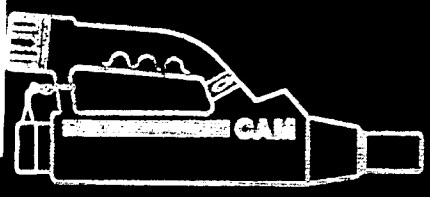

Worldwide Chemical Detection Equipment Handbook

Chemical and Biological Defense Information Analysis Center

CBIAC

Serving the DoD Science Community

552057

Worldwide Chemical Detection Equipment Handbook

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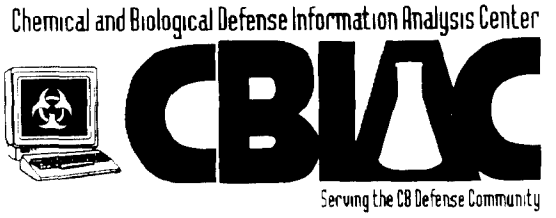

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PREFACE

This is the first edition of the Chemical and Biological Defense Information Analysis Center's (CBIAC) Worldwide Chemical Detection Equipment Handbook. This handbook highlights equipment and technologies used internationally for the detection of chemical warfare agents. In an effort to keep the chemical defense community abreast of the most current trends in detection equipment and technologies, the CBIAC will produce periodic updates to this handbook. We invite handbook users to contribute information on newly introduced equipment and modifications to existing systems as it becomes available. User contributions will ensure that future editions of this handbook will be comprehensive and of optimal quality. Please mail, fax or electronic mail your comments to:

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FOREWORD

Recent events such as the Tokyo subway incident have raised public awareness of the chemical and biological (CB) threat and underscore the importance of CB defense efforts. The ability to detect the presence of chemical warfare agents is critical for the protection of front-line soldiers, anti-terrorist applications, treaty verification and compliance efforts and in the destruction of existing stockpiles. Even with this new public awareness, Government resources for CB defense efforts are limited and the process of evaluating information must be made more efficient. High quality information resources such as this Worldwide Chemical Detection Equipment Handbook will assist users in achieving this efficiency by collating the scientific and technical information they need from a multitude of international sources into one centralized publication.

For nearly a decade, the Chemical and Biological Defense Information Analysis Center (CBIAC) has made major contributions to chemical and biological defense efforts, thus establishing itself as a highly respected and valued resource for the Department of Defense and industrial user community. It is part of the CBIAC mission to produce products such as this handbook to serve the needs of its users.

Dr. Theodore Prociv
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(Chemical and Biological Matters)
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1.0 INTRODUCTION

A number of countries around the world have the capability to use chemical weapons. Moreover, the threat of their proliferation by third world nations is ever increasing. In fact, within the past decade, several examples of their use have been well documented including Iraq's use of chemical weapons on its own Kurdish citizens and the recent use of the nerve gas GB on the Tsukijiki subway line in Japan.

The Persian Gulf War further underscored the need for effective detection equipment. The threat for the potential use of chemical weapons resulted in the deployment of an extensive array of chemical detection equipment to the Gulf region. Each nation represented in the coalition deployed "their own" equipment to the region, whether it was equipment that was manufactured by the country or purchased from other countries.

This handbook serves as a compendium of information pertaining to chemical warfare agent detection systems and technologies being used around the world. It includes U.S. and foreign military chemical warfare agent detectors currently being used or procured and detectors in the final stages of development for military use. It also includes some commercial detectors that have potential military applications or that have been modified to satisfy a specific military role. Although we have tried our best to be as comprehensive as possible, this handbook does not address all chemical detectors. Future updates to this handbook will be published as additional information becomes available.

Data contained herein was obtained from a multitude of sources, ranging from government provided data to manufacturer's literature. We have attempted to include information from all sectors that responded to our request, although responses varied widely both in content and in level of detail. In most cases, the source of the data is indicated. The data provided is not based on a universal protocol; therefore, it should not be used for comparative purposes. While we have made our best effort to include accurate data, we do not make any representation of the validity of any of the information or data contained in the handbook, or of the availability of any of the detectors from the listed sources, or that any of the listed sources have the legal right to market and sell any of the identified detectors. Readers should not rely exclusively on the information contained in this document, which may be out of date, but should instead contact the listed sources to obtain the most current information and data regarding the availability of the detectors, their performance and their fitness for the reader's particular purpose.

This handbook is generally divided by participating country. An attempt was made to acquire data pertaining to the information fields discussed below for each item described in this handbook. However, some gaps in data exist. Information that was not available is indicated by an asterisk (*). An attempt was also made to include a photograph or sketch of the item being described; however, in some cases, photos were not available. Each country chapter also includes a list of references. The reference lists will help readers to make an independent evaluation of the validity of the data presented in that chapter.

Information Field	***Description***
Designator(s):	*Acronym and/or alpha-numeric designation associated with an item.*
Item Name(s):	*Complete nomenclature associated with an item.*
Item Description:	*Physical characteristics of the detector and its components.*
System Components:	*Elements that compose the base detector.*
Support Equipment:	*Attachments, remote units and other supplementary equipment that can be used with the base detector.*
Equipment Hardness:	*Design elements of the equipment that render it resistant to degradation by chemical agents and decontaminants, the environment and battlefield conditions.*
Dimensions and Weight:	*Length, width and height in metric units and weight of the item in metric units.*
Technology:	*Fundamental method of agent detection used in the detector (i.e., ion mobility, flame photometry, mass spectrometry, fourier transform infrared spectroscopy, photoacoustic infrared spectroscopy, electrochemistry or chemical reactions, etc.).*
Status:	*The item's stage of development, (i.e., fielded, developmental, production item, etc.).*
Uses:	*The type of detection capability (i.e., standoff, remote, point, etc.) and the applications for the item in NBC defense.*
Deployment:	*Countries that have purchased the item or the rights to produce the item and the branch(es) of the armed forces that use(s) the detector (i.e., Army, Navy, Air Force, Marine Corps).*
Agents Detected:	*The chemical warfare agent(s) which cause(s) the detector to respond via an auditory or visual signal.*
Detection Sensitivity:	*The minimum concentration of chemical warfare agent that will cause an auditory or visual signal from the detector.*
Response Time:	*The minimum time required for the detector to signal the presence of chemical warfare agents.*
False Responses/Interferents:	*Environmental conditions or chemicals, other than the chemical warfare agents intended, which will cause the detector to respond.*

Information Field	***Description***
Safety Features/Safety Hazards:	*Design features that protect the user from any aspects of the equipment which endanger human health and well-being/aspects of the equipment which endanger human health and well-being.*
Power Requirements:	*Energy source(s) required to operate the detector including any auxiliary power sources.*
Transport Requirements:	*Methods, personnel and/or vehicles required to move the detector.*
Personnel Requirements:	*Personnel and skill level required to operate the detection equipment.*
Operational Information:	*Procedures and general information pertinent to the function of the detection equipment including operating temperature and humidity.*
Stock Number(s):	*NATO and/or National Stock Numbers.*
Miscellaneous:	*Supplemental information on the detector not previously addressed including, but not limited to, communication interfaces, logistical information such as Reliability, Availability and Maintainability (RAM) and storage information.*
Contact(s):	*The manufacturer, development agency and/or distributor(s) associated with the detection equipment.*

In addition to the country chapters, a chapter providing a general overview of existing detection technologies is included (Chapter 2). This chapter covers detection technologies such as ionization/ion mobility, flame photometry, mass spectrometry, standoff detection, passive and active systems, photoacoustic infrared spectroscopy, electrochemistry, and chemical reactions used in detection kits, tickets and papers.

In order to enhance the utility of this handbook, a number of appendices have been included. An alphabetical equipment index and indices by country, technology and manufacturer are located in the back of the handbook. A table showing the agents detected by various detectors and a list of definitions for abbreviations, acronyms and symbols are also included.

Chapter 2 - TECHNOLOGIES

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2.0 INTRODUCTION TO DETECTION TECHNOLOGIES

This section briefly describes the chemical detection technologies used in today's fielded detectors. Technologies may have a different application in a specific instrument. For example, sensors or signal processors may be different or be configured differently in two detectors which use the same basic technology. The unique aspects of how the technology is applied in the various detectors are discussed in the sections on each specific instrument. In this section, a general description and a schematic (if applicable) of the technology is presented.

Chemical Warfare (CW) agent detector technologies can be divided into two general categories: point and standoff. Point detectors sample the air (soil or water in the case of specialized detection kits) for the presence of CW agents in the immediate vicinity of the detector. Point detectors are generally used:

- To monitor for the presence of agent in the atmosphere.
- To provide post-attack monitoring to identify, define the limits of, or locate CW contamination.
- To monitor collective protection areas and entrance ways.
- To monitor decontamination operations for effectiveness.
- To signal when contamination has been encountered during reconnaissance efforts.

The point detection technologies covered in this section include ionization (or ion mobility), flame photometry, mass spectrometry, photoacoustic infrared spectroscopy, electrochemistry, and detection kits and tickets which use a variety of chemical reactions. Standoff detectors use Optical Remote Sensing (ORS) techniques to detect the presence of CW agents out to ranges of one kilometer to five kilometers. Standoff detectors are used:

- To provide early warning of a CW threat, thus allowing time to increase protective posture.
- To allow ground forces to employ contamination avoidance doctrine.

The standoff detection technologies covered in this section include passive remote sensing systems which generally use a Fourier Transform Infrared (FTIR) spectrometer or a spectrally modified Forward Looking Infrared (FLIR) imager and active remote sensing systems which use a tunable laser source and Light Detection and Ranging (LIDAR) techniques to illuminate the CW vapor cloud and background.

2.1 POINT DETECTION

2.1.1 Ionization/Ion Mobility

This technology is also referred to as ion mobility spectrometry (IMS). Many of the point CW agent detectors/alarms in use by military forces worldwide utilize IMS technology. The basic concept of IMS is to characterize chemical substances through gas-phase ion mobilities. Originally termed plasma chromatography, IMS has also been used commercially for qualitative and quantitative analysis of various toxic chemicals, explosives, and narcotics both in laboratory and field applications.

IMS operates by drawing air at atmospheric pressure into a reaction region where the air and all it's constituents are ionized. The ionization is generally a collisional charge exchange or ion-molecule reaction resulting in formation of low energy, stable, charged molecules (ions). A radioactive source is generally used to continuously emit energy (charged particles) which is transferred to the sample molecules. The most common sources are Ni^{63} (Nickel 63 is a β-emitting isotope) or Am^{241} (Americium 241 is an α-emitting isotope). Radioactive sources are preferred since they require no external power, have no electronic components, and do not require service. [1]

The air and agent ions are then passed into a drift tube or drift region. A membrane or shutter is used to isolate the drift tube from the outside air, and the sample is injected or pulsed through the shutter and into the drift tube. The IMS drift region is under a weak electric field gradient and the ions will travel down this charged tube to a detector plate or electrode at the far end. As the ions collide with the detector plate, charge (current) is registered and an ion mobility spectrum is generated as a series of peaks (normally displayed on a graph as time (x axis) verses current (y axis)). Figures 1A and 1B are a diagram and schematic of the basic components of IMS, respectively. [2]

Ions of chemical agents, as well as other vapors, have a characteristic mobility time (length of time it takes the ions to travel down the drift tube to the collector electrode). Time is measured from the pulse or gating (time = 0 seconds) of the sample into the drift tube. The intensity (height) of the peaks in the spectrum, which corresponds to the amount of charge, gives an indication of the relative concentration of the agent present. Many factors influence the spectrum, and refinements to signal acquisition and processing reduce these effects and allow for differentiation from interfering substances. [1,2]

An advantage of IMS is that it allows outside air to be drawn directly into the instrument without preparation or concentration. Other advantages are: the actual analysis of the air takes place in a small chamber that is rugged, simple, and relatively inexpensive; it is reliable compared to some other technologies and achieves excellent detection sensitivities. A disadvantage of IMS is known as "matrix effects" whereby the humidity, temperature, and composition of the air that contains the compounds of interest (agents) may influence the response of the detector. Certain interferents have been found to cause false positive responses in several of the fielded IMS detectors. However, measures have been incorporated to minimize these effects, and IMS is the most widely used electronic, point chemical warfare agent detection technology. Another disadvantage is that radioactive sources are controlled and require licensing in most countries. [1]

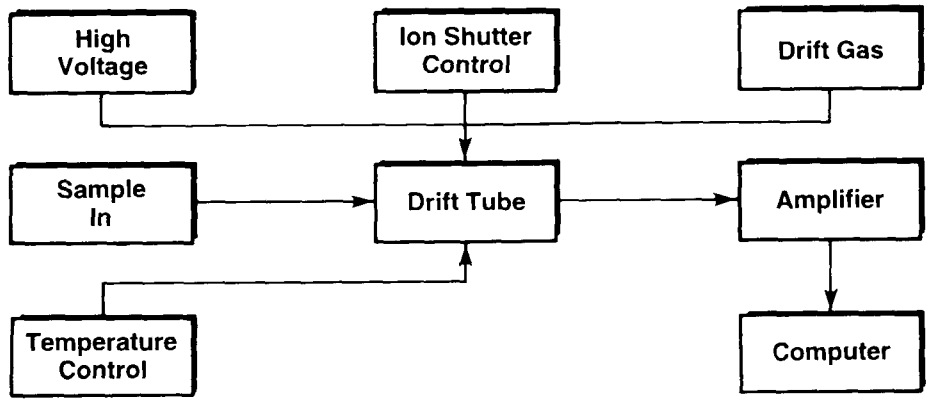
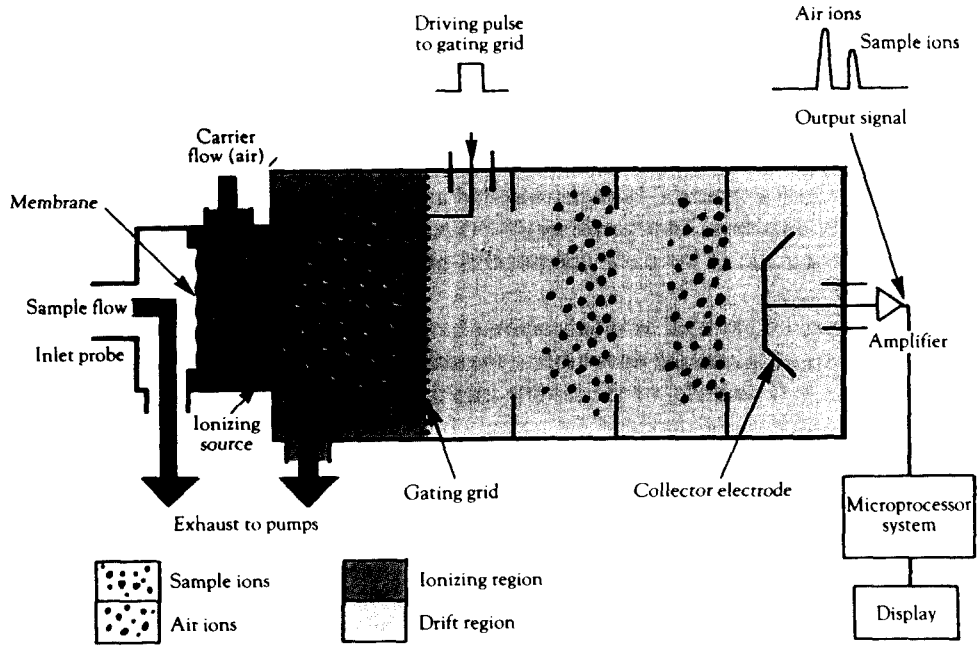


Figure 1A
Diagram of Ion Mobility Spectrometry



Schematic courtesy of Graseby Ionics Division
Graseby Dynamics Limited

Figure 1B
Ion Mobility Spectrometry Schematic [1,2]

2.1.2 Flame Photometry

Several chemical warfare agent detectors in use today employ the flame photometric technology. In flame photometry, the sampled air is burned in a hydrogen rich flame. The compounds present, when burned, will emit light of certain wavelengths in the flame. An optical filter is used to "watch" the flame and only lets one specific wavelength of light pass through it. A photosensitive detector (photomultiplier tube) senses the light that passes through the selective filter, producing a response

signal. Since some elements will emit a unique and characteristic wavelength of light when burned in this flame, employing an optical filter which only lets that unique wavelength pass allows for detection of specific elements. Flame photometry is used extensively as a laboratory analytical technique, mostly as the detector for gas chromatographs. Field (portable) detectors (both military and commercial), as well as some fixed site and laboratory monitors also use this technology.

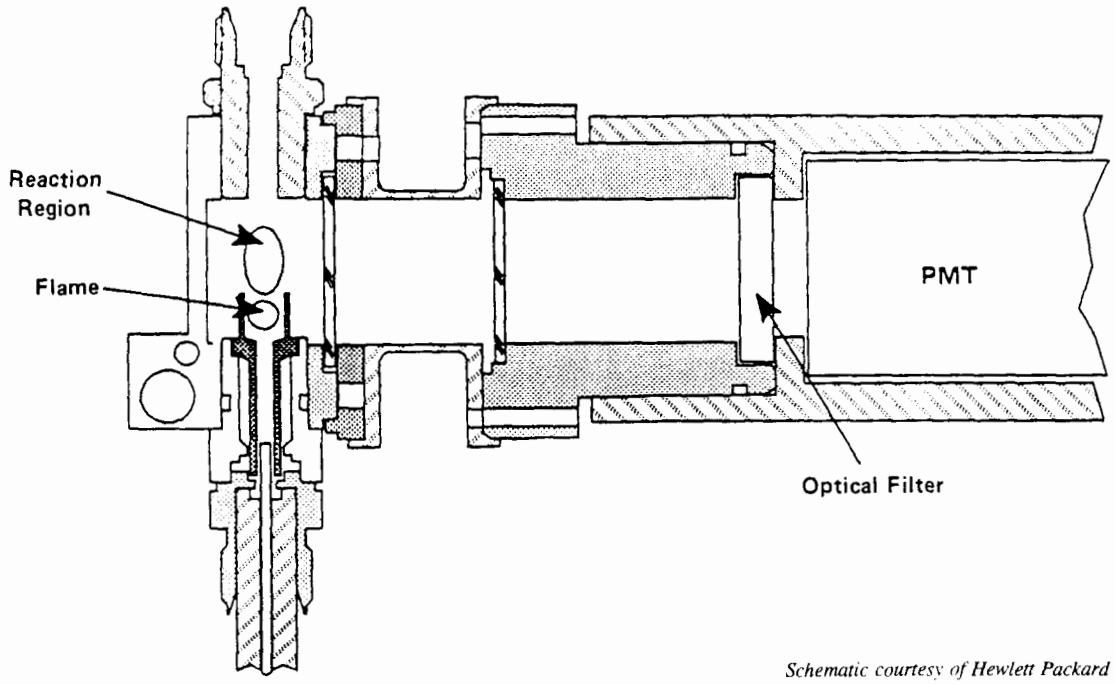
In a flame photometric detector, the sample is burned in a low temperature, hydrogen rich flame. The species HPO is emitted at about 510 nm to 526 nm , and the species S_2 radiates at about 394 nm. The radiation is detected by photomultiplier tubes monitoring for those specific wavelengths. Filters are employed to isolate these bands. The photomultiplier tubes produce an analog signal (voltage) which is amplified and interpreted to determine if an agent is present. The HPO molecule is produced when compounds containing phosphorus (such as some of the nerve agents) are burned in the hydrogen rich flame. The S_2 species is produced when compounds containing sulfur (such as many of the blister agents) are burned in the flame. Figure 2 is a schematic diagram of the flame photometry technology. [3]

An advantage of flame photometry is that it allows for ambient air to be drawn directly into the instrument and analyzed. Moreover, the technology is sensitive and selective. However, flame photometry involves elemental analysis. This means that the detector is actually sensing elemental sulfur or phosphorus, and not the larger more complex agent molecules. A disadvantage of flame photometry is that it is prone to interference from other compounds containing sulfur and phosphorus. For example, the pesticide Malathion contains both sulfur and phosphorus, and can cause a false positive response in some flame photometric detectors.

Some techniques can reduce the effects of potential interferents. Sample separation techniques, such as chromatography or a pre-concentrator, can reduce the possibility of common substances interfering with agent detection and are used in the more stationary flame photometric monitors. In chromatographic separations, the chemical agents will each have a characteristic retention time in the chromatographic column. These retention times create agent "gates" or windows, which are blocks of time after sample introduction during which the agent can be expected to appear. The presence of the wavelengths of light produced when a compound containing sulfur or phosphorus is burned in the flame can thus be expected to coincide with the agent gate (or retention time). Another technique uses a selective adsorbent preconcentrator. The theory is that the agents of interest will be retained on the adsorbents, while potential interferents will not. Another approach to interferent rejection uses multiple optical filters on a wheel or "chopper." Two different optical filters are used to look for emissions in the flame at two separate wavelengths for each characteristic chemical species, sulfur and phosphorus. Thus, a total of four optical filters and one photomultiplier tube are used. The wheel rotates and produces a time modulated signal from the single photomultiplier tube. The algorithm senses the presence of agent based on characteristic differences in intensity of the emissions at two wavelengths. Sulfur or phosphorus containing interferents do not produce the same intensity difference.

2.1.3 Mass Spectrometry

Mass Spectrometry (MS) is one of the most widely used analytical techniques available today. Though primarily a laboratory analytical tool, recent advances in instrumentation have resulted in smaller, more portable MS instruments. Several countries have fielded, or are in the process of fielding, MS instruments specifically for detection of CW agents.



Schematic courtesy of Hewlett Packard

Figure 2
Flame Photometry Schematic Diagram

All mass spectrometers consist of a sample inlet system, an ion source, a mass analyzer, a detector, and a signal processing system. Many MS systems operate under reduced pressure (or vacuum), but there are some atmospheric pressure MS instruments available. A sample is introduced into the instrument, a charge is imparted to the molecules present in the sample, and the resultant ions (charged molecules) are separated by the mass analyzer component. MS instruments are actually measuring the *mass to charge* ratio of the atomic or molecular ion. This term is obtained by dividing the atomic or molecular mass of the ion (m) by the number of charges (z) the ion bears. The capability of a MS to differentiate between masses is usually stated as it's resolution. The resolution depends greatly on the specific application. A mass spectrum is produced which appears as a number of peaks on a graph, with mass to charge on the x axis and intensity on the y axis. [3]

Different methods of sample introduction are used based on the state of the sample to be analyzed. A common technique uses a gas chromatograph (GC) to separate the constituents of the sample before it enters the mass analyzer region. For solid or aerosol samples, some method of vaporizing the sample is used such as a pyrolizer. All types of samples generally pass through some type of semi-permeable membrane (such as methylsilicone) before entering the mass analyzer region. Figures 3A and 3B are a diagram and schematic of the mass spectrometry technology, respectively. [3]

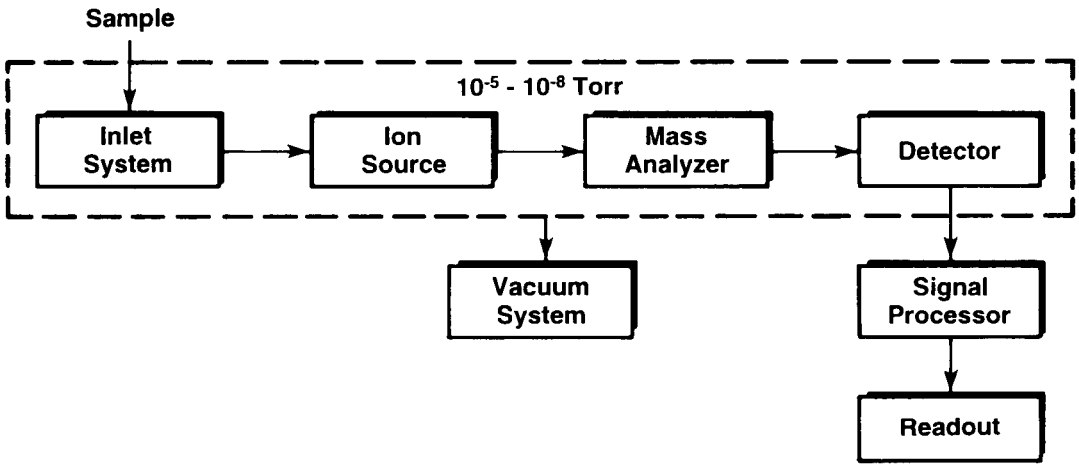
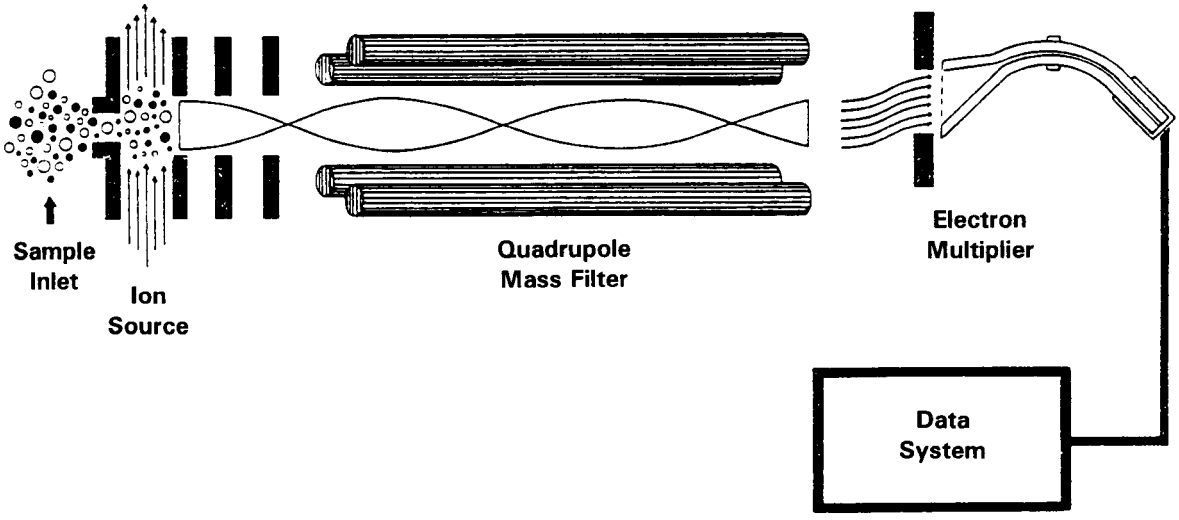


Figure 3A
Diagram of the Components of a Mass Spectrometer



Schematic courtesy of Hewlett Packard

Figure 3B
Mass Spectrometry Schematic

Although many types of mass analyzers are available, the most common in transportable MS are the quadrupole mass filter and the ion trap. In a quadrupole instrument, four cylindrically shaped metal rods serve as electrodes for the mass filter. A charge field is created by applying an increasing voltage to pairs of the rods. A small range of *m/z* ratios is analyzed due to the operating conditions, and other ions are neutralized or carried away as uncharged molecules. Spectral scanning is achieved by varying the electric field from zero to some maximum value, thus determining the entire *m/z* range of

the sample. In an ion trap device, the ions are trapped by an oscillating electromagnetic field until a desired concentration is reached, then ejected according to their *m/z*. In an MS/MS device, an ion of a particular m/z is isolated, and then further dissociated into smaller ions. This "parent-daughter" ion approach allows for definitive identification of many chemical species. [4]

The most common type of detector is an electron multiplier. The energetic ions from the mass analyzer strike the surface of the dynode which causes electrons to be emitted from the dynode. These electrons skip along the dynode surface, causing more electrons to be emitted with each impact. The current gain is measured at an anode, where it is amplified and displayed in the mass spectra. [3]

MS offers some significant advantages for agent detection. It can provide sensitive, reliable, and versatile recognition of CW agents. Rapid characterization and quantification is possible, and interference is not likely. Complex mixtures of compounds can be analyzed for both qualitative and quantitative information. Specificity and sensitivity are high compared to other detection technologies. However, the cost, complexity, ruggedness, power, and maintenance requirements of the technology detract from the potential field CW detection applications. There are many different types of MS instruments available, each of which has unique advantages and disadvantages. [3]

2.1.4 Photoacoustic IR Spectroscopy

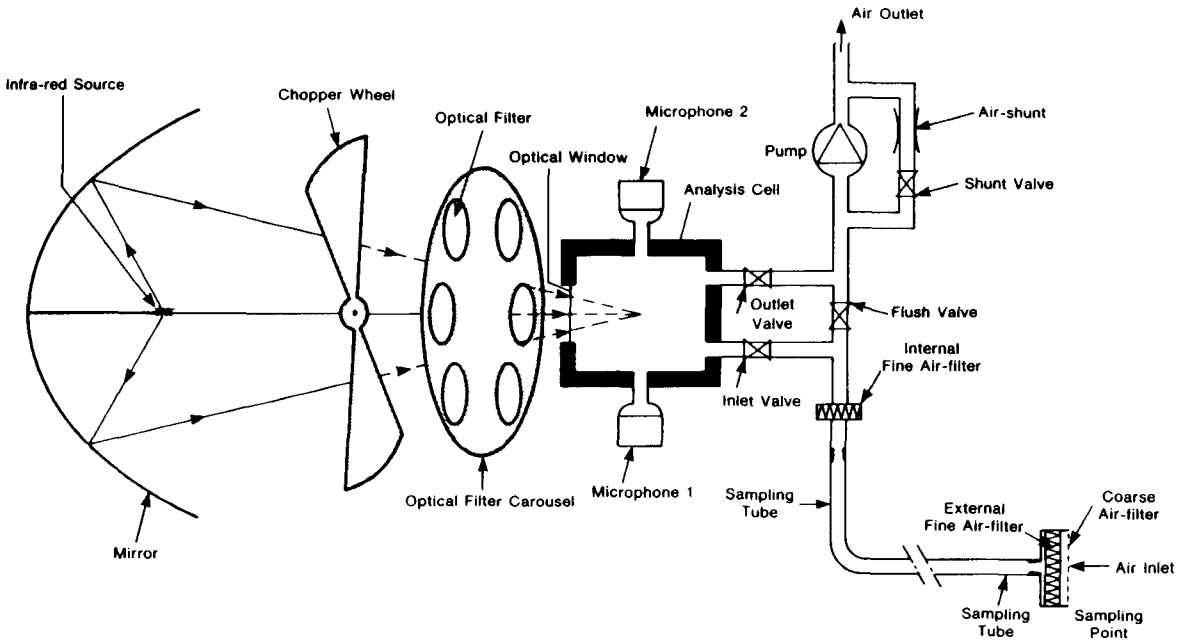
Photoacoustic Infrared Spectroscopy (PIRS) is a relatively recent CW detection technology. Commercial instruments are available which have been modified to detect CW agents. PIRS uses the selective absorption of infrared radiation by the CW agent vapors to allow for identification and quantification of the agent present. In theory, most vapors can be detected with this technology.

Air is drawn into the analysis cell through filters, and the cell is then sealed. A specific wavelength of infrared light is pulsated into the sample through an optical filter. A different optical filter is used for each specific type of agent or toxic vapor that is to be detected. The light transmitted by the optical filter (one specific wavelength) is selectively absorbed by the gas being monitored, so if any of the desired gas is present there will be a resulting increase in the temperature of the gas. This temperature increase also causes an equivalent increase in the pressure of the gas (since the sample cell is sealed). Because the light entering the cell is pulsating, the pressure in the cell will also fluctuate (pulsate), creating an acoustic wave in the cell which is directly proportional to the concentration of the gas in the cell. This is the photo-acoustic effect. Two microphones mounted inside the cell monitor the acoustic signal produced, and send results to the control station. Figure 4 is a schematic of the PIRS technology. [5]

PIRS has the advantage of being quite selective since a unique optical filter is used for each agent that is to be detected. A disadvantage of this technology is that it is effected by humidity and other environmental factors (temperature, for example). Calibration in the actual detection environment may allow for correction of the influences of some of these factors.

2.1.5 Electrochemistry

There are several CW agent detectors which operate on the principle of electrochemistry. Fundamentally, electrochemistry is based on a chemical reaction which occurs when the CW agent enters the detection region, and produces some change in the electrical potential. This is normally a"wet chemistry" type of reaction (a liquid solution is used which reacts with the CW agents). When the reaction occurs, some change in the electrical potential in the solution is created. This change is



Schematic courtesy of Brüel and Kjaer

Figure 4
Photoacoustic IR Spectroscopy Schematic

normally monitored through some type of electrode. A threshold concentration of agent is required, which corresponds to a change in the monitored electrical potential. A common type of electrochemical cell for nerve agent detection monitors the hydrolytic activity of an enzyme (cholinesterase) by irrigation with an organic ester (butylthiocholine) followed by an electrochemical determination of the hydrolysis product (thiocholine) using a graphite measuring electrode. Other types of chemical reactions are used for specific agents and in different detectors. [6]

Another type of electrochemical reaction uses a paint resin in which fine particles of silver flakes are suspended. The paint resin is selectively soluble for the agents of interest. The silver-bearing paint acts as an electrical conductor, which when attacked by a CW agent, swells, causing physical separation of the conductive silver flakes, resulting in a change in the electrical resistance of the detector grid. This change in resistance is monitored and an alarm condition exists when the threshold resistance is reached. [7]

Many different variations in electrochemical detection exist. These methods are in general selective, but not as sensitive as some other methods. Several of the fielded instruments have experienced problems at environmental extremes.

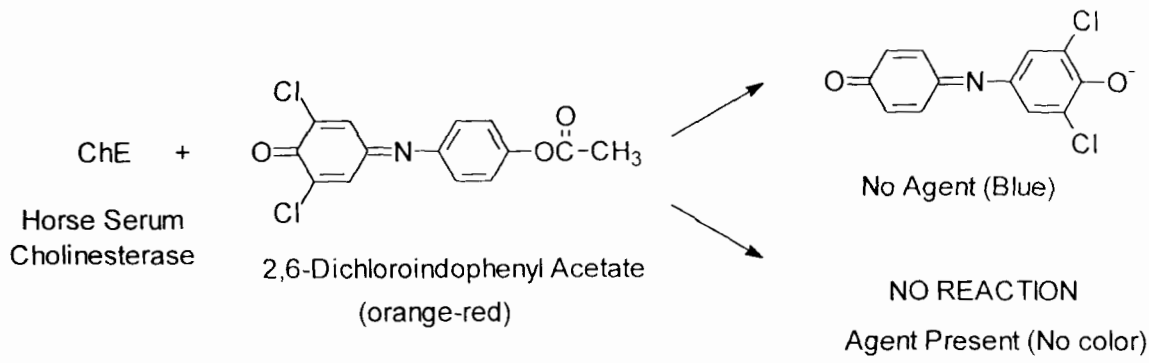
2.1.6 Detection Kits and Tickets

Most countries have at least one detection kit or ticket. These kits are generally configured for specific purposes, such as CW agent detection in water, or confirmatory detection after an automatic alarm or monitor. The basic technology uses chemical reactions that occur when CW agents interact with the various solutions and substrates, and the most common indicator (for a positive response) is a color change. Vapor detection kits or tickets use some form of surface or substrate to which the reagent chemicals are added, and the substrate exposed to the sampled air. Some kits use a filter paper surface that is exposed directly or the sampled air is drawn through the paper with an aspirator bulb. The other common type of surface is a tube of adsorbent to which the reagent solution is applied. Sampled air is then drawn through the tube. Many of these kits are complex and include multiple tests for specific agents or families of agents. As such, there are a great number of specific chemical reactions used in these kits. Rather than describe each specific chemical reaction, the general types of reactions and their reaction principles are discussed here.

2.1.6.1 Nerve Agent Reactions

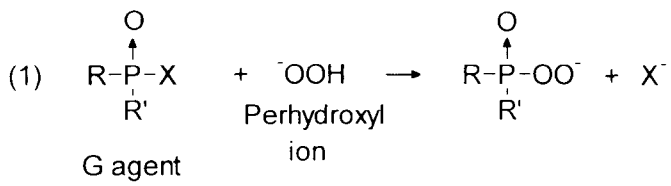
Anticholinesterase Reaction [8]

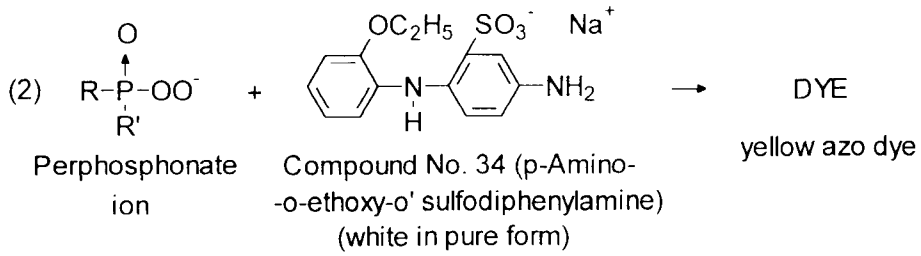
This reaction relies on the inhibition of an enzyme by the anticholinesterase agent (G or V series), resulting in no color change. Thus, if agent is present, no color change occurs (no blue color appears).



Schoeneman Reaction [9]

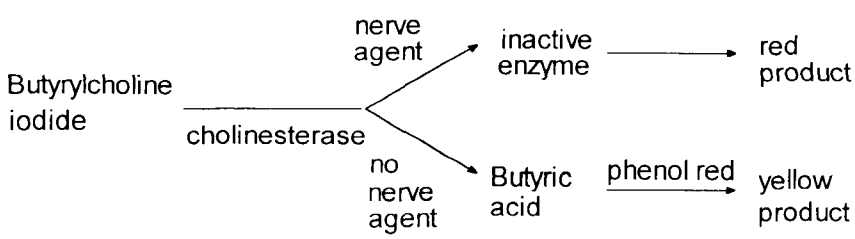
This reaction is based on the oxidation of an amine. It is used to detect G series nerve agents, but will not detect VX. Therefore, this reaction is a method of distinguishing between G agents and VX. Strong oxidizing agents such as Cl_2, Br_2, and NO_2 will interfere with the test. Most kits that use this reaction have some type of detection tube filled with an impregnated gel to which a prepared solution is added, and sampled air is drawn through the tube. A yellow color indicates a positive response, while no color or some other color indicates a negative response. This two step reaction proceeds as follows:





Butyrylcholine Iodide Reaction [10]

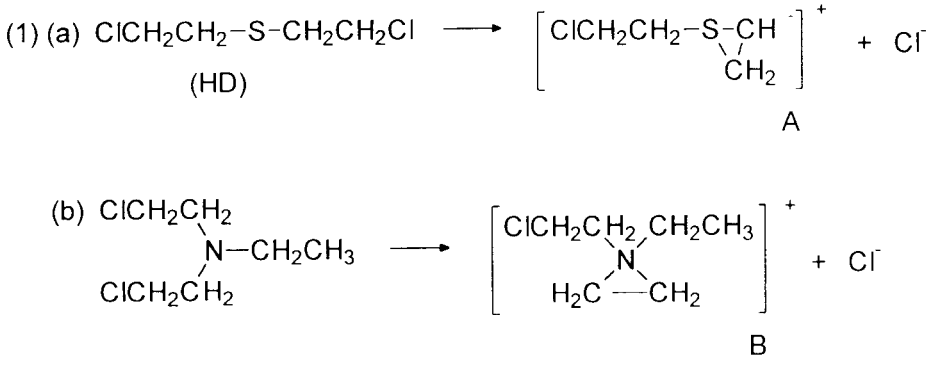
This reaction is based on the interaction of butyrylcholine iodide with the enzyme cholinesterase. If phosphoric acid esters (such as nerve agents) are present, the enzyme is inactivated and does not react with the butyrylcholine iodide, thus butyric acid will not form. The color indicator (phenol red) will remain red. If no nerve agent is present, the enzyme remains active and reacts with the butyrylcholine iodide, forming butyric acid. Butyric acid reacts with the phenol red to give a yellow color in the absence of nerve agents.

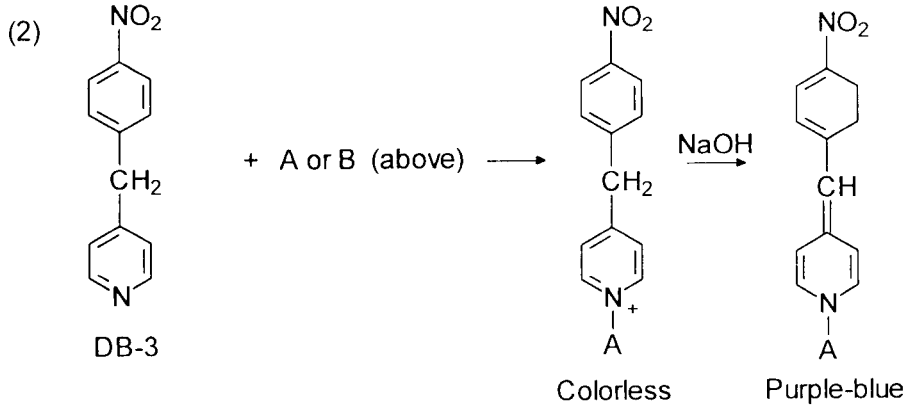


2.1.6.2 Blister Agent Reactions

Mustard Agent Reactions [11,12]

The reaction of compound DB-3 (α(p-Nitrobenzyl)-Pyridine) in the presence of a catalyst (usually mercuric cyanide) is used in an alkylation reaction to detect HD, HN, and CX (phosgene oxime). Heating tends to facilitate this reaction for some agents. The general the reaction proceeds as follows:



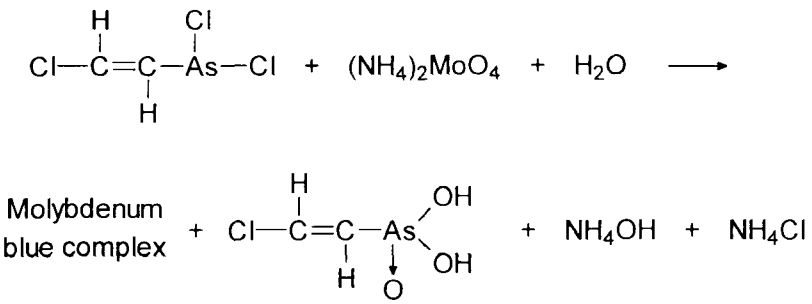


Lewisite Agent Reactions

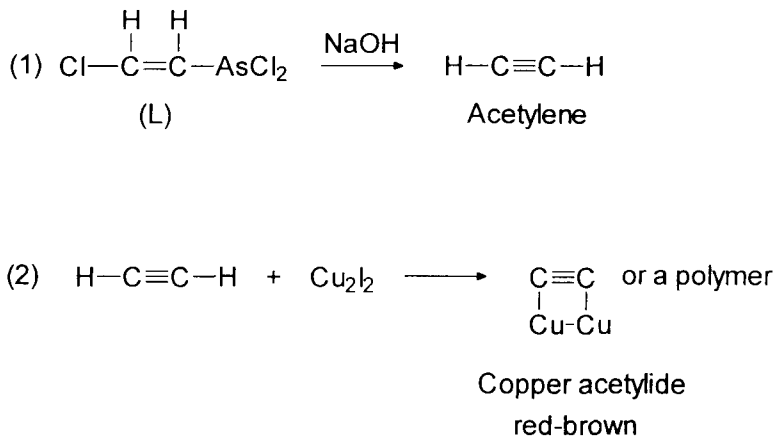
Lewisite is quite difficult to detect when compared to the other CW agents. Most CW agent detection is accomplished through detection of the agents vapors in the atmosphere. The reactivity of Lewisite vapors is the main reason that the detection of these vapors is difficult. Lewisite vapors hydrolyze almost instantaneously in the atmosphere to form 2-chlorovinylarsonous acid (CVA), particularly in high humidity. Since CVA is nonvolatile, it is difficult to detect in the atmosphere. Any method which is based on detection of arsenic containing compounds has interferent problems since arsenic is naturally occurring. The difficulty arises because increased sensitivity is needed due to the low volatility of the byproducts, but increased sensitivity makes the methods more prone to interferents from naturally occurring arsenic.

Several different reactions are used in fielded detection kits for the detection of Lewisite. Two of these reactions are presented here. The first is based on the reduction of ammonium molybdate by trivalent arsenicals. The second is based on the tendency of Lewisite and Lewisite oxide in the presence of a base to liberate acetylene. The acetylene reacts with copper iodide to form copper acetylide (reddish brown). The third is based on a reaction with Thio Micheler's Ketone (TMK). [13]

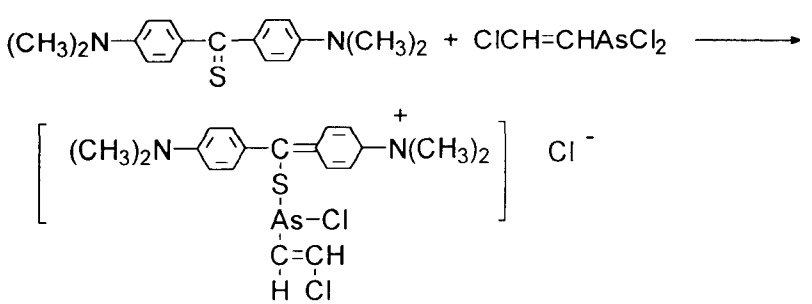
Detection of Lewisite by reduction of ammonium molybdate [14,15]



Detection of Lewisite by acetylene reacting with copper iodide [16]



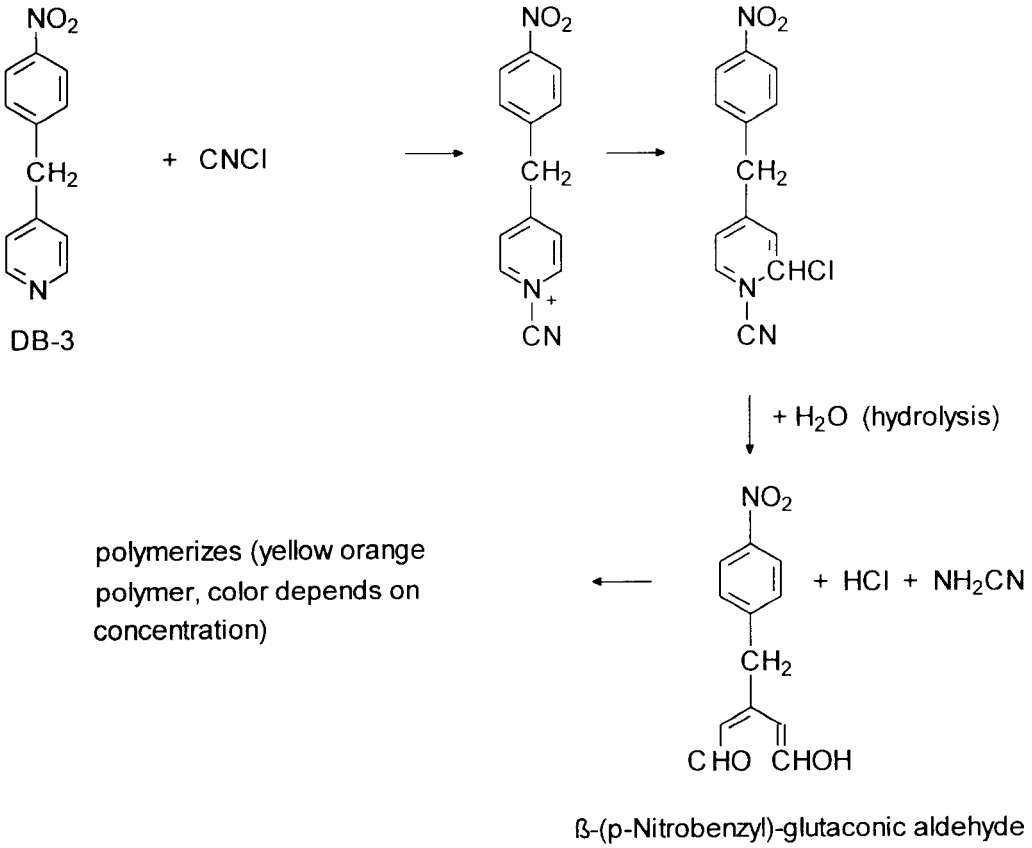
Detection of Lewisite by reaction with TMK [13]



2.1.6.3 Blood Agent Reactions

Cyanogen Chloride (CK) Reaction [17]

The reaction of compound DB-3 (α(p-Nitrobenzyl)-Pyridine) with CNCl results in a carbonium ion, which is then hydrolyzed and polymerizes to produce a color change. The general reaction is as follows:



Hydrogen Cyanide (AC) Reactions [18,19]

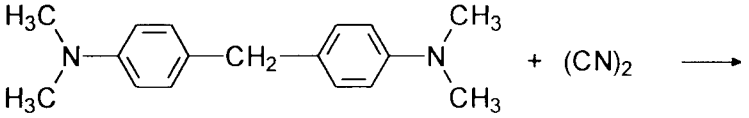
Two types of AC detection reactions are commonly used. One relies on the DB-3 reaction described above for cyanogen chloride. The other forms cyanogen $(CN)_2$ through a copper catalyst, then reacts the cyanogen with a tetra-base to produce a color change. The reactions are as follows:

Hydrogen Cyanide (AC) Reactions (continued) [18,19]

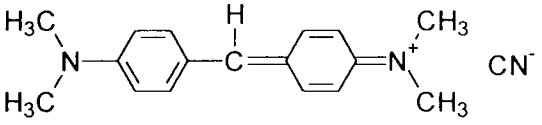
(1) $HCN + Cl_2 \longrightarrow CNCl \longrightarrow$ Detect as above in cyanogen chloride reaction
(bleach)

(2) 1. $Cu^{++} + 2HCN \longrightarrow Cu(CN)_2 + 2H^+$

2. $2Cu(CN)_2 \longrightarrow Cu_2(CN)_2 + (CN)_2$
cyanogen

3. 

Tetramethyldiaminodiphenylmethane



Blue + HCN

2.1.7 Detection Papers

Detection papers operate on the principle of selective solubility. Crystals of dye are suspended in the paper matrix. When CW agents are applied to the paper, the dye crystals are soluble in the agents. The crystals dissolve and a color is visible for a specific type or class of agent.

2.1.8. Surface Acoustic Wave (SAW)

Several developmental sensors that may be applicable to field CW detection use SAW technology. Most SAW devices use a quartz piezoelectric crystal substrate. Electrodes placed on the crystal create an electric field, which generates a surface acoustic Rayleigh wave between the electrodes. Most of the energy traveling in this Rayleigh wave is constrained to the surface of the crystal. Thus, any material in contact with the surface would interact strongly with the wave. A chemically absorbent coating on the surface of the crystal absorbs the agent vapors, and produces changes in the mass, mechanical modulus, or electrical properties of the surface coating and the wave as it travels through the coating. Different selective coatings are applied to the substrate for detection of different agents, and the sensitivity is a function of the coatings ability to absorb vapors. [20]

2.2 STANDOFF DETECTION

The ability to detect CW agents to ranges of one kilometer to five kilometers provides early warning for increasing protective posture and allows ground forces to employ contamination avoidance doctrine. The development of standoff detection techniques provides wide area surveillance capability while simultaneously reducing the total number of detectors required in the field. Optical Remote Sensing (ORS) technologies, utilizing infrared spectral analysis techniques, have been employed in the development of CW standoff detection instruments.

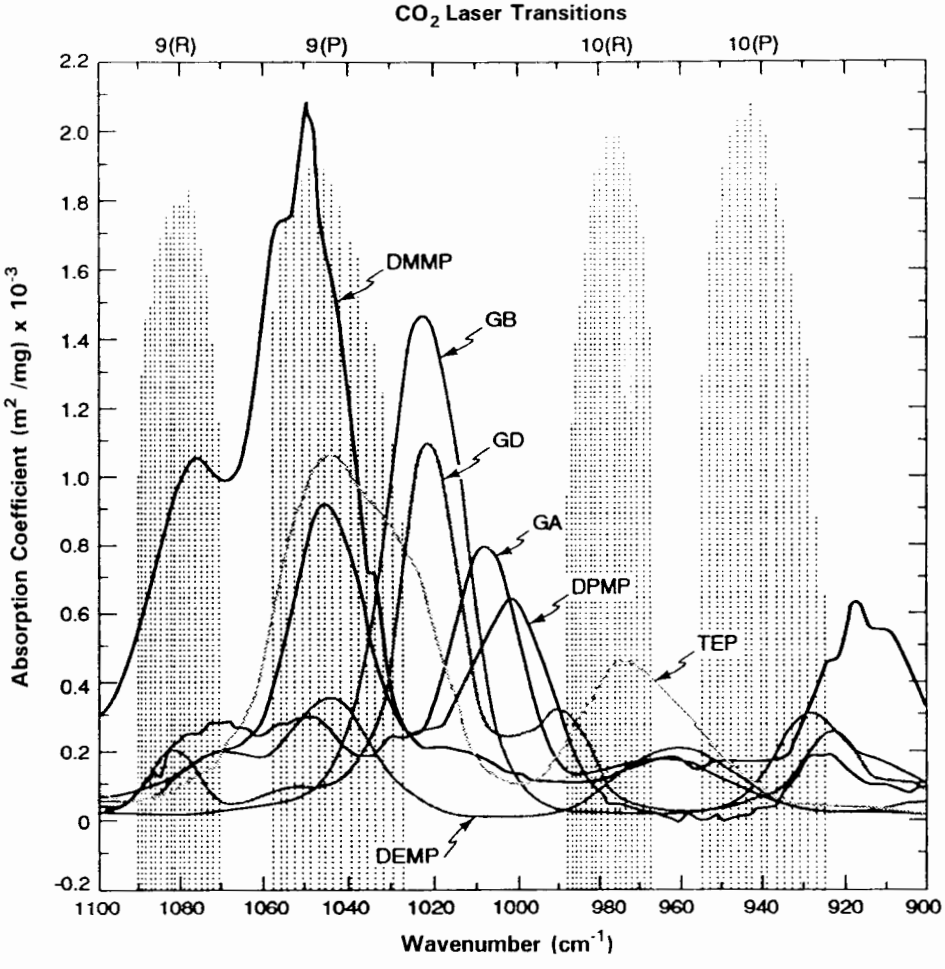


Figure 5
Infrared absorption spectrum of
chemical warfare nerve agents and selected precursors. [21]

Two basic types of ORS technologies, passive and active (laser) remote sensing systems, have been evaluated, developed, and engineered into fielded devices. Passive remote sensing systems collect infrared radiation emitted and/or measure infrared radiation absorbed from the background to detect CW agent vapor clouds. Passive remote sensing systems using a Fourier Transform Infrared (FTIR) spectrometer or a spectrally modified Forward Looking Infrared (FLIR) imager have been

engineered and fielded. The active remote sensing system uses a tunable laser source and Light Detection and Ranging (LIDAR) techniques to illuminate the CW vapor cloud and background. The differential absorption LIDAR (DIAL) system collects the scattered or reradiated energy and measures the wavelength dependent differential absorption characteristics of the CW vapor cloud. Active remote sensing has been the subject of extensive exploratory development for the past 10 years. Both passive and active ORS systems exploit the rich infrared absorption spectrum of CW agents in the 9 to 11 μm region, which is due to the organophosphorus (R-P=O) moiety present in the molecular structure of the nerve agents. Figure 5 shows the infrared absorption spectrum of several nerve agents and their precursors in the 9 to 11 μm region. The 9 to 11 μm region also lies in a spectral transmission "window" of the atmosphere where atmospheric attenuation due to oxygen, carbon dioxide, and water vapor is low. This allows both the passive and active ORS technologies to be effective to five kilometers. [21]

2.2.1 Passive (i.e., Forward Looking Infrared, Fourier Transform Infrared)

Two passive remote sensing systems have been fielded by the United States and will be used as examples in describing this technology. The United States Army has developed for fielding the M21, Remote Sensing Chemical Agent Alarm (RSCAAL), a passive infrared spectral radiometer utilizing FTIR technology. The United States Navy has fielded the AN/KAS-1 Chemical Warfare Directional Detector (CWDD), a spectrally modified FLIR imager. Further details on these systems can be found in their respective descriptions in the U.S. section.

The M21 utilizes FTIR technology and records the infrared spectrum of the atmosphere in the 8 μm to 12 μm region through the use of a Michelson interferometer and a MC68000 microprocessor. The interferometer provides an interferogram, which is taken in the time domain and converted to a frequency domain spectrum in the microprocessor by means of a fast Fourier transform. Figure 6 is a schematic of an operational FTIR ORS system. The M21 is designed to detect nerve and vesicant agent vapor clouds at ranges up to five kilometers. The basic operational concept of the M21 is shown in Figure 7. The M21 weighs approximately 55 pounds and can be mounted on a tripod or a vehicle mount. It cannot operate from a moving platform. The M21 measures and stores the long-wave infrared spectral radiance of a 60 degree scene over seven distinct, 1.5 degree, fields-of-view (FOV) within 60 seconds. At one kilometer, the size of one FOV is 26 meters wide, at five kilometers, it is 131 meters wide. The background spectrum collected by the M21 originates from the constituents with the scene, which generally is a mixture of terrain, sky, and the ambient atmosphere. These components all radiate at different levels, depending upon their temperature and their emissivities. When a chemical agent cloud is within the FOV the background radiance collected by the M21 may be either increased or decreased, depending on the scene and the agent conditions. The M21 monitors the radiance from each FOV and compares it to a stored background from that FOV free of chemical agent clouds. When the radiance difference or the effective temperature difference, ($\triangle$T) exceeds a threshold, the M21 alarms. If the CW agent cloud fills the entire FOV, the sensitivity is on the order of 150 mg/m^2. The M21 software allows for the detection and identification of chemical agents by their infrared spectral absorption properties. [22,23,24]

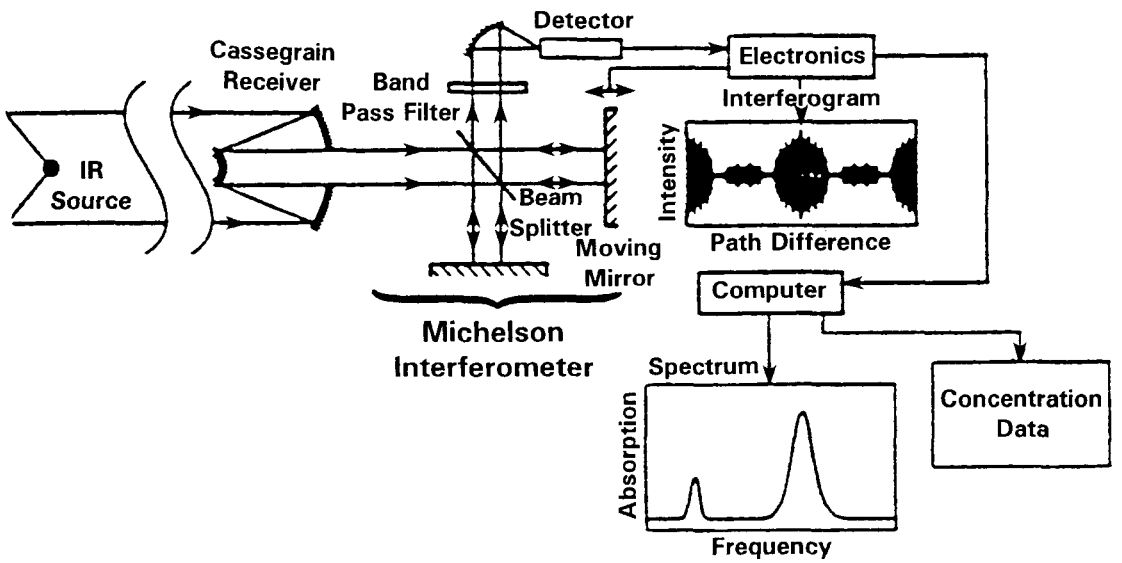
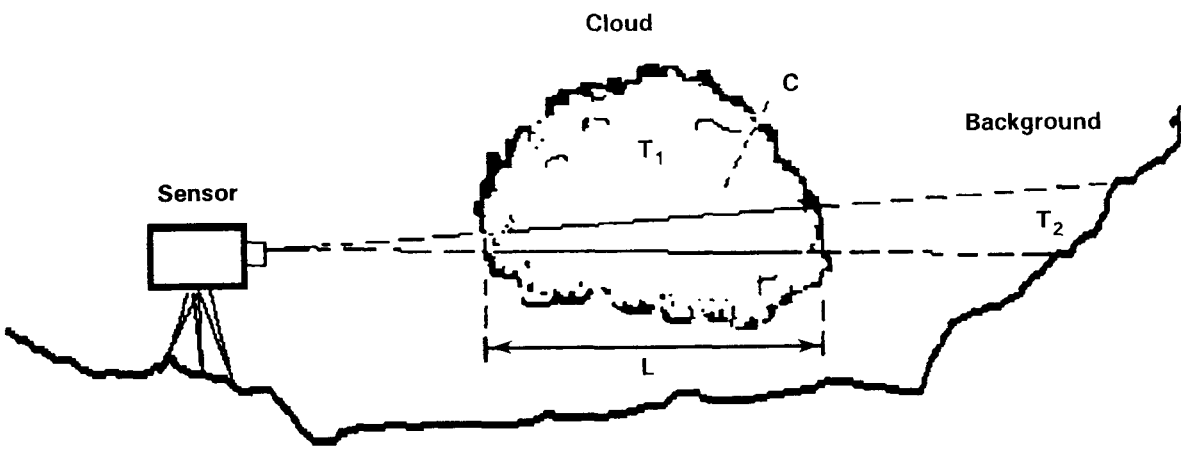


Figure 6
Block diagram of a Fourier Transform Infrared (FTIR) spectrometer being used in a long-path configuration, showing the key optical elements, the interferogram, and the resulting absorption spectrum. [23]



C = Concentration
L = Length

Figure 7
Principle of operation of a passive remote IR chemical sensor. The spectral emission band intensity is governed by three parameters: the cloud length, the cloud concentration, and the relative temperature difference between the cloud and its background. The spectral features can be either absorption ($T_2 > T_1$) or emission ($T_1 > T_2$). [24]

The AN/KAS-1 utilizes a common module FLIR and a four position filter wheel containing three narrow-band infrared filters and one neutral density filter. A FLIR measures a thermal 2-D image using mechanical scanning or a focal plan infrared detector array. The infrared filters spectrally modifies the infrared scene observed by the operator. The operator can manually select the filter wheel position that places the selected narrow-band filter into the FOV of the imager. By comparing the images produced by the different filters, the operator declares a detection of nerve agent vapor clouds. The FLIR used in the AN/KAS-1 has sensor module containing 60 detector elements and is cryogenically cooled. Two FOVs are available: wide, 3.4 x 6.8 degrees and narrow, 1.2 x 2.2 degrees. The AN/KAS-1 weighs approximately 44 pounds. The AN/KAS-1 has a secondary role of providing thermal imaging for night surveillance.

2.2.2 Active (i.e., Differential Absorption LIDAR)

The U.S. has been involved in a multi-year exploratory development program to investigate and evaluate the capabilities and limitations of DIAL technology. Several breadboard CO_2 laser-based DIAL systems have been developed since 1984. These systems have demonstrated in numerous government field test studies the ability of active remote sensing systems to detect and track vapor clouds using range-resolved and topographic concentration measurement techniques. A DIAL system determines the concentration of a chemical vapor in the atmosphere by measuring the wavelength-dependent backscatter or absorption of laser light at two or more wavelengths. Light at several wavelengths is produced by a laser transmitter and is directed through the atmosphere to be measured. Some of the light is reflected back to the LIDAR system from distant topographic features, naturally occurring aerosols, or materials of interest. This light is collected by a telescope and is converted to an electrical signal by a photovoltaic detector. [22]

The laser transmitter for an IR DIAL system consists of at least two manual or a single frequency agile grating-tuned, Transverse Excited Atmospheric (TEA) CO_2 pulsed lasers. Commercially available CO_2 lasers can generate high peak power pulse pairs at Pulse Repetition Frequencies (PRF) up to 50 Hertz. Near simultaneous laser firing is generally desirable to ensure that the pulse pair probes the same target area and to reduce the effects of atmospheric scintillation and target variability. The receiver consists of a telescope to collect backscatter laser energy and focus it onto a cryogenically cooled Mercury-Cadmium-Tellurium (HgCdTe) detector, which converts the signal to electrical energy. The signal is amplified both linearly and logarithmically and then directed to the control and data acquisition module for recording. The control and data acquisition subsystem provides control signals for the transmitter and data recording and processing functions. The control and data acquisition subsystem consists of a computer with its associated software, digitizers, and data loggers. A video terminal is included to display data and to provide a quick-look capability.

In the simplest case for DIAL measurements, only two wavelengths are used. One is chosen to correspond to an absorption peak in the IR vapor spectrum of the chemical to be measured; the other is chosen to be the reference and is unabsorbed by the same chemical vapor. The two wavelengths are transmitted nearly simultaneously (100 ms or less spacing between the two pulses) to "freeze" temporal variations of atmospheric parameters. The difference in the intensities of the backscattered light of these wavelengths can be processed by computer to yield quantitative information about the chemical species in the atmosphere. The backscattered light from the two wavelengths is converted to electrical signals, which are then processed by taking the derivative, with respect to distance, of the

logarithm of the ratio of the two signals, yielding the concentration of the chemical species in the atmosphere along the laser Line of Sight (LOS). The log ratio of their return powers (normalized by the transmit energies) can be used to compute the path integrated vapor concentration as a function of range.

A DIAL system can measure chemical vapor concentration in two modes: column-content and range-resolved. In the column-content mode, laser light is reflected from a hard target or topographic feature and the Signal-to-Noise Ratio (SNR) is high. The resulting vapor measurement is a concentration-pathlength product (CL) and indicates the total concentration of the chemical vapor present between the LIDAR system and the target, but provides no information about the range or concentration distribution of the vapor cloud. The CL measurement is an integrated concentration measurement and is often expressed in units of mg/m^2 or ppm-m. Since the CL expression represents an integrated measurement, then a detection of 3 ppm-m of a particular gas vapor provides no further information concerning the location or distribution of the vapor along that line-of-site and 3 ppm-m is the same as 300 ppb over 10 meters, 30 ppb over 100 meters or 3 ppb over one kilometer. Column-content vapor measurements have been demonstrated to 10 kilometers.

In the range-resolved mode, laser light is backscattered from natural aerosols in the atmosphere and the resulting SNR is low, requiring pulse averaging. The firing of the transmitted laser energy is clocked, and the temporal history of the backscattered light produces a range-resolved or range-distributed signal. The range-resolved mode allows for the mapping of the spatial distribution of the desired materials along the optical path. Computer processing of the data yields concentration as a function of range along the LIDAR LOS. The range-resolved mode provides concentration measurements as a function of range in units of mg/m^3 or ppm and contour maps of the chemical vapor clouds can be obtained in near real-time. Range-resolved measurements are generally less sensitive than column-content measurements for ranges beyond one kilometer. Vapor range-resolved measurements have been demonstrated out to 2.4 kilometers. Additional wavelengths are used to extend the dynamic range of concentration measurement and to discriminate against possible interference by dust or other materials.

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Chapter 3 - CANADA

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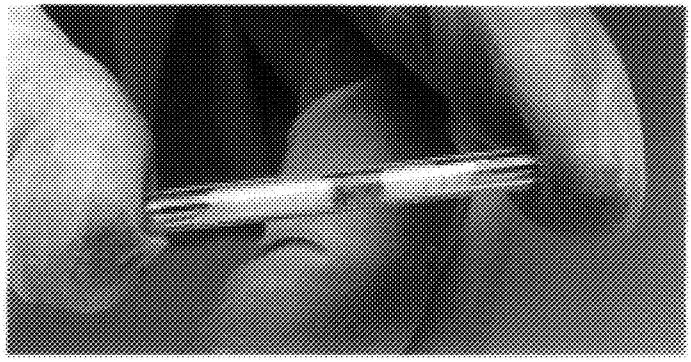
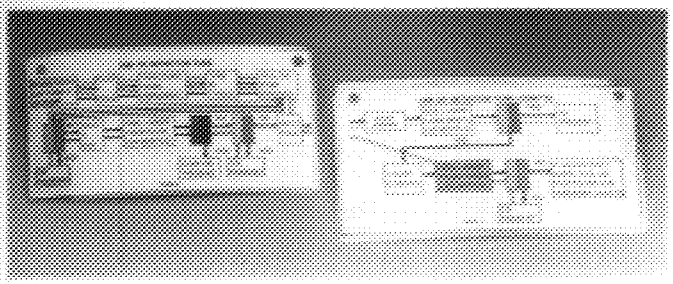
3.1 CHEMICAL AGENT DETECTORS



Plain-Band Detector Tube indicating mustard presence.

Photos courtesy of Defence Research Establishment Suffield



Instruction cards showing the easy to follow steps for agent detection using the plain-band detector tubes.

Using the C2 Kit in the field.

The C2 Chemical Agent Detector Kit

- **Designator(s):** C2

- **Item Name(s):** C2 Chemical Agent Detector Kit

- **Item Description:** The C2 Kit is a multicomponent kit which uses colorimetric chemical reaction technology for detecting nerve, blister, blood and choking agents in vapor form, and nerve and blister agents in liquid form. It is used to collect vapor samples of unknown chemical agents for laboratory identification; identify safe times to unmask for 30 minutes or 12 hour periods, and test for the presence of chemical agents after decontamination operations. The kit is easily operated by a fully (NBC) protected soldier and is compatible with infantry equipment. The kit is lightweight, low volume and has a long shelf life. [3,4]

- **System Components:** [3]

  3-Way Detector Paper
  Air Sampling Pump
  Chemical Reagent Bottles (3)
  Detector Tube Dispenser
  Instruction Cards
  Nerve Agent Vapor Detector (NAVD)
  Plain-Band Detector Tubes
  Vinyl Coated Carrying Case (for components listed)
  Water Bottle
  White-Band Detector Tubes

- **Support Equipment:** For unknown vapor samples collected in the white-band detector tubes, appropriate gas analyzing equipment is required for agent identification. The rest of the C2 Kit is stand-alone. [3]

- **Equipment Hardness:** The carrying case is designed to withstand severe environmental conditions. The NAVD and detector tubes are contained within waterproof packages. All individual components are rugged enough for intended military application. [3]

- **Dimensions and Weight:** Fully equipped C2 Kit (carrying case plus components). [3]

Length:	23 cm
Width:	9 cm
Height:	14 cm
Weight:	1.4 kg

- **Technology:** Wet chemistry kit. The presence or absence of a chemical agent is indicated by a color change reaction. [3,4]

- **Status:** In service since the 1970s. Recently, the Canadian Forces acquired the Chemical Agent Monitor (CAM) for detecting nerve and mustard agent vapors. The C2 Kit; however, still fulfills several requirements that the CAM is unable to meet and serves as a backup/confirmation to the CAM. [3]

- **Uses:** Designed to be used by an individual soldier, such as an NBC sentry or a member of a reconnaissance team. [3]

- **Deployment:** Canada and Australia. [18]

- **Agents Detected:** [3]

ITEM(S)	AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY		RESPONSE TIME
			MINIMUM	MAXIMUM	
NAVD	Nerve	GA	0.002 mg/m^3	0.04 g/m^3	several min
		GB	0.004 mg/m^3	3 g/m^3	several min
		GD	0.002 mg/m^3	0.6 g/m^3	several min
		VX	0.0007 mg/m^3	0.002 g/m^3	several min
3-Way Detector Paper	Blister	H (liquid)	0.07 mg/m^3	0.3 g/m^3	immediate
	Nerve	Same as NAVD (liquid)	Same as NAVD	Same as NAVD	immediate
Plain-Band Detector Tubes	Blister	CX	*	*	*
		H	0.07 mg/m^3	0.3 g/m^3	several min
		HN	0.07 mg/m^3	0.3 g/m^3	several min
		T	0.07 mg/m^3	0.3 g/m^3	several min
	Blood	AC	35 mg/m^3	90 g/m^3	several min
		CK	45 mg/m^3	270 g/m^3	several min
	Choking	CG	6 mg/m^3	450 g/m^3	several min
White-Band Detector Tubes	*	This is used in conjunction with the air sampling pump only.			

- **Detection Sensitivity:** The C2 Kit will detect chemical agent vapors at low enough concentrations to permit the safe removal of protective masks for short (30 minutes) and long (12 hours) periods of time. The 3-Way Detector Paper will detect G, H and V agents with a minimum drop size of 0.075 mm. [3]

See ***Agents Detected*** for further information.

- **Response Time:** Varies from immediate for liquid agent detection to several minutes for vapor agent detection. [3]

  See ***Agents Detected*** for further information.

- **False Responses/Interferents:** 3-Way Detector Paper may change color with some insect repellents, insecticides, defoliants and plant growth regulators. Vapor detectors are very specific and not expected to give false responses if used appropriately. [3]

- **Safety Features/Safety Hazards:** Some of the chemical reagent bottles contain caustic materials. The remaining components are non-hazardous. [3]

- **Power Requirements:** None. [3]

- **Transport Requirements:** No special requirements. [3]

- **Personnel Requirements:** Individually operated easily. The only manpower requirements are for the simple tasks required to complete the necessary steps for chemical agent detection, such as operating the air sampling pump. [3]

- **Operational Information:** The C2 Kit comes with easy-to-understand instruction cards which guide the user through the steps required for chemical agent detection. [3]

- **Stock Number(s):** Although the NAVD and the 3-Way Detector Paper are kit components, they are also issued as separate items. [3]

C2 Detector Kit:	6665-21-870-6740 (NSN) [3,4]
NAVD:	6665-21-846-4563 (NSN) [3]
3-Way Detector Paper:	6665-21-858-8494 (NSN) [3]

- **Miscellaneous:** The C-2 Kit has an indefinite shelf life with the exception of the following consumable components: 1) nerve agent vapor detectors, 2) chemical agent detector tubes, and 3) chemical reagents. Presently, these consumables have a four-year shelf life. [12]

  Packed one kit per box, 10 boxes per case, 12 cases per pallet (120 kits per pallet). Each pallet weighs 175 kg and encompasses a volume of 0.76 m^3. [4]

  The manufacturer of the C2 Kit has developed new detectors which can be used with the air sampling pump. These detectors are more user-friendly because the chemical reagents are contained within crushable ampoules which are part of the detector. This eliminates the need for detector tubes and chemical reagent bottles. [3]

- **Contact(s):**

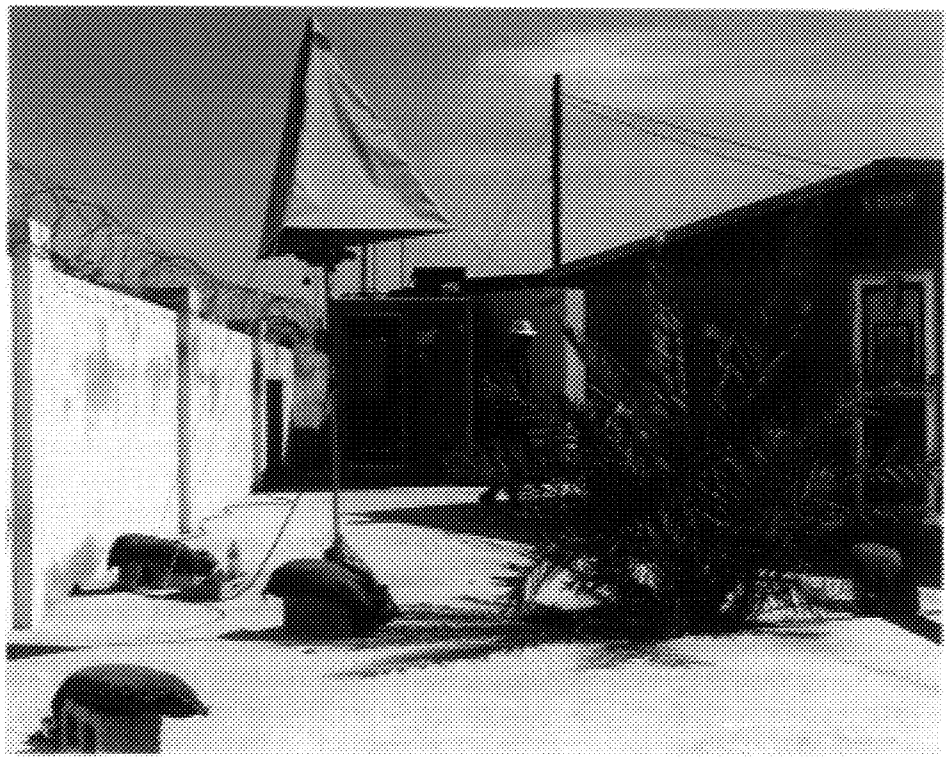
  Developer:
  Defence Research Establishment Suffield
  P.O. Box 4000
  Medicine Hat, Alberta T1A 8K6
  Canada
  Tel: (403) 544-4612 [3]

- **Contact(s) (continued):**

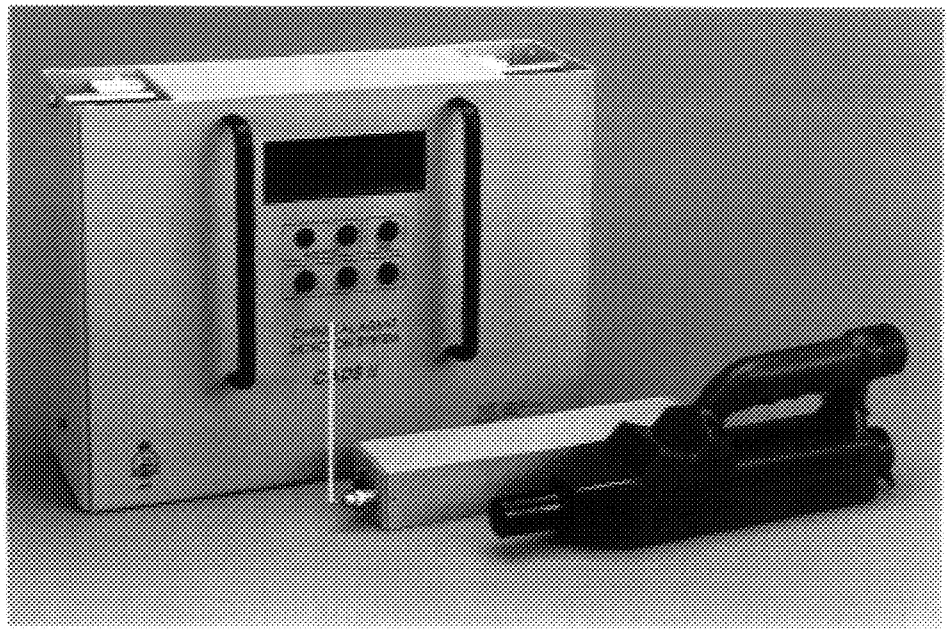
Manufacturer:
Anachemia Canada Inc.
500 Second Avenue
P.O. Box 147
Lacine (Montreal), Québec H8S 4A7
Canada
Tel: (514) 489-5711
Fax: (514) 363-5281
Telex: 055-66129 (3)

U.S. Office:
Anachemia Inc.
11 Butternut Street
Champlain, NY 12919
U.S.A.
Tel: (518) 298-4444 (4)

Land Sensor Station at Canada Dry 1 (Qatar) during the Persian Gulf War (1991).



Photos courtesy of the Defence Research Establishment Suffield



The Canadian Chemical Agent Detection System II (CADS II) Central Control Unit (background), Radio Frequency Transceiver (mid-ground) and Chemical Agent Monitor (CAM) (foreground).

Designator(s): CADS
CADS II

- **Item Name(s):** Chemical Agent Detection System II (CADS II)
Detector Network, Chemical Agent Detection System II (CADS II)

- **Item Description:** CADS II is an advanced, field portable chemical warfare agent detection system that uses a network of NATO issue Chemical Agent Monitors (CAMs) to remotely detect and identify chemical warfare agents. The CADS II provides advanced warning against chemical agent attack using an audible and visible alarm. This system can provide a protective warning perimeter around military installations as well as a monitoring system for chemical agents at storage and disposal sites. The CADS II consists of a Central Control Unit (CCU) and a remote Land Sensor Station (LSS) with sampling stations positioned up to four kilometers from the CCU. The CCU can monitor in real-time up to eight sensor stations each containing two CAMs, one operating in the nerve agent mode (G-mode) and the other operating in the mustard agent mode (H-mode). Chemical threat level data from the network of sensor stations is identical to that of the CAM and may be communicated over distances up to four kilometers using radio frequency or hard wire linkages. The CADS II uses the Ion Mobility Spectrometry (IMS) technology which is employed by the NATO issue CAM, the sensing unit. (For further information on the CAM see United Kingdom chapter.) There is an integrated power system for uninterrupted use. The CCU displays the status of each of the remote sampling stations, alarm conditions, chemical agent type and relative concentration. The CCU also has an on/off control for each of the up to eight remote sampling sensor stations. The high and low level audible alarms have programmable thresholds. The alarms do not have an automatic reset but can be reprogrammed. There is a cleardown mode of less than 1.5 minutes. [13,16]

  The design of the CADS is such that it can be expanded and has an additional serial communications port for future expansion. [13]

- **System Components:** Potential deployment configurations are described below.

