

NUREG-0274  
Five in a Series of  
Five Reports

# CATALOG OF PHYSICAL PROTECTION EQUIPMENT

Book 2

Volume V. Contraband Detection Components

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The MITRE Corporation  
for  
U. S. Nuclear Regulatory Commission

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NUREG-0274  
Five in a Series of Five Reports

# CATALOG OF PHYSICAL PROTECTION EQUIPMENT

## Book 2

### Volume V. Contraband Detection Components

Wolf Haberman, and Others

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Division of Safeguards, Fuel Cycle and Environmental Research  
Office of Nuclear Regulatory Research  
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2. Physical Protection Equipment Study: Final Report

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4. Guide for the Evaluation of Physical Protection Equipment

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5. **Catalog of Physical Protection Equipment**

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## ABSTRACT

A catalog of commercially available physical protection equipment has been prepared under MITRE contract AT(49-24)-0376 for use by the U. S. Nuclear Regulatory Commission (NRC). Included is information on barrier structures and equipment, interior and exterior intrusion detection sensors, entry (access) control devices, surveillance and alarm assessment equipment, contraband detection sensors, automated response equipment, general purpose displays and general purpose communications, with one volume devoted to each of these eight areas. For each item of equipment the information included consists of performance, physical, cost and supply/logistics data. The entire catalog is contained in three notebooks for ease in its use by licensing and inspection staff at NRC.

THIS CATALOG DOES NOT REPRESENT A QUALIFIED PRODUCTS LIST. INCLUSION OF ANY ITEM IN THE CATALOG DOES NOT CONSTITUTE AN ENDORSEMENT BY EITHER THE MITRE CORPORATION OR THE U. S. NUCLEAR REGULATORY COMMISSION.

## PREFACE AND ACKNOWLEDGEMENTS

The Catalog of Physical Protection Equipment presents information on currently used or currently available physical protection equipment that could be employed to safeguard special nuclear materials. The primary source of information was the responses of manufacturers and vendors to requests for literature and data, unless otherwise noted, and as discussed in the Final Report (NUREG-0271, MTR 3458). All equipment listed in the Catalog has been screened in accordance with the following general criteria, and only items meeting one or more of these criteria have been included:

- Equipment is commercially available off-the-shelf;
- Equipment is currently in use at commercial nuclear facilities licensed or to be licensed by NRC;
- Equipment is applicable for use at nuclear facilities licensed or to be licensed by NRC;
- Equipment can operate in the environmental conditions present at nuclear facilities;
- Equipment is not designed solely or primarily for residential use.

The final report describes the methodology and rationale used to create the Catalog of Physical Protection Equipment. Individuals seeking background information concerning the Catalog are directed to that report.

The Catalog of Physical Protection Equipment was edited and reviewed by W. L. Parlee; W. Haberman had overall responsibility for its preparation. Inputs to the catalog were prepared by the following individuals, and their contributions are gratefully acknowledged:

Volume I.

L. I. Egelson	Sections 1, 4, 5, 6, 7, 8, 9, 10
R. G. Hansen	Sections 2, 3

Volume II.

J. L. Conway	Section 1
R. D. Cotell	Section 2
Z. Kohorn	Sections 11, 14
R. N. Lawson	Sections 4, 5, 7, 9, 12
J. O. Runkle	Sections 6, 8, 10, 13, 15
G. O. Sauermann	Section 3

Volume III.

W. L. Parlee

Volume IV.

G. O. Sauermann

Volume V.

A. J. Graff

Volume VI.

R. N. Lawson

Volume VII.

C. E. Deiberg

Volume VIII.

D. Stone

D. G. Willard

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## PORTABLE EXPLOSIVES DETECTION COMPONENTS

Gas chromatography is the most common method employed in explosives detectors for security applications. The principal components of a gas chromatograph are the air sample collector and concentrator, the carrier gas injection system, the chromatographic column and the electron capture detector and recorder.

The air sampling system draws a sample of the suspect air at a rate of several liters per minute over a metal surface which adsorbs the trace explosive constituents onto its surface. Vapor selectivity or specificity can, to a degree, be achieved by proper selection of metal. Since explosive effluents may be present in very low concentration, it may be necessary to sample a large volume of air in order to concentrate enough effluent on the adsorbing material so that an analysis can be made.

After the air sample has been taken, a neutral carrier gas (usually argon or helium) is passed over the adsorbing material. The adsorbing material may be heated during this process in order to ensure that the vapors are desorbed and transferred to the carrier gas stream.

The vapor-laden carrier gas then feeds into the chromatographic column. Each constituent has a characteristic retention time in the column which varies according to the vapor pressure of the sample constituents, their solubility in the column material, temperature, etc. The time required by the various constituents to reach the detector (electron capture type) at the selected operating temperature allows an analysis of the vapor to be made.

In the electron capture detector the vapor laden carrier gas is exposed to electrons from a radioactive source (such as tritium

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or nickel-63) and they tend to attach with high probability to the trace constituents\* which have high electron affinity. The normal operating current flowing in the detector is reduced in proportion to the concentration of the trace constituents. The signature of the vapor is obtained by recording the detector current as a function of time on a strip-chart recorder. A more practical mode of operation permits automatic programming by providing a time window which is on the order of several seconds duration and which can be located within a retention time interval between zero and 99 seconds. If a particular constituent reaches the detector during the selected time period, a visual or audible alarm is activated. The response of the instrument can be optimized by varying the temperature of the chromatographic column and the pressure of the carrier gas.

The usefulness of a detector of explosives effluents in a practical security system depends on the following instrument characteristics:

- Sensitivity -- the minimum detectable concentration of a trace gas in air.
- Response Time -- the period of time between sample injection and measurable instrument response.
- Specificity -- the uniqueness of the instrumental signature -- the absence of false alarms due to innocuous constituents in air such as perfumes,

\*Molecules containing halogen or nitro-groups typically have a high electron affinity. In the case of dynamite, the major effluent is ethylene glycol dinitrate (EGDN). In the case of TNT, the major constituent is trinitrotoluene, but mononitrotoluene and dinitrotoluene (DNT) are also present in the effluent. Hydrocarbons, such as are found in gasoline or jet fuel, produce no effect.

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shaving lotions, shoe polish, and others commonly found in the environment in which the detector is used.

- Convenience -- including portability, warmup time, power consumption, operator training required and frequency of adjustment.
- Cost -- capital investment, operational and maintenance expenditures.

Sensitivity is determined by injecting measured quantities of air saturated with explosives effluent into the airstream sampled by the instrument during normal operation. From the magnitude of the response of the detector to a certain vapor, and from separate determination of the background response (i.e., determination of the signal-to-noise ratio), the minimum detectable concentration can be estimated. Lack of sensitivity would yield a low probability of detecting a well-wrapped, concealed parcel of explosives. The response time clearly is important for security applications of explosive detectors, since it governs the rate at which traffic can flow through the inspection area. Generally the higher the concentration of the effluent, the shorter the response time. However, once an instrument has been exposed to an unduly high concentration of effluent, it may require a recovery time of several minutes or even longer to regain its full sensitivity.

Most explosives detectors for security applications on the market today are of a portable configuration. In most cases the device can fit into a suitcase. A hand-held sampling probe is used to search the suspect person or object. The primary advantage of the portable explosives detector is that it can be used anywhere, and the location of the explosives can be precisely determined. Specificity of these devices to various explosives effluents varies from manufacturer to manufacturer and, where available, this in-

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formation has been included in the Catalog data sheet. Some of the portable explosives detectors contained in the Catalog have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA and the U.S. Army MERADCOM.

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## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Elbit, Ltd.  
P.O. Box 5258  
Haifa, Israel  
Tel. 522516

**Model** 103A

Reference Evaluation Guide Procedure No. V-1.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Vapor Trace Analyzer, Model 103A, captures the impurities from a large volume of air 1qt (1l) and transfers them to a gas chromatographic column in a controlled carrier gas stream. The sampling device used in this detector has highly selective vapor adsorption characteristics and has the capability to sample a large volume of air, thereby enhancing the ability of the device to detect minute trace vapors. The transit times of various vapors through the chromatographic column are unique. An electron capture detector placed at the column output responds only to highly polar compounds, and provides the means to identify the vapors by comparison of retention times of the various vapors with known standards.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** 0/3000 samples.  
**Detection/Operation Time:** 20 to 40 seconds. Service time after positive indication, 1 to 15 minutes.  
**Detection Mechanism:** Vapor adsorption on platinum wire, transfer to gas chromatographic column/electron capture detector.  
**Target Characteristics:** Detection of vapors in quantities of  $10^{-12}$  grams and below concentrations of several ppt ( $10^{12}$ ); sensitive to TNT, DNT, GELINITE, Chloro-fluoro-nitro-organic compounds.  
**Area (Volume) of Coverage:** Air sample in search area.  
**Alarm Presentation:** Audible, visible; hard copy via potentiometer strip chart recorder.  
**Resistance to Spoofing and Tampering:** Function of device selectivity.  
**Indoor/Outdoor Operation:** Capable of both.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Output available for strip chart; standard 110V outlet for power connection.

### PHYSICAL DATA

**Size:** 20x16x10in (50x40x25cm).  
**Weight:** 70lb (32kg).  
**Power (Primary/Secondary):** 220/110V ac. 50/60Hz, 500W — no secondary.  
**Emplacement:** Portable, can be carried to any location.

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#### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

#### COST DATA

**Unit Acquisition Cost:** \$18,000. F.O.B. N.J.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Carrier gases — helium or argon consumed at 150cc per min.; one lecture bottle is sufficient for 6 hr of operation.

#### NOTES

U.S. Distributor: Elscint, Ltd., P.O. Box 297, Paisades Park, NJ 07650, (201) 461-5406

Some information contained in this data sheet was obtained by a telephone conversation with a company representative.

#### INSTALLATIONS

## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Elscint, Inc.  
P.O. Box 5258  
Haifa, Israel  
Tel. 522516

**Model** EXD-2

Reference Evaluation Guide Procedure No. V-1.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Elscint EXD-2 is an automatic instrument designed for detection of various explosives. It identifies the presence of the explosives through detection of their vapor traces in the atmosphere. This device is sensitive enough to allow detection of explosives which are wrapped, covered, or concealed. It will also detect those having a very low vapor pressure. The device is designed to be selective with almost no incidence of false alarm. The principle of operation of the EXD-2 is based on vapor selection and concentration from the atmosphere, separation of these vapors by a chromatographic column and detection by means of an ionization detector. The unit is completely portable, containing its own gas and power source for one day's continuous operation.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Warm-up period 15 minutes; response time is 8 to 12 seconds for single explosive and 30 to 60 seconds for several types of explosives.
<b>Detection Mechanism:</b>	Gas chromatograph/ionization detector.
<b>Target Characteristics:</b>	Detects concentrations of a few parts in $10^{12}$ of the following compounds: Dynamite, Gelanite, DNT, TNT, C <sub>4</sub> , Various combinations of other explosives; see notes.
<b>Area (Volume) of Coverage:</b>	Air sample in search area.
<b>Alarm Presentation:</b>	Audible and visual alarms.
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Capable of both.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	12x15x10in (30.5x38x25cm).
<b>Weight:</b>	40lb (18kg).
<b>Power (Primary/Secondary):</b>	12V dc, 2A, or 110/220V ac; can be operated for 6 to 8 hr with batteries.
<b>Emplacement:</b>	Portable, can be carried to any location.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Information not available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Carrier gases — helium or argon, one lecture bottle is sufficient for 6 to 8 hr of operation.

### NOTES

An analysis of the EXD-2 was conducted by the National Bureau of Standards; an abstract of the Report of Analysis dated 15 July 1976 is presented below.

The response of the instrument to various concentrations of explosive vapors was measured. The test mixtures were generated, using the equipment and technique developed by P. A. Pella (report in preparation). A Teflon sampling line was used to connect the instrument with the manifold of the test-mixture generator. The operating instructions furnished with the instrument were followed and an "Omniscribe" recorder, furnished with the instrument, was used as a readout device. The response, in scale divisions, for several test mixtures is given below:

EGDN	- 35 ppt (0.035 ppb) 50 scale divisions
2,4,6 TNT	- 7 ppt (0.007 ppb) 20 scale divisions

The limit of detection was not determined but it appears that concentrations of at least one-half of the lowest level measurements, i.e., 2.5 ppt for 2,6 DNT would be detectable.

The measurements reported apply only to the specific instrument investigated and may or may not be typical. The test results are for the information of the requestor and the test in no way implies endorsement of the instrument by the National Bureau of Standards.

### INSTALLATIONS

## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Ion Track Instruments, Inc.  
179 Beer Hill Rd.  
Waltham, MA 02154  
(617) 890-4343

**Model** 58

**Reference Evaluation Guide Procedure No.** V-1.A      **NRC Identification No.**

### NARRATIVE DESCRIPTION

The Model 58 is a portable explosives detector which employs an electron capture detector cell with a heated sampling system and film concentrator. This device is sensitive to commercial nitrate-based explosives including those with low vapor pressures. The detector operates continuously and will indicate the presence of explosive vapors by an audible and visible warning and also a meter reading. The detector is designed to be suitable for continuous use as part of an automatic screening system, and special electronics circuits have been included for this purpose. In this mode of operation, the detector may be operated directly from an ac source. The detector system consists of four units: i.e. control console; search gun; argon supply; battery pack. The whole system is available fitted into a carrying case for ease of use. If it is in continuous fixed use, then the detector may be bench-mounted and the battery pack disconnected.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	See Note 2.
<b>Detection/Operation Time:</b>	Two second detection; variable clear down, depending upon detected substance (see notes). Detector warmup time is 15 minutes (100C), or 20 minutes, (150C).
<b>Detection Mechanism:</b>	Electron capture detector cell with heated sampling system and film concentrator.
<b>Target Characteristics:</b>	Minimum sensitivity in terms of concentration not available. Note 1 contains a list of typical responses to the saturated vapor pressure of several explosives at an ambient temperature of 68F (20C). The detector will respond to most commercial nitrated compounds which have a vapor pressure greater than $10^{-7}$ Torr. These can include: Gelignite, Dynamite, Nitrobenzene, DNT, TNT, PETN, and RDX. Since the detector sniffs the vapor of these explosives, it works best when there is a relatively high concentration of vapor present. Higher vapor concentrations are found at higher ambient temperatures and in confined spaces. When a particular explosive is sought, e.g., TNT, then the detector temperature should be set at a temperature which will give a good response, but at the same time will give a characteristically long clear down time. In Note 2 the optimum detector temperature for four explosives are presented.
<b>Area (Volume) of Coverage:</b>	Air sample in search area.
<b>Alarm Presentation:</b>	Audible, visible, meter reading.
<b>Resistance to Spoofing and Tampering:</b>	Information not available. See Note 2 for a general discussion of response to masking agents.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Three-pole socket provided for alarm relay output. N.C. and N.C. contacts have the following ratings for non-inductive loads: 5A @ 30V dc 5A @ 230V ac

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### PHYSICAL DATA

**Size:** 5x12x10in (13x30x25cm).  
**Weight:** 50lb (23kg).  
**Power (Primary/Secondary):** 110/220/240V ac, 50/60Hz, 100VA for continuous operation; or nickel cadmium rechargeable batteries (capable of up to 8 hours operation on battery supply).  
**Emplacement:** Portable, can be carried to any location.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Instruction manual available. It is recommended that any users of equipment become familiar with the type of response obtained from the explosives for which they are searching, and the characteristic clear down time.  
**Parts and Repairs:** Spare parts kits available; maintenance by competent engineer suggested for intensive service.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available. See Note 4 for preventive maintenance required.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** \$6,600. F.O.B. Waltham, Mass. Lease programs available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available, but will include cost of carrier gas.

### NOTES

Some of the information contained in this data sheet was obtained from a telephone conversation with a company representative. The information contained in Tables 1 and 2 below was extracted from the manufacturer's instruction manual. This device has been independently evaluated by the U.S. Army (USALWL Technical Memorandum #74-14, May 1974).

#### 1. Responses and Response Times

TEMP-C	GELIGNITE		PETN		EXPLOSIVE RDX		TNT		INHIBITED 111 TRICHLOROETHANE (GENCLEAN)	
	Response on X 1	Clear Down Time Sec's	Response on X 1	Clear Down Time Sec's	Response on X 1	Clear Down Time Sec's	Response on X 1	Clear Down Time Sec's	Response on X 1	Clear Down Time Sec's
Ambient	4400	150	144	30	490	55	0	—	5000	15
50	4500	150	270	20	900	20	0	—	3000	15
100	2800	65	120	15	900	15	120	70	1600	12
150	2800	15	300	12	700	15	900	35	1600	7

**IMPORTANT NOTE:** The responses given in this table are based on military and commercial explosives tested by us. Samples from different sources may give rise to responses, particularly with PETN and RDX.

## 2. Identification of "Nitro" Response

Many compounds other than nitro groups give a response on the "detector". These include chlorinated industrial solvents, freons, or halocarbons from refrigerators, some fire extinguisher fluids, some aerosol propellant fluids, cigar and cigarette smoke. The size of the response on the sniffer depends upon the length of time the material is sniffed and its sensitivity. It is characteristic of all these nonexplosive compounds that they will clear down very quickly (less than 10 seconds unless a very large dose of pure material is sniffed) when the probe is removed and allowed to sniff fresh air.

A characteristic of all nitro responses is a slower response time and the clear down time when fresh air is sampled is slower than non-nitrated compounds. However, as the temperature is increased, the response and clear-down time may not be possible to distinguish the response of gelignite from a chlorinated solvent.

