C. U.S. Ordnance and British Royal Engineers would forge a partnership that worked quite effectively in war -- a friendship persisting to this day.

1942 was a banner year for the fledgling EOD program. U.S. Army Lt. Col. Thomas Kane, who began in 1940 as a Bomb Disposal Instructor in the School of Civilian Defense, traveled with eight other troops to the UK for initial EOD training. Kane took over the US Army Bomb Disposal School at Aberdeen Proving Ground. Three members of Kane's training mission later served as Bomb Disposal squad commanders in the battlefield: Ronald L. Felton (12th Bomb Disposal Squad Separate) in Italy, Joseph C. Pilcher (17th Bomb Disposal Squad Separate) in France and Germany, and Richard Metress (209th Bomb Disposal Squad Separate) in the Philippines Islands. Captain Metress and most of his squad were killed in 1945 while dismantling a Japanese IED.

Graduates of the Aberdeen School formed the first Army Bomb Disposal companies, starting with the 231st Ordnance Bomb Disposal Company. The now-familiar shoulder emblem for Army EOD Technicians, a red bomb on an oval, black background was approved for them to wear. Following initial deployments in North Africa and Sicily, U.S. Army commanders registered their disapproval of these cumbersome units. In 1943, companies were phased out, to be replaced by mobile seven-man squads in the field. In 1944, Col. Thomas Kane oversaw all European Theater Bomb Disposal operations, starting with reconnaissance training for the U.S. forces engaging the Germans on D-Day. Unfortunately, the Pacific Theater lacked a similar administration.

Late in 1942, the first US Navy EOD casualty was recorded. Ensign Howard, USNR, was performing a render-safe procedure against a German moored mine when it detonated. Only a few months later, the first two Army EOD fatalities occurred during the Aleutian Islands campaign. While conducting EOD operations on Attu Island, LT Rodger & T/SGT Rapp (Commander and NCOIC of 5th Ordnance Bomb Disposal Squad) were fatally injured by unexploded ordnance.

US Navy explosive ordnance disposal (EOD) divers.

Overall, about forty Americans were killed outright performing the specialized services of bomb and mine disposal in World War II. Scores more were maimed or injured during combat operations requiring ordnance support. At Schwammanuel Dam in Germany, two Bomb Disposal squads acting as a "T Force" were exposed to enemy mortar and small arms fire. Captain Marshall Crow (18th Squad) took serious wounds, even as his party drove German defenders from their positions.'

Ironically, the only major ordnance attack against the continental U.S. would be handled by the 555th Parachute Infantry Battalion, who dealt with the Japanese Fu-Go balloon bomb menace in 1945. The all-black 555th "Smokejumpers" were trained by ordnance personnel to defuse these incendiary bombs before they could kill civilians or start forest fires.

Following the war, U.S. Bomb Disposal Technicians continued to clear Nazi and Japanese stockpiles, remove UXO from battlefields, while training host nation (HN) troops to do these tasks. This established a tradition for U.S. EOD services to operate during peace as well as war.

Colonel Kane remained in contact with EOD until his retirement in 1955. He urged reforms in the Bomb Disposal organization and training policy. Wartime errors were rectified in 1947 when Army personnel started attending a new school at Indian Head, MD, under U.S. Navy direction. This course was named the Explosive Ordnance Disposal Course, governing training in all basic types of ammunition and projectiles.

1947 also saw the Army Air Corps separate and become the US Air Force, gaining their own EOD branch. That same year, the forerunner of the EOD Technology Center, the USN Bureau of Naval Weapons, charged with research, development, test, and evaluation of EOD tools, tactics and procedures was born. 1949 marked the official end of an era, as Army and Navy Bomb Disposal squads were reclassified into Explosive Ordnance Disposal units.

In 1953, reflecting the trend in name changing, the EOD School formally became the Naval School, Explosive Ordnance Disposal (NAVSCOLEOD). Two years later, the Army Bomb Disposal School would close, making Indian Head the sole Joint Service EOD School in the US. That is, until 1985, when work began on the current EOD School at Eglin AF Base, Florida.

The current, most recognizable distinctive item of wear by EOD Technicians, affectionately referred to as the ‘crab’, began uniform wear as the Basic EOD Qualification Badge in 1957. The Master Badge would not appear until 1969. (See picture on the right)

On 31 March 2004, the U.S. Army EOD Headquarters at Fort Gillem, Georgia dedicated its new building to Col. Thomas J. Kane (1900-65). Whether Kane Hall remains after the Bush Administration's recent base closure announcement remains to be seen.

Northern Ireland 1969–present

The Ammunition Technicians of the Royal Logistic Corps (formerly RAOC) have become the world's foremost experts in IED disposal, after many years of dealing with bombs planted by the IRA. The bombs the IRA employed ranged from simple pipe bombs to sophisticated victim-triggered devices. The roadside bomb was in use by the IRA from the early 1970's onwards, evolving over time with different types of explosives and triggers.