  CCU: Contains a computer, a power supply, an audible/visible alarm and displays real-time status for up to eight sensor stations including the alarm condition, type of agent detected, threat level and faults. [16]

  LSS: Each of up to eight sensor stations contains two CAMs, a telescopying mounting pole, an interface module, a sun shade, and an optional radio frequency transceiver. Power is provided by solar panel/battery backup or from the CCU. [16]

  LSS would be deployed approximately one km from a military site with preference being given sites in the direction of the prevailing winds. One or more LSS and the CCU would be located within the Command and Control area of the military site to permit on-site monitoring and alarming. [16]

- **System Components (continued):**

LSS (continued): The LSS may be connected to the CADS II in any combination of the following three possible configurations: [16]

- The station(s) may be connected to the CCU with up to 1,000 m of four conductor cables with power being supplied to station(s) from the CCU. [16]
- The station(s) may be connected to the CCU with up to 3,000 m of light single twisted pair for serial data transmission. Power to the station(s) is provided by a solar panel with a rechargeable battery backup. [16]
- The station(s) may communicate serial data using radio frequency transmission over distances up to 4,000 m. Power to the station(s) is provided by a solar panel with a rechargeable battery backup. [16]

Marine Sensor Station: (MSS): [16] Contains two CAMs and an interface module in a sealed protective enclosure. Power is provided from the CCU. Two MSS would be located on either side of the bridge with the CCU being located within the bridge. Power to the station(s) is provided by the CCU. [16]

CAMs: Two NATO issue CAMs per sensor station. [16]

- **Support Equipment:** Normal CAM support equipment. [16]

- **Equipment Hardness:** The system was designed to meet NATO specifications. It has been designed to minimize chemical warfare agent pooling or adsorption through the use of rounded or flush surfaces and chemical resistant paint and materials. All equipment was designed to meet military ruggedness and environmental requirements. [16]

- **Dimensions and Weight:** (shipping). A complete land based system including one CCU, eight LSSs (with Solar Panel/Battery backup) and two CAMs per Sensor Station occupies approximately one cubic meter and weighs approximately 600 kg. [16]

PRMTRS	CCU	LSS	SOLAR PANEL	BATTERY	MSS	CAM
Length	52 cm	104 cm	118 cm	31 cm	53 cm	39 cm
Width	40 cm	23 cm	60 cm	27 cm	24 cm	15 cm
Height	23 cm	20 cm	6 cm	21 cm	23 cm	8 cm
Weight	30 kg	16 kg	27 kg	24 kg	26 kg	1.7 kg

- **Technology:** The CADS II system provides the user with a dual use for the CAM; that of a monitor and that of a remote point source detector. CADS II utilizes RF communication technology to facilitate real-time remote detection of chemical warfare agents using the IMS based CAM. (16)

- **Status:** In production. (13)

- **Uses:** CADS II was developed to fulfill a Canadian Forces perimeter monitoring requirement during the Persian Gulf War (1990-1991). It has been commercially available since 1991 and has been used on two occasions in support of United Nations sanctions against Iraq. Fifteen CADS II systems are on inventory for Canadian Forces use. (16)

- **Deployment:** Four prototypes were deployed in support of Canadian Forces operating in the Persian Gulf theater during 90/91; United Nations personnel used a production model during the destruction of Iraqi chemical weapons by United Nations Security Commission (UNSCOM) 29 during February and March of 1992. Canadian Forces installed a naval version on a warship operating in the Persian Gulf. (13)

- **Agents Detected:** Does not discriminate between the specific agents within each category. (13)

  The chemical vapors detected by the CAM are detected by CADS(II): (16)

Blister (H-mode):	HN and HS (16)
Nerve (G-mode):	GA, GB, GD and VX (16)

- **Detection Sensitivity:** The CAM deployed in the CADS II network detects chemical warfare agent vapors below the level for which masking is required. (16)

- **Response Time:** The CADS II system is a real-time detection system that updates the CCU display and alarm status every four to eight seconds in a bar format identical to that used for the CAM. (16)

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** The CADS II CCU has a default alarm setting and can be used to perform several user functions. However if the operator becomes distracted, the CCU will automatically revert in 10 seconds to real-time monitoring of the network of LSS. No hazards are associated with its use. (16)

- **Power Requirements:** The CCU contains a rugged power supply capable of operating with 90 V AC to 130 V AC and 200 V AC to 260 V AC (50/60 Hz) with automatic voltage range switching. In addition the operator has the option to use 24 V DC. Continuous operation of the complete CADS II system during a power failure is possible for half an hour to three hours (depending on CADS II configuration) using rechargeable batteries housed within the CCU. (16)

  LSS require 5 V DC for the CAMs. This is provided by the CCU supply or by the solar panel/rechargeable battery backup. (16)

- **Transport Requirements:** Portable, no special tools required for set-up allowing for easy assembly and disassembly in mobile military operations. No special requirements. [13,16]

- **Personnel Requirements:** Training on set-up and operation of the CADS II system takes two hours. A complete land based CADS II network would take two persons one day for deployment. Once deployed, CADS II operates in an autonomous manner and effort is limited to periodic confidence testing of the deployed CAMs. [16]

- **Operational Information:** Operations of the CADS II system is simple (basically ON/OFF operation), requiring a skill level similar to operation of a CAM. A complete manual for operation is provided to the operator. [16]

  Operational Temperature: -30°C to +70°C (CCU) [13]
  Relative Humidity: Up to 100% [13]

- **Stock Number(s):** Currently stocked for the Canadian Forces at the Defence Research Establishment Suffield. [16]

- **Miscellaneous:** An early version of CADS was used in a safety monitoring role during destruction of the chemical warfare agent waste in Canada. [16]

  CADS provided Canadian Forces operating during the Persian Gulf War (1990-1991) with an early warning capability in the event of a chemical attack. Canadian Forces were able to operate in an unprotected or relaxed state, secure in the knowledge that these systems would provide ample warning for the taking of protective action necessary to minimize chemical exposure. [16]

  A maritime version of CADS II was installed in 1992 on the HMCS Restigouche patrolling in the Middle East in support of United Nations sanctions against Iraq. [16]

  CADS II was utilized for perimeter and safety monitoring by the United Nations during the United Nations Special Commission, (UNSCOM 29), destruction of Iraqi chemical rockets in 1992. [16]

  Storage Temperature: -40°C to +160°C (CCU). [13]

- **Contact(s):**

  Developer: Defence Research Establishment Suffield
  P.O. Box 4000
  Medicine Hat, Alberta T1A 8K6
  Canada
  Tel: (403) 544-4670
  Fax: (403) 544-3388 [16]

- **Contact(s) (continued):**

Manufacturer:

Scientific Instrumentation Limited (SIL)
2233 Hanselman Avenue
Saskatoon, Saskatchewan S7L 6A7
Canada
Tel: (306) 244-0881
Fax: (306) 665-6263 [16]

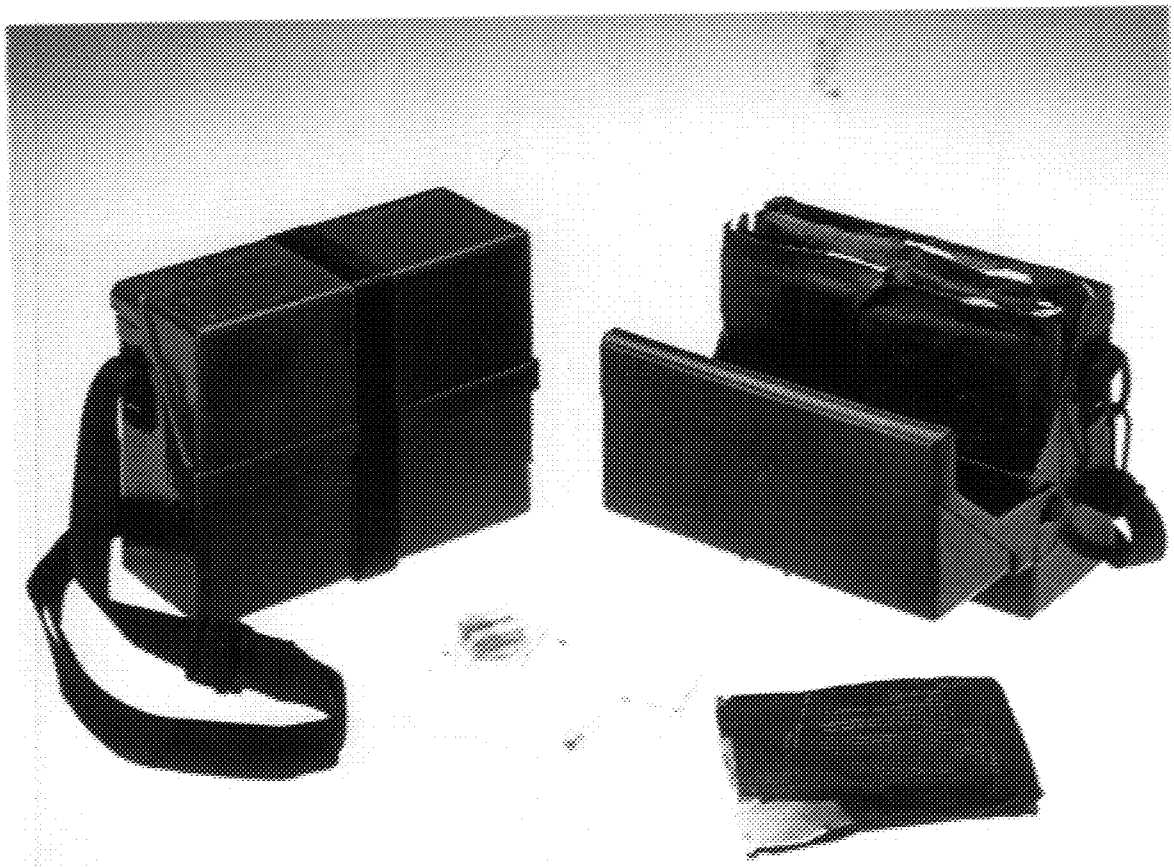


Photo courtesy of Defence Research Establishment Suffield

The M256 Kit.

Anachemia manufactures the M256 Kit for Canada using specifications which are identical to the U.S. M256 Kit.
See U.S. Chapter for further details on this item.

The M272 Water Testing Kit.

Anachemia manufactures the M272 Kit for Canada using specifications which are identical to the U.S. M272 Kit.
See U.S. Chapter for further details on this item.

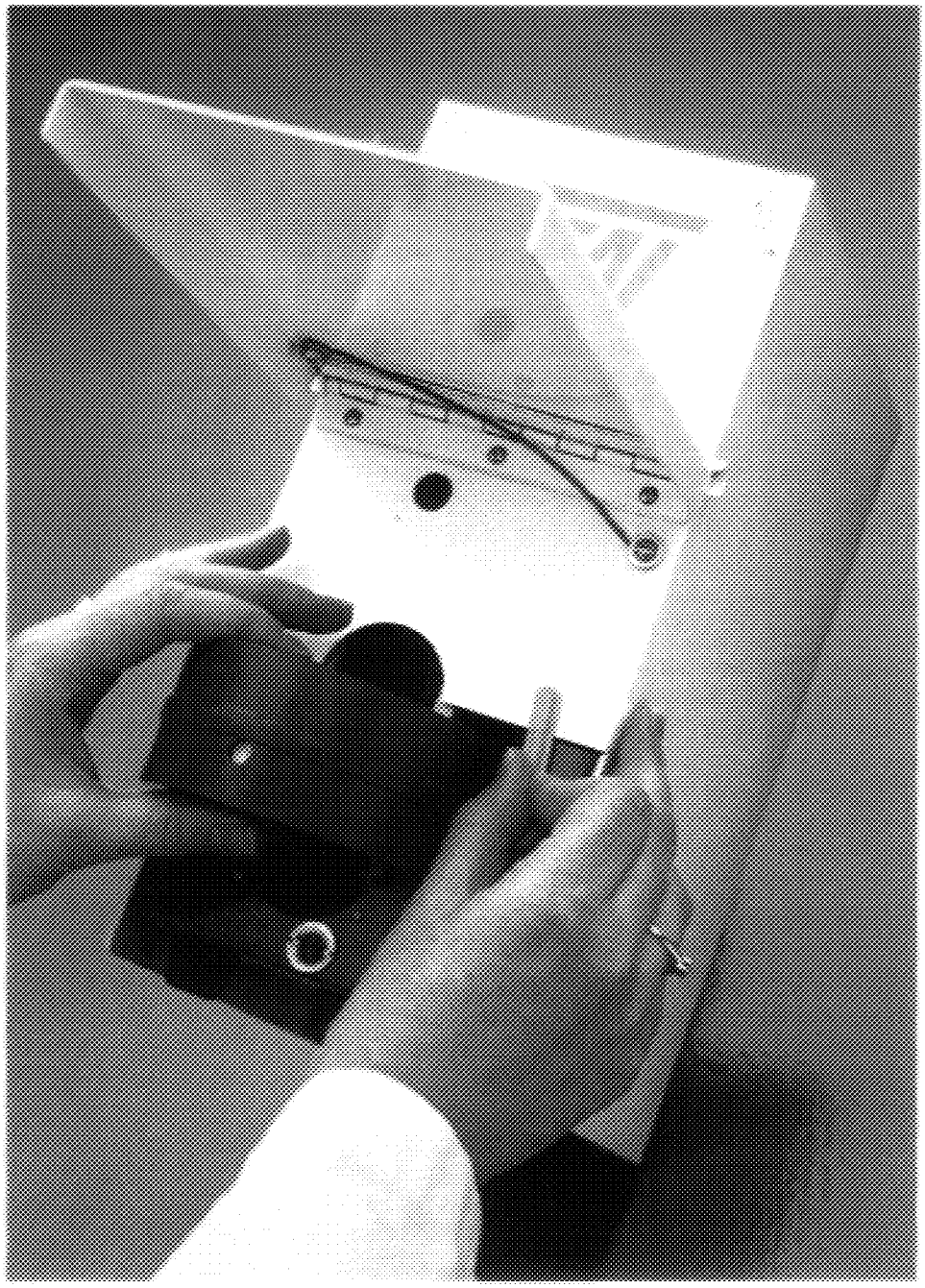


Photo courtesy of Canadian Center for Advanced Instrumentation

The MINITUBE™ Air Sampling System

Designator(s): MASS

- **Item Name(s):** MINITUBE™ Air Sampling System (MASS)

- **Item Description:** The MINITUBE™ Air Sampling System (MASS) efficiently traps and collects airborne contaminants in the form of gases, vapors and aerosols on miniature solid-sorbent tubes. The system consists of a number of field based microprocessor controlled samplers and a specially modified gas chromatograph. Large or small sampling arrays or individual sampling stations can be used. The MINITUBE™ Air Sampler is designed to regulate airflow at a pre-programmed rate and time through a minitube. The MINITUBE™ contains a polymer adsorber. A set of 50 minitubes are housed in a removable carousel allowing the operator to take up to 50 sequential samples. The operator specifies the pre-programmed sampling time and airflow rates thus resulting in efficient use of sampling time. Upon sampling completion, the minitubes which contain the samples are taken to a laboratory for analysis by thermal desorption of the adsorbed contaminants in a gas chromatograph. [7,9,10,11,18]

  The air sampler has the capacity to store up to twenty libraries. Each library can contain sampling parameters for up to 50 sampling sequences corresponding to 50 minitubes. A sampling sequence for one MINITUBE™ contains three parameters: wait time, sample time, and flow rate. [9]

- **System Components:** [7]

  Air Sampler (two types - smart and slave)
  Automated Thermal Desorption Unit (ATDU)
  Controller (for use with multiple slave Air Samplers)
  Initiator (RF remote or hard-wired)
  MINITUBE™ Carousel

- **Support Equipment:** [7]

  Analytical Instrumentation
  MINITUBE™ Fabricator/Packer
  PC-based Electromagnetically Programmed Read Only Memory (EPROM) Programmer
  RF Transmitter (for remote activation of samplers)

- **Equipment Hardness:** Requires additional hardening for military applications. Air sampler normally used in outdoor field trial settings. Has previously been used in military application for sampling airborne agents during weapons destruction operation (UNSCOM 29). [7]

- **Dimensions and Weight:** [7]

PARAMETERS	AIR SAMPLER	ATDU	MINITUBE™ CAROUSEL
Length	23 cm	32 cm	*
Width	13 cm	15 cm	*
Height	33 cm	19 cm	4.5 cm
Diameter	*	*	9 cm
Weight	3.9 kg	7.6 kg	0.16 kg

- **Technology:** Miniaturized solid-sorbent air sampling tubes (50) contained in a carousel housing which mates with an automated air sampler. The tube carousel also serves as the storage and transport container for the sample tubes. The tubes may be directly analyzed by thermal desorption gas chromatography without physical removal from the housing. Following analysis, the housing may be reinserted into an air sampler and re-used to collect further air samples. [7]

- **Status:** Available commercially and marketed internationally. Under evaluation by international defence Research and Development (R&D) communities for military and scientific uses. [7]

  Under evaluation by the Canadian Armed Forces. For use outdoors or in enclosures such as buildings and collective protection shelters. [18]

- **Uses:** Collection and quantitative analysis of trace airborne vapors of chemical agents, commercial chemicals, volatile organic chemicals, etc. Suggested military uses include: verifying chemical agent stockpile destruction, supporting investigations into allegations of chemical agent usage, determining protection factors/integrity of collective protection shelters, determining effectiveness of surface decontamination of military equipment, monitoring workplace air quality in depots, determine downwind hazard from disseminated chemical agents, and environmental monitoring in support of range clean-up operations. [7]

- **Deployment:** *

- **Agents Detected:** All known chemical agents. Collective efficiency depends on adsorbent packing used in MINITUBEs™. [7]

- **Detection Sensitivity:** Depends on analytical instrumentation used for the analysis of minitubes. Typical gas chromatographic sensitivity is in the nanogram (10^{-9} g) to picogram (10^{-12} g) range (detectable mass of collected agent). [7]

- **Response Time:** Not applicable. Retrospective sampling and analysis procedure. Depends on length of sample collection time, transport of sample to analytical instrumentation and analysis time. Once sample is received, typical analysis time is five minutes to 30 minutes. [7]

- **False Responses/Interferents:** Depends on complexity of air sample collected and selectivity of analytical equipment and analytical procedure. [7]

- **Safety Features/Safety Hazards:** Non-hazardous equipment. Electrical hazard if system components are powered from AC mains rather than from a battery. [7]

- **Power Requirements:** Air samplers may be powered from small battery pack or use AC power (115 V AC/230 V AC) depending on application. ATDU requires AC power. [7]

- **Transport Requirements:** Non-hazardous equipment transportable by all means. Equipment placed in sturdy aluminum box for transport. Sealed MINITUBE™ carousels with adsorbed agent are safe for transport as quantity of agent trapped for analysis is very small (a few micrograms (10^{-6} g) at maximum). [7]

- **Personnel Requirements:** One controller can control up to 10 field samplers. Program modules are easily changed in the field within minutes. [10]

  One operator may set up and run the system. Once running, the system is highly automated and does not require operator intervention until sampling cycle is complete. [7]

- **Operational Information:** Various sampling routines pre-programmed on EPROM cards to meet requirements. Samplers equipped with EPROM cards are initiated remotely or through hard-wire connection and automatically follow selected sampling routines. System can run unattended until sampling routine is completed. [7]

- **Stock Number(s):** Manufacturer stock numbers available. [7]

- **Miscellaneous:** Manufacturer can supply minitubes packed with a variety of adsorbents to meet specific air sample collection requirements. [7]

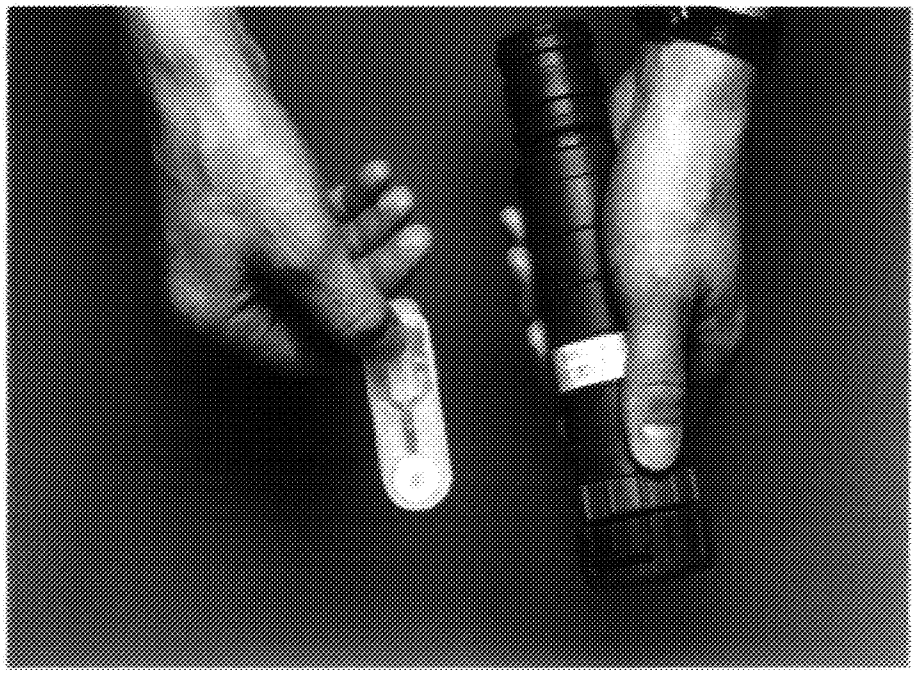
- **Contact(s):**

Developer:
Defence Research Establishment Suffield
P.O. Box 4000
Medicine Hat, Alberta T1A 8K6
Canada
Tel: (403) 544-4635
Fax: (403) 544-3388 [7]

Manufacturer:
Canadian Centre for Advanced Instrumentation
15 Innovation Boulevard
Saskatoon, Saskatchewan S7N 2X8
Canada
Tel: (306) 933-7066
Fax: (306) 933-7446
Telex: 074-2484 [7]

The new user-friendly Nerve Agent Vapor Detector (NAVD) with chemical reagents contained in crushable ampoules.

Photo courtesy of the Defence Research Establishment Suffield



The NAVD
(Blue or green color indicates that there is no nerve agent present.)

- **Designator(s):** NAVD

- **Item Name(s):** Nerve Agent Vapor Detector (NAVD)
  Chemical Agent (Nerve Vapor) Detector

- **Item Description:** The NAVD is used to determine the presence of nerve agent vapors. [15]

- **System Components:** The detector consists of a plastic detector body containing an enzyme impregnated test paper and a plastic holder containing a chemically impregnated test paper and an instruction sheet. [15]

- **Support Equipment:** None. [14]

- **Equipment Hardness:** NAVD is contained within a waterproof package and is rugged enough for intended military applications. [18]

- **Dimensions and Weight:**

  Length: 5.5 cm [1]
  Width: 25 cm [1]
  Height: 0.2 cm [1]
  Weight: 0.025 kg [14]

- **Technology:** Enzyme detector. [15]

- **Status:** Fielded. [14]

- **Uses:** Detection of nerve gas vapor. [14]

- **Deployment:** In service with the Armed Forces of all NATO member countries. [14]

- **Agents Detected:**

AGENT CLASS [1]	AGENT(S) [1]	DETECTION SENSITIVITY [14]	RESPONSE TIME [14]
Nerve	GA and GD	0.002 mg/m^3	2 minutes
	GB	0.004 mg/m^3	2 minutes
	VX	0.007 mg/m^3	2 minutes

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** Strong acid vapors may give a positive response; strong alkaline vapors may give a negative response. [14]

- **Safety Features/Safety Hazards:** Requires use of impervious gloves and safety goggles. [14]

- **Power Requirements:** None. [14]

- **Transport Requirements:** No special requirements. [14]

- **Personnel Requirements:** One operator. [14]

- **Operational Information:** To conduct the test, the test paper in the detector body is moistened and exposed to the atmosphere. Then the detector body is pressed into the holder so the papers touch. In the absence of nerve agents, the test paper will change color from blue to green. If nerve agent is present the test paper will remain white. If the test is done incorrectly, the color of the test paper will remain unchanged. [1,19]

- **Stock Number(s):** 6665-21-846-4563 (NSN). [1]

- **Miscellaneous:** Packaged in an airtight, moisture-proof foil wrap for protection against environmental conditions. A silica-gel air dryer agent pack is included. The individual units are packaged in groups of 40 in an airtight, moisture-proof container with dimensions of 9.5 x 9.5 x 5.1 cm. [15]

  Packed 40 envelopes per box, 30 boxes per case, 6 cases per pallet. One pallet contains 7200 detectors weighing a total of 180 kg and having a total volume of 1.02 m^3. [1]

- **Contact(s):**

Manufacturer:
Anachemia Canada Inc.
500 Second Avenue
P.O. Box 147
Lacine (Montreal), Québec H8S 4A7
Canada
Tel: (514) 489-5711
Fax: (514) 363-5281
Telex: 055-66129 [1]

U.S. Office:
Anachemia Inc.
11 Butternut Street
Champlain, NY 12919
U.S.A.
Tel: (518) 298-4444 [1]

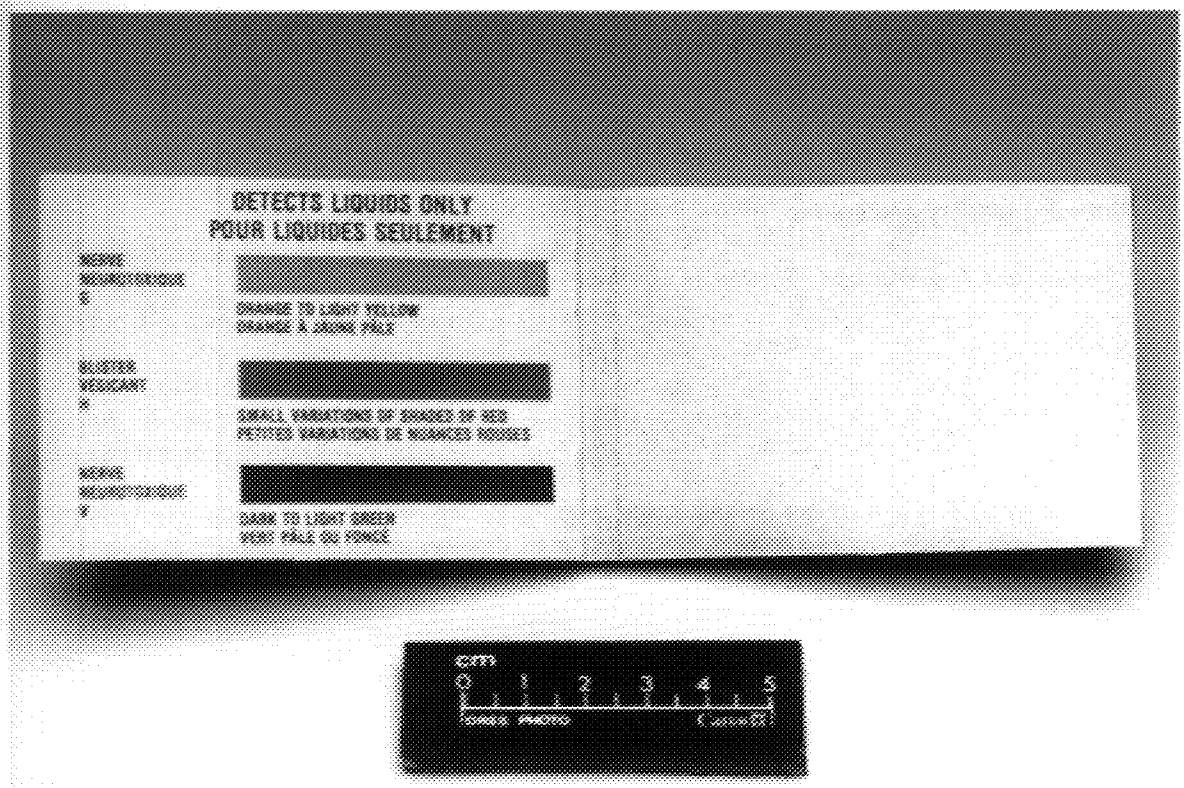


Photo courtesy of Defence Research Establishment Suffield

3-Way Detector Paper

- **Designator(s):** 3-Way

- **Item Name(s):** Paper, Chemical Agent Liquid Detectors, 3-Way

- **Item Description:** The 3-way Chemical Agent Liquid Detector paper provides a simple, rapid method of detecting G, H or V liquid agents. The 3-way detector consists of booklets of dye impregnated paper sheets sensitive to liquid agents with adhesive backing covered with a silicone-treated kraft release paper. The adhesive backing is used for attaching the paper to surfaces, including clothing, vehicles and other materials. The paper will change to one of three colors to signify the presence of G, H or V agents. The color changes for G, H and V are yellowish to yellow-red, purplish-red, and green to greenish-yellow; respectively. [5,8]

- **System Components:** Booklet with dye impregnated sheets, Munsell Book of Color, and a reference contamination density sheet illustrating the pattern produced on the detector paper by 150 micron to 200 micron V-agent droplets at a standard contamination density. [5,8]

- **Support Equipment:** None required. [18]

- **Equipment Hardness:** Booklets come in waterproof packaging and are rugged enough for intended military applications. [18]

- **Dimensions and Weight:** (Booklet of 12 sheets). [18]

Length:	10 cm
Width:	6.5 cm
Height:	0.5 cm
Weight:	25 g

- **Technology:** Crystals of dye are suspended in the detection paper matrix. On contact with a liquid agent, which acts as a solvent, the dye crystals dissolve and a color change is observed. [15]

- **Status:** Fielded. [5]

- **Uses:** Liquid agent detection. [2]

- **Deployment:** In service with the Armed Forces of all NATO countries. [2]

- **Agents Detected:**

AGENT CLASS [6]	AGENT(S) [6]	DETECTION SENSITIVITY [2]	RESPONSE TIME [2]
Blister	H (liquid)	0.02 ml droplet mg/m^3	immediate
Nerve	G and V (liquid)	0.02 ml droplet mg/m^3	immediate

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** See ***Agents Detected*** for information.
- **False Responses/Interferents:** Color change may occur with some solvents and solvent/base mixtures. [18]
- **Safety Features/Safety Hazards:** Requires use of impervious gloves and safety goggles. [2]
- **Power Requirements:** None. [8]
- **Transport Requirements:** No special requirements. [2]
- **Personnel Requirements:** One operator. [2]
- **Operational Information:** The test consists of detaching a piece of the paper from the booklet and then exposing the paper to a surface suspected of liquid chemical agent contamination, wiping the suspected surface with the paper or attaching the paper to a surface which may be exposed in the future. [5,8]
- **Stock Number(s):** 6665-21-858-8494 (NSN). [5]
- **Miscellaneous:** Conforms to specification CF-P-214A. [8]

  Each booklet of 12 sheets is packed in a poly bag. There are 50 booklets per box, 20 boxes per case, 10 cases per pallet (10,000 books per pallet). Each pallet weighs 270 kg and encompasses a volume of 0.55 m^3. [5]

  3-Way detector paper booklets also come without adhesive backing (M-8) or in dispenser rolls with adhesive backing (M-9). [18]

- **Contact(s):**

Manufacturer: (3-Way)	Anachemia Canada Inc. 500 Second Avenue P.O. Box 147 Lacine (Montreal), Québec H8S 4A7 Canada Tel: (514) 489-5711 Fax: (514) 363-5281 Telex: 055-66129 [5]
U.S. Office:	Anachemia Inc. 11 Butternut Street Champlain, NY 12919 U.S.A. Tel: (518) 298-4444 [5]

- **Contact(s) (continued):**

Manufacturers: (Adhesives)	Morgan Adhesives of Canada Limited 100 Kennedy Road S. Brampton, Ontario, Canada [8]
(Munsell Book of Color)	Munsell Color Company 2441 N. Calvert Street Baltimore, MD [8]

3.2 REFERENCES

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Chapter 4 - COMMONWEALTH OF INDEPENDENT STATES

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4.1 CHEMICAL AGENT DETECTORS

Photo courtesy of Defence Ministry of the Russian Federation

The GO-27 Nuclear and Chemical Contamination Detector

- **Designator(s):** GO-27 (Cyrillic Designation ГО-27)

- **Item Name(s):** GO-27 Nuclear and Chemical Contamination Detector

- **Item Description:** The GO-27 Nuclear and Chemical Contamination Detector is deployed in Former Soviet Union (FSU) armored vehicles to detect both nuclear and chemical contamination outside the vehicle. The GO-27 signals an alarm inside the vehicle upon detection of contaminants. It is a component of the PRKhR Chemical Reconnaissance System (Cyrillic Designation ПРХР). (1,2)

- **System Components:** (1)

  Accessory Kit
  Control Module
  Detector
  Heating System Control Cyclotron (for spinning electrons)
  Interconnecting Cable
  Power Supply
  Spare Parts

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** (1)

Length:	80 cm
Width:	60 cm
Height:	50 cm
Weight:	12 kg

- **Technology:** Ion mobility spectrometry.

- **Status:** Fielded in FSU military vehicles. (1)

- **Uses:** Used in tanks and armored fighting vehicles for continuous monitoring, detection and alarm in the presence of a threshold concentration of nerve agents. (1)

- **Deployment:** Marketed in Bulgaria by Kokintex Share Holding Company. (1)

- **Agents Detected:** (2)

Nerve:	GB, GD and VX.

- **Detection Sensitivity:** 3×10^{-5} mg/l (2)

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *
- **Power Requirements:** Draws vehicle electric power, 27 V. [1]
- **Transport Requirements:** Vehicle mounted. [1]
- **Personnel Requirements:** One operator. [1]
- **Operational Information:**

  Operational Temperature: -40°C to +50°C.[1]

- **Stock Number(s):** *
- **Miscellaneous:** *
- **Contact(s):**

Manufacturer:

nlm
Uniilransmash (Russian Mobile Vehicle Engineering Institute)
Zarechnaja Str.
St. Petersburg 198323
Russia
Tel: 07 812 1359850
07 812 1359837

Marketer:

Kokintex Share Holding Company
66 James Boucher
1407 Sofia
Bulgaria
Tel: 0359 2 662311
Fax: 0359 2 658191
0359 2 658101

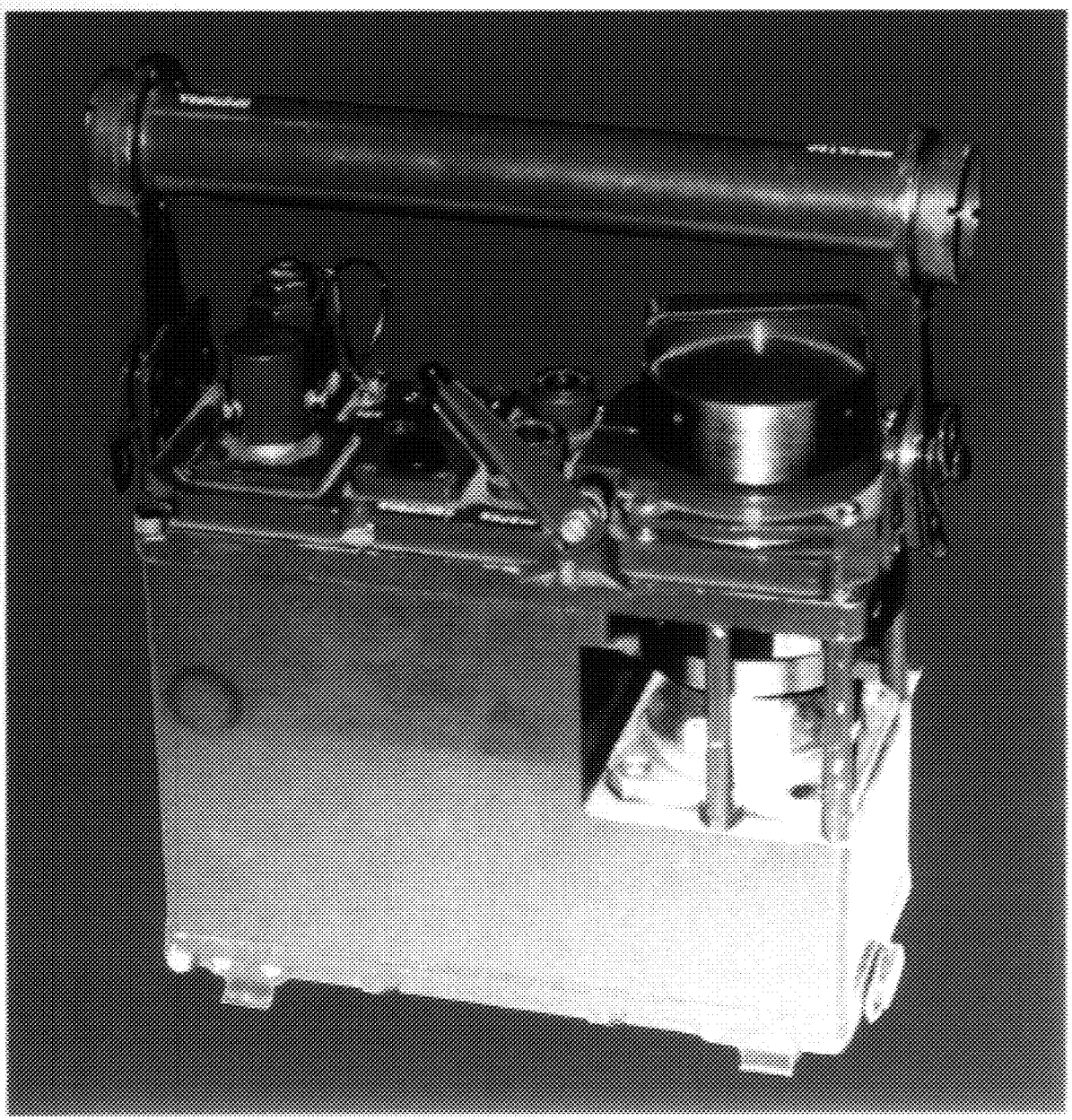


Photo courtesy of Russia

The GSA-1 Chemical Detector Model (Cyrillic Designation ГСА-1)

- **Designator(s):** GSA-1 (Cyrillic Designation ГСА-1)
- **Item Name(s):** GSA-1 Chemical Detector Model
- **Item Description:** The GSA-1 detector/alarm is a portable, hand-held unit which operates on the principle of ion mobility and uses a radioactive source. The unit has red and yellow indicator lights which provide a visual signal in the presence of G and V nerve agents. [3]
- **System Components:** *
- **Support Equipment:** *
- **Equipment Hardness:** *
- **Dimensions and Weight:** *
- **Technology:** Ion Mobility. [3]
- **Status:** *
- **Uses:** *
- **Deployment:** *
- **Agents Detected:**

  Nerve: GA, GB and VX. [21]
- **Detection Sensitivity:** *
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** Radioactive source. [3]
- **Power Requirements:** Battery operated. [3]
- **Transport Requirements:** *
- **Personnel Requirements:** *
- **Operational Information:** *
- **Stock Number(s):** *

- **Miscellaneous:** *
- **Contact(s):** *

- **Designator(s):** GSA-12 (Cyrillic Designation ГСА-12)
- **Item Name(s):** GSA-12 Automatic Chemical Signaling Device
- **Item Description:** The GSA-12 Automatic Chemical Signaling Device is used to detect organophosphorus chemical vapors. It does not identify the specific agent or agent concentration encountered. It operates on the principle of optical mechanical photoelectric colorimetry. It includes both audible and visible alarms. [4,5,20]
- **System Components:** [4]

  Accessories
  Cables
  Power Pack
  Remote Signal Panel Alarm
  Sensor
  Spare Parts

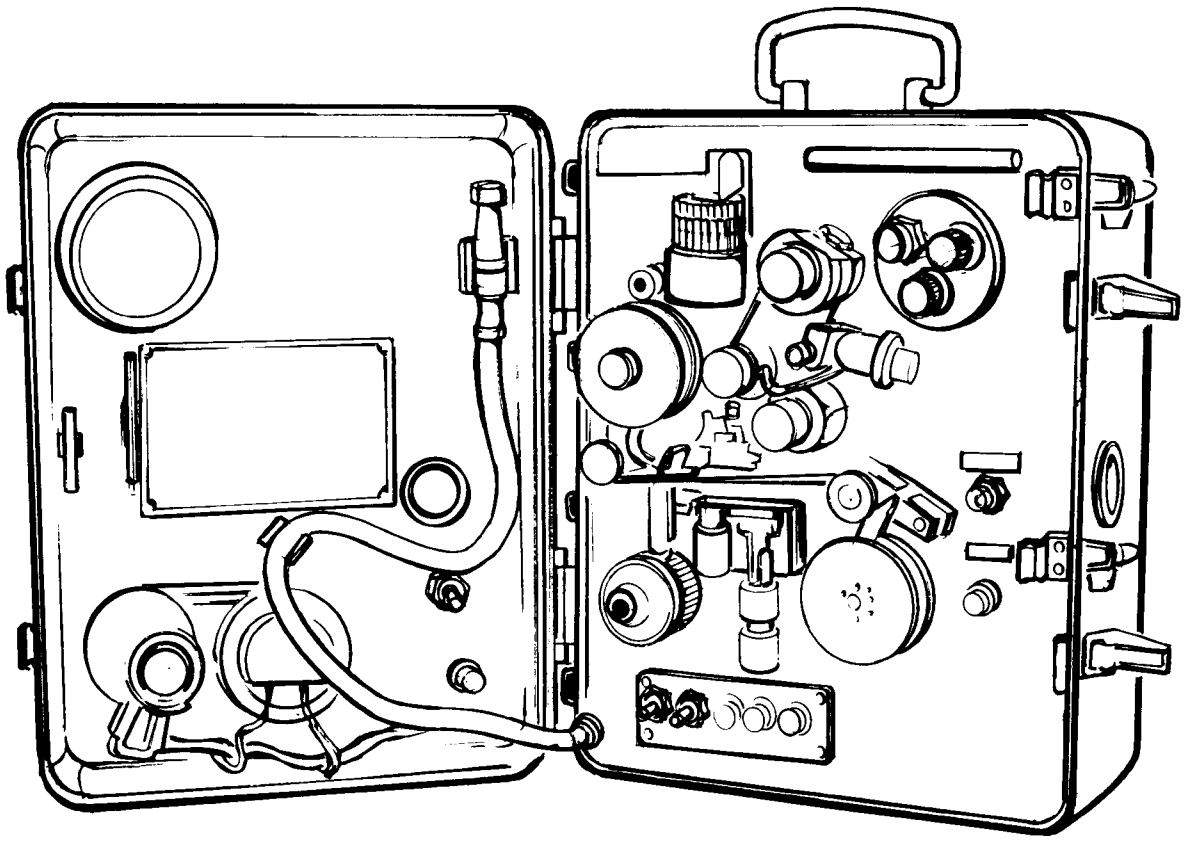
- **Support Equipment:** *
- **Equipment Hardness:** *
- **Dimensions and Weight:** *
- **Technology:** Operates on the principle of optical mechanical photoelectric colorimetry. [4,5]
- **Status:** Used in the BRDM-2rkhb Chemical Reconnaissance Vehicle to detect chemical warfare agents. [20]
- **Uses:** Used to monitor air for the presence of chemical agents. [20]
- **Deployment:** *
- **Agents Detected:** Nerve.
- **Detection Sensitivity:** *
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** *
- **Transport Requirements:** *
- **Personnel Requirements:** *

- **Operational Information:** When the gas signal unit is switched on, the indicator tape begins to rewind. Once the next operating section of the tape (25 mm in length) reaches the special analyzing chamber, the analyzed air is pumped through it. If organophosphorus vapors are present, they are absorbed by the belt within two minutes. Then solution No. 1 is applied to this section and solution No. 2 is applied following a specified time. Thirty seconds after applying solution No. 2, the photometric measurement is taken. The optical density of the operating section of the tape is compared with a threshold value. In the presence of organophosphorus vapor, the optical density of the working section of the tape cannot drop to threshold value, resulting in audible and visible signals. If organophosphorus vapor is not present in the air at the time of testing, the reduction in optical density of the working section of the tape take place quickly. After 30 seconds, the optical density value becomes less than the threshold value and no audible or visible signal is given. [4]

- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):** *



Sketch courtesy of Battelle

The GSP-1M

- **Designator(s):** GSP-1 (Cyrillic Designation ГСП-1)
  GSP-1M (Cyrillic Designation ГСП-1М)

- **Item Name(s):** GSP-1 Nuclear and Chemical Detector Alarm
  GSP-1M Nuclear and Chemical Detector Alarm

- **Item Description:** The GSP-1 and GSP-1M are used to monitor the presence of atmospheric G-type nerve agents. The GSP-1M is the modified version of its predecessor, the GSP-1. Specifically, these units detect a color change on a tape that has been treated with reagent (Schoenemann reaction) using a photodetector cell. In addition, these detectors use a halide counter to detect nuclear radiation in the environment in excess of 0.1 rad/hour. However, these detectors do not indicate the intensity of radiation. For both nuclear and chemical detection, audible and visible alarms are activated. These systems do not determine the concentration of the contaminant. [9,10,12]

- **System Components:**

  GSP-1 and GSP-1M:
  Air Sampling System
  Photodetector
  Power Supply
  Tape and Dropper System (consists of indicator tape and a dropper with reagent reservoir)

  GSP-1 Refill Kit: [13]
  Ampoule Opener
  Ampoules with dry reagent #2 (3)
  Ampoules with reagent #204 (3)
  Cardboard Box
  Cartridges in test tubes (3)
  Chlorinating Flasks with reagent #203 (3)
  Color Chart for Comparison (2)
  Instructions
  Intake Filters (12)
  Jar for Preparation of Detector Solution
  Packet of Cotton
  PVC Packets (3)
  Rolls of Detecting Tape (3)
  Test Tube with dry reagent #1

- **Support Equipment:** The GSP-1 and GSP-1M use a refill kit containing reagents for a Schoenemann type reaction. [6]

- **Equipment Hardness:** *

- **Dimensions and Weight:**

PARAMETERS	GSP-1 and GSP-1M [11]	BATTERY [11]	GSP-1 and GSP-1M REFILL KIT [13]
Length	45 cm	31 cm	25.2 cm
Width	30 cm	26 cm	7.9 cm
Height	15 cm	12 cm	8.9 cm
Weight	10 kg	8 kg	0.8 kg

- **Technology:** The GSP-1 and GSP-1M use a photo detection principle to detect G-type agents. However, the color change results from a Schoenemann reaction rather than an acetylcholinesterase inhibition. [7,9]

- **Status:** The GSP-1 and GSP-1M are used by FSU forces to detect G-type nerve agents. [7]

- **Uses:** The GSP series may be used for fixed point continuous monitoring of air or mounted in reconnaissance vehicles. If nerve agents are detected, the VPKhR Kit is used as a follow-up to identify the specific agent and its concentration. [12,13]

- **Deployment:** The GSP-1 and GSP-1M are in use in most Former Warsaw Pact countries. [8]

  A Hungarian item designated AVJ-1 also appears to be similar to the CIS GSP series.

- **Agents Detected:** The GSP-1 and GSP-1M detect G-type nerve agents as well as nuclear radiation. [7,11]

- **Detection Sensitivity:** 0.1 rad/hr for nuclear radiation. [12]

- **Response Time:** *

- **False Responses/Interferents:** Temperatures beyond the range of -30°C to +40°C will cause the alarm to cease functioning and give a false alarm. [11]

- **Safety Features/Safety Hazards:** The GSP-1 and GSP-1M Refill Kit should not be stored near heating devices. [6,11]

- **Power Requirements:** The GSP-1 and GSP-1M may be operated using vehicle power or two rechargeable battery packs which require recharging every eight hours. [7,8,10]

- **Transport Requirements:** *

- **Personnel Requirements:** *

- **Operational Information:** Air is drawn through the detection tape that has been soaked in Operating Solution No. 1. After exposure to the air sample being tested, the tape is wetted with Operating Solution No. 2. A chemical reaction creates a color change which is checked by a photoelectric detector. If the concentration of nerve agent present in the sample exceeds a threshold level, an audible and visible alarm will sound. [6]

  Solutions used in the GSP-1 and GSP-1M Refill Kit must be mixed following a series of wet chemistry procedures explained in each kit. The solutions must be prepared and the reagent dropper for the gas alarm filled and calibrated. [6]

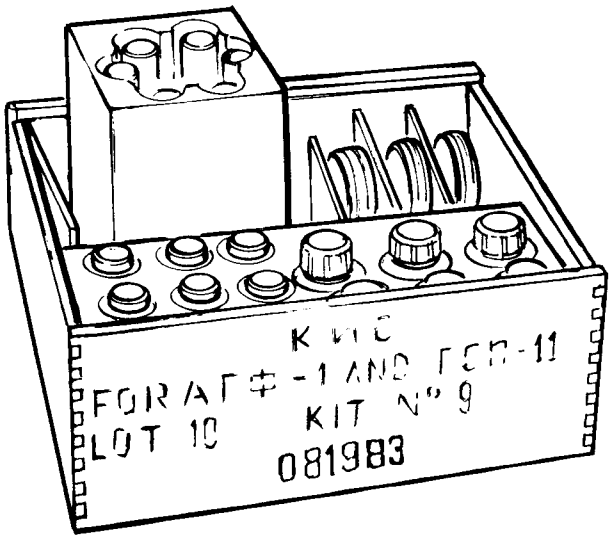
  Duration of Operation: The tape must be changed and the reagent reservoirs refilled after eight hours of operation. [11]
  Operational Temperature: -30°C to +40°C (GSP-1 and GSP-1M). [10]

- **Stock Number(s):** *

- **Miscellaneous:**

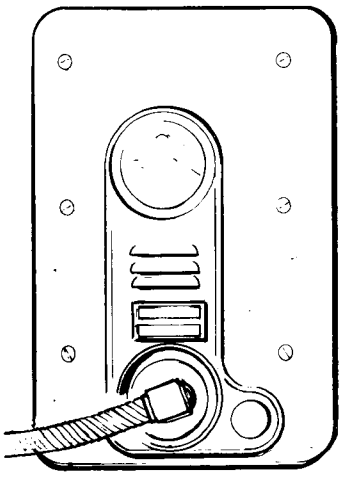
  Storage Conditions: Store in dry, closed, unheated premises free from vapors, acids, bases or gases, and in temperatures not exceeding 20°C. [6,13]

- **Contact(s):** *

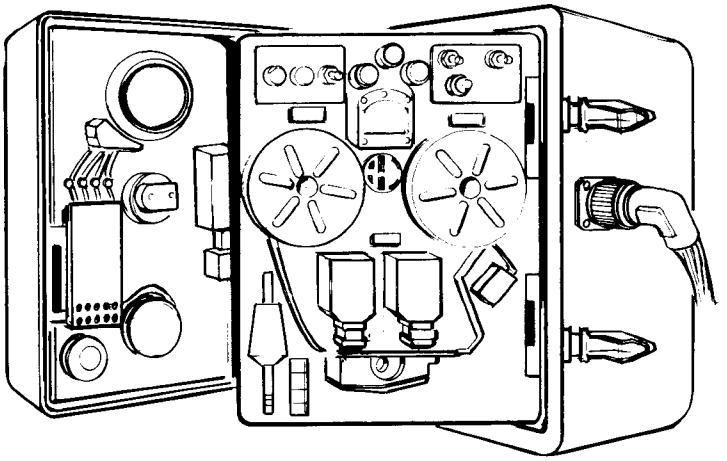


The KIS Refill Kit for use with the GSP-11.

The outside of the GSP-11



The inside of the GSP-11



Sketches courtesy of Battelle

- **Designator(s):** GSP-11 (Cyrillic Designation ГСП-11)

- **Item Name(s):** GSP-11 Automatic Nerve Agent Detector

- **Item Description:** The GSP-11 is the most recent item in the CIS GSP detector series. Like its predecessors, the GSP-11 uses a photodetector to detect a color change on a tape that has been treated with a reagent. The presence of nerve agent is signaled by both an audible and visible alarm. The GSP-11 uses biochemical reaction (acetylcholinesterase inhibition) chemistry. As a result, the GSP-11 has the ability to detect both G- and V-type nerve agents, a significant increase in chemical detection capability over its predecessors. Because the acetylcholinesterase inhibition reaction is temperature sensitive, the GSP-11 has a thermostatically controlled electric heater which maintains a constant temperature between +33°C and +38°C. The GSP-11 does not detect radiation. [6,7,9]

  The KIS Refill Kit (Cyrillic Designation КИС) contains reagents for use with the GSP-11 and AGF-1 (Cyrillic Designation АГП-1)

- **System Components:**

  GSP-11: [7]
  - Accessories
  - Alarm
  - Battery Packs (2)
  - Control Unit
  - Reagent Sets (2)
  - Spares
  - Tools

  KIS Refill Kit: [6]
  - Activated Silica Gel Cartridges (3)
  - Ampoules with Solution No. 1 (3)
  - Ampoules with Solution No. 2 (3)
  - Case
  - Flasks with washing liquid (3)
  - Flasks with Reagent No. 1 (3)
  - Flasks with Reagent No. 2 (3)
  - Instructions
  - Hermetically Sealed Jars Holding Tape (3)
  - Polystyrene Holder/Rack
  - Protective Cartridge with marking
  - Protective Cartridges without marking (3)

- **Support Equipment:** The KIS Refill Kit is used with both the GSP-11 and AGF-1 detectors. [6]

- **Equipment Hardness:** *

- **Dimensions and Weight:**

PARAMETERS	GSP-11 [11]	BATTERY [11]	KIS REFILL KIT [6]
Length	45 cm	31 cm	25 cm
Width	30 cm	26 cm	20 cm
Height	15 cm	12 cm	11 cm
Weight	10 kg	8 kg	2.2 kg

- **Technology:** The GSP-11 has an electric pump that draws air over tape that has been soaked in Reagent Solution No. 1. Upon exposure to air, the tape is treated with a drop of Reagent Solution No. 2. If agent is present, a color change (indicated by comparison with a reference beam within the system) is detected by a photodetector, resulting in audible and visible alarms. [6,7]

  The color change results from an acetylcholinesterase inhibition. [7,9]

- **Status:** The GSP-11 is currently used by Former Soviet Union (FSU) forces to detect G- and V-type nerve agents. [7]

- **Uses:** The GSP-11 may be used for fixed point continuous monitoring of air or mounted in reconnaissance vehicles. If nerve agents are detected, the VPKhR Kit is used as a follow-up to identify the specific agent and its concentration. [12,13]

- **Deployment:** The GSP-11 is in use in most Former Warsaw Pact countries. In Bulgaria an item designated as the AGS-1 and appearing to be virtually identical to the GSP-11 is used in the MARITZA Automated Radiation and Chemical Reconnaissance System. [8]

  A Hungarian item designated AVJ-1 also appears to be similar to the CIS GSP series.

- **Agents Detected:** G- and V-type nerve agents. [7,11]

- **Detection Sensitivity:** *

- **Response Time:** *

- **False Responses/Interferents:** Temperatures beyond the range of -30°C to +40°C will cause the alarm to cease functioning or give a false alarm. [11]

- **Safety Features/Safety Hazards:** When opening the glass ampoules in the KIS Refill Kit, hands must be protected from sharp edges. The washing liquid and Solution No. 2 found in the KIS Refill Kit contain methanol, which is extremely poisonous. [6]

  Preparation of Solutions No. 1 and 2 (KIS Refill Kit) by using reagents taken from kits of different lots is not recommended. [6]

- **Safety Features/Safety Hazards:** The KIS Refill Kit should not be stored near heating devices. [6,11]

- **Power Requirements:** May be operated using vehicle power or two rechargeable battery packs which require recharging every eight hours. [7,8,10]

- **Transport Requirements:** The KIS Refill Kit should be protected from atmospheric moisture during transport. [6]

- **Personnel Requirements:** *

- **Operational Information:** An air sample is drawn through detection tape that has been soaked in Operating Solution No. 1. After exposure to the air sample being tested, the tape is wetted with Operating Solution No. 2. A biochemical reaction creates a color change which is checked by a photoelectric detector. If the concentration of nerve agent present in the sample exceeds a threshold level, an audible and visible alarm will sound. [6]

  Instructions for the preparation of Operating Solutions No. 1 and 2 are found in the KIS Refill Kit for use with the GSP-11 and AGF-1 detectors. When preparing Solution Nos. 1 and 2 at low temperatures, the solutions must be warmed. The time required to prepare these solutions is 20 minutes. One refill ensures continuous operation of the GSP-11 or AGF-1 for two hours when in Operating Mode 1 and 10 hours to 12 hours in Operating Mode 2. [6]

  Duration of Operation: The tape must be changed and the reagent reservoirs must be refilled after eight hours of operation. [11]
  Operational Temperature: -40°C to +40°C (KIS Refill Kit) [6]

- **Stock Number(s):** *

- **Miscellaneous:**

  Shelf Life: (KIS Refill Kit) Three days for Solutions No. 1 and No. 2. [6]

  Storage Conditions: (KIS Refill Kit) Store in dry, closed, unheated premises free from vapors, acids, bases or gases, and in temperatures not exceeding +20°C. [6,13]

- **Contact(s):** *

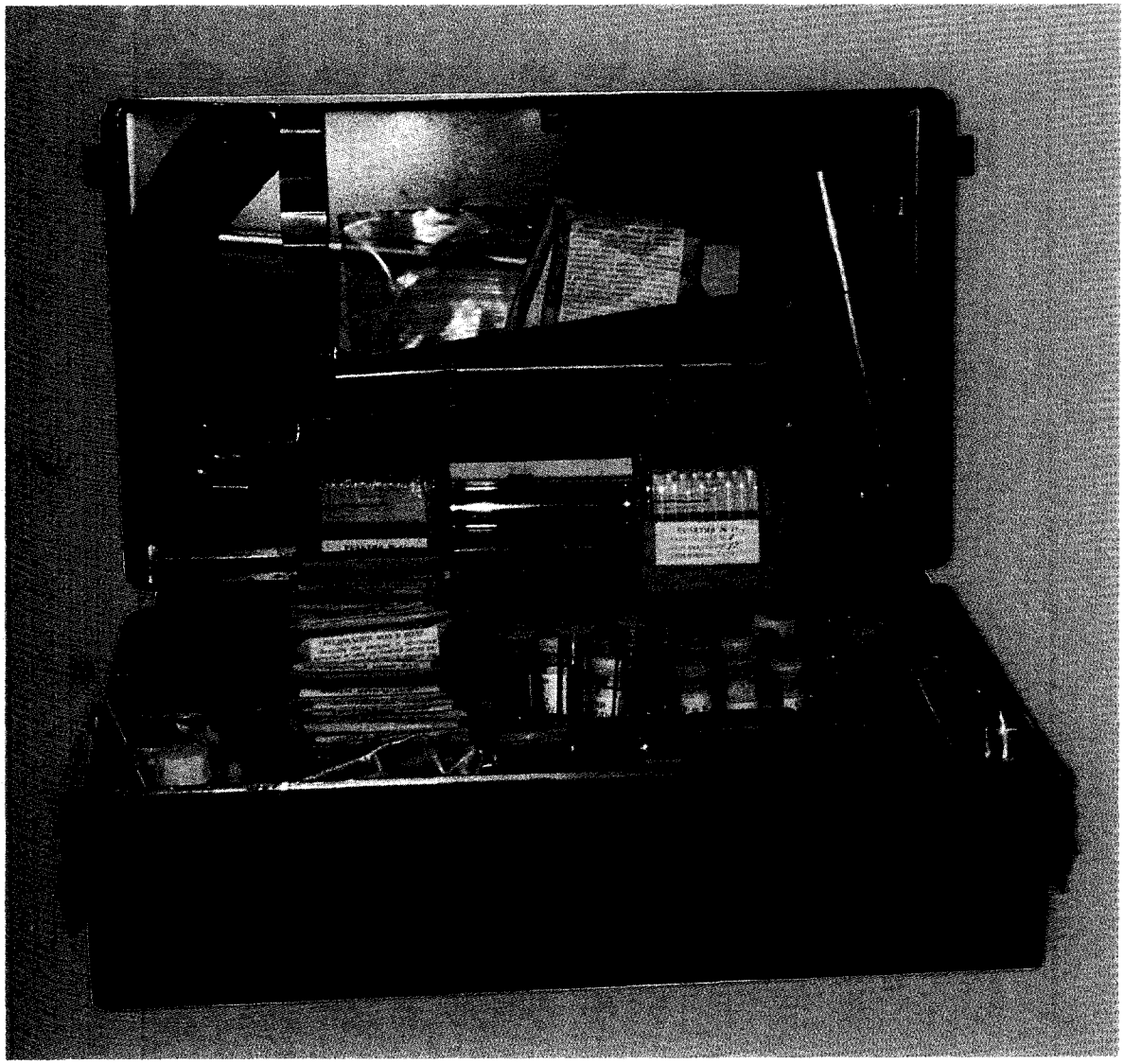


Photo courtesy of Battelle

The MPKhR Portable Laboratory (Cyrillic Designation МПХР) [3]

This is used to detect and identify chemical agents in air, water and soil. The MPKhR contains many of the same detector tubes found in the VPKhR detection kit series, but, in a larger quantity, as well as laboratory glassware including flasks and test tubes and other hardware items including a chemical balance and an air pump for aspirating air samples. The MPKhR weighs approximately 7.5 kg and is housed in a metal case with dimensions of 42.7 cm x 24.2 cm x 16.2 cm.

The MPKhL (Cyrillic Designation МПХЛ) Field Laboratory is a larger version of the MPKhR weighing 35 kg and measuring 56 cm x 28.2 cm x 45.9 cm.

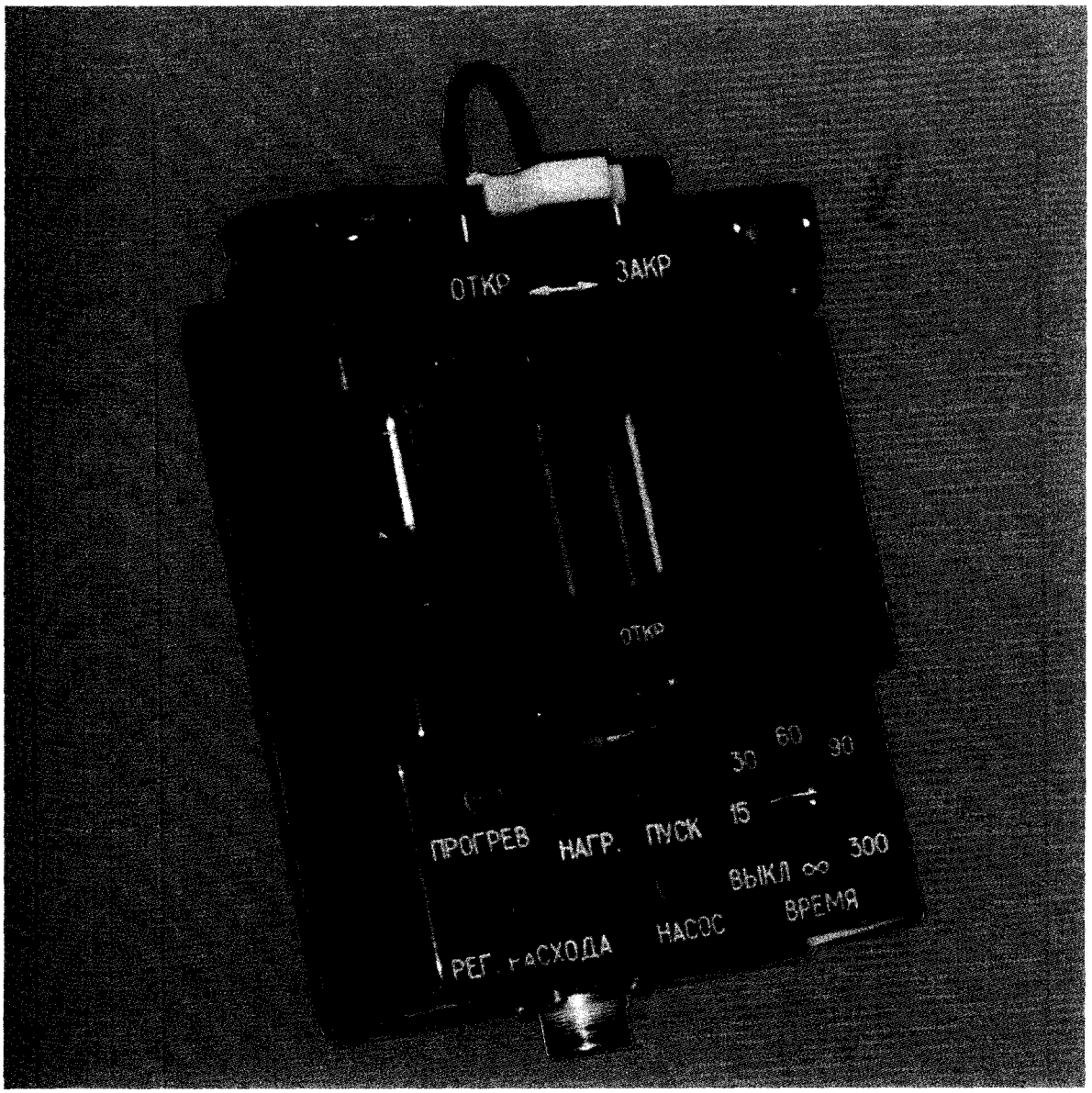
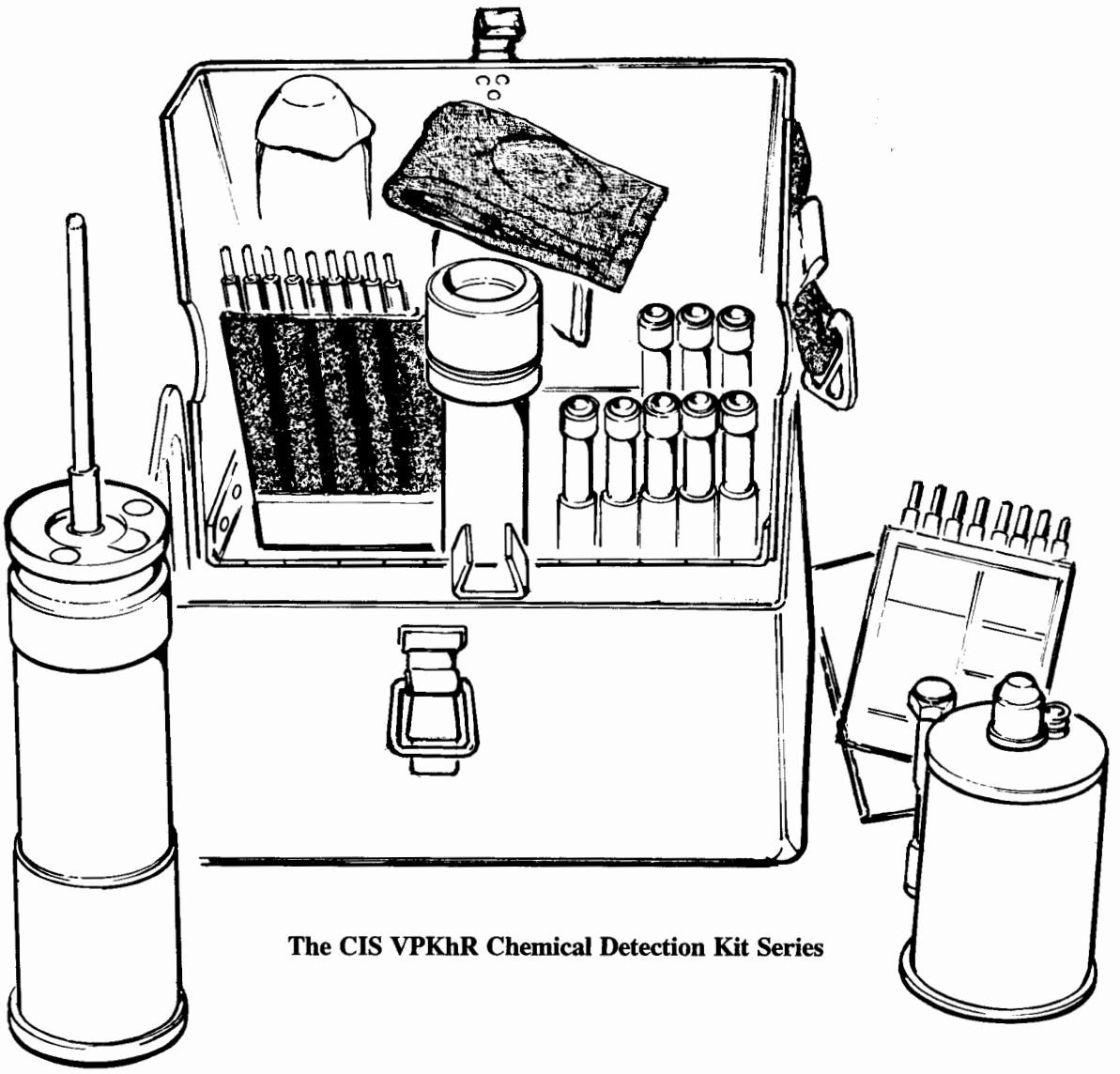


Photo courtesy of Battelle

The PGO-11 Semi-Automatic Detector/Alarm (Cyrillic Designation ПГО-11) [3]

The PGO-11 Semi-Automatic Detector/Alarm uses detector tube technology to measure the presence of organophosphorus agents and phosgene in air and on surfaces. In the presence of agents, the tubes provide a visual color change. Test tube samples are inserted into a holder for measurement of color intensity. The detection time for air samples is 15 seconds to five minutes; for surface samples detection time is two and a half minutes to seven minutes. The instrument operates on a 12 W or 27 W power source. The operational temperature is -40°C to +50°C and it weighs 21 kg packed in a box.



The CIS VPKhR Chemical Detection Kit Series

Sketch courtesy of Battelle

- **Designator(s):** VPKhR (Cyrillic Designation ВПХР)

- **Item Name(s):** VPKhR Chemical Detection Kit Series

- **Item Description:** The VPKhR is the standard issue detection and identification kit. The case is constructed of sheet metal and is the newest of the Soviet PKhR series. [18]

  The VPKhR uses three tubes to identify the presence of chemical agents. To operate the VPKhR, the holders with the detector tubes are to be arranged in a specific order. The detector tubes with one red band and red dot on the top are used to identify GB, GD and V-gases; the detector tubes bearing three green bands are in the middle and are used to identify CG, CK, DP and AC; the tubes bearing one yellow band are on the bottom and are used to identify H. During operation, the internal ampoules are broken and air is drawn through the tube by using a mechanical air pump. Then the color of the filling compound is compared to that of the label applied to the detector tube. To determine the presence of agent in soil or bulk material, a sample is placed in the protective cap and covered with a smoke filter. Then the air is pumped through the detector tube (the number of strokes is determined in the instruction booklet). The filter and sample are discarded. The attachment is removed from the pump and again the resulting detector tube color is compared to that on the test tube packet or the instruction booklet. [14,15,16]

  In cold weather, the VPKhR is used with a heater. The heater is a hollow plastic cylinder which is closed at both ends and lined with cotton wads. The top of the heater has four wells which hold three indicator tubes and one heating ampoule. The indicator tubes are heated for approximately one minute. However, use of the heater is not recommended at temperatures above +15°C because this can cause ejection of the liquid from the chuck. [15]

- **System Components:** [16]

  Air Pump
  Carrying Case
  Cap
  Certificate
  Detection Tube for CG, DP, AC and CK (marked with three green bands)
  Detection Tube for GB, GD and V gases (marked with a red band and dot)
  Detection Tube for H (marked with a yellow band)
  Flashlight
  Heater
  Instructions for using the kit
  Nozzle
  Shoulder Strap
  Pdf-1 Smoke Filter (Cyrillic Designation Пдф -1)
  Spatula
  Technical Description and Operating Instruction
  Wipe

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:**

PARAMETERS	VPKhR CASE [14,15]	INDICATOR TUBES [15]
Length	20.5 cm	110 mm
Width	10 cm	*
Height	14 cm	*
Diameter	*	7 mm
Weight	2.3 kg	*

- **Technology:** Chemical reaction of agents with reagents found in the indicator tubes result in a color change. The concentration of agent is determined by comparing the color intensity of the sample tube against the standard sample. [20]

- **Status:** Used by the Former Soviet Union (FSU). [16]

  Used in the BRDM-2rkhb reconnaissance vehicle. [20]

- **Uses:** Used to detect dangerous concentrations of chemical agents in air, on the ground and on surfaces. [16]

- **Deployment:** Various versions of this kit are found in most Former Warsaw Pact (FWP) countries. [15]

PKhR-50:	Formerly used in Bulgaria.
PKhR-51:	Formerly used in Bulgaria.
PKhR-54:	Used in Former East Germany (FEG) and designated KA-54 and PChR-54.
PKhR-63:	Used in FEG and designated PChR-54; an item designated as PChR-54U is a FEG modification of the PKhR-63.
VPKhR:	Used in FEG and designated as WPChR-64.

- **Agents Detected:** [16]

AGENT CLASS	AGENT(S)	DETECTION TUBE MARKINGS	DETECTION SENSITIVITY		
			SLIGHTLY DANGEROUS	DANGEROUS	VERY DANGEROUS
Blister	H	Yellow Band	0.002 mg/l to 0.003 mg/l	0.01 mg/l	0.3 mg/l
Blood	AC and CK	Three Green Bands	0.005 mg/l to 0.01 mg/l	0.1 mg/l to 0.2 mg/l	0.4 mg/l to 0.8 mg/l
Choking	CG and DP	Three Green Bands	0.005 mg/l to 0.01 mg/l	0.15 mg/l	1.5 mg/l to 3.0 mg/l
Nerve	GB, GD and V agents	Red Band and Dot	5×10^{-7} mg/l	5×10^{-5} mg/l	*

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** 1 minute to 5 minutes. [14]
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None. [14]
- **Transport Requirements:** *
- **Personnel Requirements:** *
- **Operational Information:** To conduct tests, the hand-held pump is removed from the detector kit and the ends of the tube to be used are snapped off. The color-coded tube is then inserted in a similarly marked hole in the base of the air pump and pressed against the steel spike until the ampoule inside the tube is ruptured. The tube is then inserted in the air intake hole in the pump head; the pump is then stroked. (The number of strokes required for a specific test is specified in operating instructions printed on packets of the detector tubes.) Similar procedures are followed to check for contamination on the ground, on equipment, and on other objects. The test tube to be used is prepared the same way as for testing the air for contamination and placed in the air intake hole of the air pump. The attachment is then screwed on to the pump, and the protective filter cap is placed on the attachment. While holding the attachment perpendicular to the surface to be tested with the protective cap near the surface, air is pumped through the detector tube the required number of times. To determine presence of agent in soil or bulk material, a sample is placed in the protective cap and covered with a smoke filter; air is then pumped through the detector tube. The filter and sample are discarded, and the attachment is removed from the pump. The resulting detector tube color is compared to that on the test tube packet or in the instruction booklet. [17]

- **Operational Information (continued):**

  Operational Temperature: -40°C ±4°C to +40°C ±4°C [16]
  Relative Humidity: Up to 100% [16]

- **Stock Number(s):** *

- **Miscellaneous:** Tube chemistry in the VPKhR is basically the same as that used in several U.S. kits. [15]

  The VPKhR is difficult to use with mask and gloves; it is also difficult to read the instructions and make color comparisons in the dark (at night). [19]

  The reagents have a shelf-life of one to two years but are fragile and easily broken or damaged by high temperatures. [19]

  Preparation Time: One minute to 15 minutes. [14]

- **Contact(s):** *

4.2 REFERENCES

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Chapter 5 - CZECH REPUBLIC

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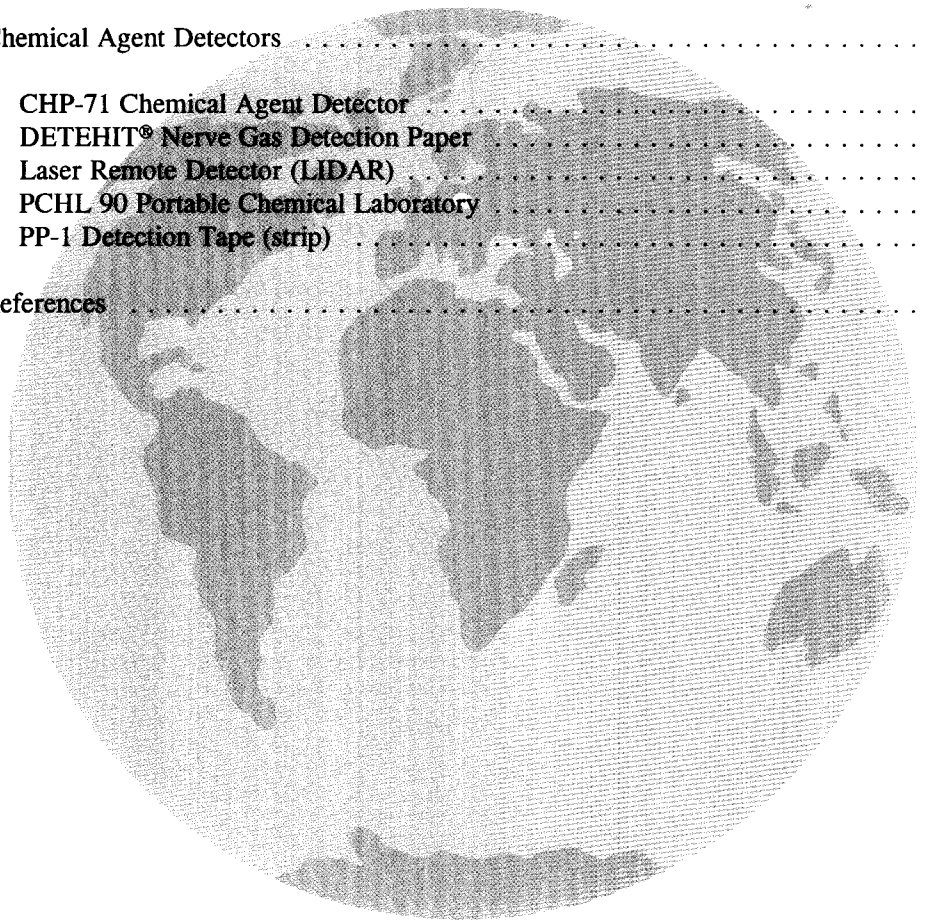


5.1 CHEMICAL AGENT DETECTORS

Parts are referenced as follows:

1 - Operations Switch
2 - Air Flow Adjusting Button
3 - Lighting of Detection Tubes and a Flow Meter Switch
4 - Detection Tubes
5 - Flow Meter
6 - Board
7 - Cap
8 - Lever Lock
9 - Face Wall of a Monitor
10 - Cap
11 - Belt Clip
12 - Left Side of a Monitor
13 - Plug
14 - Short Circuit Socket
15 - Plug for a Short Circuit Socket
16 - Cap with a Slice
17 - Heater Holder

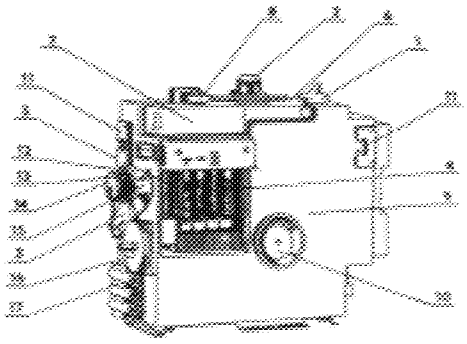
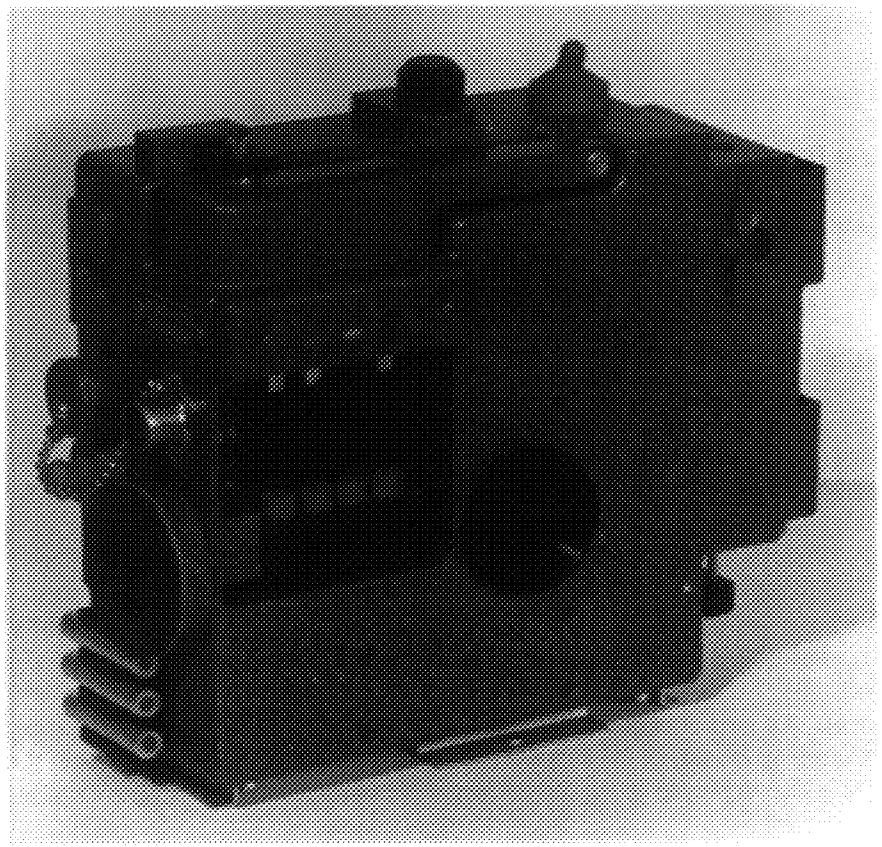


Photo and sketch courtesy of Military Technical Institute of Protection Brno



The CHP-71 Chemical Agent Detector

- **Designator(s):** CHP-71

- **Item Name(s):** CHP-71 Chemical Agent Detector

- **Item Description:** The CHP-71 is a lightweight, portable instrument used for the detection of chemical warfare agent contamination in the air, on terrain and on the surface of military equipment. A built-in motor pump draws an air sample at three l/min into the unit and through the detector tubes. Color changes in the detector tubes are compared to standards for the identification of the chemical agent. The color can also indicate the concentration level of the toxic agent identified. It can be operated inside or outside of a vehicle. [4,10]

- **System Components:** [4]

  Adapter (for detection of agents in soil and on equipment surfaces)
  Detection Tube Opener
  Detection Tubes (for nerve agent (PT-44); HD (PT-36); and AC, CG, CK and DP (PT-45))
  Heaters (for preheating the detector tubes)
  Input and Output Filters
  Spatula (for taking solid samples)
  Thermometer

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** [4]

Length:	20 cm
Width:	8 cm
Height:	23.5 cm
Weight:	5.5 kg

- **Technology:** Uses chemical reactions that provide an identifying color change for the identification of toxic agents. The color of the reaction layer is compared to a color chart. [4]

- **Status:** In production. [3]

- **Uses:** Used as a point detector of chemical warfare agents in the air, terrain and on combat arms. This instrument can work inside as well as outside the vehicle. [4]

- **Deployment:** An item resembling the CHP-71 is marketed in Bulgaria by Kokintex Share Holding Company for use in the MARITZA Automated Radiation and Chemical Reconnaissance System. It is also deployed to the Slovak Republic and in use by the Czech Republic Army. [13,14]

- **Agents Detected:** [4]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	H	1×10^{-3} mg/l	3 minutes
Blood	AC and CK	5×10^{-3} mg/l	3 minutes
Choking	CG and DP	5×10^{-3} mg/l	3 minutes
Incapacitating Agents	BZ	5×10^{-4} mg/l	3 minutes
Nerve	GB, GD and V Agents	5×10^{-7} mg/l	3 minutes to 7 minutes
Tear	CS	5×10^{-4} mg/l	3 minutes

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** See ***Agents Detected*** for information.
- **False Responses/Interferents:** High concentrations of NH_3, SO_2 or Cl_2 trigger false positives. [4]
- **Safety Features/Safety Hazards:** None. [4]
- **Power Requirements:** Requires 6 V (4 V x 1.5 V battery) or 12 V to 24 V from a vehicle power supply. [4]
- **Transport Requirements:** No special requirements. [4]
- **Personnel Requirements:** Under normal conditions, one person can operate the device. [4]
- **Operational Information:** This instrument has an unlimited operational time in the vehicle. It can operate for six hours with one battery kit at temperatures greater than 0°C. The preparation time at normal temperatures is two minutes and at temperatures below +15°C is 10 minutes. [4]

  Operational Temperature: -40°C to +50°C. [14]
- **Stock Number(s):** *
- **Miscellaneous:** *

- **Contact(s):**

Developer: Military Technical Institute of Protection Brno
Nuclear and Chemical Defence Division
P.O. Box 547
602 00 Brno
Czech Republic
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042 5 41182229
042 5 41211850 (4)

Photo courtesy of Military Technical Institute of Protection, Brno

The DETEHIT® Nerve Gas Detection Paper

Available, as shown, in foil packs of 3, 5 or 10 detector strips or in plastic tubes containing 10 detector strips per tube.