## 3. Optimum Operating Temperatures

	Gelignite	PETN	RDX	TNT
Temperature	50C	50C	100C	150C

## 14. Manufacturer's Preventive Maintenance

### Pump

The only parts requiring attention are the bearings associated with the motor, layshaft and eccentric assemblies. A little light machine oil applied to these bearings every 4 to 6 weeks will increase the life of the pump.

### Membrane

It is advisable to change the film membrane at the end of the probe at least once per week when on continuous active service.

### Instrument Out of Use

Give a freshening charge to the batteries every month.

## INSTALLATIONS

## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Ion Track Instruments, Inc.  
179 Bear Hill Rd.  
Waltham, MA 02154  
(617) 890-4343

**Model** 62

Reference Evaluation Guide Procedure No. V-1.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Model 62 explosives detector/identifier is a portable instrument which detects the presence of explosives. In addition to operating from rechargeable batteries, this device is capable of operating from most commercial power sources. A supply of argon gas, essential for correct operation, is stored in a small aluminum cylinder which is replaced when empty. The instrument consists of a control unit and search gun. The operator can search inaccessible places without the necessity of continually moving the control unit. A small pump continually draws in air through the probe mounted on the search gun. If this air contains any vapor from an explosive, it is detected in the 'search' mode and an alarm will be produced. If the air is sampled using the 'identify' mode, each individual type of explosive can be analyzed and characterized by a permanent printout produced by a recorder mounted in the control unit.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** See notes.  
**Detection/Operation Time:** Search mode, 2 second response; Identify mode, approximately 100 seconds. When the detector is out of service for a long period, the manufacturer recommends setting the detector temperature at 347F (175C) for 12 to 24 hours before operation.  
**Detection Mechanism:** Electron capture detector with heated sampling system and membrane concentrator (search mode). Cold chromatographic column/electron capture detector (identify mode).  
**Target Characteristics:** TNT, DNT, nitro-compounds (See notes). The limit of detection for TNT is 2 parts in  $10^{10}$  (mole fraction).  
**Area (Volume) of Coverage:** Air sample in search area.  
**Alarm Presentation:** Search mode: audible alarm, meter indicator, hard copy record. Identify mode: hard copy record.  
**Resistance to Spoofing and Tampering:** See notes.  
**Indoor/Outdoor Operation:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Ten foot (3m) probe service cable provided.

### PHYSICAL DATA

**Size:** 30x15x11in (76x38x28cm).  
**Weight:** 100lb (45.4kg).  
**Power (Primary/Secondary):** 110/120, 220/240V ac, 50/60Hz; battery supplies: electronics — 13 volt NiCad (500mAh capacity) provides for approximately 5 hours of normal operation; heaters — 12 volt lead-acid get (20Ah capacity) provides for approximately 6 hours of normal operation.  
**Emplacement:** Portable (console unit on wheeled chassis).

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### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Instruction manual available. It is recommended that the operator be given adequate time to become familiar with the operation of the instrument, before on-line operation. This familiarization period should involve working with a large number of different types of explosives under varying operating conditions.
<b>Parts and Repairs:</b>	Parts kits available; carrier gas: argon (a 173 liter (N.T.P.) bottle at 100 atmospheres will operate the device for approximately 23 hours).
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

### COST DATA

<b>Unit Acquisition Cost:</b>	\$12,100 F.O.B. Waltham MA; Lease programs available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available, but cost will include carrier gas.

### NOTES

Some of the information contained in this data sheet was obtained by a telephone conversation with a company representative. The information below was extracted from the manufacturer's instruction manual. This device has been evaluated by the U.S. Army MERADCOM (Report No. 2137, March 1975; AD B005380).

#### Response From Explosives

In the identify mode, responses are obtained from explosives only during the test and hardcopy display. The only exceptions to this are breakdown products and light impurities, such as nitro-methane. The order of peaks on the hardcopy obtained from nitro-explosives which have been positively identified is as follows:

- (1) Nitrobenzene
- (2) EGDN
- (3) Nitro glycerine
- (4) 2, 6 DNT
- (4) 2, 4 DNT
- (6) TNT

Peaks from pure RDX and PETN can only be obtained at elevated ambient temperature and give peaks which occur after TNT. When these materials are compounded into plastic explosives, they are mixed with more volatile materials like nitrobenzene, which gives an early peak.

### Interfering Responses From Non-Explosives

Some materials which are not explosives can produce a response in the search mode. These materials are normally halogenated hydrocarbons, such as dry cleaning fluids, aerosol propellants and refrigerant gases. These vapors are detected in the identify mode; they give a response that cannot be confused with a response from an explosive. All nitro vapors, of volatility lower than nitromethane, are retained by the column during the sniff period and are subsequently released during the test period. Some of these vapors may be emitted by non-explosives. Two known interfering responses are:

1. In some boot polishes, a peak is obtained which is consistent with nitrobenzene.
2. High concentrations of certain perfumes and aftershaves may produce a single peak which occurs almost in the same position as TNT, and is probably due to 'musk ambrette'.

### INSTALLATIONS

## PORTABLE EXPLOSIVE DETECTION COMPONENTS

**Manufacturer** Ion Track Instruments, Inc.  
179 Bear Hill Rd.  
Waltham, MA 02154  
(617) 890-4343

**Model** 70

Reference Evaluation Guide Procedure No. V-1.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The standard configuration of the Model 70 consists of a hand-held search probe containing the detector and display, which is connected to a support unit with carrying handle. The support unit includes ancillary controls, batteries and battery charger for portable operations where external power is unavailable. In operation, the Model 70 monitors continuously, visually indicating the detection of any explosive vapors on a neon logarithmic display as well as triggering an optional audio alarm. This detector utilizes a unique twin electron capture detector design. This twin detection technique results in a 1.5 second response to explosive vapors and minimizes response to other volatile electron capturing vapors. Clear down recycle time after an alarm is one second.

For access control and fixed installation screening applications, this detector is available in a modular checkpoint unit configuration designed for ease in integration with other security devices. Electronic circuitry allows alarm signals to be fed from remote locations to a central control station. This unit can be interfaced with computer-controlled security systems for unattended operations.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Detection selectivity: 100 percent, automatic rejection of non-explosive vapors.
<b>Detection/Operation Time:</b>	Response time, 1.5 seconds; clear down time, 1 second; operable after 30 minute initial warmup (unless optional pre-heater is used).
<b>Detection Mechanism:</b>	Twin electron capture detector, membrane concentrator, heated sampler system.
<b>Target Characteristics:</b>	Vapor concentration threshold is below one part explosive per billion parts of air. Detection spectrum includes commercial and military explosive compositions and derivatives.
<b>Area (Volume) of Coverage:</b>	Air sample in search area.
<b>Alarm Presentation:</b>	Indicator light, audio signal, provision for remote alarm.
<b>Resistance to Spoofing and Tampering:</b>	Dual detector design provides for improved selectivity and reduces the incidence of alarms due to non-explosive compounds.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Earphones and jack; 12V automobile battery adapter provided; two battery packs are provided; capable of interfacing with a computer-controlled security system.

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### PHYSICAL DATA

**Size:** Search Probe: 16x5x5in (40x13x13cm); Support Unit: 13x11x5in, (33x28x13cm).  
**Weight:** Search Probe: 7lb (3.2kg); Support Unit: 25lb (11.3kg); shipping weight: 70lb (32kg).  
**Power (Primary/Secondary):** 110/220V ac 50/60Hz; self-contained battery for 3½hr of operation.  
**Emplacement:** Portable unit, backpack mount provided; two 4ft<sup>3</sup> (0.12m<sup>3</sup>) argon tanks and regulator provided; NATO/Mil-spec shipping container provided; 22x22x29in (56x56x23cm).

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Instruction manual available. Minimal operator skill required.  
**Parts and Repairs:** Service, parts exchange available from supplier. Carrier gas: argon — one container permits 36 hours of normal operation.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available. Lid assembly (containing display/electronics) and detector electronics circuit boards are available under a service exchange scheme from supplier.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Basic unit, \$8,500; optional support unit, \$2,500; F.O.B. Waltham, MA; Lease programs available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

### NOTES

### INSTALLATIONS

## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Marsland Engineering, Ltd.  
350 Weber St.  
N. Waterloo, Ontario, Canada

**Model** S-201

Reference Evaluation Guide Procedure No. V-1.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Model S201 explosives detector is a portable unit which consists of a hand-held probe, a support unit, a line operation module, a battery and a charger. In operation, the instrument continuously samples the ambient air and analyzes for the vapors of explosives, ignoring interfering substances, or signalling the presence of vapors which might fool the detector. The instrument gives visible indications for ready, caution, alert and an audible tone to indicate vapor concentration. The instrument features both manual and automatic compensation for high vapor concentrations.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Less than 3 seconds; clear down time, up to 20 seconds.
<b>Detection Mechanism:</b>	Gas chromatograph.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Air sample in search area.
<b>Alarm Presentation:</b>	Visual, audio (tone pitch and amplitude).
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Suitable for both.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	Support Unit: 6x13x17in (15x33x43cm); Probe: 4x5½x8in (10x13x20cm) plus inlet tube.
<b>Weight:</b>	Support Unit: 22lb (10kg), including gas bottle; Probe: 4lb (1.8kg).
<b>Power (Primary/Secondary):</b>	Line power module, 115V, 60Hz, 50W; self-contained NiCad battery for 3½ hr operation; 230V ac line power option; 12V dc or 24V dc modules for operation from vehicles (option).
<b>Emplacement:</b>	Portable unit; remote probe operation from support unit, up to 20ft (6m); also suitable for fixed installations.

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#### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Manual available; device is operable by non-technical personnel.
<b>Parts and Repairs:</b>	Electrical and mechanical spare parts available.
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

#### COST DATA

<b>Unit Acquisition Cost:</b>	\$8,350 F.O.B. Syracuse, NY — includes battery, battery charger, manual and accessory package.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

#### NOTES

#### INSTALLATIONS

## PORTABLE EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Pye Dynamics, Ltd.  
(See notes for address of U.S.  
Distributor)

**Model** PD-2

Reference Evaluation Guide Procedure No. V 1 A NRC Identification No.

### NARRATIVE DESCRIPTION

The PD-2 is a lightweight portable explosives detector designed to distinguish between explosive and non-explosive vapors to minimize false alarms. The PD-2 is capable of detecting minute traces of explosives (sensitivity to vapor concentration of one part in several million parts of air). The device automatically adjusts itself when turned on and is operable within two minutes. The probe is directed toward the search area, the air is sampled for two seconds and is analyzed for 1.5 seconds. If the analysis is positive, an audible alarm is activated which can be fed directly to an earphone and the level of concentration is displayed on a digital readout.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Manufacturer's claim: Device is able to distinguish between explosive and non-explosive vapors.  
**Detection/Operation Time:** Approximately 3.5 seconds; clear down time not available.  
**Detection Mechanism:** Gas chromatograph.  
**Target Characteristics:** Information not available.  
**Area (Volume) of Coverage:** Air sample in search area.  
**Alarm Presentation:** Audible; indicator light denotes sampling in progress; digital readout of concentration.  
**Resistance to Spoofing and Tampering:** Manufacturer's claim: the device is able to distinguish between explosive and non-explosive vapors.  
**Indoor/Outdoor Operation:** Capable of both.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Cable for sampling probe: 5.2ft (1.6m).

### PHYSICAL DATA

**Size:** 5x18x13in (13x45x32cm).  
**Weight:** 22lb (10kg).  
**Power (Primary/Secondary):** 6V dc Nickel Cadmium rechargeable battery; continuous operation limit 6 to 8 hours.  
**Emplacement:** Portable.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operating and servicing instructions available; free operator training available.  
**Parts and Repairs:** Service contract available; carrier gas: argon — one bottle lasts for approximately 6 hours.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available. Battery and gas bottle can be changed in the field without tools in approximately 3 minutes.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Information not available.  
**Training Cost:** None.  
**Maintenance Cost:** Service contract — cost not available.  
**Operation Cost:** Information not available; will include cost of argon gas.

### NOTES

U.S. Distributor: Philips Electronics Instruments, Inc.  
750 S. Fulton Ave.  
Mt. Vernon, NY 10550  
(914) 664-4500

Options: — Spare battery.  
— Spare argon gas bottle.  
— Battery charger.  
— Gas bottle charging adapter.

### INSTALLATIONS



## WALK-THROUGH EXPLOSIVES DETECTION COMPONENTS

Gas chromatography is the most common method employed in explosives detectors for security applications. The principal components of a gas chromatograph are the air sample collector and concentrator, the carrier gas injection system, the chromatographic column and the electron capture detector and recorder.

The air sampling system draws a sample of the suspect air at a rate of several liters per minute over a metal surface which adsorbs the trace explosive constituents onto its surface. Vapor selectivity or specificity can, to a degree, be achieved by proper selection of metal. Since explosive effluents may be present in very low concentration, it may be necessary to sample a large volume of air in order to concentrate enough effluent on the adsorbing material so that an analysis can be made.

After the air sample has been taken, a neutral carrier gas (usually argon or helium) is passed over the adsorbing material. The adsorbing material may be heated during this process in order to ensure that the vapors are desorbed and transferred to the carrier gas stream.

The vapor-laden carrier gas then feeds into the chromatographic column. Each constituent has a characteristic retention time in the column which varies according to the vapor pressure of the sample constituents, their solubility in the column material, temperature, etc. The time required by the various constituents to reach the detector (electron capture type) at the selected operating temperature allows an analysis of the vapor to be made.

In the electron capture detector the vapor laden carrier gas is exposed to electrons from a radioactive source (such as tritium

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or nickel-63) and they tend to attach with high probability to the trace constituents\* which have high electron affinity. The normal operating current flowing in the detector is reduced in proportion to the concentration of the trace constituents. The signature of the vapor is obtained by recording the detector current as a function of time on a strip-chart recorder. A more practical mode of operation permits automatic programming by providing a time window which is on the order of several seconds duration and which can be located within a retention time interval between zero and 99 seconds. If a particular constituent reaches the detector during the selected time period, a visual or audible alarm is activated. The response of the instrument can be optimized by varying the temperature of the chromatographic column and the pressure of the carrier gas.

The usefulness of a detector of explosives effluents in a practical security system depends on the following instrument characteristics:

- Sensitivity -- the minimum detectable concentration of a trace gas in air.
- Response Time -- the period of time between sample injection and measurable instrument response.
- Specificity -- the uniqueness of the instrumental signature -- the absence of false alarms due to innocuous constituents in air such as perfumes,

\*Molecules containing halogen or nitro-groups typically have a high electron affinity. In the case of dynamite, the major effluent is ethylene glycol dinitrate (EGDN). In the case of TNT, the major constituent is trinitrotoluene, but mononitrotoluene and dinitrotoluene (DNT) are also present in the effluent. Hydrocarbons, such as are found in gasoline or jet fuel, produce no effect.

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shaving lotions, shoe polish, and others commonly found in the environment in which the detector is used.

- Convenience -- including portability, warmup time, power consumption, operator training required and frequency of adjustment.
- Cost -- capital investment, operational and maintenance expenditures.

Sensitivity is determined by injecting measured quantities of air saturated with explosives effluent into the airstream sampled by the instrument during normal operation. From the magnitude of the response of the detector to a certain vapor, and from separate determination of the background response (i.e., determination of the signal-to-noise ratio), the minimum detectable concentration can be estimated. Lack of sensitivity would yield a low probability of detecting a well-wrapped, concealed parcel of explosives. The response time clearly is important for security applications of explosive detectors, since it governs the rate at which traffic can flow through the inspection area. Generally the higher the concentration of the effluent, the shorter the response time. However, once an instrument has been exposed to an unduly high concentration of effluent, it may require a recovery time of several minutes or even longer to regain its full sensitivity.

Walk-through explosives detectors employ an "air curtain" within a confined area or port in order to obtain a sample of the suspect vapor. In general, they are designed for surveillance in fixed installations such as controlled access gateways and are compatible for use with other types of contraband detection devices. Some of the walk-through explosives detectors contained in the Catalog have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA.

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## WALK-THROUGH EXPLOSIVES DETECTION COMPONENTS

**Manufacturer** Marsland Engineering, Ltd.  
350 Weber St.  
N. Waterloo, Ontario Canada

**Model** S-301

Reference Evaluation Guide Procedure No. V-1.B NRC Identification No.

### NARRATIVE DESCRIPTION

The Model S301 is a walk-through vapor detector for surveillance of personnel. It detects a wide range of explosives, ignores interfering vapors and operates in near real-time. The unit is designed for surveillance in fixed installations such as controlled access gateways. It may be used alone or in conjunction with metal or nuclear detection doorways. The unit consists of an operator's control console (pedestal, table or panel mount), personnel control lights and indicators and a walk-through booth containing an air curtain sample collection system and a detection system based on the manufacturer's proprietary real-time detector.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Less than 6 seconds, rapid clear down. Screens up to 600 persons per hour.
<b>Detection Mechanism:</b>	Gas chromatograph.
<b>Test Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Defined by walk-through doorway and air curtain.
<b>Alarm Presentation:</b>	Visual (audio optional).
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Primarily indoor.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Control cable extension; external alarm system; standard ac outlet.

### PHYSICAL DATA

<b>Size:</b>	External: 77x75x30in (196x191x76cm); Ramp: 25x30in (64x76cm); Internal passage: 65x30x30in (165x76x76cm).
<b>Weight:</b>	550lb (249kg).
<b>Power (Primary/Secondary):</b>	115V, 60Hz, 600W during operation; other power options available.
<b>Emplacement:</b>	Designed for fixed emplacement (floor base); caster mount base (option) for ease in relocation; can be used alone or in conjunction with metal or nuclear detector doorways.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Manual available; operable by non-technical personnel; maintenance training may be required.