A specialist Army unit 321 EOD (now 11 EOD Regiment RLC) was created to tackle increased IRA violence and willingness to use IEDs against both civilian and military targets. The unit's radio callsign was Felix in allusion to the cat with nine lives and led to the phrase "Fetch Felix" whenever a suspect device was encountered and became the title of the 1981 book "Fetch Felix" 321 EOD Sqn RLC is unique in that it is the most decorated squadron (in peace time) in the British Army, notably for acts of bravery during OP BANNER (1969-2007) in Northern Ireland. [2].

British bomb disposal experts of 11 EOD Regiment RLC were amongst the first personnel sent into Iraq in 2003 prior to the actual invasion itself.

EOD in low intensity conflicts

IDF American Andros EOD robot. This paticular model is the MarkV-A1

The eruption of low intensity conflicts and terrorism waves at the beginning of the 21st century caused further development in the techniques and methods of Bomb Disposal. EOD Operators and Technicians had to adapt to rapidly evolving methods of constructing improvised explosive devices ranging from shrapnel-filled explosive belts to 100-kg IED charges. Since improvised explosives are generally unreliable and very unstable they pose great risk to the public and especially to the EOD Operator, trying to render them safe. Therefore, new methods like greater reliance on remote techniques, such as advanced remotely operated vehicles such as EOD robots or armored bulldozers evolved. The US Army and the Israeli Defence Forces both have remote-control EOD vehicles and EOD bulldozers (the D7 MCAP and the armored D9R respectively). Other developments include using Advanced Electronic Countermeasures to prevent a device from being detonated remotely.

The British Armed Forces have become experts in IED disposal after many years of dealing with bombs 'planted' by the IRA. These came in many different forms, particularly car bombs rigged to detonate via a variety of manners. As such the first personnel sent into Iraq in 2003 were, amongst others, British Bomb Disposal experts of 11 EOD Regiment RLC.

During the al-Aksa Intifada, Israeli EOD forces have disarmed and detonated thousands of explosive charges, lab bombs and explosive ammunition (such as rockets). Two Israeli EOD teams gained high reputation for leading the efforts in

that area: the Army's Israeli Engineering Corps' Sayeret Yaalom and the Israeli Border Guard Gaza-area EOD team.

In Iraq, the coalition forces have to face many IEDs (improvised explosive devices) on travel routes. Such charges can easily destroy light vehicles such as the HMMWV but large one can even destroy main battle tank such as the M1A1 Abrams. Side charges caused many casualties and are major threat in Iraq along the car bombs and suicide bombers. These are the main challenge of the EOD forces today.

Fields of operations

EOD

In the United Kingdom, EOD Operators are held within all three Services, the most well known being the Ammunition Technicians of the Royal Logistic Corps. Each Service deals has differing responsibilities for UXO, however they will often work closely on operations. Ammunition Technicians deal with the more complicated areas of bomb disposal namely improvised explosive devices (IEDs). Ammunition Technicians are also experts in chemical, biological, incendiary, radiological ("dirty bombs"), and nuclear weapons. They provide support to VIPs, help civilian authorities with bomb problems, teach personnel from all three services about bomb safety, and a variety of other tasks. The Royal Engineers of 33 Engineer Regiment (EOD) provide EOD support for conventional munitions on operations. Sometimes, people confuse engineers or sappers with Ammunition Technicians. However, while complimentary, and often working closely, they have differing skill sets with RAF, Navy or RE Bomb Disposal Operators handling conventional munitions, Royal Engineers dealing providing search advice and assets and the Royal Logistic Corps providing Improvised Explosive Device Disposal.

All prospective Ammunition Technicians attend a grueling course of instruction at The Army School of Ammunition and the Felix Centre, UK. The timeframe for an Ammunition Technician to complete all necessary courses prior to finally be placed on an EOD team is around 36 months. Whereas the Engineer EOD training period is about 3 weeks.

Ammunition Technicians, having completed their training will be posted to a variety of units involved in IEDD, EOD or plain conventional ammunition duties. Until recent times the most prestigious EOD unit in the world was 321 EOD, that has now been surpassed by 11 EOD Regiment RLC , who not only provides all the mainland IEDD capabilities, but also provides detachments for Op TELIC Iraq and Afghanistan

PSBT

US EOD covers both on and off base calls in the US unless there is a local PSBT or "Public Safety Bomb Technician" that can handle the IED - ordnance should only be handled by the EOD experts. Also called a "Hazardous Devices Technician", PSBTs are usually members of a Police department, although there are teams formed by fire departments or emergency management agencies.

To be certified, PSBTs must attend the joint U.S. Army-FBI Hazardous Devices School at Redstone Arsenal, Alabama which is modeled on the International IEDD Training school at The Army School of Ammunition, known as the Felix Centre. This school helps them to become knowledgable in the detection, diagnosis and disposal of hazardous devices. They are further trained to collect evidence in hazardous devices, and present expert witness testimony in court on bombing cases.

UXO

Main article: Unexploded ordnance

Before bombing ranges can be re utilized for other purposes, these ranges must be cleared of all unexploded ordnance. This is usually performed by civilian specialists trained in the field, often with prior military service in explosive ordnance disposal. These technicians use specialized tools for subsurface examination of the sites. When munitions are found, they safely neutralize them and remove them from the site.