- **Designator(s):** DETEHIT®

- **Item Name(s):** DETEHIT® Nerve Gas Detection Paper

- **Item Description:** DETEHIT® is a kit containing paper strips that have been chemically treated to provide a color change in response to the presence of nerve agents or organophosphate and carbamate insecticides in air, water, foods and on surfaces. This kit consists of white plastic strips covered with white detection cloth, yellow comparison cloth and white indicator paper. It is possible to divide this foil by tearing up to the detection and indicator part. The evaluation is provided visibly by comparison with the color cloth. [5,9]

  The white part of the DETEHIT® is to be wet and left exposed in the environment being checked. The developing time is five minutes in a solution or on a surface and two minutes in the air. The strip is folded after exposure and the wet detection cloth is pressed against the indicator paper. After one minute the paper should be removed. The coloring of the cloth is then compared with the yellow standard. If the detection cloth remains white, nerve agent has been detected. If the detection part has turned to a yellow that corresponds to the yellow standard, no nerve agent is present in the checked sample. [9]

- **System Components:** This kit consists of detection strips which are wrapped in laminated aluminum foil. They are stored in a plastic tube containing silica gel to minimize moisture. [4]

- **Support Equipment:** None. [5]

- **Equipment Hardness:** A protective cover renders it resistant to decontaminants. [14]

- **Dimensions and Weight:** [5]

PARAMETERS	DETECTION STRIPS	PCHL KIT
Length	8 cm	12 cm
Width	1 cm	*
Height	0.2 cm	*
Diameter	*	3 cm
Weight	*	0.1 kg

- **Technology:** The color of the cellulose cloth indicates a biochemical reaction between the tested substance and immobilized acetylcholinesterase. [9]

- **Status:** In production. [5]

- **Uses:** Designed for sensitive and simple detection of nerve agents in the air, water, foods, terrain and on the interior surfaces of combat equipment. [5]

- **Deployment:** Used by the Czech Republic Army. [5]

- **Agents Detected:** [9]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY [a] [11] (at given exposure time)			
		2 Min	20 Min	5 Min	30 Min
Nerve	GA	8×10^{-5}	1×10^{-6}	6×10^{-2}	2×10^{-3}
	GB	1×10^{-5}	4×10^{-7}	1×10^{-2}	1×10^{-3}
	GD	8×10^{-6}	2×10^{-7}	5×10^{-3}	4×10^{-4}
	GF	3×10^{-6}	1×10^{-7}	2×10^{-3}	1×10^{-4}
	GP	5×10^{-6}	2×10^{-7}	5×10^{-3}	2×10^{-4}
	VX	5×10^{-5}	5×10^{-7}	3×10^{-2}	3×10^{-4}

a Units are mg/l in air and water and g/m^2 on surfaces.

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** The response time is the above stated exposure time plus two minutes. [5]
- **False Responses/Interferents:** High concentrations of NH_3, SO_2, or Cl_2 and theoretically, compounds which cause an oxidation-reduction reaction may generate a false positive. [5]
- **Safety Features/Safety Hazards:** None. [5]
- **Power Requirements:** None. [5]
- **Transport Requirements:** No special requirements. [5]
- **Personnel Requirements:** Used with ease by each individual field soldier. [9]
- **Operational Information:** The detector may be used repeatedly up to 20 times in the absence of a reactant. The pigment needs to be washed off the cloth after each use. [9]

  Operational Temperature: 0°C to +40°C (may be used below 0°C if liquids have been protected from freezing). [9]

- **Stock Number(s):** *

- **Miscellaneous:** Each strip is sealed in laminated aluminum foil. They are packed either as 3, 5 or 10 detectors in a laminated aluminum foil, sealed bag or 10 detectors in a plastic tube. [9]

  Shelf Life: Two years in the original wrapping, two months after opening. [9]

  Storage Temperature: -40°C to +60°C. [9]

- **Contact(s):**

  Developer:
  Military Technical Institute of Protection Brno
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  042 5 41211850 [5]

  Manufacturer(s):
  Oritest
  Na Bělidle 21
  15000 Prague 5
  Czech Republic
  Tel: 042 2 24511382
  042 2 536443 [9,15]

  Perceptronic® Elektronische Anlagen Forschungs Entwicklungs
  Arnsteingasse 7
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  043 1 8930060
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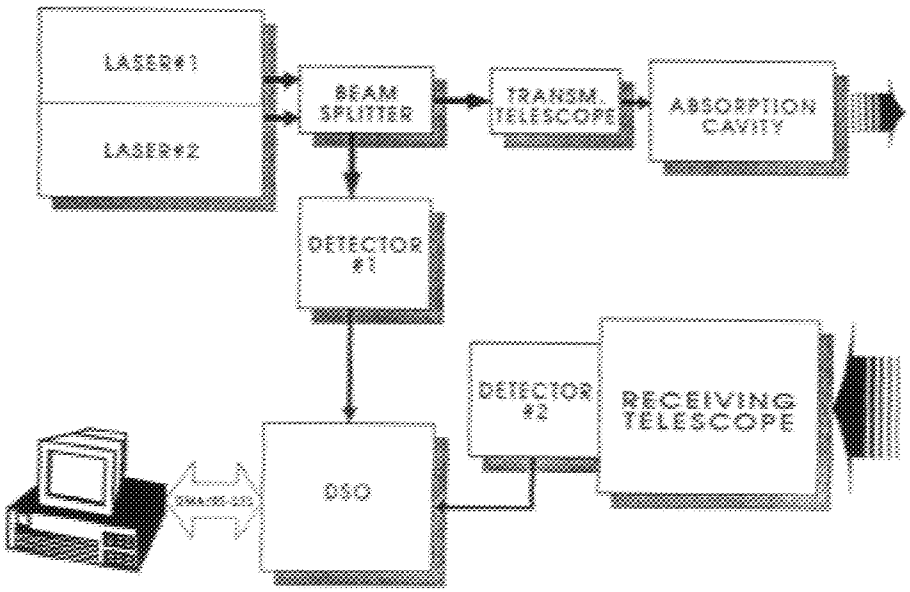
  043 1 83127120
  043 1 8930090
  043 1 893009020
  Telex: 131364 jaect a [11,15]

The LIDAR (Vehicle Mounted)

Photo and diagram courtesy of Military Technical Institute of Protection Brno



Block Diagram of the LIDAR Laser Remote Detector, General Operation

- **Designator(s):** LIDAR

- **Item Name(s):** Laser Remote Detector (LIDAR)

- **Item Description:** The Laser Remote Detector (LIDAR) is placed in the container on the LIAZ lorry chassis and utilizes a method of differential absorption of infrared radiation by observed agents. The equipment consists of two tunable Transverse Excited Atmospheric (TEA) CO_2 lasers. One of them radiates a reference beam that weakly absorbs agent and the other laser is tuned to strong absorption of the agent. The results are obtained as differences in powers of these beams. The concentration is calculated from these differences. The Cassegarin optical system is used for collection of scattered signals from the natural target. [6]

- **System Components:** This equipment consists of two tunable TEA CO_2 lasers, optical system, evaluating electronics and telescope; mounted on a LIAZ lorry chassis. [6]

- **Support Equipment:** None. [6]

- **Equipment Hardness:** *

- **Dimensions:** [6]

Length:	100 cm
Width:	100 cm
Height:	100 cm
Weight:	150 kg

- **Technology:** Uses laser and optic technologies. [6]

- **Status:** The development has been completed. [6]

- **Uses:** Enables the user to detect GB and VX type agents in the air. It may also be used to detect agents having a strong spectral absorption in the 9 μm to 11 μm wavelength. [6]

- **Deployment:** It is not being used by the Czech Armed Forces because it is cost prohibitive to deploy. [6]

- **Agents Detected:** [6]

Nerve Agents:	GA, GB and GD.

- **Detection Sensitivity:** The minimal detectable concentration x pathlength (CL) for organophosphorus agents is 40 mg/m^3·m to 80 mg/m^3·m. [6]

- **Response Time:** 30 seconds. [6]

- **False Responses/Interferents:** Theoretically, all agents having strong absorption in the spectral region of the laser beam wavelength could interfere. In case of an excess of these interferant agents in the atmosphere it is necessary to operate in more wavelengths and to mathematically eliminate any influence of interferant agents. [6]

- **Safety Features/Safety Hazards:** Hazards are those typical of working with class 4 laser sources. [6]
- **Power Requirements:** Equipped with its own small power station EC 4.5 kVA; it may also be connected to 380 V AC power supply. The rate of consumption is about one kW. [6]
- **Transport Requirements:** Vehicle mounted. [6]
- **Personnel Requirements:** One driver and two skilled operators. [6]
- **Operational Information:** Operating this device is complicated. [6]
- **Stock Number(s):** *
- **Miscellaneous:** *
- **Contact(s):**

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The PCHL 90 Carrying Case

Photos courtesy of the Military Technical Institute of Protection Brno

The PCHL 90 Portable Chemical Laboratory

- **Designator(s):** PCHL 90

- **Item Name(s):** PCHL 90 Portable Chemical Laboratory

- **Item Description:** The PCHL 90 is a portable unit containing chemical reagents and appropriate laboratory equipment. It is designed to detect the presence of chemical agents on contaminated equipment, uniforms, clothing, terrain, water, food, fodder and various materials under field conditions. These chemical tests are also designed to detect residual contamination and the effectiveness of decontaminating solutions and mixtures containing active chlorine. This portable laboratory is housed in a plastic box. Its cover is used as an area for performing the required chemical procedures. [7]

- **System Components:** [7]

  DETEHIT® Paper
  Solvents
  Stand (with chemical containers, protective equipment and decontaminants)
  Test Tubes (containing reagents)
  Water Bag

- **Support Equipment:** None. [7]

- **Equipment Hardness:** The surface of the plastic box can be decontaminated by common decontamination means. [14]

- **Dimensions:** [7]

Length:	59 cm
Width:	30 cm
Height:	42 cm
Weight:	21 kg

- **Technology:** The detection method used in this kit is based on chemical reactions that produce visible color changes. [7]

- **Status:** Development complete, available commercially. [7]

- **Uses:** Intended for rapid quantitative and semi-quantitative analysis of toxic substances such as organophosphorus based chemical warfare agents, herbicides, alkaloids and others. It checks the decontamination of materials, objects and terrain as well as solutions and mixtures which contain active chlorine. The kit is used to detect agents in water, soils, equipment, accessories, surfaces, air and food. It analyzes any undefined samples. [7]

- **Deployment:** Planned for use by the Czech Republic Army. [7]

- **Agents Detected:** [7]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	H	5 μg
Incapacitating	BZ	10 μg
Nerve	GB and GD	5×10^{-6} mg/l (in air) 1×10^{-3} mg/l (in water) 5×10^{-3} mg/m^2 (on surfaces)
	VX	5×10^{-7} mg/l (in air) 5×10^{-4} mg/l (in water) 1×10^{-3} mg/m^2 (on surfaces)
Tear	CR	2 μg
	CS	1 μg

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** The analysis can be completed in 30 minutes; reaction time is 15 minutes. [7]

- **False Responses/Interferents:** Theoretically, numerous agents can interfere. However, simultaneous use of all 10 reagents minimizes false responses. [7]

- **Safety Features/Safety Hazards:** The safety hazards correspond to the usual hazards of working in a chemical laboratory. [7]

- **Power Requirements:** None. [7]

- **Transport Requirements:** No special requirements. [7]

- **Personnel Requirements:** Can be operated by one skilled person. [7]

- **Operational Information:** This kit is operational at temperatures above +5°C. In case of lower temperatures, it can only be operated in heated rooms. It is capable of 200 full analyses. Clearing time is one hour. [7]

- **Stock Number(s):** *

- **Miscellaneous:** In 1983, the Portable Chemical Laboratory PCHL-75 was developed to update and replace the PCHL-54. The PCHL 90 appears to be an updated and improved version of the PCHL-75. [1,7]

  The PCHL-90 is also capable of detecting alkaloids, phenoxyacetic acids and heavy metal cations. [7]

  Shelf Life: Five years. [12]

- **Contact(s):**

Developer: Military Technical Institute of Protection Brno
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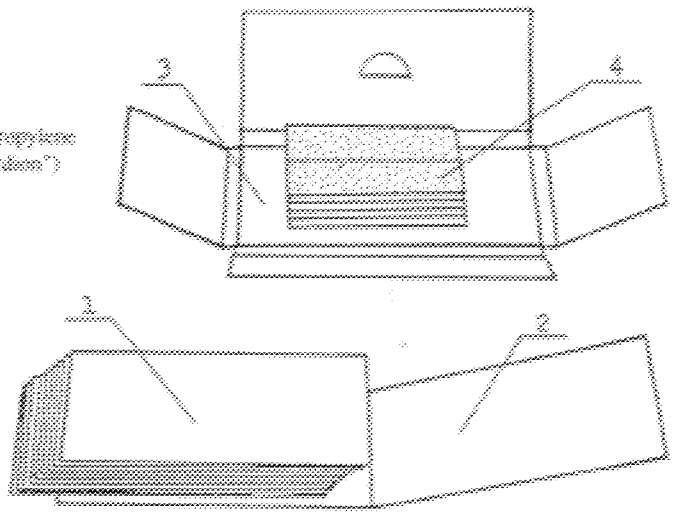
042 5 41182229
042 5 41211850 (7)

Parts are referenced as follows:

1 - Detection Strips
2 - Color comparison chart
3 - Opened Box (khaki color) and laminated with polypropylene
4 - Green Self-Sticking Labels (folded up like "an accordion")



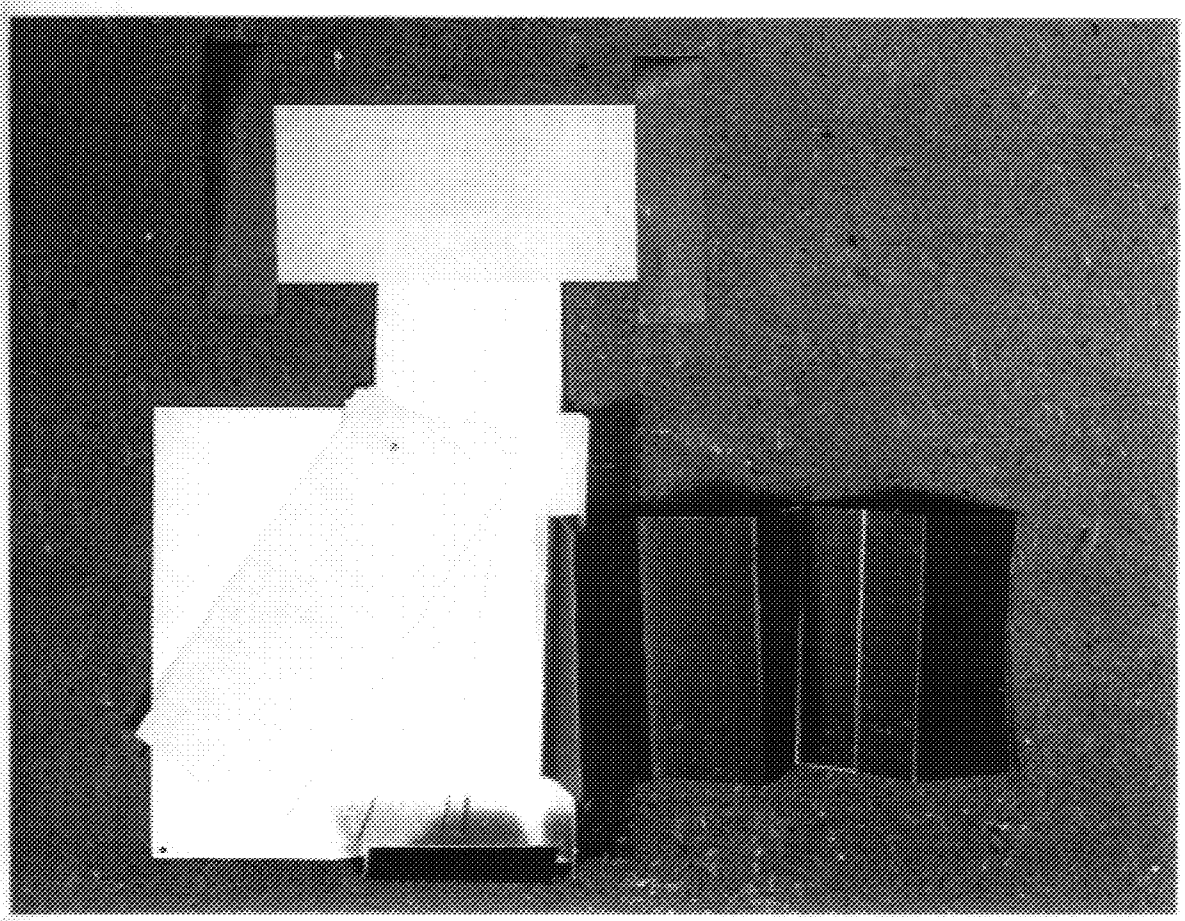


Photo and sketch courtesy of
Military Technical Institute of Protection Brno

PP-1 Detection Tape

Designator(s): PP-1

- **Item Name(s):** PP-1 Detection Tape (strip)

- **Item Description:** The PP-1 is a very simple and inexpensive paper strip used to detect VX type nerve agents. It can be used to distinguish VX agents from other nerve agents. The detection tape consists of paper impregnated with the detection reagent on a phthalein base. Droplets of the VX agent aerosol falling down on the paper's surface initiate an immediate reaction that produces a blue color. [8]

- **System Components:** [8]

  Color Comparison Chart
  Detection Tape
  Self-Sticking Labels (for attaching strips onto combat equipment)

- **Support Equipment:** None. [8]

- **Equipment Hardness:** A protective cover renders it resistant to decontaminants. [14]

- **Dimensions:** [8]

Length:	17 cm
Width:	8 cm
Height:	1.8 cm
Weight:	60 g

- **Technology:** Uses a chemical reaction to detect the presence of VX. The strip has been impregnated with reagent. Any contact by VX agent droplets with the tape is indicated immediately by a change in color. [8]

- **Status:** In production. [2,8]

- **Uses:** The detection tape is intended to detect the presence of VX aerosol in the air, as well as to detect VX agent contamination on terrain and surfaces. It can be attached to combat equipment. [8]

- **Deployment:** Used by the Czech Republic Army. [2,8]

- **Agents Detected:** [8]

  Nerve Agents: VX.

- **Detection Sensitivity:** 1 mg/m^2 [8]

- **Response Time:** [8]

  10 seconds (at +20°C)
  80 seconds (at -40°C)

- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** None. [8]
- **Power Requirements:** None. [8]
- **Transport Requirements:** No special requirements. [8]
- **Personnel Requirements:** Can be used by one skilled person. [8]
- **Operational Information:** *
- **Stock Number(s):** *
- **Miscellaneous:** *
- **Contact(s):**

Developer:

Military Technical Institute of Protection Brno
Nuclear and Chemical Defence Division
P.O. Box 547
602 00 Brno
Czech Republic
Tel: 042 5 41183152
042 5 41183159
Fax: 042 5 41183152
042 5 41182229
042 5 41211850 [8]

Manufacturer: Prazhske Papirny [2]

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Chapter 6 - DENMARK

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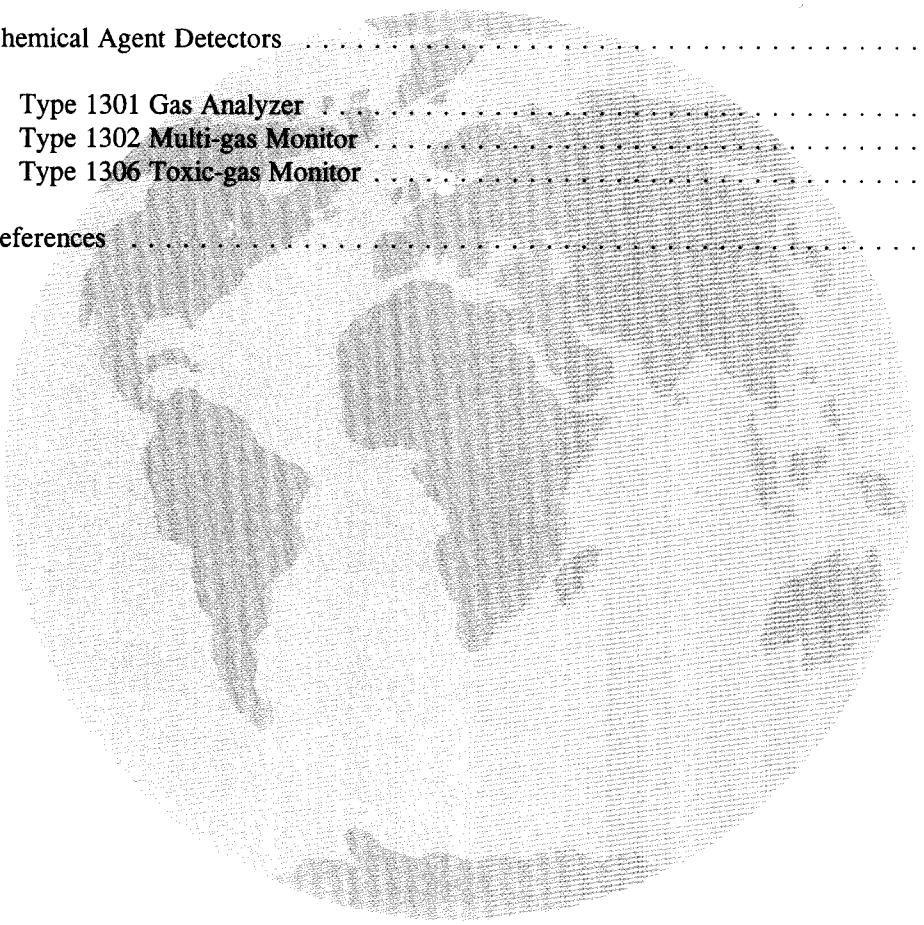

6.1 CHEMICAL AGENT DETECTORS

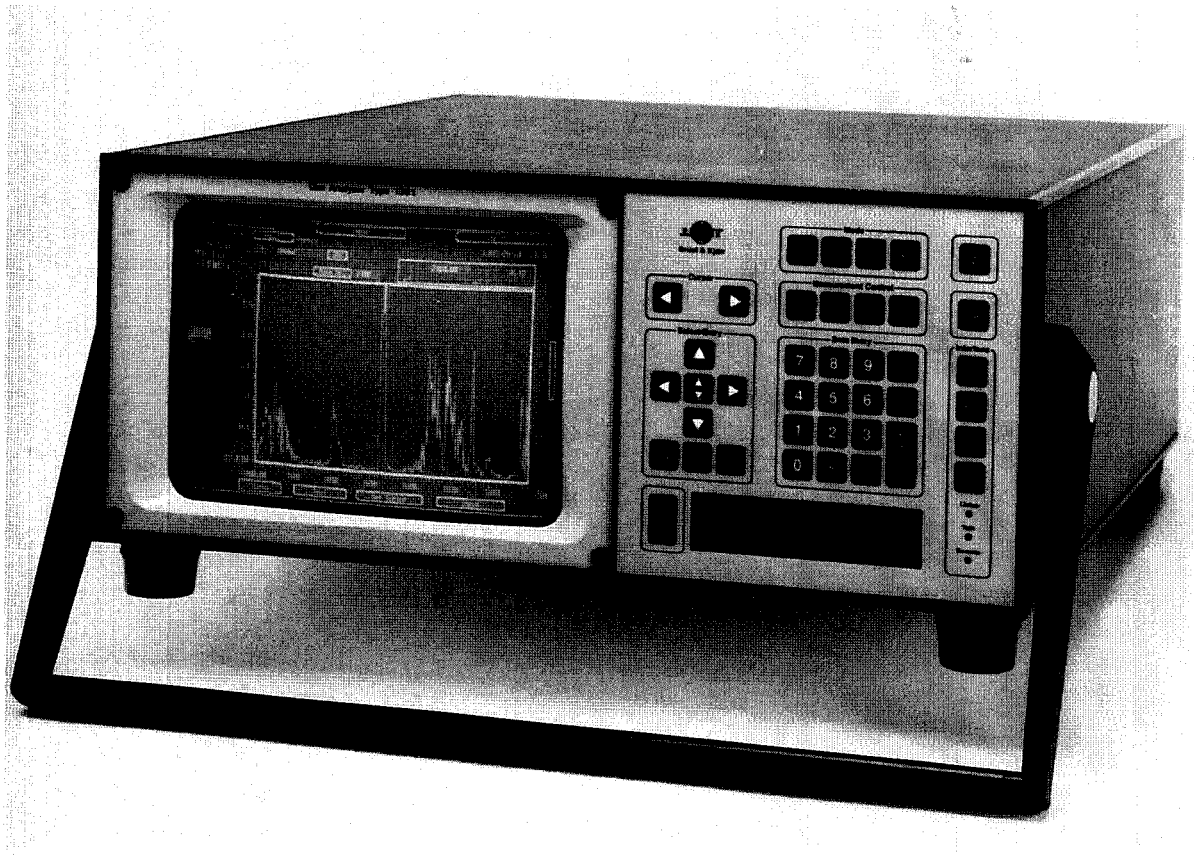

Photo courtesy of Brüel and Kjaer

Type 1301 Gas Analyzer

- **Designator(s):** Type 1301

- **Item Name(s):** Type 1301 Gas Analyzer

- **Item Description:** The Type 1301 Gas Analyzer is designed for on-site and laboratory use as a qualitative and quantitative analyzer and monitor. It is rugged, selective, sensitive, and versatile. As a monitor it can measure concentrations for up to seven gases at one time. Measurement intervals are user defined. It is totally self-contained and has an on-board pump for taking samples and a graphics display screen for displaying spectra and/or concentration results. It also has built-in self test functions. [10]

- **System Components:** [10]

  Air Inlet
  Air Outlet
  Analysis Cell
  Communication Cables
  Fine Air Filter
  Floppy Disk Drive
  Graphic Screen
  Interferometer
  Microphones (2)
  Power Cable
  Pump
  Valves

- **Support Equipment:** Operated remotely by an external computer using the RS-232-C or IEEE-488 interfaces. [3,10]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [10]

Length:	50 cm
Width:	43 cm
Height:	20.5 cm
Weight:	18 kg

- **Technology:** Fourier Transform Infrared (FTIR) spectrometer; the detection principle is based on photoacoustic absorption using Brüel and Kjaer's patented photoacoustic measurement chamber. [10]

- **Status:** In production. [3]

- **Uses:** A point detector that can be used as an analyzer or a monitor for on-site detection. Remote sampling can be achieved for areas up to 50 m away. [3]

- **Deployment:** *

- **Agents Detected:** [10]

  Blister: H and L
  Nerve: GA, GB, GD and VX

- **Detection Sensitivity:** The detection sensitivity is dependent on the frequency range chosen for detection, the gas's absorption in this range, and the number of scans co-added. It typically ranges from 0.1 ppm to 10 ppm. [10]

- **Response Time:** The response time is dependent upon the length of sample tubing and the number of scans co-added. [10]

- **False Responses/Interferents:** This is dependent upon the frequency range chosen for detection and the environment from which the air sample is taken. The 1301 can compensate measurement readings for up to two interfering gases or vapors. [10]

- **Safety Features/Safety Hazards:** Cannot be used or located in areas with explosive concentrations of flammable gases or vapors or used to measure explosive concentrations of gases and vapors. [10]

- **Power Requirements:** Powered by either a 90 V to 140 V or a 180 V AC to 264 V AC (47.5 Hz to 66 Hz) power source. It complies with IEC 248 Class 1 Safety Standards. Power consumption is approximately 100 VA. It can be powered by a battery pack with inverter. [10]

- **Transport Requirements:** Easily transported. [3]

- **Personnel Requirements:** Operated by non-technical personnel. [3]

- **Operational Information:** Operated by a series of hard keys on its front panel or a series of "soft" keys in its graphics screen display. The "soft" keys can be accessed using a computer mouse or with the use of the hard keys.

  Operational Temperature: +5°C to +40°C
  Relative Humidity: Up to 90% at +30°C (non-condensing) [10]

- **Stock Number(s):** *

- **Miscellaneous:** Communication interfaces include RS-232 serial interface and IEEE-488 parallel interface. An on-board floppy disk drive allows for storage of spectral and concentration information for transfer to a PC. It contains on-board printing and plotting functions for concentration measurement data and spectra. [10]

- **Contact(s):**

Manufacturer:	Brüel & Kjaer 307 Skodsborgvej DK-2850 Naerum Denmark Tel: 045 42 800500 Fax: 045 42 801405 Telex: 37316 Bruka dk [6]
U.S. Affiliate:	Brüel & Kjaer Instruments 2364 Park Central Boulevard Decatur, GA 30035 Tel: (800) 332-2040 Fax: (404) 808-7818 [10]

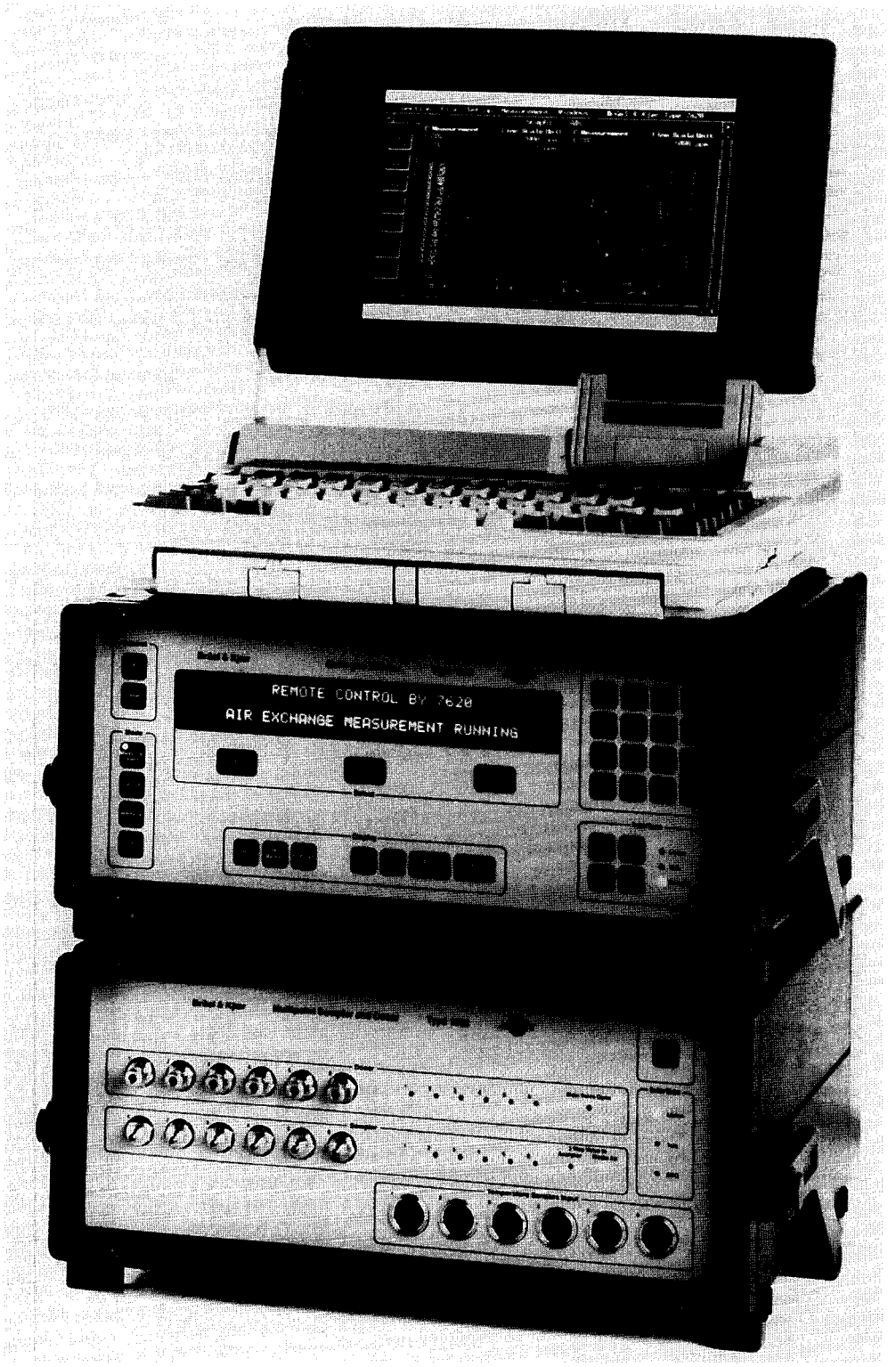

Photo courtesy of Brüel and Kjaer

The Multi-gas Monitor (Type 1302) with the Multipoint Sampler and Doser (Type 1303)

Designator(s): Type 1302

- **Item Name(s):** Type 1302 Multi-gas Monitor

- **Item Description:** The Type 1302 Multi-gas Monitor is a portable, stand-alone gas monitor that is microprocessor controlled. Designed to be highly accurate and reliable, it provides quantitative analysis results for up to five gases simultaneously as well as water vapor data. This item can compensate for the presence of known interferents and store up to one week of monitoring data for display on the front-panel screen. It is fully controllable from the front panel keys and screen, or remotely from a PC. A large memory allows results to be displayed on-screen, output in a list or graph form, or printed through the RS-232 serial or IEEE parallel interfaces, which allow data transfer and remote control operation. Warm-up time is not required, nor does it need to be recalibrated after being relocated. For long-term monitoring the Type 1302 is located indoors, with samples being collected through tubing from points up to 50 meters away. [4,5]

- **System Components:** [4]

  Air Inlet
  Air Outlet
  Analysis Cell
  Chopper Wheel
  Coarse Air Filter
  Communication Cables
  Display Screen
  Fine Air Filter
  Infrared Source
  Microphones (2)
  Mirror
  Optical Filter/Carousel
  Power Cable
  Pump
  Valves

- **Support Equipment:** The Type 1309 Multipoint Sampler and the Type 1303 Multipoint Sampler and Doser expand the monitoring capabilities of the Type 1302. The Type 1309 can provide sequential monitoring of air samples from as many as twelve locations. Each type 1303 unit can draw air samples from six locations up to 50 meters away. Two type 1303 units can be interfaced with a Type 1302, expanding its air sampling capabilities to twelve locations. The doser system within the Type 1303 enables the Type 1302 to assess ventilation systems and indoor air quality by delivering known amounts of tracer gas to "label" the air, which is then sampled for analysis. Six temperature transducers can be connected to the Type 1303 for additional environmental information. [4,5,7]

- **Equipment Hardness:** *

- **Dimensions and Weight:**

PARAMETERS	TYPE 1302 [4]	TYPE 1303 [7]
Length	30 cm	30 cm
Width	39.5 cm	35.5 cm
Height	17.5 cm	15.5 cm
Weight	9 kg	9 kg

- **Technology:** Uses a measurement principle based on photoacoustic infrared spectroscopy. [4]

- **Status:** In production. [4]

- **Uses:** A point detector with up to six optical filters is capable of selective monitoring of up to five gases and water vapor. [4]

- **Deployment:** *

- **Agents Detected:** The optical filters available allow this item to be used to detect numerous chemicals. It can be used to detect almost any gas which absorbs infrared light. [4,8]

  Blister: H and L
  Nerve: GA, GB, GD and VX

- **Detection Sensitivity:** Gas-dependent; usually ranging from 0.01 ppm to 1 ppm. Data is shown in mg/m^3 and ppm.

- **Response Time:** Depending on the number of gases being measured and the length of the sampling tube used. If the tube is less than one meter in length, the response time is approximately 30 seconds for one gas or water vapor and approximately two minutes for five gases and water vapor. A longer tube increases response time.

- **False Responses/Interferents:** Automatically compensates for interferences caused by environmental fluctuations. [4]

- **Safety Features/Safety Hazards:** Cannot be located or used as a monitor in areas with explosive concentrations of flammable gases or vapors. Certain gases or high water vapor content may damage the system. [4]

- **Power Requirements:** Requires 110 V to 127 V and 200 V to 240 V (50 Hz to 400 Hz) $\pm$10% AC. It complies with IEC 348 Class 1 safety standards. [4]

- **Transport Requirements:** Operable on the move, or in a stationary configuration. [5]

- **Personnel Requirements:** Designed for use by non-technical personnel. One person can operate the unit. No special training is needed. [4]

- **Operational Information:** Flexible design allows a stand alone fixed configuration, portable on-site monitoring, or integration into a monitoring network. A panel of push-keys is used to guide the user through the operating procedures. [4]

  Operational Temperature: +5°C to +40°C [4]
  Relative Humidity: Up to 90% at +30°C [4]

- **Stock Number(s):** *

- **Miscellaneous:** Communication interfaces include RS-232 serial interface and IEEE-488 parallel interface. The 1302 contains on-board printing and plotting functions for measurement data. [11]

- **Contact(s):**

  Manufacturer:
  Brüel & Kjaer
  307 Skodsborgvej
  DK-2850 Naerum
  Denmark
  Tel: 045 42 800500
  Fax: 045 42 801405
  Telex: 37316 Bruka dk [4]

  U.S. Affiliate:
  Brüel & Kjaer Instruments
  2364 Park Central Boulevard
  Decatur, GA 30035
  Tel: (800) 332-2040
  Fax: (404) 808-7818 [11]

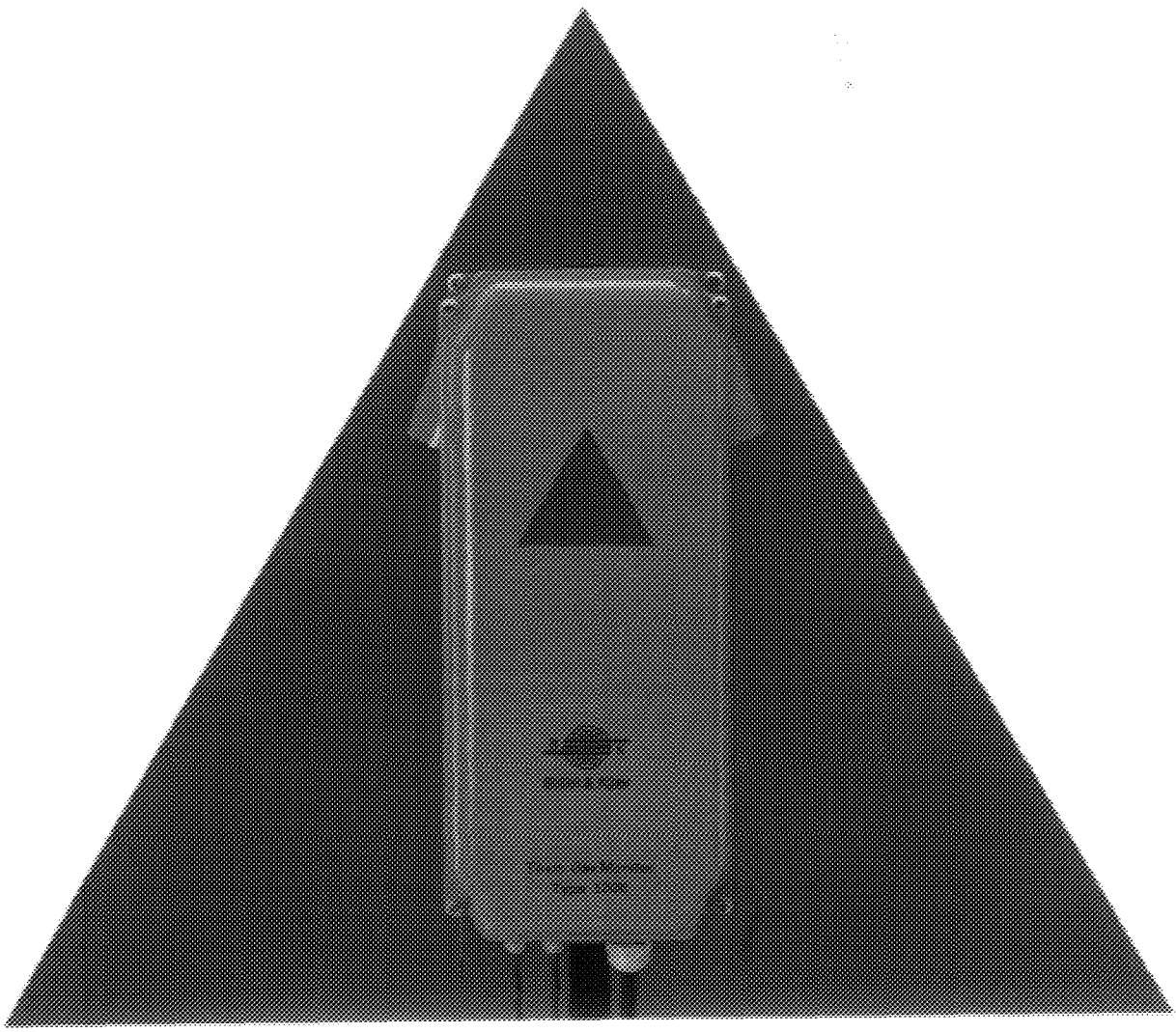

Photo courtesy of Brüel & Kjær

Toxic-gas Monitor
Type 1306

- **Designator(s):** Type 1306

- **Item Name(s):** Type 1306 Toxic-gas Monitor

- **Item Description:** The Toxic-gas Monitor Type 1306 is a low-cost, highly sensitive and reliable fixed-location point detector that provides continuous, long-term monitoring of indoor and outdoor environments for the presence of toxic gases, including nerve agents or mustard gas. It is capable of monitoring for a single gas or a group of gases, depending on the optical filter selected and installed. Operating automatically, via computer control, it draws air samples at intervals established by the user and measures the concentration of the selected gas. This item can operate for extended periods of time without maintenance and requires only minimal operational surveillance. [1,2,6,9]

- **System Components:** [1]

  Air Inlet
  Air Outlet
  Chopper
  Coarse Particle Filter
  Communication Cables
  Fine Particle Filter
  Incandescent Lamp
  Measuring Chamber
  Microphone
  Mirror
  Optical Filter
  Power Cable
  Valves

- **Support Equipment:** The monitors are remotely controlled from a PC. The Application Diskette BZ5003 communicates with a single Type 1306. B&K Application Software Type 7619 can control up to 31 monitors. The control station communicates with the Type 1306 through the RS-485 interface. [6]

- **Equipment Hardness:** Housed in a weather-proofed box enables it to function in extreme weather conditions as well as in dusty and corrosive environments. It is also protected against Electro-Magnetic Pulse (EMP). [1]

- **Dimensions and Weight:** [6]

Length:	10.2 cm
Width:	20 cm
Height:	40 cm
Weight:	5.5 kg

- **Technology:** Photoacoustic infrared spectroscopy. [1,6]

- **Status:** In production. [1,2,6]

- **Uses:** A fixed-location point detector used for perimeter monitoring or advanced warning in areas under chemical attack. [1,2,6]

- **Deployment:** The Danish Civil Defense purchased Type 1306 monitors which will be used to create an extensive network against chemical attack. [2]

- **Agents Detected:** The agent detected is determined by the optical filter installed. [1]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	H	1 mg/m^3 (~0.15 ppm)
Nerve	GA, GB and GD	0.1 mg/m^3 (~15 ppb)

- **Detection Sensitivity:** Gas-dependent; usually ranging from 0.01 ppm to 1 ppm. Detection limits depend on temperature and humidity. See ***Agents Detected*** for further information. [1]

- **Response Time:** A measurement cycle is completed in 45 to 55 seconds. The user programs the sampling frequency (usually every 10 minutes) but in the event of high concentration detection, further sampling is automatically performed without an interval. In an alarm situation this provides an immediate response. [1,6]

- **False Responses/Interferents:** This table shows the errors caused by high concentrations of interferents when detecting nerve agents. [1]

	INTERFERENT	
	LEVEL [a]	ERROR [a]
H_2O	20,000 ppm	0.2 mg/m^3
CO_2	750 ppm	0.2 mg/m^3
CO	100 ppm	0 mg/m^3
SO_2	0.2 ppm	0 mg/m^3
NO	0.2 ppm	0 mg/m^3
NO_2	0.2 ppm	0 mg/m^3
O_3	0.1 ppm	0.2 mg/m^3

a These are above-average levels of atmospheric pollutants.

- **Safety Features/Safety Hazards:** Cannot be placed in areas containing explosive concentrations of flammable gases/vapors unless it is in an explosion-proof enclosure. Certain gases or high concentrations of water vapor could damage the unit. [6]

- **Power Requirements:** Uses a 12 V DC power supply. The Power Supply ZG0309 (provided as an accessory) converts AC to DC. A 12 V car battery can be used for brief monitoring from a stationary vehicle. [6]

- **Transport Requirements:** No special requirements. [6]

- **Personnel Requirements:** The monitor is remote-controlled from a personal computer with user-friendly software. The monitoring and alarm systems are fully automated so continuous manning is not required. [1]

- **Operational Information:** Self-tests are continuously performed to insure proper functioning. It alerts the operator when it needs maintenance and calibration, which is typically three times a year. The communication system employs an RS-485 alone or an RS-485 with a converter to an RS-232. [1]

  Operational Temperature: -20°C to +50°C [1]
  Relative Humidity: 95% to 100% at +40°C [1]

- **Stock Number(s):** *

- **Miscellaneous:** Distance between monitors can be up to 1.2 km. Up to 254 monitors can be employed when a large communication network is established. [1]

  Repeatability of the monitor is within 1% of the measured value and over a three month period, the zero drift is less than the monitor's detection threshold. The range drift is within 2.5% of the measured value. [1]

- **Contact(s):**

  Manufacturer:
  Brüel & Kjaer
  307 Skodsborgvej
  DK-2850 Naerum
  Denmark
  Tel: 045 42 800500
  Fax: 045 42 801405
  Telex: 37316 Bruka dk [1,6]

  U.S. Affiliate:
  Brüel & Kjaer Instruments
  2364 Park Central Boulevard
  Decatur, GA 30035
  Tel: (800) 332-2040
  Fax: (404) 808-7818 [11]

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4. Jalenak, Wayne. (1994, February 25). *Re: Model 1302 Multigas Monitor* [7 p.]. Facsimile Transmission, Brüel and Kjaer, Nærum, Denmark.

5. Every Breath We Take. (1989, M68). *Brüel and Kjaer Monitor.*

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Chapter 7 - FINLAND

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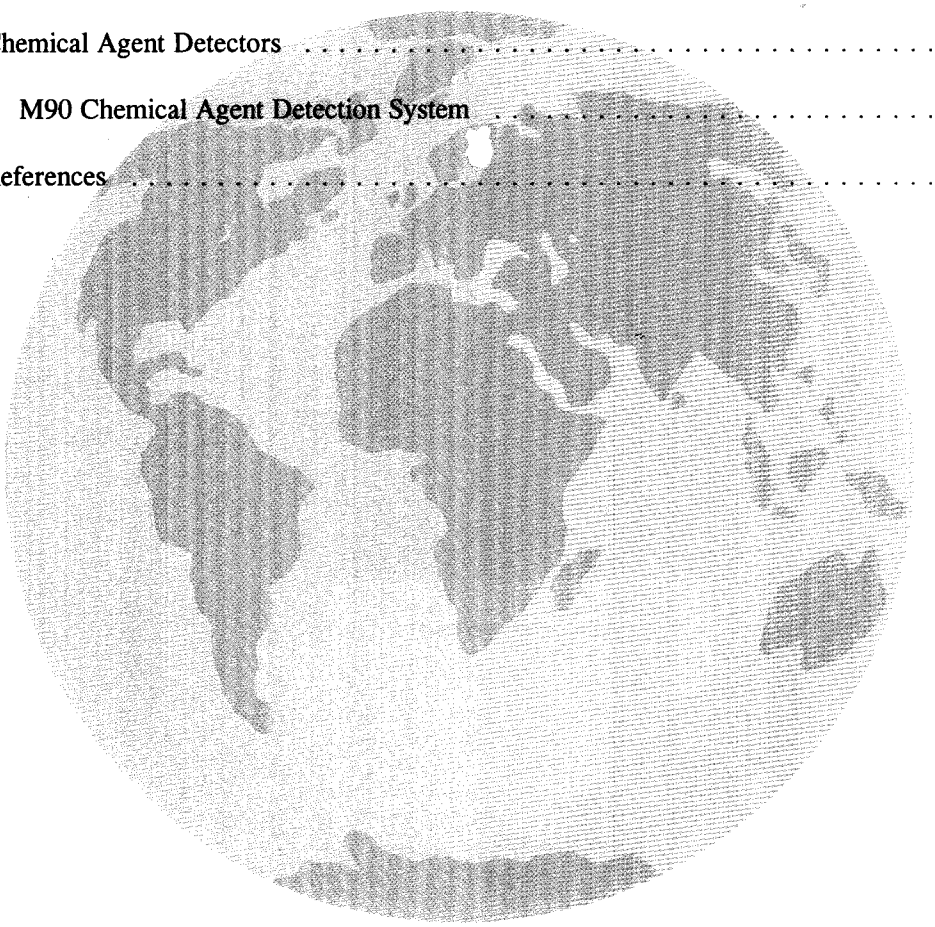
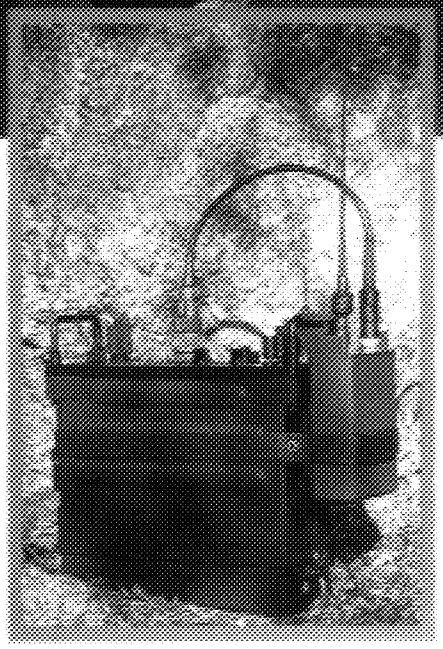


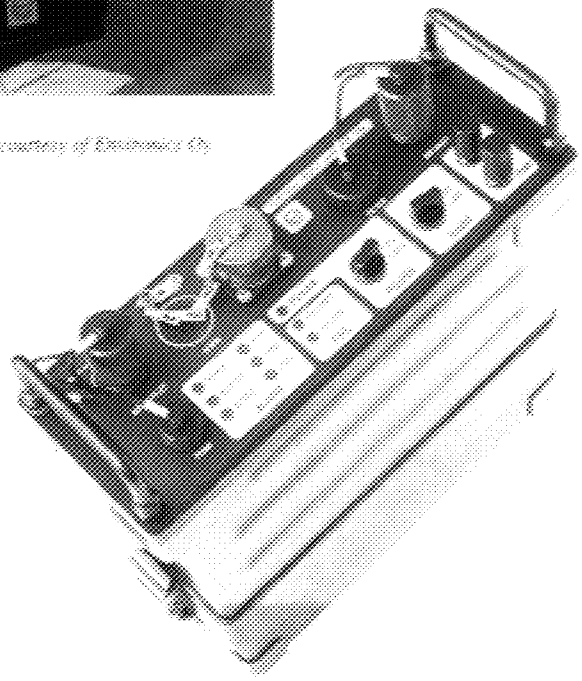
7.1 CHEMICAL AGENT DETECTORS

The M90-PA Personal Alarm Unit



The M90-TM Transmitter

Photo courtesy of Environics Oy



The M90 Chemical Warfare Agent Detector

- **Designator(s):** M90

- **Item Name(s):** M90 Chemical Agent Detection System

- **Item Description:** The M90 Chemical Agent Detection System is a network of equipment designed to meet chemical warfare agent detection, alarm and monitoring requirements. It is a versatile system, providing rapid identification and response to the presence of chemical warfare agents in the air, whether used in field settings or for shelter monitoring. The main unit in the system is the M90 Chemical Warfare Agent Detector. This improved version of the M86/A detector is capable of recognizing numerous chemical warfare agents and can be programmed to recognize interferents which would otherwise cause false alarms. It is completely programmable, so new agent characteristics can be entered at any time. The M90 is equipped with serial ports RS-232, RS-422 and RS-485 for formatted digital outputs. Communication can be accomplished via wireless systems, telephone lines and data networks. The M90-RH1 Alarm Unit is a remote alarm that sends a signal to the main unit from a distance of up to two km. It is battery operated. With the M90 Alarm Center, up to four detectors can be connected and alarm information received. Field radios or cable networks can be used to communicate. [2,7]

  The M90-PA Personal Alarm Unit, a dedicated radio message receiver, and the M90-TM Transmitter provide extended warning capabilities to the M90 Detector Base Unit. In combination with the M90, these pocket-sized, low-cost units provide an immediate secured alarm message to every individual in the military operation. The signal transmission range is three to five kilometers. The M90-PA clips to equipment or clothing and has selectable alarms that are either audio, visual or both. The M90-TM is a dedicated transmitter which attaches to the M90 and has two operation modes: the auto mode which is an automatic gas alarm transmission or the manual mode which is a manual verification of the detector alarm and transmission. Both the M90-PA and the M90-TM are recorded by an automatic code loader as often as needed so this provides a security coded alarm message. Additional features include the ability of the user to select the transmission protocol and frequencies. [1]

- **System Components:** An M90 CWA Detector (Base) Unit. [1,7]

  The following are related components for various applications: [2]

  Portable/Monitoring Use: Carrying Bag
  Monitoring Tube
  External Dust Filter

  Field Networks: Alarm Center
  Alarm Unit
  Transmitter
  Personal Alarm Unit

  Fixed Installations: Mounting Cabinet (options consist of a preheater, a prefilter, an external pump and a battery charger)
  Control Unit
  Remote Horn
  Control Center

- **System Components (continued):**

  Power Units: Rechargeable NiCd Battery
  Nonrechargeable Lithium Battery
  Main Power Supply
  Vehicle Power Supply Unit
  Mg Battery

  Training System: Trainer Unit
  Training Detector

- **Support Equipment:** No consumables. Field maintenance is limited to batteries and air filters, with fully modular repairs which reduce maintenance time. [2]

- **Equipment Hardness:** NBC Survivable, EMI-EMP tested. [3]

- **Dimensions and Weight:**

PARAMETERS	M90 [6]	M90-PA [1]	M90-TM [1]	M90-RH1 [7]
Length	28 cm	6.2 cm	5.4 cm	17.4 cm
Width	10.5 cm	1.5 cm	4.2 cm	8.1 cm
Height	28 cm	8.6 cm	10 cm	9.1 cm
Weight	4.7 kg	0.12 kg	0.87 kg	0.68 kg

- **Technology:** The improved sensor technology used in the M90 detector is based on Ion Mobility Spectroscopy (IMS). The M90 is an aspiration condenser type IMS detector combined with an Advanced Signal Pattern Recognizing Method (ASPRM) and supported by semiconductor sensor. The ASPRM compares the characteristic patterns from flowing gases to characteristic patterns programmed into the internal memory. This patented technology makes it possible for the M90 to monitor for several types of compounds simultaneously. [1,2,3,5,8]

- **Status:** In production. [9]

- **Uses:** Can be placed upwind as a point detector and alarm, or can be mounted on vehicles for mobile use. It also has a "feed tube" that can be used to check vehicles and personnel for contamination. It is widely used in fixed installations. It is compatible with all communication systems, and a remote alarm unit can be placed at distance up to 2,000 m. [6]

- **Deployment:** Deployed and delivered to U.S. Air Forces as well as to various clients in Europe, the Middle East and Far East; tested and under evaluation by the U.S. Army. [3,7]

- **Agents Detected:** [6]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY [7]	RESPONSE TIME [7]
Blister	HD	0.2 mg/m^3	10 seconds
	L	0.8 mg/m^3	80 seconds
Blood	AC	*	*
Nerve	GA	*	*
	GB	0.02 mg/m^3	2 seconds to 4 seconds
	GD	0.02 mg/m^3	2 seconds to 5 seconds
	VX	0.02 mg/m^3	5 seconds to 10 seconds

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** Alarm responds in 10 seconds or less for the lowest concentrations. [7]

  See ***Agents Detected*** for further information.

- **False Responses/Interferents:** Completely programmable, therefore potential interferents can be programmed into the unit. The detector recognizes the characteristic signal pattern of an interferant without sending an alarm signal. [2,5]

- **Safety Features/Safety Hazards:** Uses the radioactive source Am^{241} in a quantity of 160 μCi. [7]

- **Power Requirements:** [1]

M90:	There are two ways that power can be supplied; (1) the battery connection at the bottom of the detector or (2) a multipurpose connector.
M90-PA:	Lithium battery, approximately one year operation.
M90-TM:	Powered by the M90.
M90-RH1:	Battery operated; uses three dry cells (9 V).

- **Transport Requirements:**

M90:	Easily transported. [2]
M90-PA:	Clips on equipment or clothing. [1]
M90-TM:	Easily transported. [2]
M90-RH1:	Easily transported. [7]

- **Personnel Requirements:** Easily operated by field personnel. [2]

- **Operational Information:** [6]

  Operational Temperature: -30°C to +55°C.
  Relative Humidity: 5% to 95%.

- **Stock Number(s):** None. [3]

- **Miscellaneous:** [1]

  Shelf Life: Over five years (M90-PA).

- **Contact(s):**

  Manufacturer:
  Environics Oy
  Työmiehenkatu 2
  50101 Mikkeli
  Finland
  Tel: 0358 55 177011
  Fax: 0358 55 177013 [4]

  U.S. Affiliate:
  TEMET USA, Inc.
  737 Walker Road, Suite 1
  P.O. Box 439
  Great Falls, VA 22066
  U.S.A.
  Tel: (703) 759-6000
  Fax: (703) 759-6867 [9]

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Chapter 8 - FRANCE

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8.1 CHEMICAL AGENT DETECTORS

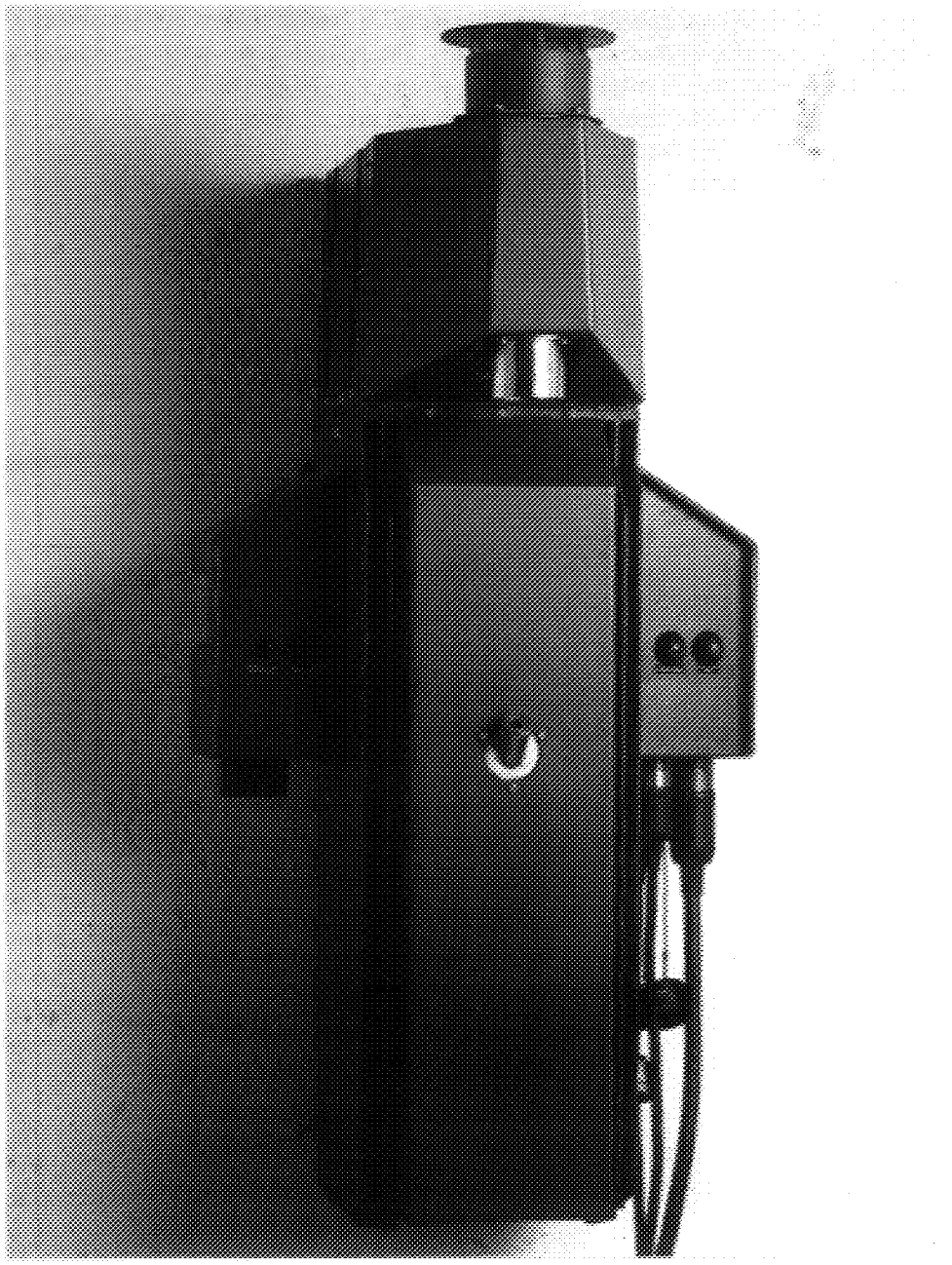

Photo courtesy of PRIENGEN

The French Local Detection Unit for Fixed Installation (ADLIF)

- **Designator(s):** ADLIF

- **Item Name(s):** ADLIF Local Detection Unit for Fixed Installation

- **Item Description:** The ADLIF is a detector that can be mounted in fixed locations for the detection of organophosphorus compounds (nerve agents) and organosulphur compounds (mustard agents) in the atmosphere. A warning signal is issued when a predetermined concentration *x* time (Ct) occurs in an air sample. The ADLIF is designed to withstand harsh environmental conditions. A remote alarm unit allows it to be mounted in areas that are not easily accessible. This item consists of a detector unit and an electrolyzing unit which must be filled once a month. With the exception of refilling the electrolyzing unit, it can operate maintenance-free in a fixed location for two years. A hydrogen cylinder can be connected to the detector unit in place of the electrolyzing unit. [23,27]

- **System Components:** [23,27]

  Accessories
  Detector
  Electrolyzing Unit or Hydrogen Cylinder

- **Support Equipment:** [23,27]

  Chemical Alarm Repeater Unit
  Chemical Alarm Signal Unit
  Electrical Supply

- **Equipment Hardness:** The exterior housing of the ADLIF is made of watertight cast-aluminum. It is not affected by dust or sea spray. It is explosion-proof and protected against Electro-Magnetic Interference (EMI) and electrical radio signal interference. [23,27]

- **Dimensions and Weight:** [23,27]

Length:	91 cm
Width:	46 cm
Height:	41 cm
Weight:	50 kg

- **Technology:** Flame spectrophotometry. [23]

- **Status:** *

- **Uses:** The ADLIF can be mounted in shelters, galleries and ventilation ducts, outdoor locations and on warships. [23,27]

- **Deployment:** Used by the French Navy and is currently being delivered to several other countries. [27,28]

- **Agents Detected:** [23,27]

  Blister: HD
  Nerve: GA, GB, GD and VX

- **Detection Sensitivity:** [27]

  Phosphorus Sensitivity
  Threshold: 0.5 $\mu g/m^3$ (PH_3 Test)

  Sulfur Sensitivity
  Threshold: 80 $\mu g/m^3$ (SO_2 Test)

- **Response Time:** 3 seconds. [23]

- **False Responses/Interferents:** Sulphurated fuel smokes can interfere with readings. [28]

- **Safety Features/Safety Hazards:** Requires precautions based on its use of a hydrogen source. It must not be used in a confined space or placed near a flame source or sparks. The hydrogen and oxygen outlets should not be blocked when stored. The unit should not be overturned. Avoid contact with the electrolyzing chemical, potassium hydroxide (KOH). [27]

- **Power Requirements:** Requires an 18 V DC to 32 V DC external power source. [23,27]

- **Transport Requirements:** Nonportable; if a unit must be moved, the cell should be drained and cleaned. [23,27,28]

- **Personnel Requirements:** One person can install the unit. No special training is required for installation or operation, but an awareness of precautions for working with a hydrogen source and caustic chemicals such as KOH is necessary. [27,28]

- **Operational Information:** Uses hydrogen produced by an electrolyzing unit to operate continuously and automatically; requires that it be filled with 1.2 liters of distilled water once a month. The electrolyzing solution consists of a solution of KOH and distilled water. A hydrogen cylinder can be used in place of the electrolyzing unit. The remote alarm is housed in a box which sends an alarm signal for a predetermined concentration of agents in the air. The alarm can be pre-programmed for concentration settings. The alarm is triggered separately by the type of agent detected (nerve agents or mustard agents). A remote control unit uses a simulant to test the detector unit for correct operation. [23,27]

  Operational Temperature: -32°C to +50°C. [27]

- **Stock Number(s):** IF 234. [28]

- **Miscellaneous:** [23]

  MTBF: 20,000 hours
  Storage Temperature: -39°C to +72°C [23,27]

- **Contact(s):** PROENGIN under DRET-CEB contract with the cooperation of the Centre D'Etudes du Bouchet. [27]

Developer:
Centre D'Etudes du Bouchet (CEB)
BP3-91710 Vert Le Petit
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Manufacturer:
PROENGIN SA
3 rue de l'Industrie
F-78210 Saint Cyr L'ecole
France
Tel: 033 130 584734
Fax: 033 130 589351
Telex: 697 113 F PROENG [27,28]

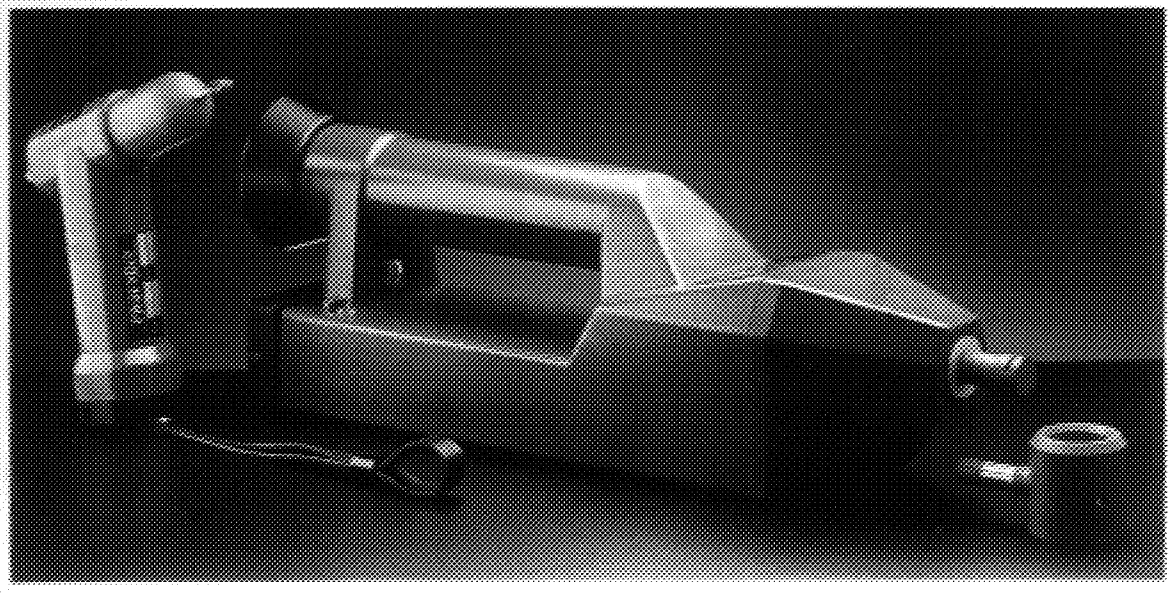

Photo courtesy of GIAT Industries

The AP2C Monitor with the Liquid Agent Sampling Tip (S4 PE)

Photo courtesy of PROENGIN

The APACC consisting of an AP2C Monitor and an ADAC Alarm Unit. The ADAC module replaces the AP2C battery compartment.

Designator(s): APACC

- **Item Name(s):** APACC Chemical Control Alarm Portable Apparatus

- **Item Description:** The APACC is a lightweight alarm unit comprised of the Portable Contamination Test Apparatus (AP2C) with an ADAC alarm unit that fits into the battery compartment of the AP2C. The AP2C is designed to detect and monitor for the presence of elemental phosphorus and sulfur in a given air sample. This detection technology allows the APACC to be used to detect the presence of nerve agents (organophosphorus compounds) and mustard agents (sulfur containing compounds) in the atmosphere. The ADAC alarm unit is activated to provide both an audible and visible alarm for a predetermined concentration *x* time (Ct). Two Ct thresholds are available for each detection line (G agents and HD agents). The alarm signal can be transmitted to a remote alarm unit using a twin-core line, or to a synthesis cabinet. The alarm signals can be transmitted 1,000 meters using a standard conductor, but there is no limitation when signal amplification is used. To detect liquid contamination, a special sampling tip is used to collect the sample which is then heated to desorb the contamination into vapor form for detection. The AP2C monitor can operate autonomously from 12 hours to 24 hours depending on conditions. [2,7,12,18,23]

  The APACC is available in two versions: a portable version, using the same battery as the AP2C and a version for use on vehicles which uses the power supply provided by the on-board system. [23]

- **System Components:** [2,7,18]

  ADAC Unit
  AP2C Monitor
  Hydrogen Cartridges (metal hydride storage device)
  Inlet Adapters
  Liquid Contamination Sampling Device (SP4E)
  Power Supply (battery or adaptor for external power source)
  Sample Scrapers

- **Support Equipment:** [8,18,22]

  AP2C Diagnostics Module
  Ear Phone Headset
  Remote Alarm Unit

- **Equipment Hardness:** The AP2C complies with MIL-STD-810D. The housing is made of cast aluminum and is watertight in its transport configuration. The detector is protected against EMP and extreme power surges/pulses. The detector has been evaluated for NBC Survivability against chemical agents and some decontamination solutions. [8,16,18]

- **Dimensions and Weight:**

PRMTRS	APACC [2] (Model 223 E30)	BASE DETECTOR [18] (w/batteries)	BATTERY UNIT [18]	HYDROGEN STORAGE UNIT [18]
Length	41.5 cm	44.4 cm	7.7 cm	16.9 cm
Width	8.6 cm	8.7 cm	6.7 cm	2.6 cm
Height	13 cm	14.1 cm	3.3 cm	*
Weight	2.2 kg	2.2 kg	0.2 kg	0.2 kg

- **Technology:** The detection capability of the AP2C Monitor is based on the principles of flame spectrophotometry. [8,18]

- **Status:** In production. [18]

- **Uses:** It can be used as a monitor for initial contamination hazard or as a monitor for residual contamination following decontamination. The APACC can be hand-held in its portable configuration, placed on the ground, or vehicle mounted using an antivibratile bracket. [7,18]

- **Deployment:** The APACC is used by the French Army, Navy, Air Force and medical services. The AP2C was used during the Persian Gulf War. [7]

- **Agents Detected:** The AP2C can detect sulfur containing blister agents and phosphorus containing nerve agents. See chart below for further details.[2,7,8,18,27]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD	Minimum related to the concentration of H in the mixture	2 seconds
	Neat and Thickened	0.4 mg/m^3	2 seconds
Nerve	GA, GB, GD and GF Neat and Thickened	0.01 mg/m^3	2 seconds
	VX	0.015 mg/m^3	2 seconds

- **Detection Sensitivity:** [27]

G-agents (Upper Value): Ct = 50 $\mu g/m^3 \cdot$ minute
(Lower Value): Ct = 2 $\mu g/m^3 \cdot$ minute

H-agents (Upper Value): Ct = 1 $mg/m^3 \cdot$ minute
(Lower Value): Ct = 0.1 $mg/m^3 \cdot$ minute

See ***Agents Detected*** for further information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** Sulfurated fuel smokes can interfere with readings. [27]

  False responses and interferents are easy to recognize even in battlefield conditions after a short training course for the user. [28]

- **Safety Features/Safety Hazards:** Cannot be operated in a flammable environment. [18]

- **Power Requirements:** The monitor is powered by an 18 V DC to 32 V DC lithium battery or by an external power supply. [7,8]

  The detector needs an inverter to run off of vehicle power (19 V to 32 V, 0.1 A to 1.5 A).[18]

- **Transport Requirements:** The APACC is portable but can be vehicle mounted. The detector can operate on a ship or in an aircraft up to 3,000 meters [7,8,18,23]

- **Personnel Requirements:** Minimal; can be hand-held.[8,18]

- **Operational Information:** The APACC can be operated by personnel in full NBC protective ensembles. The user has 12 hours of non-stop working time, even at low temperatures which need more power for heating the hydrogen storage device. Measurements may begin 10 seconds after starting (one minute at normal temperature if replacing the hydrogen cylinder and three minutes at cold temperature (-20°C) due to the need to purge the hydrogen circuit). The replacement of the cylinder is instantaneous. To operate, insert the battery, insert the hydrogen cylinder, turn the tip of the hydrogen cylinder until the white mark faces the "ON" index. The system is operating when the green "READY" light glows. [22]

  The alarm is activated for a predetermined Ct. The unit can also be used as a point sampling alarm, monitor/survey instrument, and as a collective protection equipment monitor. The alarm will signal for a constant Ct of 100 $\mu g/m^3$ of G agent and VX for one minute, and/or 1 mg/m^3 of HD for one minute. Return to zero is established by a push button on the portable version and from the control panel for the vehicle version.[7,18,23]

  The APACC is operational up to 3,000 meters altitude and complies with MIL-STD-810D. It is hardened against humidity and rain. [7,8]

Operational Set-up Time:	Less than 10 minutes at temperatures below 0°C [7] Less than 2 minutes at temperatures above 0°C (no calibration necessary during set-up) [7,18]
Operational Temperature:	-32°C to +55°C [2]
Relative Humidity:	0% to 95% [18]

- **Stock Number(s):** 66-65-14-460-2523 (NATO) for AP2C. [28]

- **Miscellaneous:** The APACC detects chemical agent precursors and degradation products. [27]

  Decontaminable with DS2, hot soapy water and methyl alcohol. [18]

Maintenance:	Integrated auto-test for first level maintenance, automatic diagnostic box for second level maintenance, computerized test bench for third level maintenance [7]
Shelf Life:	Ten years (APACC) [18]
Storage Temperature:	-39°C to +75°C [18]

- **Contact(s):** The APACC is developed by PROENGIN under DRET-CEB contract, with the cooperation of the Centre du Bouchet. [27]

  Developer:
  Centre D'Etudes du Bouchet (CEB)
  BP3-91710 Vert Le Petit
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  Telex: SEBCVER 692 776 F [16]

  Manufacturers:
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  Tel: 033 130 973737
  Fax: 033 130 973900 [18]

  (Electronic Optical Board)
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  Route d'Eygúieres
  13113 Lamanon
  France
  Tel: 033 90 595959
  Fax: 033 90 595518 [18]

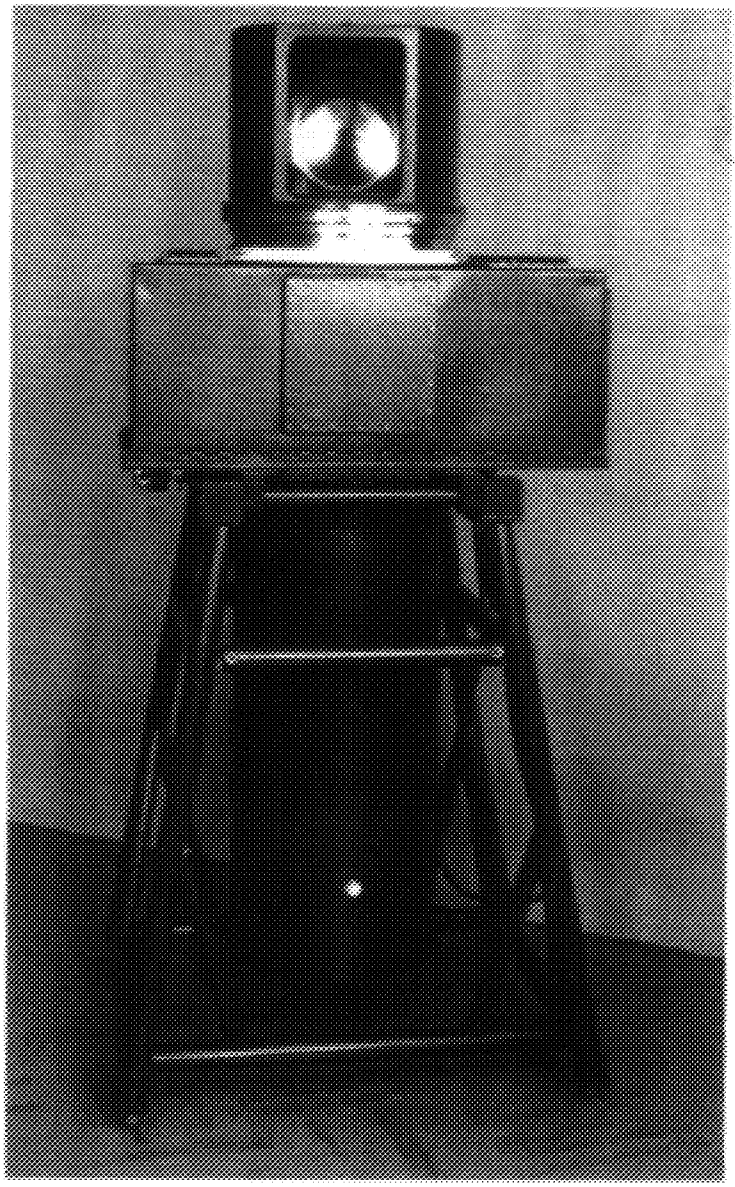


Photo courtesy of the Centre D'Etudes du Ronchet (CED)

The DETADIS by CILAS

- **Designator(s):** DETADIS

- **Item Name(s):** DETADIS Detection Device
  Remote Laser Sensor of Chemical War Agents
  Dispositif de Detection a Distance des Agents Chimique de Guerre par Laser

- **Item Description:** The DETADIS is a developmental laser detector designed for the remote detection of chemical warfare agent vapors. It is designed for area surveillance, stand-off detection, identification and quantitative measurement (concentration *x* times cloudlength) of nerve and blister agents. The system measures the differential absorption of two Transverse Excited Atmospheric (TEA) CO_2 pulsed laser beams emitted toward landscape targets which have been selected and stored in memory. A double warning system consists of an automatic transmission to the computer network and an alarm system with lights and/or siren. [1,14,20]

- **System Components:** [14,20]

  Command Keyboard
  Display Unit
  Electronic Box (Central Processing Unit)
  Optronic Station (optical head that is mobile both in elevation and azimuth, laser unit containing one tuneable CO_2 laser and one reference CO_2 laser and a power supply)

- **Support Equipment:** None. [28]

- **Equipment Hardness:** Designed for resistance to mechanical stress such as vibrations and shock as well as survivability in an NBC environment. [14]

- **Dimensions and Weight:** [14,20]

PARAMETERS	OPTRONIC STATION	ELECTRONIC BOX	DISPLAY UNIT	COMMAND KEYBOARD
Length	*	30 cm	26 cm	30 cm
Width	40 cm (diameter)	30 cm	15 cm	20 cm
Height	150 cm	22 cm	10 cm	3 cm
Weight	$\leq$150 kg	$\leq$15 kg	$\leq$4 kg	$\leq$2 kg

- **Technology:** Based on the differential absorption mode called DIAL (Differential Absorption LIDAR). [6]

- **Status:** In development for military use. It has been field tested and is awaiting the industrialization phase. [14,20]

- **Uses:** Can be used as a stand-alone unit or vehicle-mounted and may be employed for remote area, point or installation surveillance. [11,14]

- **Deployment:** None. [28]

- **Agents Detected:** [20]

  Blister: H (when complementary passive detector is used)
  Nerve: GB, GD and VX

- **Detection Sensitivity:** Senses vapors with a concentration of 300 $mg/m^3/m$ or greater. [11,14]

- **Response Time:** The maximum warning delay is 30 seconds. [14]

- **False Responses/Interferents:** None. [28]

- **Safety Features/Safety Hazards:** High voltage hazards exist. [28]

- **Power Requirements:** The power required is less than 500 watts. It requires a 24 V DC power supply. [20]

- **Transport Requirements:** Not portable; vehicle transport is required. [20]

- **Personnel Requirements:** One skilled person can operate. [28]

- **Operational Information:** In one minute, it scans a sector of 180° in azimuth and $\pm 10°$ in elevation. A range of three km has been achieved during development. [10,11,14]

  Operational Temperature: -32°C to +49°C.

- **Stock Number(s):** Not yet assigned. [28]

- **Miscellaneous:** Peak power emission from lasers is 500 kW. [11,14]

  Memorization Capability: 10 to 20 natural targets
  Repetition Rates: 5 Hz and 10 Hz

- **Contact(s):**

  Developers: Centre D'Etudes du Bouchet (CEB)
  BP3-91710 Vert Le Petit
  France
  Tel: 033 64 932261
  Telex: SEBCVER 692 776 F [6]

- **Contact(s) (continued):**

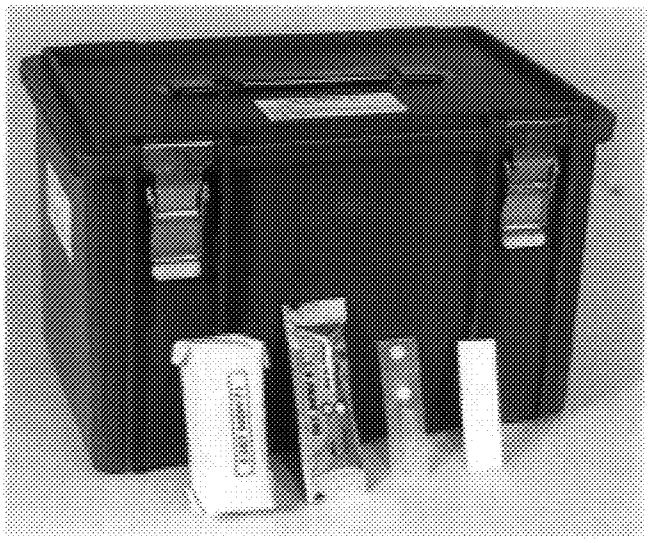
Compagnie Industrielle des Lasers (CILAS)
Route de Nozay BP 27
Marcoussis, F-91460
France
Tel: 033 164 544800
Fax: 033 169 013739
Telex: 601862 f [20]

Manufacturer:

CILAS ALCATEL
Rue de la Terre-de-Feu
Z.A. de Courtaboeuf
91940 LES ULIS
Tel: 033 69 288450
Fax: 033 69 287326
Telex: 600485 F [15]

The DET INDIV Individual Nerve Gas Detector (Détecteur Individual De Contrôle De Neurotoxiques) by GIAT Industries

Photos courtesy of GIAT Industries



The DET INDIV is available in metal boxes containing 275 detectors per box. (55 packs of 5 detectors per packet)

The DET INDIV detectors are each sealed in an aluminum polyethylene bag. The detectors are then grouped in packets containing five detectors per packet.