**Parts and Repairs:** Spare electrical and mechanical parts available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** Information not available.

**Government or Professional Standards:** Information not available.

**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** \$22,700 F.O.B. Syracuse, NY.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

### INSTALLATIONS

## HAND-HELD FERROUS METAL DETECTION COMPONENTS

All commercial devices that detect only ferrous or magnetic materials operate on the same principles, though the sensor elements in the instruments may differ in shape and use different materials. The characteristics of these devices depend on the sensor element which may be either a magnetometer or gradiometer. A typical magnetometer configuration consist of an oscillator, a cylindrical saturable core wound with two coils (primary and secondary) and a detector circuit, though other core/coil geometries may be used. The primary coil is connected to the oscillator, and the current flowing in the coil drives the core into saturation during a portion of each half-cycle of the driving frequency. As a result of the changing flux in the core, voltage pulses are induced in the secondary coil. The polarity and magnitude of these pulses vary with the rate of change of magnetic flux in the core. When no external field is present, the voltage pulses induced in the secondary coil are evenly spaced in time, and their frequency spectrum contains only odd harmonics. As ferrous metal is brought into the vicinity of the coil the magnetic field is altered, and unevenly spaced voltage pulses are produced in the secondary circuit. When this occurs, the secondary voltage waveform has a frequency spectrum which contains a detectable and measurable second harmonic component (a component at twice the frequency of the oscillator). To improve detection of the second harmonic component, a special circuit tuned to this frequency may be employed in the secondary circuit. A device of this type is called a second harmonic magnetometer.

Another common second harmonic magnetometer configuration consists of a ferrite torroidal core wound with an excitation

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coil (primary coil); a secondary coil is wound diametrically around the core and is called a flux-gate magnetometer. The principles of operation are similar to those discussed above.

When magnetometers are used as weapons detectors, two identical sensor elements are often used and are configured so that only the field gradient (difference) between the elements is detected and measured. This arrangement is called a gradiometer. In all configurations the detection of ferrous metal objects depends on the fact that such objects distort the earth's magnetic field or, if magnetized, provide their own external field.

The principal advantages of magnetometers are their low cost and light weight. Their basic disadvantages are their extreme sensitivity to permanently magnetized materials and their relative insensitivity to ferrous metal objects which are oriented with their major axis at right angles to the earth's field. Of course these devices cannot detect non-ferrous materials; thus they do not protect against weapons made of non-magnetic stainless steel, aluminum, beryllium-copper or plastic.

Many of the hand-held ferrous metal detectors contained in the catalog are configured in the form of a night stick or club and are rugged enough to be used as such. A few concealed models are available which are strapped onto the body of a guard and are very convenient for covert searches. Hand-held detectors are relatively insensitive to large ferrous metal objects in their vicinity because of their limited range of sensitivity. In addition, they are able to precisely locate ferrous metal objects on the person being searched. Some of the hand-held ferrous metal detectors contained in the Catalog have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA.

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## HAND-HELD FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Infinetics, Inc.  
1601 Jessup St.,  
Wilmington, DL 19802  
(302) 658-2471

**Model** Body Guard MK3

Reference Evaluation Guide Procedure No. V-2.A NRC Identification No.

### NARRATIVE DESCRIPTION

The Body Guard MK3 is a portable search device which consists of a sensor worn on the security officer's forearm, and an electronics pouch worn around the waist. A single control powers the unit and adjusts the intensity of the alarm signal. This device responds to magnetic metal objects.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Real time.
<b>Detection Mechanism:</b>	Magnetometer.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Scan 2 to 3in (5 to 7.6cm) from subject.
<b>Alarm Presentation:</b>	Audio.
<b>Resistance to Spoofing and Tampering:</b>	Limited detection range minimizes activation from extraneous objects.
<b>Indoor/Outdoor Operation:</b>	Suitable for both.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Self-contained.

### PHYSICAL DATA

<b>Size:</b>	Sensor: 5x1.1x8.5in (12.5x2.8x22cm); Pouch: 1x4x9in (2.5x10x23cm).
<b>Weight:</b>	Sensor: 0.3lb (0.13kg); Pouch: 0.9lb (0.4kg).
<b>Power (Primary/Secondary):</b>	Two 9V batteries; 10 to 40 hours of operation;
<b>Emplacement:</b>	Attached to security guard's body.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Owners manual provided; training not needed.
<b>Parts and Repairs:</b>	24 hour service from the manufacturer.
<b>Reliability:</b>	MTBF not available
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	One year guarantee against material defects and workmanship.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Off-the-shelf.

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**COST DATA**

<b>Unit Acquisition Cost:</b>	\$500. (Qty. 1 to 3); quantity discounts available.
<b>Unit Installation Cost:</b>	None.
<b>Training Cost:</b>	None.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

**NOTES**

**INSTALLATIONS**

## HAND-HELD FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Infinetics, Inc.  
1601 Jessup St.,  
Wilmington, DL 19802  
(302) 658-2473

**Model** Friskem MK 7a, MK 7b,  
MK 8, MK 10

Reference Evaluation Guide Procedure No. V-2.A      NRC Identification No.

### NARRATIVE DESCRIPTION

All Friskem hand-held units are ferrous metal detectors constructed within a sturdy metal tube. The gripping surface is a spongy, non-skid handle, and a plastic snap-in plug allows for quick replacement of batteries. Controls include off/on switch and nulling control both of which are operated with the thumb. Models MK 7 and MK 8 provide meter indication of alarm; Model MK 10 provides audio indications. All models scan at about 2 to 3 inches (5 to 7.6cm) from the subject. All models may also be used as a protective club.

### PERFORMANCE DATA

**Probability of Detection:** No data available. D.O.T. tests of a similar device indicates sensitivity to small magnetic objects including small knives. (See notes.)

**False Alarm Rate:** Expected to be low due to short distance range of sensitivity.

**Detection/Operation Time:** Real Time.

**Detection Mechanism:** Magnetometer.

**Target Characteristics:** Small ferrous metal objects such as knives.

**Area (Volume) of Coverage:** Scan subject 2 to 3 inches (5 to 7.6cm) from body.

**Alarm Presentation:** MK 7 and MK 8, meter indicator; MK 10, audio.

**Resistance to Spoofing and Tampering:** Balancing circuits provided; Spoofing susceptibility minimized by short detection range.

**Indoor/Outdoor Operation:** Suitable for both.

**Temperature:** Information not available.

**Humidity:** Information not available.

**Other Environmental Characteristics:** Information not available.

**Interface:** Self-contained.

### PHYSICAL DATA

Size/Weight:	Model	Size (in)	Size (cm)	Wgt (lb)	Wgt (kg)
	N/S MK 8 (meter)	1.5 dia. x 24	3.8 dia. x 60	1.5	0.7
	N/S MK 10 (audio)	2.0 dia. x 24	5.0 dia. 60	2.0	0.9
	Bat MK 7a Baton	1.5 dia. x 24	3.8 dia. x 60	2.0	0.9
	Bat MK 7b Baton	1.5 dia x 18	3.8 dia x 45	1.8	0.8

**Power (Primary/Secondary):** Two 9V batteries.

**Emplacement:** Portable/hand-held.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Owners manual provided; tests on similar devices indicate medium operation skill required. (See notes.)  
**Parts and Repairs:** 24 hour service from manufacturer.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** One year against defects in materials or workmanship.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Off-the-shelf.

### COST DATA

Unit Acquisition Cost:	Prices — Qty. 1-3	Domestic	Foreign
	MK 8 Nightstick (meter)	\$165	\$180
	MK 10 Nightstick (audio)	200	230
	MK 7a Hand-Held Baton	150	165
	MK 7b Hand-Held Baton	150	165
<b>Unit Installation Cost:</b>	None.		
<b>Training Cost:</b>	None.		
<b>Maintenance Cost:</b>	Information not available.		
<b>Operation Cost:</b>	Information not available.		

### NOTES

Infinetics Nightstick tested by D.O.T. Transportation Systems Center (Report No. DOT-TSC-OST-71-15).  
Performance rating: acceptable (good).

### INSTALLATIONS

## HAND-HELD FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Schonstedt Instrument Co.  
1775 Wiehle Ave.  
Reston, VA 22070  
(703) 471-1050

**Model** GB-3

Reference Evaluation Guide Procedure No. V-2.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The GB-3 Magnetic Gradiometer is a portable locator used to detect the presence of ferromagnetic objects (ferrous metals). It consists of a battery-operated electronic unit that may be carried in a pocket, a sensor probe with arm straps, and an earphone. When worn under a jacket or overcoat, the electronic unit and sensor are completely concealed. As the sensor is brought near a magnetic object, a high-pitched "squeal" is heard in the earphone. The sound reaches a higher frequency in relation to the size of the object and its proximity to the sensor. A concealed weapon will typically be detected within one foot (30cm) from the probe. A minimum gradient threshold allows detection of ferromagnetic objects in a magnetically cluttered environment.

### PERFORMANCE DATA

<b>Probability of Detection (Target Characteristics):</b>	Sensitivity: Nominal 2,000Hz output at $\pm 6,000$ gamma gradient (see Note 1). Threshold: 0 to $\pm 300$ gamma gradient results in a constant output of 30Hz.
<b>False Alarm Rate:</b>	Medium (see Note 2).
<b>Detection/Operation Time:</b>	Real Time.
<b>Detection Mechanism:</b>	Magnetic gradiometer employing two parallel flux gate sensors spaced 4in (10.1cm) apart.
<b>Target Characteristics:</b>	Concealed weapons.
<b>Area (Volume) of Coverage:</b>	Scan one foot (30cm) from subject.
<b>Alarm Presentation:</b>	Audio signal, 30Hz, to 2,000Hz; frequency is a function of the gradient of the magnetic field (Audio output less than or equal to 30Hz per 50,000 gamma of applied field).
<b>Resistance to Spoofing and Tampering:</b>	Low response to metal objects at distances greater than one foot (30cm).
<b>Indoor/Outdoor Operation:</b>	Capable of both within environmental constraints.
<b>Temperature:</b>	60 to 110F (15 to 45C).
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Self-contained.

### PHYSICAL DATA

<b>Size:</b>	Electronic Unit: 1x3x5in (2.5x7.6x12.5cm); Probe: $\frac{5}{8}$ inch dia. x 6 $\frac{1}{2}$ inches long (1.7cm dia. x 16.5cm).
<b>Weight:</b>	Approximately 12oz (0.35kg).
<b>Power (Primary/Secondary):</b>	12.5V dc mercury battery (Duracell type, TR-169); battery life: 40 hours.
<b>Emplacement:</b>	Hand-held.

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#### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available on manuals or training. Operator skill required, high (see Note 2).  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

#### COST DATA

**Unit Acquisition Cost:** \$750 F.O.B. Reston, VA; quantity discounts available.  
**Unit Installation Cost:** None.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

#### NOTES

1. One gamma equals  $10^{-5}$  Oersteds.
2. Evaluated by the DOT Transportation Systems Center (Report No. DOT-TSC-OST-71-15). Performance Rating — Acceptable (good). Operator skill required — high. Does not respond to non-magnetic stainless steel.

#### INSTALLATIONS

## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

All commercial devices that detect only ferrous or magnetic materials operate on the same principles, though the sensor elements in the instruments may differ in shape and use different materials. The characteristics of these devices depend on the sensor element which may be either a magnetometer or gradiometer. A typical magnetometer configuration consist of an oscillator, a cylindrical saturable core wound with two coils (primary and secondary) and a detector circuit, though other core/coil geometries may be used. The primary coil is connected to the oscillator, and the current flowing in the coil drives the core into saturation during a portion of each half-cycle of the driving frequency. As a result of the changing flux in the core, voltage pulses are induced in the secondary coil. The polarity and magnitude of these pulses vary with the rate of change of magnetic flux in the core. When no external field is present, the voltage pulses induced in the secondary coil are evenly spaced in time, and their frequency spectrum contains only odd harmonics. As ferrous metal is brought into the vicinity of the coil the magnetic field is altered, and unevenly spaced voltage pulses are produced in the secondary circuit. When this occurs, the secondary voltage waveform has a frequency spectrum which contains a detectable and measurable second harmonic component (a component at twice the frequency of the oscillator). To improve detection of the second harmonic component, a special circuit tuned to this frequency may be employed in the secondary circuit. A device of this type is called a second harmonic magnetometer.

Another common second harmonic magnetometer configuration consists of a ferrite torroidal core wound with an excitation

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coil (primary coil); a secondary coil is wound diametrically around the core and is called a flux-gate magnetometer. The principles of operation are similar to those discussed above.

When magnetometers are used as weapons detectors, two identical sensor elements are often used and are configured so that only the field gradient (difference) between the elements is detected and measured. This arrangement is called a gradiometer. In all configurations the detection of ferrous metal objects depends on the fact that such objects distort the earth's magnetic field or, if magnetized, provide their own external field.

The principal advantages of magnetometers are their low cost and light weight. Their basic disadvantages are their extreme sensitivity to permanently magnetized materials and their relative insensitivity to ferrous metal objects which are oriented with their major axis at right angles to the earth's field. Of course these devices cannot detect non-ferrous materials; thus they do not protect against weapons made of non-magnetic stainless steel, aluminum, beryllium-copper or plastic.

Walk-through ferrous metal detectors can be of very compact size because of their inherent simplicity. A problem that frequently arises in their use is sensitivity to moving ferrous metal (especially if magnetized) in their vicinity. As a result, a great deal of care must be exercised in the selection of a suitable installation location in industrial environments. Many of the devices can be made less sensitive to external effects by proper orientation with respect to the metal object, and the portal itself can be used to determine the best orientation by adjusting its orientation until external effects are minimized.

Because of the fundamental weakness of ferrous metal detectors (their inability to detect weapons or other devices made of non-

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ferrous metal) procedures for follow-up manual search or search with a hand-held detector are generally recommended.

Some of the walk-through ferrous metal detectors contained in the catalog have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA.

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## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer** EMCO  
P.O. Box 1546  
Austin, TX 78767  
(512) 451-8273

**Model** 8000 Series

Reference Evaluation Guide Procedure No. V-2 A      NRC Identification No.

### NARRATIVE DESCRIPTION

The EMCO 8000 Series Magnetic Security System consists of an alarm amplifier, alarm readout options and two to six sensors which respond to the movement of ferrous metals and magnetic materials. The series consists of both fixed and portable versions. The portable versions, Model 8300 series, operate from self-contained batteries; the fixed versions (8100 and 8200 series) rely on external power sources. The EMCO systems are useful in detecting the presence of weapons, ferrous metals and magnets. To provide reliable alarm responses when such objects move past the sensors, the sensors can be installed around doorways and passageways leading to secure areas. The following data pertains to all systems except as noted. Other specific model information is provided in Note 1.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Sensor characteristics are minimum sensitivity, 2 gammas, (Note 2); frequency response, 0.2 to 5Hz; output scale factor, 100 gammas/Vol. System sensitivity of sensor and amplifier and 5 to 400 gammas (adjustable).
<b>False Alarm Rate:</b>	Dependent upon sensitivity calibration for minimum target.
<b>Detection/Operation Time:</b>	Real time.
<b>Detection Mechanism:</b>	Magnetometer.
<b>Target Characteristics:</b>	Presence of weapons, ferrous metals, and magnets.
<b>Area (Volume) of Coverage:</b>	Dependent upon emplacement of sensors (2 to 6 sensors can be used). See Note 3.
<b>Alarm Presentation:</b>	Fixed installation (8100, 8200 series), latching relay with N.O., N.C. contacts (external display required); portable (8300 series), latching relay plus panel light and audio alarm.
<b>Self-test Capability:</b>	Calibrate and test using minimum size standard target suitable for the specific installation.
<b>Resistance to Spoofing and Tampering:</b>	Magnetometers are extremely sensitive to permanently magnetized materials and relatively insensitive to metallic objects which are placed with their major axis at right angles to the earth's magnetic field (See Note 3). The Series 8100 and 8200 alarm amplifier chassis is equipped with a keylock, but no tamper alarm.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Alarm output on all models consists of a latching relay N.O. or N.C. contacts. See Note 1.

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### PHYSICAL DATA

<b>Size:</b>	Sensor 7 $\frac{3}{4}$ x1 $\frac{1}{4}$ x $\frac{7}{8}$ in (19.7x4.4x2.2cm)	Alarm Amp (8100,8200) 10x12x5in (25.4x30.5x12.7cm)	8300 series (Portable Unit) Attache Case: 18x14x5in (45.7x35.6x12.7cm) contains up to 4 sensors and cables 19 $\frac{1}{4}$ lb (8.7kg)
<b>Weight</b>	$\frac{3}{4}$ lb (0.3kg)	12 lbs (5.4kg)	
<b>Power (Primary/ Secondary):</b>	See Note 1.		
<b>Emplacement:</b>	Sensors are to be mounted on a flat surface; interconnecting cables are supplied. 8300 series portable.		

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available.
<b>Parts and Repairs:</b>	Information not available
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

### COST DATA

<b>Unit Acquisition Cost:</b>	See Note 1; quantity discounts available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

- The basic Magnetic Security System, EMCO Model 8104 consists of:
  - Basic alarm amplifier with latching relay circuit mounted in an industrial enclosure with keylock.
  - Four magnetic sensors.
  - No power supply; system must be supplied externally by a 24 $\pm$ 6V dc, 0.2A supply.