Other (training, mining, fireworks)

In addition to neutralizing munitions or IEDs, conducting training and presenting evidence, Technicians also respond to other problems. They dispose of old or unstable explosives, such as ones used in quarrying or mining, as well as old or unstable fireworks and ammunition. They escort VIPs and dignitaries. They assist specialist police units, raid and entry teams with boobytrap detection and avoidance. Another function of an EOD Operator is the conducting of post-blast investigations. The EOD Operators' training and experience with improvised explosive devices (IEDs) make them an integral part of any bombing investigation. Another part of a Technician's job involves supporting the government intelligence units. This involves searching all places that the high ranking government officers or other protected dignitaries travel, stay or visit.

Techniques

Wheelbarrow remotely controlled bomb disposal tool.

Generally EOD render safe procedures (RSP) are a type of tradecraft protected from public dissemination in order to limit access and knowledge, depriving the enemy of specific technical procedures used to render safe ordnance or an improvised device.

Many techniques exist for the making safe of a bomb or munition. Selection of a technique depends on several variables. The greatest variable is the proximity of the munition or device to people or critical facilities. Explosives in remote localities are handled very differently from those in densely-population areas.

Contrary to the image portrayed in modern day movies, the role of the Bomb Disposal Operator is to accomplish their task as remotely as possible. Actually laying hands on a bomb is only done in an extremely life-threatening situation, where the hazards to people and critical structures can't be lessened.

Ammunition Technicians have many tools for remote operations, one of which is the RCV, or remotely controlled vehicle, also known as the "Wheelbarrow". Outfitted with cameras, microphones, and sensors for chemical, biological, or nuclear agents, the Wheelbarrow can help the Technician get an excellent idea of what the munition or device is. Many of these robots even have hand-like manipulators in case a door needs to be opened, or a munition or bomb requires handling or moving.

The first ever Wheelbarrow was invented by Lieutenant-Colonel 'Peter' Miller[3] in 1972 and used by Ammunition Technicians in the battle against Provisional Irish Republican Army IED's.

Also of great use are items that allow Ammunition technicians to remotely diagnose the innards of a munition or IED. These include devices similar to the X-ray used by medical personnel, and high-performance sensors that can detect and help interpret sounds, odors, or even images from within the munition or bomb.

Once the technicians determine what the munition or device is, and what state it is in, they will formulate a procedure to disarm it. This may include things as simple as replacing safety features, or as difficult as using high-powered

explosive-actuated devices to shear, jam, bind, or remove parts of the item's firing train.

Preferably, this will be accomplished remotely, but there are still circumstances when a robot won't do, and a technician must put themself at risk by personally going near the bomb. The Technician will don a specialized suit, using flame and fragmentation-resistant material similar to bulletproof vests. Some suits have advanced features such as internal cooling, amplified hearing, and communications back to the control area. This suit is designed to increase the odds of survival for the Technician should the munition or IED function while they are near it.

Rarely, the specifics of a munition or bomb will allow the Technician to first remove it from the area. In these cases, a containment vessel is used. Some are shaped like small water tanks, others like large spheres. Using remote methods, the Technician places the item in the container and retires to an uninhabited area to complete the neutralization. Because of the instability and complexity of modern bombs, this is rarely done.

After the munition or bomb has been rendered safe, the Technicians will assist in the removal of the remaining parts so the area can be returned to normal.

All of this, called a Render Safe Procedure, can take a great deal of time. Because of the construction of devices, a waiting period must be taken to ensure that whatever render-safe method was used worked as intended. While time is usually not on the EOD Operator's side, rushing usually ends in disaster.

EOD Equipment

A bomb manipulator of the German Army

"Pigstick" is a British Army term for the waterjet disrupter commonly deployed on the Wheelbarrow remotely operated vehicle against IRA bombs in the 1970's. The pigstick is a device that disables improvised explosive devices (IEDs). It fires an explosively-propelled jet of water to disrupt the circuitry of a bomb and thereby disable it with a low risk of detonation. The modern pigstick is a very reliable device and fires many times with minimal maintenance. It is now used worldwide. It is about 485 mm long, weighs 3 kg. It is made of metal, and can be mounted on a remotely operated vehicle (ROV). These factors make it a very effective, safe way to disarm IEDs.

History

The name "pigstick" is an odd analogy coming from the verb meaning “to hunt the wild boar on horseback with a spear.”

It was invented for the British army in 1972; prior to that time bombs would be dismantled by hand, which was obviously very dangerous. It has to be held three inches from the IED to disarm it, still putting the user in danger. So explosive ordnance disposal (EOD) operators started connecting them to Wheelbarrows, and “in the period 1972-1978, and taking into account machines which had been exported, over 400 Wheelbarrows were destroyed while dealing with terrorist devices. In many of these cases, it can be assumed that the loss of a machine represented the saving of an EOD man's life.” [4]

EOD badges

The EOD Badge.

The EOD Badge.