- **Designator(s):** DET INDIV

- **Item Name(s):** DET INDIV Individual Nerve Agent Detector
  Détecteur Individual De Contrôle De Neurotoxiques
  Individual Neurotoxic Product Detector
  Individual Nerve Gas Detector

- **Item Description:** The DET INDIV detects the presence of nerve agents in vapor form. It is a thin strip of plastic. On one-half of the strip are two paper discs, one white and the other pink. An ampule containing the reagent is enclosed in a tube which is molded on the other half of the plastic strip. The ampule is broken manually and the reagent flows to the paper disc. The plastic strip is waved in the air for contact with nerve agent. A blue color indicates the absence of nerve agents. A white surface indicates the presence of nerve agents. The detectors are stored individually in sealed, waterproof aluminum/polyethylene packaging. The detector packets are also available in a larger packet containing five individually wrapped detectors per packet. A large waterproof box containing 275 detectors is also available. A set of two boxes comes in reinforced packaging. [3,9]

- **System Components:** The plastic strip is designed with the following components: [3]

  Glass Container (filled with a buffer solution)
  Paper Disc (one impregnated with colorless enzymes and another impregnated with a pink substrate)
  Tube (allowing the flow of liquid to the enzyme treated paper disc)

- **Support Equipment:** None. [3]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [3,19,26]

PRMTRS	INDIVIDUAL PLASTIC DETECTOR STRIP	DETECTOR STRIP (in aluminum packaging)	METAL BOX (containing 275 DET INDIV [55 packets of 5 detectors])
Length	8 cm	12 cm	33 cm
Width	0.8 cm	4 cm	20 cm
Height	2.5 cm	0.5 cm	20.5 cm
Weight	4.6 g	30 g	3.54 kg

- **Technology:** Uses the biochemical inhibition of cholinesterase by nerve agents. An enzyme reaction produces a blue color change in the absence of nerve agents. [19]

- **Status:** Fielded. [3,9,19]

- **Uses:** A vapor nerve agent detector which allows individual soldiers to unmask following a possible exposure to nerve agents in vapor form. [9]

- **Deployment:** Used by the French Forces as well as by foreign forces. [3,9,19]

- **Agents Detected:** (in vapor form). [3]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Nerve	GA	0.05 mg/m^3
	GB	0.01 mg/m^3
	GD	0.02 mg/m^3

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** Requires approximately eight minutes to complete the full detection sequence (five minutes for exposure to atmosphere, 20 seconds for reagent transfer, two minutes for color development). [3]

- **False Responses/Interferents:** Chlorine vapors. [26]

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** None. [9]

- **Transport Requirements:** Small and portable. [3]

- **Personnel Requirements:** The Nerve Gas Detectors are made for individual use. [3,9]

- **Operational Information:** Operated by removing the detector from the wrapping and then removing the protection sheet. Next, the container within the detector must be broken (using the thumb and the forefinger) and exposed to the air for five minutes. After exposure, the disc is folded over onto the white disc and successively pressed several times in 20 seconds. After two minutes the white surface is checked. No nerve agents are present if there is a blue color. White indicates the presence of nerve agents. [3,9]

- **Stock Number(s):** 6665-14-363-9378 (NATO). [26,28]

- **Miscellaneous:** [3,9,26]

Plastic Case of 275 detectors: Reference 062854 B
Package of 5 detectors: Reference 062861 J
Shelf Life: 3 years

- **Miscellaneous (continued):** [3,9,26]

  Packaging: Each detector is packed in an individually sealed package made of aluminum polyethylene composite. The detectors are batched five individual detectors per larger package. The DET INDIV is stocked in a tight plastic box containing a total of 275 detectors (55 packages of five DET INDIVs).

- **Contact(s):**

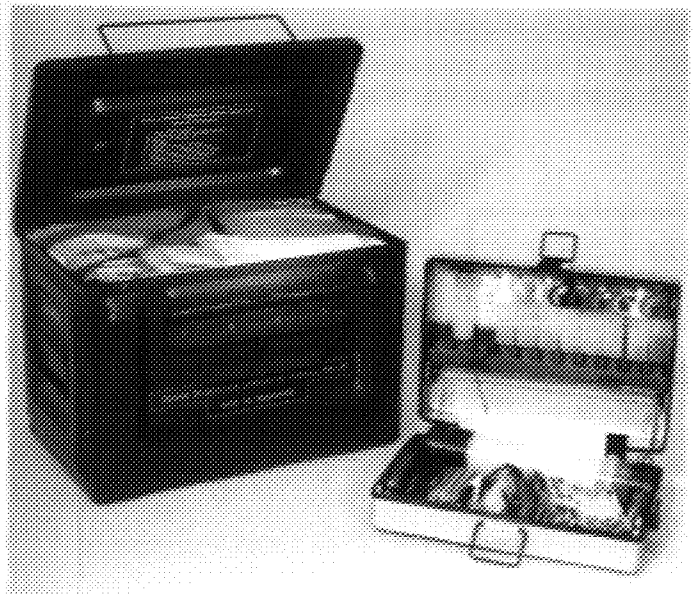
  Manufacturer:
  GIAT-Industries
  Branche Gitech-NBC
  13 route de la Miniére
  F-78034 Versailles Cedex
  France
  Tel: 033 139 498102
  Fax: 033 139 498106 [22]

The TDCC Chemical Detection Control Kit by GIAT Industries (Trousse De Détection Chimique et De Contrôle)

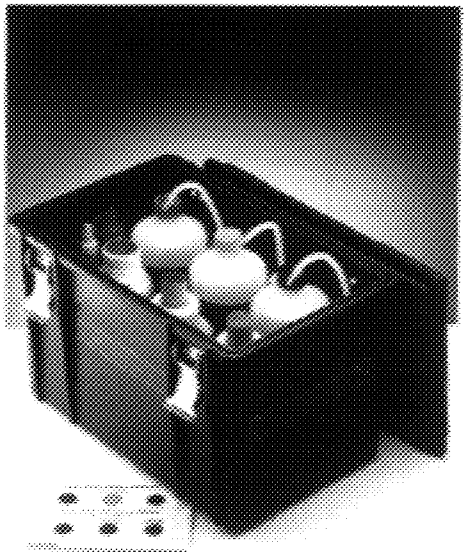
Photos courtesy of GIAT Industries

The TDCC Test Kit Components

The TDCC in use



The TDCC and the Refill Kit



The TDCC Training Kit

- **Designator(s):** TDCC

- **Item Name(s):** TDCC Chemical Detection Control Kit
  Trousse de Détection Chimique de Contrôle (TDCC Model 1 bis)
  Chemical Detection and Monitoring Test Kit Model 1 bis

- **Item Description:** The TDCC is used to detect and identify chemical agent vapors in the air and liquid contamination in water and on various surfaces. A hand pump draws a constant volume of ambient air through an absorbent paper disc mounted at the end of the pump via a special fitting. Toxic agents adhering to the paper are identified after exposure to one or more of eight reagents provided in the kit. The reagents produce a color change that is specific to each type of chemical agent. These reagents are stored in sealed glass vials until needed. The vials are broken in a flexible plastic container which is designed to mix and pour off pre-determined volumes of reagents. Liquid contamination is identified using the detection paper included in the kit. [4,5,13,24]

- **System Components:** [21]

  Accessories (cotton plugs, adapters for US and Dutch equipment)
  Air Sampling Tags (40)
  Booklets of Detecting Paper (2)
  Carrying Case
  Hand Pump
  Reagent Containers (8)
  Refill Kit (10 days of intensive use)

- **Support Equipment:** A box of consumable products is needed to refill the kit for 10 days of intensive use. A training kit that includes simulants is available for instructional use. [21,24]

- **Equipment Hardness:** The carrying case is air-tight and decontaminable. [28]

- **Dimensions and Weight:** [5]

PARAMETERS	BOX OF SPARES	KIT
Length	33 cm	25 cm
Width	20 cm	15 cm
Height	20.5 cm	6.5 cm
Weight	7 kg	1.2 kg

- **Technology:** The detection and identification capabilities are based on visible colorimetric chemical and biochemical reactions. [21]

- **Status:** In production and fielded. [4,5,21]

- **Uses:** It can be used to monitor and detect chemical warfare agents in the atmosphere, in water and on surfaces. It can also be used for the identification of these agents and provide a general estimate of their concentrations. [21]

- **Deployment:** In service with the French forces as well as by foreign forces. [25]

- **Agents Detected:** [4,5,13,21,24]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	HD and HN	1 mg/m^3 [21] >0.15 mg/m^3 [25]
Blood	AC	0.35 mg/m^3 [5,13,21,25]
	CK	2 mg/m^3 [4,5,13,25]
Choking	CG	2 mg/m^3 [4,5,13,25]
Nerve	GA (chemical reaction)	3.5 mg/m^3 [21]
	GB (chemical reaction)	0.10 mg/m^3 [21]
	GA and GB (biochemical reaction)	0.001 mg/m^3 [4,5,13,25]
	V Agents (biochemical reaction)	0.0001 mg/m^3 [25]

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** Five minutes; a four operations procedure covers the whole range of toxic detection. The TDCC requires two minutes for each detection. A full detection sequence requires 30 minutes if there is no information known about the nature of the toxic substance. [21,25]

- **False Responses/Interferents:** [21]

AGENT(S) DETECTED	FALSE POSITIVE RESPONSES	INTERFERENTS
Biochemical Detection of G and V Agents	Phosphorus Vapors (incendiaries)	Chlorine Vapors (decontaminants)
Chemical Detection of G Agents	Chlorine Vapors (exhaust gas) High concentrations of HD and CG	*
CG	Hexachloroethane (obscurant)	*
HD/HN	Hexachloroethane	Chlorine Vapors
AC CK	Hexachloroethane Exhaust and Explosion Gas Chlorine Vapors	*

- **Safety Features/Safety Hazards:** None. [28]

- **Power Requirements:** A battery type BA 30, 1.5 V is required for lighting. [21]

- **Transport Requirements:** Portable; carried by one person. [26,28]

- **Personnel Requirements:** Requires one person for air sampling; however, it is preferable to have two people for detection from water or soil samples. The TDCC can be operated day or night by a one person. [21,25]

- **Operational Information:** The pump is used to draw an air sample through a sample tag fitted to the specially designed rubber nozzle. This nozzle can also be fitted to a sample socket and, with the use of an adapter, to United States detecting tubes or Dutch buttons. A battery-powered light is included on the pump. Polyethylene containers hold glass vials of reagents which are crushed inside the container prior to use. A color-coded cap delivers the appropriate amount of reagent for use on the sample tag. The sample tags consist of two disks of silica paper, one for sampling and one to be used as a reference. Paper tickets impregnated with reagents are used to detect liquid mustard and nerve agents. Specific color reactions occur for HD, G and V agents. Samples can be heated with copper chloride if necessary. [25]

- **Stock Number(s):**

  F5321 TDCC MLE 1 BIS 151 [26]
  8145-14-406-1051 [28]

- **Miscellaneous:** [4]

Various accessories are provided to:	Perform night-time detection Use specific reagents in service with other armies Provide energy needed for chemical reactions Record the operations Supply/take samples from contaminated objects
Maintenance:	The TDCC must be aired out after use in a contaminated area. After each day's use, the accessories must be cleaned (and decontaminated if necessary). If vials have been crushed, containers must be replaced. [21]
Shelf Life of Reagents:	Three years (inside their glass vials) One day (after vial is opened)

- **Contact(s):**

Manufacturer:	GIAT-Industries Branche Gitech-NBC 13 route de la Miniére F-78034 Versailles Cedex France Tel: 033 139 498102 Fax: 033 139 498106 [26]

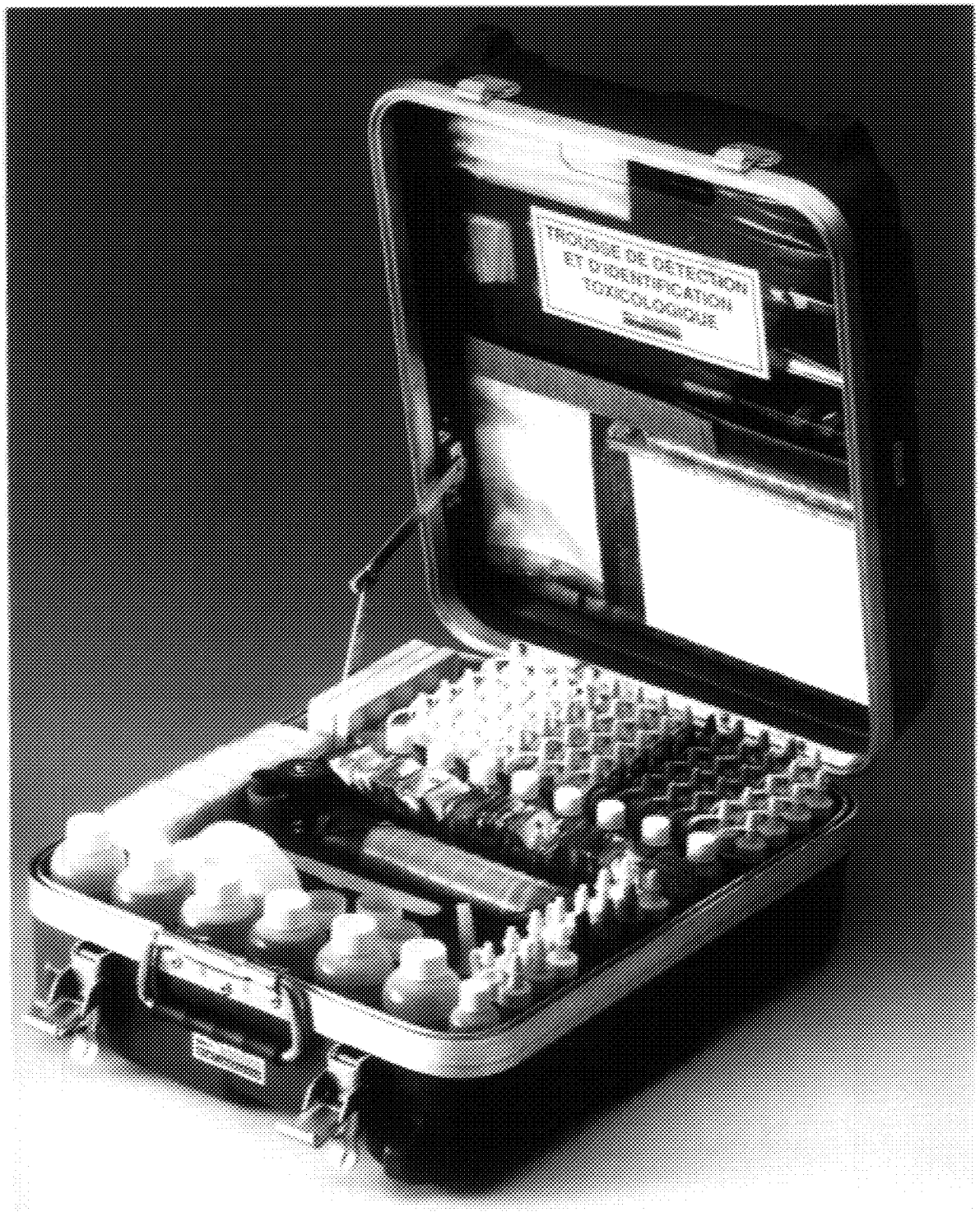


Photo courtesy of GIAT Industries

The Toxic Agent Detection and Identification Kit (Trousse Z)

- **Designator(s):** Trousse Z

- **Item Name(s):** Toxic Agent Detection and Identification Kit
  Necessaire Toxicologique Z
  La Trousse de Detection et d'Identification Toxicologique Z

- **Item Description:** The Toxic Agent Detection and Identification Kit is a portable wet chemistry kit containing chemicals, reagents and lab equipment that can be used to detect and identify toxic chemical agents in the air, materials, soils, foodstuffs with low humidity, water, fatty substances and meat. A training kit with simulants is also available. [17]

- **System Components:** [17]

  Carrying Case
  Reagents (16 in varying quantities)
  Sampling Equipment (including tweezers, scissors, bags, flasks, etc.)

- **Support Equipment:** None.

- **Equipment Hardness:** The metal case is airtight and decontaminable. [29]

- **Dimensions and Weight:** [17]

Length:	40 cm
Width:	40 cm
Height:	15 cm
Weight:	5 kg

- **Technology:** Uses wet chemistry methods to produce identifying reactions. [17]

- **Status:** In production. [17,26,29]

- **Uses:** The Toxic Agent Detection and Identification Kit can be used for the identification and/or verification of chemical agent contamination in air, water, soil, materials and food. It can be used by medical personnel for treatment evaluation and by reconnaissance teams. [17,29]

- **Deployment:** Used by the French medical corps as well as by specialized chemical reconnaissance teams of the Health Services of French Forces. [17,26,29]

- **Agents Detected:** (in air) [17]

AGENTS CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	H and HN	0.15 to 1.0 mg/m^3 (depending on humidity)
	L	0.09 mg/m^3
Blood	AC	0.35 mg/m^3
	CK	2.0 mg/m^3
Choking	CG	2.0 mg/m^3
	Palite, Super Palite and Chloropicrin	< 1.0 mg/m^3
Nerve	GA	0.010 mg/m^3
	GB	0.005 mg/m^3
	V Agents	*
Tear	CN	1.0 mg/m^3
Vomiting	Diphenylaminochlorarsine	*
Other	Hydrogen Arsenide	0.2 mg/m^3

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** Depends on the agent. [26]
- **False Responses/Interferents:** Chlorine can cause a false response. [26]
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None.
- **Transport Requirements:** Portable. [17]
- **Personnel Requirements:** One operator with training. [26]
- **Operational Information:** *
- **Stock Number(s):** F532100104897C. [26]
- **Miscellaneous:** *

- **Contact(s):**

Manufacturer:

GIAT-Industries
Branche Gitech-NBC
13 route de la Miniére
F-78034 Versailles Cedex
France
Tel: 033 139 498102
Fax: 033 139 498106 [26]

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Chapter 9 - GERMANY

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9.1 CHEMICAL AGENT DETECTORS

Photo courtesy of Bruker Saxonia Analytik GmbH

The Bruker A2 Chemical Agent Detection System

- **Designator(s):** Bruker A2
  Bruker KAG

- **Item Name(s):** Bruker A2 Chemical Agent Detection System
  Bruker Kampfstoffalarmgeraet

- **Item Description:** The A2 is a small, microprocessor-based portable chemical warfare agent detector, which can be used to protect personnel by releasing an alarm when chemical warfare agents are detected. The A2 includes three different sensors for the detection of blister, blood, choking and nerve agents. Detection limits and response times meet NATO requirements. [28]

  Blister agents are detected by a pair of baffle cells. A measuring cell and a reference cell are arranged in an internal gas loop. Blister agents enter this gas loop by permeation through a membrane which separates the sample air stream from the measuring cell. As the detectability of negative blister agent ions is suppressed by normal environmental air humidity, the gas in the internal loop has to pass through a water absorber. This filter lasts about 24 hours under normal humidity conditions. [28]

  Blood and choking agents are detected by an electrochemical cell. When activated, the life time of this cell is up to 12 months. [28]

  Nerve agents are analyzed by means of a dynamic grid cell, which separates the heavier nerve agent cluster ions from other positive ions. [28]

  The A2 detector can be connected to a remote control and alarm unit by a two-wire field cable up to 1,000 meters in length. The remote unit provides remote alarm, control function and additional battery capacity. [28]

- **System Components:** [28]

  Detector/Alarm Unit
  Remote Control/Alarm Unit

- **Support Equipment:** [28]

  Confidence Samples
  Dust Filters
  Field Cable
  Power Cable (vehicle)
  Transport Case
  Water Absorber

- **Equipment Hardness:** Complies with German Armed Forces' standards. [28]

- **Dimensions and Weight:** (For both the detector and remote unit) [28]

  Length: 23.5 cm
  Width: 12.8 cm
  Height: 5.4 cm
  Weight: 1.5 kg

- **Technology:** Agent detection is performed by two baffle cells (blister agents), one electro-chemical cell (blood and choking agents) and one dynamic grid cell (nerve agents). [28]

- **Status:** In production. [28]

- **Uses:** Used as a point detector (with remote alarm unit standoff detector) and as a chemical alarm in order to alert personnel of NBC conditions. [28]

- **Deployment:** Currently used by the German Army Rapid Reaction Forces, NBC Defense Corps and the main German Defense Forces. [28]

- **Agents Detected:** [28]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD	10 mg/m^3 2 mg/m^3	30 seconds 120 seconds
	HN	*	*
Blood	AC	50 mg/m^3	5 seconds
Choking	CG	10 mg/m^3	20 seconds
Nerve	GB	0.4 mg/m^3 0.08 mg/m^3	5 seconds 30 seconds
	V agents	*	*

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** Uses three Am^{241} radioactive sources. [28]

- **Power Requirements:** 4Ah lithium batteries, 11.2 V. [28]

- **Transport Requirements:** Hand carried in transport case with no shipment restrictions. [28]

- **Personnel Requirements:** One person can easily use the light-weight instrument after a short training period; no special requirements. [6,28]

- **Operational Information:** [28]

  Battery Life: 24 hours
  Operational Temperature: -20°C to +50°C
  Relative Humidity: Up to 90%
  Water Dryer Life: 24 hours

- **Stock Number(s):** 6665-12-337-2376. [28]

- **Miscellaneous:** *

- **Contact(s):**

  Manufacturer:

  Bruker Saxonia Analytik GmbH
  HPA 5, PF 37
  D-04301 Leipzig
  Germany
  Tel: 049 341 2352453
  Fax: 049 341 2353605 [28]

  or

  Bruker Saxonia Analytik GmbH
  Permoserstrasse 15
  D-04318 Leipzig
  Germany [28]

  Bruker Saxonia Analytik GmbH is under contract to the German Army for mass production of the A2 detector developed by Honeywell and has no rights to produce or distribute this equipment to any third party. [29]

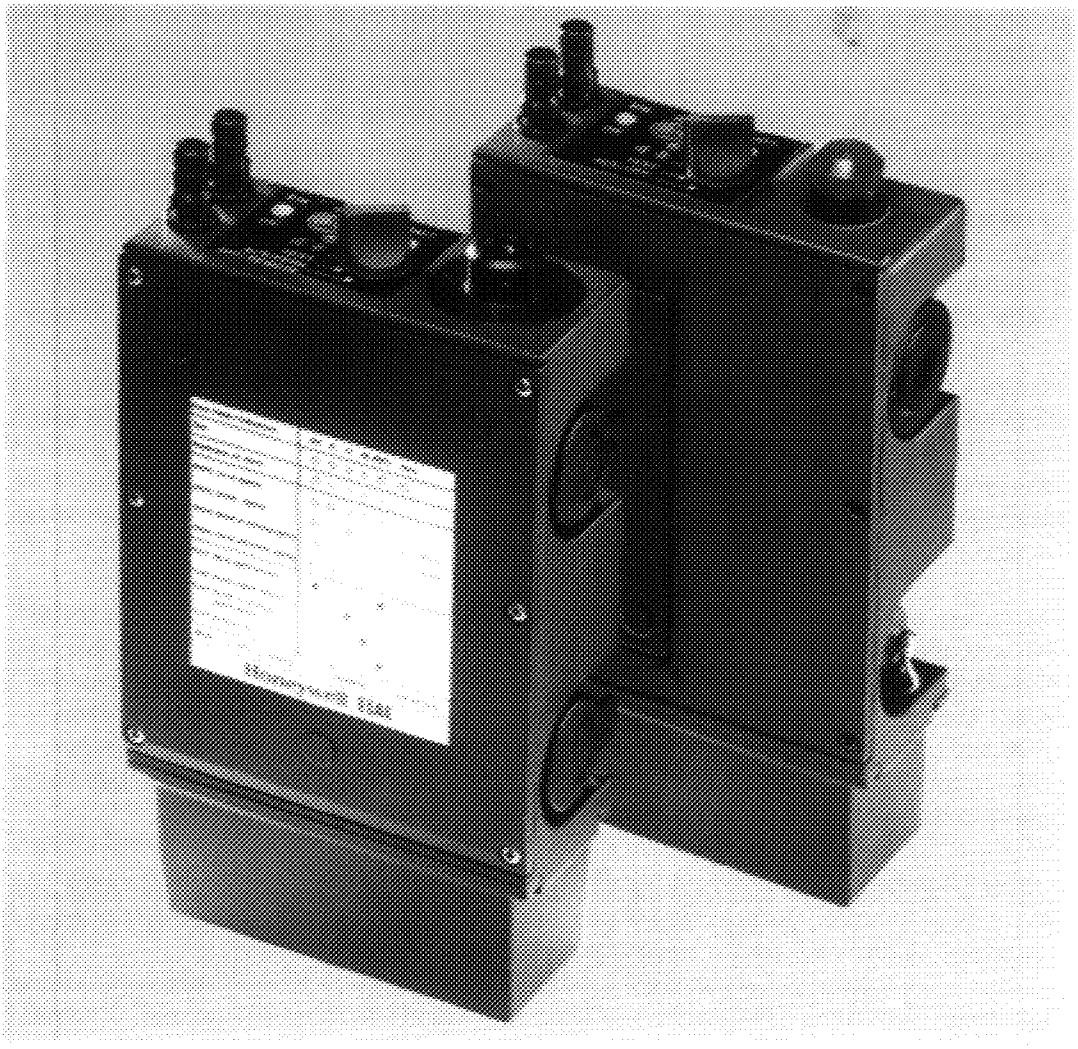


Photo courtesy of Honeywell Regelsysteme GmbH

The Honeywell A2 Chemical Agent Detection System

- **Designator(s):** Honeywell A2
  Honeywell Mini A2

- **Item Name(s):** Honeywell A2 Chemical Agent Detection System
  Honeywell Mini A2 Chemical Agent Detection System

- **Item Description:** The A2 is a lightweight, battery-operated automatic warning device which responds to chemical warfare agents and is capable of continuous operation. The A2 monitors the air for the presence of agents and provides early warning of chemical attacks. The detector is contained in a sealed aluminum housing and receives electrical power through a battery pack attached to the bottom of the unit. The air inlet and outlet are located on the side of the housing. The control panel, alarm horn and connection posts for the remote control cables are located on the top plate, while test and power connectors are provided on the bottom. The detector contains three sensors which detect nerve, blister, blood and choking agents. In any operational position, a periodic self-test of the electronics is automatically performed. Readiness is indicated by blinking of a green Light Emitting Diode (LED). An alarm condition is signaled by three red LED's in the center panel. Each alarm LED is assigned to a different group of chemical agents. If combinations of these agents are detected, the respective LED's light up simultaneously. Alarm will continue as long as the agent concentration is above the threshold value. [17]

- **System Components:** The primary system components are the detector, remote control and alarm unit. The detector may be used as a personal or point detector. In the personal detector mode it is contained in a case and carried by the soldier on a shoulder strap. In the point detector mode it is operated unattended. The detector can be controlled and monitored remotely. The unit may also be vehicle mounted and controlled and monitored from the vehicle interior. [17]

  The remote control and alarm unit is designed to repeat alarms triggered by the detector at distances of up to 1,000 meters. This is done by linking two units via a twin-core cable which is connected to the remote terminals. The remote unit also supplies power to the detector via the cable. The remote unit can be battery powered or can operate from vehicle power when connected by a cable, which is included in the accessories. The unit, cable reel and spare batteries may be carried in a case that is similar to that of the detector. For stationary use, remote units may be mounted in a central unit or in a 19 inch mechanical frame. [17]

- **Support Equipment:** The system is supplied with a carrying case, confidence samples, cable reel, vehicle mounting plate, vehicle power cable, and transport case. The protective housing and remote control rack are for stationary applications. [17]

- **Equipment Hardness:** (For both the detector and remote control and alarm unit) [17]

EMI:	Complies with MIL-STD-461
EMP:	Complies with STANAG 4145
Shock and Vibration:	Complies with MIL-STD-810

- **Equipment Hardness (continued):**

  Complies with the following requirements: [27]

EMI:	VG 95 373
High Temperature:	MIL-STD-810C, Method 501.1-II
Low Temperature:	MIL-STD-810C, Method 502.1-I
Nuclear Survivability:	AEP-4 (TREE, EMP, Blast, Thermal)
Rain:	MIL-STD-810C, Method 506.1-I
Salt Fog:	MIL-STD-810C, Method 509.1-I
Shock:	MIL-STD-810C, Method 516.2-II
Temperature Humidity:	MIL-STD-810C, Method 507.1-II
Vibration:	MIL-STD-810C, Method 14.2-VIII

- **Dimensions and Weight:** (For both the detector and remote control and alarm unit.) [17]

Length:	5.20 cm
Width:	12.5 cm
Height:	20.7 cm
Weight:	1.36 kg

- **Technology:** For nerve and blister agent detection, ion mobility technology is used. Blood and choking agents are detected by an electrochemical cell. Diffusion of agent molecules to a sensing electrode leads to the formation of ions and a change of the potential difference between the sensing and a counter electrode. The resultant current is proportional to the concentration of the chemical agent. [17]

- **Status:** *

- **Uses:** Used as a personal detection system, stationary detection system for protection of fixed installations, vehicle patrols, combat and transportation vehicles and helicopters. [17]

- **Deployment:** *

- **Agents Detected:** [27]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD, HN and L	10 mg/m^3 2 mg/m^3	30 seconds 120 seconds
Blood	AC	50 mg/m^3	10 seconds
Nerve	GA, GB, GD and VX	>0.4 mg/m^3 <0.08 mg/m^3	5 seconds 120 seconds

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** Contains 50 μCi Am^{241}. [27]

- **Power Requirements:** (For both the detector and remote control and alarm unit) [17,27]

Battery Life:	72 hours of continuous operation at +20°C 18 hours of continuous operation at +20°C for rechargeable battery
4 Ah Lithium Battery Packs:	11.2 V to 14.4 V
External Power:	10 V DC to 32 V DC

- **Transport Requirements:** No special transport equipment required; contains radioactive source and must comply to local radiation regulations. [27]

- **Personnel Requirements:** Designed for operation by individual soldier; no special skill level required. [27]

- **Operational Information:** *

- **Stock Number(s):** *

- **Miscellaneous:** A desiccant filter is installed behind a cover on the rear side. The filter must be replaced every 24 hours during operation or after storage. [17]

MTBF:	2,000 hours (detector) 3,000 hours (remote control and alarm unit) [17]

- **Contact(s):**

Developer/Manufacturer: Honeywell Regelsysteme GmbH
Geschäftsbereich Sondertechnik
Postfach 2010
D-63475 Maintal
Germany
Tel: 049 6181 401416
Fax: 049 6181 401289 [15]

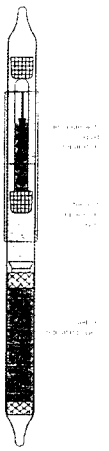
Honeywell is the developer of the Mini A2 Detection System and owns the whole data package as well as the worldwide export rights. [26]

- **Contact(s) (continued):**

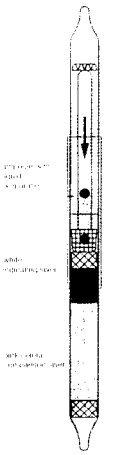
Distributor/Manufacturer: Intellitec (formerly Brunswick Corporation)
2000 Brunswick Lane
DeLand, FL 32724
Tel: (904) 736-1700
Fax: (904) 736-2250 [15]

Intellitec is exclusively representing Honeywell in North America on the A2. There is a distribution as well as manufacturing license agreement signed between the parties. [27]

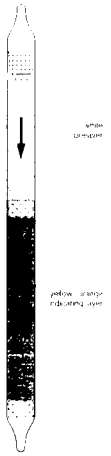
Chloroformates 0.2/b for detection of DP



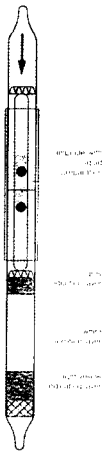
Cyanide 2/a for detection of AC



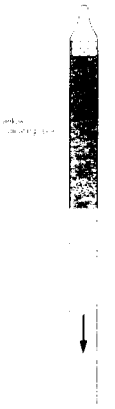
Cyanogen Chloride 0.25/a for detection of CK



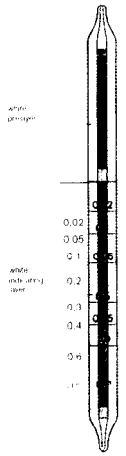
Hydrocyanic Acid 2/a for detection of AC



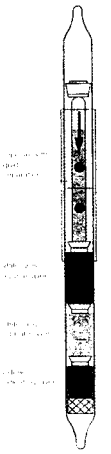
Organic Arsenic Compounds and Arsine for detection of L



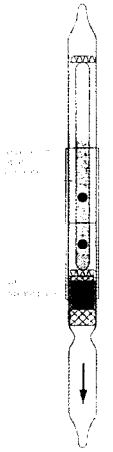
Organic Basic Nitrogen Compounds for detection of HN



Phosgene 0.02/a for detection of CG



Phosphoric Acid Esters 0.05/a for detection of nerve agents



Thioether for detection of HS

Sketches courtesy of National Draeger

Designator(s): Dräger Tubes

- **Item Name(s):** Dräger Detector Tubes

- **Item Description:** The Dräger Gas Detection System consists of the combination of a Dräger Tube and a Dräger Bellows Pump. The basic operation consists of hand-operated bellows aspirating the gas sample which supplies 100 cubic centimeters with each stroke. The bellows pump simultaneously carries out a volume measurement with each stroke. [12]

  The bellows of the gas detector pump is made from neoprene and automatically opens after compressing and releasing the pump. Two steel springs built into the pump affect the opening process. The end of the suction process is attained when the limit chain is taut. The new version of bellows pump features a pop-up end of stroke indicator. The one valve in the gas detector pump is closed when the pump sucks in the sample and opens again on squeezing the bellows. The Dräger Tube fits into the aperture on the pump head. The opening time is the duration of one pump stroke and the time depends on the flow resistance of the Dräger Tube inserted. Reaction kinetics and the flow resistance of the tube cause the opening time of the gas detector tube/pump system to differ depending upon the type of tube used. Some tubes allow the pump to open for three seconds while others require 40 seconds or more. [12,25]

  Presently, there are more than 200 different Dräger Tubes for the Dräger Gas Detector which detect a large number of different gases and vapors. Dräger produces direct reading detector tubes for short-term measurements and long-term measurements. The long term tubes consist of two types, those which require a constant flow pump and diffusion detector tubes. [12,25]

  The premise of operation of the diffusion detector tubes involves a glass tube containing a chemical reagent on an inert carrier. One end of the tube is opened and the contaminant molecules enter the tube based on diffusion principles. A holder holds the tube during measurement. When the pollutant gas molecules pass through the tube, the air impurity in the tube reacts with the chemicals on the carrier by forming a colored reaction product. Considering the sampling period, the length of the discolored zone is a measure for the average concentration of the material measured. [12]

- **System Components:** The Dräger Gas Detector consists of the specific Dräger Tube and the Dräger Bellows Pump. Listed below are the Dräger Tubes used for the detection of chemical warfare agents. [12,24]

  Chloroformates 0.2/b: The presence of diphosgene is detected by a color change from white to yellow. The reaction principle involves diphosgene reacting with 4-(4-nitrobenzyl)-pyridine to yield the yellow reaction product. [24,25]

  Cyanide 2/a: The presence of AC is indicated by a red reaction product. The reaction principle involves cyanide compounds combining with sulfuric acid to yield hydrogen cyanide. Hydrogen cyanide then combines with mercury chloride to yield hydrogen chloride. Hydrogen chloride and methyl red combine to form the red reaction product. [12]

- **System Components (continued):**

Cyanogen Chloride 0.25/a:	The presence of cyanogen chloride is indicated by a pink reaction product and follows a reaction principle documented by Matousek and Tomecek. [12,25]
Hydrocyanic Acid 2/a:	The presence of hydrogen cyanide is detected by a color change from yellow-orange to red. The reaction principle involves hydrogen cyanide reacting with mercury chloride, yielding hydrochloric acid. Hydrochloric acid then reacts with methyl red to yield a red reaction product. [24,25]
Organic Arsenic Compounds and Arsine:	The presence of organic arsenic compounds and L is indicated by a color change to greyish-black. The reaction principle involves the organic arsenic compound combining with zinc and hydrochloric acid to produce an arsenic product (AsH_3). The AsH_3 then combines with a gold-mercury complex to yield a product which is greyish-black. [12,25]
Organic Basic Nitrogen Compounds:	The presence of nitrogen mustard [bis-(2-chloroethyl)ethylamine] is detected by a color change from yellow to orange-red. The reaction principle involves nitrogen mustard reacting with bismuth potassium iodide to yield the orange-red reaction product. [24,25]
Phosgene 0.02/a:	The presence of phosgene is indicated by a color change to red. The reaction principle involves phosgene combining with an aromatic amine to yield a red reaction product. [12,25]
Phosphoric Acid Esters 0.05/a:	The presence of nerve agents is indicated by a color change to red. The reaction principle is based on a biochemical method involving dimethyldichlorovinyl phosphate interacting with cholinesterase and resulting in an inactive phosphorylated enzyme product. [12]
Thioether:	The presence of sulfur mustards [bis-(2-chloroethyl)sulfide] is indicated by a color change to orange. The reaction principle involves the thioether reacting with $AuCl_3$ and chloroamide to yield the orange reaction product. [12,25]

- **Support Equipment:** *
- **Equipment Hardness:** *

- **Dimensions and Weight:** [2,3,4,25]

PARAMETERS	TUBES PACKAGING	PUMP
Length	13.8 cm	17 cm
Width	4.8 cm	8.7 cm
Height	2.9 cm	4.4 cm
Weight	0.15 kg (tubes only)	0.25 kg

- **Technology:** Chemical reaction resulting in a color change. [12]
- **Status:** In service with the German Armed Forces. [8]
- **Uses:** Used for detection of agents in vapor form. [1]
- **Deployment:** *
- **Agents Detected:** [24,25]

DRÄGER TUBE	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Chloroformates 0.2/b	DP	0.2 ppm to 10 ppm	3 minutes
Cyanide 2/a	AC	2 mg/m^3 to 15 mg/m^3	2.5 minutes
Cyanogen Chloride 0.25/a	CK	0.25 ppm to 5 ppm	5 minutes (max)
Hydrocyanic Acid 2/a	AC	2 ppm to 30 ppm	1 minute
Organic Arsenic Compounds and Arsine	L	3 mg/m^3	3 minutes
Organic Basic Nitrogen Compounds	HN	1 mg/m^3	1.5 minutes
Phosgene 0.02/a	CG	0.02 ppm to 1 ppm 0.02 ppm to 0.6 ppm	6 minutes 12 minutes
Phosphoric Acid Esters 0.05/a	Nerve	0.05 ppm	5 minutes
Thioether	HS	1 mg/m^3	1.5 minutes

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:**

Chloroformates 0.2/b:	Methyl, ethyl and isopropylchloroformate are indicated with approximately the same sensitivity. It is impossible to differentiate between them. [24]
	Petroleum hydrocarbons, aromatics, alcohols and ketones do not interfere in the TLV range. [24]
	It is impossible to measure chloroformates in the presence of phosgene. [24]
Cyanide 2/a:	Free hydrogen cyanide is indicated even before the ampoule is broken. [24]
	Some acid gases are also indicated. [12]
	When using the tubes it should be noted that, because of the low resistance of NaCN and KCN, decomposition can occur in the presence of CO_2 whereby free hydrogen cyanide is produced from the cyanide. (In this case, indication will take place before breaking the reagent ampoule.) [12]
	It is not possible to measure cyanide in the presence of phosphine. [24]
Cyanogen Chloride 0.25/a:	Cyanogen bromide is also indicated, but with a different sensitivity. Calibration data is not available. [12,25]
Hydrocyanic Acid 2/a:	100 ppm hydrogen sulfide, 300 ppm ammonia, 200 ppm sulfur dioxide, 50 ppm nitrogen dioxide and 1,000 ppm hydrogen chloride do not affect the indication. Hydrogen sulfide turns the precleanse layer dark brown, but does not influence the hydrocyanic acid indication. [24,25]
	Ammonia concentrations above 300 ppm can cause the hydrocyanic acid indication at the start of the indicating layer to discolor back to yellow. [24]
	There is no effect on the indication by up to 1,000 ppm acrylonitrile. [24]
	It is impossible to measure hydrocyanic acid in the presence of phosphine. [24]
Organic Arsenic Compounds and Arsine:	Phosphine and arsine are indicated before the ampoule is broken, but with different sensitivities. [25]
Organic Basic Nitrogen Compounds:	Various organic basic nitrogen compounds are indicated. It is impossible to differentiate between them. [24]

- **False Responses/Interferents (continued):**

  Phosgene 0.02/a: Chlorine and hydrochloric acid lead to plus errors and at higher concentration, to bleaching of the indicating layer. [24]

  Concentration of phosgene above 30 ppm will also lead to bleaching of the indicating layer. [24]

  Phosphoric Acid Esters 0.05/a: Other phosphoric acid esters, which also cause suppression of cholinesterase, can be detected with this reagent system, but with different sensitivities. [12,25]

  Thioether: Various thioethers are indicated, but it is impossible to differentiate between them. [24]

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** None.

- **Transport Requirements:** Small and portable; no special requirements.

- **Personnel Requirements:** One operator.

- **Operational Information:** [24]

DRÄGER TUBE	OPERATING TEMPERATURE	HUMIDITY
Chloroformates 0.2/b	+10°C to +40°C	5 to 15 mg H_2O/l
Cyanide 2/a	0°C to +30°C	< 20 mg H_2O/l
Cyanogen Chloride 0.25/a	+5°C to +40°C	< 50 mg H_2O/l
Hydrocyanic Acid 2/a	0°C to +30°C	max 20 mg H_2O/l
Organic Arsenic Compounds and Arsine	0°C to +40°C	< 50 mg H_2O/l
Organic Basic Nitrogen Compounds	0°C to +40°C	< 50 mg H_2O/l
Phosgene 0.02/a	0°C to +40°C	3 to 15 mg H_2O/l
Phosphoric Acid Esters 0.05/a	+10°C to +40°C	3 to 18 mg H_2O/l
Thioether	0°C to +40°C	< 50 mg H_2O/l

- **Stock Number(s):** [12,24]

DRÄGER TUBE	DRÄGER PART NUMBER
Chloroformates 0.2/b	6718601
Cyanide 2/a	67 28791
Cyanogen Chloride 0.25/a	CH 19801
Hydrocyanic Acid 2/a	CH 25701
Organic Arsenic Compounds and Arsine	CH 26303
Organic Basic Nitrogen Compounds	CH 25903
Phosgene 0.02/a	8101521
Phosphoric Acid Esters 0.05/a	6728461
Thioether	CH 25803

- **Miscellaneous:**

Shelf Life: Two years at room temperature. [12,25]

- **Contact(s):**

Manufacturer:
Drägerwerk AG Lübeck
Postfach 1339
Moislinger Allee 53/55
D-2400 Lübeck 1
Germany
Tel: 049 451 8820
Telex: 26807-0 [12,25]

U.S. Affiliate:
National Draeger, Inc.
101 Technology Drive
P.O. Box 120
Pittsburgh, PA 15230
U.S.A.
Tel: (412) 787-8383
Fax: (412) 787-2207
Telex: 86-6704 [1,25]

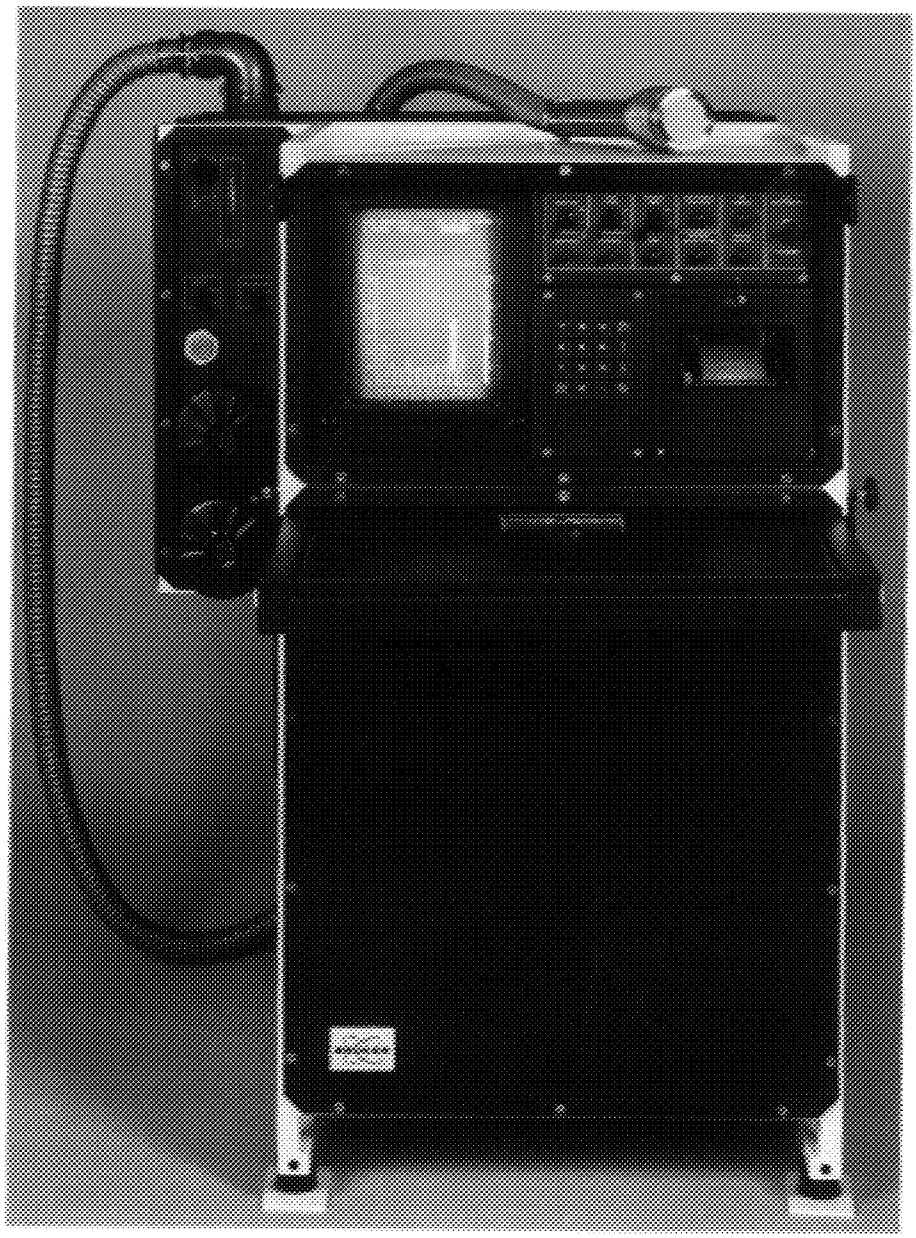
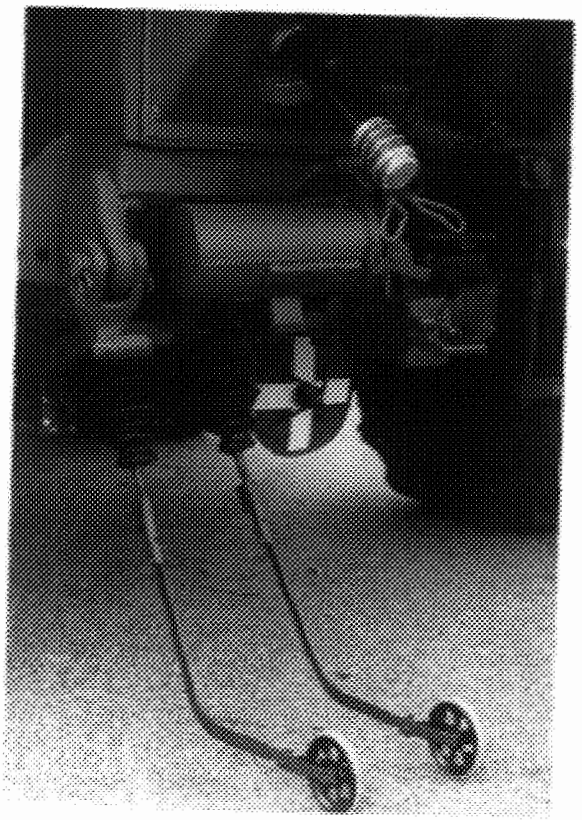


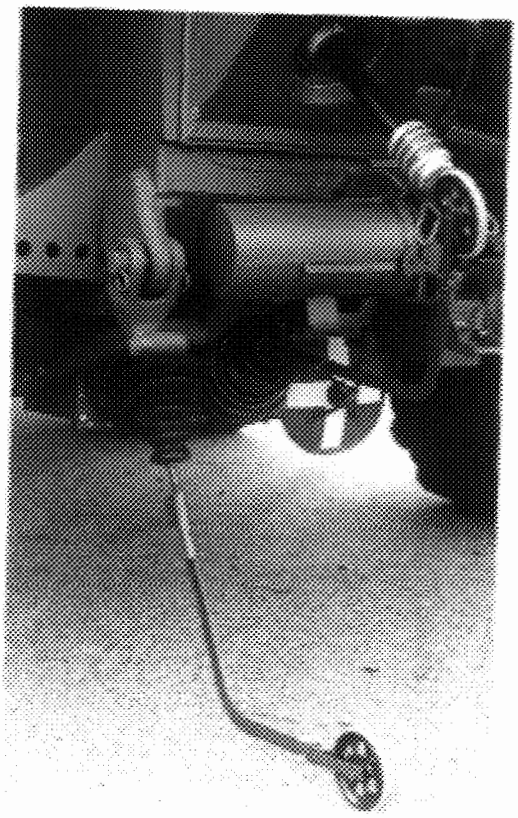
Photo courtesy of Bruker Franzen Analytik GmbH

MM-1 Mobile Mass Spectrometer

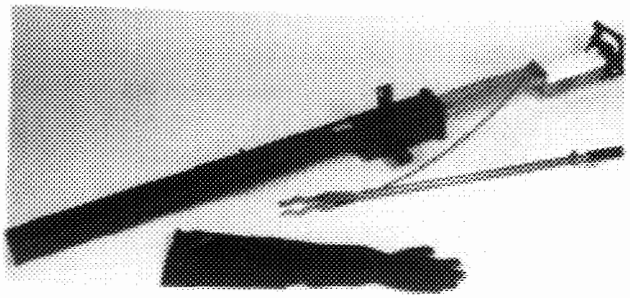
Photos courtesy of
Odenwald-Werke Rinnthaler GmbH



The Double Wheel Sampling Unit is used in the Fox NBC Reconnaissance Vehicle for collecting organic compounds from surfaces, the MM-1 Mobile Mass Spectrometer is then used to analyze the composition of the sample.



The detection wheel is raised to the detection probe thereby transferring the sample.



NBC Sampling Device and Glove

- **Designator(s):** MM-1

- **Item Name(s):** MM-1 Mobile Mass Spectrometer
  MM-1 Quadrupole Mass Spectrometer

- **Item Description:** The MM-1 Mobile Mass Spectrometer is designed to detect chemical agents on the battlefield. The unit consists of a combined sampling and detection system, a control system, the operator's control unit, printer and electronics. Two automatic monitoring routines are used for normal monitoring work. For air sampling the continuous monitoring mode is used while the storage monitoring mode is used for surface work. If contaminant concentrations exceed the preset alarm limit, both audible and visible alarm warnings are given. [16]

  The MM-1 is a hardened detector designed to be mounted in a vehicle. It has a sampler designed with a sampling head heatable to +200°C; fitted with a nickel fabric, coated with silicone. The inlet line running from the sampling head to the mass spectrometer is an SE-54 bonded phase fused silica Gas Chromatograph (GC) capillary column, with associated heating elements. The GC column is mounted in a flexible tube allowing the sampling head to be easily moved to the area to be measured. Using a membrane pump, ambient air is drawn through the sampler and past a silicone membrane. Up to 22 chemicals can be analyzed simultaneously using the MM-1. [6,14,19,20]

  The unit is deployed in the Fox NBC Reconnaissance Vehicle. In this vehicle, the MM-1 is used with the following items: [14]

  - Detection Probe with Detection Head and Temperature Controlled Probe Lead
  - Sensor Unit and the Electronic Control and Evaluation Circuitry
  - Double Wheel Sampling Unit
  - NBC Sampling Device

  The Double Wheel Sampling Unit has a detection wheel mechanism with electronically controlled drive and sampling wheels (silicone tires). The purpose of the controllable sampling wheels is to register settled warfare agents while the vehicle is on the move. The detection wheels are alternately brought into contact with the detection probe of the Mobile Mass Spectrometer (MM-1). Contamination adhering to the wheel is passed through the detection probe and into the mass spectrometer and is then detected. Detection wheels may be replaced from the interior of the vehicle via the glove port in the tail of the Fox NBC Reconnaissance Vehicle. [6,14]

  The NBC Sampling Device consists of the sampling receptacle with a gripper arm for picking up and transporting samples. Sampling is done while maintaining an agent-free vehicle interior environment. Using a special glove, samples are taken through the work opening in the rear of the Fox NBC Reconnaissance Vehicle for later analysis. [14]

- **System Components:** [19]

  Sampler
  Quadrupole Mass Spectrometer (with electron impact source, associated power and control electronics)

- **Support Equipment:** [6]

  Full logistical support is available for field and depot maintenance consisting of:
  - Service manuals
  - Spare parts catalogue
  - Test equipment and tools
  - Spare and repair parts in field proven containers
  - Training on maintenance simulators

  Full operational support is available consisting of users manuals:
  - Classroom trainer for operators
  - Reconnaissance vehicle simulator for crew training
  - Training aids for field exercises

  Analytical/operational improvements have been made as follows:
  - Sample enrichment systems for surface and air samples
  - GC sample separation systems
  - Data communication and remote control interface to the vehicle's central computer
  - Post processing software for host computers
  - New solid state RF generator

- **Equipment Hardness:** Can be used under extreme conditions of temperature and humidity in motion and on any terrain allowing vehicle access. [21]

- **Dimensions and Weight:** [6]

Length:	77 cm
Width:	72 cm
Height:	95 cm
Weight:	225 kg

- **Technology:** Gas chromatograph/quadrupole mass spectrometer. [19]

- **Status:** Currently being produced. [6]

- **Uses:** Used as a point detector in the FUCHS/Fox NBCRS and the French VAB RECCO for long range chemical reconnaissance, used on a small Volkswagen pick-up truck for site reconnaissance on air fields, used on Jeep type and other vehicles for environmental applications. [6]

- **Deployment:** Fielded by the German Army, Navy and Air Force; in use by the U.S. Army, U.S. Marine Corps, British Army, Israeli Self-Defense Forces, Saudi Arabian Armed Forces and several industrial users worldwide. Under procurement contract with the French Army and in preparation for the South Korean Army. [6]

- **Agents Detected:** Chemical agents and associated products on surfaces and in the air, based on an MM-1 internal database. Chemical warfare agents and environmental pollutants based on mass spectral databases on external computers. [6]

- **Detection Sensitivity:** Greater than 10 mg/m^2 for surface monitoring. Vapor monitoring sensitivities are classified. Sensitivity for selected environmental pollutants such as toluene is greater than 10 ppb in air. [19]

- **Response Time:** The fast GC column results in analysis times ranging from five seconds to three minutes and 20 seconds. [20]

- **False Responses/Interferents:** Extremely low interference due to the use of GC separation and software precautions against false alarms. Four ion based selected ion monitoring for substance identification. Full spectrum acquisition and spectrum based peak separation program for use with external MS databases (e.g. NIST). [6]

- **Safety Features/Safety Hazards:** Hot surface/air sampler head (approximately +200°C). [6]

- **Power Requirements:** 18 V DC to 32 V DC, 1080 VA. [6]

- **Transport Requirements:** Vehicle mounted. [21]

- **Personnel Requirements:** In basic configuration, two people can operate; in automated host computer supported operation, one person operation is possible. Special operation training in the chemical platoons is necessary for conducting the following tasks: [6]

  Brigade/Division level; route and area reconnaissance to:
  - Identify persistent chemical warfare agent (CWA) contaminations and analyze the chemical compounds used
  - Define and mark the contamination borders
  - Find and mark clear lanes
  - Report to command post

- **Operational Information:** [6]

  Operational Temperature: -30°C to +50°C
  Relative Humidity: 5% to 95%

- **Stock Number(s):** [6]

  MM-1: 6665-12-196-8946
  Sampling Wheels: 6665-12-332-6114

- **Miscellaneous:** Four to seven systems are deployed per NBC reconnaissance platoon. [6]

  Shock: Up to 6 G.

- **Contact(s):**

Manufacturer: (MM-1, Double Wheel Sampling Unit, Sampling Wheels, NBC Sampling Device and Glove)	Bruker-Franzen Analytik GmbH Fahrenheitstrasse 4 D-28359 Bremen Germany Tel: 049 421 22050 Fax: 049 421 2205103 [6]
Distributors:	Bruker Instruments, Inc. Manning Park 19 Fortune Drive Billerica, MA 01821-3991 Tel: (508) 667-9580 Fax: (508) 667-5993 [6] Bruker Instruments is the exclusive representative of Bruker-Franzen Analytik GmbH in the United States for the MM-1. [6] SADIS Bruker Spectrospin SA 34, rue de l'industrie F-67166 Wissembourg France Tel: 033 88 736800 Fax: 033 88 736819 [6] Bruker Spectrospin is the exclusive representative for Bruker-Franzen Analytik GmbH in France for the MM-1. [6]
Manufacturer: (Double Wheel Sampling Unit, NBC Sampling Device and Glove)	Odenwald-Werke Rittersbach GmbH D-6957 Elztal-Rittersbach Germany Tel: 049 62 93731 Fax: 049 62 9373219 Telex: 466786 owrd [14]

Photo courtesy of Honeywell ELAC Nautik GmbH

Mustard Module (BBCA) with NiCd Battery

Designator(s): BBCA

- **Item Name(s):** Mustard Module
  Blood, Blister and Choking Agent (BBCA)

- **Item Description:** The BBCA (Blood, Blister and Choking Agent) System is an automatic chemical agent detector and alarm which can be used as a stand alone detector or with the following: M43A1 Detector (see U.S. chapter entry on the M8A1 System), M42G Alarm which reproduces an alarm at up to 2,000 meters from the detection system, NiCd Battery, M10G2 Power Supply and Battery Charger for stationary use. It is used for the warning of troops, ships, air bases, shelters, and other fixed installations of exposure to blister, blood and choking agents. The system can be used in a portable, mobile, or stationary mode. The detector continually monitors for the presence of blister, blood and choking agents and signals with audible and visible alarms which can be transmitted to a remote alarm unit. The audible alarm reaches a peak of 92 db. Audible and visible alarms are indicated as summarized below: [9,18,22]

  - Mustard Agent Alarm is signaled by three flashing yellow Light Emitting Diodes (LEDs) and an intermittent howling tone if horn is activated. [22]
  - Blood or choking agent alarm is indicated by three flashing red LEDs and an intermittent howling tone if horn is activated. [22]

- **System Components:** [18]

  M10G2 Power Supply and Battery Charger
  M42G Alarm
  Mustard Module
  NiCd Battery

- **Support Equipment:** [18]

  BA 3571/U Battery (not rechargeable)
  Backpack
  Electronic Filter (for vehicle-borne operation)
  M140G Test Set
  M182 Vehicle Mounting Kit
  M228 Vehicle Mounting Kit

- **Equipment Hardness:** [5]

  EMI: Complies with MIL-STD-461
  Environmental: Complies with MIL-STD-810

- **Dimensions and Weight:** [18,22]

PRMTRS	MUSTARD MODULE	NiCd BATTERY	M42G REMOTE ALARM	POWER SUPPLY AND CHARGER	M140G TEST SET
Length	16.5 cm	16.5 cm	9.7 cm	16.5 cm	53 cm
Width	14 cm	14 cm	18 cm	14 cm	44.5 cm
Height	12.8 cm	13.5 cm	6 cm	14 cm	25.5 cm
Weight	2.7 kg	5.4 kg	0.7 kg	3 kg	15 kg

- **Technology:** The detection technology used is based on gas ionization. Agent molecules are converted into ion clusters and detected as ionic current in sensor cells. The ionization sensors provide a very short response time and do not require replaceable chemicals. [18]

- **Status:** *

- **Uses:** Warning troops, ships, air bases and other fixed installations. The M43A1 has been deployed in the Fuchs NBC Reconnaissance Vehicle. [14,18]

- **Deployment:** In use by the German Armed Forces as well as the Israeli and Austrian Armed Forces. [8,11]

- **Agents Detected:** [13,23]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD, HN and L	2 mg/m^3	<2 minutes
Blood	AC	50 mg/m^3	<10 seconds
Choking	CG	20 mg/m^3	<20 seconds

- **Detection Sensitivity:** Complies with present NATO requirements. [18]

  See ***Agents Detected*** for further information.

- **Response Time:** Complies with present NATO requirements. [18]

  See ***Agents Detected*** for further information.

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** The Mustard Module houses two encapsulated ionization cells containing 200 μCi of the radioactive source Am^{241}. [22]

- **Power Requirements:** May be powered by an 18 V DC to 36 V DC battery, automotive battery, generator or a stationary power supply. [18]

- **Transport Requirements:** May be used in portable, mobile and stationary modes. [18]

- **Personnel Requirements:** One operator, no special training required. [23]

- **Operational Information:**

  Operational Temperature: -30°C to +60°C [18]
  Relative Humidity: Up to 100% [5]

- **Stock Number(s):** *

- **Miscellaneous:**

  MTBF: 2,000 hours [18]
  Storage Temperature: -40°C to +70°C [5]

- **Contact(s):**

  Distributor/Manufacturer: Honeywell Regelsysteme GmbH
  Geschäftsbereich Sondertechnik
  Postfach 2010
  D-63475 Maintal
  Germany
  Tel: 049 6181 401466
  Fax: 049 6181 401467 [15,23]

  Distributor: Intellitec (formerly Brunswick Corporation)
  2000 Brunswick Lane
  DeLand, FL 32724
  Tel: (904) 736-1700
  Fax: (904) 736-2250 [15,23]

Photo courtesy of Bruker Saxonia Analytik GmbH

The RAID-1

- **Designator(s):** RAID-1
  RAID-S

- **Item Name(s):** Rapid Alarm and Identification Device

- **Item Description:** The RAID-1 is a hand-held Ion Mobility Spectrometer (IMS) for the detection of chemical warfare agents in the air and on surfaces. The RAID-S is a stationary version of the RAID-1 with larger inner circuit dryers allowing for one year of continuous operation.

  After a short warming up phase the RAID checks itself for correct functioning. When this is satisfactory a chemical simulant test is possible, but not essential. After warming up, the user selects either the automatic (AUTO) or manual (MANU) operating modes. [6]

  The AUTO mode is used for rapid detection. The air is continuously drawn past the inlet membrane through which the organic substances penetrate and reach the reactant cell. Here both positive and negative reactant product ions are generated. After a measurement of the positive ions the accelerating high voltage of the IMS tube is automatically switched over to allow measurement of the negative ions. One such complete cycle, including evaluation, takes up to six seconds. If a large concentration of a programmed chemical warfare agent is detected the RAID switches automatically into the "Backflush" status. Here the flow direction is reversed and a stream of purified air (generated by sucking atmospheric air through a filter) is led past the inlet membrane. When the chemical warfare agent (CWA) signal drops significantly the system switches back to sampling flow. This overload protection significantly reduces recovery time and keeps the alarm system active even in a contaminated environment, and enables the detector to define the end of danger. [6]

  As in the AUTO mode, the MANU mode measures for a preset time and then returns to the "Backflush" status. It remains ready for a new started monitoring cycle. This reduces the background chemical noise to a minimum and consequently allows detection of very low traces of chemical warfare agents. [6]

  In either mode, when the measurement indicates the presence of a chemical warfare agent, the RAID-1 results are displayed on its Liquid Crystal Display (LCD). If the concentration exceeds the chemical warfare agent specific pre-set software alarm level, a red Light Emitting Diode (LED) is switched on and a preactivated acoustic signal is given. [6]

  Several interfaces for the RAID are available for remote control and data transmission (i.e., RS232 and RS485 standards or analog signal in order to trigger a M42 alarm module). This allows connection of RAID systems with central computers for object surveillance. [6]

  RAID systems allow for the identification of leaks on gas filtering system with leak rates down to 10^{-5} After changing the gas filters of a filter system the tightness and correct installation can easily be checked by using an nontoxic simulant. During chemical operations RAID systems can be used to check for filter saturation and breakthrough even on filters which emit NH_3.

- **System Components:** [6]

  Basic RAID-1 module
  Battery housing (for Li/MnO_2 batteries)
  NiCd Rechargeable Battery

- **Support Equipment:** [6]

  Combined Power Supply (several)
  Data System Interfaces
  Evaluation Software
  PC Based Control
  Storage and Transport Container

- **Equipment Hardness:** Decontaminable by complete immersion. [7]

- **Dimensions and Weight:** [6]

Length:	20 cm
Width:	18 cm
Height:	7 cm
Weight:	3 kg (including Li/MnO_2 battery)

- **Technology:** Ion Mobility Spectrometry. [6]

- **Status:** Technology is ready for series production; production item. Several RAID-S systems are installed. [6]

- **Uses:** The RAID-1 has applications in hazardous waste sites for personal protection against possible chemical agent contamination including Explosive Ordnance Disposal (EOD), emission control chemical warfare agent demilitarization facility filters and analysis of pesticides. [6]

- **Deployment:** Currently being negotiated with several customers. [6]

- **Agents Detected:** [6]

AGENT CLASS	AGENT(S)	ALARM LEVEL	MINIMUM DETECTION LEVEL
Blister	HD, HN and L	80 ppb	40 ppb
Blood	AC	5 ppm	2 ppm
Choking	CG	5 ppm	2 ppm
Nerve	GA, GB, GD and VX	30 ppb	15 ppb

- **Detection Sensitivity:** See ***Agents Detected*** for further information.

- **Response Time:** Five seconds for battlefield concentrations, less than one minute for very small concentrations. [10]

- **False Responses/Interferents:** False alarm tests were conducted on 10 RAID-1 systems and the results are shown below: [6]

INTERFERENT	REQUIREMENT (no false alarm below given concentration)	TEST DATA	
		(concentration)	(type of false alarm)
F 54 Diesel	500 mg/m^3	650 mg/m^3	none
F 40 Gasoline	1,500 mg/m^3	1,350 mg/m^3	none
$C_2H_4Cl_2$	1,000 mg/m^3	1,260 mg/m^3	none
HCHO	20 mg/m^3	23 mg/m^3	none
CH_3OH	30 mg/m^3	24 mg/m^3	none
NH_3	7 mg/m^3	6 mg/m^3	none
HCl	20 mg/m^3	12 mg/m^3	none
SO_2	7 mg/m^3	8 mg/m^3	none
Cl_2	5 mg/m^3	7 mg/m^3	none
CO	80 mg/m^3	128 mg/m^3	none
CO_2	60,000 mg/m^3	60,500 mg/m^3	none
NO_2	5 mg/m^3	7 mg/m^3	none

- **Safety Features/Safety Hazards:** Ni^{63} Beta radiation source, construction approved by appropriate German authorities. [6]

- **Power Requirements:** [10]

  Internal: Lithium battery pack for six hours to eight hours of continuous operation at ambient temperatures.

  External: 4 V DC to 32 V DC.

- **Transport Requirements:** Hand-held unit; may be used on the move or stationary. [7]

- **Personnel Requirements:** Portable by one person; lightweight; short training period; no special requirements. [6]

- **Operational Information:** [6]

  Maximum Altitude: 3,000 m
  Operational Temperature: -25°C to +50°C
  Relative Humidity: 5% to 95%

- **Stock Number(s):** Not yet assigned. [6]

- **Miscellaneous:** [10]

  MTBF: 2500 hours.

- **Contact(s):**

  Distributor/Manufacturer: Bruker Saxonia Analytik GmbH
  HPA 5, PF 37
  D-04301 Leipzig
  Germany
  Tel: 049 341 2352453
  Fax: 049 341 2353605 [6]

  or

  Bruker Saxonia Analytik GmbH
  Permoserstrasse 15
  D-04318 Leipzig
  Germany

  Distributor: Bruker Instruments Inc.
  Manning Park
  19 Fortune Drive
  Billerica, MA 01821-3991
  Tel: (508) 667 9580
  Fax: (508) 667 5993 [6]

  Bruker Instruments is the exclusive representative of Bruker Saxonia Analytik GmbH in the United States for their chemical warfare agent detectors.

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21. (1984, June). *The MM-1 A Mobile Mass Spectrometer Military Version for the Identification and Determination of Trace Amounts of Organic Substances in the Environment.*

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24. Ligus, Edward G. Jr. (1995, April). *Re: Dräger Tube Products* [10 p.]. Correspondence, National Draeger, Inc., Pittsburgh, PA, U.S.A.

25. Ligus, Edward G., Jr. (1995, April). *Re: Dräger Tube Products* [8 p.]. Facsimile Transmission, National Draeger, Inc., Pittsburgh, PA, U.S.A.

26. Keip, E. & Jacobs, A. (1995, July). *Re: Honeywell Products* [1 p.]. Facsimile Transmission, Honeywell Regelsysteme GmbH, Maintal, Germany.

27. Phillips, Mike. (1995, March). *Re: Honeywell A2* [7 p.]. Facsimile Transmission, Brunswick Corporation (now Intellitec), DeLand, FL, U.S.A.

28. Baum, H.J. (1995, May). *Re: Bruker A2* [6 p.]. Facsimile Transmission, Bruker Franzen Analytik GmbH, Bremen, Germany.

29. Schweizer, Dr. (1995, June). *Re: German Detection Equipment* [3 p.]. Facsimile Transmission, Bundesant für Wehrtechnik und Beschaffung, Koblenz, Germany.

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Chapter 10 - HUNGARY

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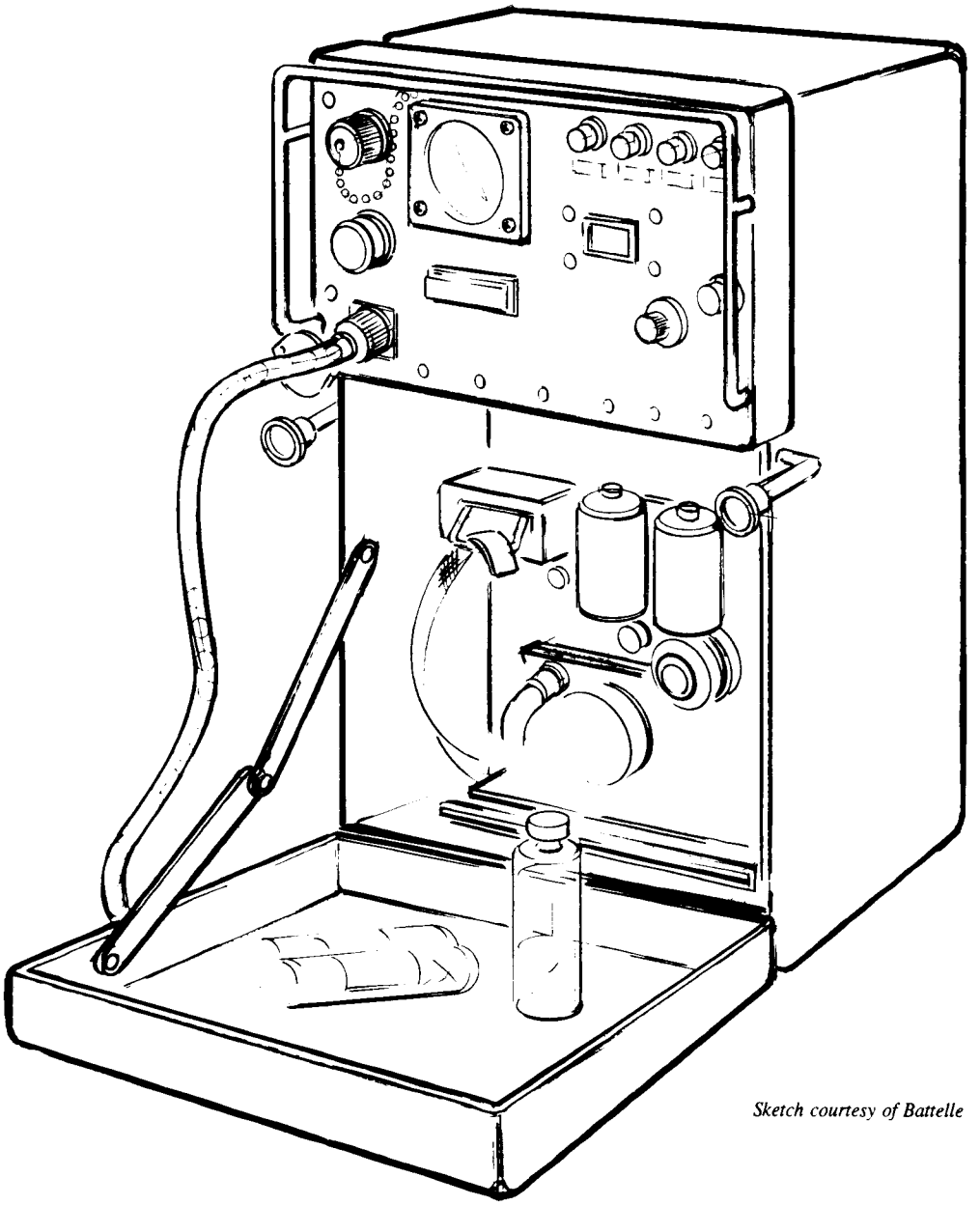
10.1 CHEMICAL AGENT DETECTORS



Sketch courtesy of Battelle

The Automatic Chemical Indicator Type AVJ-1

- **Designator(s):** Type AVJ-1

- **Item Name(s):** Automatic Chemical Indicator Type AVJ-1

- **Item Description:** The Type AVJ-1 is used to detect the presence of nerve agents and other organophosphorus compounds in the air. It can be used in a vehicle or at a fixed location. Two operational modes allow a variation in the time interval used to collect the air sample. The air sample passes through a reagent treated absorbent tape. The transport system advances the exposed tape to the colorimetric detector. An alarm signal indicates a color change greater than a preset limit. It can operate autonomously, requiring minimal maintenance. [2,7]

- **System Components:** *

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** *

- **Technology:** The detection technology is based on a biochemical reaction (enzyme product) that produces a color change in the presence of organophosphorus agents. [2]

- **Status:** *

- **Uses:** Used to continuously monitor the atmosphere for the presence of nerve agents and other organophosphorus compounds. [2]

- **Deployment:** *

- **Agents Detected:** Nerve agents and other organophosphorus compounds in the air. [2,7]

- **Detection Sensitivity:** *

- **Response Time:** [7]

Air Sampling Time:	30 seconds (Mode I)
	3 minutes (Mode II)
Detector Preparation:	20 minutes
Refill Time:	10 minutes

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Operates on a 24 V DC vehicle battery. The maximum average consumption is 1.4 A from 24 V. [2,7]

- **Transport Requirements:** *

- **Personnel Requirements:** Once set-up, the only attendance required is occasional refilling of the reagent tanks. [2]

- **Operational Information:** Operates on a biochemical reaction using a special tape that has been wetted with an enzyme product. This tape is then moved step-wise in front of the opening of the air transport pump, so the air to be analyzed is passed through the activated tape section. After 30 seconds (Mode I) or three minutes (Mode II), the tape transport system advances the exposed, activated tape section into the colorimetric detector. With the highly selective interference filters in the colorimetric detector, even small color differences can be detected. An alarm circuit is activated if the color change exceeds preset limits. The signal is transferred through a data transmitter. The detection sensitivity increases in the longer integration time mode. [2,7]

  The preparation time of the instrument is 20 minutes. The reagents are refilled in 10 minutes. [7]

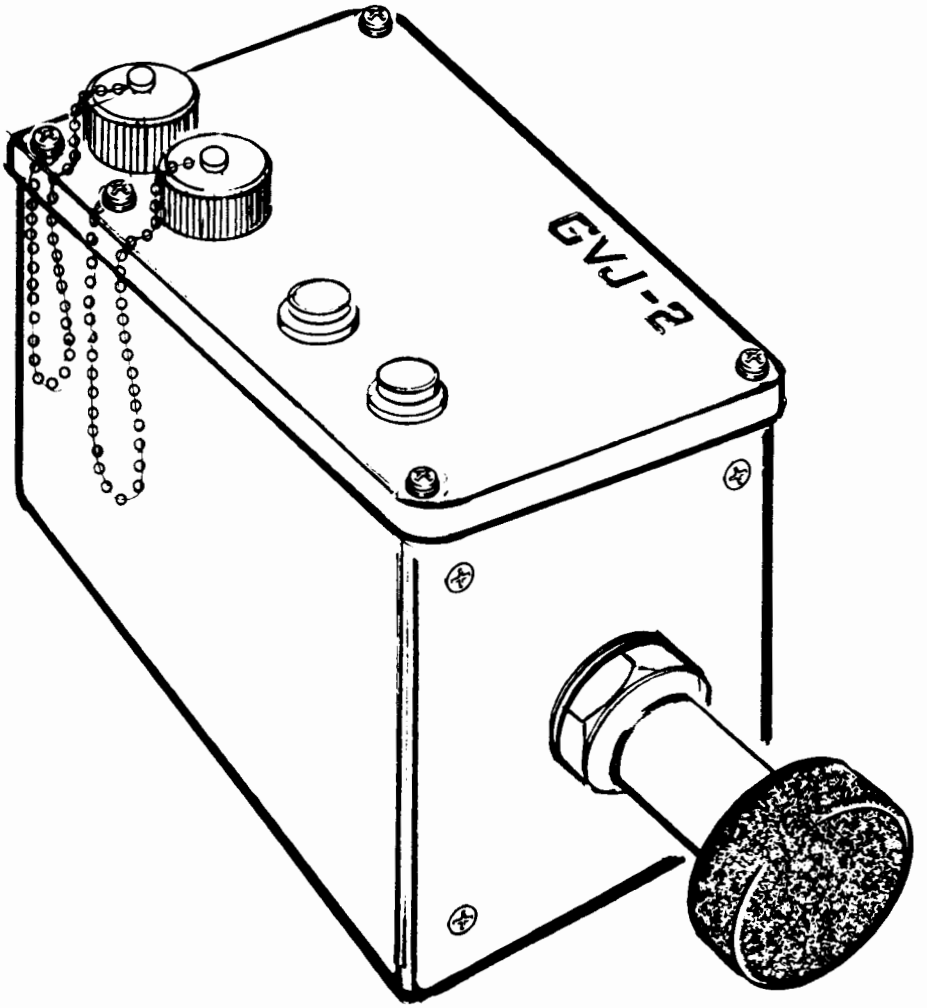
- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):**

  Marketer:

  TECHNIKA Foreign Trading Company LTD
  P.O. Box 125
  X., Salgólarjáni út 20
  H-1475 Budapest
  Hungary
  Tel: 036 1 1143230
  036 1 1141290
  Fax: 036 1 1134686
  Telex: 22-5765 tkvbp h. [2]



Sketch courtesy of Battelle

The Chemical Agent Sensor Type GVJ-2

- **Designator(s):** Type GVJ-2

- **Item Name(s):** Chemical Agent Sensor Type GVJ-2

- **Item Description:** The Type GVJ-2 is designed to detect blister and nerve agents as well as toxic industrial chemicals in the air. While primarily a hand-operated, portable instrument, it can be vehicle mounted. The vehicle battery can be used to power the sensor while the unit batteries are recharging. An automatic alarm provides both an audible and visible signal in the presence of chemical contamination. The instrument can be remotely operated using a serial interface. [2,3]

- **System Components:** *

- **Support Equipment:** *

- **Equipment Hardness:** The instrument is protected against spraying water. [2]

  Mechanical Shock: The sensor can withstand single or repeated dropping from 75 cm height for two, three or five times on a plate, edge or respective edge.