Model No.	No. Sensors	Description	Power Input Requirements	Alarm Output	Dealer's or OEM Base Price (Single Qty.)
8104	4	Basic system, 4 sensors; fixed installation	External 24 $\pm$ 6V dc, 0.2A	Latching Relay; N.O., N.C. contacts	\$1,388.00
8106	6	Same as 8104 except 6 sensors; fixed installation	External 24 $\pm$ 6V dc, 0.2A	Latching Relay; N.O., N.C. contacts	\$1,825.00
8204	4	Basic system with integral ac power supply	Line input 120/240V ac 50 to 400Hz	Latching Relay; N.O., N.C. contacts	\$1,506.00

8206	6	Same as 8204 except 6 sensors; fixed installation	Line Input 120/240V ac 50 to 400Hz	Latching Relay; N.O., N.C. contacts	\$1,944.00
8214	4	Basic System, 4 sensors; fixed installation	Rechargeable Battery pack	Latching Relay; N.O., N.C. contacts	\$1,631.00
8216	6	Same as 8214 except 6 sensors; fixed installation	Rechargeable Battery pack	Latching Relay; N.O., N.C. contacts	\$2,069.00
8304	4	Portable system, self-contained in attache case with rechargeable battery pack and 4 sensors	Operates from self-contained rechargeable battery pack.	Latching Relay; N.O., N.C. contacts, panel light; audible alarm	\$1,744.00

2. 1 gamma =  $10^{-5}$  Oersteds.

3. A greater distance between the target object and a sensor produces a lower magnetic "signal" strength at the sensor. Adequate protection for many applications can be accomplished using four sensors. In order to achieve the most uniform sensitivity when mounted in a doorway or passageway, six sensors are suggested by the manufacturer.

4. Information extracted from a report prepared by the DOT Transportation Systems Center, Cambridge, MA: "Aircraft Hijacking Deterrence Instrumentation and Techniques", April, 1971.

**INSTALLATIONS**

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## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Infinetics, Inc.  
1601 Jessup St.  
Wilmington, DL 19802  
(302) 658-2471

**Model** I-riskem Type 3  
and Type 7

Reference Evaluation Guide Procedure No. V-2 A

NRC Identification No.

### NARRATIVE DESCRIPTION

The Infinetics Type 3 walk-through metal detector responds to ferrous metals such as grenades, larger knives and handguns of quality construction. Five pre-calibrated sensitivity choices are available to correspond to potential risks and to minimize unnecessary false alarms. This unit also features self-balancing to accommodate changing ambient conditions. This unit was evaluated on the basis of limited field tests by the DOT Transportation Systems Center (see note 1.) The Type 3 includes twin detector panels, a separate electronic monitor and the selected choice of mounting and a remote viewer alarm with 20ft (6.1m) of cable. The Type 7 walk-through ferrous metal detector is identical to the Type 3 with the exception that the passageway is divided into three vertical channels which function automatically with the horizontal zones of the Type 3 version. Each of the vertical channels is independently adjustable to match right, left or center on the subject's body. The alarm viewer consists of a facsimile of a person's body; an indicator glows in the zone in which a detection is made.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Dependent upon sensitivity. (See Note 2.)
<b>False Alarm Rate:</b>	Medium; minimized by proper location of equipment.
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Magnetometer.
<b>Target Characteristics:</b>	Detects presence of object containing magnetic metal (but not non-magnetic stainless steel) such as objects larger than a small knife (See Note 1).
<b>Area (Volume) of Coverage:</b>	Walk-through portal.
<b>Alarm Presentation:</b>	Visual alarm indication (lights and meter display).
<b>Self-Test Capability:</b>	Troubleshooting guidance provided in owner's manual.
<b>Resistance to Spoofing and Tampering:</b>	Response to extraneous metal objects and disturbances, medium (See Note 1); unit can be used to indicate direction from which disturbance originates; no data available on tampering.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Panel cables (10ft (3m)) supplied; Viewer cables (20ft (6.1m)) supplied; Power cable (10ft (3m)) supplied.

### PHYSICAL DATA

<b>Size:</b>	Panels approximately 6ft (1.8m) High; Console, 7.5x11x12in (19x28x30.5cm).
<b>Weight:</b>	13.5lb (6kg).
<b>Power (Primary/Secondary):</b>	Domestic: 100 to 130V ac, 45 to 420Hz, single phase, 1/4A. Foreign: 100 to 250V ac.
<b>Emplacement:</b>	Completely portable; both detectors available in three different mounting configurations.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Manuals with parts lists, schematics, etc. are provided on special order. No training is provided.

**Parts and Repairs:** 24 hour service available from manufacturer; spares (other than expendable) are "rarely needed".

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year guarantee against parts or workmanship defects.

**Government or Professional Standards:** Information not available.

**Lead Time:** Off-the-shelf.

### COST DATA

**Unit Acquisition Cost:** \$2200 to 2650, qty 1-3.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

1. In 1971, the Type 3 Detector provided independent detection capability in 3 zones. Now, the Type 3 does not offer discrete processing of the 3 zones. However, Type 7 does incorporate this feature. Evaluated by the DOT Transportation Systems Center (report No DOT-TSC-OST-71-15). Performance Rating: Good to Excellent.
2. Manufacturer states in literature that, with slight factory alteration of sensitivity ranges, the Type 3 can be used for many anti-theft security applications.

### INSTALLATIONS

## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer:** Infinetics, Inc.  
1601 Jessup St.  
Wilmington, DL 19802  
(302) 658-2471

**Model:** Friskem Type 5  
and Type 6

Reference Evaluation Guide Procedure No. V-2.A

NRC Identification No.

### NARRATIVE DESCRIPTION

The Infinetics Types 5 and 6 are ferrous metal detectors featuring self-balancing to accommodate local ambient conditions. Both are completely portable, employ plug-in circuit modules for ease of maintenance and provide mounting configuration options and various accessories. Type 5 consists of an electronics monitor, twin detector towers, selected choice of mounting and a remote alarm light with 50 feet (15m) of cable. Type 5 is capable of remote alarm activation. Type 6 consists of twin detector towers, electronics console and selected choice of mounting; it does not have the capability of activating remote alarm devices. Both units employ the same detection circuitry and can be custom tailored as desired.

### PERFORMANCE DATA

**Probability of Detection:** information not available.  
**False Alarm Rate:** information not available; however, this type of detector may be susceptible to activation by metal supports in shoes.  
**Detection/Operation Time:** Information not available.  
**Detection Mechanism:** Magnetometer.  
**Target Characteristics:** Information not available.  
**Area (Volume) of Coverage:** Walk-through portal.  
**Alarm Presentation:** Type 5: Visual alarm light and remote alarm capability, meter display.  
Type 6: Visual alarm light on electronics console, meter display.  
**Self Test Capability:** Information not available.  
**Resistance to Spoofing and Tampering:** May be susceptible to extraneous metal objects and electrical disturbances. No data available on tampering.  
**Indoor/Outdoor Operation:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Type 5: Remote alarm light: 50ft(15m) of cable; Types 5 and 6 supplied with a 10ft(3m) power cord.

### PHYSICAL DATA

**Size:** (Both Type 5 and 6): Detection towers, approximately 6ft(1.8m) high; Console, 13.5x6x9in (34.3x15.2x22.9cm).  
**Weight:** Approximately 3lb (1.0kg) (electronics console only).  
**Power (Primary/Secondary):** 90 to 250V ac, 45 to 420Hz, single phase, ¼A.  
**Emplacement:** Completely portable; quick set-up; choice of mounting configuration.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Owners manual complete with schematics, parts lists, etc.; training is not required.

**Parts and Repairs:** Available from manufacturer; 24 hour service available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** Information not available.

**Government or Professional Standards:** Information not available.

**Lead Time:** Off-the-shelf.

### COST DATA

**Unit Acquisition Cost:** Quantity of 1 to 3 (discounts available):

TYPE 5	TYPE 6	TYPE:	Domestic		Foreign	
			5	6	5	6
---	6L4P*	---		\$1950	---	\$2150
5L4S, 5L4M	6L4S, 6L4M		\$1900	1750	\$2200	1950
5L4F, 5L4W	6L4F, 6L4W		1850	1700	2150	1900
5L4T	6L4T		1800	1 50	2000	1800
5L2S, 5L2M	6L2S, 6L2M		1650	1500	1900	1700
5L2F, 5L2W	6L2F, 6L2W		1650	1500	1800	1650
6L2T	6L2T		1600	1450	1750	1600

**Unit Installation Cost:** Information not available.

**Training Cost:** None.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

\*Type 6 is available in a completely portable model (Model 6L4P) in which the entire unit is contained in a suitcase.

### INSTALLATIONS

## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Robot Industries, Inc.  
7041 Orchard St.  
Dearborn, MI 48126  
(313) 846-2623

**Model** FML Series

Reference Evaluation Guide Procedure No. V-2.A NRC Identification No.

### NARRATIVE DESCRIPTION

Robot Industries magnetometer Model FML is capable of detecting ferrous metal objects, weapons and magnets and indicating the position of the object on the person within three levels (shoulder, waist and knee). The detector is available in four configurations, three of which are built into turnstiles, booths or doors.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Information not available.  
**Detection/Operation Time:** Information not available.  
**Detection Mechanism:** Magnetometer.  
**Target Characteristics:** Information not available.  
**Area (Volume) of Coverage:** Head-to-toe coverage within walk-through portal; 3 zones of detection available.  
**Alarm Presentation:** Multiple indicator lights (3) on monitor indicates the location of the ferrous metal object. Provisions for remote audio and visual alarms available.  
**Self Test Capability:** Information not available.  
**Resistance to Spoofing and Tampering:** Information not available.  
**Indoor/Outdoor Operation:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Remote alarm interface detailed information not available.

### PHYSICAL DATA

**Size:** Outside dimensions of detector frame model FML: 60x4x84 1/2 in (152.4x10.2x214.6cm).  
**Weight:** Information not available.  
**Power (Primary/Secondary):** Information not available.  
**Emplacement:** Three models built into turnstiles, booths and doors (see notes).

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Guaranteed one year against any defects in materials and workmanship.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

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### COST DATA

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Detailed information not available; manufacturer offers free engineering services.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

Each unit is completely wired, assembled and tested at the factory, and shipped ready for installation.

Optional Equipment — Guide rails for channeling pedestrian traffic through the magnetometers as may be required.

#### Models Available:

Model FML -	Basic detector
Model FTML -	Basic detector with turnstile
Model HTB -	Basic detector with booth
Model FML -SLD -	Basic detector with slide door

### INSTALLATIONS

## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer:** Robot Industries, Inc.  
7041 Orchard St.  
Dearborn, MI 48126  
(313) 846-2623

**Model:** FSL Series

Reference Evaluation Guide Procedure No. V-2.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Robot Industries magnetometer walk-through detector, Model FSL, provides a capability to detect ferrous metal products or weapons carried on a person. This detector is available in four configurations, three of which are built into booths, turnstiles or doors.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Information not available.  
**Detection/Operation Time:** Real time, 2 seconds per person.  
**Detection Mechanism:** Magnetometer.  
**Target Characteristics:** Information not available.  
**Area (Volume) of Coverage:** Head-to-toe detection range within walk-through portal.  
**Alarm Presentation:** Light indicator on electronics console (mounted on frame); provisions for remote audio or visual alarms.  
**Self Test Capability:** Information not available.  
**Resistance to Spoofing and Tampering:** Information not available.  
**Indoor/Outdoor Operation:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Remote alarm capability, information not available on interface.

### PHYSICAL DATA

**Size:** Outside dimensions of the basic detection frame: 38x4x84½in (96.5x10.2x214.6cm).  
**Weight:** Information not available.  
**Power (Primary/Secondary):** 120V ac.  
**Emplacement:** Detection units can be employed in both fixed and portable installations.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Guaranteed for one year against any defects in materials and workmanship.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

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### COST DATA

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Detailed information not available; manufacturer offers free engineering services.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

Each unit is completely wired, assembled and tested at the factory, and shipped completely assembled for setting in desired location.

Optional Equipment: Guide rails for channeling pedestrian traffic through the magnetometers as may be required.

#### Models Available:

Model FSL	—	Detector
Model FTSL	—	Detector with turnstile
Model LTB	—	Detector with booth
Model FSL-SWD	—	Detector with swing door

### INSTALLATIONS

## WALK-THROUGH FERROUS METAL DETECTION COMPONENTS

**Manufacturer** Schonstedt Instrument Co.  
1775 Wiehle Ave.  
Reston, VA 22070  
(703) 471-1050

**Model** SD-2

Reference Evaluation Guide Procedure No. V-2.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Model SD-2 "Searcher" detects magnetic objects and ferrous metal objects including guns and knives which may be carried on a person. The unit consists of two stands containing Schonstedt HeliFlux® magnetic field sensors which are positioned up to four feet apart in a walk-through configuration. The unit features easy set up, high stability, a wide range of sensitivity settings and high tolerance to changes in the ambient magnetic field without adjustment.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Depends upon sensitivity setting for minimum target size; orientation sensitive (see notes).
<b>False Alarm Rate:</b>	Information not available; however, the manufacturer claims the SD-2 to be relatively insensitive to changes in ambient magnetic field; responds only to induced magnetic field. Likelihood of false alarms is medium, and can be especially caused by metal supports in men's shoes (see notes).
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Magnetometer (flux gate sensor).
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Area between detection sensors.
<b>Alarm Presentation:</b>	Visual lamp indicator. Optional capability to operate 110V ac alarms or controls.
<b>Self Test Capability:</b>	Information not available.
<b>Resistance to Spoofing and Tampering:</b>	Medium response to extraneous metal objects and electrical disturbances (especially large objects made of magnetic material in motion near the unit) (see notes); tampering information not available.
<b>Indoor/Outdoor Operation:</b>	Suitable for both.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	Detector units approximately 2in x 5ft long (5cm dia. x 1.5m).
<b>Weight:</b>	Information not available.
<b>Power (Primary/Secondary):</b>	110V ac. Operation from rechargeable batteries optional.
<b>Emplacement:</b>	Completely portable or may be used in fixed installation; detector stands may be placed up to four feet (1.2m) apart; a concealed version is available for installation in doorways.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available. Operator skill required, is low (see notes).  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** \$1,220., quantity discounts available; F.O.B. Reston, VA.  
**Unit Installation Cost:** Information not available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

### NOTES

Evaluated by the DOT Transportation Systems Center  
(report No. DOT-TSC-OST-71-15). Performance Rating: Fair. Cost Effectiveness: Good. Operator Skill  
Required: Low. Does not respond to non-magnetic stainless steel.

### INSTALLATIONS

## HAND-HELD ALL-METAL DETECTION COMPONENTS

Detectors of all metals measure the disturbances in an alternating electromagnetic field caused by the presence of any metallic object. The field may be characterized by its frequency and uniformity; beyond this, the various manufacturers of these devices use different configurations. Some of the configurations/techniques employed are listed below.

- Single coil -- inductance change measured by phase of amplitude variations.
- Dual oscillator -- measurement of beat frequency.
- Dual coils -- measurement of changes in mutual coupling.
- Transmitter/receiver loops -- measurement of transmission losses.
- Marginal oscillator arrangements using feedback changes to vary oscillator output.
- Pulsed field -- eddy current decay detection and analysis.

The simplest form of all-metal detector consists of a single coil of wire which forms one element of an alternating current impedance bridge circuit. A metal object in or near the plane of the coil changes the circuit impedance, unbalances the bridge and results in a signal indicating the presence of the object. Commercial all-metal detectors use many variations of this basic concept.

For maximum effectiveness the all-metal detectors must have high field strength uniformity. Otherwise, performance will vary greatly with the location of a metal object relative to the primary coil. However, the direction of the field should not be uniform, because the orientation of a weapon with respect to the field determines the strength of the interaction. Also, the excitation frequency must not be too high, or the device will be too sensitive to foil wrappers, etc., and will have a high nuisance alarm rate. Many of the less expensive single-coil models operate at high frequencies (20 kHz or higher) and also produce nonuniform fields. Devices operating at frequencies below 200 Hz have difficulty in detecting weapons made of high-resistivity metals such as stainless steel.

Hand-held all-metal detectors are compact in size and may be shaped in the form of a club (and are rugged enough to be used as such). These units typically have balance adjustments and provide an audio alarm presentation. The primary advantages of hand-held detectors is that they can precisely locate a metal object concealed on a person's body without hands-on search, and they are insensitive to large metal objects in the nearby vicinity because the detection range is limited to the immediate vicinity of the search coil. Many of these hand-held detectors have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA.

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## HAND-HELD ALL-METAL DETECTION COMPONENTS

**Manufacturer** Federal Laboratories, Inc.  
Saltsburg, PA 15651  
(412) 639-3511

**Model** Transfrisker #6030

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Federal Laboratories Transfrisker #6030 is a fully transistorized, battery-operated, hand-held search unit which responds to both ferrous and non-ferrous metal objects. This device features an earphone which allows it to be used in noisy areas. Detection cuts off at 18in (45.7cm), so the device can be used near large masses of metal without affecting its efficiency. (See notes.)

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Response to extraneous metal objects and electrical disturbance is low at distance of one foot (30.5cm); operator must be familiar with response to coins, etc. to distinguish these from small metal weapons; detection cut off of 18in (45.7cm) reduces spurious alarms.  
**Detection/Operation Time:** Real time.  
**Detection Mechanism:** Induction balance system (active field).  
**Target Characteristics:** Detects a dime at 2in (5cm) separation.  
**Area (Volume) of Coverage:** Detection cuts off at 18in (45.7cm) from subject.  
**Alarm Presentation:** Electronic squeal indicates proximity of metal.  
**Indoor/Outdoor Operation:** Capable of both.  
**Resistance to Spoofing and Tampering:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Self-contained.