Israeli "Yahalom" unit pin.The Israeli EOD was merged with other engineering-units into "Yahalom"

Old Israeli EOD (Yachsap) pin, before it was merged to "Yahalom".

British Army

Having been pre-selected for training as Ammunition Technicians soldiers will attend the specialised course at the Army School of Ammunition with both soldiers and officers completing an almost identical course. Only Ammunition Technicians and Ammunition Technical Officers of the Royal Logistics Corps are entitled to wear the flaming A badge on their uniform . If serving in the Corps of Royal Engineers and passing the Explosive Ordnance Disposal course at the Defence Explosive Ordnance Disposal School, Sappers are entitled to wear the EOD badge.

The move in recent years has been to make best use of the specialist training and skills set of the individual services; recognition that each service has its particular strengths within the field of EOD and will be tasked accordingly. EOD support to UK military personnel reflects the tri-service capabilities with the inclusion of subject matter experts from all three services. RLC, RE, RAF and Navy SMEs and operators are tasked through a Joint Service cell depending on the type of ordnance requiring attention.

This joint approach now applies to the manner in which the services are trained and commanded. RLC,RE RAF and RN EOD personnel go through basic IEDD training together, ensuring all can provide the basic capability. The RLC Ammunition Technicians also train in High Threat and Advanced Manual Techniques at The Felix Centre. RE, RAF and RN personnel receive some basic training at Defence EOD School to provide them with the basic EOD skills for use in War and peace support operations in clearing battle fields of mines and explosive remnants of war; a separate skills set reflecting the larger scale of battlefield EOD clearance in deployed theatres. This allows RLC Ammunition Technicians to focus on providing the lead for IEDD in the UK and all overseas theatres of operation, reflecting the many years experience the RLC have in IEDD terrorist/insurgent devices in Northern Ireland, UK, Europe, Iraq and Afghanistan. Within the UK the RLC (30 teams), RAF (2 teams) and RN (6 teams) are responsible for UK IEDD cover.

Within the UK the RLC are responsible for High Threat IEDD and the disposal of Land service ammunition items, including ammunition used by the Army Air Corps. As the subject matter experts they are responsible for the training of all IEDD teams and provide back up on the ground to RAF and RN teams faced by complex devices or those from known terrorist organisations. RLC Ammunition Technicians are also responsible for Nuclear, Biological and Chemical munitions disposal.

Within the UK the Royal Engineers BDOs are responsible for enemy air dropped ammunition

Within the UK the Royal Navy are responsible for ammunition items found below the High Tide mark.

Royal Air Force

Within the UK the Royal Air Force are responsible for UK service airdropped ammunition less ammunition used by the Army Air Corps helicopters like the AH-64 Longbow Apache

No 5131(BD) Squadron (RAF) Mission Statement To deliver and develop EOD capability to support UK defence policy No 5131(BD) Squadron is a sub-unit within the Armament Support Unit which delivers and develops EOD capability to support UK defence policy. Airfield EOD assets provide rapid Explosive Ordnance Clearance (EOC) of Unexploded Ordnance (UXO) and other explosive hazards prior to or during DOB activation. The prime function of this Force Element is the generation of an aircraft Main Operating Surface, Main Aircraft Operating Surface and the EOC of facilities for vital Detached Operation Bases (DOB) installations. Following DOB activation, it provides continuing EOD support to air operations and DOB Force Protection (FP) assets within the FP AOR.

The Squadron will provide a 5-man AEOD C2 team (to integrate within the Force Protection Headquarters). The 3-man EOD teams deploy in Spartan CVR(T) fitted with Clansman (to be replaced with BOWMAN). Force strength deployed will depend upon the threat. Additional EOD personnel are available from non-cadre EOD posts (NFU personnel). During peacetime, the Squadron fulfils Military Task 1 (UK MACP) and Conventional Munitions Disposal - and conducts EOC Tasks across the UK ranging from the clearance of Air Weapon ranges and the land remediation of current MoD sites to the removal of hazard from former chemical weapon storage sites.

United States

US military EOD Technicians are awarded a specialized badge upon successful completion of school, informally referred to as a 'crab'. Civilian PSBTs have a similar badge. The components of the badge each have a special meaning:

* The Wreath: Symbolic of the achievements and laurels gained in minimizing incidents through the ingenuity and devotion to duty of its members. It is in memory of those EOD members who gave their lives while performing EOD duties.

* The Bomb: Copied from the design of the World War II Bomb Disposal badge, represents the historic and major objective of the EOD mission, the unexploded bomb. The three fins represent the major areas of nuclear, conventional and chemical/biological interest.

* Lightning Bolts: Symbolizes the potential destructive power of the bomb and the courage and professionalism of EOD personnel.

* The Shield: Represents the EOD mission -- to prevent a detonation and protect the surrounding area and property to the utmost.

Israeli

The Israeli military EOD technicians wear the badge and pin of Yahalom unit, after the SAP unit was merged with Sayeret Yael and grew up to other fields as well.