- **Dimensions and Weight:**

  Length: 40 cm (at longest point) [1]
  Width: *
  Height: *
  Weight: 1.8 kg (with batteries) [1]

- **Technology:** Ion Mobility Spectroscopy; analysis is performed in an ionization cell under the control of a microprocessor. [1,2,3]

- **Status:** *

- **Uses:** *

- **Deployment:** *

- **Agents Detected:** [2]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD	0.02 mg/l	10 seconds
Nerve	GB, GD and VX	0.00005 mg/l	10 seconds

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** Does not give false alarms while on the battlefield. [2]

- **Safety Features/Safety Hazards:** Alpha radiation source. [2,3]

- **Power Requirements:** Four RSH-4 type NiCd batteries. [2]

- **Transport Requirements:** Portable. [2]

- **Personnel Requirements:** One operator. [2]

- **Operational Information:** Operates using a specially constructed dynamic dual-grid cell. An alpha radiation source ionizes the air which is drawn through the cell. Analysis of the air is carried out using ion mobility spectroscopy under the control of a microprocessor. [2,3]

Operational Temperature:	-25°C to +50°C ambient temperature [2]
Operational Time:	Minimum 6 hours (if temperature is greater than +20°C) [2] Portable configuration using fully charged batteries
Relative Humidity:	Up to 98% [2]
Typical Continuous Use:	10 hours (when temperature is greater than +20°C) [1]

- **Stock Number(s):** *

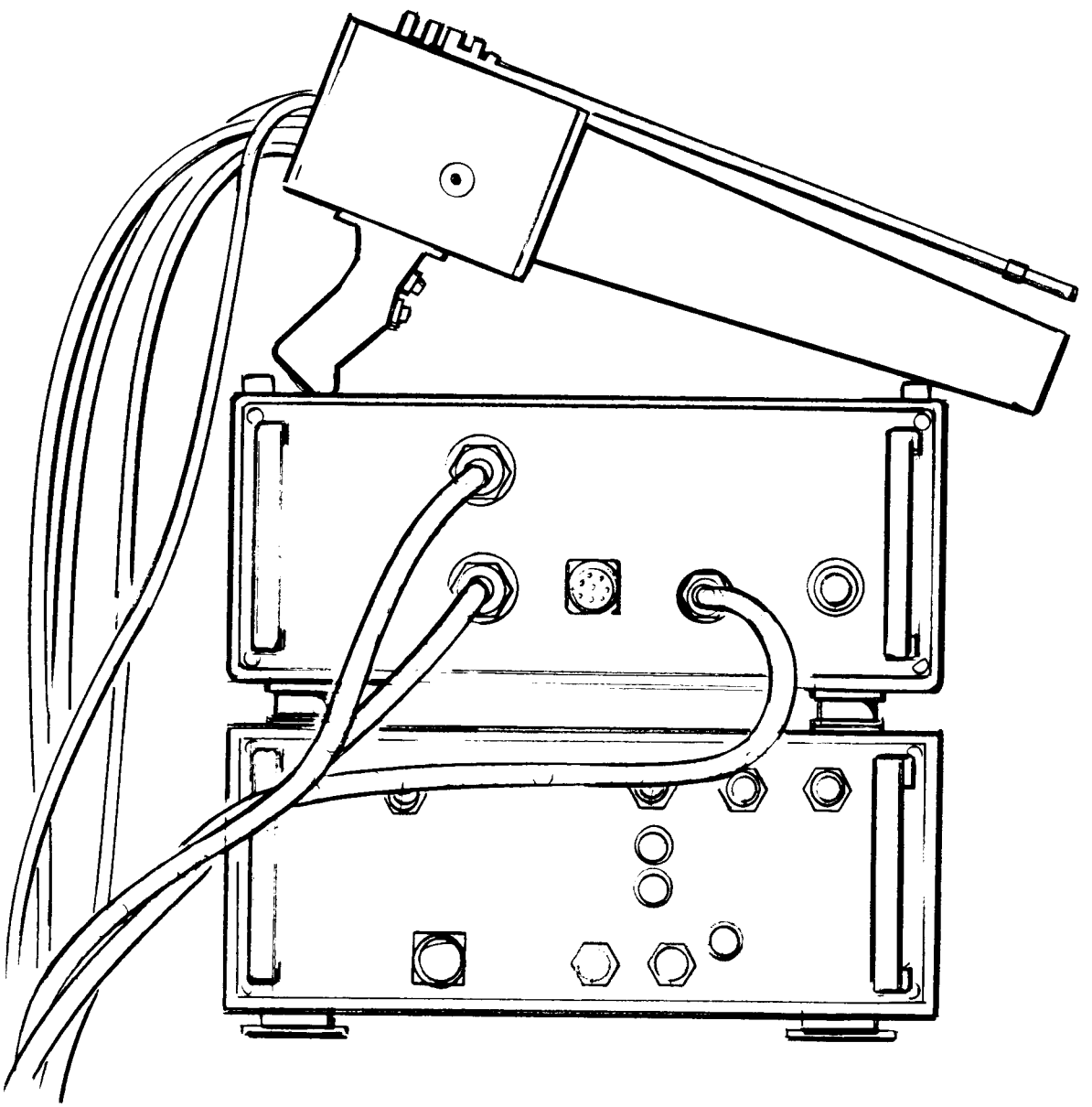
- **Miscellaneous:** [2]

Acceleration Amplitude:	40 m/sec^2
Mechanical Resistance:	Sinusoidal Oscillation 1 Hz to 80 Hz
Storage Temperature:	-35°C to +70°C (without batteries)

- **Contact(s):**

  Marketer:

  TECHNIKA Foreign Trading Company LTD
  P.O. Box 125
  X., Salgólarjáni út 20
  H-1475 Budapest
  Hungary
  Tel: 036 1 1143230
  036 1 1141290
  Fax: 036 1 1134686
  Telex: 22-5765 tkvbp h. [2]



Sketch courtesy of Battelle

The Chemical Contamination Detector Type VSJ-1

- **Designator(s):** Type VSJ-1

- **Item Name(s):** Chemical Contamination Detector Type VSJ-1
  VSJ-1 Surface Contamination Detector

- **Item Description:** The Type VSJ-1 detects surface contamination resulting from exposure to nerve agents (G and V), and HD-type compounds. Audible and/or visible warning signals occur when the contamination detected is greater than a predetermined threshold value. The reagents in the Type VSJ-1 can be used to analyze samples obtained in both the liquid and solid states. Air samples must be drawn through distilled water for collection prior to analysis. Surface contamination can be washed off with a sprayer into distilled water for analysis while solid samples must be turned into a solution before being analyzed. The Type VSJ-1 is equipped with a vibration isolation device. It can be used in the field or in a laboratory vehicle. [13,14]

- **System Components:** [13,14]

  Optoelectronic Unit: Provides the light for excitation of the sample molecules and senses the resulting fluorescent light. Sensitivity can be adjusted.

  Sensor Head: Allows the illumination of the whole surface of the sample, collects the resulting fluorescent light and sends it through the optical link to the optoelectronic unit.

- **Support Equipment:** [13,14]

  24 V DC Power Supply
  Reagent Kit

- **Equipment Hardness:** [13,14]

  Vibration Isolation: 2 G, 25 Hz (shock)
  Water Resistant: IP-33

- **Dimensions and Weight:** [13,14]

PARAMETERS	OPTOELECTRONIC UNIT	SENSOR HEAD
Length	47.2 cm	16.3 cm
Width	52 cm	16.3 cm
Height	29 cm	27 cm
Weight	15 kg	1 kg

The total unit weight with isolator package is 20 kg.

- **Technology:** The detection capability of the Type VSJ-1 is based on the measurement of the fluorescence that occurs after a catalytic reaction between the toxic compound molecules and a special reagent used to treat the sample. The fluorescent product is exposed to light from a high-pressure HBO Mercury short arc lamp, housed in the optoelectronic unit, which results in the emission of fluorescent light at another wavelength. The fluorescent light is collected by the sensor head that transforms it into an electronic signal. The amplitude of this signal is proportional to the concentration of the toxic compound. [13,14]

- **Status:** *

- **Uses:** The Type VSJ-1 can be used in the field or in a laboratory vehicle for the detection of nerve agent or HD-type agent surface contamination. [13,14]

- **Deployment:** *

- **Agents Detected:** [13,14]

AGENT CLASS	AGENT(S)[a]	DETECTION SENSITIVITY[b]	RESPONSE TIME[c]
Blister	HD-type	5 $\mu g/cm^3$	3 minutes
Nerve	G- and V-type	1 $\mu g/cm^3$	30 seconds

[a] Toxic compounds of the phosphoric ester type and HD-type compounds.
[b] Using the 100 sensitivity setting.
[c] Warm-up time is 15 minutes.

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** The starting current may reach 10 A. Optical cables from the sensor head must be connected to the correct connectors of the optoelectronic unit at the innermost position and must not be disconnected once the unit is turned on. [13,14]

  The high pressure HBO short arc lamp contains Mercury. The lamp should be replaced as soon as advanced blackening occurs. If the lamp bursts, toxic Mercury is released. Personnel should leave the area, which should be ventilated for a minimum of 30 minutes. [13,14]

- **Power Requirements:** [13,14]

  Current: 8.5 A
  Electronic Consumption: 24 V DC power supply with the correct polarity

- **Transport Requirements:** Can be transported in vehicle laboratory or set up for field use. [13,14]

- **Personnel Requirements:** *

- **Operational Information:** [13,14]

  Operational Temperature: 0°C to +40°C

  Sample Preparation: The reagent can be used to analyze samples taken in a liquid and/or solid state, but samples must be in liquid form before analysis can be initiated. Air samples must be bubbled through 10 ml of distilled water. The temperature must be between +5°C and +40°C and the pH range of the liquid must be between 9 and 10. The solution can be used for one day if stored in a cool, dark place. Samples must be prepared in clean Petri dishes which are inserted in the bottom drawer of the sensor head. Directions are included for the preparation of each type of toxic agent sample.

  Measurement and General Instructions: The covers for the Type VSJ-1 must be removed and room left behind the unit to allow for ventilation. The unit should be connected to the power supply, insuring the correct polarity. The optical cables must be connected to the appropriate ports, since they cannot be interchanged. The lamp housing should be closed before the lamp is switched on. The light source is stabilized after 15 minutes, as shown by the "READY" LED. Select the compounds to be detected (G, VX, HD). Insert a clean Petri dish in the drawer of the sensor head to set the zero point on the potentiometer. For HD analysis, set the zero point with reagent "H". Select the sensitivity range required (1, 10, or 100). The prepared sample must be positioned in the drawer of the sensor head, reagent stirred in and the "Timer" button pushed within 15 seconds. When the concentration of toxic agent exceeds the predetermined level, the "AGENT DETECTED" red LED will flash and audible warning signal will sound if it has been activated. If no detectable agent is present after one minute, the green LED "NO AGENT" will light. The operator can select a different sensitivity setting at any time, but the potentiometer must be set to zero each time it is changed.

- **Stock Number(s):** *

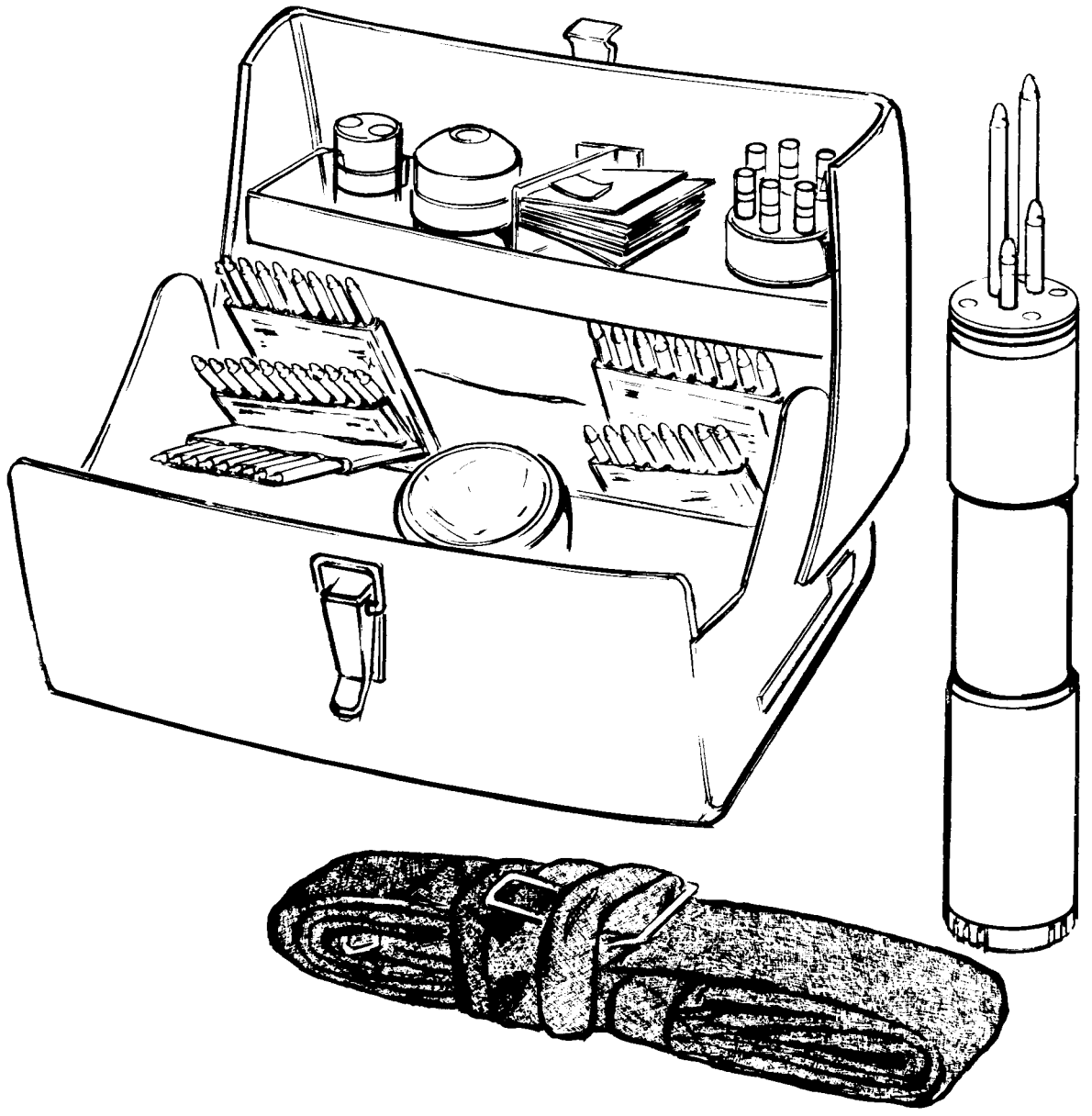
- **Miscellaneous:** The average life for the mercury lamp is based on an average period of use of two hours. Once in use, the lamp should be left on for a minimum of 15 minutes. It is recommended that an interval of at least 40 minutes be allowed after turning off the unit and before a second start-up is initiated. [13,14]

  Storage Temperature: -20°C to +50°C

- **Contact(s):**

Manufacturer:

LASRAM Laser Technology Ltd.
H-1558 Budapest 139
P.O. Box 56
Hungary
Tel: 036 1 1696619
Fax: 036 1 1601684 [13]



Sketch courtesy of Battelle

The Chemical Reconnaissance Set Type 66-M

Designator(s): Type 66-M

- **Item Name(s):** Chemical Reconnaissance Set Type 66-M

- **Item Description:** The Type 66-M is a simple, easy-to-use chemical agent detection system designed for use by the front line soldiers. A manual pump draws air samples through various indicator tubes treated with agent-specific reagents which change colors in the presence of the targeted agents. From one to five chemical agents can be detected simultaneously. The type of indicator tube selected determines whether sampling can be continuous or periodic. A heater cartridge is provided for use in temperatures below 0°C. [2,3,4,5]

- **System Components:** [2,3,4,5]

  Carrying Case
  Disposable Supplies
  Filters
  Flashlight
  Hand Pump
  Heater Cartridge
  Indicator Tubes
  Tools

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:**

Length:	100 ±3 mm (indicator tubes) [2]
Width (diameter):	6.2 ±1 mm (indicator tubes) [2]
Height:	*
Weight:	3.2 kg [5]

- **Technology:** In the presence of agent, a chemical reaction resulting in a change in color intensity is detected by the Type 66-M instrument. [2,4]

- **Status:** *

- **Uses:** Used to detect and identify battlefield chemical agents in the air, on military equipment and protective clothing and other objects. [5]

- **Deployment:** Used by the Hungarian Armed Forces. [2]

- **Agents Detected:** [2,4,9,10]

AGENT CLASS	AGENT(S)	MARKING RING	DETECTION SENSITIVITY
Blister	HD[a]	1 Yellow	0.001 mg/l to 0.3 mg/l
	HN[b]	2 Yellow	0.001 mg/l to 0.25 mg/l
	HS	*	*
	L[b]	3 Yellow	0.002 mg/l to 1.3 mg/l
Blood	AC[a] and CK[a]	1 Blue	0.005 mg/l to 0.5 mg/l
Choking	CG[a]	1 Green	0.005 mg/l to 0.8 mg/l
Incapacitating	BZ[b]	1 Brown	0.01 mg/l to 0.1 mg/l
Nerve	VX[b]	2 Red	$\geq$ 0.000001 mg/l
	GA, GB and GD	*	*
Tear	CS[a]	3 White	0.0005 mg/l to 0.05 mg/l
	CN[b]	1 White	0.0001 mg/l to 0.1 mg/l
Vomiting	DM[b]	2 White	0.0002 mg/l to 0.2 mg/l

[a] "Unified" indicator tubes do not contain inner ampoules; hence, they can be used to continuously monitor air samples. [4]

[b] "Non-unified" indicator tubes contain one or two inner ampoules that must be broken before detection can occur; hence, they cannot be used to continuously monitor air samples. [4]

- **Detection Sensitivity:** Based on indicator tube information.
- **Response Time:** One minute to two minutes. [5]
- **False Responses/Interferents:** A filter disk (adaptor part with filter paper attached to the hand pump) is used for detection of samples in smoke. [4,5]
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None. [5]
- **Transport Requirements:** Carried by a motor vehicle or by a soldier. [5]
- **Personnel Requirements:** Can be operated by a person that has been trained for less than one hour. [2,5]

- **Operational Information:** The Type 66-M uses indicator tubes containing chemical reagents that produce a color change if the air pumped through them contains a chemical agent concentration that exceeds a threshold level. Two types of indicators can be found: "unified" indicator tubes which do not contain any reagent-filled inner ampoules and "non-unified" or "ordinary" indicator tubes which contain reagent-filled inner ampoules which must be opened and mixed before the detection reaction can occur. Unified indicator tubes can be used for continuous sampling while non-unified indicator tubes can only be used for one-time sample collection and detection. [4]

  Before using an indicator tube, both ends of the tube must be opened with a needle. The tube is then fitted on the air pump so that an air sample can be drawn across the indicator tube. The manual pump is operated at one stroke per second. While as many as five chemical agents can be detected simultaneously, the indicator tube for VX must be used alone. Two indicator tubes are used to determine the presence of VX. One of the tubes is used as the color standard. [4]

  Filter paper is included in the Type 66-M and should be mounted on the air pump if artificial smoke screens are present. When analyzing soil samples, the adaptor is attached to the air pump with the sample holding dish covered by filter paper. Soil samples are taken using the spatula contained in the kit. [4]

  At low temperatures, the chemical reactions are slower, so the heater cartridge is used to raise the temperature of the tube. The tube must be warmed for one minute before opening. After the sample is taken, the indicator tube should be warmed again for one minute. The heating cartridge is pricked open and placed in the central opening of the heat exchanger. The indicator tubes are placed in the opening around the central area. Three tubes can be warmed at one time.

  A special set of indicator tubes are available for training purposes. These training tubes simulate the color changes that would occur if chemical agents were being detected. [4]

  The Type 66-M should be inspected before and after use to insure that all parts are clean and in working condition. Consumables should be restocked. [4]

- **Stock Number(s):** *

- **Miscellaneous:** The Type 66-M should be decontaminated using methanol. After cleaning, the filter inside the hand pump must be replaced. The system should be ventilated for 15 hours. [4]

  Packaging: Ten pieces in plastic box (indicator tubes). [2]

  Shelf Life: Two years if stored between +15°C and +25°C (indicator tubes). [2]

- **Contact(s):**

  Manufacturers: (Type 66-M)
  GAMMAWORKS
  Budapest
  Hungary [4]

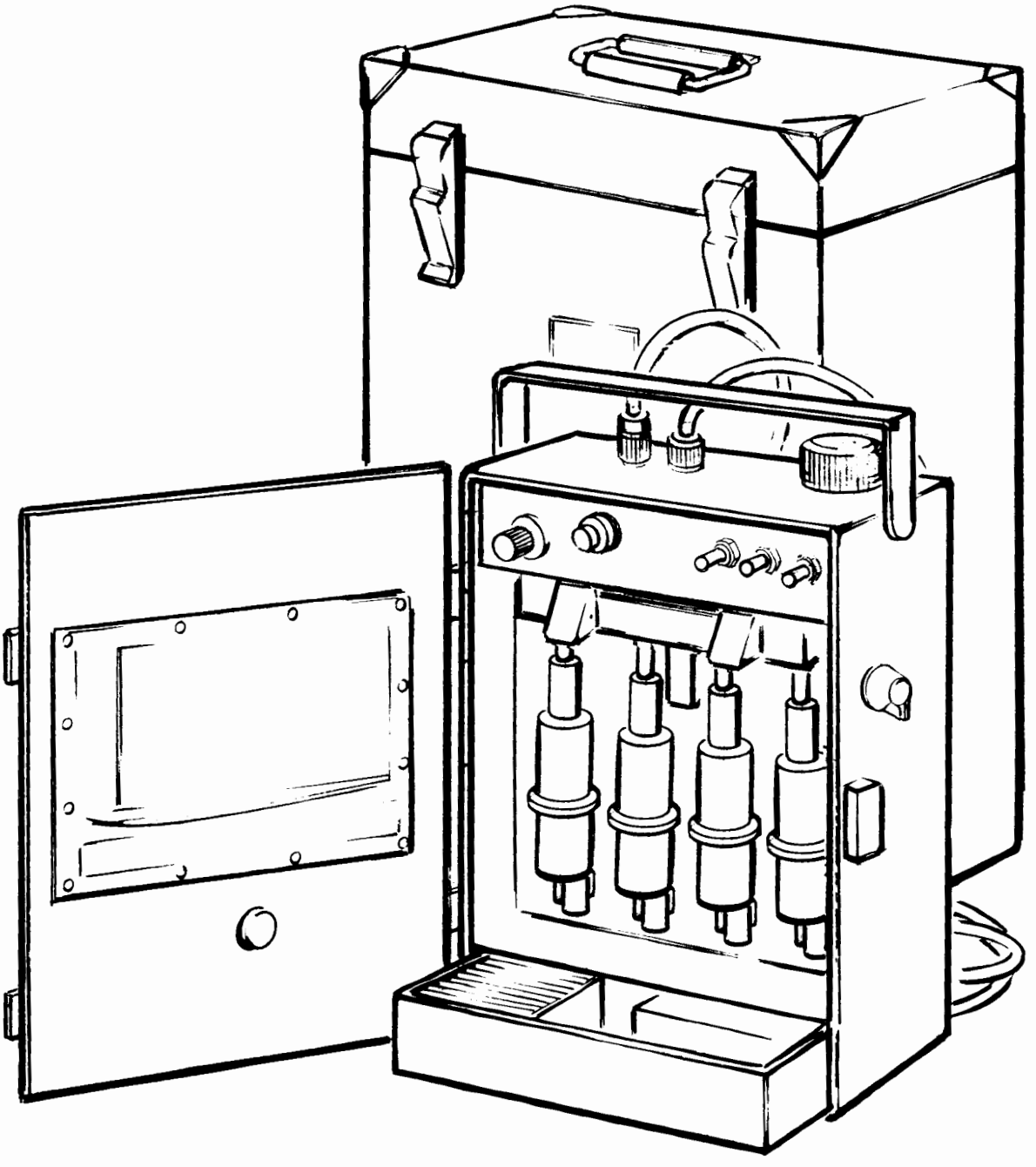
- **Contact(s) (continued):**

(Indicator Tubes)

Reanal Finechemical Co.
Budapest
Hungary
Tel: 036 1 2513999
Fax: 036 1 2521483 (4)

Marketer:

TECHNIKA Foreign Trading Company LTD
P.O. Box 125
X., Salgólarjáni út 20
H-1475 Budapest
Hungary
Tel: 036 1 1143230
036 1 11141290
Fax: 036 1 1134686
Telex: 22-5765 tkvbp h. (2)



Sketch courtesy of Battelle

The Continuous Chemical Detector Type FVJ

- **Designator(s):** Type FVJ

- **Item Name(s):** Continuous Chemical Detector Type FVJ

- **Item Description:** The Type FVJ is used to continuously monitor and detect chemical warfare agents in the air. It is designed to monitor up to four chemical agents simultaneously. This is accomplished by pumping air through the indicator tubes using an electromotor driven pump and monitoring the color change of the indicator tubes. This detector uses only "unified" indicator tubes, which do not contain reagent-filled inner ampoules. The system can be vehicle-mounted with the vehicle battery providing the electricity for the pump. The vehicle battery also provides power to the indicator tube heater, for use in cold temperatures. [3,6]

- **System Components:** [6]

  Electrical Air Pump
  Heater
  Indicator Tubes

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:**

PARAMETERS	TYPE FVJ [6]	INDICATOR TUBES [2]
Length	34.6 cm	100 ±3 mm
Width	24 cm	*
Diameter	*	6.2 ±1 mm
Height	13.5 cm	*
Weight	6.5 kg	*

- **Technology:** Uses chemical reactions which produce identifying color changes in the presence of an agent. [6]

- **Status:** *

- **Uses:** Designed to be used on vehicles. [6]

- **Deployment:** Used by the Hungarian Armed Forces. [2]

- **Agents Detected:** [2,4]

AGENT CLASS	AGENT(S)	MARKING RING	DETECTION SENSITIVITY
Blister	HD	1 Yellow	0.001 mg/l to 0.3 mg/l
Blood	AC	1 Blue	0.005 mg/l to 0.5 mg/l
Choking	CG	1 Green	0.005 mg/l to 0.8 mg/l
Tear	CS	3 White	0.0005 mg/l to 0.05 mg/l

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Requires a 24 V DC battery or a vehicle 24 V power supply. It can also be operated from a 12 V battery. Maximum power consumption is 2 A (when powered from 24 V). [6]

- **Transport Requirements:** Designed for vehicle transport. [6]

- **Personnel Requirements:** Once installed, continuous attendance is required to monitor the color change in the indicator tubes and to periodically replace them. [3]

- **Operational Information:** Uses an electromotor driven pump to draw air samples through indicator tubes containing chemical reagents that produce a color change, if the air pumped through them contains a chemical agent concentration that exceeds a threshold level. Only "unified" indicator tubes are used. Unified indicator tubes do not contain any reagent-filled inner ampoules so they can be used for continuous monitoring and detection. To use, both ends of the selected tubes must be opened, mounted in the Type FVJ and air pumped through them. If a color change occurs, it is compared to the color standard provided, thus identifying the type of chemical agent contamination present.

  Training tubes are available. These tubes simulate the color change that would occur if the specified chemical agents were present.

  Cleaning and decontamination procedures are similar to the Type 66-M. Consumables must be replaced. [4]

- **Stock Number(s):** *

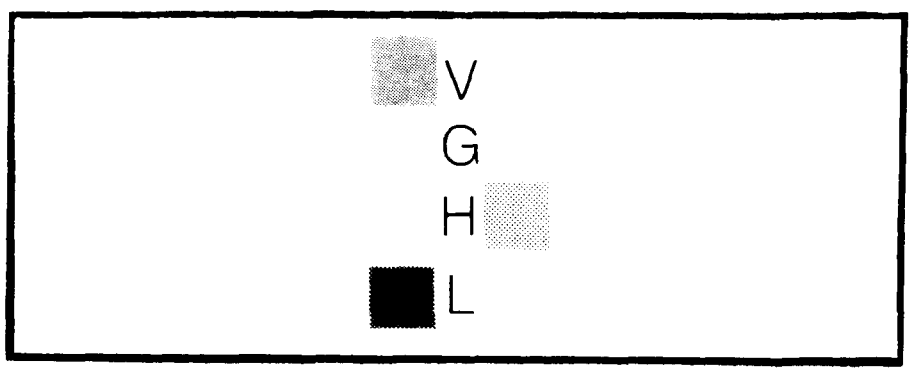
- **Miscellaneous:** [2]

Packaging:	Ten pieces in a plastic box (indicator tubes)
Shelf Life:	Two years if stored between +15°C and +25°C (indicator tubes)

- **Contact(s):**

Marketer:

TECHNIKA Foreign Trading Company LTD
P.O. Box 125
X., Salgólarjáni út 20
H-1475 Budapest
Hungary
Tel: 036 1 1143230
036 1 1141290
Fax: 036 1 1134686
Telex: 22-5765 tkvbp h. [2]



Sketch courtesy of Battelle

The Double Way® Chemical Agent Indicator Stripe

- **Designator(s):** *

- **Item Name(s):** Double Way® Chemical Agent Indicator Stripe

- **Item Description:** The Double Way® Chemical Agent Indicator Stripe is a self-adhesive stripe that can be attached to uniforms, protective clothing, vehicle wind screens or metallic parts of armored vehicles to monitor for the presence of nerve and blister agents. A color change signals the type of agent present. A color comparison chart is provided in the middle of the stripe. The indicator stripe has a special waterproof protective layer to allow its use even in rain. [2,11]

- **System Components:** *

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** *

- **Technology:** Uses a wet chemistry color change to identify agents. The stripe contains two sensor surfaces which indicate any hazardous substance getting onto their surface by color change, independently of one another. When the color change is compared to the color standard placed between the sensor surfaces then a given chemical agent can be identified if both sensor surfaces show a color change corresponding to the given agent. [2,4]

- **Status:** *

- **Uses:** Monitors for nerve and blister agent contamination. [2,11]

- **Deployment:** *

- **Agents Detected:** [2,4,11]

  Blister: H, HD, HN and L
  Nerve: GB, GD and VX

- **Detection Sensitivity:** *

- **Response Time:** *

- **False Responses/Interferents:** Fuels and explosives may cause a false response; however, by using the two different types of indicators, cross effects could be minimized. [2,3,11]

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** None. [2,11]

- **Transport Requirements:** None. [2,11]

- **Personnel Requirements:** None. Tape is adhered to a surface. Color change occurs if it is exposed to nerve or blister agents. [2,11]

- **Operational Information:** *

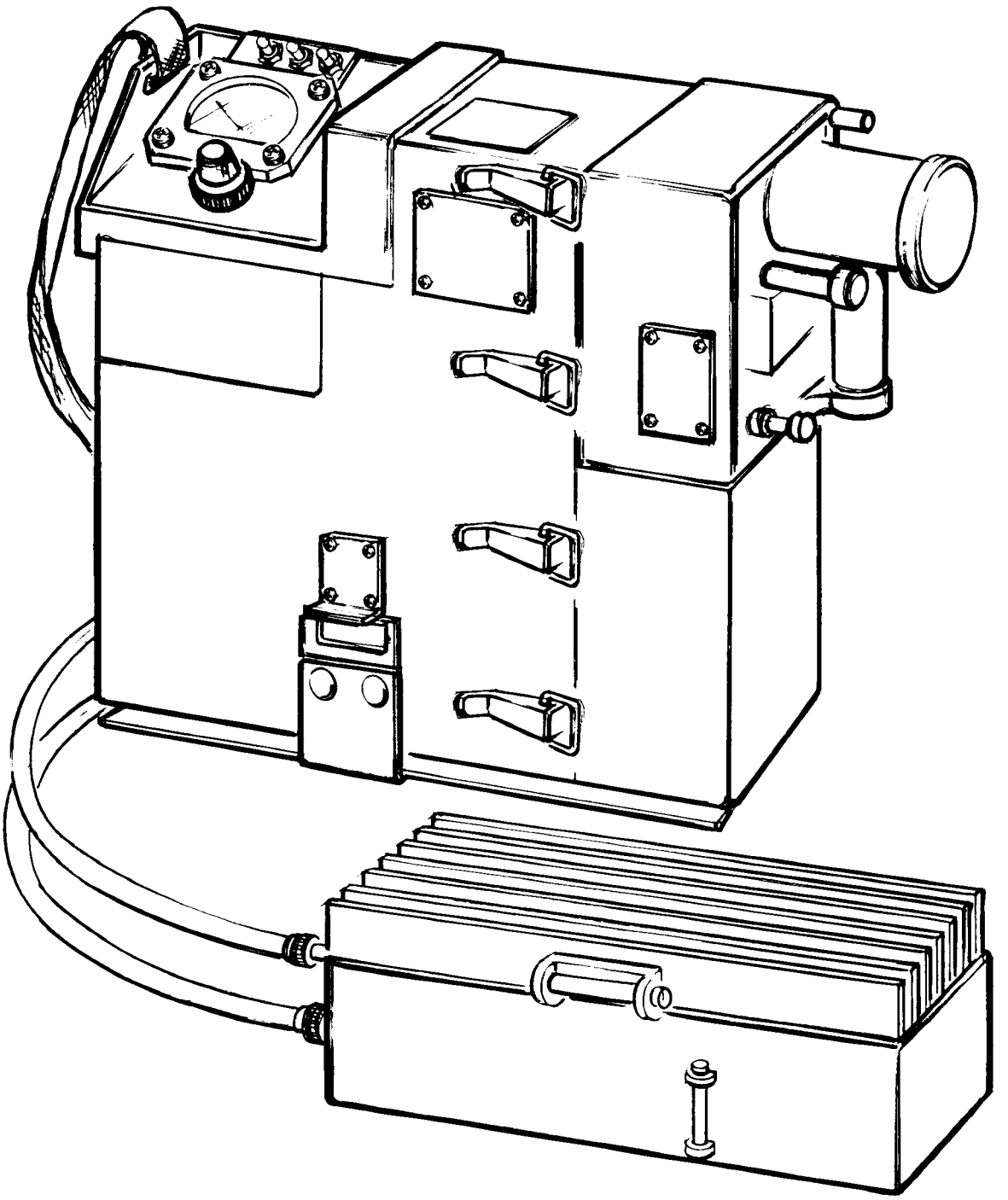
- **Stock Number(s):** *

- **Miscellaneous:** Individually packaged in airtight aluminum bags; however, collective packaging is available upon request. [2,11]

- **Contact(s):**

Manufacturer:
Reanal Finechemical Co.
Budapest
Hungary
Tel: 036 1 2513999
Fax: 036 1 2521483

Marketer:
TECHNIKA Foreign Trading Company LTD
P.O. Box 125
X., Salgólarjáni út 20
H-1475 Budapest
Hungary
Tel: 036 1 1143230
036 1 1141290
Fax: 036 1 1134686
Telex: 22-5765 tkvbp h. [2,11]



Sketch courtesy of Battelle

The Fast Chemical Detector Type GVJ-1

- **Designator(s):** GVJ-1
- **Item Name(s):** Fast Chemical Detector Type GVJ-1
- **Item Description:** The Type GVJ-1 is a vehicle transported or field-installed instrument used to continuously monitor the air for the presence of nerve agents and other toxic substances. Nerve agents are detected by a physical method while other toxic compounds are detected by the use of detection tubes. [8]
- **System Components:** *
- **Support Equipment:** *
- **Equipment Hardness:** *
- **Dimensions and Weight:** This item weighs 10 kg. [8]
- **Technology:** The principle of operation is based on an Excess Electron Capture detector with classical detection tubes. It ionizes the sample using a built-in Am^{241} source. [2,8]
- **Status:** *
- **Uses:** *
- **Deployment:** *
- **Agents Detected:** Nerve. [8]
- **Detection Sensitivity:** *
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** Am^{241} radioactive source. [2,8]
- **Power Requirements:** Operated from the built-in storage battery (4.8 V) or with a 12 V or 24 V DC battery. [8]
- **Transport Requirements:** Vehicle installed or field installed. [8]
- **Personnel Requirements:** Once installed, it requires attendance only. [8]

- **Operational Information:** The Type GVJ-1 uses an Excess Electron Capture detector with detection tubes for the detection of nerve agents. To begin the detection process, the electric pump-driven air flow enters the differential ionization chamber. When nerve agents are present, the currents from the series connected ionization chambers will have a different value due to the excess electron effect. This difference will trigger an alarm circuit. The alarm signal can be transferred automatically through a data transmitter system. The system responds quickly. The system depends mainly on the "dead-volume" of the piping layout connecting the detectors to the outside world. [2,8]

  Following the set-up, the system needs to be reset at three hour intervals or as indicated by an indicator meter. [8]

- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):**

  Marketer: TECHNIKA Foreign Trading Company LTD
  P.O. Box 125
  X., Salgólarjáni út 20
  H-1475 Budapest
  Hungary
  Tel: 036 1 1143230
  036 1 1141290
  Fax: 036 1 1134686
  Telex: 22-5765 tkvbp h. [2]

- **Designator(s):** Type TVL-63

- **Item Name(s):** Portable Field Chemical Laboratory Type TVL-63

- **Item Description:** The Type TVL-63 is a portable chemical laboratory used to detect and identify chemicals in soil, water and other materials. All necessary equipment is transported in a large carrying case. [12]

- **System Components:** [12]

  Chemicals and Reagents (83)
  Laboratory Glassware and Supplies
  Metal Plate
  Wooden Suitcase

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** *

- **Technology:** Portable wet chemistry laboratory. The detection and identification reactions and other chemical procedures are wet chemistry processes. [12]

- **Status:** *

- **Uses:** Used to perform filtration, distillation, extraction and other chemical processes. It provides quantitative analyses of samples and can be used to determine the effectiveness of decontamination processes. [12]

- **Deployment:** *

- **Agents Detected:** *

- **Detection Sensitivity:** *

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** None. [12]

- **Transport Requirements:** *

- **Personnel Requirements:** *

- **Operational Information:** *

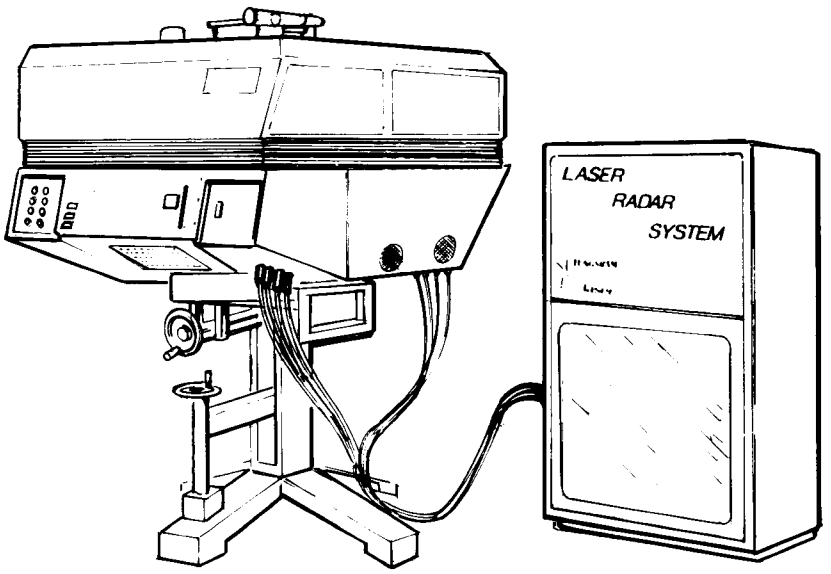
- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):**

Marketer:

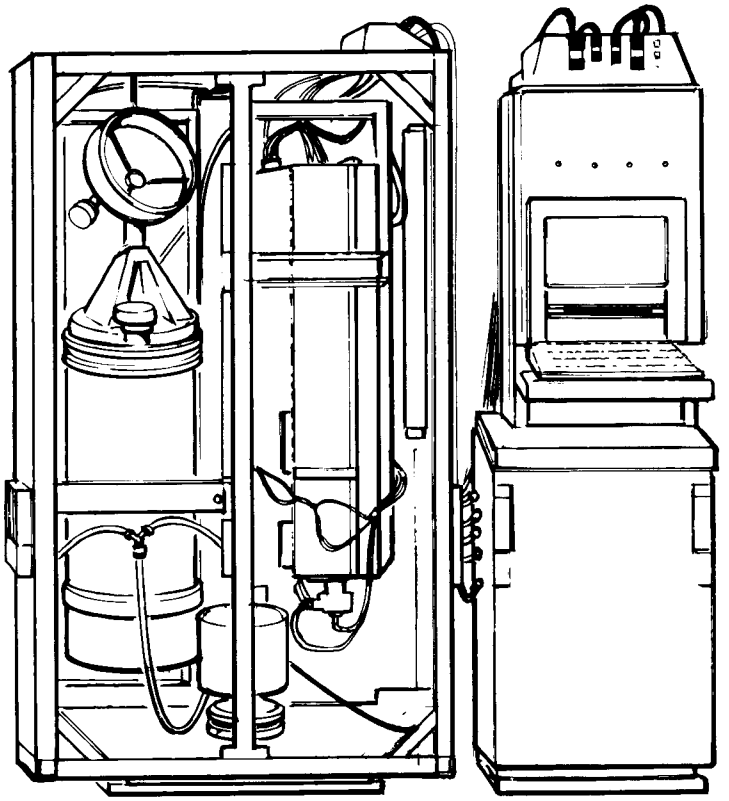
TECHNIKA Foreign Trading Company LTD
P.O. Box 125
X., Salgólarjáni út 20
H-1475 Budapest
Hungary
Tel: 036 1 1143230
036 1 1141290
Fax: 036 1 1134686
Telex: 22-5765 tkvbp h. [2]



The Remote Chemical Agent Sensor VTB-1

Sketches courtesy of Battelle

The Remote Chemical Agent Sensor VTB-2



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7. Technika. (1989). *Automatic Chemical Detector Type AVJ* [Brochure]. Budapest, Hungary.

8. Technika. (1989). *Fast Chemical Detector Type GVJ-1* [Brochure]. Budapest, Hungary.

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11. Technika. *Double Way® Indicator Stripe for the Detection of Chemical Warfare Agents* [Brochure]. Budapest, Hungary.

12. Technika. (1989). *Field Chemical Laboratory Type TVL-63* [Technical Data Sheets]. Budapest, Hungary.

13. Leonelli, Joe. (1995, June). *Re: LASRAM Laser Technology Ltd. Fact Sheet on VSJ-1 Surface Contamination Detector* [1 p.]. Facsimile Transmission, Battelle, Columbus, OH, U.S.A.

14. Leonelli, Joe. (1995, June). *Re: VSJ-1 Surface Contamination Detector, Technical Description and Instruction Manual, 1992, 3rd ed.* [12 p.]. Facsimile Transmission, Battelle, Columbus, OH U.S.A.

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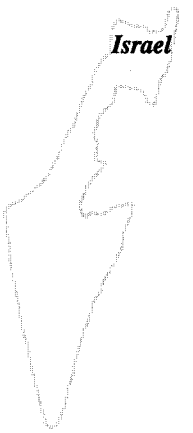

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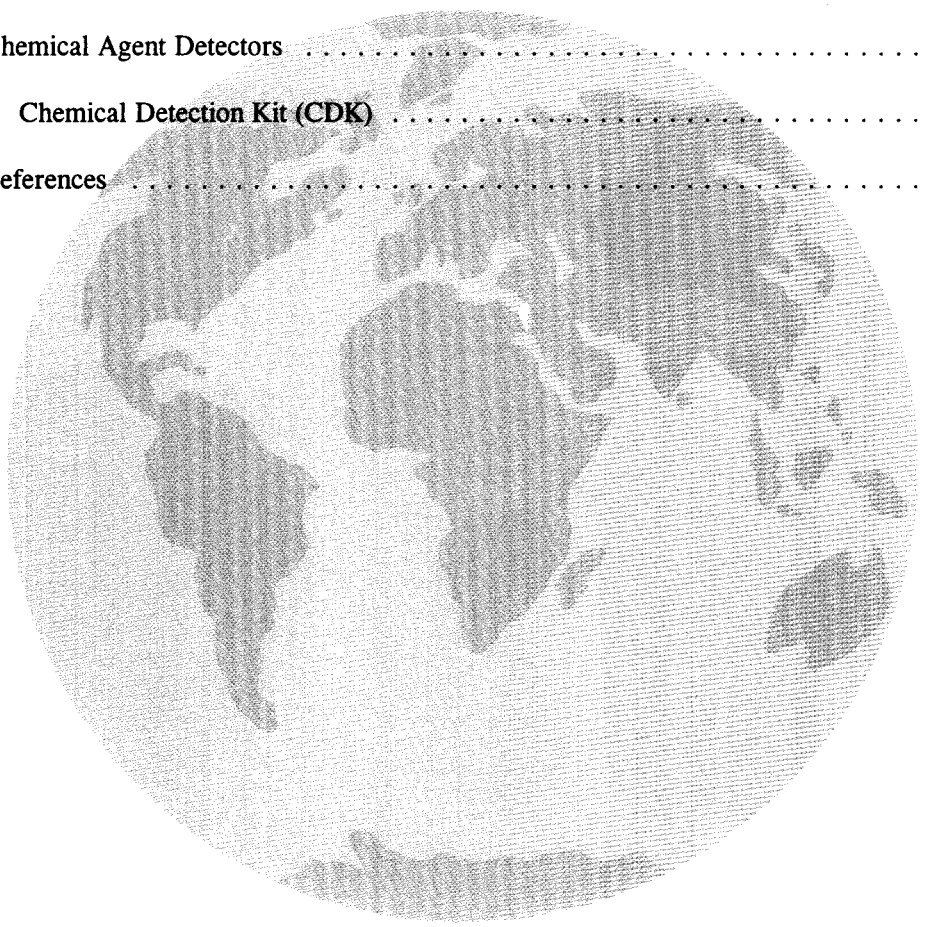

11.1 CHEMICAL AGENT DETECTORS

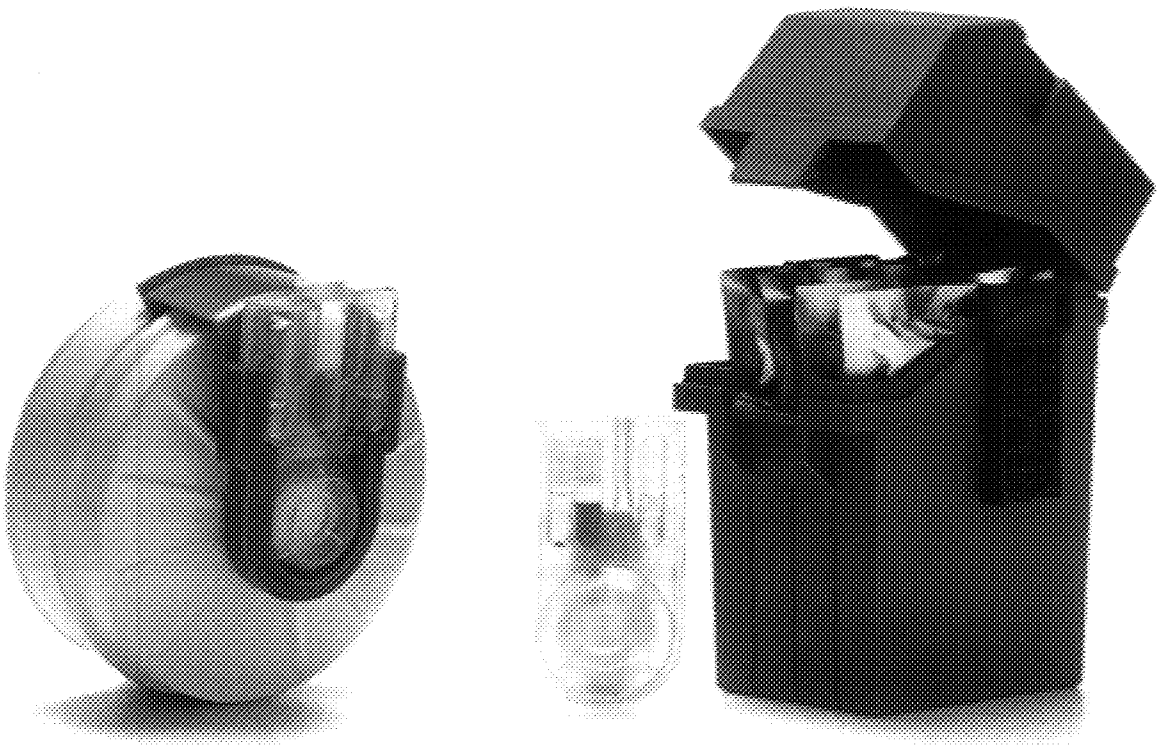

Photo courtesy of Israel Institute for Biological Research

The Israeli Gas Mask Filter-Mounted CDK

- **Designator(s):** CDK

- **Item Name(s):** Chemical Detection Kit (CDK)

- **Item Description:** The CDK is a gas mask filter-mounted detector intended to provide non-dedicated units with the ability to detect nerve and blister agents at lower detection thresholds. The use of two samplers allows the identification of nerve or blister agents by color reaction. [1]

- **System Components:** [1]

  Instructions
  Plastic Adapter (for canister mounting)
  Two plastic Cases (each including four detection samplers for either blister or nerve agents)

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** [1]

PARAMETERS	NERVE DETECTION SAMPLER	BLISTER DETECTION SAMPLER	DETECTION KIT
Length	7.8 cm	8 cm	9.2 cm
Width	3.9 cm	4.8 cm	6.9 cm
Height	1.1 cm	1.1 cm	13.9 cm
Weight	11.1 g 33.4 g (with adapter)	12.5 g 34.8 g (with adapter)	208 g (nerve kit) 213 g (blister kit)

- **Technology:** Wet chemistry, colorimetric reaction. [1]

- **Status:** *

- **Uses:** Detection and identification of agents, confirmation of demasking and mapping of contaminated areas. [1]

- **Deployment:** *

- **Agents Detected:** (in vapor or aerosol state) [1]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	HD	2 μg/l to 4 μg/l air
Nerve	GA	6 ng/l to 12 ng/l air
	GB and GD	2 ng/l to 5 ng/l air
	VX	8 ng/l to 15 ng/l air

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** 6 minutes to 10 minutes.
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None. [1]
- **Transport Requirements:** Compact and portable; mounted on end of mask filter. [1]
- **Personnel Requirements:** Simple to use; used by soldiers after a few minutes of instruction. [1]
- **Operational Information:** [1]

  Operational Temperature: 0°C to +50°C
  Relative Humidity: 20% to 85%

- **Stock Number(s):** *
- **Miscellaneous:** Complies with MIL-STD-810D. Approved by the Israeli Defence Forces (IDF). [1]

  Shelf Life: Five years at +37°C. [1]

- **Contact(s):**

  Manufacturer: Israel Institute for Biological Research (IIBR)
  P.O. Box 19
  Ness-Ziona 70450
  Israel
  Tel: 0972 8 381687
  Fax: 0972 8 401094 [1]

- **Contact(s) (continued):**

Ministry of Defense: SIBAT
8 David Elazar St.
Hakirya
Tel Aviv 61909
Israel
Tel: 0972 3 69755851
0972 3 6975762
Fax: 0972 3 6976724
Telex: 361203 SIBAT [2]

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1. Israel Institute for Biological Research (IIBR). (1992). *Chemical Detection Kit-CDK* [Brochure]. Ness-Ziona, Israel

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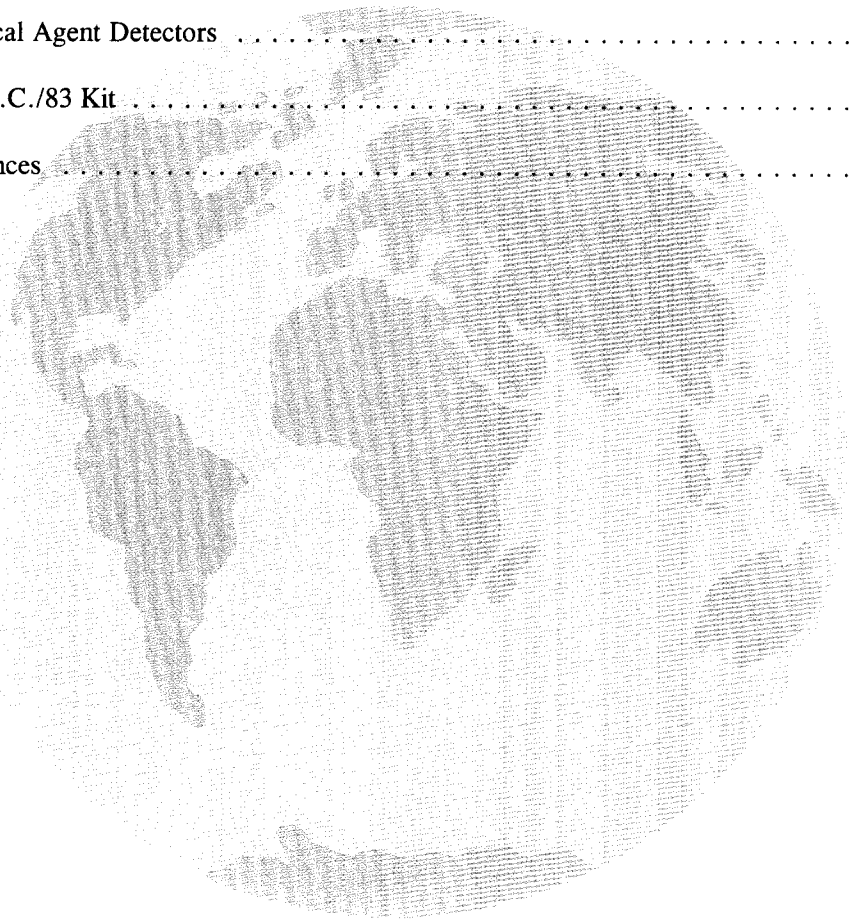

12.1 CHEMICAL AGENT DETECTORS

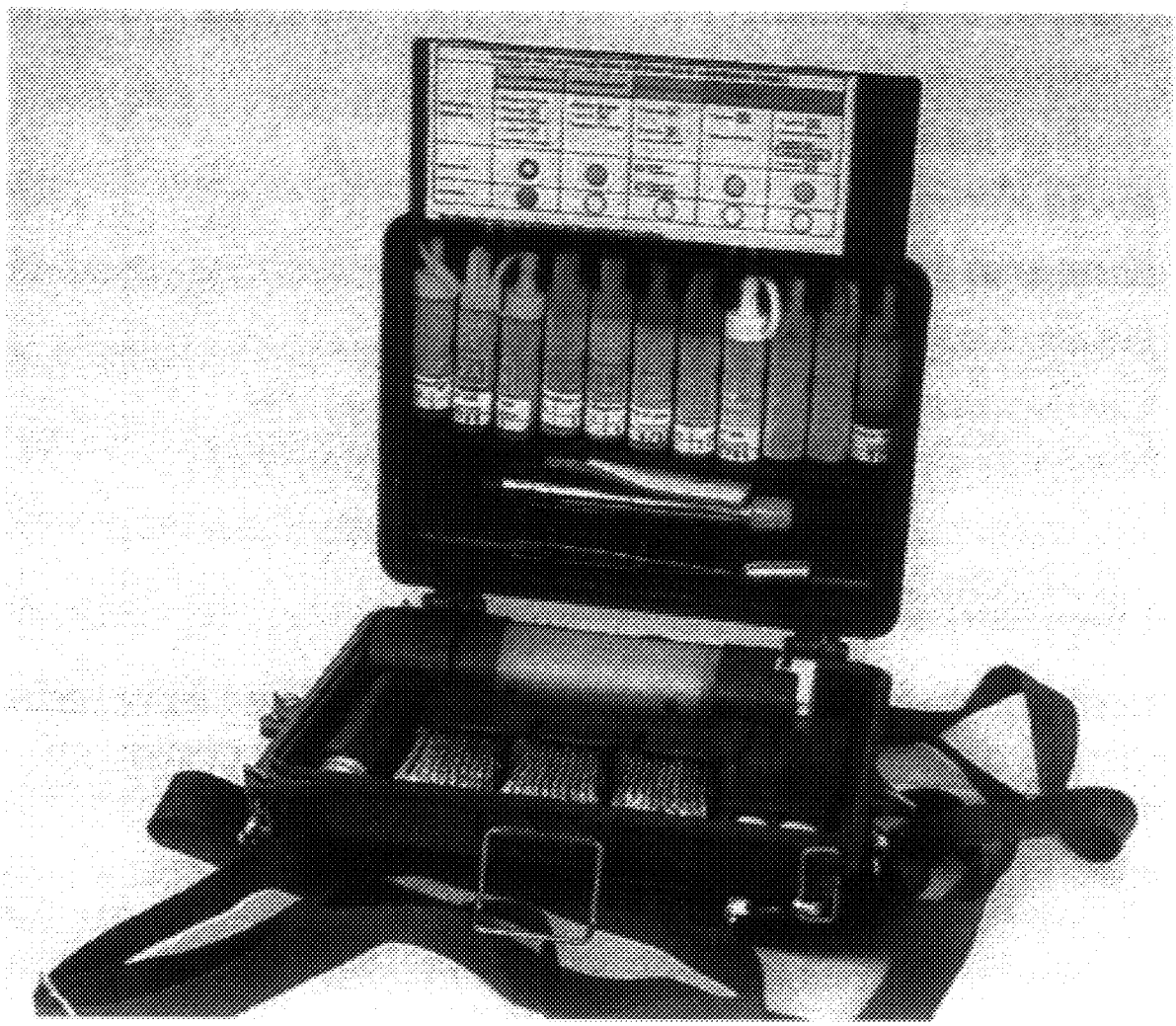

Photo courtesy of the Italian Embassy, Office of the Military Attache

The Italian R.A.C./83 Chemical Agent Detection Kit

- **Designator(s):** R.A.C./83

- **Item Name(s):** R.A.C./83 Kit

- **Item Description:** The R.A.C./83 detection kit contains materials for sampling and detecting chemical agents. [1]

- **System Components:** [1]

  Aspirator (for sample collection)
  Color Comparison Table (for determining presence of agents)
  Cotton Balls (20 per container)
  Detection Paper
  Empty Bottles (2)
  Flashlight
  Notepad
  Pen
  Reagent Bottles (9)
  Sample Collection Plates (30)
  Sample Collection Spoon

- **Support Equipment:** Refill kits are available. [1]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [1]

PARAMETERS	PRIMARY KIT	REFILL KIT
Length	23.8 cm	35.6 cm
Width	17.5 cm	24 cm
Height	6.8 cm	22.8 cm
Weight	1.44 kg	5.41 kg

- **Technology:** Chemical reactions/wet chemistry. [1]

- **Status:** *

- **Uses:** Used for detecting chemical agents in the air, ground, clothing, equipment, food and on surfaces. [1]

- **Deployment:** *

- **Agents Detected:** This kit detects the agents listed below in gas, aerosol and liquid form. [1]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY (at +20°C and 60% RH)
Blister	HD	1.0 mg/m^3
Blood	AC	1.2 mg/m^3
	CK	2.5 mg/m^3
Choking	*	1.8 mg/m^3
Nerve	GA, GB and GD	0.03 mg/m^3
	VX	0.01 mg/m^3

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** No power required to operate the kit; flashlight requires two 1.5 V batteries. [1]
- **Transport Requirements:** Portable; comes with a polyester carrying strap to facilitate transport. [1]
- **Personnel Requirements:** One operator. [1]
- **Operational Information:** *
- **Stock Number(s):** 6640-15-066-0694 (NATO). [1]
- **Miscellaneous:** *
- **Contact(s):**

Manufacturer: Farmitalia Carlo Erba S.p.A.
Via Carlo Imbonati 24
20159 Milano
Italy
Tel: 039 2 48381
039 2 48382734 [1]

12.2 REFERENCES

1. Coccia, Maurizio. (1994, June). *Re: R.A.C./83* [7 p.]. Correspondence, Italian Embassy - Office of the Military Attache, Washington, D.C., U.S.A.

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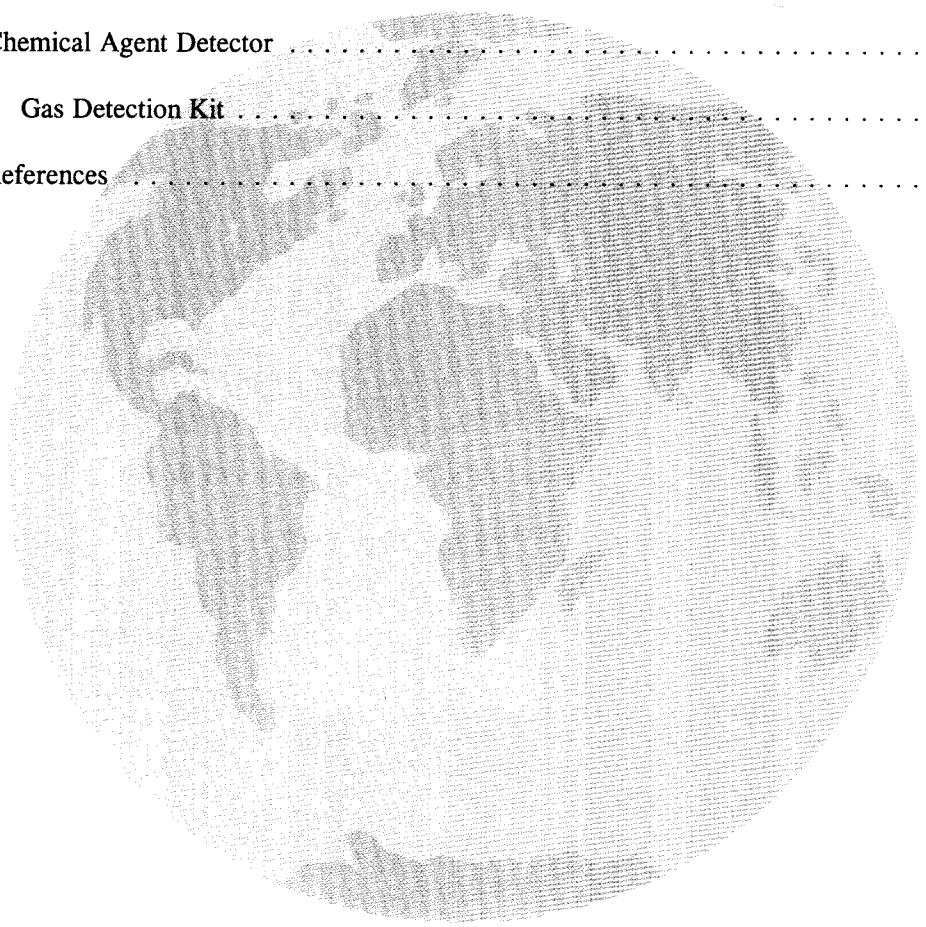
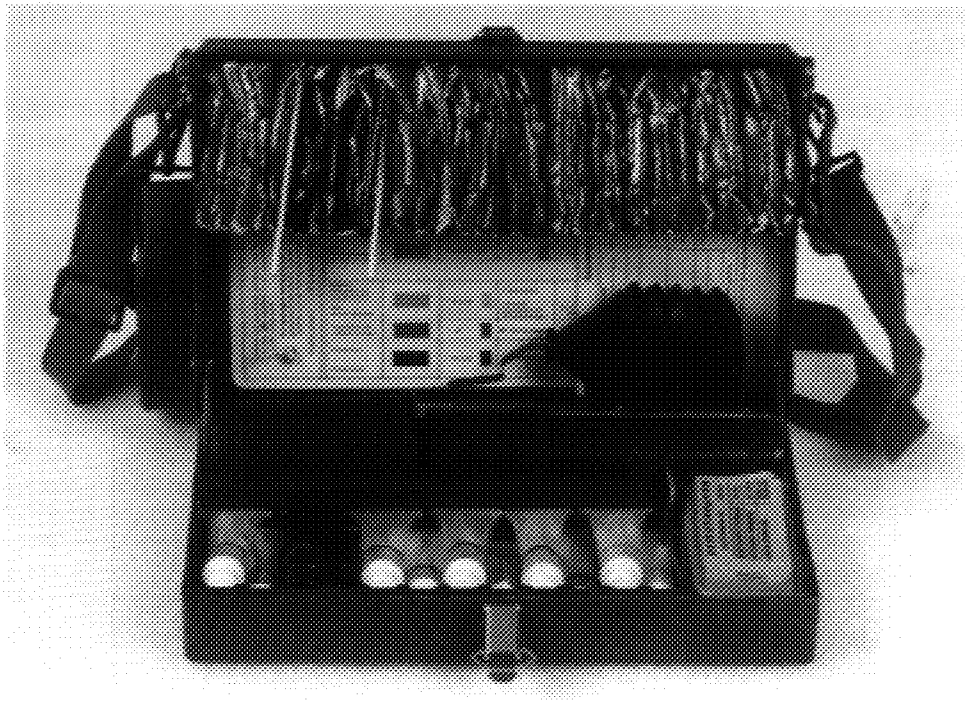


13.1 CHEMICAL AGENT DETECTORS



Gas Detection Kit Filled with Droppers and Tickets

Photos courtesy of the Dutch NBC School

Supplementary Packets for the Gas Detection Kit

- **Designator(s):** GVU

- **Item Name(s):** Gas Detection Kit
  Gas Verkenningsuitrusting

- **Item Description:** The Gas Detection Kit is a portable unit containing chemical or enzymatic reagents that produce color changes in the presence of chemical warfare agents. Chemical agents in vapor, aerosol or liquid form can be detected using this kit. The reagents for the various detection reactions are packaged in small glass ampoules contained in plastic droppers. (1)

- **System Components:** One box (with droppers and tickets with two supplementary packets). (1)

  Air Pump (manual)
  Plastic Funnel Attachment
  Reagent Ampoules
  Storage Case
  Supplementary Packets

- **Support Equipment:** None. (1)

- **Equipment Hardness:** The storage case is NBC hardened, except for the harness, which is very difficult to decontaminate. (1)

- **Dimensions and Weight:** (1)

PARAMETERS	BOX	SUPPLEMENTARY PACKET (each)
Length	29 cm	19 cm
Width	19 cm	19 cm
Height	7 cm	12 cm
Weight	1.7 kg	1.3 kg

- **Technology:** Uses wet chemistry and enzymatic reactions to produce color changes. The nerve gases are detected by the enzyme-inhibition reaction using freeze-dried pseudo-cholinesterase and 2,6-dichloro benzenone indophenylacetate as reagents on non-impregnated silica paper. For a positive reaction to nerve agents, a white spot on a blue background will appear. The mustard gases are detected by means of the DB-3 reaction, using p-(4-nitro-benzyl) pyridine (mercury cyanide and NaOH solution) on non-impregnated silica paper. A blue color will appear to indicate a positive reaction to mustard gases. Lewisite and other arsenicals are detected by means of the molybdate reaction, using ammonium molybdate-impregnated silica paper to which NaOH solution is added after sampling of the air. A blue color will appear to indicate a positive reaction to arsenic compounds. Phosgene and, if desired, phosgene oxime can also be detected by means of the DB-3 reaction, using p-(4-nitrobenzyl) pyridine and mercury cyanide, but no NaOH solution, on non-impregnated silica paper. An orange-yellow color will appear to

- **Technology (continued):** indicate a positive reaction to phosgene. Hydrocyanic acid and cyanogen chloride are detected by the pyridine/benzidine reaction, using a mixed pyridine (for CK) and benzidine (for AC) reagent on copper acetate-impregnated silica paper. A blue color will appear for AC, and a pink color will appear for CK if a positive reaction is indicated. (1)

- **Status:** Fielded. (1) No longer in production. (2)

- **Uses:** This kit is used by military forces to search and locate contamination on personnel, equipment, ships, aircraft, land vehicles, buildings and terrain. (1)

- **Deployment:** In service with the Dutch Army for over 30 years; also used by the Royal Netherlands Army. (1)

- **Agents Detected:** (1)

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Arsenicals	L	1 μg to 2 μg
Blister	HN and HS	0.2 μg to 1 μg
Blood	AC	1.5 μg to 2.5 μg
	CK	0.6 μg to 1 μg
Choking	CG	0.2 μg to 0.5 μg
Nerve	G and V (without distinction)	0.003 μg to 0.006 μg

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** Benzidene is a carcinogen. (4)

- **Power Requirements:** None. (1)

- **Transport Requirements:** Portable; no special requirements. (1)

- **Personnel Requirements:** Minimal. (1)

- **Operational Information:** The detection of CW agents in vapor or aerosol form is performed by placing a ticket with silica paper in a pump and passing the contaminated air through the paper by carrying out a certain number of strokes. The necessary reagents are added to the silica paper after sampling of the air or, in some cases, before sampling. [1]

  Each detection reaction is carried out with one or two droppers, the contents of which are prepared beforehand by breaking the ampoules and shaking them. [1]

  The more volatile CW agents (except V) in liquid form, can be detected in the form of vapor by pumping, with a plastic funnel fixed to the mouthpiece of the pump, just above the contaminated area. [1]

  A second method is an extraction method based on the before-mentioned enzyme-inhibition reaction, which can be used for the detection of V-agents in soil. [1]

- **Stock Number(s):** 6665-17-704-3326 (NSN). [1]

- **Miscellaneous:** The reagents for the various detection reactions are stored in small glass ampoules contained in plastic droppers, thus rendering as long a shelf life for the reagents as possible. [1]

- **Contact(s):**

  Developer: DMKLIALG UITR
  Post Office Box 90822
  2509 LV Den Haag
  The Netherlands [3]

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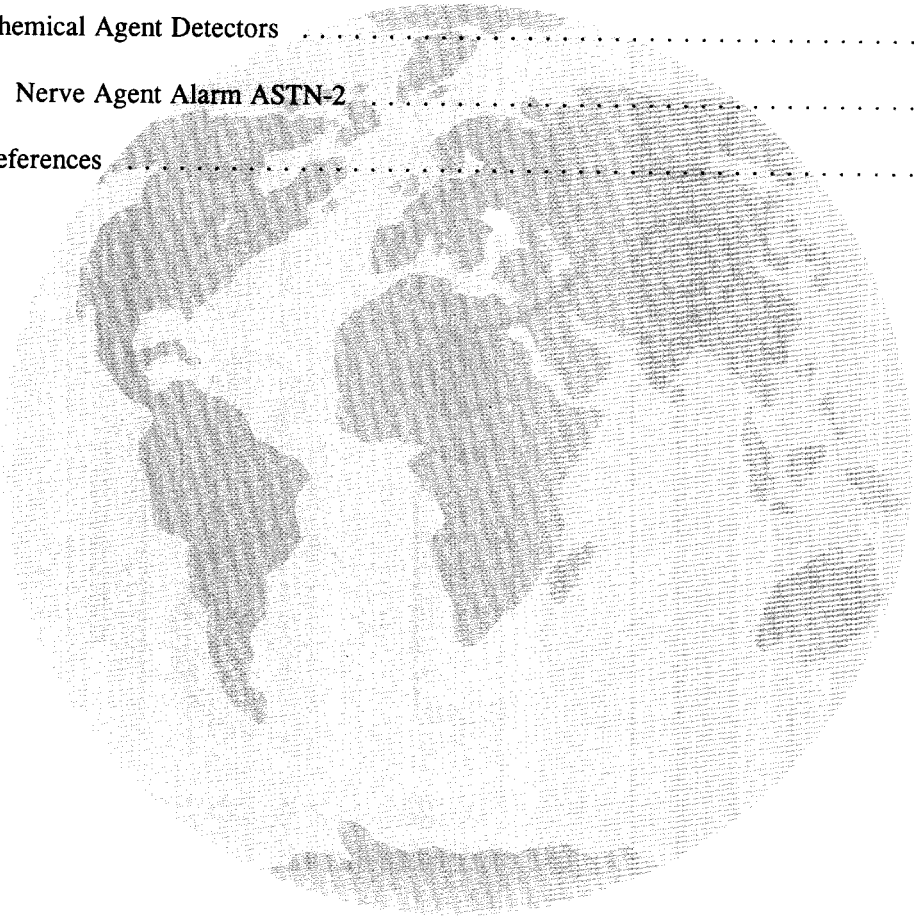
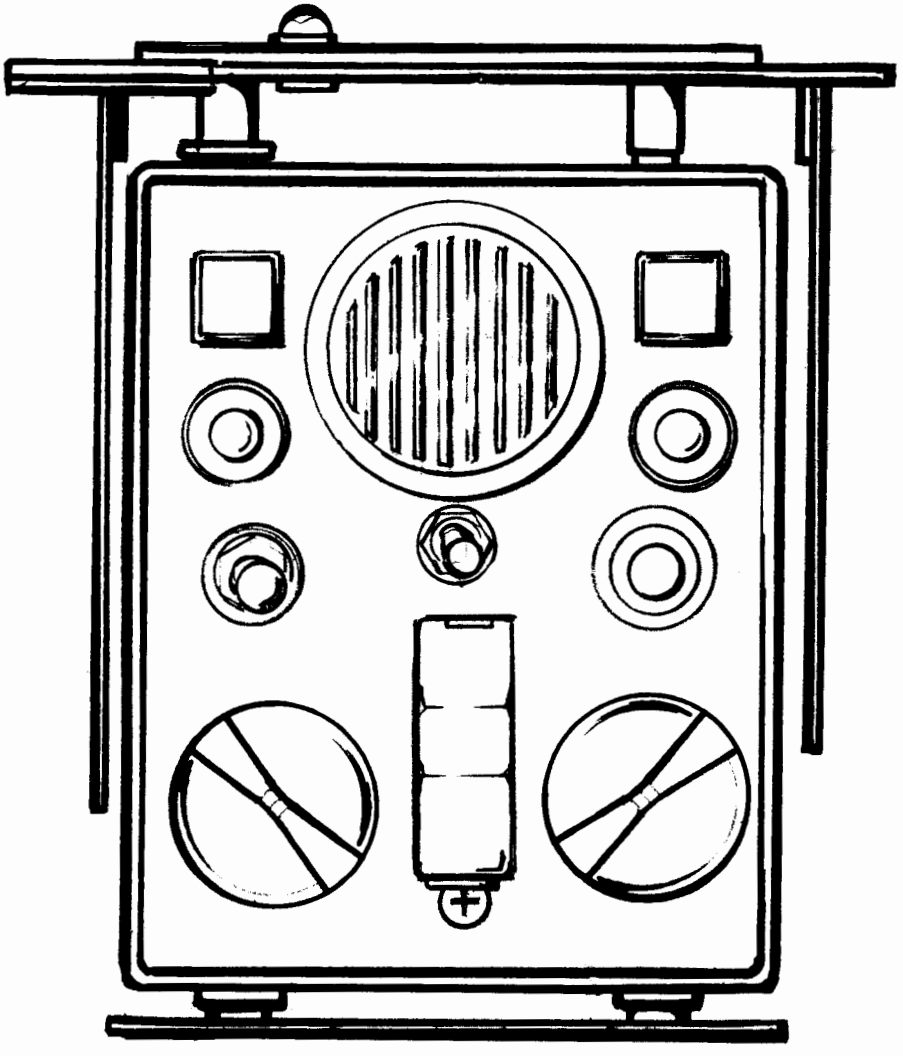


14.1 CHEMICAL AGENT DETECTORS



Sketch courtesy of Battelle

The Romanian Nerve Agent Alarm ASTN-2

- **Designator(s):** ASTN-2

- **Item Name(s):** Nerve Agent Alarm ASTN-2

- **Item Description:** The ASTN-2 is designed to detect the presence of nerve agents in the air. It provides an audible and visible signal if the concentration of nerve agent exceeds a predetermined level. The acoustical warning signal is in the frequency between 1,000 Hz and 2,500 Hz (60 db). Remote detection is possible by circuits connected to a radiotelephone station which provides remote transmission by cable or radio signals if nerve agent is present. The ASTN-2 can be vehicle mounted. Samples are drawn at a flow rate of one liter per minute. (1)

- **System Components:** *

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** (with base) (1)

Length:	24.5 cm
Width:	21 cm
Height:	22.5 cm
Weight:	2 kg (absorber base)
	6 kg (detector)

- **Technology:** *

- **Status:** *

- **Uses:** *

- **Deployment:** *

- **Agents Detected:** Nerve. (1)

- **Detection Sensitivity:** $\geq 5 \times 10^{-4}$ mg/l of air. (1)

- **Response Time:** 20 seconds. (1)

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** It is protected by a power supply reverse connection. (1)

- **Power Requirements:** Uses a battery or vehicle power source between 12 V and 27 V. The maximum power needed is 0.8 A during sampling and 1 A during detection and alarm. (1)

- **Transport Requirements:** Vehicle-mounted; mounting is not required for operation. (1)

- **Personnel Requirements:** *

- **Operational Information:** (1)

  Operational Temperature: -24°C to +40°C.

- **Stock Number(s):** *

- **Miscellaneous:** Continuous operation for 24 hours. The radio communication's minimum amplitude of warning and modulation electric signal is 0.5 V. (1)

- **Contact(s):**

Marketer:

ROMTECHNICA
9-11 Drumul Taberei Street
Bucharest
Romania
Tel: 040 1 462087
Fax: 040 1 460317
Telex: 11608 TXKCO

14.2 REFERENCES

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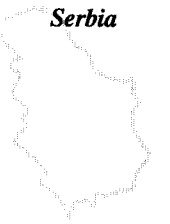

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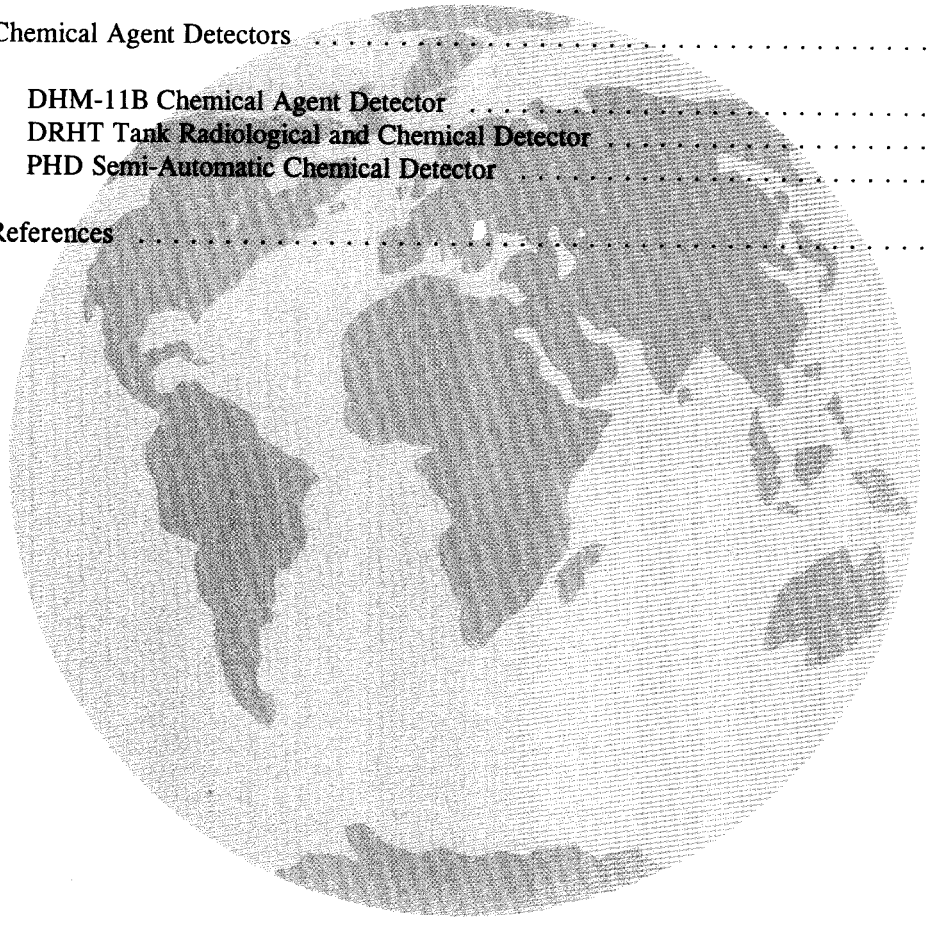


15.1 CHEMICAL AGENT DETECTORS

Serbia's Chemical Detector Kit DHM-11B

Photos courtesy of the
Federal Directorate of Supply and Procurement

Field Use of the DHM-11B

- **Designator(s):** DHM-11B

- **Item Name(s):** DHM-11B Chemical Agent Detector

- **Item Description:** The DHM-11B Chemical Agent Detector is a manually operated chemical warfare agent detector kit that can detect agents in the air, on the ground, on weapons, technical equipment and food. The detector may be used to take samples of air, smoke, snow, earth, sand and dust from contaminated surfaces. A manual pump is used to draw air samples into reagent-treated indicator tubes. A color change signals the presence of a particular agent. [4,5]

- **System Components:** [2,3]

  Carrying Case
  Indicator Tubes/Holders
  Manual Pump Assembly (in a carrying case)
  Paper Filter
  Plastic Dust Filter
  Pocket Flashlight
  Pump Attachments
  Storage Containers
  Trowel

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** *

- **Technology:** Uses chemical reactions which produce color changes in the presence of chemical agents. The detector kit reagents are sensitive enough to detect agents even in harmless concentrations. [4]

- **Status:** In production. [2]

- **Uses:** It can detect agents in the air, on the ground, on weapons, technical items and equipment, and other surfaces. The detector may also be used to take samples of contaminated air, smoke, snow, earth, sand and dust taken from contaminated surfaces. [4,5]

- **Deployment:** Used by the Serbian Armed Forces.