### PHYSICAL DATA

**Size:** 13¼x2¼x3½in (33.6x5.7x8.0cm).  
**Weight:** 1lb 13oz (0.8kg).  
**Power (Primary/Secondary):** Two 9V transistor batteries.  
**Placement:** Hand-held.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available; operators require medium to high skill to operate (see notes).  
**Parts and Repairs:** Serviced by manufacturer.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

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#### COST DATA

Unit Acquisition Cost:	\$225.
Unit Installation Cost:	Not applicable.
Training Cost:	Information not available.
Maintenance Cost:	Information not available.
Operation Cost:	Information not available.

#### NOTES

An earlier model of this device (Model 6010), has been evaluated by the DOT Transportation Systems Center, Cambridge, MA 02142. According to report No. DOT-TSC-OST-71-15, June 1971, Model 6010 was rated good to excellent based on limited field tests in:

1. Low-risk capital cost-effectiveness
  2. High-risk capital cost-effectiveness
  3. Low-risk Performance
  4. High-risk Performance
- Operator Skill Required: medium to high:

#### INSTALLATIONS

## HAND-HELD ALL-METAL DETECTION COMPONENTS

**Manufacturer** Rens Manufacturing Co.  
P.O. Box 337  
Creswell, OR 97426  
(503) 895-2172

**Model** Minisquealer Model 25

Reference Evaluation Guide Procedure No. V-3.A NRC Identification No.

### NARRATIVE DESCRIPTION

The Rens Minisquealer, Model 25, is a hand-held, battery-operated scanner which is capable of detecting both ferrous and non-ferrous metal objects. Typical applications include the scanning of small packages for hidden metal objects. Metal detection is indicated by a change in the audible signal.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Low due to limited detection range.
<b>Detection/Operation Time:</b>	Real time.
<b>Detection Mechanism:</b>	Active field; nominal frequency 130kHz.
<b>Target Characteristics:</b>	Manufacturer claims that the highest sensitivity (for paper clips, razor blades, etc.) is found when the calibration control is set just to the left threshold point where the chirping sound stops. Setting the calibration control 30 degrees to the left of the threshold point will yield a sensitivity making keys or a wristwatch detectable at about a 1in (2.5cm) distance, and a cigarette pack at about a 4in (10cm) distance.
<b>Area (Volume) of Coverage:</b>	Scan in vicinity of subject.
<b>Alarm Presentation:</b>	Audio signal.
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Either within temperature limits.
<b>Temperature:</b>	32 to 113F (0 to 45C).
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Self-contained.

### PHYSICAL DATA

<b>Size:</b>	Length, 17 $\frac{3}{8}$ in (44.1cm); width, 6in (15.2cm) at probe coil.
<b>Weight:</b>	22oz (620gm) with battery.
<b>Power (Primary/Secondary):</b>	One 9V Eveready 216 (NEDA 1604) or equivalent. Power consumption: 11mA (0.1W) unit sounding; 6.5mA (0.06W) unit silent. Useful battery voltage drops to approximately 6V.
<b>Emplacement:</b>	Hand-held.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Factory direct repair service.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** One year warranty.  
**Government or Professional Standards:** FCC regulation, Part 15; NILECJ-STD-0602.00.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** \$199.50  
**Unit Installation Cost:** Not applicable.  
**Training Cost:** Information not available.  
**Maintenance Cost:** No data available.  
**Operation Cost:** Information not available.

### NOTES

### INSTALLATIONS

## HAND-HELD ALL-METAL DETECTION COMPONENTS

**Manufacturer** Rens Manufacturing Co.  
P.O. Box 387  
Creswell, OR 97426  
(503) 895-2172

**Model** SQ-15 Squealer

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Rens SQ-15 Squealer is a hand-held, battery-operated scanner which is capable of detecting both ferrous and non-ferrous metal objects. This unit facilitates the pinpointing of metal objects on the person. Metal detection is indicated by variations in the pitch and intensity of the speaker tone. The coil in the search probe is connected to a high frequency oscillator. This unit was evaluated in 1971 by D.O.T. (see notes).

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Operator must be familiar with response to coins, keys, or metal foil to distinguish these from small metal weapons; or subject must divest himself of all extraneous metal (see notes).  
**Detection/Operation Time:** Real time.  
**Detection Mechanism:** Active field.  
**Target Characteristics:** Sensitive to all metal objects including small knives (see notes).  
**Area (Volume) of Coverage:** Scan about 3 inches (7.5cm) from subject.  
**Alarm Presentation:** Variable pitch and volume audio alarm.  
**Resistance to Spoofing and Tampering:** Response to extraneous metal objects and electrical disturbances is low at distances greater than one foot (see notes). No data available on resistance to tampering.  
**Indoor/Outdoor Operation:** Suitable for both.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Self-contained.

### PHYSICAL DATA

**Size:** 2½x3½x15¾in (6.4x8.9x40cm).  
**Weight:** 26oz (0.7kg).  
**Power (Primary/Secondary):** Battery-operated.  
**Emplacement:** Hand-held.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available; operator skill required — medium to high (see notes).  
**Parts and Repairs:** Direct factory repair service; temporary service replacement units are available.  
**Reliability:** Information not available.  
**Maintainability:** Information not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

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#### COST DATA

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

#### NOTES

Laboratory evaluation based on exhaustive testing at the DOT Transportation Systems Center (report No. DOT-TSC-OST-71-15). Performance Rating: Excellent. Operator Skill Required: medium to high.

#### INSTALLATIONS

## HAND-HELD ALL-METAL DETECTION COMPONENTS

<i>Manufacturer</i>	Solco Engineering, Inc. 9555 Cozycroft Ave. Clatsworth, CA 91311 (213) 882-2755
<i>Model</i>	Electro-Search Hand Scanner
Reference Evaluation Guide Procedure No. V-3.A	NRC Identification No.

### NARRATIVE DESCRIPTION

The Electro-Search Hand Scanner is a hand-held all-metal detector which is used to pinpoint the location of any metal on a subject. It features an audio tone which is proportional to the mass and the distance to the metal being detected. Easy action momentary ON/OFF switch automatically deactivates unit when thumb pressure is released.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Real time.
<b>Detection Mechanism:</b>	Active field.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Information not available.
<b>Alarm Presentation:</b>	Audible tone, frequency proportional to mass of and distance from metal.
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Self-contained.

### PHYSICAL DATA

<b>Size:</b>	Fits in the palm of the hand.
<b>Weight:</b>	2lb (0.9kg).
<b>Power (Primary):</b>	Two 9V batteries.
<b>Emplacement:</b>	Hand-held.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available.
<b>Parts and Repairs:</b>	Information not available.
<b>Reliability:</b>	Information not available.
<b>Maintainability:</b>	Information not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

**COST DATA**

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

**NOTES**

**INSTALLATIONS**

## HAND-HELD ALL-METAL DETECTION COMPONENTS

**Manufacturer** Law Enforcement Associates  
88 Holmes St.  
Belleville, NJ 01709  
(201) 751-0001

**Model** LEA-100

Reference Evaluation Guide Procedure No. V-3.A NRC Identification No.

### NARRATIVE DESCRIPTION

The LEA-100 Electronics Weapons Detector is a hand-held unit suitable for body searches for concealed weapons.

### PERFORMANCE DATA

**Probability of Detection (Target Characteristics):** Information not available.  
**False Alarm Rate:** Information not available.  
**Detection/Operation Time:** Real time.  
**Detection Mechanism:** Information not available.  
**Target Characteristics:** Dime or hidden razor blade.  
**Area (Volume) of Coverage:** Adjustable penetration from 1 inch to 1ft (2.5 to 30.5cm).  
**Alarm Presentation:** Visual warning light.  
**Resistance to Spoofing and Tampering:** Information not available.  
**Indoor/Outdoor Operation:** Suitable for both.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Self-contained.

### PHYSICAL DATA

**Size:** Approximately 6' 1/2 x 1 x 3 in (16.5 x 2.5 x 7.5 cm).  
**Weight:** Information not available.  
**Power (Primary/Secondary):** Battery-operated.  
**Emplacement:** Hand-held.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information on documentation not available; training is not required.  
**Parts and Repairs:** Information not available.  
**Reliability:** Information not available.  
**Maintainability:** Information not available.  
**Warranty information:** Unconditional one year guarantee (replaced free if found defective during first year).  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

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**COST DATA**

Unit Acquisition Cost:	\$95.
Unit Installation Cost:	None.
Training Cost:	None.
Maintenance Cost:	Information not available.
Operation Cost:	Information not available.

**NOTES**

**INSTALLATIONS**

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

Detectors of all metals measure the disturbances in an alternating electromagnetic field caused by the presence of any metallic object. The field may be characterized by its frequency and uniformity; beyond this, the various manufacturers of these devices use different configurations. Some of the configurations/techniques employed are listed below.

- Single coil -- inductance change measured by phase of amplitude variations.
- Dual oscillator -- measurement of beat frequency.
- Dual coils -- measurement of changes in mutual coupling.
- Transmitter/receiver loops -- measurement of transmission losses.
- Marginal oscillator arrangements using feedback changes to vary oscillator output.
- Pulsed field -- eddy current decay detection and analysis.

In a typical walk-through active field all-metal detector, two coils, primary and secondary, are located several feet apart. The primary coil is energized by an oscillator and produces an electromagnetic field which is coupled to the secondary coil. Under quiescent operating conditions the detector circuit, typically a balanced bridge circuit, maintains a zero signal condition at the indicator device. If a metallic object is introduced between the

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coils, the coupling between the primary and secondary coils is altered, the detector becomes unbalanced and the indicator displays the signal. Magnetic and non-magnetic metals each alter the coupling in a different way, and they can be differentiated by noting the polarity of the displayed signal. If the change in field coupling measured by the device exceeds a preselected threshold, an alarm circuit can be actuated.

The simplest form of all-metal detector consists of a single coil of wire which forms one element of an alternating current impedance bridge circuit. A metal object in or near the plane of the coil changes the circuit impedance, unbalances the bridge and results in a signal indicating the presence of the object. Commercial all-metal detectors use many variations of this basic concept.

For maximum effectiveness the all-metal detectors must have high field strength uniformity. Otherwise, performance will vary greatly with the location of a metal object relative to the primary coil. However, the direction of the field should not be uniform, because the orientation of a weapon with respect to the field determines the strength of the interaction. Also, the excitation frequency must not be too high, or the device will be too sensitive to foil wrappers, etc., and will have a high nuisance alarm rate. Many of the less expensive single-coil models operate at high frequencies (20 kHz or higher) and also produce nonuniform fields. The more costly units use multiple coils to improve field uniformity and operate at lower frequencies to improve detection performance. At frequencies below 200 Hz, however, it is difficult to detect weapons made of high-resistivity metals such as stainless steel.

The operation of the most advanced pulsed-field detectors involves the detailed interaction between electromagnetic fields and metal objects. When an object is immersed in an electromagnetic

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field, circulating currents (eddy currents) are induced in it which give rise to losses and secondary electromagnetic fields which affect the primary circuit both of which are detectable and measurable. The respective magnitudes of these two effects vary with the geometry of the object, its resistivity thickness, and orientation in the field as well as the frequency of the field. As a result, it is possible to determine the "signature" of specific metal objects and to use logic circuitry to identify them. These devices can be optimized by adjustment of the pulse and detection circuitry to discriminate target objects from background objects in order to reduce the occurrence of nuisance alarms.

Walk-through all metal detectors typically consist of a portal, the sides of which contain the search coils, and an electronics console. In most cases the equipment can be operated in the vicinity of other equipment such as x-ray inspection gear. If several units are employed in a confined area it is generally recommended that they be synchronized with each other in order to eliminate mutual interference.

Various levels of search can be made with these devices depending upon the sensitivity setting selected. The usual practice in using walk-through detectors is to require the persons to be screened to divest themselves of all metal objects before entering the portal in order to reduce the incidence of nuisance alarms. If an alarm condition results, hand scanner or manual inspection is required. Among the causes of nuisance alarms are metal supports in shoes (which may be a particularly troublesome source in license facilities) and metal foil such as that found in cigarette packages and candy bars. Manual search procedures should be established and adhered to in order to protect against "masking" of a concealed weapon by a known nuisance alarm source.

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Some walk-through all-metal detectors have been evaluated by the Department of Transportation, Transportation Systems Center, Cambridge, MA.

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## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Boekels, Dr. Hans  
GmbH & Co.  
Postfach 847  
D5100 Aachen  
Federal Republic of  
Germany

**Model** Boekels Metal Detector

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Boekels Metal Detector is an all-metal, walk-through detector which features location discrimination. The device consists of three essential parts: the electronic control unit, a search coil, which, in the case of personnel screening is a gate approximately the size of an ordinary door (size can be adapted to special needs), and an indicator device. The passage area of the coil and indicator panel are subdivided into 16 zones: four vertical zones, right, right-center, left-center, and left; and four horizontal zones, head, chest, hip and leg.

### PERFORMANCE DATA

**Probability of Detection:** Detection sensitivity variable. Will detect all metal weapons, and often discriminates between them and innocuous metal objects (see notes).

**False Alarm Rate:** Likelihood of false alarms is extremely low (see notes).

**Detection/Operation Time:** Traffic flow is regulated by means of stop-go lights; detection is made in real time.

**Detection Mechanism:** Active field 15kHz  $\pm$  1 percent.

**Target Characteristics:** Information not available

**Area (Volume) of Coverage:** Walk-through portal.

**Alarm Presentation:** 16 LED indicators, relay contacts. Self-test capability: Lamp test ensures processing of signals and that signal indicators are functioning.

**Resistance to Spoofing and Tampering:** Information not available.

**Indoor/Outdoor Operation:** Indoor.

**Temperature:** Information not available.

**Humidity:** Information not available.

**Other Environmental Characteristics:** Information not available.

**Interface:** All cables and connectors provided; buyer supplies power cord.

### PHYSICAL DATA

	Search Coil	Control Unit	Indicator and Control Unit
<b>Size: H</b>	43 $\frac{1}{4}$ in (111cm)	21in (53.5cm)	6 $\frac{1}{2}$ in (16.5cm)
<b>W</b>	96 $\frac{1}{2}$ in (245cm)	23in (58.7cm)	15 $\frac{1}{2}$ in (39cm)
<b>D</b>	38 $\frac{3}{8}$ in (97.5cm)	12in (30cm)	4 $\frac{1}{2}$ in (11cm)
<b>Weight:</b>	1,440lb (650kg)	90lb (40kg)	25lb (11.5kg)
<b>Power (Primary/Secondary):</b>	220V/50Hz, 70VA. Other Voltages and frequencies available.		
<b>Emplacement:</b>	Less than 10ft (3m) in all directions required for installation.		

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Documentation information not available; operator's skill required: medium (see notes).  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** \$9,600.  
**Unit Installation Cost:** Information not available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

### NOTES

This device was evaluated in experimental stage and the results were reported in U.S. Department of Transportation report No. DOT-TSC-OST-71-15. The evaluation was based on Government reports on an experimental model by the Federal Republic of Germany.  
Performance Rating: Excellent.

### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer:** Federal Laboratories, Inc.  
Saltsburg, PA 15681  
(412) 639-3511

**Model:** FL-6050-AN

**Reference Evaluation Guide Procedure No. V-3.A**      **NRC Identification No.**

### NARRATIVE DESCRIPTION

The Federal Laboratories FL-6050-AN is a walk-through metal detector which employs an active magnetic field making the device capable of detecting all types of metals. This device features automatic balancing and a sensitivity adjustment control. The detector is adaptable for remote control operation and is compatible with a security system alarm interface.

### PERFORMANCE DATA

**Probability of Detection:** Information not available.  
**False Alarm Rate:** Information not available.  
**Detection/Operation Time:** Throughput rate — 4 to 15 people per minute (depending on sensitivity level).  
**Detection Mechanism:** Active field with automatic balancing.  
**Target Characteristics:** Capable of detecting all objects under the basic requirements of LEAA NILECJ-STD-0601.00.  
**Area (Volume) of Coverage:** Walk-through portal, 78.5in high x 26in wide x 16in long (199x66x41cm).  
**Alarm Presentation:** Audible and visual (meter indication) with selective deactivation of audible possible.  
**Self-Test Capability:** Press-to-test switch on electronic control console.  
**Resistance to Spoofing and Tampering:** Information not available.  
**Indoor/Outdoor Operation:** Information not available.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Information not available.

### PHYSICAL DATA

**Size:** Console: 16½x37¾x18¼in (42x96x46cm); Floor Space: 11ft<sup>2</sup> (1m<sup>2</sup>) including walkway.  
**Weight:** 240lb (109kg).  
**Power (Primary/Secondary):** 115V ac, 60Hz, 20W.  
**Emplacement:** Fixed installation.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Capable of detecting test objects conforming to NILECJ-STD-0601.00.  
**Lead Time:** Information not available.