Canadian

The Canadian military EOD Technicians wear this patch: http://jfchalifoux.com/explosive_ordinance_destruction_gold_bullion_new_uniform.jpg.

Combat Engineers, Air Weapon Systems Technicians (now called AVN techs), Ammunition Technicians and Clearance divers are all candidates for EOD training.

It is the Dress Uniform version of the EOD badge.

Basque Country-Spain

In the basque country, sited in the north of Spain, there are three corps in charge of bomb disposal nowadays. Policia Nacional, Guardia Civil, and Ertzaintza.

Ertzaintza has its Bomb Disposal Unit since the 80's when they started been trained by a British Expert from the London MET. They have been making safe IEDs from the terrorist group ETA since then. ETA is possibly the European only terrorist group still setting bombs . They have an EOD-IED association call Adexe

Digger DTR

The Digger Foundation is a Swiss humanitarian and non profit organization. The Foundation is based in Tavannes, Switzerland, and its goal is to promote technological assistance project in humanitarian demining. The Foundation produce demining vehicles marketed and branded “Digger DTR (Demining Technologies)”.

History

The founder of Digger DTR, Frédéric Guerne, had worked as an engineer at the Ecole Polytechnique Fédérale de Lausanne on detection’s mines projects, whose ended in 1997. Passionate and engaged, in 1998 he gathered around him and a new project about thirty volunteer from different but complementary horizons and know-how. It started as an association and Digger DTR became a foundation in 2005.

The anteater is the symbol of Digger. Its long, tubular snouts and its tapering tongue helps it to search, dig and clean the ground!

Produced machines

D-1

Digger D1 tested with a charge of TNT

First Digger’s engine, this little tank looks like an armoured lawn mower of four tones, made for clearing mine fields before demining. In some case, vegetation may be very dense and hiding trapped mines, extremely dangerous for the hand worker staff. D-1, operated by remote control, allows doubling the global demining speed and lowing risks of accidents by 80%!

D-2

Taking in consideration remarks and comments of deminers following tests of D-1, engineers and technicians of Digger DTR developed a new concept: the Digger D-2. Capable of vegetation clearance, this engine has also the ability of demining. The main change is the flail unit. Hitting violently the ground, it digs it to 20cm. Unlike D-1, D-2 can destroy mines. After its passage, most of mines are exploded and work of deminers is easier. That helps to increase from five to seven times the speed of demining. For its new task, D-2 is equipped with a more powerful engine, 140 horsepower against 57 horsepower for D-1. However, human control remains essential to insure a cleaning of 100% before allowing a farmer to go back on his lands safely. In fact, a forgotten mine in the ground is going to cause a fatal accident sooner or later.

Tests and success

Moving of D-2 on the operation zone, Sudan

Summer 2002, the D-1 prototype is tested in Kosovo. This operation showed the weaknesses of the machine. Improved, it is extensively tested in Switzerland, with the cooperation of the Swiss Army. Finally, at the request of deminers for a most effective tool, Digger decided not to produce this model.
2006, the first D-2 vehicle is engaged in Sudan, in a test operation, in collaboration with the Swiss Foundation For Mine Action (FSD), the financing of the city of Geneva (Switzerland), the Swiss Agency for Development and Cooperation (SDC), the Swiss Army, the Canton of Berne (Switzerland) and Swiss Solidarity.

Extreme conditions, like temperature of 45°C, dense vegetation or very hard ground had taught the Digger staff about potentiality of their tool. After 9 months of testing, Digger D-2 had been integrated into a demining team of the Swiss Foundation For Mine Action. The team was accredited by the United Nations in October 2006, essential step before working in mine fields. Then, this D-2 worked for a couple of months near Kurmuk, village on the Ethiopian and Sudanese border, until June 2007. Following good results in harsh conditions, UNO recommended this machine to other potential users in Sudan. Following this advice, the British organization “The Development Initiative (TDI)” purchased a standardized D-2 in July 2007 for their South-Sudan program.

D-2 has also been certified by ITEP (International Test and Evaluation Program for Humanitarian Demining), a neutral and international organization. The very positive report may be downloaded on their web site (http://www.itep.ws/pdf/DiggerD2_PTAfinal.pdf).

Philosophy

“You have survived war – you shall now survive peace”. [1] .

As Non Profit Organization, the Digger Foundation’s goal is to promote technical assistance for humanitarian demining.

The Foundation supports demining efforts regardless of their location or religious, ethnic or political orientation.

It can support only projects motivated by an active and profound humanitarian spirit of assistance.

The main task of the Digger Foundation is to provide a technological solution to deminers, to raise their effectiveness and the security of their work. It offers quality solutions and thinks its engine for field adapted reparations and maintenance.

Technical data sheet Digger D-2[2]

D-2 in testing phases in Switzerland.