- **Agents Detected:** [4]

Blister:	H and HN
Blood:	AC and CK
Choking:	CG and DP
Nerve:	GA and others

- **Detection Sensitivity:** The sensitivity of the chemical reactions in the DHM-11B allows it to detect chemical warfare agents even in harmless concentrations. [4]

- **Response Time:** The time required to prepare the detector kit is 1.5 minutes to 3 minutes. The response time is between 1.5 minutes to 5 minutes. [4]

- **False Responses/Interferents:** Residual chemicals from previous tests may give a false reading on the current test. [2]

- **Safety Features/Safety Hazards:** Since the DHM-11B is designed for use in a contaminated environment, users should be in full chemical protective attire before conducting the detection tests. [2]

- **Power Requirements:** None. [4]

- **Transport Requirements:** Portable. [3]

- **Personnel Requirements:** Tests with the DHM-11B require the use of both hands, therefore assistance is required if the flashlight is needed. [2]

- **Operational Information:** The manual pump is used to draw air through indicator tubes treated with various reagents. A color change signals the presence of a particular agent. The indicator tubes are marked using various colors. The tubes marked with yellow and green rings and a yellow dot detect phosgene, diphosgene, mustard and nitrogen mustard. These tubes may be used for three years. The tubes with the blue ring and blue dot detect AC, CK, GA and cyanide group compounds. These tubes may be used for two years. The tubes with the red ring detect nerve agents and may be used for two years. After the expiration date, the tubes should be replaced with new ones and the expired ones can be used for training purposes. When using the detector tubes, the tube order of usage is as follows: the tube with the red ring is first, then the tube with the blue ring and blue dot on the top, and finally, the tube with the yellow and green ring and yellow dot on the top. [3,4]

  A tube with silica gel is also provided to take aerosol samples. Sampling is carried out by cutting and opening the tube on both ends. Contaminated air is then pumped through the detector tube (pumped 5 to 10 times) and the detector tube is plugged at both ends with plastic plugs. A mobile chemical laboratory is used to analyze the sample. [3]

  Agent in vapor form can also be analyzed using the detector tube containing cotton wool. The operating procedure is the same as with the tube with silica gel. Yellow and blue indicator papers are used to detect blister agents on the ground. A color change occurs when blister agents come in contact with the chemically treated papers. [3]

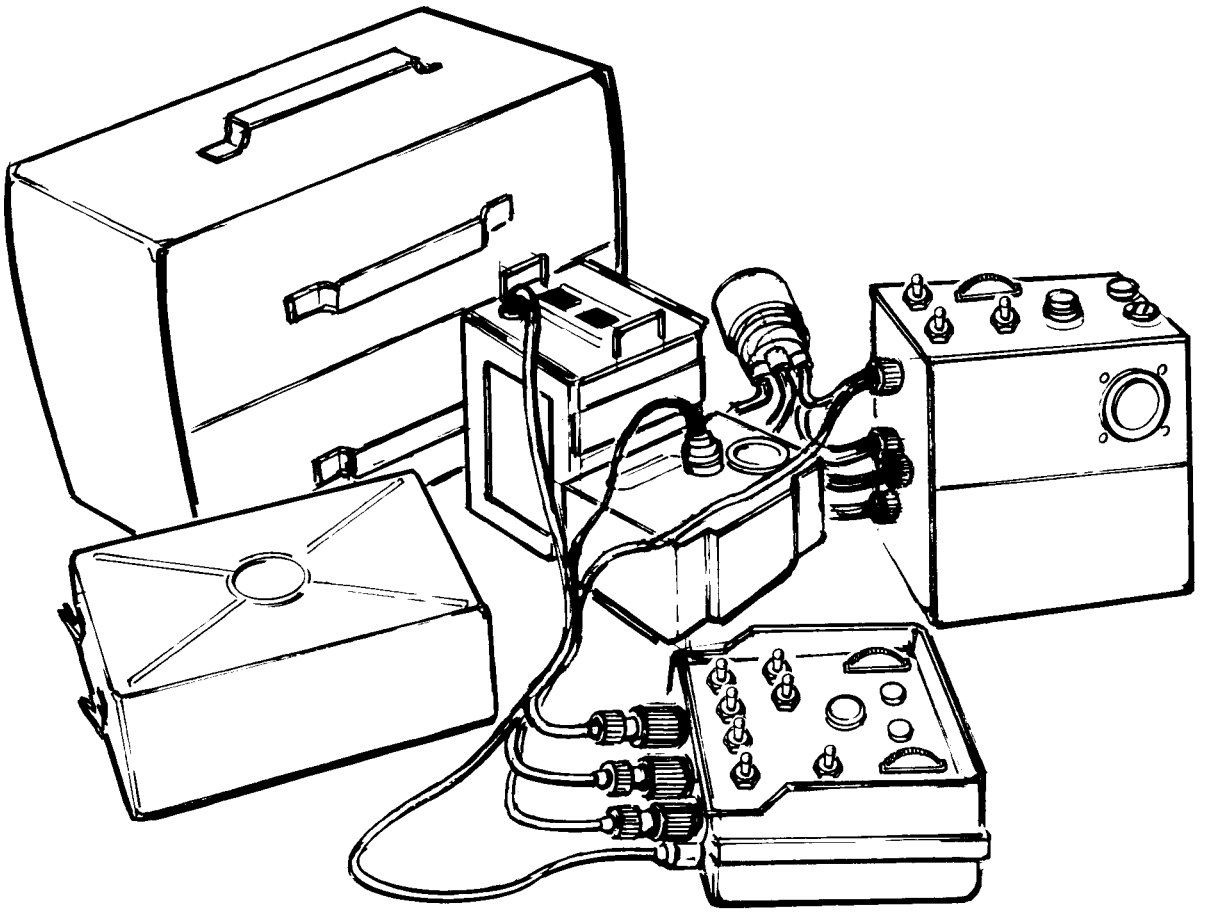
- **Stock Number(s):** *

- **Miscellaneous:** Decontamination is required on all outer containers and some components of the detector kit. The detectors both in use and in storage should be kept in dry clean rooms and protected against direct sun rays. [2,3]

  Storage Temperature: +5°C to +25°C. [3]

- **Contact(s):**

Developer:	SDPR - Federal Directorate of Supply and Procurement 9 Nemanjina St. YU-11105 Beograd Serbia Tel: 038 11 621522 Fax: 038 11 324981 Telex: 038 11 11360 YU SDPR [4]
Manufacturer:	Industrija Miloje Zakitj Krusevac, Serbia [5]



Sketch courtesy of Battelle

DRHT Tank Radiological and Chemical Detector

Designator(s): DRHT

- **Item Name(s):** DRHT Tank Radiological and Chemical Detector

- **Item Description:** The DRHT is designed for use by tank crews to detect nuclear radiation and chemical agents in the atmosphere. It can transmit signals automatically to remote locations when a radio network is established. [6]

- **System Components:** [6]

  Automatic Chemical Agent Detector
  Compressor Unit
  Cyclotron
  Measurement and Control Unit
  Radiation Detector

  There is also a consumables kit, tools and accessories including the interconnecting cables. [6]

- **Support Equipment:** *

- **Equipment Hardness:** This detector has a mechanical resistance to vibrations of 5 Hz to 55 Hz, amplitude ± 0.25 mm. [6]

- **Dimensions and Weight:** [6]

Length:	*
Width:	*
Height:	*
Weight:	30 kg (entire system)

- **Technology:** *

- **Status:** *

- **Uses:** Used to detect the initial gamma radiation emitted from a nuclear explosion as well as gamma radiation from settled debris and secondary radiological contamination. An alarm signal will alert the crew if a predetermined dose level has been exceeded. [6]

  An alarm will signal the presence of chemical agent contamination in vapor and aerosol form that exceeds the preset threshold concentration. The DRHT can also be used to measure the accumulated agent concentration in the tank cabin. The alarm signal can be transmitted to remote locations via a radio network. [6]

- **Deployment:** *

- **Agents Detected:** [6]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blood	AC	*
Choking	CG	*
Nerve	GB	6 x 10^4 mg/dm^3
	GD	5 x 10^4 mg/dm^3
	VX	*

- **Detection Sensitivity:** See ***Agents Detected*** for further information.
- **Response Time:** Chemical agents can be detected after 90 seconds at a temperature of +20°C ±5°C. [6]
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** Less than 7 A when operated from a vehicle's 27 V DC power supply. [6]
- **Transport Requirements:** Tank transported. [6]
- **Personnel Requirements:** *
- **Operational Information:**

  Operational Temperature: -15°C to +55°C. [6]

- **Stock Number(s):** *
- **Miscellaneous:**

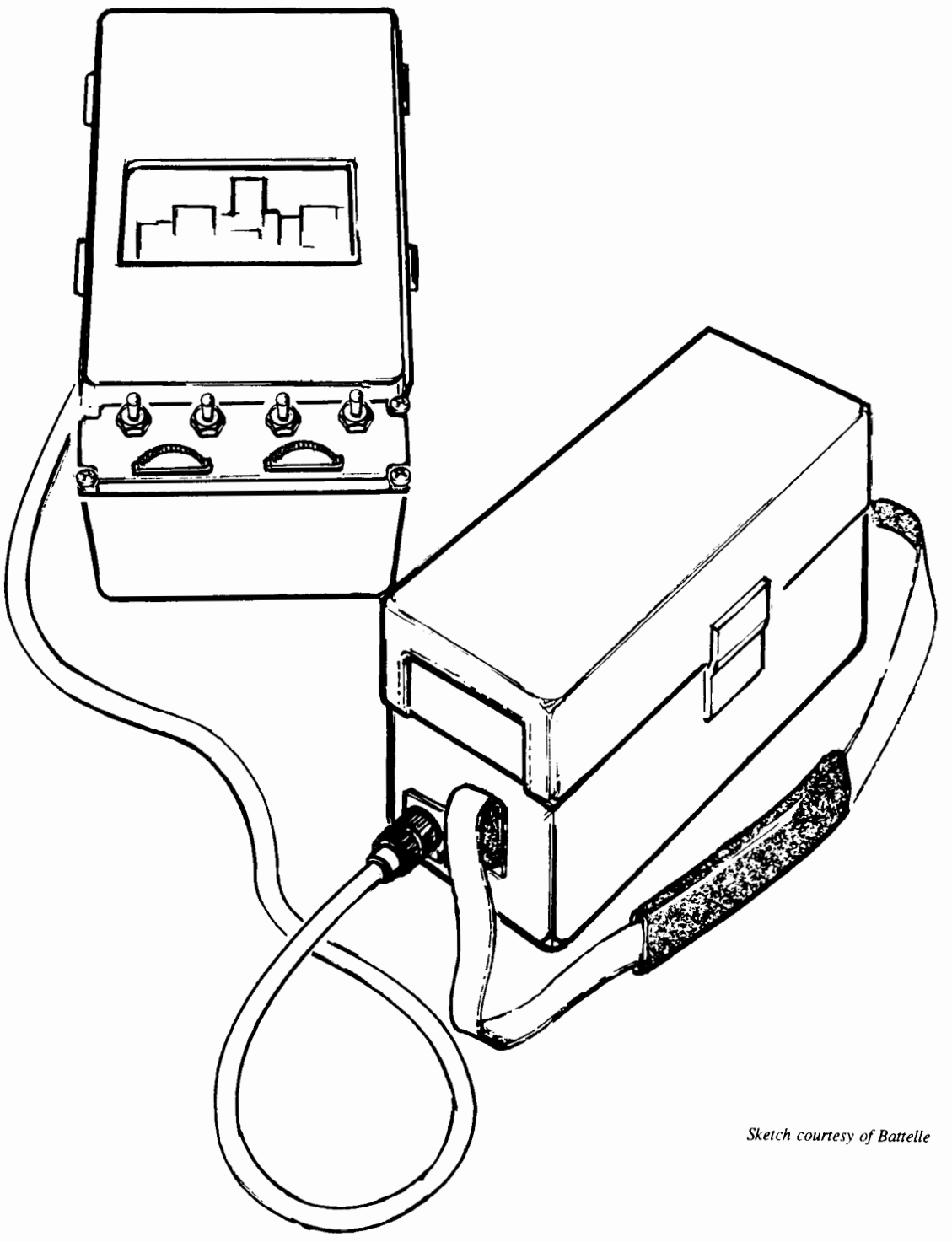
  Storage Temperature: -40°C to +70°C. [6]

- **Contact(s):**

  Developer: SDPR - Federal Directorate of Supply and Procurement
  9 Nemanjina St.
  YU-11105 Beograd
  Serbia
  Tel: 038 11 621522
  Fax: 038 11 324981
  Telex: 038 11 11360 YU SDPR [4]

- **Contact(s) (continued):**

Manufacturer:	Industrija Miloje Zakitj Krusevac, Serbia [5]



Sketch courtesy of Battelle

PHD Semi-Automatic Chemical Detector

- **Designator(s):** PHD

- **Item Name(s):** PHD Semi-Automatic Chemical Detector

- **Item Description:** The PHD Semi-Automatic Chemical Agent Detector is a portable unit intended for continuous or periodic detection of the presence of chemical agents either in gas or aerosol state. It uses detector tubes which result in a visible color change in the presence of agents. The power supply is a separate unit, connected by cable to the detector unit. [1]

- **System Components:** [1]

  Accessories
  Cable (for connection to vehicle or storage battery)
  Consumable Material Kit (KPM)
  Detector Unit
  Power Supply (two storage batteries)
  Spare Tools

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** [1]

  Length: *
  Width: *
  Height: *
  Weight: 5 kg

- **Technology:** Uses detector tube technology.

- **Status:** *

- **Uses:** *

- **Deployment:** *

- **Agents Detected:** [1]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY (within temperature range of +15°C to +25°C)
Blister	HD	5 x 10^3 mg/l to 9 x 10^3 mg/l
Blood	AC and CK	4 x 10^3 mg/l to 8 x 10^3 mg/l
Choking	CG and DP	3 x 10^3 mg/l to 6 x 10^3 mg/l

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** The PHD detector responds in three minutes to five minutes for low concentrations and in 10 seconds to 20 seconds for lethal and combat concentrations. [1]

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Powered by its own 12 V storage battery (two 6 V batteries) or from a vehicle storage battery. It uses less than 700 mA of power. [1]

- **Transport Requirements:** Portable unit with a carrying bag. [1]

- **Personnel Requirements:** *

- **Operational Information:**

  Operational Temperature: -30°C to +55°C. [1]

- **Stock Number(s):** *

- **Miscellaneous:** The PHD has mechanical resistance vibrations of 5 Hz to 55 Hz and amplitude of 10.35 mm. [1]

  Storage Temperature: -40°C to +70°C. [1]

- **Contact(s):**

  Developer: SDPR - Federal Directorate of Supply and Procurement
  9 Nemanjina St.
  YU-11105 Beograd
  Serbia
  Tel: 038 11 621522
  Fax: 038 11 324981
  Telex: 038 11 11360 YU SDPR [3]

  Manufacturer: Industrija Miloje Zakitj
  Krusevac, Serbia [5]

15.2 REFERENCES

1. Federal Directorate of Supply and Procurement (SDPR). (1993). *NBC Defence: Semi-Automatic Chemical Detector PHD* [Brochure]. Beograd, Serbia, CB-023232.

2. *Operating Instructions for the DHM-11B.*

3. Federal Directorate of Supply and Procurement (SDPR). (1993). *NBC Defence: DHM-11B* [Brochure]. Beograd, Serbia, CB-023232.

4. Federal Directorate of Supply and Procurement (SDPR). (1993). *NBC Defence: Chemical Detector Kit DHM-11B* [Fact Sheet]. Beograd, Serbia, CB-023232.

5. Industrija Miloje Zakitj. (1988). *DHM-11B Chemical Detector* [Technical Data Sheets]. Krusevac, Serbia.

6. Federal Directorate of Supply and Procurement (SDPR). (1993). *NBC Defence: Tank Radiological and Chemical Detector DRHT* [Brochure]. Beograd, Serbia, CB-023232.

Chapter 16 - SOUTH AFRICA

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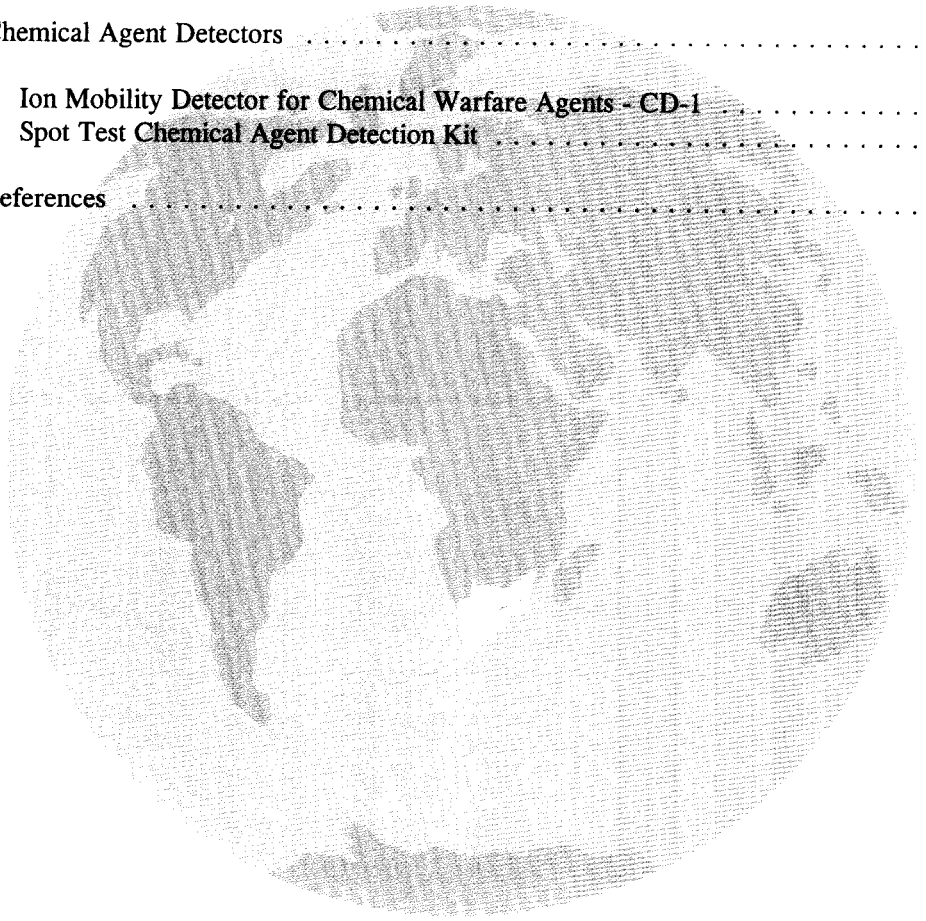
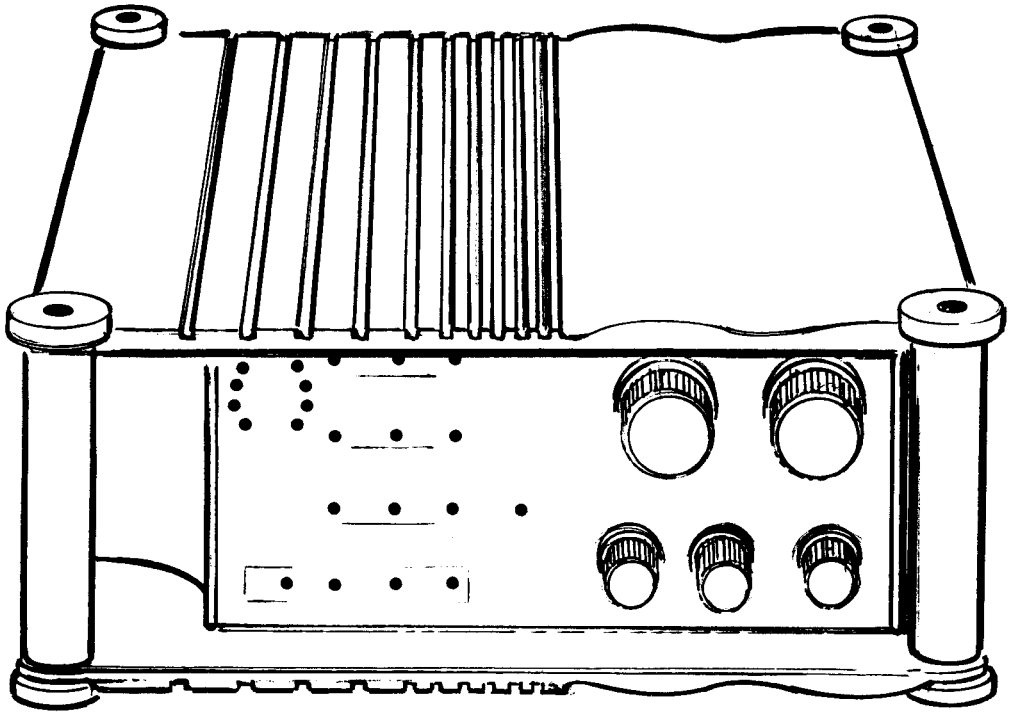


16.1 CHEMICAL AGENT DETECTORS



Sketch courtesy of Battelle

The Ion Mobility Detector for Chemical Warfare Agents - CD-1

- **Designator(s):** CD-1

- **Item Name(s):** Ion Mobility Detector for Chemical Warfare Agents - CD-1

- **Item Description:** The Ion Mobility Detector for Chemical Warfare Agents is a detection and warning system which uses the Ion Mobility Spectrometry (IMS) principle. It is an automatic, portable and decontaminable system. It has an audible and visible alarm on the detector and an audible remote alarm unit that can be added to the system. [1]

- **System Components:** [1]

  Battery
  Detector
  Remote Alarm Unit

- **Support Equipment:** Battery charger available. [5]

- **Equipment Hardness:** Complies with MIL-STD-810D for ruggedness. [1]

- **Dimensions and Weight:** (including rechargeable NiCd battery pack) [1]

Length:	30 cm
Width:	40 cm
Height:	12 cm
Weight:	13 kg

- **Technology:** IMS. [1]

- **Status:** Currently undergoing evaluation by the South African Defence Forces. Currently undergoing further development, no longer being manufactured by Hazmat. [3,4,6]

- **Uses:** Detects agents at below LD50 values. Used for contamination control and as a point detector. [5]

- **Deployment:** None. [6]

- **Agents Detected:** [1]

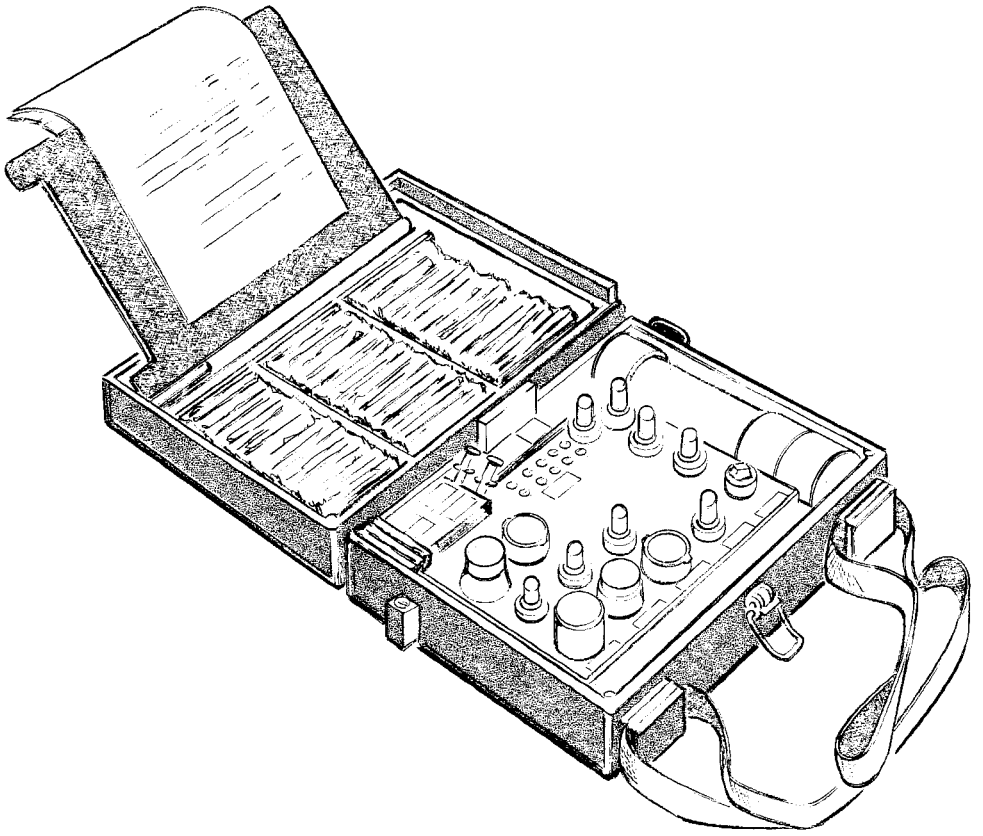
AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	HD	0.05 mg/m^3
Blood	AC	0.1 mg/m^3
Nerve	GA, GB, GD and VX	0.07 mg/m^3

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** Approximately 15 seconds with simultaneous single channel detection. (1)
- **False Responses/Interferents:** Currently being determined, includes acetone. (5)
- **Safety Features/Safety Hazards:** Radioactive source. (5)
- **Power Requirements:** Rechargeable NiCd battery pack which has a battery life of eight hours minimum under continuous use. 24 V source. (1,5)
- **Transport Requirements:** Portable; complies with relevant sections of MIL-STD-810 D. (5)
- **Personnel Requirements:** Minimal training required. (5)
- **Operational Information:** Tested between 0°C and +45°C and at temperature-humidity combinations of +35°C and 80% RH. (6)
- **Stock Number(s):** Not yet assigned. (6)
- **Miscellaneous:** AC detection capability is available as an option via a built-in electrochemical cell. (5)
- **Contact(s):**

Developer:
Protechnik Laboratories (Pty) Limited
P.O. Box 2276
Randburg 2125
South Africa
Tel: 027 12 6690730
Fax: 027 12 6690635 (3)

Former Manufacturer:
Hazmat Protective Systems (Pty) Limited
P.O. Box 36852
Menlo Park 0102
South Africa
Tel: 027 12 8042292
Fax: 027 12 8041605 (4)



Sketch courtesy of Battelle

Spot Test Chemical Agent Detection Kit for air and water samples

- **Designator(s):** *

- **Item Name(s):** Spot Test Chemical Agent Detection Kit

- **Item Description:** The Spot Test Chemical Agent Detection Kit for air and water samples is a detection kit packaged in a portable polypropylene container with a shoulder strap. The enclosed color-coded instruction book gives detailed descriptions of operational procedures for each test to be performed. Additionally, the reagents and test paper packagings are color coded to correspond with the color of a positive test for each agent type. Sufficient reagents and test papers are provided for 10 tests per agent type specified. [2]

- **System Components:** Polypropylene Container with Shoulder Strap containing: [2]

  Air Sampling Pump
  Instruction Booklet
  Needles
  Paper Holders
  Reagents
  Syringes
  Test Paper
  Tweezers

- **Support Equipment:** Additional reagents. [5]

- **Equipment Hardness:** Complies with MIL-STD-810D. [5]

- **Dimensions and Weight:** [2]

Length:	28 cm
Width:	22 cm
Height:	14 cm
Weight:	3.5 kg

- **Technology:** Wet chemistry, color change. [2]

- **Status:** Currently undergoing further development, no longer being manufactured by Hazmat. [3,4]

- **Uses:** Tests for presence of chemical agents in air and water. [2]

- **Deployment:** Supplied to the South African Defence Force for field evaluation purposes. [3]

- **Agents Detected:** [2]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Arsenic Compounds	Inorganic and Organic	50 μg/ml (water)
Blister	HN and HS	100 μg/ml (acetone)
Blood	Cyanides	30 μg/ml (water)
Choking	CG	5 mg/ml (toluene)
Nerve	G-type	9.6 μg/ml (water)

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** One minute to three minutes.
- **False Responses/Interferents:** Some have been documented. [5]
- **Safety Features/Safety Hazards:** Detection kit was designed for use by personnel wearing full protective clothing. [6]
- **Power Requirements:** None. [5]
- **Transport Requirements:** Portable; complies with MIL-STD-810D. [1,5]
- **Personnel Requirements:** Minimal training required. [5]
- **Operational Information:** Tested between +5°C and +45°C. [6]
- **Stock Number(s):** Not yet assigned. [6]
- **Miscellaneous:** Also available with a canvas carrying bag which reduces the weight of the kit significantly. [5]

Shelf Life: 5 years (accelerated storage testing at +65°C). [2]

- **Contact(s):**

Developer:
Protechnik Laboratories (Pty) Limited
P.O. Box 2276
Randburg 2125
South Africa
Tel: 027 12 6690730
Fax: 027 12 6690635 [3]

- **Contact(s) (continued):**

Former Manufacturer: Hazmat Protective Systems (Pty) Limited
P.O. Box 36852
Menlo Park 0102
South Africa
Tel: 027 12 8042292
Fax: 027 12 8041605 (4)

16.2 REFERENCES

1. Hazmat Protective Systems (Pty) Limited. (1992). *Ion Mobility Detector for Chemical Warfare Agents* [Fact Sheet]. Menlo Park, South Africa.

2. Hazmat Protective Systems (Pty) Limited. (1992). *Spot Test Chemical Agent Detection Kit for Air and Water Samples* [Specification Sheet]. Menlo Park, South Africa.

3. Coleman, P.C. (1994, February 10). *Re: Spot Detection Kit and Ion Mobility Spectrometry Detectors* [3 p.]. Facsimile Transmission, Protechnik Laboratories (Pty) Limited, Randburg, South Africa.

4. Zan Niekrek, Linda. (1995, February 2). *Re: CD-1 Ion Mobility Detector and Spot Test Kit.* Interview, Hazmat Protective Systems (Pty) Limited, Menlo Park, South Africa.

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Chapter 17 - SWEDEN

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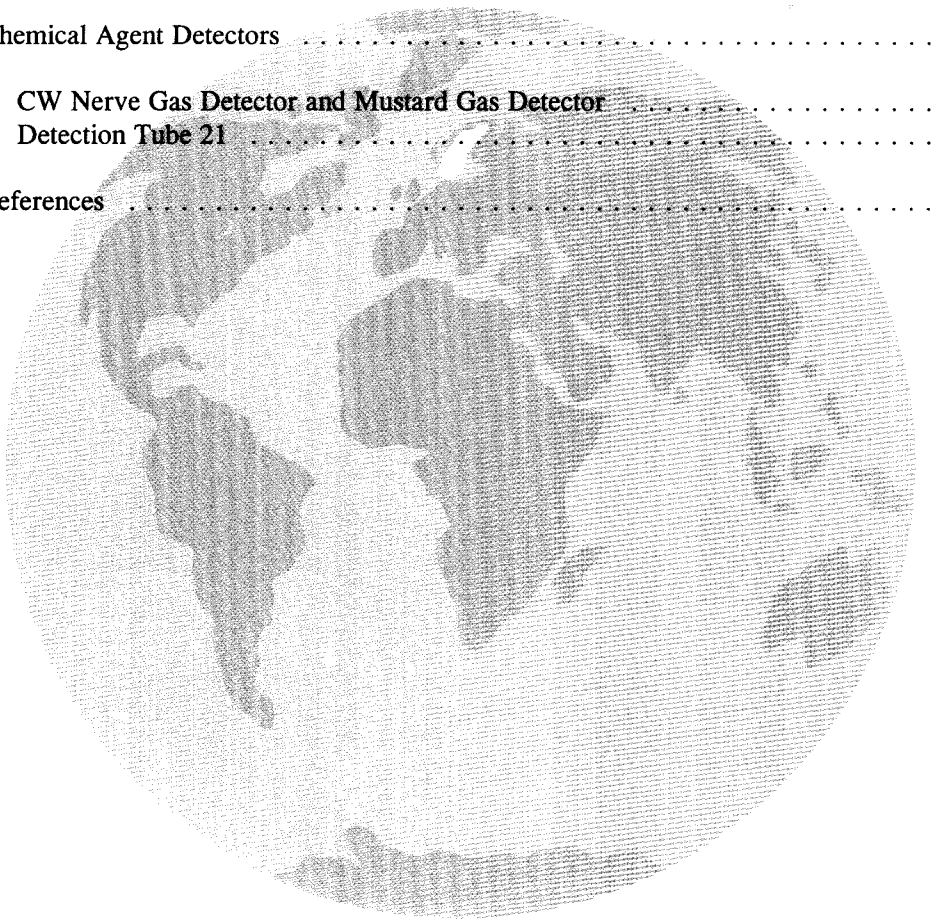

17.1 CHEMICAL AGENT DETECTORS

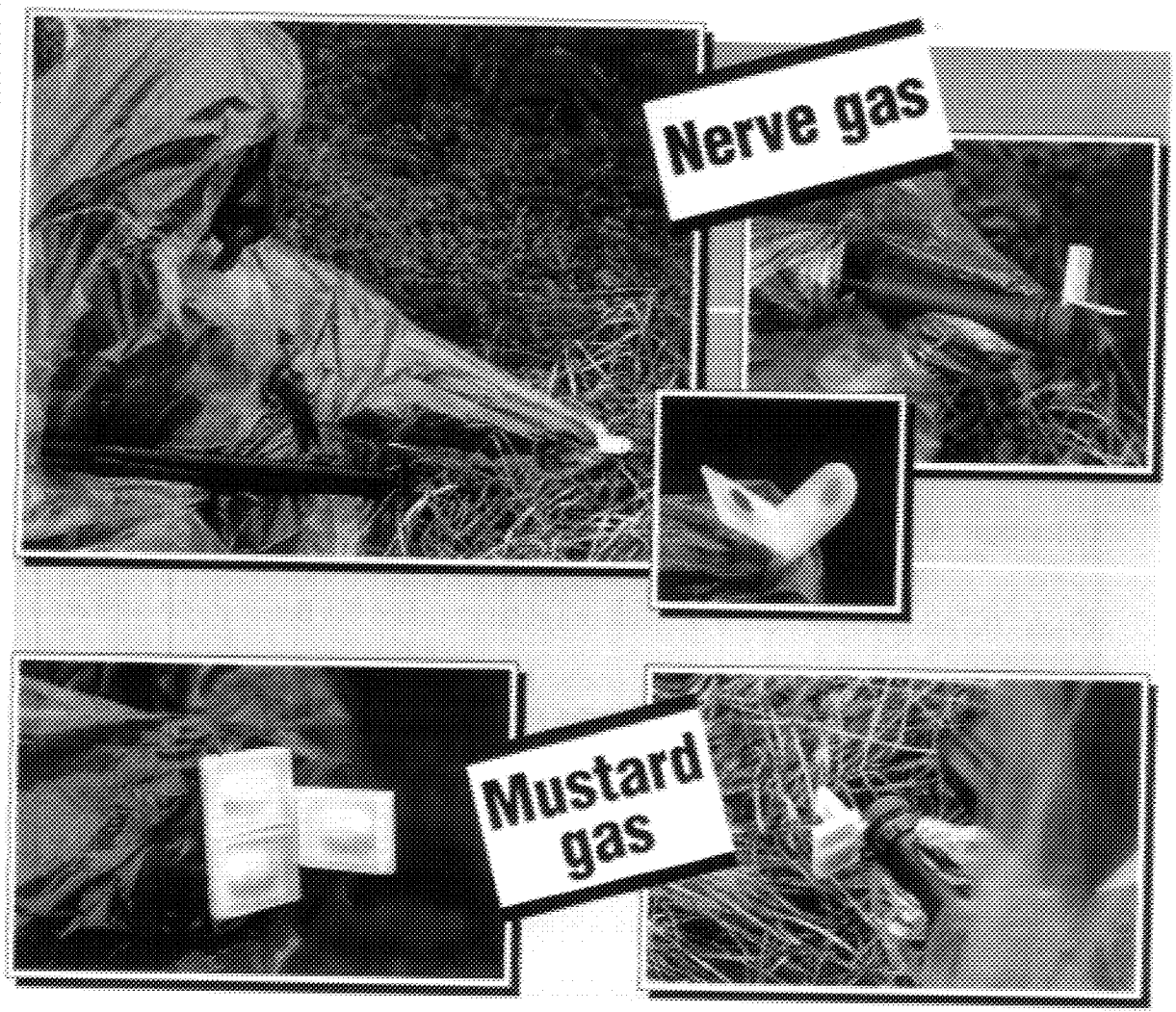

Photo courtesy of Åkers Krutbruk

Manual CW Detector for Nerve Gas and Mustard Gas.

- **Designator(s):** *
- **Item Name(s):** CW Nerve Gas Detector and Mustard Gas Detector
- **Item Description:** The CW Nerve Gas Detector and Mustard Gas Detector are pocket-sized, low cost detectors that have a high sensitivity to the presence of mustard gas in air and nerve gas in air or water. [1,5]
- **System Components:** Detector Tube. [1]
- **Support Equipment:** *
- **Equipment Hardness:** *
- **Dimensions and Weight:** [7]

PARAMETERS	NERVE GAS DETECTOR	MUSTARD GAS DETECTOR
Length	8 cm	8 cm
Width	2.8 cm	4.5 cm
Height	1 cm	1.8 cm
Weight	10 g	20 g

- **Technology:** A chemical reaction provides a color change indicative of the presence or absence of agent. Reactions are enzyme based for the nerve gas detection device. [5,7]
- **Status:** The Nerve Gas Detector is in production and the Mustard Gas Detector's development is completed. [4]
- **Uses:** The Nerve Gas Detector can be used to detect nerve agent contamination in air or water. The Mustard Gas Detector can be used to detect mustard agent contamination in air. [4,7]
- **Deployment:** *
- **Agents Detected:** [4,7]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME	
			EXPOSURE TIME	DEVELOPMENT TIME
Blister	H	1 mg/m^3 (with pump, in air)	10 strokes	2 minutes
Nerve	*	0.1 mg/m^3 (in air) 0.01 mg/m^3 (with pump, in air) 0.1 mg/l (in water)	2 minutes 10 strokes 2 minutes	2 minutes (at -20°C to +40°C)

- **Detection Sensitivity:** See ***Agents Detected*** for information.
- **Response Time:** See ***Agents Detected*** for information.
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None.
- **Transport Requirements:** The CW detectors are pocket-sized, therefore easily transportable. [4]
- **Personnel Requirements:** Operable by a field soldier. [4]
- **Operational Information:** *
- **Stock Number(s):** *
- **Miscellaneous:** [4,7]

Shelf Life:	20 years (mustard gas detector)
Storage Temperature:	+25°C for 5 years (nerve gas detector)
	-18°C for 20 years (nerve gas detector)

- **Contact(s):**

Developer:
National Defence Research Establishment (FOA)
Department of NBC Defence
S-901 82 Umea
Sweden
Tel: 046 90 106600
Fax: 046 90 106800 [1]

Manufacturer:
Åkers Krutbruk Protection AB
S-640 60 Åkers Styckebruk
Sweden
Tel: 046 159 36600
Fax: 046 159 30728 [4]

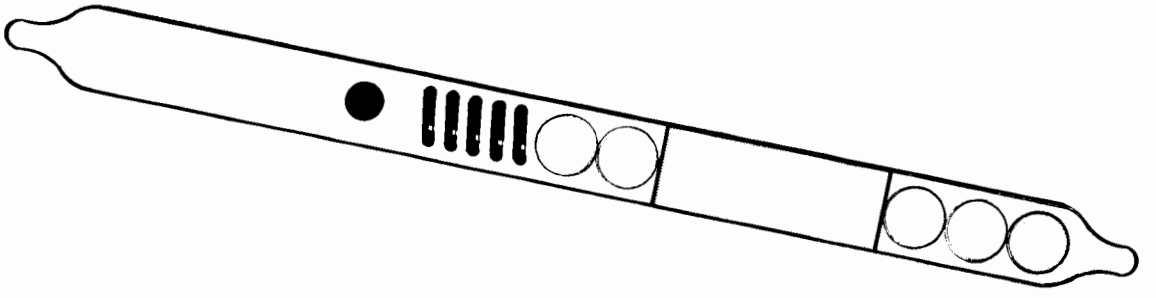

Illustration courtesy of
The National Defence Research Institute

Detection Tube 21

- **Designator(s):** *
- **Item Name(s):** Detection Tube 21
- **Item Description:** Detection Tube 21 is a tube through which an air sample is drawn. A color change indicates the presence of chemical agents. [1,2,3]
- **System Components:** *
- **Support Equipment:** Detection Tube 21 is used with Detection Ticket 141 and a manual air sampling pump. [1]
- **Equipment Hardness:** *
- **Dimensions and Weight:** *
- **Technology:** The detection capability is based on a chemical reaction that creates a color change if the target agent is present. [1,3]
- **Status:** Fielded. [1]
- **Uses:** Chemical agents vapors or aerosols can be detected for the field soldier after a chemical agent attack. [1,3]
- **Deployment:** *
- **Agents Detected:** [1,3]

  Blister: H and L (in high concentrations).

- **Detection Sensitivity:** *
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None.
- **Transport Requirements:** *
- **Personnel Requirements:** *
- **Operational Information:** *
- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):**

Developer:
National Defence Research Establishment (FOA)
Department of NBC Defence
S-901 82 Umeå
Sweden
Tel: 046 90 106600
Fax: 046 90 106800 (1)

Manufacturer:
Stedt & Co AB
Box 21
S-596 00 Skänninge
Sweden
Tel: 046 142 41030
Fax: 046 142 42692 (6)

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6. Olofsson, Göran. (1994, August 1). Re: Detection Tube 21 [1 p.]. Facsimile Transmission, National Defence Research Establishment (FOA), Umeå, Sweden.

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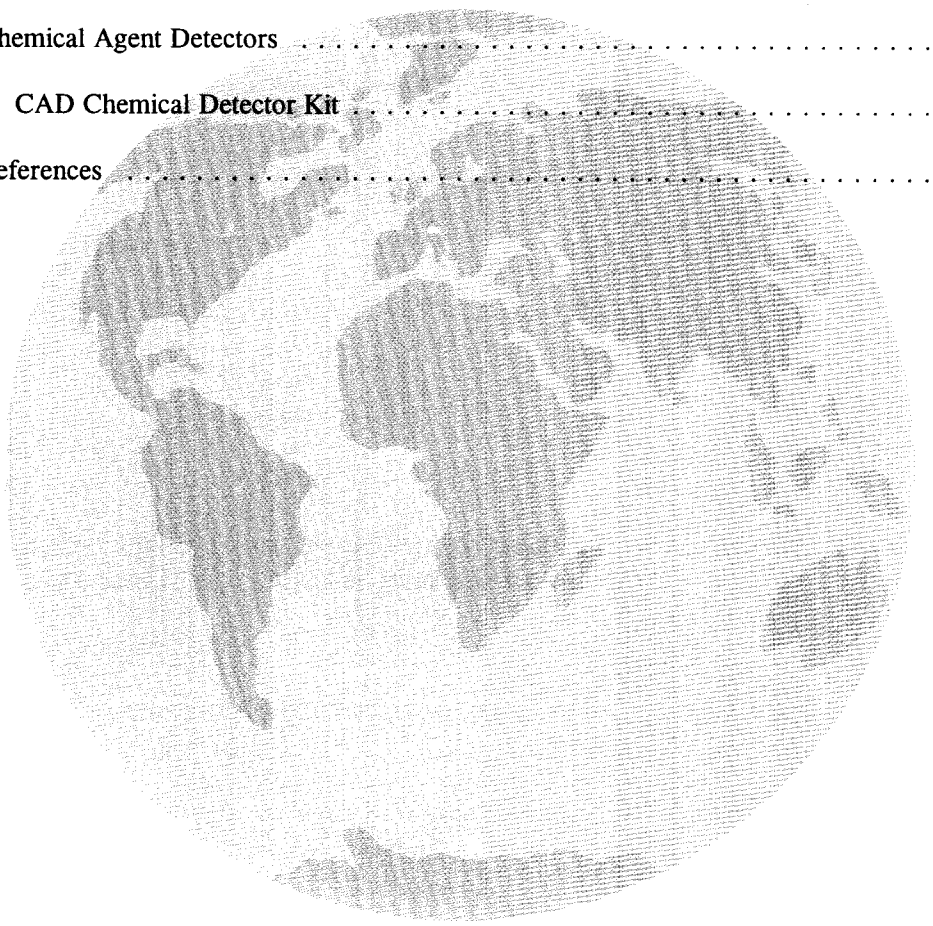

18.1 CHEMICAL AGENT DETECTORS

- **Designator(s):** CAD

- **Item Name(s):** CAD Chemical Detector Kit

- **Item Description:** The CAD Chemical Detector Kit is contained in a plastic shoulder-slung box and detects blister and nerve agents, including GB in less than three minutes. The CAD is an inexpensive, easy to use detector used by Army platoons and Civil Defence units for NBC reconnaissance. It is manually operated and requires no power. (1)

- **System Components:** Each kit contains enough supplies for 30 tests; additional refills are available. (1)

- **Support Equipment:** A training kit is available. (1)

- **Equipment Hardness:** *

- **Dimensions and Weight:** (1)

Length:	22 cm
Width:	16 cm
Height:	11 cm
Weight:	1.5 kg

- **Technology:** A pump draws air over a special membrane; chemical agents react with a reagent resulting in a color change within two minutes to three minutes. (1)

- **Status:** In production. (1)

- **Uses:** Used by Army platoons for NBC reconnaissance; may be used to analyze urine samples from contaminated patients. (1)

- **Deployment:** In use with the Swiss Army and Civil Defence. Several other armed forces use the CAD including the Argentinean Navy. (1)

- **Agents Detected:** (1)

Blister
Nerve

- **Detection Sensitivity:** (1)

Blister:	2 mg/m^3
Nerve:	20 $\mu g/m^3$ to 100 $\mu g/m^3$
Other:	2 mg/m^3

- **Response Time:** 120 seconds to 150 seconds. (1)
- **False Responses/Interferents:** None. (1)
- **Safety Features/Safety Hazards:** Negative test results should be followed by a second test after 10 minutes. (1)
- **Power Requirements:** None. (1)
- **Transport Requirements:** No special requirements. (1)
- **Personnel Requirements:** One operator. (1)
- **Operational Information:** *
- **Stock Number(s):** ALN-NSA-665-757-0600. (1)
- **Miscellaneous:** During the Iraq/Iran war, the CAD was the best working detector for the medical contamination control of contaminated patients in hospitals. (1)
- **Contact(s):**

Manufacturer:	Louis Schleiffer Ltd. CH-8126 Zumikon Switzerland Tel: 041 198 1586 (1)
Proponent:	Swiss Army Laboratory CH 3700 Spiez Switzerland (1)

18.2 REFERENCES

1. Schleiffer, A.G. (1995, February 2). *Re: CB Detection Equipment* [1 p.]. Facsimile Transmission, Louis Schleiffer, Ltd., Zumikon, Switzerland.

Chapter 19 - UNITED KINGDOM

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19.1 CHEMICAL AGENT DETECTORS

Photo courtesy of Graseby Ionics Division
Graseby Dynamics Limited

The U.K. CAM™

Designed and manufactured by Graseby Ionics Division, Graseby Dynamics Limited.

- **Designator(s):** CAM™

- **Item Name(s):** Chemical Agent Monitor (CAM™)

- **Item Description:** The CAM™ is a portable, hand-held instrument used to monitor the presence of nerve or blister agents or liquid agent contamination. It will also determine whether it is safe for personnel to relax chemical warfare protective measures. The CAM™ can be used by personnel in full NBC protective equipment under all climatic conditions. [4,15,37]

  Air is drawn into the unit and is ionized by a weak radioactive source. The molecules of certain types of agent vapors are characterized by their ability to form low-mobility ionic clusters. These ionic clusters are then further classified according to their mobility relative to a known vapor source. The level of toxic hazard is assessed by an on-board micro computer and indicated by a Liquid Crystal Display (LCD). It is small, lightweight and designed for ease of operation. One hand operation is normal and controls are simplified to an ON/OFF button and a MODE CHANGE button for switching from nerve agent monitoring to blister agent monitoring. It is highly sensitive to agents, operates in real time and has an extremely low false alarm rate. It is easily decontaminated, rugged and fully compatible with other military equipment. [4,15,37]

- **System Components:** [4,37]

  Carrying Case (contains spare battery, stand-off collars, confidence tester and shoulder strap)
  Monitor

- **Support Equipment:**

Diagnostic Test Set:	Enables fault diagnosis to be undertaken down to replacement module level. [15]
Field Alarm Module: (FAM™)	Allows the CAM™ to be deployed a suitable distance up-wind while connected to the FAM™. It will automatically switch the CAM™ between the nerve and blister agent modes, repeats the CAM™ display and gives an audible and visible alarm at a preset level. [15,17,37]
Flexiboard Test Set [5]	
Headphones [37]	
Remote Display Alarm (RDA-1) [6]	
Vapor Generator:	Provides known concentrations of simulant to calibrate the CAM™ monitor. [15]
Vehicle Alarm Module: (VAM)	Allows the CAM™ and the FAM™ to be fitted to an armored fighting vehicle (AFV). [19]

- **Equipment Hardness:** Chemically hardened. [37]

Durability:	Complies with DEFSTAN 07-55 [37]
EMP:	Complies with NATO levels. [37]
Environment:	Complies with DEFSTAN 00-1 Cat. A2 to C1 [37]

- **Dimensions and Weight:** [37]

Length:	38 cm
Width:	8 cm
Height:	14 cm
Weight:	1.7 kg (with battery)

- **Technology:** The CAM™ utilizes Ion Mobility Spectrometry (IMS) principles. [37]

- **Status:** In production; fielded. [15,37]

- **Uses:** The CAM™ can determine whether a ground area is contaminated or clean, assess the extent of a chemical attack, confirm when a hazardous area is cleared of contamination, as well as determine the existence of agent residue on stores, vehicles and aircrafts. This monitor can also indicate the effectiveness of decontamination procedures and check casualties and personnel prior to entering a clean collective protection area. It is also a realistic training aide for confirming the effectiveness of NBC procedures when set to monitor the presence of agent simulants. Used in combination with the FAM™, the CAM™-FAM™ takes on a monitoring role. [6,15,37]

- **Deployment:** The CAM™ was produced for the UK Ministry of Defence. Later it was supplied to the U.S. Army, Air Force and Marine Corps and the Canadian Department of Defence. The CAM™ was used on four United Nation's Security Council missions investigating alleged use of chemical weapons in the Iran/Iraq conflict. During this war, the CAM™ was deployed by the front-line Allied Forces. The CAM™ is purchased by Sweden for use by the Swedish Army, Navy and Air Force. The Swedish Navy uses the CAM™/FAM™ combination. The Swedish Air Force will soon connect their CAM™s to a FAM™ module as well. The CAM™ is used by 13 NATO nations and a total of 26 nations worldwide. [1,15,37]

  Graseby has also received contracts for the CAM™ from Norway, Spain, Sweden and several middle eastern countries. [9]

  The Royal Netherlands Army has, on behalf of all three Netherlands Armed Forces, have placed an order with Graseby Ionics for the CAM™ and the FAM™. [11]

  The Belgium Army and Air Force are using the CAM™ and have placed an order for additional CAM™ units and FAM™ modules. [9,12,13]

- **Agents Detected:** Can detect the blister agent H and the nerve agent G as well as other agents. Additional programming can be included to extend the range to cover other agents and certain harmless chemical simulants used as training aids. [15,37]

- **Detection Sensitivity:** Levels of detection for each agent are in line with or exceed the present NATO requirements. [15]

- **Response Time:** Warm-up time is approximately one minute. [5]

  Response time is five seconds to 10 seconds. [21]

- **False Responses/Interferents:** Classified. [37]

- **Safety Features/Safety Hazards:** Radioactive source. [37]

- **Power Requirements:** Single 6 V battery (sealed Li/SO_2 system). Rechargeable and training options are available. [4,15,37]

Battery Life:	Minimal:	Six hours of continuous use at +20°C [4]
	Typical:	14 hours of continuous use at +20°C [15]

- **Transport Requirements:** Hand portable. [4]

- **Personnel Requirements:** One individual can operate. One-hand operation is normal. The CAM™ can be operated by relatively unskilled operators, who only need to change batteries and inlet collars, and check the unit with confidence samples. [4,15,37]

- **Operational Information:**

  Operational Temperature: -30°C to +55°C. [5]

- **Stock Number(s):** 6665-99-225-4126 (NATO). [37]

- **Miscellaneous:** Variants of the CAM™ are the Otto Fuel Monitor (OFM) and the Airborne Vapor Monitor (AVM). [5]

  Storage Temperature: -55°C to +70°C. [5]

- **Contact(s):**

  Developer:
  Chemical and Biological Defence Establishment
  Porton Down, SP4 0JQ
  United Kingdom

  Manufacturer:
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  Graseby Dynamics Limited
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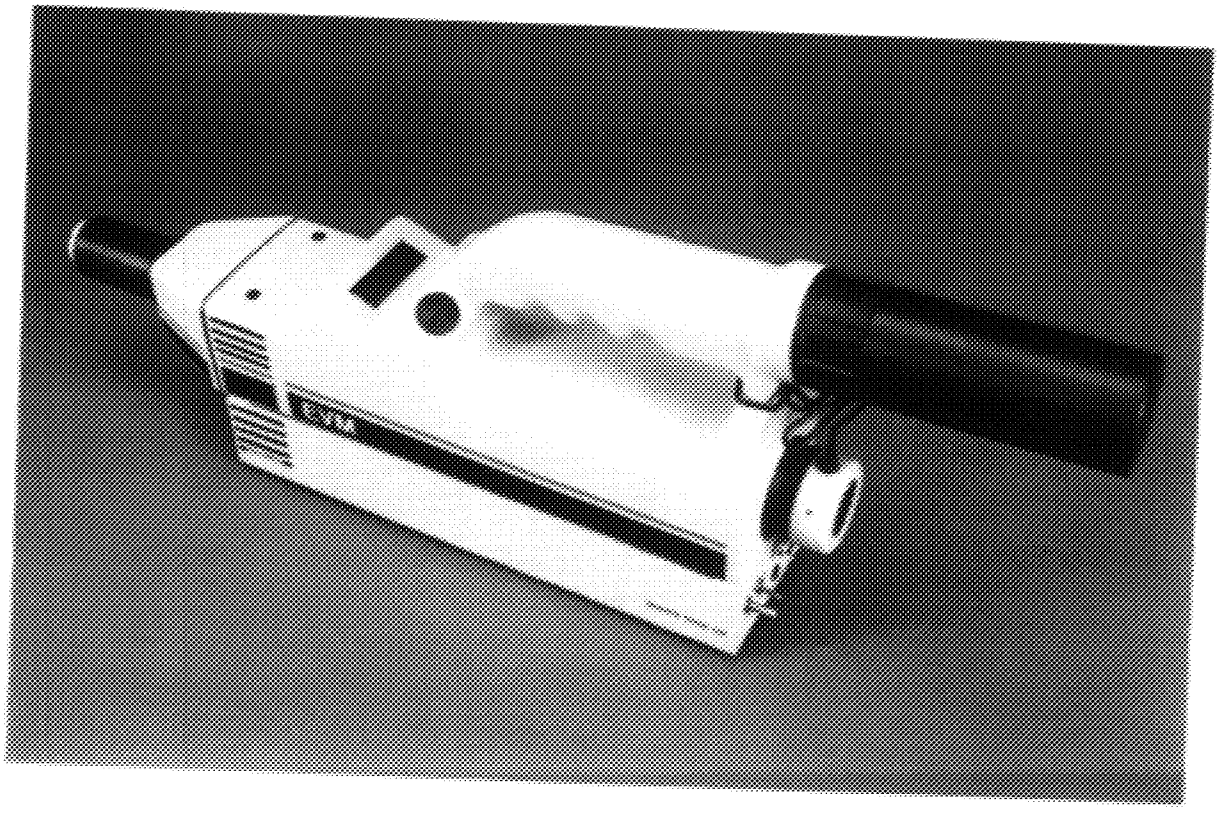

Photo courtesy of Graseby Ionics Division, Graseby Dynamics Limited

The Graseby Environmental Vapor Monitor (EVM)

- **Designator(s):** EVM

- **Item Name(s):** Environmental Vapor Monitor (EVM)

- **Item Description:** The EVM is the first product to combine Gas Chromatography (GC) and Ion Mobility Spectrometry (IMS) technologies in one lightweight, compact, hand-held unit and is modeled on current, proven, high volume, production instrumentation. Once initiated, the EVM carries out a diagnostic self-check to ensure optimum operation before monitoring can begin. The user presents the instrument's nozzle to the vapor source, a pulsed sample of the unknown vapor enters the EVM's detector via a low volume pumping system. The unknown compounds of the vapor are initially phase separated by the 'front end' capillary Gas Chromatograph before entering the IMS cell which, in conjunction with the unit's software, establishes whether the components of the unknown vapor are those already targeted within the instrument's memory. Its on-board Liquid Crystal Display (LCD) would indicate the presence of a targeted vapor or on an external large format display, showing greater analytical response data. The EVM, within a typical period of 15 seconds from sampling, can separate, detect and identify vapor mixtures such as Phosphonates, Ketones and other solvents. [16]

- **System Components:** *

- **Support Equipment:** None. [30]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [30]

Length:	45 cm
Width:	8 cm
Height:	20 cm
Weight:	3.5 kg

- **Technology:** GC capillary linked with IMS technology. [30]

- **Status:** In development; anticipated fielding date is 1995. [30,34]

- **Uses:** Capability to detect chemical agents and agent precursors and is ideal for treaty verification operations. [30]

- **Deployment:** *

- **Agents Detected:** This unit is able to detect a wide range of warfare agents and precursors, including vapor mixtures such as Phosphonates and Ketones. [16,30]

- **Detection Sensitivity:** Classified. [30]

- **Response Time:** Classified. [30]

- **False Responses/Interferents:** Classified. [30]
- **Safety Features/Safety Hazards:** Radioactive source of Ni^{63}, 10 mCi. [34]
- **Power Requirements:** 6 V rechargeable battery. [30]
- **Transport Requirements:** None. [30]
- **Personnel Requirements:** One individual can operate this unit. Varying degrees of data are provided to the individual depending upon their skill level. [16,30]
- **Operational Information:** *
- **Stock Number(s):** NATO stock number not yet assigned. [30]
- **Miscellaneous:** *
- **Contact(s):**

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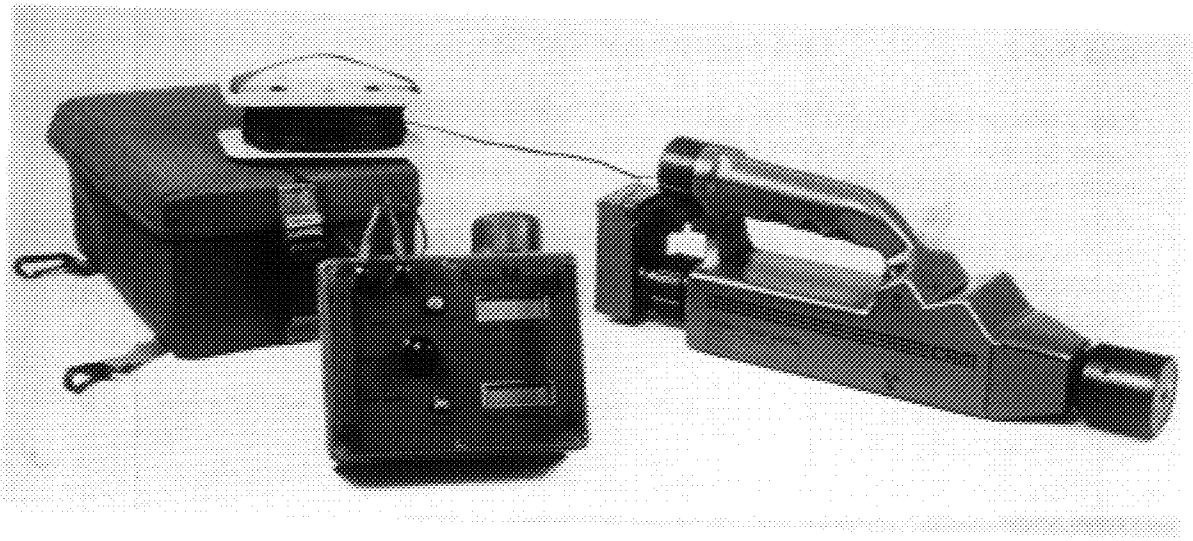

The CAM™ - FAM™ System

Photos courtesy of Graseby Ionics Division, Graseby Dynamics Limited

Field Use of the U.K. Field Alarm Module (FAM™)

- **Designator(s):** FAM™

- **Item Name(s):** Field Alarm Module (FAM™)

- **Item Description:** The FAM™ is a remote sentry alarm, designed to operate with the Chemical Agent Monitor (CAM™) to offer a remote display/early alarm feature at a pre-selected level. It continuously indicates the increase or decrease in the level of the vapor threat and it automatically switches CAM™ between nerve and blister agent mode. The FAM™ gives both audible and visible alarms at a preselected threshold. The FAM™ is supplied in a case which can be attached to the CAM™ carrying bag. The FAM™ unit is powered by a CAM™ battery and operates by using serial data from the rear socket of CAM™, to which it is connected by field telephone cable. [7,38]

- **System Components:** The items below are all contained in a carrying case that can attach to the CAM™ carrying bag. [7]

  EMP Unit
  FAM™ Field Alarm Module Unit
  Rain Shield Cap
  Reel of Field Telephone Cable (30 meters)

- **Support Equipment:** None. [38]

- **Equipment Hardness:** EMP to NATO levels. [38]

  Durability: Complies with DEFSTAN 07-55. [17]

- **Dimensions and Weight:** [17,38]

PARAMETERS	FAM™	FAM™ (including case and accessories)
Length	16.4 cm	22 cm
Width	16 cm	31 cm
Height	9.7 cm	14 cm
Weight	1.4 kg	2.8 kg

- **Technology:** Electronic; uses serial data from the rear socket of the CAM™, to which it is connected by a field telephone cable. [17,38]

- **Status:** In production. [38]

- **Uses:** Remote display/alarm for CAM™. [17]

- **Deployment:** Used in field and naval applications with the CAM™ by the Swedish Navy and Air Force. The FAM™ is also deployed to the Netherlands and Belgium Air Forces. It was used by several allied forces during the Gulf War. (11,12,38)

- **Agents Detected:** When it is used with the CAM™, it can detect blister, nerve and other agents. (38)

- **Detection Sensitivity:** Classified. (38)

- **Response Time:** Classified. (38)

- **False Responses/Interferents:** Classified. (38)

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Single 6 V battery (sealed Li/SO_2 system), providing a life in excess of 40 hours. (17,38)

- **Transport Requirements:** Hand-carried. (17)

- **Personnel Requirements:** One field soldier. (17,38)

- **Operational Information:** Works in connection to CAM™ only. (17)

  Operational Temperature: -25°C to +50°C. (17)

- **Stock Number(s):** 6665-99-087-4539 (NATO). (38)

- **Miscellaneous:** *

- **Contact(s):**

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459 Park Avenue, Bushey
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- **Contact(s) (continued):**

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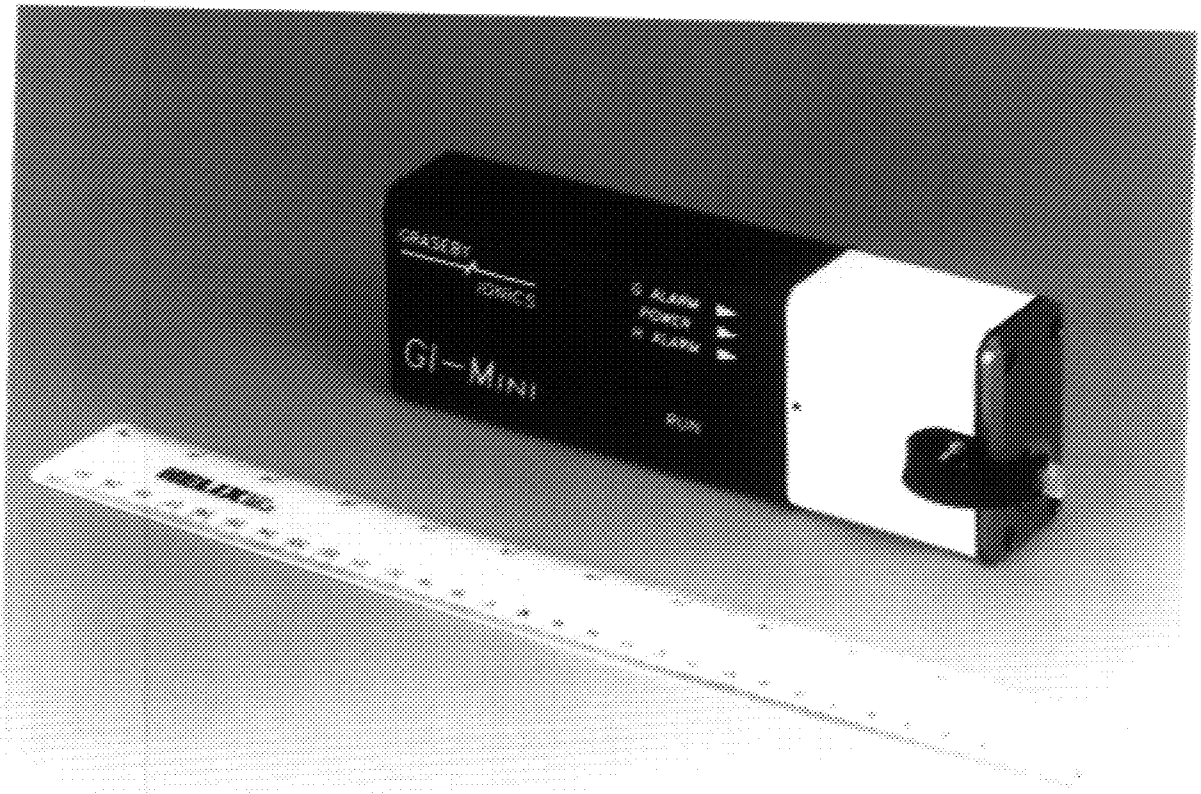

Photo courtesy of Graseby Ionics Division,
Graseby Dynamics Limited

The Graseby GI-MINI

- **Designator(s):** GI-MINI

- **Item Name(s):** GI-MINI Miniature Chemical Warfare Detector/Monitor

- **Item Description:** The GI-MINI is a small and compact unit worn by an individual soldier, clipped to webbing or carried in a pocket, to signal the presence of a chemical agent threat. This unit monitors the atmosphere for the presence of nerve and blister agents simultaneously. When the agent concentration reaches a pre-set threshold, the operator is warned by a visible and audible alarm. Lethality levels can also be indicated. It operates in real-time on either a continuous or an 'on-demand' basis and clears down quickly. It has the capability of being linked into a detector network system and can also send control signals and receive serial data over the RS-232C link. [22]

- **System Components:** [22]

  Field Chemical Agent Monitor
  Field Chemical Alarm (with small remote module)
  Personal Alarm
  Vehicle Detection System

- **Support Equipment:** Network Remote Alarm. [24]

- **Equipment Hardness:** *

- **Dimensions and Weight:**

Length:	18 cm [24]
Width:	4 cm [24]
Height:	6 cm [24]
Weight:	~0.5 kg [22]

- **Technology:** Ion Mobility Spectrometry (IMS) technology. [24]

- **Status:** Released for commercial use at the end of 1994; military availability to be determined. In development. [24,27]

- **Uses:** Individual issue detector able to signal the presence of a chemical agent threat. It may be used as a chemical agent alarm or monitor, as a personal alarm or in a vehicle detection system. [22]

- **Deployment:** *

- **Agents Detected:** [24]

  Blister
  Nerve
  Others (as required)

- **Detection Sensitivity:** Classified. [24] In line with NATO requirements. [22]

- **Response Time:** Classified. [24]
- **False Responses/Interferents:** Classified. [24]
- **Safety Features/Safety Hazards:** The military version has a radioactive source of Ni^{63} in a quantity of 10 mCi. Non-radioactive upgrade is possible. [27]
- **Power Requirements:** Standard 9 V PP3 battery; can be powered externally, if required. [22]
- **Transport Requirements:** None. [24]
- **Personnel Requirements:** Requires minimal training. [22]
- **Operational Information:** Little maintenance required. [22]

  Operational Temperature: -20°C to +55°C. [22]
- **Stock Number(s):** *
- **Miscellaneous:** *
- **Contact(s):**

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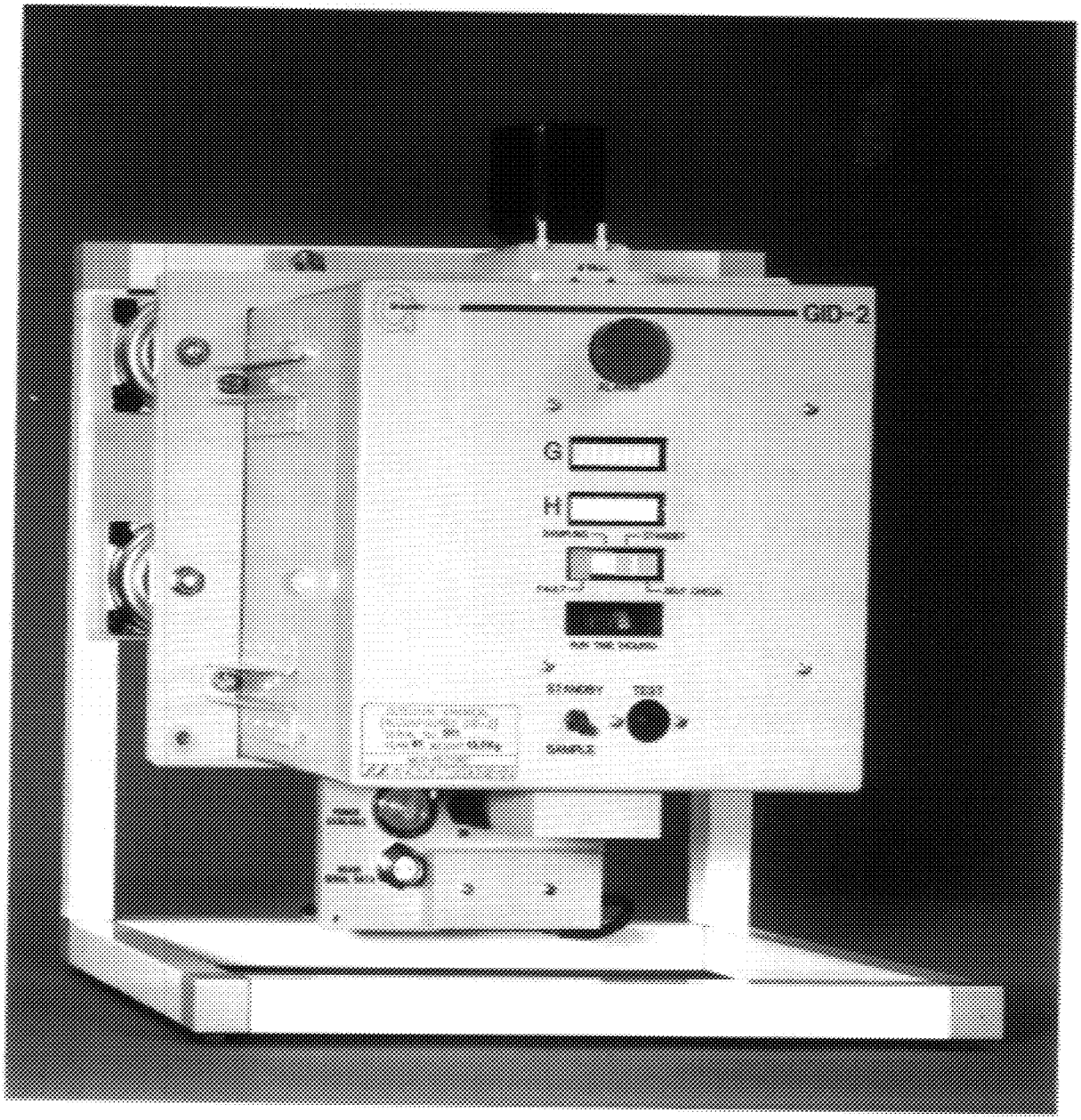

Photo courtesy of Chemring Ionics Division
Chemring Dynamics Limited

The U.K. GID-2™ Chemical Agent Detector

- **Designator(s):** GID-2™

- **Item Name(s):** GID-2™ Chemical Agent Detector
  Graseby Ionics Detector (GID-2™)

- **Item Description:** The GID-2™ is a fixed Chemical Agent Detector for shipborne and other applications that offers continuous detection and assessment of chemical agents. It is designed to be integrated into a wide range of collective or individual protection systems to safeguard personnel and insure operational capabilities. It responds simultaneously to nerve and blister agents in real time and is capable of being reprogrammed to meet new threats as needed. The detector uses Ion Mobility Spectrometry (IMS) technology. It incorporates an automatic self-flushing device, which is activated in very high vapor concentrations. It offers both audible and visible warnings. The standard display/alarm gives a block display (one to eight blocks) showing the severity of the threat level, an agent indicator code and fault information. The equipment is mainly powered with standby facilities, but can also be powered from ship or vehicle sources. [18,36]

- **System Components:** [36]

  Detector
  Remote Network Control Unit (NCU)

- **Support Equipment:** *

- **Equipment Hardness:** EMP to NATO levels. [36]

- **Dimensions and Weight:** [36]

PARAMETERS	DETECTOR	NCU
Length	37 cm	34 cm
Width	27 cm	16 cm
Height	42 cm	17 cm
Weight	14 kg	5 kg

- **Technology:** IMS technology. [18,36]

- **Status:** In production. [36]

- **Uses:** Can be configured and integrated across a wide range of deployment requirements. It can be used to monitor interior and exterior atmospheres, as well as the integrity of filtration systems in ships, aircraft and vehicle NBC systems, military bases, headquarters and building protection systems. It can also be used as a permanent detector for chemical agents in a ship environment. [18,19,36]

- **Deployment:** In service with the UK Royal Navy throughout the Gulf War. It is now used by or in trials with seven navies worldwide. [36]

- **Agents Detected:** [36]

  Blister
  Nerve
  Others (as required)

- **Detection Sensitivity:** Classified. [36]

- **Response Time:** Classified. [36]

- **False Responses/Interferents:** Classified. [36]

- **Safety Features/Safety Hazards:** Contains a 10 mCi source of Ni^{63}. [29]

- **Power Requirements:** This unit operates on a ship's power supply, typically 115 V 60 Hz. [36]

- **Transport Requirements:** *

- **Personnel Requirements:** None. [36]

- **Operational Information:** *

- **Stock Number(s):** 6630-99-430-5417 (NATO). [36]

- **Miscellaneous:** The number of detectors deployed is dependent on ship size. There is one issued per minehunter type vessel and a network of 15 issued on aircraft carriers. [36]

- **Contact(s):**

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U.S. Affiliate:	Graseby Ionics 1251 Research Parkway Orlando, FL 32826 U.S.A. Tel: (407) 275-8730 Fax: (407) 282-7988 [29]

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United Kingdom

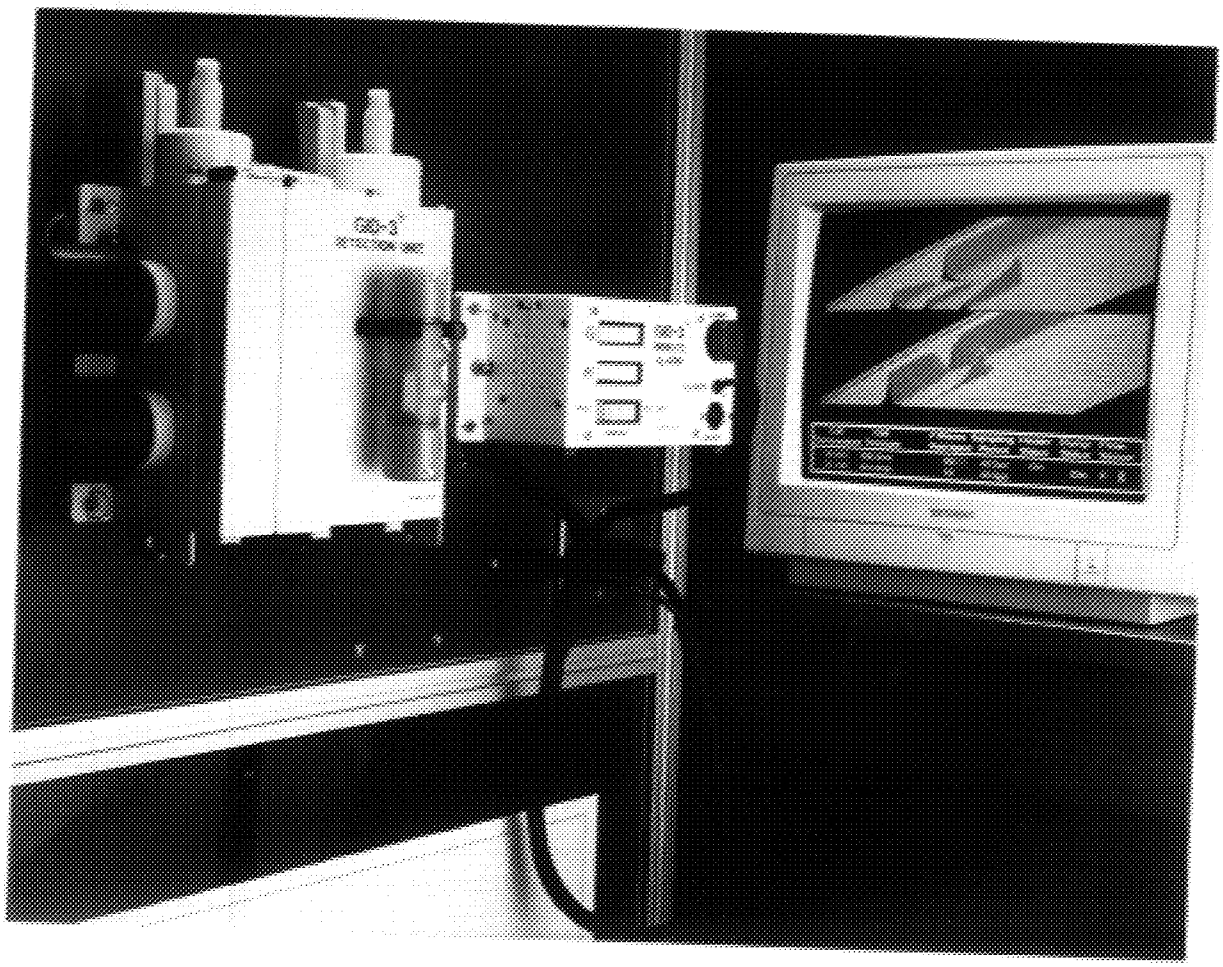

Photo courtesy of Graseby Ionics Division, Graseby Dynamics Limited

The GID-3™ Chemical Agent Detector

Designator(s): GID-3™

- **Item Name(s):** GID-3™ Chemical Agent Detector
  Graseby Ionics Detector (GID-3™)

- **Item Description:** The GID-3™ is a chemical agent detector that has been designed for use in small ships, Armored Fighting Vehicles (AFV's) and filtration systems; external vehicle detection for mobile surveillance/reconnaissance; autonomous point detection; and networked perimeter defence. It uses Ion Mobility Spectrometry (IMS) to provide a local and remote audible and visible alarm, operates continuously with a rapid response and cleardown and indicates the identity of the nerve and/or blister agent hazard. The GID-3™ can detect the chemical agent threat outside, monitor the collective protection of the crew compartment and confirm the effective operation of the filter system in AFVs. The detector can be fitted to most vehicles and can also be man-portable and used for point detection with a remote alarm or it can be networked together as a perimeter defence warning system. The detector unit has a built-in communications system. [19,20]

- **System Components:** [35]

  Detector
  Remote Alarm Unit

- **Support Equipment:** None. [35]

- **Equipment Hardness:** EMP to NATO levels. [35]

- **Dimensions and Weight:** [35]

Length:	15 cm
Width:	13 cm
Height:	23 cm
Weight:	4.5 kg

- **Technology:** IMS technology. [35]

- **Status:** In production. [35]

- **Uses:** Can be used to monitor collective protection for vehicles both internally and externally, small ships and filtration systems. As a detection for mobile surveillance/reconnaissance, a bolt-on pack of two GID-3™ units can be fitted to most vehicles. One is mounted low to the ground, the other at eye level. Automatic comparison of the two readings by the software indicates a liquid or vapor threat. It can be made portable, dismounted and used for point detection with a remote alarm. Along with the functions above, the GID-3™ can be networked together as a perimeter defence warning system, reporting to a central display console. [20,35]

- **Deployment:** Used in the UK Vehicle Electronic Research Defence Initiative (VERDI) program to detect the chemical warfare threat outside the AFV, monitor the collective protection of the crew compartment and confirm the filter system's efficacy. It has been integrated with the Marconi Centaur Weapon Control System and selected for various vehicle projects including the Canadian DND Light Armored Vehicle (LAV) and the Kuwait Army Warrior. One or two GID-3™ are deployed per vehicle. [19,35]

- **Agents Detected:** [35]

  Blister
  Blood
  Choking
  Nerve
  Others (as required)

- **Detection Sensitivity:** Classified. [35]

- **Response Time:** Classified. [35]

- **False Responses/Interferents:** Classified. [35]

- **Safety Features/Safety Hazards:** Contains 10 mCi of a Ni^{63} radiation source. [31]

- **Power Requirements:** Supplied by vehicle power (typically 24 V); complies with DEFSTAN 61-05. [35]

- **Transport Requirements:** No special requirements; portable. [20,35]

- **Personnel Requirements:** None. [35]

- **Operational Information:** The detector unit can supply display to remote alarm or directly into vehicle systems such as commander console, headphones, gun sights, etc. [35]

- **Stock Number(s):** NATO stock number not yet assigned. [35]

- **Miscellaneous:** *

- **Contact(s):**

Manufacturer:

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Tel: 044 923 238483
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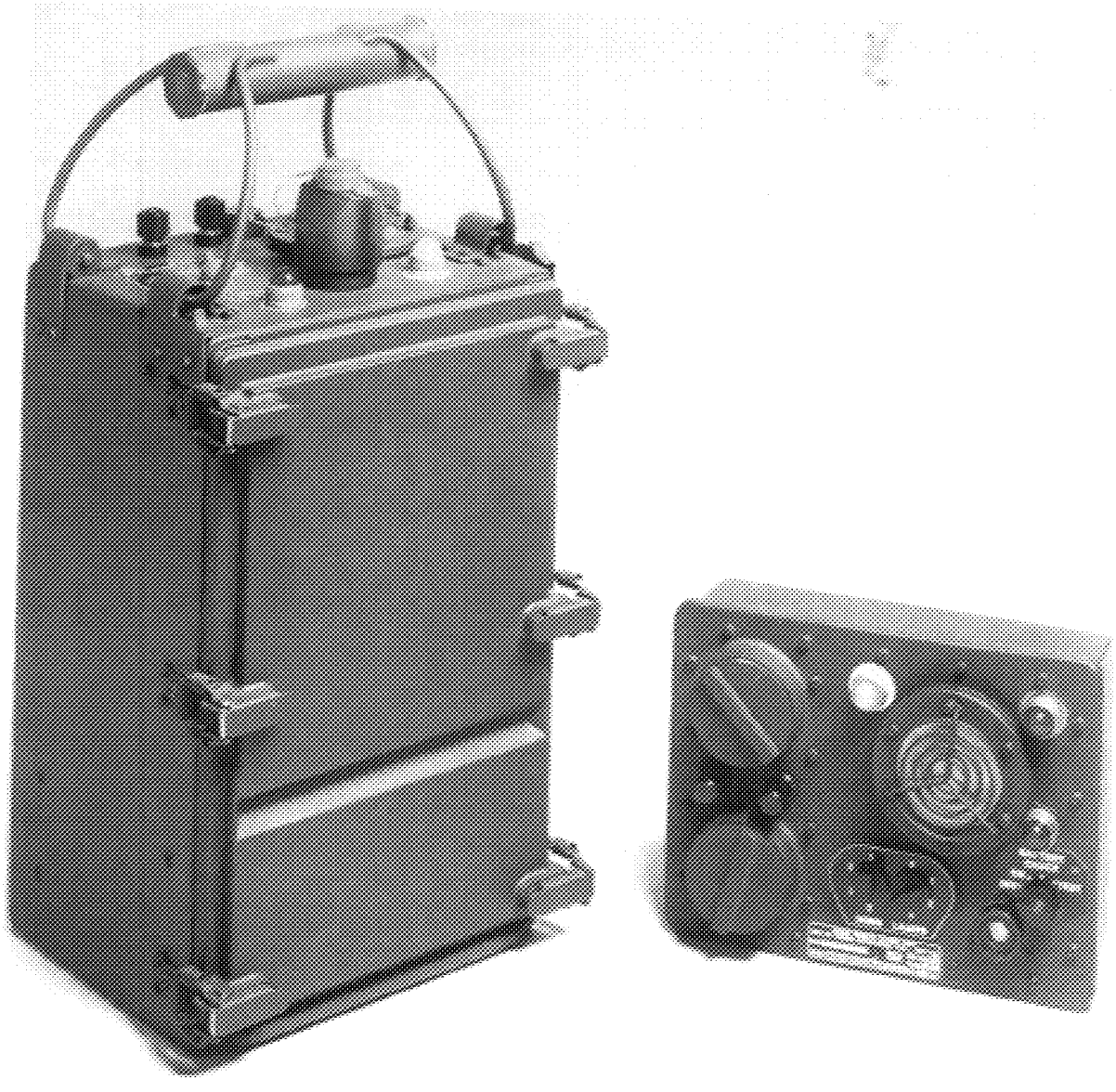


Photo courtesy of the Defence Nuclear Biological and Chemical Centre

The U.K. Nerve Agent Immobilized-Enzyme Alarm and Detector (NAIAD)

Designator(s): NAIAD
L1A1

- **Item Name(s):** Nerve Agent Immobilized-Enzyme Alarm and Detector (NAIAD)

- **Item Description:** The NAIAD is an automatic alarm system that monitors the atmosphere continuously and provides the user with an audible and/or visible signal indicating the presence of nerve agent vapor or aerosol. The NAIAD is the primary detector in the Ship Installed Chemical Alarm System (SICAS) and battery. [14]

- **System Components:** [26]

Battery
Point Sampling Detection Unit
Remote Alarm Unit (reproduces the detector's audible and visible alarm signals at distances up to 500 meters)

- **Support Equipment:**

Base Workshop Test Set [8]
Battery Charger [8]
Decontamination Kit [8]
Field Test Kit [8]
Refill Kit (enzyme pad holders, reagent modules) [26]
Test Set [26]
Training Kit [8]
Vehicle Installation Kit (scaled to detector) [26]
Vehicle Modification Kit (scaled to vehicle) [26]

- **Equipment Hardness:** Nuclear and chemically hardened. [8]