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**COST DATA**

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

**NOTES**

**INSTALLATIONS**

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Intex, Inc.  
6935 Wisconsin Ave.  
Chevy Chase, MD 20015  
(301) 654-4550

**Model** FS-1

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Sentry Model FS-1 Weapons Detector is a walk-through structure employing a detector designed to detect any metal by using pulsed magnetic fields to excite transient eddy currents in target metal objects, and to sense and process secondary signals during the ON and/or OFF time of the excitation pulses. This unit is widely used within government agencies and by major aviation and industrial corporations. Double portal, co-planar portable and battery-operated versions are available for screening personnel or non-metallic containers. Sensor coils are encapsulated in ruggedized panels with formica finish; console is constructed of heavy gauge aluminum with solid walnut end-panels.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Detection of .22 caliber handgun with non-ferrous frame or a 2oz(57g) knife with confidence level of 95 percent or better; alarm level adjustable.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Pulsed magnetic field/eddy current decay, self-balancing — field balancing not required.
<b>Target Characteristics:</b>	Will detect a .22 caliber handgun with non-ferrous frame or 2oz(57g) knife.
<b>Area (Volume) of Coverage:</b>	Defined by sensor coil emplacement.
<b>Alarm Presentation:</b>	Adjustable audio; red alarm lamp; green stand by/normal lamp.
<b>Self-Test Capability:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Indoor and outdoor within temperature limits.
<b>Resistance to Spoofing and Tampering:</b>	Insensitive to fixed metal objects in vicinity. Relatively insensitive to electromagnetic or electrostatic interference.
<b>Temperature:</b>	32 to 131F (0 to 55C).
<b>Humidity:</b>	Up to 95 percent.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Shielded pair cable for remote alarm devices up to 200ft(61m) from console; remote alarm contacts are provided on alarm relay and are accessible at screw terminals in the rear of the console; uses standard ac outlet.

### PHYSICAL DATA

<b>Size:</b>	Passageway, 13½x30x77in (34x76x196cm); Overall Arch Assembly, 13½x36x79½in (34x91x202cm); Electronic Console, 12½x17½x6½in (32x44x16cm).
<b>Weight:</b>	Archway, 60lb (27kg); Console, 20lb (9kg).
<b>Power (Primary/Secondary):</b>	115/230V ac, 50/60Hz, less than 100VA; battery operation optional.
<b>Emplacement:</b>	Sensor panels can be relocated to suit special applications.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Installation, operation and maintenance manuals available. Training information not available.

**Parts and Repairs:** PC boards and IC's are removable and available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year from acceptance date in accordance to terms specified in technical documentation.

**Government or Professional Standards:** Meets requirements of FAA Security Manual, Chapter 5. U.S. Bureau of Standards criteria, NILECJ Standards for security levels 1, 2 and 3.

**Lead Time:** information not available.

### COST DATA

**Unit Acquisition Cost:** Information not available.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Infinetics, Inc.  
1601 Jessup St.  
Wilmington, DL 19802  
(302) 658-2471

**Model** Friskem Series 40

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Friskem Series 40 detectors are active field, all-metal walk-through detection devices which are "task optimized" to concentrate on any selected metal (see notes for a description of the detection specialties of the 44 models available in Series 40).

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Manufacturer claims 100 percent scores in FAA calibrations.
<b>False Alarm Rate:</b>	Manufacturer claims less than 5 percent in normal anti-hijacking operations without emptying pockets. Lockout prevents any alarms from ambient disturbances while the unit is not in actual service (the detector is active only when a person occupies the detection zone).
<b>Detection/Operation Time:</b>	Cycle times average 2 to 3 seconds (normal walking pace); operation time is in microseconds; an automatic traffic monitor is used to control pedestrian traffic.
<b>Detection Mechanism:</b>	Active field with electronic logic discrimination. Detection signal is composed of ferrous and non-ferrous metal contributions.
<b>Target Characteristics:</b>	See notes.
<b>Area (Volume) of Coverage:</b>	Walk-through portal.
<b>Alarm Presentation:</b>	Visual readout (indicator light); optional relay for remote alarm devices.
<b>Self-Test Capability:</b>	Troubleshooting facilitated through the use of function indicator lights. Failsafe circuitry incorporated in the field generation unit causes it to shut down if the field is too high or too low. If the unit is out of adjustment past its automatic correction circuit limits, lockouts prevent further use.
<b>Resistance to Spoofing and Tampering:</b>	Automatic nulling circuits; built-in shielding; insensitive to X-ray inspection equipment, passing vehicles, electrical interference, and other site-specific difficulties.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Requirements:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	See notes.
<b>Weight:</b>	See notes.
<b>Power (Primary/Secondary):</b>	Nominal line input 50/60Hz, 115V ac, 1.5A, 200W, single phase; internal adjustment available for line voltage.
<b>Emplacement:</b>	Information not available.

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### PERFORMANCE DATA

**Documentation and Training:** Instructions include comprehensive troubleshooting guide which permits locating problems with a common VOM meter; no special training required.

**Parts and Repairs:** Plug-in modules, spare parts, etc., available from manufacturer.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available. Modular construction for ease of part replacement; no periodic maintenance required.

**Warranty Information:** Warranted for one year against parts and workmanship defects. After warranty period, repair modules are available at 30 percent of list price.

**Government or Professional Standards:** Evaluated by FAA. Type 43, Model A (airport weapon detector) is calibrated to match FAA regulations based on a specific gun test.

**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** See notes; GSA pricing.

**Unit Installation Cost:** Information not available.

**Training Cost:** No training required.

**Maintenance Cost:** Maintenance can be performed by semi-skilled personnel; cost information not available.

**Operation Cost:** Information not available.

### NOTES

**Construction:** Early models employed wooden detection planes; current models employ molded plastic detection planes.

**Controls and indicators on operator's panel:** Circuit Saturation, Low Field, Reset (optional), Advisory (optional), Alarm, Clear, Power Supply Lamp, Sensitivity dial, Threshold Potentiometer.

### ASSEMBLED DETECTOR

<b>Specifications:</b>		<b>Domestic (Overseas)</b>
	Floor Space	4x4ft (1.2x1.2m)
	Minimum Ceiling	7ft (2.1m)
	Std. Aisle	30in (.76m)
	Weight	120lb (57kg)

### SERIES 40 WALK-THRU DETECTORS

Type No.	Detection Specialty	Base Price 1-3 Units	
		Domestic	Overseas
41	BRASS, Thin	\$2500	\$2900
42	TIN, Thick	2750	3200
43	GUN, Lo Risk; FAA airport regulations	2600	3000
43B	GUN, Lo Risk; nuclear regulations	2600	3000
43C1	GUN, Med. Risk; prison visit, court, etc.	2600	3000
43C2	GUN, Hi Risk; prison inmate, etc.	2600	3000
43D	GUN, Militarized for tactical operation	2900	3400
44	LEAD, Thick & nuclear regulations	2750	3200
45	SILVER, Thick	2900	3400

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46	SILVER, Thin	2900	3400
47	GOLD, Thick	2900	3400
48	BRASS, Thick	2750	3200
49	STAINLESS, Non-magnetic	2825	3300
50	COPPER, Thick	2750	3200
51	ALUMINUM, Thick	2750	3200
52	NICKEL, Thin	2900	3400
53	NICKEL, Thick	2900	3400
54	SILVERPLATE, Hi-quality	2900	3400
55	COPPER, Thin	2750	3200
56	ALUMINUM, Thin	2900	3400
57	GOLD, Thin	2900	3400
58	GUN, Poor-quality	2750	3200
59	BOMB COMPONENTS	2825	3300
60	GEN. PURPOSE: Mostly ferrous metal	2600	3000
61	GEN. PURPOSE: Mostly non-ferrous metals	2750	3200
62	GEN. PURPOSE: Pewter & brass	2750	3200
63	GEN. PURPOSE: All common metals	2825	3300
64	GEN. PURPOSE: Pewter & silver	2900	3400
65	GEN. PURPOSE: Copper, bronze, steel	2900	3400
66	GEN. PURPOSE: Nickel, zinc, cadmium, steel	2900	3400
67	GEN. PURPOSE: Gold & silver	2900	3400
68	GEN. PURPOSE: Jewelry products	2900	3400
69	GEN. PURPOSE: Electronic assemblies	2825	3300
70	MERCURY	2825	3300
71	CADMIUM, Thin	2900	3400
72	CADMIUM, Thick	2900	3400
73	TITANIUM, Thin	2825	3300
74	TITANIUM, Thick	2825	3300
75	PLATINUM, Thin	2900	3400
76	PLATINUM, Thick	2900	3400
77	ZINC, Thin	2740	3200
78	ZINC, Thick	2750	3200
79	AUTOMOTIVE MECHANICAL ASSEMBLIES	2600	3000
80	POWER TOOLS	2600	3000

#### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Outokumpu Oy  
P.O.B. 27  
02101 Espoo 10  
Finland  
(See Note 1 for U.S. distributor)

**Model** METOR 112/0508

**Reference Evaluation Guide Procedure No.** V-3.A      **NRC Identification No.**

### NARRATIVE DESCRIPTION

The METOR Detection System Model 112/0508 is a walk-through system capable of detecting the presence of both ferrous and non-ferrous metals. The unit is supplied with an electronics console of solid-state circuit design which may be adjusted to allow the unit to detect objects of various minimum sizes. The coil assembly is of elliptical geometry and is of rugged design for both indoor and outdoor operation. The unit may be used adjacent to other units by synchronous interconnection of all units.

### PERFORMANCE DATA

**Probability of Detection:** 95 percent dependent upon minimum target sensitivity.  
**False Alarm Rate:** 5 percent; occasional response to metal supports in shoes.  
**Detection/Operation Time:** 20 persons per minute. Alarm circuit latch is reset automatically one second after alarm activation; manual reset optional.  
**Detection Mechanism:** Active field detection based on conductivity; multidirectional field for uniformity of coverage within the portal. Nominal operating frequency: 384Hz; adjustable from 90 to 1000Hz.  
**Target Characteristics:** Small knives and guns.  
**Area (Volume) of Coverage:** Walk-through portal.  
**Alarm Presentation:** Audible alarm (optional); visual alarm (red lamp); auxiliary relay contacts.  
**Self-Test Capability:** Information not available.  
**Resistance to Spoofing and Tampering:** Response to extraneous metal objects and electrical disturbances is low (see Note 2); electronics controls are accessible by way of a locked cover.  
**Indoor/Outdoor Operation:** Capable of both, within environmental limits.  
**Temperature:** 19 to 131F (-10 to +55C).  
**Humidity:** Less than 95 percent.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** 25ft (7.5m) communications cable supplied (connectors factory-installed). Relay contacts for auxiliary alarm rated for the following maximum resistive load: 100VA ac, 54VA dc, maximum voltage, 250V, maximum current, 2A.

### PHYSICAL DATA

**Size:** Coils, 8ft high x 8ft long x 5ft wide (2.4x2.4x1.5m); Electronics package, 13.8x19.7x7.8in (35cx50x18.5cm).  
**Weight:** 600lb (226kg).  
**Power (Primary/Secondary):** 115 or 220V ac  $\pm$  15 percent, 40 to 60Hz, 25VA.  
**Emplacement:** Fixed installation; relocatable.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operating manual, maintenance manual; operator skill required is medium (see Note 2). Sufficient training information contained in operating manual, so that formal training not usually required; however, training is available.

**Parts and Repairs:** Service and parts are available from the distributor (Salt Lake City).

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year warranty on workmanship and materials.

**Government or Professional Standards:** Information not available.

**Lead Time:** Delivery 5 weeks after receipt of purchase order.

### COST DATA

**Unit Acquisition Cost:** \$5,350 (F.O.B. Salt Lake City UT); quantity discounts available; spare electronics console, \$2,850.

**Unit Installation Cost:** Information not available.

**Training Cost:** Distributor offers training at \$75 to \$100 per day, plus travel expenses.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

1. U.S. Representative: Harrison-Cooper Systems Inc.  
AMF Box 22014g  
Salt Lake City, UT 84122  
(801) 295-2345
2. This unit was tested by the DOT Transportation Systems Laboratory with the following results (refer to Report No. DOT-TSC-OST-71-15).  
Performance Rating: Excellent.  
Cost Effectiveness: Good to Excellent.
3. Options and accessories:  
Audible alarm (factory-installed)  
Audible alarm (kit)  
Console-mounted reset switch  
Remote foot switch with 12ft(3.6m) cable for manual reset  
Dual-level sensitivity (independently adjustable)  
Remote foot switch with 12ft(3.6m) cable for dual-level sensitivity

### INSTALLATIONS



## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer:** Outokumpu Oy  
P.O.B. 27  
02101 Espoo 10  
Finland  
(See Note 1 for U.S. distributor)

**Model:** METOR 112/0843

**Reference Evaluation Guide Procedure No. V-3.A**      **NRC Identification No.**

### NARRATIVE DESCRIPTION

The METOR Model 112/0843 is a walk-through system capable of detecting the presence of both ferrous and non-ferrous metals. The unit is supplied with an electronics console of solid-state circuit design which allows for adjustment of detection sensitivity to enable the unit to detect various minimum size objects. The coil assembly consists of four main parts: top, floor and two sides. Each section contains one or two coil windings which produce a multi-directional field pattern in the detection zone. The unit is capable of synchronous operation with up to 6 adjacent units.

### PERFORMANCE DATA

**Probability of Detection:** 95 percent, dependent upon minimum target sensitivity (see Note 2).  
**False Alarm Rate:** 5 percent (See Note 2).  
**Detection/Operation Time:** 20 persons per minute. Alarm circuit latch is reset automatically one second after alarm activation; manual reset optional.  
**Detection Mechanism:** Active field detection based on conductivity; multidirectional field for uniformity of coverage within the portal. Nominal operating frequency: 384Hz; adjustable from 90 to 1000Hz.  
**Target Characteristics:** Small knives and guns.  
**Area (Volume) of Coverage:** Walk-through portal.  
**Alarm Presentation:** Audible alarm (optional); visual alarm (red light); auxiliary relay contacts.  
**Self-Test Capabilities:** Information not available.  
**Resistance to Spoofing and Tampering:** Shielding provided to eliminate spurious signals; electronics console controls are accessible by way of a locked cover.  
**Indoor/Outdoor Operation:** Capable of both within environmental limits.  
**Temperature:** 19 to 131F (-10 to +55C).  
**Humidity:** Less than 95 percent.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** 25ft(7.5m) communications cable supplied (connectors factory-installed). Relay contacts for auxiliary alarm rated for the following maximum resistive load: 100 VA ac, 54VA dc, maximum voltage, 250V, maximum current 2A; 20ft (6m) power cable supplied.

### PHYSICAL DATA

**Size:** Coil Configuration: 93.3in long x 83in high x 33.5in wide (237x210.8x85cm); Electronics Console: 13.8in long x 19.7in high x 7.8in wide (35x50x18.5cm).  
**Weight:** Coil: 275lb (125kg); Electronics package: 30lb(14kg).  
**Power (Primary/Secondary):** 110, 117, 220 or 230V ac, 40 to 60Hz; voltage tolerance,  $\pm$  15 percent Power consumption, 25VA.  
**Emplacement:** Fixed installation; relocatable.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operating manual, maintenance manual, minimum operator skill required; sufficient training information contained in operating manual so that formal training is not required; however, training is available.

**Parts and Repairs:** Service and parts are available from the distributor.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year warranty on materials and workmanship.

**Government or Professional Standards:** Information not available.

**Lead Time:** Delivery 5 weeks after receipt of purchase order.

### COST DATA

**Unit Acquisition Cost:** \$4,900 (F.O.B. Salt Lake City, UT); quantity discounts available; spare electronics console, \$2,850.

**Unit Installation Cost:** Information not available.

**Training Cost:** Distributor offers training at \$75 to \$100 per day, plus travel expenses.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

1. U.S. Distributor: Harrison R. Cooper Systems Inc.  
AMF Box 22014  
Salt Lake City, UT 84122
2. This unit has been tested and evaluated by the Canadian Ministry of Transportation; the test report was not yet available.
3. Options and Accessories:
  - Audible alarm (factory-installed)
  - Audible alarm (kit)
  - Console-mounted manual reset switch
  - Remote foot switch with 12ft (3.6m) cable for manual reset
  - Dual-level sensitivity (independently adjustable)
  - Remote foot switch with 12ft(3.6m) for dual-level sensitivity

### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Philips Electronics Instruments, Inc.  
750 S. Fulton Ave.  
Mt. Vernon, NY 10550

**Model** WT-1

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Philips Metal Detector, Model WT-1, is a walk-through device employing pulse-wave technology to provide the ability to discriminate between metals as well as to achieve insensitivity to fixed metal objects in the vicinity. Alarm levels are adjustable over a broad range allowing for normal detection of a .22 caliber handgun with a non-ferrous frame or a 2oz(56g) knife with a confidence level of 95 percent or better. The device can be programmed to alarm selectively on certain classes of metals.

### PERFORMANCE DATA

**Probability of Detection:** .22 caliber handgun with non-ferrous frame, 2oz(56g) knife at greater than 95 percent confidence level.

**False Alarm Rate:** Dependent upon sensitivity adjustment.

**Detection/Operation Time:** "High" throughput; real time operation.

**Detection Mechanism:** Pulsed field.

**Target Characteristics:** .22 caliber handgun with non-ferrous frame; 2oz(56g) knife.

**Area (Volume) of Coverage:** Walk-through portal — 13½x30x77in (34x86x196cm).

**Alarm Presentation:** Red alarm lamp; audible alarm with volume control; provision for remote alarm devices up to 200ft (61m) from console (remote alarm relay contacts).

**Self-Test Capability:** Information not available.

**Resistance to Spoofing and Tampering:** Complete RFI shielding; insensitive to fixed metal objects in vicinity; electronics console equipped with keylock cover.

**Indoor/Outdoor Operation:** Within environmental limitations.

**Temperature:** 19 to 131F (-10 to +55C)

**Humidity:** Less than 95 percent.

**Other Environmental Characteristics:** Information not available.

**Interface:** Remote alarm devices operable up to 200ft(61m) from console by way of shielded pair cable; remote alarm contacts are accessible at screw terminals in the rear of the console.

### PHYSICAL DATA

**Size:** Arch Assembly: 13½x36x79½in (34x91x202cm); Electronic Console: 12½x17½x6¼in (32x44x16cm); System Volume: 7½ft³ (0.2m³).