Dimensions data

* Overall length 5450 mm
* Overall width 2250 mm
* Height 1800 mm
* Mass total 7300 kg
* Armour 10 mm hardened steel

Engine

* Type John Deere, 4 cylinders, turbodiesel
* Displacement 4500 cm3
* Max power 140 ch
* Max torque 540 Nm

Powertrain

Type Hydrostatic, electronic remote control

Mine Action Information Center

The Mine Action Information Center at James Madison University in Harrisonburg, VA, is a public-policy center that manages information and conducts training relevant to humanitarian mine clearance, victim assistance, mine-risk reduction and other landmine-related issues. As an information clearinghouse, the MAIC provides training, operates a help desk for queries, hosts conferences and symposia on landmine-related topics, publishes a journal about mine action, maintains a content-rich Web site, develops mine-action education materials, produces geographical information system (GIS) products, and conducts studies and surveys designed to facilitate and improve global landmine action.

Staff

The MAIC has a full-time staff that organizes faculty, students and other subject-matter experts into teams to address specific landmine-related issues. Drawing on university programs and mine-action experience, the MAIC is in a unique position to facilitate integrative approaches and innovative solutions to mine-action information and training.

History

The JMU program began in 1996 under a Department of Defense directive by the Under Secretary of Defense for Policy to serve as a humanitarian demining information clearinghouse. In 1997, the Under Secretary chartered MAIC as a Department of Defense Center of Excellence. Starting in 1998, MAIC began to receive support from the Department of State's Vietnam Initiative. Subsequently, between 2000 and 2001, the core United States government support transferred from the Department of Defense to the Department of State. From 2001 to 2006, MAIC has expanded its global support network to include the United Nations, Canada, Switzerland, the Slovenia International Trust Fund, and more.

Journal of Mine Action

Winter 2006 cover of the JMA

Published twice a year, the Journal of Mine Action is an international print and online magazine designed to provide a forum for the global landmine community. Through editorials, articles, reports, reviews, profiles and news, the Journal strives to bring current and valuable information to its readers. The print magazine has a circulation of 1,500, two-thirds of which is outside the US. Another 135,000 unique visitors view the magazine online annually. The Journal of Mine Action is written by in-house staff and mine-action practitioners from around the world. Authors explore current practices, new equipment and techniques, procedures, lessons learned and newsworthy information important to the international mine-action community. The magazine is funded by contracts from the United States Department of State's Bureau of Political-Military Affairs.

Global Mine Action Registry

The Global Mine Action Registry is a resource database of the most up-to-date contact information on hundreds of mine-action organizations, available online for the MAIC Website customers. The Registry is a free tool for organizations working directly in mine action. One can do an online search to find virtually any type of organization, in any field, and in every country around the world. In addition to having organizations register their contact information, the Mine Action Information Center also encourages them to keep it informed of their current activities and fieldwork.

UNDP Senior Management Training Course

Participants of the SMC

The MAIC was selected by the United Nations Development Programme to conduct a five-week residence course aimed at national mine-action senior staff. A total of 84 participants from 31 mine-affected countries attended the four sessions offered from 2004-2006. The courses are integrated in order to form a unique comprehensive program. The curriculum of instruction utilizes case studies, small group projects, and various exercises to help students apply the information to their particular contexts. In addition, guest speakers (mine-action subject-matter experts) allow for realistic applications of the subject matter. The students' achievements include presenting country updates, creating draft national plans, briefing key donors and leaders in mine action, and speaking at university and community events. Outside of the classroom, participants visit the U.S. government mine-action R&D program at Fort A.P. Hill as well as cultural, historical and natural sites. The Senior Management Training Course has created cross-cultural friendships and working relationships among the participants, connecting mine-action managers around the world.

Mine clearance agencies

A mine-clearance agency, or demining agency, is an organization involved in removal of land mines for military, humanitarian, or commercial reasons.

Demining includes mine clearance (actual removal of land mines from the ground), as well as surveying, mapping and marking of minefields. The broader realm of mine action also includes advocacy, victim assistance, mine awareness, mine risk education, and research.

Military mine clearance agencies

Military mine clearance agencies focus on the process undertaken by soldiers to clear a safe path so they can advance during conflict. The military process of mine clearance only clears mines that block strategic pathways required in the advance or retreat of soldiers at war. The military term used for mine clearance is breaching. This process accepts that limited casualties may occur.

Humanitarian mine clearance agencies

Humanitarian mine clearance agencies are very different. The aim to clear land so that civilians can return to their homes and their everyday routines without the threat of landmines and unexploded remnants of war (ERW), which include unexploded ordnance and abandoned explosive ordnance. This means that all the mines and ERW affecting the places where ordinary people live must be cleared, and their safety in areas that have been cleared must be guaranteed. Mines are cleared and the areas are thoroughly verified so that they can say without a doubt that the land is now safe, and people can use it without worrying about the weapons. Humanitarian mine clearance agencies are usually funded by International Governments and Private Donations. The main governments that fund Humanitarian Mine Clearance Agencies are: USA, UK, Japan and the Netherlands.