Satisfies "man in the open" criteria; electromagnetic compatibility with other service equipment. Does not present interference with other service equipment and can be used in close proximity to most nuclear and radar installations. This item meets DEFSTAN 07/55 for durability. It is tested against exposure to explosive and propellant fumes, vehicle and aircraft exhaust fumes, dust and smokes. [10,26]

Durability: Complies with DEFSTAN 07/55 in open criteria and DEFSTAN 00-1 at -31°C to +52°C and 0% to 100% RH. [8]

- **Dimensions and Weight:**

PARAMETERS	DETECTOR UNIT [8]	REMOTE ALARM UNIT [10]
Length	25.1 cm	23.2 cm
Width	20.9 cm	17.7 cm
Height	47.5 cm (including protective roll bars)	9.9 cm
Weight	~ 12.5 kg (with battery)	~2.5 kg (with battery)

- **Technology:** Potentiometric indirect biosensor. [8] Enzyme reaction. [10]

- **Status:** Fielded. [8]

- **Uses:** Rapid detection of nerve agent vapor and aerosol in front line battlefield situations, support areas and personnel protection. Man portable for field use, ship and vehicle use; can also be located at fixed installations, complete sites, buildings and collective protection areas. The Fixed Installation NAIAD Equipment (FINE), a custom designed system for detecting and monitoring the presence of chemical warfare vapor and aerosol, may be employed at fixed locations. [8]

- **Deployment:** In service with U.K. and other armed forces. [8]

- **Agents Detected:** [26]

  Blood: AC and CK
  Nerve: All (in vapor or aerosol form)

- **Detection Sensitivity:**

  Nerve agents: 0.005 mg/m^3 to 0.05 mg/m^3 depending upon the agent. [10]

- **Response Time:** Classified. [8]

- **False Responses/Interferents:** Classified. [8]

- **Safety Features/Safety Hazards:** Fail-safe characteristics; no high voltages or radioactive sources; simple to operate; no loose chemicals to handle; electromagnetically compatible with other service equipment. [8]

- **Power Requirements:** The detector is powered with an integral 3.3 Ah NiCd rechargeable battery and is operated on a 12-hour replenishment cycle. The Remote Alarm is powered by Hg batteries. [26]

- **Transport Requirements:** Portable or vehicle mountable. [26]

  Pressurized air carriage which requires that the case vent be opened. [8]

- **Personnel Requirements:** One operator. [8]

- **Operational Information:**

  Operational Temperature: -31°C to +52°C (complies with DEFSTAN 00-1) [26]
  Relative Humidity: 0% to 100% [26]

- **Stock Number(s):** [8]

Base Workshop Test:	6665-99-966-3922 (NSN)
Battery:	6140-99-620-8057 (NSN)
	6135-99-130-6823 (NSN)
Battery Charger:	Part No. 10170
Decontamination Unit:	6665-99-225-4356 (NSN)
Detector Unit:	6665-99-966-1252 (NSN)
Field Test Kit:	6665-99-966-3882 (NSN)
Refill Kits:	6665-99-966-3883 (NSN)
Remote Alarm Unit:	6665-99-966-1253 (NSN)
Training Kit:	6665-99-225-3949 (NSN)

- **Miscellaneous:** *

- **Contact(s):**

  Developer: Chemical and Biological Defence Establishment
  Porton Down, SP4 0JQ
  United Kingdom

  Manufacturer: Jasmin Simtec Limited
  Sellers Wood Drive
  Bulwell, Nottingham NG6 8UX
  United Kingdom
  Tel: 044 602 273741
  Fax: 044 602 278614 [8]

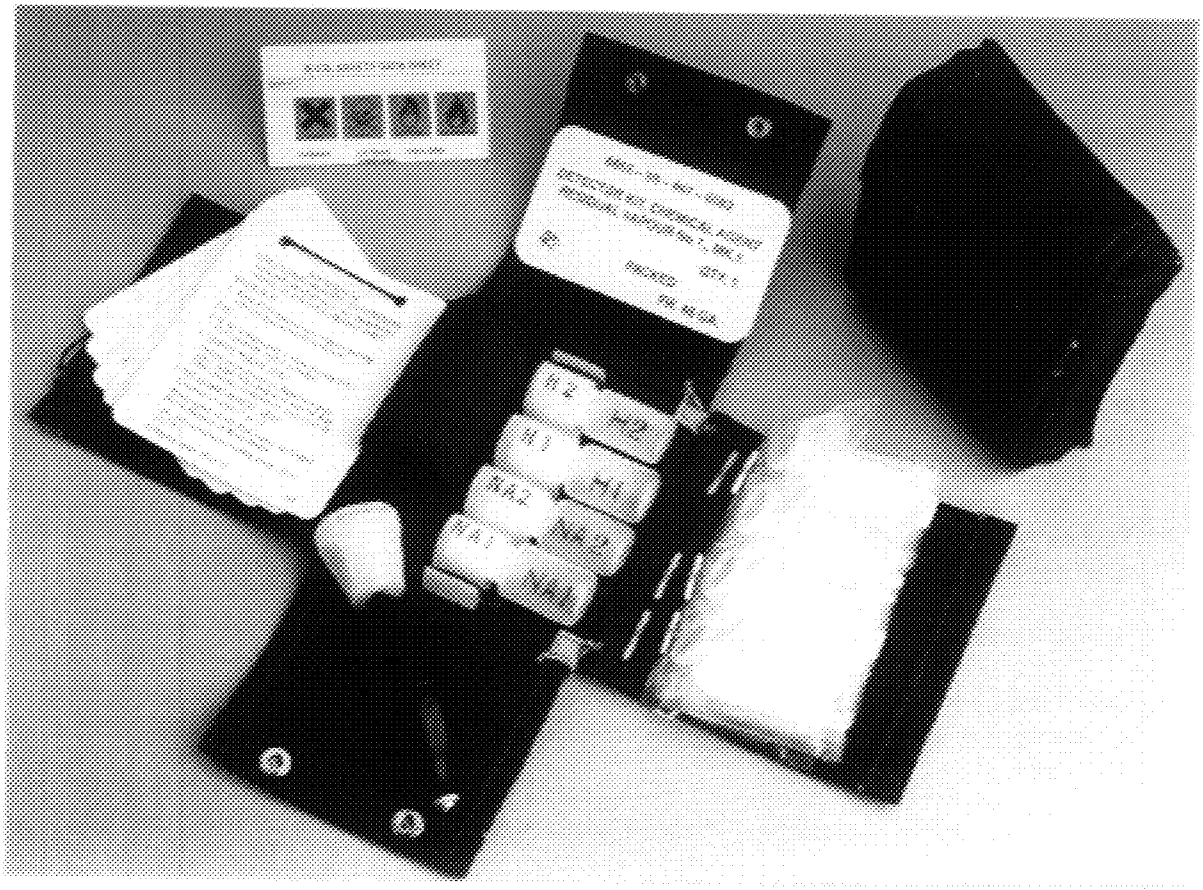


Photo courtesy of the Defence Nuclear, Biological and Chemical Centre

The U.K. No. 1, Mk. 1 Kit
(Also known as the Residual Vapor Detector (RVD))

- **Designator(s):** No. 1 Mark 1
  No. 1 Mk. 1
  RVD

- **Item Name(s):** No. 1 Mark 1 Detector Kit Chemical Agent Residual Vapor
  Detector Kit Chemical Agent Residual Vapor No. 1 Mk. 1 (RVD)

- **Item Description:** The Residual Vapor Detector (RVD) No. 1 Mk. 1 is a personal kit issued to section leaders to detect the presence of mustard and nerve agents in the atmosphere following a chemical attack. [2]

- **System Components:** The kit consists of a water repellent canvas wallet containing plastic instruction cards, detector tickets, reagents and an atmospheric sampling device (air pump) fitted with an adapter to receive the detector ticket. [2]

- **Support Equipment:** Nerve agents can be simulated for training exercises using a tactical training aid (NATO 6665-99-224-2631). [25]

- **Equipment Hardness:** *

- **Dimensions and Weight:**

Length:	15 cm
Width:	13 cm
Height:	5 cm
Weight:	0.35 kg

- **Technology:** Wet chemistry using reagents that cause a color change to indicate the presence of agent vapors. [2]

- **Status:** In service with the U.K. Armed Forces for over 10 years. [2]

- **Uses:** The kit is used in the field to detect nerve and mustard agent vapor in the atmosphere. It is distributed at the section/squad level and serves as an aid for decisions on unmasking after a CW attack. [2]

- **Deployment:** *

- **Agents Detected:** (in vapor form). [2]

AGENT CLASS	AGENT(S) (in vapor form) [2]	DETECTION SENSITIVITY (at +3°C to +38°C) [3]
Blister	HD	0.5 mg/m^3
	HN	0.3 mg/m^3
Nerve	GA	0.03 mg/m^3
	GB and GD	0.02 mg/m^3
	VX	0.04 mg/m^3
	VX (aerosols)	5 microns

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** The response time is temperature and agent concentration dependent. [2]

- **False Responses/Interferents:** False positives are caused when Cl_2 is at concentrations of greater than 10 to 20 ppm and SO_2 is at concentrations of greater than 3 ppm or if there is very dense and acrid wood smoke. Field trials performed in the presence of common battlefield contaminants such as efflux from weapons propellants, vehicle exhaust and screening smokes, have not revealed any practical interference problems. [2]

- **Safety Features/Safety Hazards:** None. [2]

- **Power Requirements:** None. [2]

- **Transport Requirements:** Portable. A wide loop is provided on the back of the canvas wallet for easy attachment to a belt. [2,3]

- **Personnel Requirements:** One operator. [2]

- **Operational Information:** The reagent capsules are activated to moisten the sampler tickets and the hand pump is operated. The reagent changes color if a particular vapor is present. [25]

- **Stock Number(s):** 6665-99-961-6082 (NSN). [2]

- **Miscellaneous:** Spare reagents and spare sampler tickets are available. [2]

Shelf Life: 10 years. [2]

- **Contact(s):**

Manufacturer:

Richmond Packaging (UK) Limited
New Road
Winsford, Chesire CW7 2NY
United Kingdom
Tel: 044 606 557422
Fax: 044 606 861063 (2)

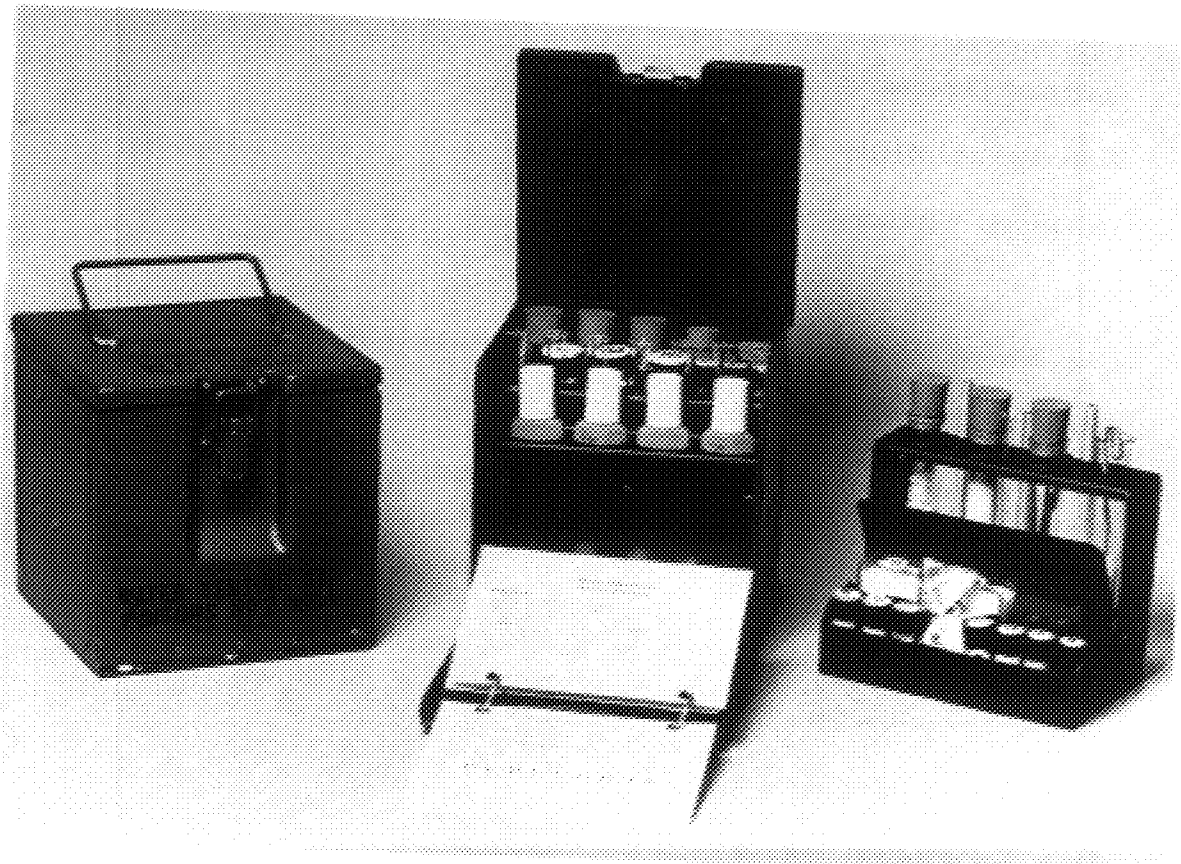


Photo courtesy of Richmond Packaging (UK) Limited

The U.K. No. 2 Mk. 1 Water Test Kit for Poisons

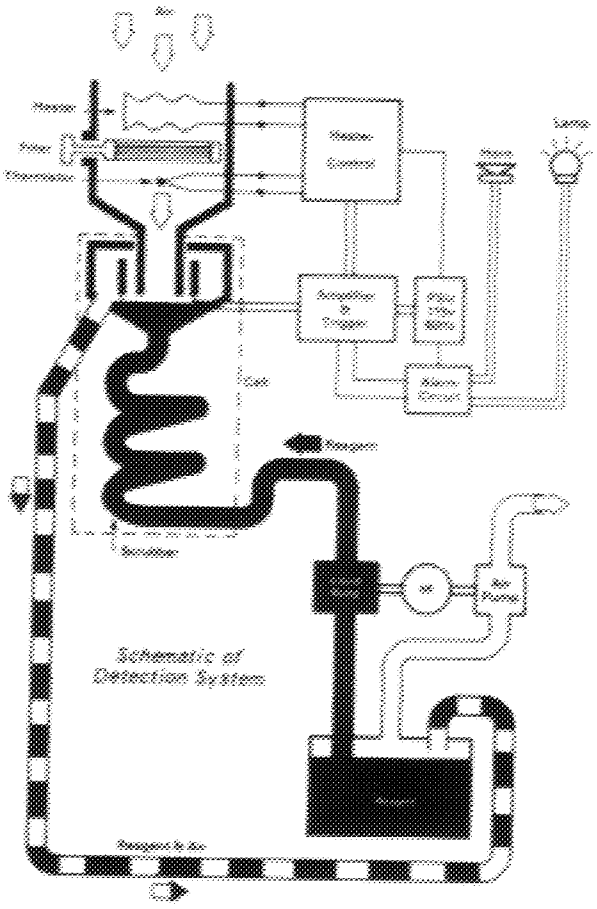
Designator(s): No. 2 Mk. 1

- **Item Name(s):** No. 2 Mark 1 Water Test Kit, Poisons
- **Item Description:** The No. 2 Mk. 1 is a self-contained, portable water testing kit designed to provide field soldiers with the capability of detecting toxic chemicals in the water supply or environment. [25]
- **System Components:** *
- **Support Equipment:** A tactical training device is available to simulate the presence of agents. [25]
- **Equipment Hardness:** *
- **Dimensions and Weight:** *
- **Technology:** Wet chemistry methods. [25]
- **Status:** *
- **Uses:** Designed for use in the field to test for toxic chemicals in water supplies. [25]
- **Deployment:** *
- **Agents Detected:** Contains tests for the detection of cyanides, nerve agents, mustard gases, heavy metals and arsenic. [25]
- **Detection Sensitivity:** *
- **Response Time:** *
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None. [25]
- **Transport Requirements:** Portable. [25]
- **Personnel Requirements:** One person can perform tests. [25]
- **Operational Information:** *
- **Stock Number(s):** 6665-99-225-0948 (NATO). [25]
- **Miscellaneous:** *

- **Contact(s):**

Manufacturer:

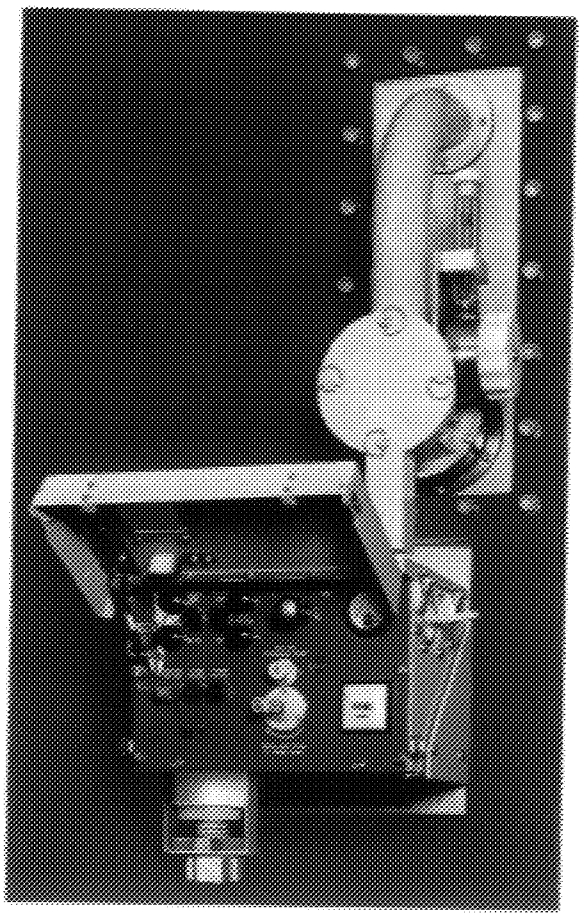
Richmond Packaging (UK) Limited
New Road
Winsford, Chesire CW7 2NY
United Kingdom
Tel: 0101 606 557422
Fax: 0101 606 861063 [25]



Schematic of Detection System

The Operation of the SICS Mk. 7 NHA

Illustration and photo courtesy of the Defence Nuclear, Biological and Chemical Centre



The U.K. SICS Mk. 7 NHA

Designator(s): SICS Mk.7 NHA

- **Item Name(s):** Ship Installed Chemical System (SICS Mk.7 NHA)

- **Item Description:** The Ship Installed Chemical System (SICS) is a detection system fitted to surface ships for detecting contamination of the air, by chemical attack both within the citadel and around the ship. Both audible and visible warning is given. The system may also be used to activate the ships broadcast system if required. It can also be used to form the basis of the Ship Installed Chemical Agent Alarm System (SICAS) which employs NAIAD as the primary detector.[14]

  The SICS is the outcome of a development program carried out by Thorn Automation Ltd. in collaboration with the Ministry of Defence. It is produced to DEFSTAN 05-21 with full documentation and support, and has been in service with the Royal Navy since 1974. SICS is installed in surface ships in order to detect any contamination of the air, by chemical agent attack, both within the Citadel and around the ship. The system is arranged to provide rapid automatic warning to the whole ships' complement so the necessary defensive equipment and procedures can be deployed. Monitoring of the air is continuous, the SICS detector units are sensitive to chemical agents in vapor or aerosol form. When the presence of contamination is detected, both visible and audible alarms are activated automatically. The visible alarm is displayed to the ships' NBC Protection Officer and indicates the detector concerned, while the audible alarm is broadcast over the Ships' General Broadcast System. The number of detectors required and their location varies with the class of ship involved. A typical frigate or destroyer installation would consist of six detectors connected to a Visual Alarm Panel. Four of the detectors would be located at carefully selected positions to monitor the atmosphere inside the Citadel, while the other two would be sighted at either side of the bridge to sample external air via Through-Bulkhead Units. The audible alarm may also be activated by the operation of manual alarm push-buttons strategically positioned throughout the ship. Replacement of the reagent solution and filter pad in each detector is needed once every 24 hours, and correct functioning of the unit is checked by a simulant provided in the On-Board Test Kit. The SICS meets all naval environmental requirements, and as all the detector units, including those sampling external air, are mounted inside the ship, they are not subject to severe climatic conditions. Modular design of the units ensures easy and rapid maintenance by replacement when necessary. A Base Test Set is available for second-line maintenance of Detector Units and functional modules. [28]

- **System Components:**

  Bulkhead Unit (MK8NM) [28]
  Detector Unit (MK7NHA) [28]
  Network Control Unit [32]
  Visual Alarm Panel [28]

- **Support Equipment:** [14]

  On Board Test Kit (MK28NTV)
  Replenishment Kit
  Test Set (MK27NTU) - Dockyard

- **Equipment Hardness:** *

- **Dimensions and Weight:** [14]

PARAMETERS	DETECTOR	BULKHEAD UNIT
Length	23 cm	30 cm
Width	28 cm	21 cm
Height	31 cm	51 cm
Weight	13.6 kg	9.7 kg

- **Technology:** Electro-chemical. [14]

  Sample air is heated, passed through a filter into the detector cell and there it is mixed with a reagent solution. The reaction produces cyanide ions which cause a voltage to be developed between two electrodes. The change in electrical output is detected electronically, activating the alarm relay and stopping the pump motor. [28]

- **Status:** Fielded. [28]

- **Uses:** Detects contamination of air by chemical agent attack, within a ship's citadel and around the ship. Automatically provides audible and visible warning to the whole ship's company. [14]

- **Deployment:** In service with the Royal Navy since 1974. [28]

- **Agents Detected:** Chemical agents in vapor and aerosol form. [28]

- **Detection Sensitivity:** 0.2 mg/m^3 to 0.4 mg/m^3. [28]

- **Response Time:** Confidential. [14]

- **False Responses/Interferents:** Low false alarm rate; details are confidential. [14,28]

- **Safety Features/Safety Hazards:** Fails safe, no high voltages or radioactive sources. [14]

- **Power Requirements:** Supplied by ship power (115 V 60 Hz). [14]

- **Transport Requirements:** No special requirements. [14]

- **Personnel Requirements:** *

- **Operational Information:** Sampled air is drawn through the detectors' air inlet, heated to a predetermined temperature and passed through a filter into the detector cell, where it is mixed with reagent solution. [28]

- **Operational Information (continued):** The filter, in addition to removing interfering materials from the incoming air, converts V-agents into corresponding G-type compounds. G-agents, whether from the sampled air, or from conversion from V-agents, break down an oxime present in the reagent. This reaction produces cyanide ions which cause a voltage to be developed between two electrodes, and this change in electrical output is detected electronically, activating the alarm relay, and stopping the pump motor. [28]

  The reagent solution is pumped at a controlled rate into the detector cell from a storage container. After being mixed with sampled air in the cell the reagent, now containing air bubbles, is drawn back into the container under the partial vacuum provided by an air pump. Here it is separated from the air and recycled. [28]

  On detection of a chemical agent, only a small amount of reagent solution is contaminated, and this is rendered fit for re-use in the normal passage of the reagent through a catalytic scrubber incorporated in the cell. Thus the detector unit may be put back into service without delay using normal startup procedures and eliminating the need for tedious cleansing of the system. [28]

  The chemicals needed for the simple preparation of the reagent are contained in the Chemical Replenishment Kit, which provides for continuous operation of one SICS detector for 30 days. [28]

- **Stock Number(s):** [28]

Detector Unit:	6665-99-224-5930 (NSN)
Detector Cell:	6665-99-224-6660 (NSN)
Air Filter:	6665-99-224-6661 (NSN)
Through Bulkhead Unit:	6665-99-224-5931 (NSN)
Replenishment Kit:	6665-99-224-6564 (NSN)
On Board Test Kit:	6665-99-527-9687 (NSN)
Test Set (Dockyard):	6665-99-224-6617 (NSN)

- **Miscellaneous:** Complies with DEFSTAN 05-21 for durability and is electro-compatible with other service equipment. [14]

- **Contact(s):**

Manufacturer:
Jasmin Simtec Limited
Sellers Wood Drive
Bulwell, Nottingham NG6 8UX
United Kingdom
Tel: 044 602 273741
Fax: 044 602 278614 [14]

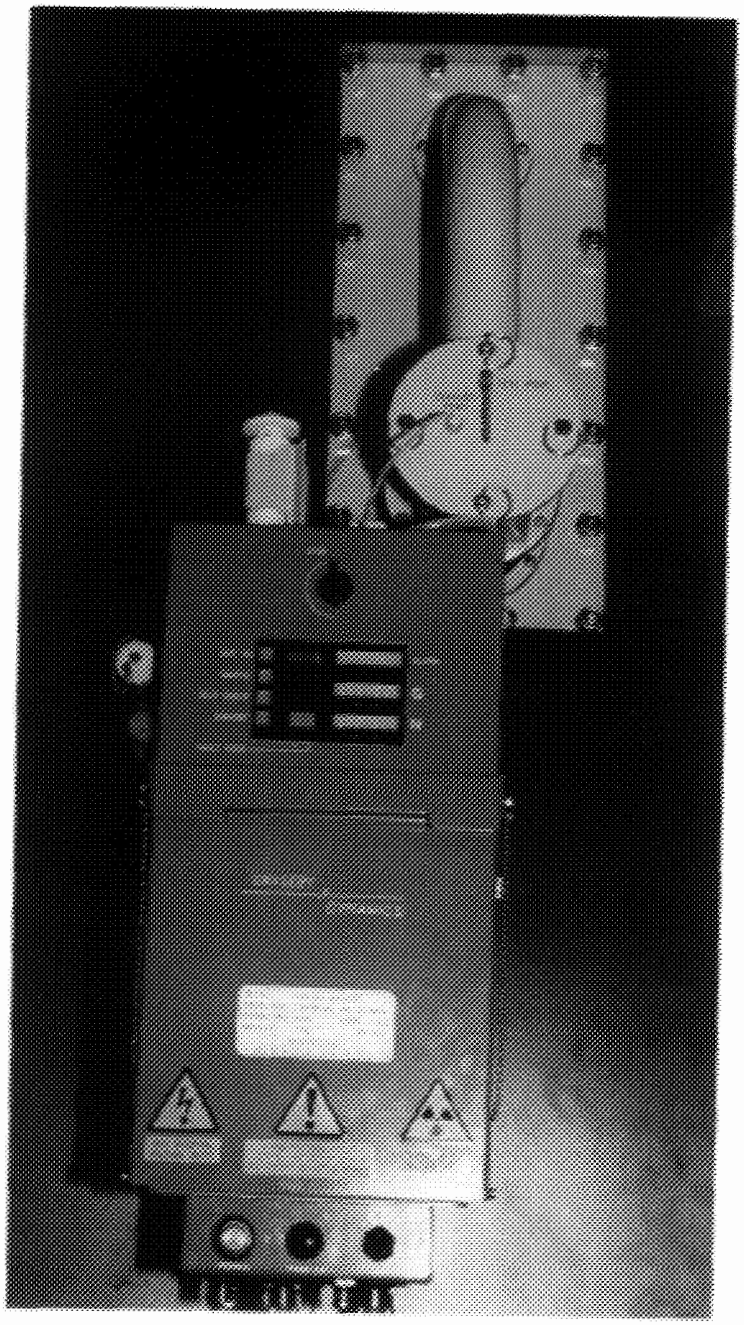


Photo courtesy of the Graseby Dynamics Limited

The SICS MK10/GID-2B

Manufactured by Graseby Ionics Division, Graseby Dynamics Limited

- **Designator(s):** SICS MK10/GID-2B

- **Item Name(s):** Ship Installed Chemical System (SICS MK10/GID-2B)

- **Item Description:** The Ship Installed Chemical System (SICS) is a detection system fitted to surface ships for detecting contamination of the air, by chemical attack both within the citadel and around the ship. [32]

- **System Components:** [32]

  Detector
  Network Control Unit

- **Support Equipment:** None. [32]

- **Equipment Hardness:** EMP to NATO levels. [32]

- **Dimensions and Weight:** [32]

Length:	22 cm
Width:	29 cm
Height:	56 cm
Weight:	17 kg

- **Technology:** Ion Mobility Spectrometry (IMS). [32]

- **Status:** In production. [32]

- **Uses:** One of several detectors deployed around the ship both detecting external atmosphere and internal atmospheres. [32]

- **Deployment:** *

- **Agents Detected:** [32]

  Blister
  Blood
  Choking
  Nerve
  Others (as required)

- **Detection Sensitivity:** Confidential. [32]

- **Response Time:** Confidential. [32]

- **False Responses/Interferents:** Confidential. [32]

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Supplied by ship power (115 V 60 Hz). [32]
- **Transport Requirements:** *
- **Personnel Requirements:** None. [32]
- **Operational Information:** *
- **Stock Number(s):** NATO stock number not yet assigned. [32]
- **Miscellaneous:** *
- **Contact(s):**

Manufacturer:	Graseby Ionics Division Graseby Dynamics Limited 459 Park Avenue, Bushey, Hertfordshire WD2 2BW United Kingdom Tel: 044 923 238483 Fax: 044 923 221361 [32]
U.S. Affiliate:	Graseby Ionics 1251 Research Parkway Orlando, FL 32826 U.S.A. Tel: (407) 275-8730 Fax: (407) 282-7988 [31]
Ministry of Defense:	DGFS(ES) ES 267 Room A5 Block B Foxhill, Bath BA1 5AB United Kingdom

19.2 REFERENCES

1. Olofsson, Göran. (1994, January 25). *Re: CB Detection Equipment* [2 p.]. Correspondence, National Defence Research Establishment (FOA), Umeå, Sweden.

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Chapter 20 - UNITED STATES

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20.1 CHEMICAL AGENT DETECTORS

Photo courtesy of Naval Sea Systems Command

The U.S. Navy AN/KAS-1A

- **Designator(s):** AN/KAS-1
  AN/KAS-1A

- **Item Name(s):** AN/KAS-1 Chemical Warfare Directional Detector
  Chemical Warfare Directional Detector (CWDD)

- **Item Description:** The AN/KAS-1 is a two field of view, forward looking infrared system used for the stand-off detection of nerve agent vapors. A selectable filter enables the operator to interrogate potential threats. By comparing images produced by the filter's three available spectral bands, the operator can distinguish the presence of nerve agent vapor accumulations. As a secondary function, the AN/KAS-1 provides thermal imaging for night surveillance, navigation, search and rescue operations and numerous other unique applications. The AN/KAS-1A provides remote video display, remote relative bearing display, chemical filter select and other engineering improvements. [6]

- **System Components:** [6]

  Power Conversion Unit
  Sensor

- **Support Equipment:** [6]

  Carrying Case: Holds sensor unit, pivot mount, interconnecting cable, overboard lanyard, maintenance kit and cover

  Dry Nitrogen Purse Kit
  Lens Cleaning Material

- **Equipment Hardness:** [6]

  Shock: Complies with MIL-STD-901
  Vibration: Complies with MIL-STD-167/1 and MIL-STD-810C

- **Dimensions and Weight:** [6]

PARAMETERS	SENSOR	POWER CONTROL UNIT
Length	45.7 cm	30.5 cm
Width	50.8 cm	50.8 cm
Height	45.7 cm	17.8 cm
Weight	12.7 kg	8.2 kg

- **Technology:** The AN/KAS-1 is a passive standoff detector utilizing Forward Looking Infrared (FLIR) technology. The AN/KAS-1 uses a selectable filter (one of three available) to enable an operator to interrogate potential threats. By comparing images produced by the filter's three available spectral bands, the operator can distinguish the presence of nerve agent vapor accumulations. [6]

- **Status:** In production. [6]

- **Uses:** Identifies the presence of nerve agent vapor accumulations. As a secondary function, the AN/KAS-1 provides thermal imaging for night surveillance, navigation, and search and rescue operations and numerous other unique applications. [6]

- **Deployment:** Over 800 units in service aboard ships. Two detector units and four mounts (to cover 360° view) are installed onboard U.S. Navy Ships. Smaller ships in the mine sweep category are provided with two mounts and one detector. [6]

- **Agents Detected:** [6]

  Nerve: G and V agents.

- **Detection Sensitivity:** *

- **Response Time:** Based on operator skill and experience and vapor cloud density. [6]

- **False Responses/Interferents:** Based on operator skill and experience. [6]

- **Safety Features/Safety Hazards:** None. [6]

- **Power Requirements:** 115 V AC, 60 Hz. [6]

- **Transport Requirements:** Carrying case is provided for transportation and storage. [6]

- **Personnel Requirements:** Trained signalman. [6]

- **Operational Information:**

  Operational Temperature: -48°C to +52°C. [9]

- **Stock Number(s):** [11]

  AN/KAS-1: 5855-01-147-2768 (NSN)
  (Detector only)

  AN/KAS-1: 5855-01-147-4362 (NSN)
  (Detector and
  installation material)

  AN/KAS-1A: 5855-01-352-7033 (NSN)
  (Detector only)

  AN/KAS-1A: 5855-01-352-7032 (NSN)
  (Detector and
  installation material)

  PCU: 5855-01-147-2774 (NSN)

- **Miscellaneous:** Not releasable for foreign military sales. [6]

Field of View (Wide):	34° x 68° [9]
Field of View (Narrow):	1.1° x 2.2° [9]
Resolution (Wide):	0.40 mrads [9]
Resolution (Narrow):	0.13 mrads [9]
Storage Temperature:	-54°C to +68°C [9]

- **Contact(s):**

Manufacturer:

Intellitec (formerly Brunswick Corporation)
2000 Brunswick Lane
DeLand, FL 32724
U.S.A.
Tel: (904) 736-1700
Fax: (904) 736-2250 [6]

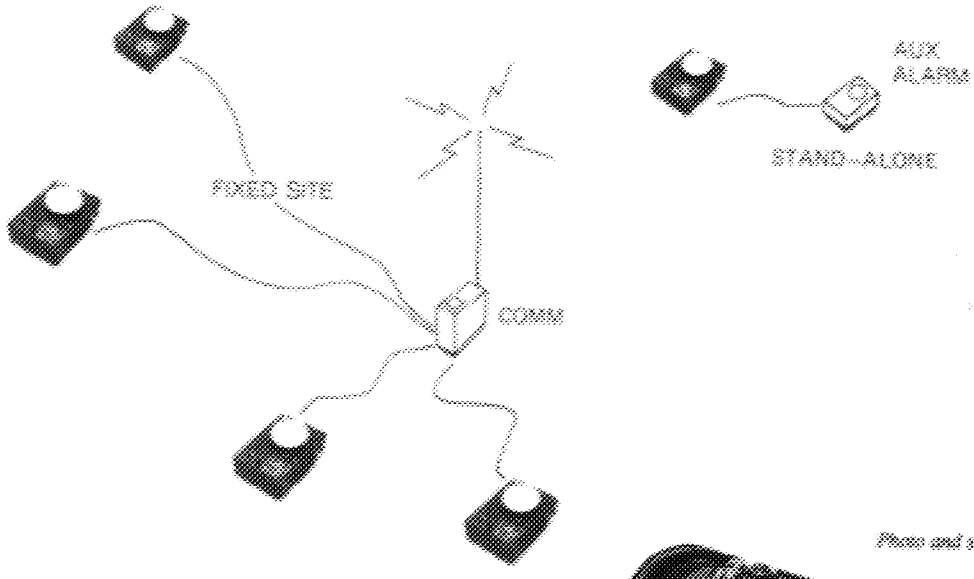


Photo and sketch courtesy of Calspan

The ALAD by Calspan can stand alone or be used in a network.

- **Designator(s):** ALAD

- **Item Name(s):** Automatic Liquid Agent Detector System (ALAD)

- **Item Description:** The ALAD is a detector that can be used for point, remote or dropoff detection of nerve agents and blister agents in liquid or solid form. It provides a local audible and visible alarm that can be by-passed if a louder, remote alarm is required. It can be used as a stand-alone detector or as part of a chemical warning system network for fixed site applications. The ALAD meets NBC survivability requirements. A Built-in Test (BIT) provides a continuous read-out of the detector status. The ALAD may be incorporated into a network by hardware, fiberoptics or radio signals. [3,4]

- **System Components:** *

- **Support Equipment:** May be networked to remote alarms and communication centers.

- **Equipment Hardness:** Complies with MIL-STD-461 for Electro-Magnetic Pulse (EMP) and Electro-Magnetic Interference (EMI) and MIL-STD-810D/E for shock, vibration, rain, immersion, salt fog, sunloading, fungus, humidity, high temperature, low temperature, dust, altitude and explosive atmosphere. [3]

  Also complies with AR 70-71 for NBC survivability. [4]

- **Dimensions and Weight:** [8]

Length:	31.2 cm
Width:	24.4 cm
Height:	13.4 cm
Weight:	4.5 kg

- **Technology:** Operates on the principle of electrochemistry. The sensor is a one use item that detects small liquid droplets, frozen and thickened forms of blister agents and nerve agents via microprocessor based electronics. [8]

- **Status:** Fielded and in use. [7]

- **Uses:** The ALAD is used for point source, local area, and remote warning when hooked to a network or radio link. The detector unit has an integral horn and lamp which can warn personnel for ranges of 7.6 meters to 15.24 meters. Stand-alone point liquid agent detector and alarm, or in a networked system. [3,5]

- **Deployment:** U.S. Air Force. [7]

- **Agents Detected:** [3]

AGENT CLASS	AGENT(S)	SINGLE DROPLET	TYPICAL ALARM RESPONSE TIMES		
			Battery Power @ +25°C	Battery Power @ +15°C	AC Power @ -35°C
Blister	HD	200 μ	10 seconds	50 seconds	1 second[a]
	L	800 μ	2 seconds	2 seconds	1 second[a]
Nerve	GD	200 μ	10 seconds	25 seconds	5 seconds
	Thickened GD	1,000 μ	10 seconds	15 seconds	5 seconds
	VX	200 μ	20 seconds	35 seconds	15 seconds

[a] Droplet near freezing point: +14°C for HD and -18°C for L.

- **Detection Sensitivity:** See ***Agents Detected*** for further information.
- **Response Time:** See ***Agents Detected*** for further information.
- **False Responses/Interferents:** *
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** [3]

Battery Life:	30+ days
Power:	One 12 V lithium battery BA-5588 or 110/220 V, 50 Hz to 60 Hz
Power Consumption:	0.028 W on battery, 160 W maximum on AC line

- **Transport Requirements:** None.
- **Personnel Requirements:** Operated as an additional duty, with training. [7]
- **Operational Information:** The detector unit can be connected to an M42 Alarm (see M8A1 Alarm System description), or the ALAD Auxiliary Alarm. The binding posts on the detector unit allow for connection to a communications network. Three signals are relayed over the network, an "Operating & OK" signal, a "Needs Service" signal (low battery), and an "ALARM" signal. The ALAD can run unattended for 30 days on battery power. The ALAD has a low power consumption to allow 30 or more days of unattended operating time without changing the battery or sensor. In a fixed installation, the ALAD uses AC power and provides full detection capabilities at lower temperatures. For the detection of HD in solid form (freezing point is 14°C) in less than 60 seconds, AC line power is required for ambient temperatures below 15°C (60°F). The heating unit in the detector operates when AC is used. The heater is thermostatically controlled and responds to the ambient temperature changes. [3,4,5]

- **Operational Information (continued):**

  Operational Temperature: -35°C to +52°C. [3]

- **Stock Number(s):** 6665-01-314-2086. [10]

- **Miscellaneous:** The ALAD can be operated in MOPP IV clothing. [3]

  The internal audible/visible alarm has a 7.6 m range. [4]

  The ALAD has a BIT for low battery, internal/external alarm, sensor and electronic self check. [4]

MTBF:	Greater than 5,400 hours [4]
Storage Temperature:	-59°C to +74°C [3]

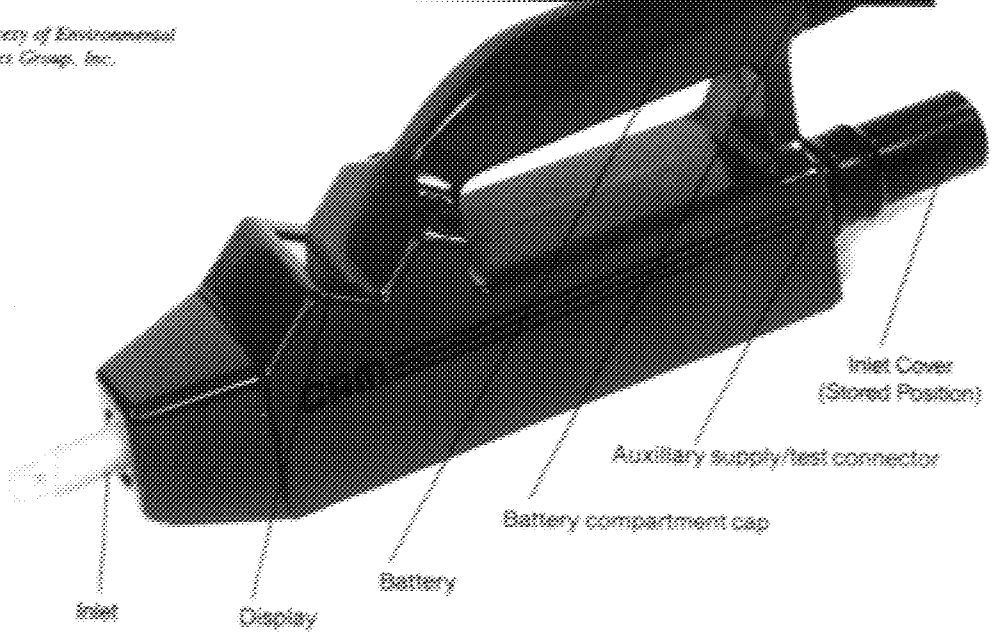
- **Contact(s):**

  Developer:
  Brooks Air Force Base
  San Antonio, TX 78235-5000
  Tel: (210) 536-5784 [10]

  Manufacturer:
  ARVIN CALSPAN
  Advanced Technology Center
  P.O. Box 400
  Buffalo, N.Y. 14225
  U.S.A.
  Tel: (716) 631-6812
  Fax: (716) 631-6722
  Telex: 91-270-200915 [3]

Field Use of the CAM

Photo courtesy of Environmental Technologies Group, Inc.



Close-Up of the CAM

- **Designator(s):** CAM/ICAM

- **Item Name(s):** Chemical Agent Monitor (CAM)/Improved Chemical Agent Monitor (ICAM)

- **Item Description:** The CAM and ICAM are hand-held, soldier-operated devices designed for monitoring chemical agent contamination on personnel and equipment. The CAM and ICAM utilize ion mobility spectrometry technology to detect and discriminate between mustard and nerve agent vapors. The ICAM was developed to reduce operation and support cost by simplifying the design and improving the reliability of the CAM. The ICAM incorporates two major changes to the original CAM: a redesigned molecular sieve which is enlarged and more easily replaced, and an updated electronics board which is less costly to produce. The design changes incorporated in the ICAM are transparent to the user. However, the ICAM has increased reliability and improved start-up characteristics when compared to the CAM. [7]

  The units can be held in either hand and operated while wearing chemical protective clothing. Both units are simple to operate and can be operated day or night. Relative vapor hazard and malfunction information is displayed on a Liquid Crystal Display (LCD). [7]

- **System Components:** [7]

  Buzzer
  Carrying Case with harness (for over the shoulder transport)
  Confidence Sample
  Environmental Cap (to protect the electrical connector)
  Filtered Nozzle Assemblies
  Nozzle Protective Cap and Spare (sealed in a container in case of contamination)
  Spare Battery

- **Support Equipment:** Diagnostic Test Set (DTS). [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [7]

Length:	39 cm
Width:	8 cm
Height:	14.5 cm
Weight:	1.7 kg

- **Technology:** The CAM uses time of flight Ion Mobility Spectrometry (IMS) to respond selectively to agent vapors. The operator must select G or H mode when operating the CAM or ICAM. Thus, the CAM and ICAM cannot detect both types of agent simultaneously. [7]

- **Status:** The CAM was type classified for limited production of 5,000 units by the U.S. Army in May 1985. The limited production CAMs have been fielded with the First Unit Equipped (FUE) to U.S. Army TRADOC in December 1988. A full production quantity of 6,400 CAMs was completed in June 1994. The ICAM was type classified in 1993 and is awaiting production to be initiated in FY96. [7]

- **Uses:** The CAM is used by ground forces to search out clean areas, to search and locate contamination on personnel, equipment, structures, aircraft, vehicles, terrain, and to monitor the effectiveness of decontamination. It can also be used for monitoring collective protection. The CAM is a post-attack monitor and not a detector or alarm. Since it is a monitor, the CAM can become contaminated and overloaded (saturated). The CAM can only report conditions at the front of the inlet probe. It is a point monitor only and cannot give a realistic assessment of the vapor hazard over an area from one position. [7]

- **Deployment:** In service with 16 countries including Australia, Bahrain, Belgium, Canada, Denmark, Italy, Netherlands, Norway, Spain, Sweden, Turkey, United Kingdom, and other Middle Eastern countries. The U.S. manufacturer (E.T.G.) does not produce CAM's for export. The ICAM has not yet been deployed. [7]

- **Agents Detected:** [7]

Blister:	HD, HN_3
Nerve:	G agents and VX.

- **Detection Sensitivity:** Responds to 0.1 mg/m^3 (and higher) concentrations. [7]

- **Response Time:** Within 1 minute. [7]

- **False Responses/Interferents:** The CAM may give false readings when used in enclosed spaces or when sampling near strong vapor sources (i.e., in dense smoke). Some vapors known to give false readings are: aromatic vapors (perfumes, food flavorings, some aftershaves, peppermints, cough lozenges, and menthol cigarettes (when vapors are exhaled directly into the nozzle)), cleaning compounds (disinfectants, methyl salicylate, menthol, etc.), smokes and fumes (exhaust from some rocket motors, fumes from some munitions) and some wood preservative treatments (polychlorinated biphenyls (PCBs)) when in an enclosed space. The operator should "experiment" in his environment to determine what common items will cause his CAM to respond. [7]

- **Safety Features/Safety Hazards:** The CAM and ICAM contain a beta radioactive source licensed for use by the U.S. Nuclear Regulatory Commission (NRC) under Title 10 Code of Federal Regulations. NRC and local applicable (i.e., Army) regulations must be followed for storage, shipment, and disposal. Do not attempt to open either the CAM or ICAM case. A damaged CAM or ICAM should be immediately packaged in the original container and shipped to direct support maintenance. Batteries can present a hazard if mishandled or damaged, crushed, or burned. [7]

- **Power Requirements:** The CAM operates on one internal 6 V lithium-sulfur dioxide battery. A CAM Training Battery Assembly is available as a nonstandard alternate power source for use in training to allow the CAM to be powered by four alkaline D cell batteries (BA 3030/U) instead of the standard CAM battery. [7]

- **Transport Requirements:** The CAM is portable and operable on the move. A simple packing procedure is required before movement. When transporting the CAM, NRC regulations must be complied with since the CAM has a radioactive source. [7]

- **Personnel Requirements:** CAM and ICAM can be operated as an additional duty by soldiers of any specialty with appropriate training. [7]

- **Operational Information:** There is a specific procedure to change modes. The object to be monitored is approached, and the CAM is held one inch from the surface. As soon as any bar reading is detected, the soldier immediately backs away from the object, puts the protective cap on the nozzle, and waits for the CAM to clear down (back to a zero bar reading). The operator can then continue monitoring. Weekly preventative maintenance checks and services (PMCS) are required to maintain the operational readiness of the CAM. [7]

  The CAM should always be backed up with an M256 Kit to verify the concentration present when a unit is considering unmasking. Also, the response times of various CAM's, sensitivities, etc. make it difficult to correlate bar readings to absolute concentrations. The CAM gives relative hazard indications for the area being monitored. It was not designed to be a dosimeter or to give concentration readings to the operator. [7]

- **Stock Number(s):** [7]

Buzzer:	6665-01-394-9916 (NSN)
CAM System:	6665-01-199-4153 (NSN)
Battery:	6665-99-760-9742 (NSN)
Case Assembly:	6665-99-225-3965 (NSN)
Confidence Sample:	6665-99-225-3523 (NSN)
Harness Assembly:	6665-99-225-4103 (NSN)
ICAM:	6665-01-357-8502 (NSN)
Nozzle (filtered):	6665-99-225-3522 (NSN)

- **Miscellaneous:** Do NOT use the following items to decontaminate a CAM or any of its accessories: M258A1 Personal Decontamination Kit (4230-01-101-3984 [NSN]); M280 Individual Equipment Decontamination Kit (4230-01-206-4252 [NSN]). [7]

- **Contact(s):**

Developer:	U.S. Army CBDCOM Aberdeen Proving Ground, MD 21010 U.S.A. [7]
Limited Production Manufacturer: (CAM)	Graseby Ionics Division Graseby Dynamics Limited 459 Park Avenue, Bushey Hertfordshire WD2 2BW United Kingdom Tel: 044 923 238483 Fax: 044 923 221361 [7]

- **Contact(s) (continued):**

Full Scale Production Manufacturer: (CAM)	Environmental Technologies Group, Inc. 1400 Taylor Avenue Baltimore, MD 21284-9840 U.S.A. Tel: (410) 321-5114 (410) 321-5200 Fax: (410) 321-5255 [7]

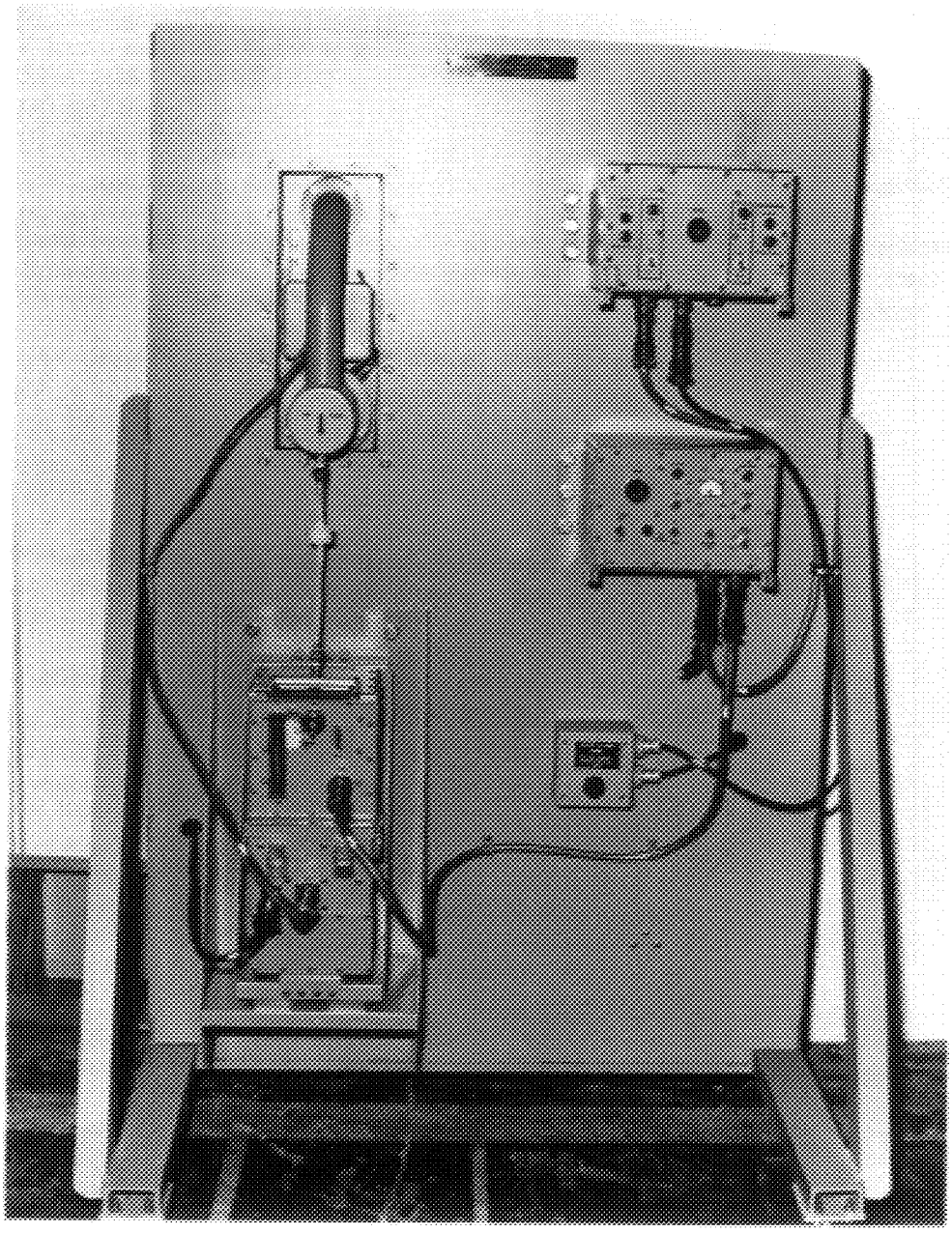


Photo courtesy of Naval Sea Systems Command

The U.S. Navy Chemical Agent Point Detection System (CAPDS MK21 Mod 1)

STE Units shown

Designator(s): CAPDS MK21 Mod 1

- **Item Name(s):** Chemical Agent Point Detection System (CAPDS)
  MK21 Chemical Agent Point Detection System

- **Item Description:** The Chemical Agent Point Detection System (CAPDS) consists of two separate detection systems, one port and one starboard, integrated into the ships overall alarm system. The components of each system include a Through Bulkhead Unit (TBU), Ionization Detector Unit (IDU), a shared Remote Status Unit (RSU) and a Remote Control Unit (RCU). The IDU contains a power supply and an alarm unit. The presence of nerve agents is signaled by audible and visible alarms. [6]

- **System Components:** The CAPDS consists of two modified Ionization Detector Units (IDU) with shock mounts, two TBUs, two RCUs and one RSU. An additional IDU and a third RCU are provided as spares. [6]

  IDU: The IDU consists of an Alarm Unit and a Power Supply. The Alarm Unit detects chemical nerve agents as sampled air from the TBU is drawn through it. It consists of an aluminum housing containing the sensor cell, the alarm and power conditioning circuits, a sampling pump and a flow indicator. [6]

  RCU: The RCU is bulkhead mounted and provides operation and maintenance personnel with the controls and indicators for operating and troubleshooting the CAPDS. The RCU receives alarm signals from the sensor circuits in the Alarm. [6]

  RSU: The RSU is bulkhead mounted and provides monitoring of both port and starboard IDU's. The RSU identifies the status of both IDU's (safe or alarming) and presents this information both audibly and visibly. [6]

  TBU: The TBU provides continuous outside airflow at a rate of approximately 30 CFM to 50 CFM for alarm unit outside air sampling. [6]

- **Support Equipment:** Confidence Checker. [6]

- **Equipment Hardness:** Complies with MIL-STD-2036. [6]

- **Dimensions and Weight:** [27]

PARAMETERS	ALARM	POWER SUPPLY	RCU	RSU	TBU	IDU SHOCK MOUNT
Length	23.5 cm	20 cm	18 cm	18 cm	28 cm	23.4 cm
Width	19.7 cm	20 cm	34 cm	35.6 cm	20 cm	31.5 cm
Height	24.8 cm	26.7 cm	19.7 cm	19.7 cm	40 cm	64.8 cm
Weight	4.08 kg	8.16 kg	3.97 kg	2.61 kg	9.3 kg	6.35 kg

- **Technology:** Ionization detector. [27]
- **Status:** Used by U.S. Navy. Production complete. [6]
- **Uses:** Used as a shipboard chemical agent detector. [6]
- **Deployment:** Installed onboard U.S. Navy Surface Ships. [6]
- **Agents Detected:** [6]

  Nerve: GB, GD and VX.

- **Detection Sensitivity:** 0.3 mg/m^3 for all nerve agents detected. [6]
- **Response Time:** 2 minutes. [6]
- **False Responses/Interferents:** Some shipboard vapors at high concentrations. [6]
- **Safety Features/Safety Hazards:** Radiation source. [6]
- **Power Requirements:** 115 V AC 60 Hz. An internal battery provides emergency power for two hours to six hours, depending on temperature. [6]

  Operates on fully charged batteries for six hours at a temperature of +75°F and for four hours at a temperature of -10°F. [6]

- **Transport Requirements:** Nuclear radiation requirements apply. [6]
- **Personnel Requirements:** No increase in ship crew size to operate or maintain. [6]
- **Operational Information:** Outside air is drawn into the system through the TBUs. The IDU continually samples outside air for the presence of agents. A small current results if CW nerve agents are present. [6]

  Operational Temperature: Complies with MIL-E-16400G.

- **Stock Number(s):** 6665-01-A124-2556 (NSN). [6]

- **Miscellaneous:** *

- **Contact(s):**

Manufacturer: Nuclear Research Corporation
125 Titus Avenue
Warrington, PA 18976
U.S.A.
Tel: (215) 343-5900 [6]

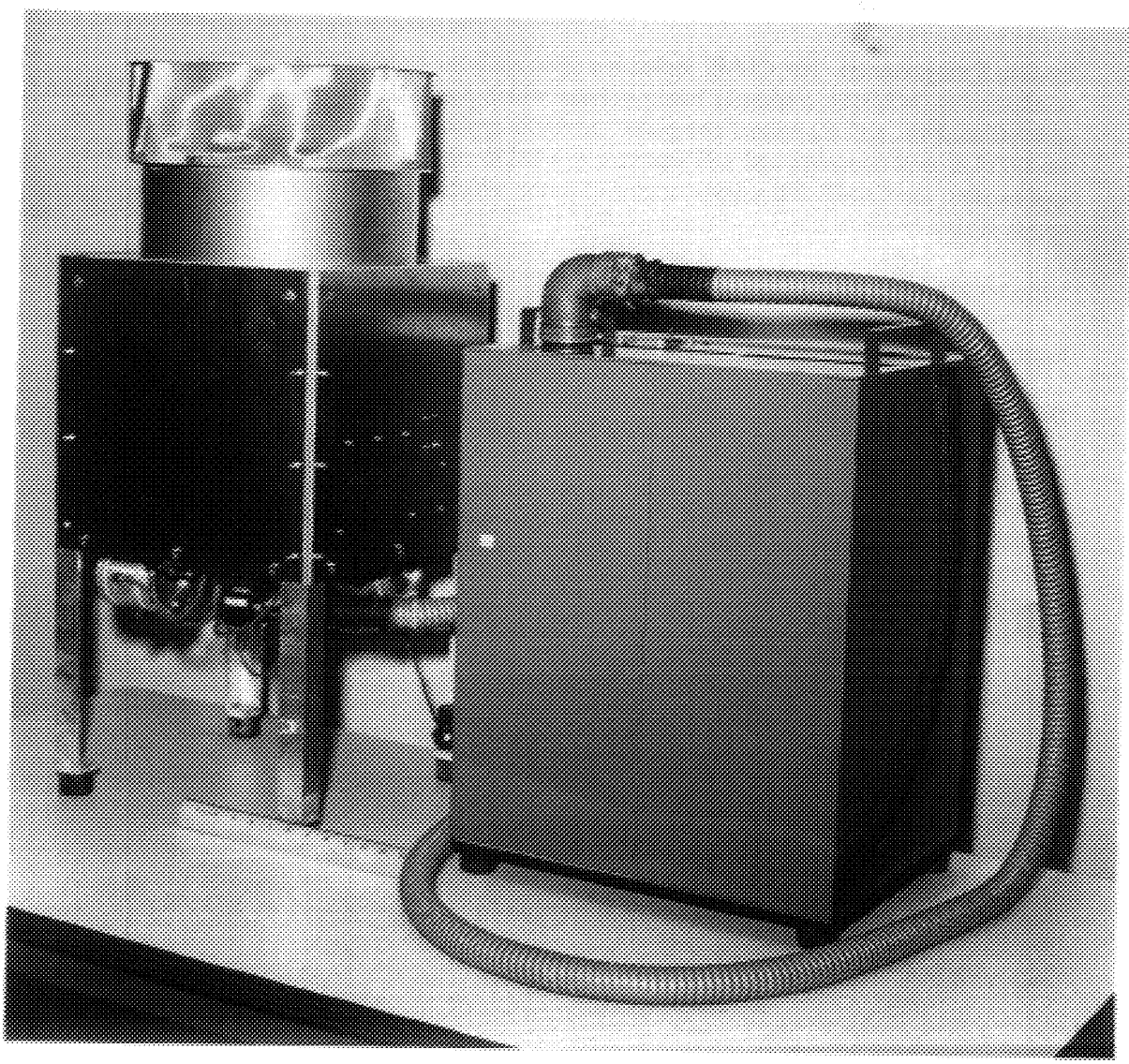


Photo courtesy of the U.S. Army ERDEC

A Prototype of the CBMS

- **Designator(s):** CBMS

- **Item Name(s):** Chemical Biological Mass Spectrometer (CBMS)

- **Item Description:** The CBMS is a candidate component for applications in the Biological Integrated Detection System (BIDS) and the Nuclear, Biological and Chemical Reconnaissance System (NBCRS). In the NBCRS, the CBMS is expected to replace the current MM1. The CBMS is being designed to automatically detect and presumptively identify chemical and biological threat materials. [7]

- **System Components:** The CBMS includes a mass analyzer capable of tandem mass spectrometry (MS/MS), a transfer line/pyrolyzer which pyrolysis aerosol materials prior to mass spectral analysis, and a personal computer. In BIDS applications, the CBMS will be linked to the BIDS central computer and will interface to a BIDS aerosol sampling device. In NBCRS applications, the CBMS will support a ground probe which will be used to detect chemical agents during reconnaissance applications. [7]

- **Support Equipment:** *

- **Equipment Hardness:** *

- **Dimensions and Weight:** (Prototype) [14]

Length:	44 cm
Width:	34 cm
Height:	52 cm
Weight:	40 kg

- **Technology:** Mass spectrometry. [7]

- **Status:** Transitioned to Demonstration and Validation state of development in FY94. [7]

- **Uses:** Potential applications in the BIDS and NBCRS. [7]

- **Deployment:** Fielding will be concurrent with future fieldings of BIDS (beginning in FY98) and the NBCRS (in FY02). [7]

- **Agents Detected:** Detection capability expected to be similar to that of the EM640. [7]

- **Detection Sensitivity:** *

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** External power sources (vehicle/generator). [7]
- **Transport Requirements:** The CBMS is to be transported within either the NBCRS or BIDS. [7]
- **Personnel Requirements:** Operable by trained, chemical specialty soldiers. [7]
- **Operational Information:** Potential applications within the BIDS and NBCRS. [7]
- **Stock Number(s):** Not yet assigned. [7]
- **Miscellaneous:** *
- **Contact(s):**

Developer:
U.S. Army CBDCOM
Program Director for Biological Defense Systems
Aberdeen Proving Ground, MD 21010-5423
U.S.A. [7]

Manufacturer:
Bruker Instruments, Inc.
Manning Park, 19 Fortune Drive
Billerica, MA 01821-3991
U.S.A.
Tel: (508) 667-9580
Fax: (508) 667-3954 [7]

Photo courtesy of Environmental Technologies Group, Inc.

The ICAD Miniature Chemical Agent Detector

- **Designator(s):** ICAD

- **Item Name(s):** ICAD (Miniature Chemical Agent Detector)

- **Item Description:** The ICAD is a miniature, lightweight, plastic chemical warfare agent detector. The unit consists of a sensor module and an electronics module. The system is designed to operate continuously for up to four months. A confidence tester allows for repeated verification of proper performance. The unit has both audible and visible alarms. The audible alarm has a pulsed continuous tone, with a fixed time duration. The visible alarm is a continuous flashing Light Emitting Diode (LED) indicator for blister, blood, choking and/or nerve agents. [2,7]

- **System Components:** [7]

  Electronics Module
  Sensor Module

- **Support Equipment:** The sensor module can be replaced by the operator, after four months of continuous service. [7]

- **Equipment Hardness:** ICAD can be decontaminated with bleach and water or the U.S. M258 decontamination kit. [2]

- **Dimensions and Weight:**

Length:	2.8 cm [7]
Width:	6.6 cm [7]
Height:	11 cm [7]
Weight:	215 g [2]

- **Technology:** The ICAD sensor module contains two miniature electrochemical sensors and a lithium battery. One sensor detects nerve, blood, and choking agents while the other detects blister agents. Chemical agent vapors diffuse through membranes on the sensors where they undergo electrochemical reactions. The electronics module continuously monitors the output from the sensor modules. When the threshold concentration of agent is reached, the unit sounds an audible alarm and an LED illuminates. [7]

- **Status:** The U.S. Marines have purchased a large number of ICAD units for fielding and use. The system has been evaluated by ERDEC, but there are currently no plans to acquire, or conduct further testing or development, on the ICAD by the U.S. Army. Several foreign countries have expressed an interest in the ICAD. [7]

- **Uses:** Can be used as a point sensor for small unit or individual applications. The manufacturer has developed a receiver/transmitter and associated interfaces to use ICAD in a network (remote) configuration. It can also be used on board combat vehicles, as a monitor for collective protection shelters, and dropped off in a remote detection role. It could be interfaced to the MICAD system, although no hardware has been developed. [7]

- **Deployment:** Used by NATO forces. [2]

- **Agents Detected:** Manufacturers stated sensitivities are as follows: [2]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD	$\geq$ 10.0 mg/m^3	< 120 seconds
	HD and L	$\geq$ 50.0 mg/m^3	< 30 seconds
Blood	AC	$\geq$ 50.0 mg/m^3	< 120 seconds
Choking	CG	$\geq$ 25.0 mg/m^3	< 15 seconds
Nerve	GA, GB and GD	0.2 mg/m^3 to 0.5 mg/m^3	< 120 seconds
	GB	$\geq$ 5.0 mg/m^3	< 30 seconds
	GA and GD	$\geq$ 5.0 mg/m^3	< 60 seconds

Testing to determine actual detection sensitivities has been conducted by ERDEC. These results are available to qualified personnel. [7]

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** None. [2]

- **Power Requirements:** A lithium battery internal to the electronics module. [7]

- **Transport Requirements:** None. [7]

- **Personnel Requirements:** Operated as an additional duty by any soldier. [7]

- **Operational Information:** [2]

  Operational Life: Four months continuous service
  Operational Temperature: -18°C to +45°C
  Relative Humidity: 5% to 95%

- **Stock Number(s):** 6665-01-340-1693 (NSN). [2]

- **Miscellaneous:** [2]

Clear Down/Reset Time:	Greater than five minutes at minimum alarm levels
Maintainability:	Sensor module is replaceable in field by operator
Shelf Life:	Five years
Storage Temperature:	-40°C to +65°C

- **Contact(s):**

Developer/ Manufacturer:	Environmental Technologies Group, Inc. Chemical/Biological Warfare Marketing Manager 1400 Taylor Ave. Baltimore, MD 21284-9840 U.S.A. Tel: (301) 321-5114/5200 Fax: (301) 321-5255 [2]

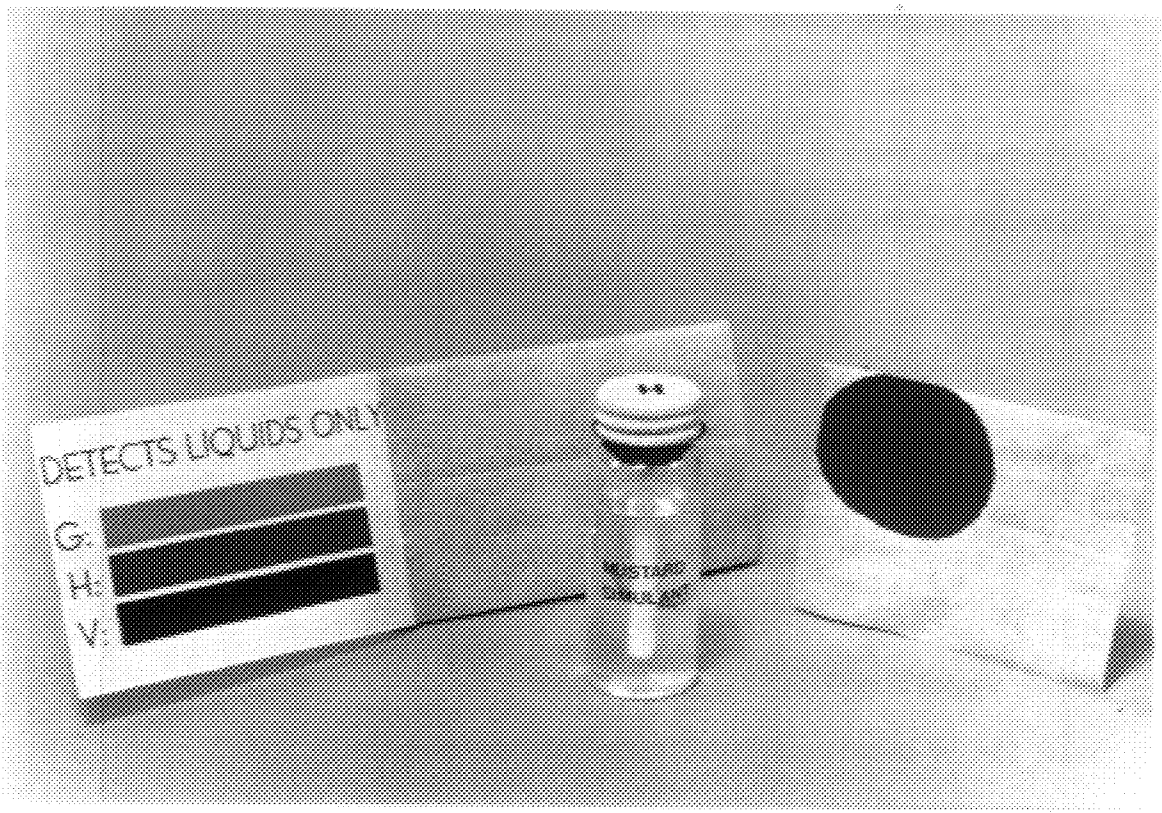


Photo courtesy of the U.S. Army ERDEC

M72A2 Liquid Agent Simulant and M8 Chemical Agent Detector Paper

- **Designator(s):** M8 Paper

- **Item Name(s):** M8 Chemical Agent Detector Paper
  ABC-M8 VGH Chemical Agent Detector Paper
  M8 Paper

- **Item Description:** M8 Paper detects and identifies liquid chemical agents. M8 Paper is tan in color and comes in a booklet containing twenty-five 2.5 inches *x* 4 inches perforated sheets. The booklet is heat sealed in a polyethylene envelope. [7]

- **System Components:** One booklet in a polyethylene bag. [7]

- **Support Equipment:** None. [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [7]

Length:	10 cm
Width:	6.5 cm
Height:	*
Weight:	0.02 kg

- **Technology:** There are three sensitive indicator dyes suspended in the paper matrix. The paper is blotted on a suspected liquid agent and observed for a color change (liquid agent adsorption). There is a color chart inside the front cover of the booklet for comparison. The chemical reaction between the M8 paper and chemical agent creates a pH dependent color change on the M8 paper. V-type nerve agents turn the M8 paper dark green, G-type nerve agents turn it yellow, and blister agents (H) turn it red. [7]

- **Status:** Fielded item. [7]

- **Uses:** Used by ground forces to detect liquid chemical agents. [7]

- **Deployment:** Used by most NATO countries. [7]

- **Agents Detected:** [7]

Blister:	H and L
Nerve:	G and V agents

- **Detection Sensitivity:** Responds to droplets of 0.02 ml or larger. [7]

- **Response Time:** Color change occurs within 30 seconds. [8]

- **False Responses/Interferents:** M8 Paper responds to some common battlefield interferents. Among them are, certain cleaning solvents (ammonia), DS2, "Break Free" (a weapons cleaner and lubricant), high temperatures, and some petroleum products. [7]

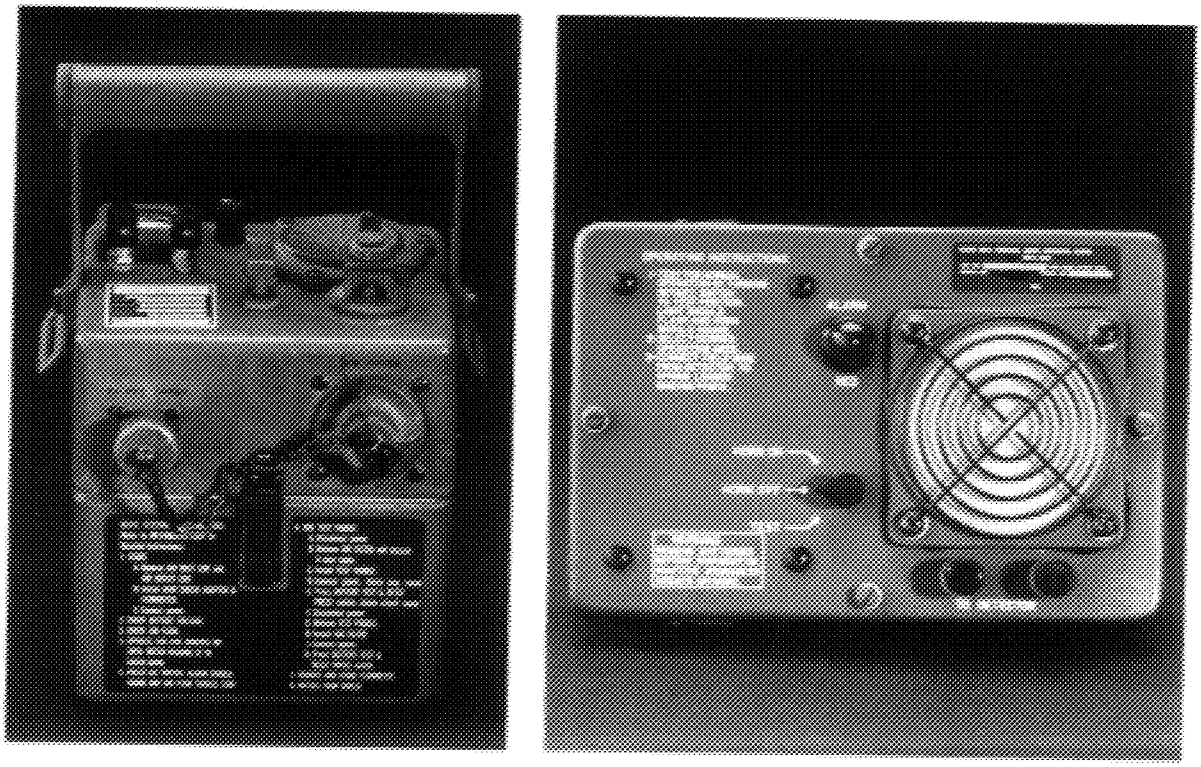
- **Safety Features/Safety Hazards:** *
- **Power Requirements:** None; manually operated. [7]
- **Transport Requirements:** No special requirements. [7]
- **Personnel Requirements:** All soldiers are required to know how to use M8 Paper. [7]
- **Operational Information:** M8 Paper is widely distributed on the battlefield. Each soldier has a booklet in his protective mask carrier. It is also found in the carrying case for the M256A1 Kit and in the M18A2 Chemical Agent Detection Kit. M8 Paper is used any time the soldier suspects liquid contamination is present. The paper must touch the liquid agent. It does not detect vapors. It is best suited for use on non-porous materials. Since M8 paper will also change color from many interferents, it is unreliable to check for completeness of decontamination. M8 paper is never used as a sole basis for agent identification. It must always be verified with a more reliable means (i.e., M256A1 Kit) of identification. Also, soldiers have some difficulty identifying the color change at night and differentiating it from wet paper. [7]
- **Stock Number(s):** 6665-00-050-8529 (NSN). [7]
- **Miscellaneous:** *
- **Contact(s):**

Developer:
Director
U.S. Army Edgewood Research, Development and Engineering Ctr.
Edgewood Area, APG, MD 21010-5423
U.S.A. [7]

Manufacturer:
Anachemia Canada Inc.
500 Second Avenue
P.O. Box 147
Lacine (Montreal), Québec H8S 4A7
Canada
Tel: (514) 489-5711
Fax: (514) 363-5281
Telex: 055-66129

U.S. Office:
Anachemia Inc.
11 Butternut Street
Champlain, NY 12919
U.S.A.
Tel: (518) 298-4444

Marketer:
Tradeways Limited
307-F Maple Avenue West
Vienna, VA 22180
U.S.A.
Tel: (703) 281-5482 [7]



Photos courtesy of U.S. Army ERDEC

The M8A1 Automatic Chemical Agent Alarm System consists of the M43A1 Detector (left) and M42 Alarm (right)

- **Designator(s):** M8A1

- **Item Name(s):** M8A1 Automatic Chemical Agent Alarm System

- **Item Description:** The M8A1 is an automatic chemical agent detection and warning system designed to detect the presence of nerve agent vapors or inhalable aerosols. The M8A1 will automatically signal the presence of the nerve agent in the air by providing troops with both a audible and visible warning. The M8A1 was fielded to replace the wet chemical M8 detector with a dry system which eliminated the M229 refill kit, the logistic burden and associated cost. The M8A1 operates in a fixed, portable, or vehicle mounted configuration. [7]

- **System Components:** Up to five M42 Alarms may be used per M43A1 Detector and placed at locations remote from the detector. [7]

  Battery (BA3517/U)
  M42 Alarm
  M43A1 Detector
  Power Supplies (M10 and M10A1)

- **Support Equipment:** WD-1 or TT DR-8 Cable is required to connect the M43A1 Detector to the M42 Alarm. A winterization kit (M253) is available for operation in cold climates (below -6.67°C). Various expendable supplies are required for routine operation and maintenance. Mounting hardware includes the M228 high profile and M182 low profile Mounting Kits. [7]

  The M273 Maintenance Kit is available which provides 10 spare inlet dust filters and 10 test paddles. The test paddles contain agent simulant to provide confidence that the system is operating properly. [1]

  A M10A1 Power Supply is available to power the M43A1 from AC mains power, either 110 V or 220 V. The M10A1 clamps to the bottom of the M43A1 and on the top of the BA3517/U battery. The battery provides automatic backup power in the event of a power failure. The battery can be connected directly to the M43A1 for operation. [1]

- **Equipment Hardness:** Passed all nuclear hardness tests required in the U.S. NBC Survivability criteria for chemical detection equipment (specific results are classified). [1]

- **Dimensions and Weight:** [7,13]

PRMTRS	M43A1 DETECTOR	M42 ALARM	BATTERY (BA3517/U)	POWER SUPPLIES		MOUNTING KITS	
				M10	M10A1	M228	M182
Length	16.5 cm	22.1 cm	16 cm	30.5 cm	19 cm	22.9 cm	22.9 cm
Width	14 cm	14.7 cm	19.6 cm	15.2 cm	16.5 cm	25.4 cm	25.4 cm
Height	27.5 cm	6 cm	13 cm	17.8 cm	8.1 cm	35.6 cm	22.9 cm
Weight	3.4 kg	1.9 kg	3.9 kg	8.2 kg	2.9 kg	7.3 kg	6.8 kg

- **Technology:** The M43A1 is an ionization product diffusion/ion mobility type detector. Air is continuously drawn through the internal sensor by a pump at the rate of approximately 1.2 l/min ($\pm$ 0.2 l/min.). As the air and agent molecules are drawn past a radioactive source (Am^{241}), a small percentage are ionized by alpha-rays. As the air and agent ions are drawn through the baffle sections of the cell, the lighter and less stable air ions diffuse to the walls and are neutralized more quickly than the heavier and more stable agent ions. As a result, the collector senses a greater current when nerve agents are present compared to the current when only clean air is sampled. An electronic module monitors the current produced by the sensor and triggers the alarm when a critical threshold of current (which corresponds to the critical concentration of agent) is reached. [7]

- **Status:** Fielded in 1985 and is in use in all U.S. Army units. In use or being fielded by U.S. Air Force units. [7]

- **Uses:** Used by ground troops and fixed sites as an automatic point nerve agent detector and alarm. [7]

- **Deployment:** Over 35,000 systems have been manufactured and delivered to over 20 nations worldwide. In use in Japan, Germany, Abu Dabi, Israel, Austria, Spain, UK, Netherlands, Egypt, Italy, Denmark and Greece. [1,13]

- **Agents Detected:** [7]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY [8] (in vapor form)
Nerve	GA, GB and GD	0.1 mg/m^3 to 0.20 mg/m^3
	VX	0.4 mg/m^3

- **Detection Sensitivity:** See ***Agents Detected*** for further information.