**Weight:** Arch assembly 60lb (27kg); electronic console 20lb (9kg).

**Power (Primary/Secondary):** 115V or 230V ac, 50/60Hz, 100VA.

**Emplacement:** Portable; requires 3.5ft² (0.3m²) floor space.

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#### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Installation and operation manual; maintenance manual. Training information contained in operation manual.

**Parts and Repairs:** Information not available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty information:** Information not available.

**Government or Professional Standards:** Complies with NILECJ-STD-0601.00 for walk-through metal detectors.

**Lead Time:** Information not available.

#### COST DATA

**Unit Acquisition Cost:** Information not available.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

#### NOTES

#### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacture** Rens Manufacturing Company  
P.O. Box 337  
Creswell, OR 97426  
(503) 895-2172

**Model** 773LF

Reference Evaluation Guide Procedure No. V-3.A NRC Identification No.

### NARRATIVE DESCRIPTION

The Rens 773LF Personnel Scanner is capable of detecting both ferrous and non-ferrous metals utilizing an active time/rate sensitive, low frequency system. The unit's sensitivity may be adjusted to accommodate various levels of security. The unit is a walk-through detector which has no ramp and is easy to set up and take down. The control instrumentation is built into the walk-through unit and five operational frequencies are available for multiple unit installations. The control console features all solid-state components.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Active field.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Walk-through portal.
<b>Alarm Presentation:</b>	Audible indicator; meter; visual indicator.
<b>Resistance to Spoofing and Tampering:</b>	Control unit mounted out of reach atop the walk-through gate.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	26 $\frac{1}{2}$ x37 $\frac{1}{4}$ x87 $\frac{1}{2}$ in (68x95x222cm).
<b>Weight:</b>	Approximately 200lb (90kg) with control unit.
<b>Power (Primary/secondary):</b>	110/120V ac, 50/60Hz, 1 $\Phi$ , 30W; overseas option to 230V ac.
<b>Emplacement:</b>	Portable, optional wheels and transporting bars available.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available.
<b>Parts and Repairs:</b>	Factory direct repair service; temporary service replacement units.
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

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**COST DATA**

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

**NOTES**

**INSTALLATIONS**

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer** Sen-Tek Inc.  
2846 N.E. 19th Drive  
P. O. Box 56  
Gainesville, FL 32602  
(See Note 1.)  
(904) 377-1002

**Model** SMD-1000W

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The SMD-1000W is a walk-through metal detector capable of detecting all metals both ferrous and non-ferrous. The extremely low magnetic field of the search coils (1 to 2 gauss) ensures no damage to watches, pacemakers, etc. The system consists of a walk-through arch-type gate, a pedestal-mounted control console and a 15 foot (4.5m) interconnecting cable assembly. The system is portable and will fit through all standard doors. The electronics employed is solid-state mounted on plug-in printed circuit boards. The SMD-1000, which was formerly manufactured by Sperry Rand, was evaluated by the U.S. Department of Transportation (see Note 2).

The system has two separate detection channels; one for each side panel of the walk-through gate. Each panel is a separate, distinct metal detector. Thus, the unit could be converted to built-in applications of various passage dimensions with only minor structural modifications. Pushbutton-controlled logic allows the operator the choice of employing either or both of the two detection channels to sense metal. This is useful in preventing false alarms if much traffic near one side of the gate is necessary in an installation.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Active field.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Information not available.
<b>Alarm Presentation:</b>	At high and medium sensitivity visual indicator for each channel indicates which side the metal object is passing near; at low sensitivity, both indicator lights illuminate when metal is present. Adjustable audio.
<b>Resistance to Spoofing and Tampering:</b>	Balanced field detection; interconnection cables electrostatically shielded; electronics are contained in fiberglass console with locking cover.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	15ft(4.5m) connecting cable provided (gate to console) with polarized plug ends

### PHYSICAL DATA

<b>Size:</b>	Control console: 9x14x6½in (23x36x16.5cm), total height on pedestal, 40in (102cm); Walk-through gate: 6½ft(2m) high x 30in (76cm) wide.
<b>Weight:</b>	Console and pedestal, 35lb(16kg).
<b>Power (Primary/Secondary):</b>	115V ac or 230V ac, 1.5A, 50/60Hz (voltage selection by means of transformer taps).
<b>Emplacement:</b>	See Note 3.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Instruction manual containing circuit diagrams and maintenance guidelines.  
Training information not available.

**Parts and Repairs:** Information not available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year warranty.

**Government or Professional Standards:** Information not available.

**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Qty. 1 to 3, \$2,350.00 each; Qty. 4 to 10, \$2,130.00 each.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

1. This device is an improved version of the Sperry Rand SMD-1000 unit. (Sen-Tek has taken over the manufacture of this device from Sperry Rand).
2. Report No. DOT-TSC-OST-71-15.
3. Units are supplied with different operating frequencies (designated in letter suffix after model number). Units on the same frequency must not be operated within 100 feet (30m) of one another or interaction will occur. Units having different operating frequencies may be operated near one another.

### INSTALLATIONS



## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

**Manufacturer:** Solco Engineering Inc.  
9555 Cozycroft Ave.  
Chatsworth, CA 91311  
(213) 882-2755

**Model:** Electro Search  
VII, VIII, IX, XI

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

"Electro Search" metal detection systems are walk-through units designed to detect ferrous and/or non-ferrous metals or combinations of metals. Each is designed with an automatic balancing feature for ease in operation, visual and audio signals for immediate indication of detected metal, a variable sensitivity control to adjust to individual target size, and a hand scanner (refer to Catalog Sheet V-3 a.4 to pinpoint the exact location of the detected metal). Units are installed by Solco factory representatives.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Active field.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	Walk-through portal.
<b>Alarm Presentation:</b>	Audio and visual (lamp and meter indication); optional remote audio alarm and remote control relay available.
<b>Resistance to Spoofing and Tampering:</b>	Shielding provided to minimize radio frequency interference. Electronics supplied in a security cabinet. Optional pedestal cabinet with security lock available for all models.
<b>Indoor/Outdoor Operation:</b>	Information not available.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	Information not available.
<b>Weight:</b>	Information not available.
<b>Construction:</b>	Information not available.
<b>Power (Primary/Secondary):</b>	See notes.
<b>Emplacement:</b>	See notes. The detector should not be mounted in the vicinity of large moving metal objects or near electronic equipment such as welders, switch gear, etc.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty information:** Information not available.  
**Government or Professional Standards:** Designed to meet NRC Regulating Guide 5.7 requirement: for minimum metal detection.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Information not available.  
**Unit Installation Cost:** Information not available.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

### NOTES

	MODEL VII	MODEL VIII	MODEL IX	MODEL XI
Emplacement	Portable	Fixed Installation	Fixed Installation	Portable
Power Supply	Commercial ac and/or battery	Commercial ac power	Commercial ac and/or rechargeable batteries for uninterrupted service.	Commercial ac power
Other		Features four times the detection capability of Mod. VII.	Equipped with a digital readout permitting identification of concealed metal and a relay for remote control of other equipment.	Designed to detect dense metal in which other metal articles could be passed.

### INSTALLATIONS

## WALK-THROUGH ALL-METAL DETECTION COMPONENTS

<b>Manufacturer</b>	Sperry Rand, Sensor Group Gainesville, FL 32601 (See Note 1.) (904) 372-0411		
<b>Model</b>	SMD-1000		
<b>Reference Evaluation Guide Procedure No.</b>	V-3.A	<b>NRC Identification No.</b>	

### NARRATIVE DESCRIPTION

The SMD-1000 is a weapons detector which is capable of detecting both ferrous and non-ferrous metals. The unit consists of two assemblies: a walk-through gate, and a control console. Gates and consoles are fully interchangeable. The gate and console can be separated up to 50 feet (4.5m) via a supplied cable. This weapons detector produces alarms for ferrous and non-ferrous metals independently on the right and left sides of the gate in the form of audio and/or visual alarms. Sensitivity is adjustable to three levels. Evaluated by DOT (see Note 2).

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Information not available.
<b>False Alarm Rate:</b>	Information not available.
<b>Detection/Operation Time:</b>	Real time; walk-through gate.
<b>Detection Mechanism:</b>	Active element detector, eddy current decay.
<b>Target Characteristics:</b>	Information not available.
<b>Area (Volume) of Coverage:</b>	6.5ftx30in (2mx76cm) in plane of gate.
<b>Alarm Presentation:</b>	Visual and adjustable audio.
<b>Indoor/Outdoor Operation:</b>	Primarily indoor, outdoor environment limited.
<b>Resistance to Spoofing and Tampering:</b>	Electronics console equipped with lock; no power line supervision.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Standard ac outlet.

### PHYSICAL DATA

<b>Size:</b>	Gate: 6½ft (2m) high, 30in (76cm) wide; Console: 9x14x6½in (23x36x16.5cm); 40in (102cm) high pedestal.
<b>Weight:</b>	Gate: (incl. ramp), 165lb (75kg); Console: 20lb (9kg).
<b>Power (Primary/Secondary):</b>	115/230V, 50/60Hz, no secondary.
<b>Emplacement:</b>	Console mounts on pedestal, counter top, desk or wall bracket; sufficient space for gate required; not portable, but easily relocated.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available; no previous experience or long-term training required.
<b>Parts and Repairs:</b>	Replacement printed circuit boards exchanged at factory; serviceable via conventional test gear and troubleshooting techniques.
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Information not available.
<b>Lead Time:</b>	Information not available.

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### COST DATA

<b>Unit Acquisition Cost:</b>	\$1,950.00, F.O.B., Gainesville, FL; quantity discount available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	None.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

1. Sperry Rand no longer manufactures this device; parts can be obtained from: Sen. Tek, Gainesville, FL 32601; Tel (904) 377-1002.
2. This unit was tested by the DOT Transportation Systems Laboratory (refer to Report No. DOT-TSC-OST-71-15).

### INSTALLATIONS

## SNM DETECTION COMPONENTS

Special nuclear material (SNM) monitors sense the presence of gamma radiation produced both by radioactive decay occurring in soil, rocks and air (natural background radiation) and by radioactive decay occurring in SNM or other radioisotopes which may be within the monitor's field of view. Both sources of radiation can be highly variable. The natural background radiation varies geographically from a few microroentgens per hour in some regions, such as the southeastern United States, to as high as approximately 25 microroentgens per hour in Rocky Mountain cities. The gamma radiation from SNM includes not only the intrinsic radiation from the uranium or plutonium isotopes but also from radionuclides, particularly in the case of spent or recycled material.

The basic problem in the detection of SNM is to distinguish the presence of a significant quantity of SNM from a background that may include natural radiation and radiation from stored SNM, other radioactive material or waste. The amount of background radiation sensed by the monitor is a constraint on its ability to determine that a signal caused by SNM is present. Quantitatively, the magnitude of the variation in the background radiation count is proportional to the square root of that count. False alarms are minimized by setting the alarm level high enough so that the variation in the background count is unlikely to exceed this threshold. The false alarm rate then will remain reasonably constant as the background radiation changes. As the SNM that is to be detected produces a signal or net count that is greater than the square root of the background radiation, it is more likely to be detected. The alarm condition occurs then when the background plus signal is equal to or greater than the background plus the expected variation in the background count.

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Commercially available SNM detectors are configured as walk-through portals and have five basic elements: gamma detector, portal occupancy monitor, signal conditioning electronics, analyzer and logic/control unit. The types of gamma detectors used are solid, liquid and crystal scintillators and Geiger tubes. In a scintillator light pulses are produced as gamma radiation and absorbed by the material. These pulses are converted to electrical signals by means of a photomultiplier. Liquid, plastic and sodium-iodide (NaI) crystal scintillating materials are available which have adequate sensitivity to accumulate a significant signal count in a short period of time. Geiger tube detectors convert the incoming radiation directly to an electrical signal. These devices are, however, much less sensitive than scintillators and are used primarily for radiological health monitoring.

The signal pulses produced by the detector are examined with an analyzer, then transmitted to the control unit, where they are counted and processed by logic circuitry which determines if an alarm condition exists. The portal occupancy monitor allows the logic/control to determine if it is processing background signals or background plus source signals. In this way the background can be updated continuously, and separate alarms can be generated if the background exceeds a preselected threshold.

In choosing the location for an SNM monitor it must be kept in mind that the signal count will be essentially the same for the same amount of SNM to be detected independent of where the monitor is located, but that the background may vary from one location to another. At some location the variation in the background may be large enough so that the signal is no longer detectable, and the monitor will no longer have adequate sensitivity. If the sensitivity of a given monitor configuration is found to be background-limited, it may be possible to increase the signal by modifying the configuration (e.g., by decreasing the distance between the target material

and the detector, or by adding shielding in an appropriate way). In any case it is best to select a monitor location that has a background low enough for proper operation. Increases or other variations in background radiation at the monitor location might be caused by the storage or movement of process materials in its vicinity, and could produce nuisance alarms.

Another means of reducing the sensitivity of a SNM monitor is to reduce the signal. This may be done by transporting the source (target) material around the monitor (circumvention); by moving the source rapidly through the monitor (for example, by throwing it or swinging it through the monitor so that it spends little time within the detector's field of view); or by shielding the source with an appropriate material. To prevent circumvention and rapid transport, some combination of barriers and supervision of the traffic flow is required.

Shielding by means of lead or other metals is particularly effective in hiding uranium 235. Small quantities of uranium 235, perhaps up to 200 grams, shielded by 0.32 cm of lead might not be detected by an SNM portal monitor. Such a shielded source might also be undetectable by means of a metal detector unless special provision is made to operate the metal detector at very high sensitivity. In order to reduce the ease of transporting such shielded material, a separate search of hand baggage, parcels, etc., may be necessary and/or a high sensitivity all-metal detector should be used in conjunction with the SNM detector.

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## SNM DETECTION COMPONENTS

**Manufacturer** IRT Corp.  
P.O. Box 80817  
San Diego, CA 92138  
(714) 565-7171

**Model** PRM-110

Reference Evaluation Guide Procedure No. V-4.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The PRM-110 Portal Monitor for SNM (see Note 1) employs two vertical liquid scintillator gamma radiation detectors that, with a connecting cable tray, form the portal. Lead shielding (252mil (6.4mm) thick) is used to limit the sensitive area of the doorway to an area just beyond the portal. An infrared light barrier is positioned at the entrance to the portal to indicate occupancy; a door switch or door mat can also be used for this purpose. The cable tray at the top of the portal houses the photomultiplier power supply, signal conditioning electronics and a single channel analyzer (SCA). The signals produced by the SCA are transmitted to the PRM-110 console control unit which processes them by means of a microprocessor programmed to operate in two modes, background and signal. In the background mode, the monitor averages the background radiation level over a period of 1.5 seconds, and determines the statistical variance. When the portal occupancy monitor is interrupted, the unit transfers to the signal mode in which the "occupied" radiation count is determined and compared to the background and variance (alarm level). The signal mode continues for about 1.5 seconds (or more as adjusted) unless the occupancy monitor is still interrupted, in which case, the signal mode continues until about 1.5 seconds after occupancy terminates. If the signal level exceeds the calculated alarm level, an alarm condition occurs. A master alarm indicator is turned on along with a smaller "high signal" alarm indicator, and relay closures are provided for external remote alarm indicators. This unit, which is useful for the detection of  $^{235}\text{U}$  or  $^{239}\text{Pu}$  —  $^{233}\text{U}$ , was fully evaluated by the Los Alamos Scientific Laboratories (LASL).

### PERFORMANCE DATA

<b>Probability of Detection:</b>	See Note 2, ERDA sensitivity test results.
<b>False Alarm Rate:</b>	Function of alarm level settings ( $\sigma$ multiplier). See Note 3; alarm rates per passage are adequate to meet ERDA requirement of less than one false alarm per 8-hour period.
<b>Detection/Operation Time:</b>	Approximately 1.5 seconds (adjustable).
<b>Detection Mechanism:</b>	Liquid scintillator gamma detector.
<b>Target Characteristics:</b>	$^{235}\text{U}$ or $^{239}\text{Pu}$ — $^{233}\text{U}$ . (See Note 4.)
<b>Area (Volume) of Coverage:</b>	Lead shielding used to limit sensitive area of doorway to the area just beyond the portal.
<b>Alarm Presentation:</b>	Visual indication of alarm for both high signal and high or low background; provisions for remote alarm via relay (alarm latch/manual reset).
<b>Resistance to Spoofing and Tampering:</b>	The monitor is vulnerable to certain modes of transporting sources through it, e.g.: shielding by lead or other metals, rapid movement of the source through the sensitive area, etc. (this is not a unique weakness). Sensitivity adjustments, etc. are protected by a locked, transparent door on the front of the console module.
<b>Indoor/Outdoor Operation:</b>	Basically an indoor instrument; no weather protection is provided, and the operating temperature range does not extend below freezing.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Cables for photomultipliers, power supply, signal conditioning boards, control unit, occupancy monitor and single channel analyzer are provided.

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### PHYSICAL DATA

**Size:** Portal: 3x6ft (0.9x2m) interior; 4.5x8ft (1.3x2.4m) exterior. Scintillators: 4in diameter x 6.5ft long (10.2cmx2.1m).

**Weight:** Information not available.

**Power (Primary/Secondary):** 110V, 60Hz (both detector and control unit). No emergency power is provided.

**Emplacement:** Installation requires mechanical assembly of scintillators and connecting tray, installation of interconnecting cables, alignment of optical barrier (if used), and calibration.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.

**Parts and Repairs:** Information not available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** Information not available.