International humanitarian mine clearance agencies

The HALO Trust – The Hazardous Areas Life-Support Organisation

The HALO Trust is a non-political, non-religious, Non-Governmental Mine Clearance Organisation registered in Britain and United States. It is the oldest and the biggest humanitarian demining NGO in the word with over 7,000 deminers, mine clearers in 10 countries. By early 2006 HALO has cleared over 5,000,000 mines and UXOs around the world. HALO has a very simple mission statement “getting mines out of the ground, now”

CGTVA

The tone or style of this article or section may not be appropriate for Wikipedia.
Specific concerns may be found on the talk page. See Wikipedia's guide to writing better articles for suggestions.(January 2008)

CGTVA is a private and independent company founded in Lisbon Portugal in 1993 to address the wide range of challenges presented by the scourge of landmines and UXO’s. We operate globally in support of humanitarian assistance projects and have offices in South Africa and Kuwait.

The CGTVA Company is a specialist demining company with both the ability and state-of-the-art equipment to effectively deal with landmines, Explosive Ordnance Disposal (EOD) and Quality Assurance.

DEMIRA Deutsche Minenraeumer e.V. - German Mine Clearer

DEMIRA Deutsche Minenraeumer e.V. is an international, humanitarian, non-governmental organization (NGO) registered in Germany. DEMIRA NGO was founded in 1996 in order to provide humanitarian mine clearance, EOD (Explosive Ordnance Disposal), emergency medical aid and disaster relief to people living in postwar countries and to victims of natural disasters and civil unrest.

MAG - Mines Advisory Group

Operates since 1989 and having worked on a variety of conflict-related projects in around 35 countries, MAG is also co-laureate of the 1997 Nobel Peace Prize, awarded for their work with the International Campaign to Ban Landmines.

Menschen gegen Minen (People against Landmines)

MgM was founded on January 16th 1996 in Germany. The goal was to establish a humanitarian mine clearance organization which would offer its services to non-governmental organizations (NGOs) dedicated to re-establishing the infrastructure of dangerous regions in post war scenarios. Hendrik Ehlers and Hans Georg Kruessen founded MgM together with others in 1996. Today they are Managing Directors and active Managers of all demining operations at the same time. They have been working since 1992 in the field of humanitarian mine clearance and the destruction of dangerous ammunition in Southern Africa. They posses a wealth of practical experience through operations management, mined area survey, demining and the destruction of explosives (EOD).

INTERSOS

INTERSOS is an independent no-profit humanitarian organization committed to assist the victims of natural disasters and armed conflicts. It was founded in 1992 with the active support of Italian Trade Unions. INTERSOS has a flexible operational structure, with the central headquarters in Rome, in charge of planning and coordination of operations, and of field offices in the countries of operation.

Response International

Response International is a UK registered charity established in 1993 to support victims of violent conflict. Over the last decade successful multi-sector programmes have been implemented in Angola, Bosnia, Chechnya, Kosovo, Lebanon and Pakistan. The objective of these programmes is to design and implement projects that offer immediate relief to victims of conflict and provide sustainable conditions to enable longer term development. Response International's projects have included landmine clearance and landmine awareness and victim rehabilitation.

DanChurchAid – DCA

DanChurchAid (Folkekirkens Nødhjælp) is one of the major Danish humanitarian non governmental organisations (NGO), working with churches and non-religious civil organisations to assist the poorest of the poor. in dignity.

Mine Awareness Trust – MAT

The Mines Awareness Trust (MAT) is a charitable organisation that endeavours to save the lives and limbs of ordinary people from the unexploded debris of war. Ben Remfrey formed the Trust in May 1999 as a direct response to the war in Kosovo.

Swiss Foundation for Mine Action (FSD)

FSD focuses on all Mine Clearance activities: mine and UXO (unexploded ordnance) survey, mapping, marking and clearance. In addition, the FSD assists with the destruction of stockpiles of landmines and conducts Mine and UXO safety training for staff of international humanitarian organisations. FSD is mainly funded by the governments of Japan, Canada, Australia and Switzerland as well as international organisations such as WFP (World Food Programme), UNDP, UNOPS or OSCE. The FSD is the WFP's standby-partner for mine action. At the request of the WFP, FSD experts must be ready to intervene worldwide within 72 hours. The FSD has worked for WFP in Afghanistan, Ethiopia, Iraq, Laos, Sudan and other countries.

Others

Mine Dog Detection – MDC

DDG – Danish Demining Group

Norwegian People's Aid – NPA

Handicap International

CEMAC

ANAMA

Commercial mine clearance agencies

Commercial mine clearance agency are profit-making organisations.

International Commercial

ArmorGroup International plc [1]

ArmorGroup is a commercial leader in the environmental remediation of landmine and unexploded ordnance (UXO) pollution, clearing battlefields, ammunition stockpile reduction and controlling conventional weapons. ArmorGroup operates globally, supporting sustainable humanitarian and reconstruction programmes to remove the menace of landmines and assisting commercial clients to conduct their business safely in post-conflict regions. Over the last 10 years ArmorGroup teams have operated in 22 different countries including Bosnia, Cyprus, Iraq, Lebanon, Mozambique, Nepal, Sakhalin Island (Russia) and Sudan.