- **Response Time:** Less than two minutes. [8]

- **False Responses/Interferents:** The M43A1 will false alarm to heavy concentrations of rocket propellant smoke, screening smoke, signaling smoke, engine exhausts, and whenever a nuclear blast occurs. [7]

- **Safety Features/Safety Hazards:** The cell module of the M43A1 contains a radioactive source, 250 μCi of Am^{241}, which is controlled by the U.S. Nuclear Regulatory Commission (NRC) under Title 10 Code of Federal Regulations. NRC and local applicable (i.e., Army) regulations must be followed for storage, shipment, and disposal. Those organizations authorized to possess and use the M43A1 must obtain an NRC license which requires the radioactive cell to be tracked throughout its life cycle in accordance with applicable regulations. Never attempt to open the M43A1 cell or pump module. A damaged M43A1 should be immediately packaged in a plastic bag, marked, and shipped to direct support maintenance or the manufacturer as per local policies. [7]

- **Power Requirements:** [7]

M43A1 Detector:	18 V DC to 36 V DC, supplied from BA3517/U Battery, BB501/U battery (winterization kit), M10 power supply, or vehicle power
M10 and M10A1 Power Supply:	115/220 V AC, 50 Hz to 400 Hz
M42 Alarm Unit:	Battery, dry, 1.5 V, BA3030/U (four batteries)

- **Transport Requirements:** Cannot be operated on the move. [7]

- **Personnel Requirements:** Operated by any soldier, with training, as an additional duty. [7]

- **Operational Information:** The M8A1 Alarm System is used primarily to alert stationary units when a cloud of nerve agent vapor has arrived or is about to arrive at their position. When employed in a stationary role, unit personnel will position the systems as soon as they arrive at a new location. The detector units are placed upwind and connected to the alarm units with standard communication wire. The detector units are positioned based on a doctrinal guide. Once the alarm sounds, the operator must disconnect the power, decontaminate the unit, and go through start up procedures again to put the alarm back in operation. [7]

- **Stock Number(s):** [1,7]

BA-3517/U Battery (Disposable):	6135-00-450-3528 (NSN)
Cable, WD-1:	6145-00-226-8812 (NSN)
M8A1 Alarm System:	6665-01-105-5623 (NSN)
M10 Power Supply:	6665-00-859-2225 (NSN)
M10A1 Power Supply:	6665-01-093-2793 (NSN)
M42 Alarm Unit:	6665-00-859-2215 (NSN)
M43A1 Detector:	6665-01-081-8140 (NSN)
M140 Chemical Agent Automatic Alarm Test Set:	6665-01-083-2749 (NSN)
M182 Mount:	6665-00-110-9492 (NSN)
M228 Mount:	6665-00-859-2212 (NSN)

- **Stock Number(s) (continued):** [1,7]

M273 Maintenance Kit:	5180-01-108-17A12 (NSN)
M293 Maintenance Kit (20 filter paddles):	5180-01-379-6409 (NSN)
Winterization Kit:	6665-00-169-1455 (NSN)

- **Miscellaneous:** *

- **Contact(s):**

Developer:	Director U.S. Army Edgewood Research, Development and Engineering Ctr. Edgewood Area, APG, MD 21010-5423 U.S.A. [7]
First Production Manufacturer:	Intellitec (formerly Brunswick Corporation) 2000 Brunswick Lane DeLand, FL 32724 U.S.A. Tel: (904) 736-1700 Fax: (904) 736-2250 [7]

Photo courtesy of the U.S. Army ERDEC

Field Use of M9 Paper

- **Designator(s):** M9 Paper

- **Item Name(s):** M9 Chemical Agent Detector Paper
  M9 Paper

- **Item Description:** M9 Paper is a portable, expendable single roll of paper which comes with mylar-adhesive backed and coated tape. It is 9.1 m long and 5.1 cm wide. It is packed in a cardboard dispenser with a serrated edge. The paper contains a suspension of an agent sensitive dye in a paper matrix. The paper is colored a pale green with insoluble pigments. [7]

- **System Components:** [7]

  M9 Paper
  M9 Paper Dispenser
  Reusable Plastic Bag

- **Support Equipment:** None. [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [7]

PARAMETERS	DISPENSER BOX (in shipping bag)	DETECTOR PAPER
Length	6.4 cm	9.1 m
Width	8.9 cm	5.1 cm
Height	8.3 cm	*
Weight	0.1984 kg	*

- **Technology:** Contains a suspension of an agent sensitive red indicator dye in a paper matrix. It will turn pink, red, reddish-brown, or red-purple when exposed to liquid agent and can detect but does not identify the specific agent. [19,22,24]

- **Status:** Fielded in 1983; over 9.2 million rolls have been produced to date. [7]

- **Uses:** Used by ground forces and is placed on personnel and equipment to identify the presence of liquid chemical agent aerosols. [7]

- **Deployment:** Many NATO countries use M9 Paper or an equivalent. [7]

- **Agents Detected:** [7]

  Blister: H and L
  Nerve: G and V agents

- **Detection Sensitivity:** Responds to 100 μ or larger droplets. [7]

- **Response Time:** 20 seconds or less. [7]

- **False Responses/Interferents:** M9 Paper responds to some common battlefield interferents. Among them are petroleum products, brake fluid, aircraft cleaning compound, DS2, insect repellent, sand color camouflage stick, FS Smoke, defoliant, ethylene glycol (antifreeze), and scuffs of dirt or mud. [7]

  The M9 Paper will not respond to chemical agents when wet and will give false positive indications when abraded against a rough surface. Heat may cause M9 Paper to turn red and cause false positive readings. [8]

- **Safety Features/Safety Hazards:** Protective gloves must be worn. [7]

- **Power Requirements:** None. [7]

- **Transport Requirements:** None. [7]

- **Personnel Requirements:** All soldiers are required to know how to use M9 Paper. [7]

- **Operational Information:** M9 Paper is the most widely used method of detecting liquid chemical agents. It is more sensitive and reacts more rapidly than M8 Paper. The self adhesive paper attaches to most surfaces. The soldier pulls out the appropriate length of paper and the backing is separated as the paper is drawn. The paper is wrapped around the lower left sleeve, upper right sleeve, and on one lower leg of the overgarment. It is also normally attached to larger equipment that the soldier will be "handling" (crew served weapons, vehicle controls, etc.). A moisture proof resealable bag is provided to store the dispenser after removal from its original package. As soon as M9 Paper indicates the presence of chemical agents, soldiers must take protective action. Problems exist during night operations and because of interferents. When under "red light" conditions, it is not possible to identify a color change. (This refers to soldiers normally using red lenses on their flashlights and other lights at night in order to decrease observability of their activities.) Commanders must periodically rotate soldiers into a white light area to check M9 Paper for a color change. [7]

- **Stock Number(s):** 6665-01-049-8982 (NSN). [7]

- **Miscellaneous:** *

- **Contact(s):**

Developer:

Director
U.S. Army Edgewood Research, Development and Engineering Ctr.
Edgewood Area, APG, MD 21010-5423
U.S.A. [7]

- **Contact(s) (continued):**

Manufacturer:	Poly Research Corporation 125 Corporate Drive Holtsville, NY 11742 Tel: (516) 758-0460 Fax: (516) 758-0471
Marketer:	Tradeways Limited 307-F Maple Avenue West Vienna, VA 22180 U.S.A. Tel: (703) 281-5482 [7]

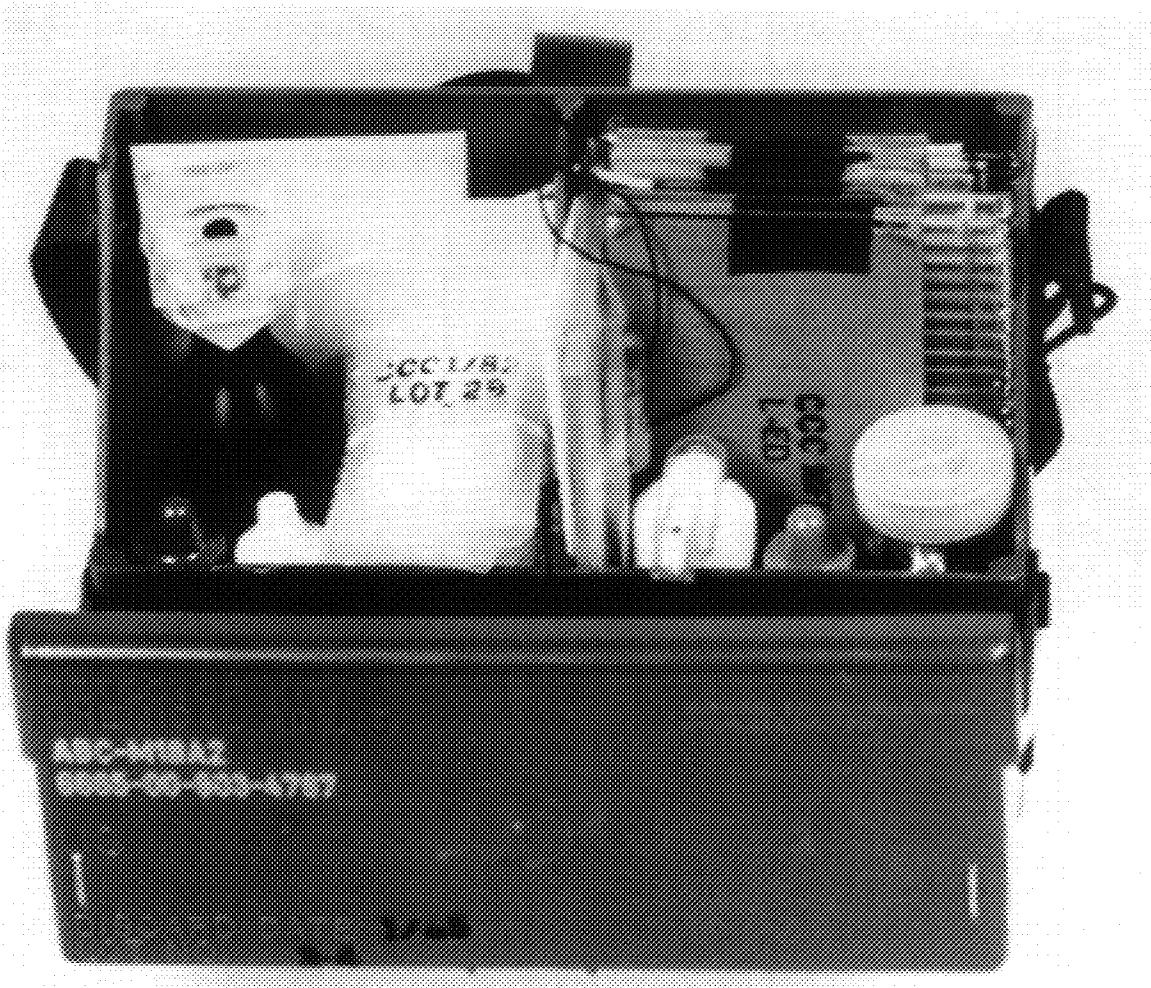


Photo courtesy of the U.S. Army EBDEC

The M18A2 Kit

Designator(s): M18A2

- **Item Name(s):** M18A2 Chemical Agent Detector Kit
  M18A2 Kit

- **Item Description:** The M18A2 Kit is a portable, expendable item capable of surface and vapor analyses. The M18A2 kit is designed primarily for detecting dangerous concentrations of vapors, aerosols, and liquid droplets of chemical agents. The kit's capability provides for the sampling of unknown NBC agents. The presence of a chemical agent is detected by distinctive color changes. If a chemical agent is suspected but cannot be detected with the kit, vapor samples can be collected in sampling tubes for forwarding to a laboratory for identification. [7]

- **System Components:** [7]

  Carrier
  Instruction Cards
  Detector Tubes (5 clips of 25 each) (blue-band, red-band, green-band and yellow-band)
  Sampling Tubes (white-band)
  M8 Chemical Agent Detector Paper
  Detector Tickets
  Plastic Squeeze Bottles (color coded) with matching color caps
  Aspirator Bulb Assembly
  Glass Vial (green marked containing 14 tablets)
  Packets (straws containing powder reagent)
  Plastic Container (for glass vials and packets)
  Dispenser (red marked)
  Report Cards (in envelopes)

- **Support Equipment:** The M30A1 Refill Kit contains one filled buffer solution (white marked bottle), one substrate solution (red-marked dispenser), one belt of 40 tickets, one book of M8 Paper and an instruction card. [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** (carrier with contents) [7]

Length:	20.3 cm
Width:	7.62 cm
Height:	15.24 cm
Weight:	1.13 kg

- **Technology:** The M18A2 Kit uses a number of different chemical reactions, primarily enzymatic-substrate based wet chemistry for nerve agents, and silica gel adsorbent color changes for other agents. [7]

- **Status:** The M18A2 Kit has been replaced in most units by the M256 Kit. Very few, if any, M18A2's remain in use by field "tactical" units. It is in use in technical escort, explosive ordnance disposal (EOD), depot storage and other specialized units and locations. [7]

- **Uses:** The principal uses for the kit are: reconnaissance in areas of suspected chemical agent contamination, finding the boundaries of contaminated areas, determining the absence of a chemical agent so that unmasking following a chemical attack can be initiated, testing for the presence of a chemical agent after decontamination, and collecting samples of suspected but unidentified chemical agents. [7]

- **Deployment:** Developed for U.S., U.K. and Canadian (i.e., A-American, B-British, C-Canadian) Armed Forces.

- **Agents Detected:** [8]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD	0.5 mg/m^3	3 minutes
	L	10.0 mg/m^3	1 minute
Blood	AC	8.0 mg/m^3	1 minute
Choking	CG	12.0 mg/m^3	1 minute
Nerve	GB and V	0.1 mg/m^3 (ticket)	4 minutes
	GB	1.0 mg/m^3 (tube)	2 minutes

- **Detection Sensitivity:** See ***Agents Detected*** for information.

- **Response Time:** See ***Agents Detected*** for information.

- **False Responses/Interferents:** Responds to some battlefield interferents materials including smoke and decontaminants. [7]

- **Safety Features/Safety Hazards:** The M18A2 Kit is used when the presence of agents is suspected. Operators must wear mask, hood, gloves, and protective overgarments when using the kit. The solutions and reagents in the kit are not extremely toxic, but care must be exercised in handling and use. Expended tubes and tickets are considered hazardous and must be disposed of accordingly. [7]

- **Power Requirements:** None. [7]

- **Transport Requirements:** Portable. [8]

- **Personnel Requirements:** Intended for use by chemical specialty personnel at the unit level. Training and the appropriate background are required for operation. [7]

- **Operational Information:** A sequence of tests are performed in accordance with the instruction card or the technical manual. The general sequence is a detector ticket test for G and V agents, detector tube tests for CK, G, H, CX, L, CG, AC, liquid agent tests, and finally sample tubes for unknown agents. A distinctive color change at any phase of the testing is indicative of a specific agent. [7]

- **Stock Number(s):** [7]

M18A2 Kit:	6665-00-903-4767 (NSN)
M30A1 Refill Kit:	6665-00-909-3647 (NSN)
Aspirator Bulb:	6640-00-630-7695 (NSN)

- **Miscellaneous:** Each M18A2 is packaged in a fiberboard box. Ten kits are packaged for shipment in a wood box. The filled carton weighs approximately 40 lbs and occupies 1.7 ft^3. [8]

- **Contact(s):**

Developer:	Director U.S. Army Edgewood Research, Development and Engineering Ctr. Edgewood Area, APG, MD 21010-5423 U.S.A. [7]
Manufacturer:	Truetech, Inc. 680 Elton Street Riverhead, NY 11901 Tel: (516) 727-8600 Fax: (516) 727-7592 [17]

Photo courtesy of Brunswick Corporation, Jane Snelling

Field Use of the M21

- **Designator(s):** M21
  XM21 Alarm

- **Item Name(s):** M21 Remote Sensing Chemical Agent Alarm (RSCAAL)
  M21 Chemical Agent Automatic Alarm

- **Item Description:** The M21 Alarm is an automatic, scanning passive infrared (IR) sensor which detects nerve and blister agent vapor clouds based on changes in the background's infrared spectra caused by the presence of the agent vapor. The M21 scans a horizontal 60° arc and can recognize agent clouds at line-of-sight ranges of up to five kilometers. In fixed site and most surveillance roles, it will be tripod-mounted and powered by a standard military power source. In the reconnaissance role, the system will be powered and operated from the Nuclear, Biological and Chemical Reconnaissance System during vehicle halts. The M21 is capable of integrating with detector networking systems and may be programmed for detecting new agents. [7]

- **System Components:** [7]

  Detector
  Transit Case
  Tripod Bag Assembly

- **Support Equipment:** *

- **Equipment Hardness:** NBC Contamination/Decontamination Survivable. [7]

- **Dimensions and Weight:** (M21 Detector Unit) [7]

Length:	19 in
Width:	20.5 in
Height:	12.5 in
Weight:	54 lbs

- **Technology:** Passive, Fourier Transform Infrared (FTIR) (standoff) Spectrometer; an onboard microcomputer makes agent/no agent decisions based on ambient radiance levels. Using the sighting device on top of the detector the M21 is normally placed looking into the wind to view a scene that consists of the background and the air path along its line of sight to the background. The M21 measures and stores a background spectrum that consists of the ambient energy contained in the scene. The M21 remains in alarm until each of the seven independent Fields of View (FOV) is clear of agent. Each of the seven FOVs is independent. [7]

- **Status:** The M21 Alarm was type classified for low rate production (TC-LRP) in March 1992. The production contract for a low rate quantity of 18 was awarded to Intellitec (formerly Brunswick Corporation) in July 1992. The first article and production qualification test effort is ongoing and is scheduled for completion in November 1994. The M21 was type classified in March, 1995 and the option for the Army's buyout quantity (156) was awarded in May, 1995. The Marine Corps procured 100 systems to support Operation Desert Shield/Desert Storm and since then have procured an additional 25 units. [7]

- **Uses:** The M21 is used by NBC reconnaissance team personnel for surveillance and reconnaissance. The M21 may be operated from its tripod for fixed site surveillance missions or may be mounted on the NBC Reconnaissance System (XM93E1) for reconnaissance or vehicle mounted surveillance missions. The M21 will be used during short halts or silent watch missions when mounted on the XM93E1. [7]

- **Deployment:** Used by the U.S. Army and U.S. Marines; no other nations are currently using the M21 Alarm. [7]

- **Agents Detected:** [7]

Blister:	HD and L
Nerve:	GA, GB and GD

- **Detection Sensitivity:** The M21 is capable of stand-off detection of nerve and blister agent vapor hazards at line of sight distances up to five kilometers. The M21 makes a detection based on the product of concentration and pathlength (CL). [7]

  For nerve agents the requirement for detection is 90 CL. This means that the M21 must detect a cloud whose C is 90 mg/m^3 at a pathlength of one meter, or a cloud whose C is 9 mg/m^3 at a pathlength of 10 meters, and so on. [7]

  The blister agent requirement is similar. The CL requirement for HD is 4,500 mg/m^2 and 500 mg/m^2 for L. [7]

  The M21, because of its IR technology, is influenced by the environment when detecting. Some temperature differentiation between the agent cloud and the background is required for detection. A large temperature difference enables the M21 to detect very small CL products - well below the required values. Temperature differentials always exist; however there are times of day (dusk, dawn and periods with lots of cloud cover) when the temperature difference is small. The amount of water vapor in the air also effects the M21's sensitivity level. [7]

- **Response Time:** One minute or less (in one field of view) providing the CL product exceeds its threshold. [7]

- **False Responses/Interferents:** "Trained" to recognize agent in the presence of most common battlefield interferents. However, large quantities of military Halon (a fire suppressant) and organophosphorus incesticides could cause a false positive. [A7]

- **Safety Features/Safety Hazards:** None. [7]

- **Power Requirements:** Requires a power source providing 21 V DC to 31 V DC. A NATO adapter is provided with the system to allow for powering from vehicles. [7]

- **Transport Requirements:** The M21 must be transported in its transit case or the XM93E1 mount assembly. When transporting the M21 in the SUSV (only in arctic environments) secured transportation must be used. [7]

- **Personnel Requirements:** The M21 Alarm requires no special skills to operate. The Army's operator is MOS 54B L5, trained by the USACMLS. The unit level maintainer is 31 Ʊ and the direct support maintainer is 35 F. [7]

- **Operational Information:** The M21 will be used as an automatic stand-off chemical agent detector for reconnaissance and surveillance missions. The M21 will be operated on the tripod using standard military power sources or operated from the NBCRS, powered by the vehicle, during vehicle halts. [7]

  Operational Temperature: -31.7°C to +48.9°C. [7]

- **Stock Number(s):** 6665-01-324-6637 (NSN). [7]

- **Miscellaneous:** *

- **Contact(s):**

Developer:	U.S. Army CBDCOM PM NBC Defense Systems Attn: AMCPM-NNA (M21 Alarm Office) Aberdeen Proving Ground, MD 21010-5423 U.S.A. Tel: (410) 671-4001 Fax: (410) 671-4029 [7]
Manufacturer:	Intellitec (formerly Brunswick Corporation) 2000 Brunswick Lane DeLand, FL 32724 U.S.A. Tel: (904) 736-1700 Fax: (904) 736-2250 [7]

The M256A1 Chemical Agent Detector Kit

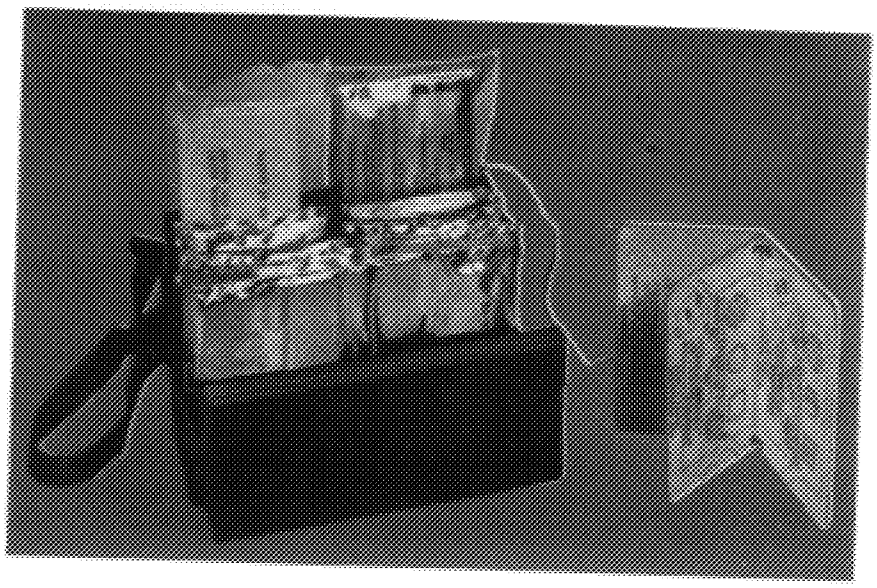
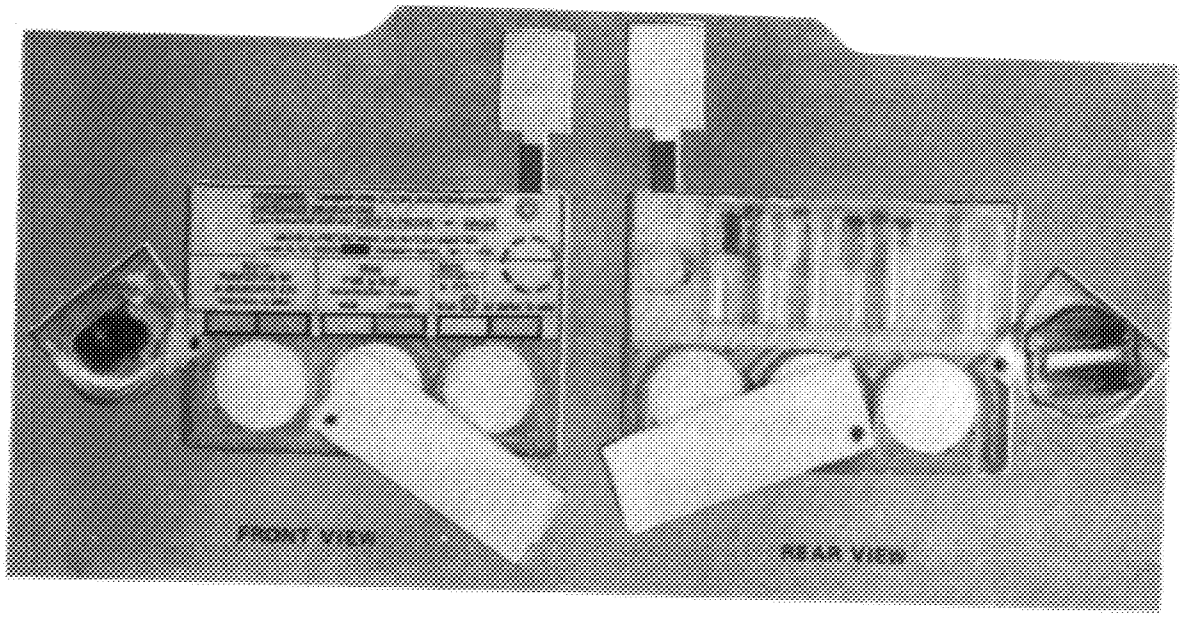


Photo courtesy of Environmental Technologies Group, Inc.



Sampler/Detector found inside the M256A1 Kit Carrying Case

- **Designator(s):** M256A1 Kit

- **Item Name(s):** M256A1 Chemical Agent Detector Kit

- **Item Description:** The M256A1 Kit is a portable, expendable item capable of detecting and identifying hazardous concentrations of chemical agent. The M256A1 Kit is used after a chemical attack to determine if it is safe to unmask. The M256A1 Kit has replaced the M256 Kit. The only difference between the two kits is that the M256A1 kit will detect lower levels of nerve agent. This improvement was accomplished by using an eel enzyme for the nerve test in the M256A1 Kit in place of the horse enzyme used in the M256 Kit. Most NATO countries also use the M256A1 Kit. [7]

- **System Components:** Each kit consists of 12 disposable plastic sampler-detectors, one booklet of M8 Paper, and a set of instruction cards attached by a lanyard to a plastic carrying case. The case is made from molded, high impact plastic and has a nylon carrying strap and a nylon belt attachment. Each sampler/detector contains a square impregnated spot for blister agents, a circular test spot for blood agents, a star test spot for nerve agents, and a lewisite detecting tablet and rubbing tab. The test spots are made of standard laboratory filter paper. There are eight glass ampoules, six containing reagents for testing and two in an attached chemical heater. [7]

- **Support Equipment:** M8 Paper can be ordered for resupply as needed. [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** (complete kit) [7]

Length:	17.8 cm
Width:	7.6 cm
Height:	12.7 cm
Weight:	0.5 kg

- **Technology:** Wet chemistry enzymatic substrate based reactions; presence of agents is indicated by a specific color change. [7]

- **Status:** In December 1985 the M256A1 Kit was adopted; this kit replaced the M256 Kit by attrition. [7]

- **Uses:** Used by ground forces to detect and classify toxic chemical agents present in vapor or liquid form. The M256A1 Kit is issued to each squad, section or independently operating element on the battlefield. Survey teams and medical facilities are issued additional kits. [7]

- **Deployment:** Most NATO countries use the M256A1 Kit. [7]

- **Agents Detected:** [7]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY
Blister	CX	3.0 mg/m^3
	HD	2.0 mg/m^3
	L	9.0 mg/m^3
Blood	AC	9.0 mg/m^3
	CK	8.0 mg/m^3
Nerve	GB	0.005 mg/m^3
	VX	0.02 mg/m^3

- **Detection Sensitivity:** Since the nerve agent mechanism of detection is a reaction with an enzyme, the G series would all be detectable on the same order of magnitude as GB. Also, any type of mustard detectable as long as a vapor is present. [7,8]

  See ***Agents Detected*** for further information.

- **Response Time:** The entire operating time for the kit is 15 minutes. The actual exposure time of the spots to the air is 10 minutes. [7]

- **False Responses/Interferents:** Some smokes, high temperatures, DS2, and petroleum products may cause false readings. It cannot be used to detect chemical agents in water. [7]

- **Safety Features/Safety Hazards:** Do not hold the sampler-detector in direct sunlight while exposing test spots. Before breaking glass ampoules (except heater ampoules) place one heater pad on each side of the sampler-detector, covering the ampoule to be broken. These pads will prevent pieces of glass from cutting your gloves or hands. Avoid vapors that may burn while crushing heater ampoules. Hold sampler-detector down and to one side while vapors are venting. Avoid sampling in smoke from burning debris, results may be inaccurate. Each sampler-detector contains 2.6 mg of mercuric cyanide which should be considered hazardous waste. Used or expired kits must be disposed of in accordance with local procedures. [7]

- **Power Requirements:** None; manually operated. [7]

- **Transport Requirements:** Portable. [7]

- **Personnel Requirements:** Operation of the M256A1 Kit is a common skill that all soldiers are required to perform. [7]

- **Operational Information:** The M256A1 Kit is used primarily to identify the type of agent present and to confirm the absence of a hazardous concentration of agent (i.e., tool to determine "all clears"). If a unit notices or suspects a chemical agent attack or an alarm has sounded, the M256A1 is used to check if there is a chemical agent present and to identify the agent. If the attack is determined to be a non-persistent agent, or if there are no agents detected or identified, the M256A1 Kit is used to determine when the area is "all clear" (negative reaction of the M256A1) and the unit can begin unmasking procedures. The M256A1 should always be used when a commander is considering unmasking or reducing the protective posture level. [7]

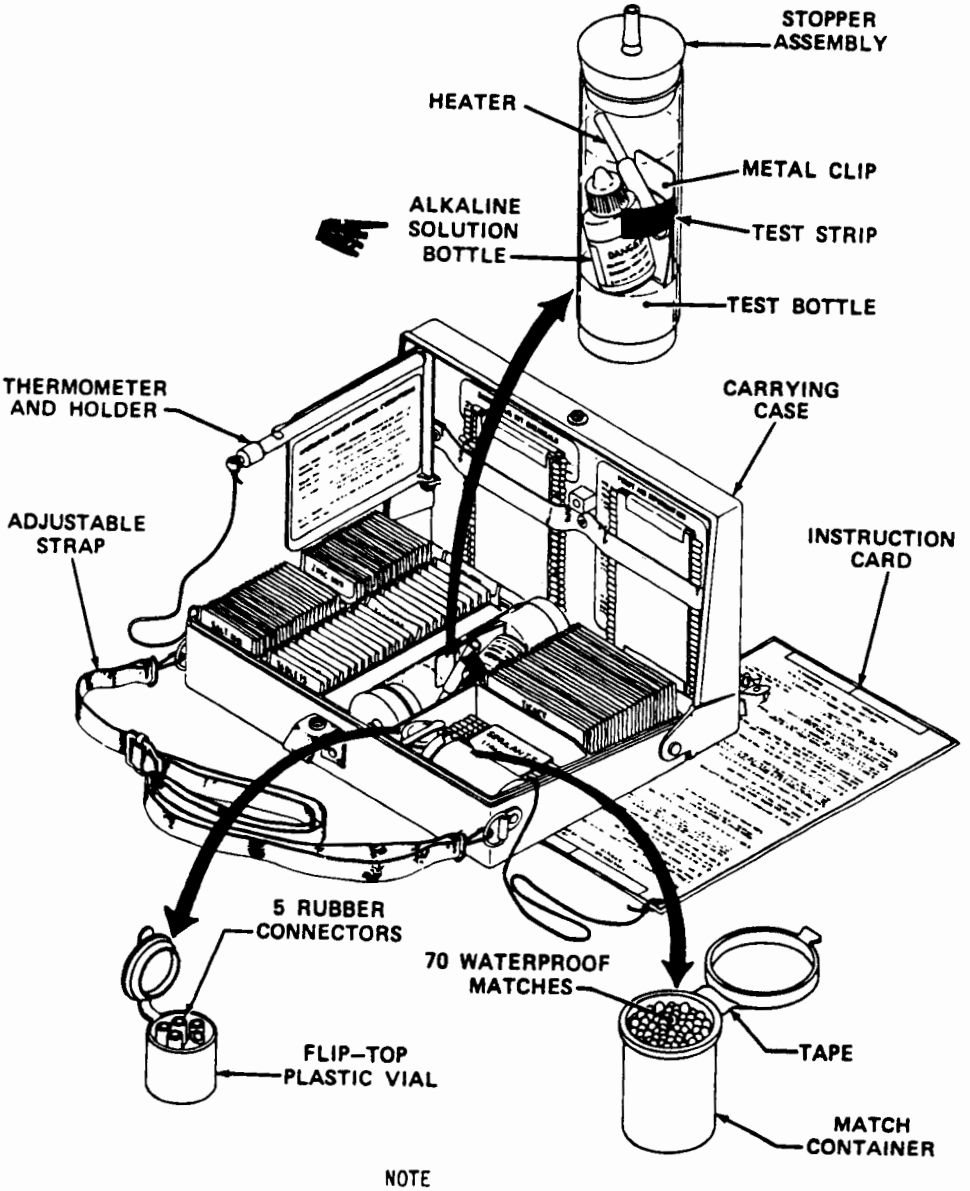
  The M256A1 is also a reconnaissance tool. Advanced parties use it to "check" an area before a unit moves in, as well as reconnaissance units to define the limits of contamination or identify "clean" areas or routes. [7]

- **Stock Number(s):** 6665-01-133-4964 (NSN). [7]

- **Miscellaneous:** *

- **Contact(s):**

Developer:	Director U.S. Army Edgewood Research, Development and Engineering Ctr. Edgewood Area, APG, MD 21010-5423 U.S.A. [7]
Manufacturer:	Anachemia Canada Inc. 500 Second Avenue P.O. Box 147 Lacine (Montreal), Québec H8S 4A7 Canada Tel: (514) 489-5711 Fax: (514) 363-5281 Telex: 055-66129
U.S. Office:	Anachemia Inc. 11 Butternut Street Champlain, NY 12919 Tel: (518) 298-4444



NOTE

New kits have a test strip instead of a thermometer. This TM shows both, in case you have an old kit.

Illustration courtesy of the U.S. Army ERDEC

The M272 Water Testing Kit and its Components

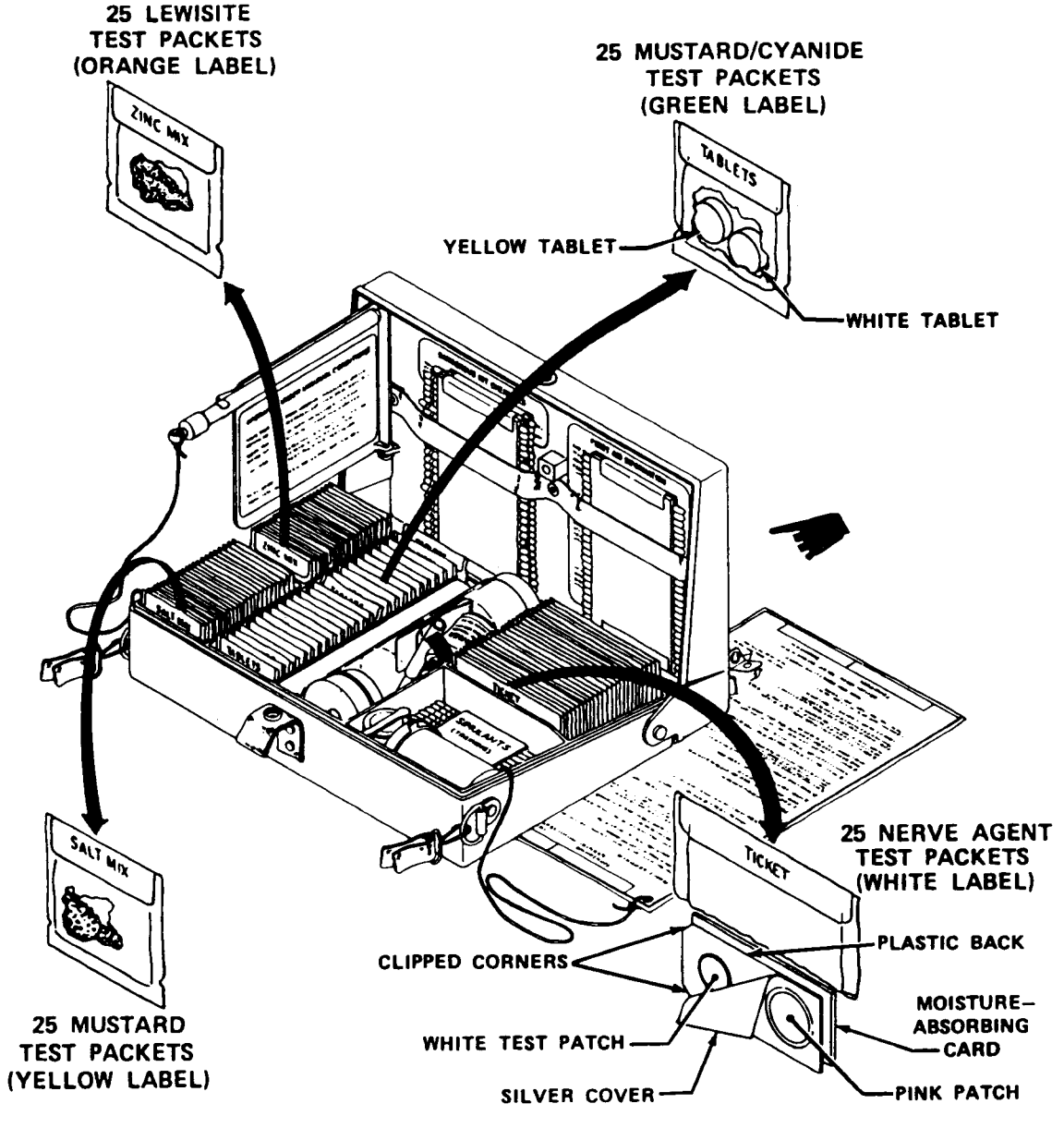


Illustration courtesy of the U.S. Army ERDEC

The M272 Water Testing Kit and its Components

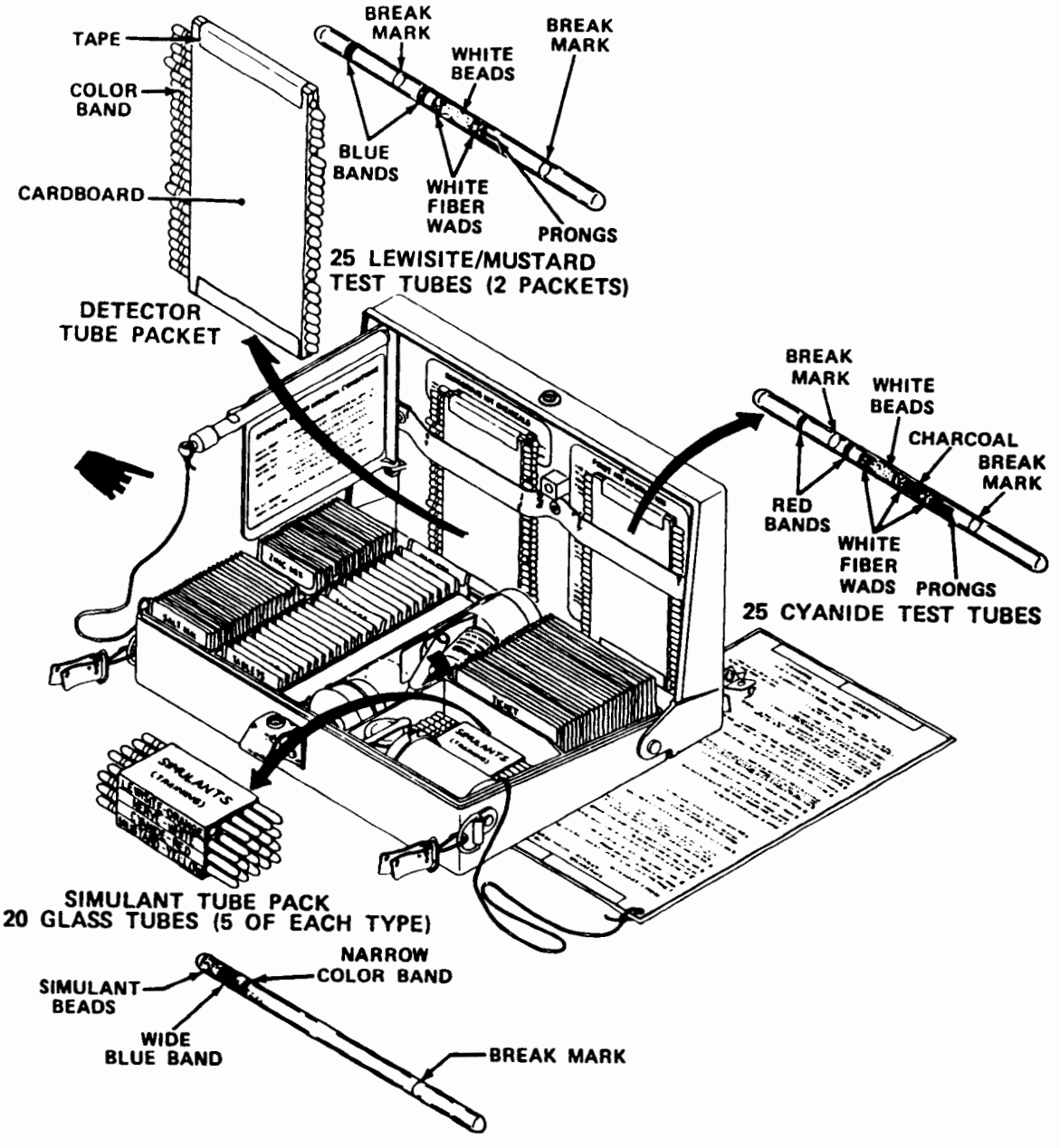


Illustration courtesy of the U.S. Army ERDEC

The M272 Water Testing Kit and its Components

- **Designator(s):** M272

- **Item Name(s):** M272 Water Testing Kit
  M272 Chemical Agents Water Testing Kit
  M272 Kit

- **Item Description:** The M272 Kit is a portable, lightweight kit that will detect and identify hazardous levels of nerve, mustard, L and blood agents in treated or untreated water sources. Detection of chemical agents is indicated by a color change. A full kit contains enough supplies to run 25 tests for each agent. Simulants are included in the kit for training use. The kit is disposable, no refills or repairs are needed. [7]

- **System Components:** [7]

  Chemical Agent Detector Tubes (banded with blue or red)
  Chemical Agent Test Reagents
  Clip
  Heat Resistant Plastic Test Container (with a rubber stopper and a connector)
  Instruction Card
  Nerve Agent Test Tickets
  Rubber Connectors (extras)
  Thermometer
  Training Simulants
  Tube Holder (fits in the lid)
  Waterproof Matches and Striking Strip

- **Support Equipment:** None required. [7]

- **Equipment Hardness:** *

- **Dimensions and Weight:** [7]

Length:	25.1 cm
Width:	15.9 cm
Height:	7 cm
Weight:	1.1 kg

- **Technology:** Wet chemistry reactions and enzyme-substrate reaction. [7]

- **Status:** Adopted into the US Army inventory in 1983. Over 61,000 M272 Kits have been produced. [7]

- **Uses:** Currently used by U.S. Army water purification units, supply organizations at various levels, technical escort units, depot storage sites, and other specialized units and locations. [7]

- **Deployment:** In use by most NATO countries. [7]

- **Agents Detected:** [7]

AGENT CLASS	AGENT(S)	DETECTION SENSITIVITY	RESPONSE TIME
Blister	HD and L	2.0 mg/l	7 minutes
Blood	AC	20.0 mg/l	6 minutes
Nerve	G and V	0.02 mg/l	7 minutes

- **Detection Sensitivity:** The detection levels of the M272 Kit are the safe drinking water levels for cold and temperate regions based on five quarts of water per day consumption level.

  See ***Agents Detected*** for further information.

- **Response Time:** 20 minutes for all four tests. [7]

  See ***Agents Detected*** for further information.

- **False Responses/Interferents:** May respond to some battlefield interferents. [7]

- **Safety Features/Safety Hazards:** Avoid all bodily contact with kit chemicals; some can be very harmful. Kit tests should be done only by personnel who are properly trained and wearing chemical protective rubber gloves with inserts and industrial goggles or protective mask. If exposed, follow FIRST AID INFORMATION inside kit lid or manual. Alkaline chemical used in the mustard test is extremely hazardous. One drop of this liquid accidentally splashed into the eye can cause permanent vision loss even if immediate first aid is applied. Read all color changes carefully, since in the nerve agent test, no color change means agent is present. [7]

- **Power Requirements:** None; manually operated. [7]

- **Transport Requirements:** Portable. [7]

- **Personnel Requirements:** The M272 Kit can be operated as an additional duty; however, only properly trained personnel wearing the appropriate protective clothing, gloves, and mask should operate this kit. [A7]

- **Operational Information:** To test for nerve agent the white patch on a test ticket is wetted by a water sample. It is placed in a clip for an indicated time and then pressed against the pink patch opposite on the ticket. If the white patch turns blue there are no nerve agents present. Tests for other agents involve filling the test container with a water sample. A reagent is added and after breaking off the ends of either the blue or red banded glass tubes, the tubes are inserted in the rubber connector. The color of the beads in the glass tubes are compared to the appropriate test color chart to determine agent presence. [7]

- **Stock Number(s):** 6665-01-134-0885 (NSN). [7]

- **Miscellaneous:** *

- **Contact(s):**

Developer:
Director
U.S. Army Edgewood Research, Development and Engineering Ctr.
Edgewood Area, APG, MD 21010-5423
U.S.A. [7]

Manufacturer:
Truetech, Inc.
680 Elton Street
Riverhead, NY 11901
Tel: (516) 727-8600
Fax: (516) 727-7592 [17]

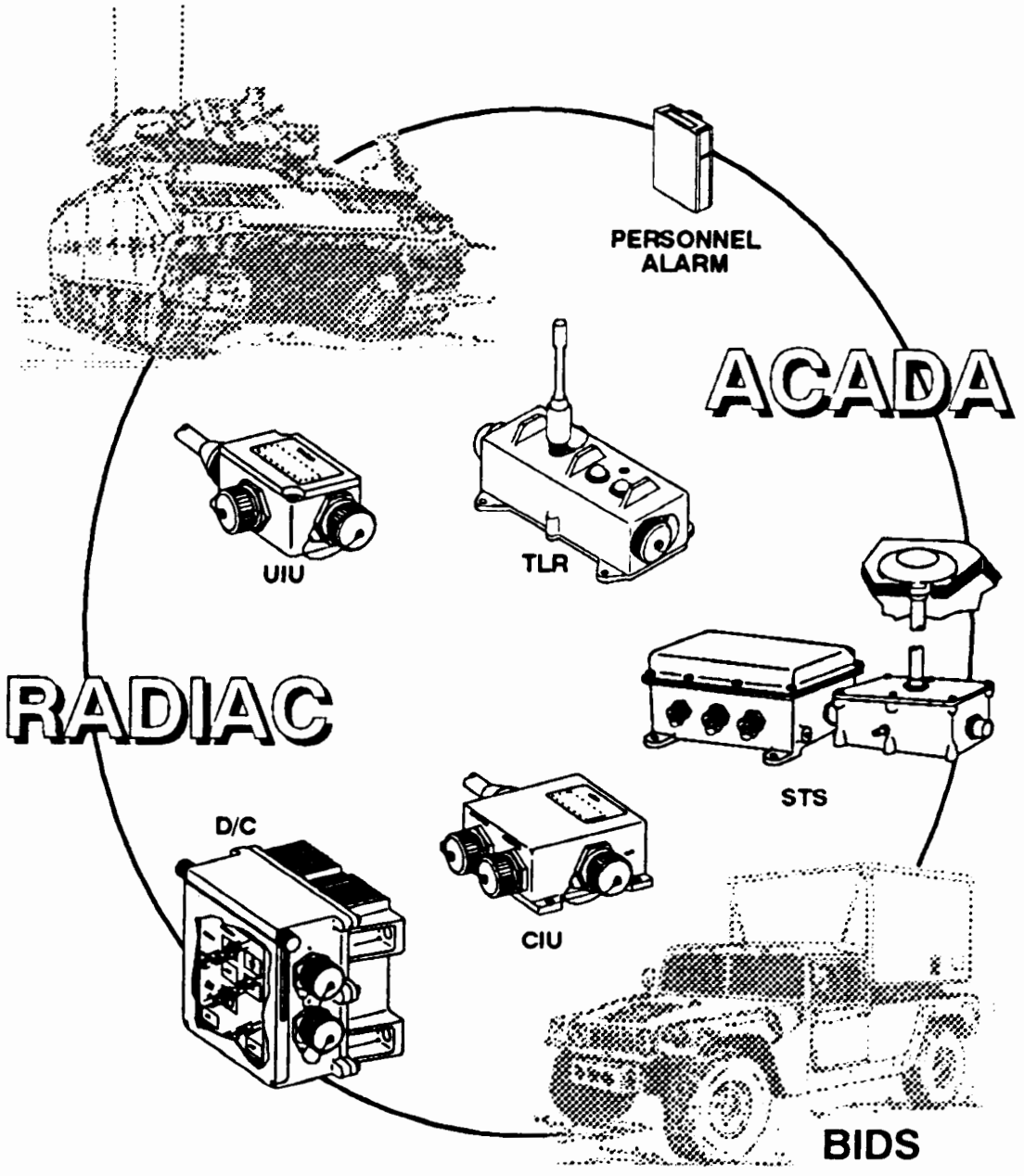


Illustration courtesy of LORAL Librascope

MICAD Components

Designator(s): MICAD

- **Item Name(s):** Multipurpose Integrated Chemical Agent Alarm (MICAD)

- **Item Description:** The MICAD is an automated warning and reporting system capable of receiving electronic alarms from NBC detectors (i.e., M43A1, AN/VDR-2 RADIAC Set, and other fielded and future NBC Detectors), and interact with locating devices (i.e., GPS), and virtually any type of sensor. The MICAD automates the local NBC warning and collective protection equipment activation processes, and automates the NBC report preparation (NBC-1/NBC-4) and transmission process from platoon to battalion level. The MICAD is compatible with the Army Global Command and Control System (AGCCS) via the Army Tactical Command and Control System (ATCCS) and the Automated Nuclear Biological and Chemical Information System (ANBACIS). [7]

  MICAD systems provide soldiers with the means to maintain real time, situation awareness of NBC contamination on the modern battlefield. Situation awareness of NBC contamination requires that a signal be provided to soldiers in time to take a protective posture, verify the contamination if necessary, and accurately communicate the NBC contamination situation specifics to higher echelons for avoidance measures. Depending on the proximity of the NBC contamination, seconds can divide the difference between survival, incapacitation, or death; mission success requires survival. Responding to NBC contamination in seconds requires automated integration of systems heretofore employed manually by soldiers. MICAD systems monitor NBC detectors and alarms for contamination identification. Upon identification, soldiers are warned via traditional and updated warning methods: an M42 Alarm Unit is activated, synthesized voice announces the nature of the contamination, and an NBC-1 or NBC-4 report is automatically formatted for transmission over available communications systems. However, many chemical detectors and alarms are not ruggedized or logistically designed for mounting externally on combat, armored, or tactical vehicles, vans, and shelters. MICAD systems which require a chemical detector be mounted internally for the host application are provided a sample transfer system. Therefore, the components of MICAD comprise the means to automate, integrate, and communicate. The MICAD components are described in detail below. [7]

- **System Components:** [7]

Display/Control (D/C):	The D/C is an integrated hardware and firmware component that allows the operator to configure, monitor and control the MICAD system.
Communications Interface Unit (CIU):	Communications interfaces are provided by the two-channel CIU. The CIU contains two modem/processors that link tactical radios or switches to the D/C via the interface architecture bus.
Universal Interface Unit (UIU):	All non-communications device interfaces are provided by the UIU. The UIU contains all circuitry necessary to interface with NBC detectors, position locating devices, collective protection equipment, telemetry links, alarms and voice intercom systems.

- **System Components (continued):**

  Telemetry Link (TL): The TL consists of a pair of identical small receiver/transmitters for relaying alarm data from a remote detector to the MICAD D/C via the UIU.

  Alert Device (AD): The AD is a commercial type personal paging unit (beeper) which will be issued to each soldier to provide audible and/or vibratory warning in the event of a chemical attack.

  Sample Transfer System (STS): The STS units for combat and armored vehicles (CAV), or for tactical vans and shelters (TVS) provide transfer of air samples from the external and internal environment to chemical detectors.

- **Support Equipment:** All subsystems that the user desires to integrate into MICAD are necessary as support equipment. [7]

- **Equipment Hardness:** The MICAD is a military hardened system designed for NBC survivability and ease of decontamination. The MICAD meets AR70-71 for NBC Survivability, AR70-60 for Electro-Magnetic Pulse (EMP) and High Altitude Electromagnetic Pulse (HAEMP) and MIL-STD-810E. [7]

- **Dimensions and Weight:** [7]

PARAMETERS	D/C	CIU or UIU	STS	TL	AD
Length	15.2 cm	10.2 cm	12.7 cm	15.4 cm	10.2 cm
Width	15.2 cm	10.2 cm	22.9 cm	8 cm	7.7 cm
Height	10.2 cm	5.1 cm	25.4 cm	7.4 cm	2.5 cm
Weight	2.72 kg	0.7 kg	6.8 kg	1.23 kg	< 0.1 kg

- **Technology:** MICAD is a microprocessor based logic system that receives signals from multiple subsystems, and processes the signals in a user defined manner. MICAD can automatically receive a signal from a detector, and format and send an NBC message to desired destinations. Also, radio and other communications systems, positioning systems, protection and filtration systems, and any other type of subsystem can be integrated into MICAD to form an integrated detection, warning, and reporting system. [7]

- **Status:** MICAD has completed the 6.3b phase, which included demonstration and validation of the MICAD concept feasibility. The D/C, Interface Architecture and Combat/Armored Vehicle STS brassboards and prototypes were fabricated and delivered; a commercial off-the-shelf RF modem was used to demonstrate the TL concept. Source selection has been made for the 6.4 Engineering and Manufacturing Development Contract. Software and hardware critical design reviews (CDR) have been conducted. Hardware and software are currently being fabricated. [7]

- **Uses:** MICAD is designed to be used for automatic warning and reporting, but the systems flexibility makes many other applications possible. MICAD can automatically receive a signal from a detector, and format and send an NBC message to desired destinations. Also, radio and other communications systems, positioning systems, protection and filtration systems, and any other type of subsystem can be integrated into MICAD to an integrated detection, warning, and reporting system. [7]

- **Deployment:** *

- **Agents Detected:** None. [7]

- **Detection Sensitivity:** None. [7]

- **Response Time:** None. [7]

- **False Responses/Interferents:** None. [7]

- **Safety Features/Safety Hazards:** The entire MICAD system is a safety feature. [7]

- **Power Requirements:** MIL-STD-1275AT compatible. [7]

DC:	Greater than 140 W, vehicle power. 28 V DC
IA:	Powered from DC
TL:	Battery powered, smallest possible
STS:	To be determined

- **Transport Requirements:** None identified; integral to vehicle or shelter. [7]

- **Personnel Requirements:** MICAD is operated as an additional duty, with training. [7]

- **Operational Information:** MICAD will be used to sample the inside/outside air, provide immediate warning, alert other units of contamination automatically and initiate collective protection with positive pressure throughout the battlefield. [7]

- **Stock Number(s):** Not yet assigned. [7]

- **Miscellaneous:** *

- **Contact(s):**

Developer:
Director
U.S. Army Edgewood Research, Development and Engineering Ctr.
Attn: SCBRD-CE/MICAD
Bldg. E3549
Aberdeen Proving Ground, MD 21010-5423
U.S.A. [7]

- **Contact(s) (continued):**

Manufacturer:

LORAL Librascope
833 Sonora Avenue
Glendale, CA 91201-2433
Tel: (818) 244-6541
Fax: (818) 502-7298 [36]

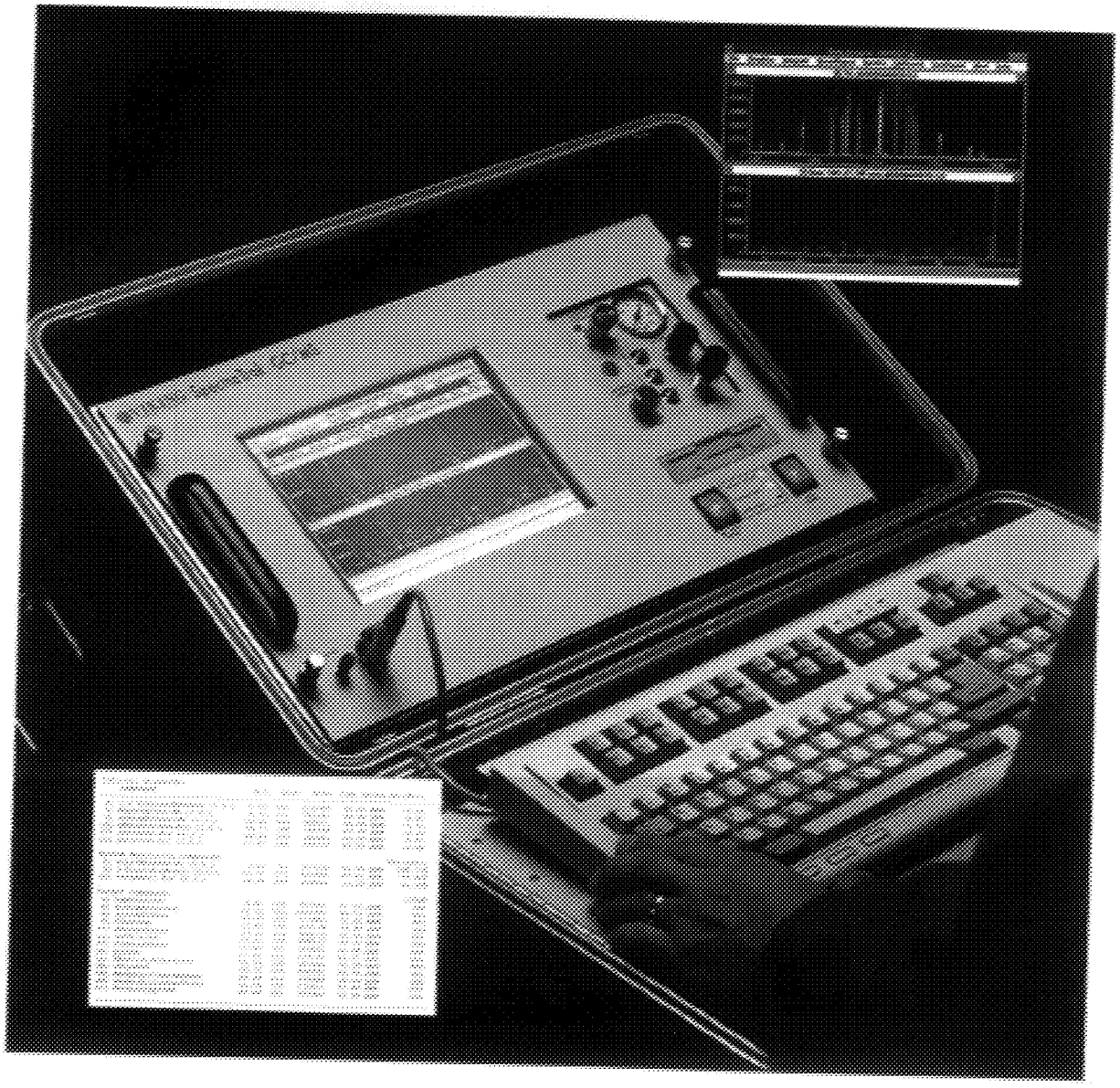


Photo courtesy of Viking Instruments Corporation

The SpectraTrak™ Transportable GC/MS System

Designator(s): SpectraTrak™

- **Item Name(s):** SpectraTrak™ Transportable GC/MS System

- **Item Description:** The SpectraTrak™ is a compact, rugged, transportable gas chromatograph (GC)/mass spectrometer (MS) designed to provide on-site, laboratory quality chemical analysis results. The SpectraTrak™ is designed and built for ease of transport, operation and maintenance in the field. It is shock-mounted in a weatherproof transport case with key components individually protected. It can be transported by vehicle or aircraft to the field site and set up for operational use within minutes. [14,15]

  Viking Instruments has ruggedized and adapted the Hewlett-Packard Mass Selective Detector (MSD). A single-piece quadrupole is the design feature that allows calibration stability, accurate and reproducible analysis results in a transportable system. Mass Spectral analysis can be performed without the gas chromatograph, thus expanding the SpectraTrak™ analytical capabilities. The SpectraTrak™ can be used to analyze air and gas samples, soil and other solid samples as well as water samples. Detection and identification results can be obtained at trace levels in the picogram and sometimes femtogram range. The ability to perform direct MS analyses allows the SpectraTrak™ to provide real-time monitoring capabilities. [14,15]

  A key feature of the SpectraTrak™'s detection and identification system is an on-line digital library of chemical warfare agents and related compounds along with library search algorithms. An on-board 486-Series computer, dedicated microprocessors and high-capacity hard disk that operates through Windows 3.1 integrate with Hewlett-Packard Chem-Station software and the Viking Spectra-Scan Operating System to provide numerous options for data analysis, storage, retrieval and transfer. [14,15]

- **System Components:** [14]

Mass Analyzer:	Hewlett-Packard 5972 Monolithic quadrupole with hyperbolic polefaces.
Vacuum System:	Analyzer vacuum maintained by an 80-L/S turbo pump with external roughing pump.
Gas Chromatograph:	A fully programmable capillary column GC for separating mixtures for analysis by the mass filter.
Sampling Systems:	Three sampling modes are available for introducing liquid, gas or air samples.
Computer:	An integral full-function system, MS-DOS-compatible with Microsoft Windows 3.1 interface is used to control instrument operation and perform various types of data analyses.
Transport Case:	The case is weatherproof with rubber boot behind the front panel. All components with the exception of the roughing pump are inside the case. The GC/MS are mounted on a shock resistant internal chassis.

- **Support Equipment:** Optional model available for remote data transfer. [16]

- **Equipment Hardness:** The transport case is weatherproof with a rubber boot behind the front panel. The GC/MS and computer are shock-mounted inside the case. [16]

- **Dimensions and Weight:** [15]

Length:	82 cm
Width:	53.3 cm
Height:	35.1 cm
Width:	59.1 kg (without the roughing pump)

- **Technology:** GC/MS. [14,15,16]

- **Status:** In production.

- **Uses:** Environmental analysis in the field; water, air, or soil samples can be analyzed. It can serve as both a continuous sampling method or can be used to determine contamination present with individual samples. Some practical uses include air and water toxic monitoring, emergency response, environmental audits, Superfund site testing and on-line process monitoring.

- **Deployment:** Used by the U.S. Army Technical Escort Unit (TEU). Other users include Sandia National Laboratories, Martin Marietta, 3M, Environmental Protection Agency (EPA), Department of Energy (DOE), Federal Bureau of Investigations (FBI) and the U.S. Coast Guard.

- **Agents Detected:** *

- **Detection Sensitivity:** *

- **Response Time:** *

- **False Responses/Interferents:** *

- **Safety Features/Safety Hazards:** *

- **Power Requirements:** Operates on 99 V to 127 V or 198 V to 254 V, single-phase, 1750 VA, line frequency 50/60 Hz. [15]

- **Transport Requirements:** System is enclosed in a transportable case which is environmentally protected with a rubber boot behind the front panel. The roughing pump is the only component that is not located inside the transportable case. The GC/MS and computer are mounted on an internal chassis that is shock-isolated from the external case. [15]

- **Personnel Requirements:** Training is needed to operate the SpectraTrak™ system. [14]

- **Operational Information:** The SpectraTrak™ GC/MS has a multifunction sampling and inlet system that supports several automated analysis cycles for direct injection or real-time air sampling with or without concentration. The system has a built-in sampling pump with a trap or concentrator, thermal desorber, on-column or split-splitless injection capability, membrane separator, mini-GC with optional cyrofocusing, MSD and computer with LCD. [16]

  Air Sampling: The membrane separator can be used to continuously introduce ambient or concentrated air samples into the MSD for analysis. Air samples can also be concentrated and thermally desorbed onto the GC, which includes optional cyrofocusing to trap light volatiles.

  Water Sampling: Direct head-space sampling or an optional purge-and-trap device can be used to analyze volatiles using the integral thermal desorber. Solvent extractions of semi-volatiles are introduced via the split-splitless injector.

  Soil Sampling: Soil and solid samples can be loaded onto a concentrator cartridge and directly thermally desorbed for MS or GC/MS analysis or extracted and injected normally.

  Prepared Samples: The injector/desorber can be used for prepared GC/MS samples or to desorb a cartridge collected off-line.

- **Stock Number(s):** *

- **Miscellaneous:** *

- **Contact(s):**

  Manufacturer:
  Viking Equipment Corp.
  12007 Sunrise Valley Drive
  Reston, VA 22091-3406
  Tel: (703) 758-9339
  Fax: (703) 391-2910 [14,15,16]

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15. Harvey, Judy. (1995 April 17). *Re: Viking SpectraTrak™ GC/MS System Specifications* [4 p.]. Facsimile Transmission, Tradeways Ltd. Vienna, VA, U.S.A.

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17. (1995, April 19). Information by U.S. Army Edgewood Research, Development and Engineering Center (ERDEC), Edgewood Area, Aberdeen Proving Ground, MD, U.S.A.

APPENDIX A

EQUIPMENT INDEX (Alphabetical)

ITEM NAME **PAGE**

APPENDIX B

EQUIPMENT INDEX
(By Country)

PAGE

FRANCE

GERMANY

HUNGARY

ISRAEL

ITALY

THE NETHERLANDS

ROMANIA

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SERBIA

SOUTH AFRICA

SWEDEN

SWITZERLAND

UNITED KINGDOM

UNITED STATES

PAGE

UNITED STATES (Continued)

APPENDIX C

EQUIPMENT INDEX
(By Manufacturer)

PAGE

PAGE

HONEYWELL REGELSYSTEME GmbH

INDUSTRIJA MILOJE ZAKITJ

INTELLITEC (formerly BRUNSWICK CORPORATION)

ISRAEL INSTITUTE FOR BIOLOGICAL RESEARCH (IIBR)

JASMIN SIMTEC LIMITED

LASRAM LASER TECHNOLOGY LTD.

LORAL LIBRASCOPE

LOUIS SCHLEIFFER AG

MERLIN GERIN PROVENCE

MORGAN ADHESIVES OF CANADA LIMITED

PAGE

PAGE

STEDT & CO AB

TRUETECH, INC.

VIKING EQUIPMENT CORP.

****

UNKNOWN MANUFACTURERS

APPENDIX D

EQUIPMENT INDEX
(By Technology)

POINT DETECTION

PAGE

IONIZATION/ION MOBILITY SPECTROMETRY (IMS)

FLAME PHOTOMETRY

MASS SPECTROMETRY

PHOTOACOUSTIC INFRARED SPECTROSCOPY

PAGE

ELECTROCHEMISTRY

WET CHEMICAL/COLORIMETRIC REACTIONS

PAGE

GAS CHROMATOGRAPHY

STANDOFF DETECTION

DIFFERENTIAL ABSORPTION LIDAR (DIAL)

FORWARD LOOKING INFRARED (FLIR)

APPENDIX E

AGENTS DETECTED BY VARIOUS DETECTORS

Country/Detector	Page	Blister Agents						Blood Agents			Choking Agents		Incapacitating Agents				Nerve Agents					Vomiting Agents		
		CX	R	^{1}HD	HN	HS	L	T	AC	CK	SA	CG	DP	BZ	CN	CR	CS	GA	GB	GD	GF	GP	VX	DA	DC	DM
CANADA																										
C2 Kit	29	X	X		X			X	X	X		X						X	X	X			X			
CADS II	35			X	X	X												X	X	X			X			
M256 Kit	41	X		X			X		X	X									X				X			
M272 Kit	43			X			X		X									X	X	X	X	X	X			
MASS	45	**All Known Chemical Agents**																								
NAVD	49																	X	X	X			X			
3-Way	53		X															X	X	X	X	X	X			
COMMONWEALTH OF INDEPENDENT STATES																										
GO-27	61																		X	X			X			
GSA-1	65																	X	X				X			
GSA-12	69																	**Nerve Agents**								
GSP-1/GSP-1M	71																	X	X	X	X	X				
GSP-11	75																	X	X	X	X	X	X			
MPKhR	79		X						X	X		X	X						X	X			X			
PGO-11	81											X						X	X	X	X	X	X			
VPKhR	83		X						X	X		X	X						X	X			X			

Country/Detector	Page	Blister Agents						Blood Agents			Choking Agents		Incapacitating Agents				Nerve Agents					Vomiting Agents		
		CX	B	HD	HN	MS	L	T	AC	CK	SA	CG	DP	BZ	CN	CR	CS	GA	GB	GD	GF	GP	VX	DA	DC	DM
CZECH REPUBLIC																										
CHP-71	93		X						X	X		X	X	X			X		X	X			X			
DETEHIT	97																	X		X	X	X	X			
LIDAR	101																	X		X						
PCHL90	105		X											X			X			X			X			
PP-1	109																									
DENMARK																										
Type 1301	117		X				X											X	X	X			X			
Type 1302	121		X				X											X	X	X			X			
Type 1306	125		X															X	X	X						
FINLAND																										
M90	133			X			X		X									X	X	X			X			
FRANCE																										
ADLIF	143			X														X	X	X			X			
APACC	147			X														X	X	X	X		X			
DETADIS	153		X																X	X			X			
DET INDIV	157																	X	X	X						
TDCC	161			X	X				X	X		X						X	X				X			
TROUSSE Z KIT	167		X		X		X		X	X	X	X				X		X	X				X			X

Country/Detector	Page	Blister Agents					Blood Agents			Choking Agents	Incapacitating Agents			Nerve Agents					Vomiting Agents		
		CX	H	HD	HN	HS	L	T	AC	CK	SA	CG	DP	BZ	CN	CR	CS	GA	GB	GD	GF	GP	VX	DA	DC	DM
GERMANY																										
A2 (Bruker)	175			X	X				X			X							X				X			
A2 (Honeywell)	179			X	X		X		X									X	X	X			X			
Dräger Tubes	185				X	X	X		X	X		X	X					X	X	X	X	X	X			
MM-1	193	**Chemical Agents**																								
BBCA	199			X	X	X	X		X			X								X						
RAID-1	203			X	X	X	X		X			X							X	X			X			
HUNGARY																										
Type AVJ-1	213																	**Nerve Agents**								
Type GVJ-2	217			X															X	X			X			
Type VSJ-1	221			X															X	X	X		X			
Type 66-M	227			X	X	X	X		X	X		X		X	X				X	X			X			X
Type FVJ	233			X					X			X					X									
Double Way	237		X	X	X	X													X	X			X			
GVJ-1	241																									
ISRAEL																		**Nerve Agents**								
CDK	253			X															X	X	X		X			
ITALY																										
RAC/83	261			X					X	X									X	X	X		X			
NETHERLANDS																										
GVU	269				X	X	X		X	X		X							X	X	X	X	X			

Country/Detector	Page	Blister Agents						Blood Agents			Choking Agents		Incapacitating Agents			Nerve Agents					Vomiting Agents		
		CX	H	HD	HN	HS	L	T	AC	CK	SA	CG	DP	BZ	CN	CR	CS	GA	GB	GD	GF	GP	VX	DA	DC	DM
ROMANIA																										
ASTN-2	277																	Nerve Agents								
SERBIA																										
DHM-11B	285	X	X		X				X	X		X	X					X								
DRHT	289								X			X							X	X			X			
PHD	293			X					X	X		X	X													
SOUTH AFRICA																										
CD-1	301			X					X									X	X	X			X			
Spot Kit	305				X	X			X	X		X						X	X	X	X	X				
SWEDEN																										
CW Nerve	313		X															Nerve Agent								
Tube 21	317		X				X																			
SWITZERLAND																										
CAD Kit	325	Blister Agents																Nerve Agent								
UNITED KINGDOM																										
CAM*	331		X															X	X	X	X	X				
EVM	335	Chemical Agents																								
FAM	339	Blister Agents																Nerve Agents								
GI-MINI	343	Blister Agents																Nerve Agents								
GID-2™	347	Blister Agents																Nerve Agents								
GID-3™	351	Blister Agents							Blood Agents			X	X					Nerve Agents								
NAIAD	355								X	X								X	X	X	X	X	X			

* May be programmed to detect other compounds

Country/Detector	Page	Blister Agents						Blood Agents			Choking Agents		Incapacitating Agents				Nerve Agents					Vomiting Agents		
		CX	H	HD	HN	HS	L	T	AC	CK	SA	CG	DP	BZ	CN	CR	CS	GA	GB	GD	GF	GP	VX	DA	DC	DM
UNITED KINGDOM (continued)																										
RVD	359			X	X													X	X	X			X			
No. 2 MK1	363	**Blister Agents**							X	X								**Nerve Agents**								
SICS MK7 NHA	367	**Chemical Agents**																								
SICS MK10/GID-2B	371	**Blister Agents**							**Blood Agents**			X	X					**Nerve Agents**								
UNITED STATES																										
AN/KAS-1	381																	X	X	X	X	X	X			
ALAD	385			X																X			X			
CAM/ICAM	389			X			X											X	X	X	X	X	X			
CAPDS	395																		X	X			X			
ICAD	403			X			X		X			X						X	X	X						
M8 Paper	407		X				X											X	X	X	X	X	X			
M8A1	411								X									X	X	X	X		X			
M9 Paper	417		X				X											X	X	X	X	X	X			
M18A2 Kit	421			X			X		X			X							X				X			
M21	425			X			X											X	X	X						
M256A1 Kit	429	X		X			X		X	X									X				X			
M272 Kit	433			X			X		X									X	X	X	X	X	X			

APPENDIX F

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

TERM	DEFINITION
α	alpha
α-emitting	alpha releasing radioactive particle
β	beta
β-emitting	beta releasing radioactive particle
μ	micro, 10^{-6}
μCi	microCurie
μg/cm^3	microgram(s) per cubic centimeter
μg/ml	microgram(s) per milliliter
μg	microgram(s)
μm	micrometer(s)
A	Amperes
AC	Alternating Current
AC	Blood agent, hydrogen cyanide; also written HCN
AD	Alert Devices
AFV	Armored Fighting Vehicle
AGCCS	Army Global Command and Control System
Ah	Ampere hours
ALAD	Automatic Liquid Agent Detector
Am^{241}	Alpha emitting radioactive isotope, Americium 241
amps	amperes
ANBACIS	Automated Nuclear Biological and Chemical Information System
AR 70-71	Army Regulation 70-71 for NBC survivability
As	Arsenic
AsH_3	Arsenic trihydride
As_2O_3	Arsenic trioxide
ASPRM	Advanced Signal Pattern Recognizing Method
ATCCS	Army Tactical Command and Control System
ATDU	Automated Thermal Desorption Unit
$AuCl_3$	Gold chloride

TERM	DEFINITION
AUTO	Automatic
AVM	Airborne Vapor Monitor
B&K	Brüel & Kjaer
BBCA	Blood, Blister and Choking Agents
BIDS	Biological Integrated Detection System
BIT	Built-in-Test
Br, Br_2	Bromine
BrCN	Cyanogen bromide
BZ	Incapacitating agent, benactyzine
C	Concentration; also carbon
°C	Degrees Celsius, temperature scale,
CA	Chloracetophenone
CADS II	Chemical Agent Detection System II
CAM™	Chemical Agent Monitor
CAPDS	Chemical Agent Point Detection System
CAT	Chemical Agent Tracer
CAV	Combat and Armored Vehicles
CBMS	Chemical Biological Mass Spectrometer
CBDCOM	Chemical and Biological Defense Command
CCU	Central Control Unit
CDK	Chemical Detector Kit
CDR	Critical Design Review
CEB	Centre d'Etudes du Bouchet
CFM	Cubic Feet per Minute
CG	Choking agent, phosgene
CH_3COCl	Acetyl Chloride
ChE	Cholinesterase
Ci	Curie
CILAS	Compagnie Industrielle des Lasers
CIRC Database	Central Information Reference and Control Database
CIS	Commonwealth of Independent States
CIU	Communications Interface Unit

TERM	DEFINITION
CK	Blood agent, cyanogen chloride; also written CNCl
CL	Product of concentration and pathlength
Cl, Cl_2	Chlorine
cm	centimeter(s)
CN	Tear agent, chloroacetophenone
$(CN)_2$	Cyanogen
CO	Carbon monoxide
CO_2	Carbon dioxide
$COBr_2$	Carbonyl bromide
CR	Tear agent, dibenz(B,F)(1,4)oxazepine
CS	Tear agent, O-chlorobenzylomalonitrile
Ct	Concentration with respect to time
Cu	Copper
CVA	2-chlorovinylarsonous acid
CW	Chemical Warfare
CWA	Chemical Warfare Agent(s)
CWC	Chemical Weapons Convention
CWDD	Chemical Warfare Directional Detector
CX	Blister agent, phosgene oxime
DA	Vomiting agent, diphenylchloroarsine
db	decibel
DB-3	Alpha (p-nitrobenzyl)-pyridine
D/C	Display/Control
DC	Direct Current
DC	Vomiting agent, diphenylcyanoarsine
DEFSTAN	Defense Standard
DIAL	Differential Absorption LIDAR
DM	Vomiting agent, diphenylaminochlorarsine; also known as adamsite
DMSO	Dimethyl sulfoxide
DOE	Department of Energy
DP	Choking agent, diphosgene

TERM	DEFINITION
DS2	Decontaminating Solution 2 Consists of a mixture of diethylenetriamine (70%), sodium hydroxide (2%) and ethylene glycol monomethyl ether (28%).
DTS	Diagnostic Test Set
EMI	Electro-Magnetic Interference
EMP	Electro-Magnetic Pulse
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPROM	Electromagnetically Programmed Read Only Memory
ERDEC	Edgewood Research Development and Engineering Center
ETG	Environmental Technologies Group
EVM	Environmental Vapor Monitor
FAM™	Field Alarm Module
FBI	Federal Bureau of Investigation
FEG	Former East Germany
FINE	Fixed Installation NAIAD Equipment
FLIR	Forward Looking Infrared
FMIB	Foreign Materiel Intelligence Battalion
FOV	Field of View
FSU	Former Soviet Union
FTIR	Fourier Transform Infrared
ft^3	cubic feet
FUE	First Unit Equipped
FWP	Former Warsaw Pact
FY	Fiscal Year
g	gram(s)
g/m^2	gram(s) per square meter
g/m^3	gram(s) per cubic meter
G, G agents	Nerve agents in the "G" class including GA, GB, GD and GF
GA	Nerve agent, tabun
GB	Nerve agent, sarin
GC/MS	Gas Chromatography/Mass Spectrometry
GC	Gas Chromatography or Gas Chromatograph

TERM	DEFINITION
GD	Nerve agent, soman
GF	Nerve agent
GP	Nerve agent of FSU origin
GPS	Global Positioning System
H	Blister agent, levinstein mustard
H, H_2	Hydrogen
H_2O	Water
HAEMP	High Altitude Electro-Magnetic Pulse
HCl	Hydrochloric acid
HD	Blister agent, distilled mustard
HgCdTe	Mercury, Cadmium, Tellurium Complex
HL	Blister agent, mixture of HD and L
HN	Blister agent, nitrogen mustard
HPO	Hydrogen Phosphorus Oxygen
HS	Blister agent, sulfur mustard
Hz	Hertz, a unit of frequency
IA	Interface Architecture
IAW	In Accordance With
ICAD	Individual Chemical Agent Detector
ICAM	Improved Chemical Agent Monitor
IDF	Israeli Defence Forces
IDS	Ion Detector System
IDU	Ionization Detector Unit
IEC	International Electrotechnical Commission
IEEE	Institute of Electronic and Electrical Engineers
IEEE STD 488	Standard entitled *Digital Interface for Programmable Instrumentation*, superceded by IEEE STD 488.1
IIBR	Israel Institute for Biological Research
IMS	Ion Mobility Spectrometry
IPR	In-house Progress Review
IR	Infrared
KCN	Potassium cyanide

TERM	DEFINITION
kg	kilogram(s)
km	kilometer(s)
KOH	Potassium hydroxide
kVA	kilovolt-Amperes
kw	kilowatt(s)
l	liter(s)
l/min	liter(s) per minute
L	Blister agent, lewisite
LAV	Light Armored Vehicle
lbs	pounds
LCD	Liquid Crystal Display
LD	Lethal Dose
LD50	Lethal dose for 50% of the exposed population
LED	Light Emitting Diode
Li/SO_2	Lithium/Sulfur dioxide
LIDAR	Light Detection and Ranging
LOS	Line of Sight
LRP	Low Rate Production
LSS	Land Sensor Station
m	molecular mass of an ion
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mA	milliamperes
MANU	Manual
MASS	Minitube™ Air Sampling System
MAX	Maximum
mCi	millicurie(s)
Mg	Magnesium
mg/m^2	milligram(s) per square meter
mg/m^3	milligram(s) per cubic meter

TERM	DEFINITION
$mg/m^3 \bullet m$	milligram(s) per cubic meter × meter(s)
mg/dm^2	milligram(s) per square decimeter
mg/dm^3	milligram(s) per cubic decimeter
mg/l	milligram(s) per liter
mg/ml	milligram(s) per milliliter
MICAD	Multipurpose Integrated Chemical Agent Alarm
MIL-STD	Military Standard
MIL-STD-810D	Military Standard entitled *Environmental Test Methods and Engineering Guidelines*, superceded by MIL-STD-810E
MIN	Minimum
Min	Minutes
Mk	Mark
ml	milliliter(s)
mm	millimeter(s)
MOPP	Mission Oriented Protective Posture
ms	millisecond(s)
MS	Mass Spectrometry
MS-DOS	Microsoft-Disk Operating System
m/sec^2	meter(s) per square second
MS/MS	Mass Spectrometry/Mass Spectrometry
MSS	Marine Sensor Station
MTBF	Mean Time Between Failure
m/z	mass to charge ratio
N, N_2	Nitrogen
NA	Not Available
NaCN	Sodium cyanide
NAIAD	Nerve Agent Immobilized-Enzyme Alarm and Detector
NaOH	Sodium hydroxide
NATO	North Atlantic Treaty Organization
NAVD	Nerve Agent Vapor Detector
NBC	Nuclear, Biological and Chemical
NBCRS	Nuclear, Biological and Chemical Reconnaissance System

TERM	DEFINITION
NCU	Network Control Unit
ng/l	nanogram(s) per liter
NH_3	Ammonia
Ni^{63}	Nickel 63, a beta radiation source
NiCd	Nickel Cadmium
nm	nanometer(s)
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NRC	Nuclear Regulatory Commission (United States)
NSN	National Stock Number or NATO Stock Number
O, O_2	Oxygen
O_3	Ozone
OFM	Otto Fuel Monitor
ORS	Optical Remote Sensing
P	Phosphorus
PA	Personnel Alarm
PC	Personal Computer
PCB	Polychlorinated biphenyl
pcs	pieces
PCU	Power Conversion Unit
pH	Scale from 1 to 14 that expresses the hydrogen ion activity of a solution; 0 to 7: acid, 7: neutral, 7 to 14: alkaline
PIP	Product Improvement Phase
PIRS	Photoacoustic Infrared Spectroscopy
PMCS	Preventative Maintenance Checks and Services
ppb	parts per billion
ppm	parts per million
ppm-m	parts per million per meter
PRF	Pulse Repetition Frequencies
PRMTRS	Parameters
PVC	Polyvinylchloride
R-	Alkyl group in an organic compound

TERM	DEFINITION
R&D	Research and Development
rad	radians
RAID	Rapid Alarm and Identification Device
RCU	Remote Control Unit
RDA-1	Remote Display Alarm-1
RF	Radio Frequency
RH	Relative Humidity
RS-232, RS-232-C	Computer communications port
RSCAAL	Remote Sensing Chemical Agent Alarm
RSU	Remote Status Unit
RVD	Residual Vapor Detector
S	Sulfur
S_2	Diatomic sulfur
SA	Blood agent, arsine
SICAS	Ship Installed Chemical Alarm System
SICS	Ship Installed Chemical System
SNR	Signal-to-Noise Ratio
SO_2	Sulfur dioxide
STANAG	NATO Standard Agreement
STS	Sample Transfer System
T	Clear, yellowish sulfur and chlorine compound in liquid form with a structure similar to distilled mustard
T	Temperature; also Time
TBP	Tributyl phosphate
TBU	Through Bulkhead Unit
TC-LRP	Type Classified for Low Rate Production
TDCC	Trousse de Détection Chimique de Contrôle
TEA	Transverse Excited Atmospheric (CO_2 pulsed lasers)
TEU	Technical Escort Unit
TL	Telemetry Link
TLR	Telemetry Link Radio
TLV	Threshold Limit Value

TERM	DEFINITION
TMK	Thio-Michler's Ketone
TRADOC	Training and Doctrine Command
TREE	Transient Radiation Effects on Electronics
TVS	Tactical Vans and Shelters
UIU	Universal Interface Unit
U.K.	United Kingdom
UNSCOM	United Nations Security Commission
U.S.	United States
USACMLS	United States Army Chemical School
V	Volts
V, V agents	Nerve agents in the "V" class
VAM	Vehicle Alarm Module
VERDI	Vehicle Electronic Research Defence Initiative Program
VX	Nerve agent, S-2 diisopropylaminoethyl methylphosphonothioate
W	Watts
z	number of charges an ion bears