Mechem - division of Denel

Mechem Demining [2] is a division of the South African aerospace and defence equipment company Denel [3]. Active in the field of humanitarian demining since 1991, Mechem utilises the considerable experience gained through three decades of involvement with the SANDF and other clients in providing landmine countermeasures and mine resistant vehicles and equipment. Mechem's demining operations are in full compliance with International Mine Action Standards (IMAS).

BACTEC International

BACTEC is the UK's foremost Explosive Ordnance Disposal (EOD) and Landmine Clearance Company.

BACTEC was established in 1991 to provide risk mitigation services for unexploded ordnance and landmine clearance, supporting construction projects and worldwide explosive ordnance clearance initiatives.

Ronco

Since 1989, RONCO has undertaken mine and unexploded ordnance (UXO) clearance operations in over 35 countries. RONCO employs nearly 200 technical advisors skilled in the training and implementation of mine/UXO clearance and disposal, and improvised explosive ordnance disposal programs. RONCO specializes in the following fields: Manual Demining, Mine Detection Dogs, Explosives Detection Dogs, Explosive Ordnance Disposal, Improvised Explosive Ordnance Disposal, Basic /Advanced Trauma Life Support, Security Management.

MineTech International

MineTech International has over 22 years experience in mine and Unexploded Ordnance clearance. MineTech works for commercial companies (mainly from the oil and gas industry) and humanitarian organisations to enable them to conduct business in countries plagued by mines and UXO.

MineTech offers services including manual, mechanical and canine mine detection and clearance, Mine Risk Education and Explosive Detection Dog teams. MineTech's Headquarters are based in the UK, with a recruitment base in Zimbabwe and a Dog School in South Africa.

Other commercial organisations

DynCorp International

UXB International

Westminster Group Plc

Minesweeper (ship)

A minesweeper is a naval warship designed to counter the threat posed by naval mines. The dedicated, purpose-built minesweeper first appeared during World War I with the Flower-class minesweeping sloop.

USS *Pivot* (AM-276), United States Navy World War II *Admirable*-class minesweeper shown in the Gulf of Mexico on sea trials 12 July 1944.

Operation and requirements

Minesweepers are equipped with mechanical or influence sweeps to detonate mines. The modern minesweeper is designed to reduce the chances of it detonating mines itself; it is soundproofed to reduce its acoustic signature and often constructed using wood, glass-reinforced plastic (GRP) or non-ferrous metal, or is degaussed to reduce its magnetic signature.

Mechanical sweeps are devices designed to cut the anchors of moored mines, and preferably attach a tag to help the subsequent localization and neutralization. They are towed behind the minesweeper, and use a towed body (e.g. oropesas, paravanes) to maintain the sweep at the desired depth and position. Influence sweeps are equipment, often towed, that emulates a particular ship signature, thereby causing a mine to actuate. The most common such sweeps are magnetic and acoustic generators.

There are two modes of operating an influence sweep: MSM (mine setting mode) and TSM (target setting mode / target simulation mode). MSM sweeping is founded on intelligence on a given type of mine, and produces the output required for detonation of this mine. If such intelligence is unavailable, the TSM sweeping instead reproduces the influence of the friendly ship that is about to transit through the area. TSM sweeping thus clears mines directed at this ship

without knowledge on the mines. However, mines directed at other ships might remain.

The minesweeper is distinct from a minehunter; the minehunter actively detects and neutralises individual mines. Minesweepers are in many cases complementary to minehunters, depending on the operation and the environment; a minesweeper is, in particular, better suited to clearing open-water areas of a large number of mines. Both kinds of ships are collectively called Mine countermeasure vessels (MCMV)]]s, a term that is also applied to a vessel that combines both roles in a single hull. The first such ship was HMS Wilton, also the first warship to be constructed from GRP.

Minesweeping aircraft

A U.S. Navy MH-53E minesweeping helicopter of HM-15 on USS Nassau.

Aircraft can also be used for minesweeping. For instance, during World War II, fifteen British Vickers Wellington bombers were modified to carry a large magnetic induction loop and an electrical generator. The Directional Wireless Installation, (DWI) a cover story for the true purpose of the magnetic loop) was used successfully on May 10, 1940 to sweep a path for the escape of the Dutch Royal Family to the UK. The DWI was used most successfully in the Mediterranean Theatre, particularly over the Suez Canal and Alexandria Harbour. Their use revealed the limitations of the technique, in that it only works effectively in very shallow water (such as canals and harbours). From about 1943, German Junkers Ju 52 transports were similarly converted.

Helicopters are used by the United States Navy for minesweeping, in the form of the MH-53E Sea Dragon, which tows a minesweeping sled.

Notable minesweepers

* HNLMS Abraham Crijnssen — famous for her escape from Surabaya, in 1942, disguised as a tropical island.

* HMS Bronington (M1115) — formerly commanded by HRH Prince Charles, Prince of Wales.

* Calypso — research vessel of Jacques-Yves Cousteau; the ex-Royal Navy BYMS-class vessel J826.

* USS Hazard (AM-240) — museum ship at Omaha, Nebraska.

* HMS Wilton, the first combined MCMV and the first warship constructed from GRP.