**Government or Professional Standards:** ERDA approved. Designed to comply fully with NRC Regulatory Guide 5.27 and ERDA Personnel Doorway Monitor Standards A-2-73-2-3, A-2-74-211, and A-2-75-298.

**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Information not available.

**Unit Installation Cost:** Information not available.

**Training Cost:** Information not available.

**Maintenance Cost:** Information not available.

**Operation Cost:** Information not available.

### NOTES

- For high background environments (to 10mR/hr), IRT Model PRM-110S is available which employs additional lead shielding, 1in (2.54cm).
- ERDA Sensitivity Test Results:  
Sensitivity tests (2a) were performed in a background of 25  $\mu$ R/hr (2b) and a monitor background count rate of 2000 cts/0.25sec.

Source (2c)	Doorway Width (m)	Alarm Level Setting (2d) (M/2) $\sigma$	False Alarm Rate (Passages)	Smallest Fraction of Passages Detected for the Two-source Positions
10g <sup>125</sup> I sphere	0.63	3.5	1 per 4781	0.25
10g <sup>235</sup> U sphere	0.76	3.0	1 per 1247	0.63
1g <sup>239</sup> Pu	1.22 (2e)	4.5	negligible	1.00

(2a) Tests performed in the location determined to be the least sensitive of the portal on the center plane between detectors at the head and foot regions.

(2b) Background as measured with Technical Associates PUG-1 NaI Survey Meter.

(2c) Described in ERDA standards.

(2d) Lower values of the  $\sigma$  multiplier (M) resulted in unacceptably high false alarm rates, higher settings resulted in inadequate sensitivity for  $^{235}\text{U}$  at the spacing used.

(2e) Based on ERDA test results, wider spacing would have produced an acceptable monitor for  $^{235}\text{Pu}$  only for the test conditions.

3. Observed statistical false alarm rate (interruption rate of 6/min and nighttime hours).

Alarm Level Setting (M/2) $\sigma$	False Alarm* Rate	Number of Hours Observed
3.0	$8.01 \times 10^{-4}$ or 1 per 1247 passages	367.3
3.5	$2.08 \times 10^{-4}$ or 1 per 4788 passages	638.3

\* The false alarm rate is per passage, which includes five tests, i.e., five 0.25-second count intervals are processed in signal mode at each passage. Queueing in the doorway or use of an optical door switch when the door could be held open for long periods of time, will increase the time the monitor stays in the signal mode and will increase the number of false alarms per eight-hour period.

4. Estimated mass sensitivity of the PRIM-110 monitor at minimum and maximum background count rates.

Monitor Configuration		Background		Minimum Detectable Unshielded Spherical Mass (g)	
Width (m)	Alarm Level Setting (M $\sigma$ )	Counts/0.25 sec ( $\mu\text{R/hr}$ )		$^{235}\text{U}$	$^{239}\text{Pu}$
0.76	3	560	7	$3.2 \pm 0.2$	0.08
0.76	3	2603	33	10	0.25
0.76	3.5	560	7	$2.2 \pm 0.2$	0.05
0.76	3.5	4139	52	10	0.25

Minimum count rates are from estimates of an isotopic-source-free background in the southeastern U.S. Monitor shielding is 252mil (0.64cm) Pb. Thicker shielding would reduce background and improve the monitor sensitivity. Plutonium sensitivities listed are estimated from  $^{235}\text{U} - ^{239}\text{Pu}$  relative sensitivity in a number of instruments. Uranium sensitivities are extrapolations from measurements. PU-239 and source composition are specified in the ERDA standards. Source movement through the portal is at its least sensitive location at a normal walking pace.

#### INSTALLATIONS

## SNM DETECTION COMPONENTS

**Manufacturer** National Nuclear Corp.  
3150 Spring St.  
Redwood City, CA 94063  
(415) 364-2880

**Model** DM-2

Reference Evaluation Guide Procedure No. V-4.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The National Nuclear Corporation Door Monitor, DM-2, is a special, high-sensitivity system designed to detect gram amounts of  $^{235}\text{U}$  and  $^{239}\text{Pu}$ . The device consists of two solid-slab scintillator gamma-ray detectors bridged by a box containing an ultrasonic occupancy monitor and the preamplifier bases for the photomultipliers. The scintillator slabs cover the full height and width of the portal. Gamma-ray shielding is provided by lead on the three sides of the scintillator external to the portal. The ultrasonic occupancy monitor located inside of the sheet-metal bridge is collimated by a hole in the bridge to limit its field of view. The control unit consists of a NIM bin with a commercial high voltage power supply, amplifier — single channel analyzer, ratemeter and a National Nuclear Corporation analog alarm logic module. Pulses from the photomultiplier are conditioned and transmitted to the control unit where they are summed, amplified and processed by a single channel analyzer (SCA). The SCA pulses are fed to a ratemeter whose output is used by the alarm logic module. The alarm module output is monitored by three separate analog circuits that alarm on high background, low background, and high signal ("fissile" alarms). The high and low background alarm points are varied by front panel potentiometers. The high background level must be set at the background rate at which false alarms in the fissile loop become too frequent; the low background alarm point is set where sensitivity is adequate. The specifications provided below are those as tested by ERDA.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Sensitivity can be preset before shipment from manufacturer. See manufacturer claims in Note 1, ERDA tests results in Note 2.
<b>False Alarm Rate:</b>	Fissile alarms produce no audio signal or relay closure when portal is unoccupied; false alarm rate must be determined during calibration/set-up to optimize the unit. Line voltage variations may sometimes cause false alarms. See ERDA test results in Note 3.
<b>Detection/Operation Time:</b>	Approximately 1 second occupancy.
<b>Detection Mechanism:</b>	Solid plastic scintillators sensitive to gamma radiation and neutrons (from Pu)
<b>Target Characteristics:</b>	Gram quantities of $^{235}\text{U}$ and $^{239}\text{Pu}$ .
<b>Area (Volume) of Coverage:</b>	Mostly inside the portal (limited by detector shielding).
<b>Alarm Presentation:</b>	Alarm indication for the three alarm conditions is given by means of indicator lights, an audible alarm and a relay closure. Count readout is provided by a ratemeter display.
<b>Resistance to Spoofing and Tampering:</b>	It is possible to shield material to reduce the gamma signal to pass material through the monitor. This is not a unique vulnerability. Sensitivity of the monitor can be reduced by changing the set-up parameters. Access to these controls is deterred by a protective transparent door on the front of the NIM bin.
<b>Indoor/Outdoor Operation:</b>	Installation limited to indoor locations or where weather protection is provided.
<b>Temperature:</b>	Information not available.
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

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### PHYSICAL DATA

Size: Information not available.  
 Weight: Information not available.  
 Power (Primary/Secondary): Information not available.  
 Emplacement: Installation requires evicting the detector columns, attaching the connecting bridge between them and connecting the electronic components together.

### SUPPLY/LOGISTICS DATA

Documentation and Training: Information not available.  
 Parts and Repairs: Information not available.  
 Reliability: MTBF not available.  
 Maintainability: MTTR not available.  
 Warranty Information: Information not available.  
 Government or Professional Standards: ERDA approved. Designed to meet the requirements of NRC Regulatory Guide 5.7 and ERDA Personnel Doorway Monitor Standards A-2-73-2-3, A-2-74-211, and A-2-75-298.  
 Lead Time: Information not available.

### COST DATA

Unit Acquisition Cost: Information not available.  
 Unit Installation Cost: Information not available.  
 Training Cost: Information not available.  
 Maintenance Cost: Information not available.  
 Operation Cost: Information not available.

### NOTES

1. Manufacturer claim for performance: Detects 3 grams U enriched 90 percent  $^{235}\text{U}$  in 3 millimeters of brass at a 50 percent confidence limit. False alarms 0.1 percent. Detects 0.5 gram Pu or 1 gram  $^{239}\text{Pu}$  in 3 millimeters of brass at a 90 percent confidence limit. False alarms 0.1 percent.
2. ERDA Tests:

#### Sensitivity Tests (2a) in a Background of $25\mu\text{R/hr}$

Source (2c)	Doorway Width (cm)	False Alarm Rate (passages)	Fraction of Passages Detected
10g $^{235}\text{U}$ sphere	76	1 per 4537	0.66
1g $^{239}\text{Pu}$ (2b) sphere	76	1 per 4537	1.00

(2a) Tests were run with a fissile potentiometer setting of 2.0 (monitor count rate of 5500 cps). The time constants were 20 and 0.4 seconds. The ratemeter was set at 10 percent fractional standard deviation and operated on 10K x 1 range. Background measured with Technical Associated PUG-1 NaI survey instrument.

(2b) The sensitivity achieved for  $^{239}\text{Pu}$  indicates that increased doorway width, reduced scintillator volume, or reduced fissile potentiometer setting and associated false alarm rate could have been used to obtain acceptable performance as a  $^{239}\text{Pu}$  only monitor under the test conditions. Similarly, at a reduced doorway width adequate performance as a  $^{235}\text{U}$  or  $^{239}\text{Pu}$  monitor could have been achieved with smaller scintillators or with reduced fissile potentiometer setting and accompanying false alarm rates. The procedure in the

sensitivity testing used a number of individuals walking through the doorway carrying the appropriate source in the previously determined least sensitive region of the portal. For this monitor, the least sensitivity is on the median plane between detectors at the foot of the portal. The sensitivity is better in the head region near the photo-multipliers, because some pulse height attenuation occurs in foot level signals, which travel the length of the scintillator, causing some pulses to fall below the SCA window. Sources were carried through the portal inside the shoe or attached to the shoe on the inside of the ankle, at a normal walking pace.

(2c) Described in ERDA standards.

(2d) Estimated Mass Sensitivity of the NNC DM-2 at Maximum and Minimum Background Count Rates

Monitor Configuration		Background		Minimum Detectable Unshielded Sphere (g)	
Width (m)	False Alarm Rate (alarms/hr)	counts/sec	( $\mu$ R/hr)	<sup>235</sup> U	<sup>239</sup> Pu
0.76	0.79	1540	7	3.2	0.08
0.76	0.79	7210	33	10	0.25

Thicker lead shielding would improve performance as would reduced width. <sup>239</sup>Pu sensitivity is estimated from the relative U-Pu sensitivity of other instruments. <sup>235</sup>U sensitivity is extrapolated from measurements. U and Pu source composition is that specified in the ERDA standards. Source movement through the portal is at the point of least sensitivity.

3. False alarm rate measured during non-work hours (3a)

Observed Alarm Rate	False Alarm Rate (3b)
0.79 alarms per hour	$2.2 \times 10^{-4}$ or
	1 per 4537 passages

(3a) The false alarm rate for this monitor was measured during the night when only statistical alarms are expected. Testing was continuous as the background update is continuous and unaffected by occupancy. Because the occupancy monitor is used to gate the audible alarms and fissile alarm relay closures, the false alarm rate per passage is the product of the hourly rate observed and the fraction of an hour that the monitor is occupied per passage.

(3b) Calculated for a one second occupancy time per passage. The conditions for these tests were: fissile potentiometer = 2.0, background rate = 5500/sec time constants = 0.4 and 20 sec, ratemeter 10K x 1 range, and 10 percent fractional sigma.

#### INSTALLATIONS

## SNM DETECTION COMPONENTS

**Manufacturer** National Nuclear Corp.  
3150 Spring St.  
Redwood City, CA 94063  
(415) 364-2880

**Model** DM-3

Reference Evaluation Guide Procedure No. V-4.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The National Nuclear Corporation (NNC) Door Monitor, DM-3, is a special, high-sensitivity system designed to detect gram amounts of  $^{235}\text{U}$  and even smaller amounts of Pu. The NNC-DM-3 utilizes heavy steel construction, plastic detectors, lead shielding and NNC background updating. The DM-3 combines this with the use of occupancy monitors and a metal detector to produce detection with minimum false alarms. The NNC-DM-3 is a self-standing unit, easily installed with its self-contained, easily serviced, NIM electronics housed in a tamper-proof cabinet. The number of detectors, count time, arrangement of the components, etc., can be changed to meet local requirements. The NNC-DM-3 meets NRC Regulatory Guide 5.7 requirements.

### PERFORMANCE DATA

**Probability of Detection:** Information not available. See notes.  
**False Alarm Rate:** Information not available.  
**Detection/Operation Time:** Adjustable time constants and sensitivity.  
**Detection Mechanism:** Solid plastic scintillators sensitive to gamma radiation and neutrons (from Pu) 12 wide NIM bin assembly, including metal detector.  
**Target Characteristics:** Gram amounts of  $^{235}\text{U}$  and  $^{239}\text{Pu}$ ; See notes.  
**Area (Volume) of Coverage:** Information not available.  
**Alarm Presentation:** Indicator lights, audible alarm, relay closure.  
**Resistance to Spoofing and Tampering:** Sensitive to means of transport (not a unique vulnerability).  
**Indoor/Outdoor Operation:** Indoor or protected location.  
**Temperature:** Information not available.  
**Humidity:** Information not available.  
**Other Environmental Characteristics:** Information not available.  
**Interface:** Information not available.

### PHYSICAL DATA

**Size:** Doorway opening, 24in (62cm); scintillator length, up to 8ft (2.4m).  
**Weight:** Information not available.  
**Power (Primary/Secondary):** Information not available.  
**Emplacement:** Horizontal or vertical mounting.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** Information not available.  
**Maintainability:** Information not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Designed to meet the requirements of NRC Regulatory Guide 5.7.  
**Lead Time:** Information not available.

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### COST DATA

<b>Unit Acquisition Cost:</b>	Information not available.
<b>Unit Installation Cost:</b>	Information not available.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

Typical sensitivities: Plutonium — Under  $\frac{1}{2}$  gram through 3 millimeters of brass.  
100 grams through 2 inches Pb (neutrons).  
Slightly enriched or normal U — 10 grams through 3 millimeters of brass  
U-233 — Under 0.1 gram through  $\frac{1}{2}$  inch lead.  
U-235 — 3 gram uranium enriched to 90 percent in  $^{235}\text{U}$  in 3 millimeters of brass (50 percent confidence).  
Metal — 200 grams non-ferrous (90 percent confidence).

### INSTALLATIONS

## SNM DETECTION COMPONENTS

**Manufacturer** Tom Scurry Associates  
Pinebrook Hills  
Boulder, CO 80302  
(303) 444-4802

**Model** VM-106 Vehicle Gate Monitor

Reference Evaluation Guide Procedure No. V-4.A NRC identification No.

### NARRATIVE DESCRIPTION

The Tom Scurry Associates (TSA) Vehicle Gate Monitor, VM-106, is a monitoring system similar to the TSA Personnel Monitor, PM-203 (see Catalog sheet V-4.a.5). The VM-106 was designed to have a high-sensitivity with the capability of increasing the sensitivity by field modifications if required. The system monitors background radiation in 20 second periods, updating the background display in counts per second at the end of each counting period. When a personnel or vehicle detector (part of the VM-106) indicates the area of interest is occupied, the system starts counting the local radiation and a microprocessor compares the count with the function  $(BG + N\Sigma)$  where BG is the last background update, N is a switch selectable constant and  $\Sigma$  is the square root of BG. If the local count is higher than the function, the instrument sounds an alarm and displays the difference between the local count and the function. In addition, while the system is monitoring the background it compares the background with two switch selectable numbers to ensure that the background remains set between high and low limits. The sensing units are shielded sodium iodide (NaI) scintillation detectors in housings located at the portal or gate. The electronics are housed in standard Nuclear Instrument Modular System (NIMS) bins and can be located over a thousand feet from the detector. The system is based on a modular concept, and all of the major components except the updating comparator (UC 101) and the infrared personnel detector (PD 231) are off the shelf components available from several suppliers. A standard vehicle detector that uses a traffic loop is provided for the vehicle sensor.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Manufacturer's claim: The following specifications are based on an N setting of 4 with a portal opening of 48in (1.2m). See notes.
<b>False Alarm Rate:</b>	Depends on dwell time of vehicle over traffic loop; a false alarm occurs approximately once in 8 hours of dwell time (manufacturer's claim).
<b>Detection/Operation Time:</b>	Information not available.
<b>Detection Mechanism:</b>	Array of NaI scintillators.
<b>Target Characteristics:</b>	See notes (Sensitivity).
<b>Area (Volume) of Coverage:</b>	Vehicle gate.
<b>Alarm Presentation:</b>	Indicator and relay closure.
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Outdoor.
<b>Temperature:</b>	32 to 122F (0 to 50C); Optional detector available for extended temperature range, -40 to +122F (-40 to +50C).
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

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### PHYSICAL DATA

**Size:** Detectors: two enclosures, 5x12x74in (12.7x30.5x188cm), mounted on each side of gate; Electronics: 8¾x19x16in (22x48x41cm).  
**Weight:** Approximately 150lb (68kg).  
**Power (Primary/Secondary):** 110 or 220V ac, 47 to 65Hz.  
**Emplacement:** Information not available.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTR not available.  
**Warranty Information:** Information not available.  
**Government or Professional Standards:** Information not available.  
**Lead Time:** Information not available.

### COST DATA

**Unit Acquisition Cost:** Vehicle Gate Monitor, \$10,750. Quantity discounts available.  
**Unit Installation Cost:** Quoted separately for each installation.  
**Training Cost:** Information not available.  
**Maintenance Cost:** Information not available.  
**Operation Cost:** Information not available.

### NOTES

#### Sensitivity.

Uranium 235 — The portal monitor will detect with a greater than 60 percent probability a 10 gram bare spherical source of <sup>235</sup>U of at least 93 percent enrichment containing 99.75 percent weight uranium in a background of at least 0.02 mR/hr.

Plutonium 239 — The portal monitor will detect with a greater than 90 percent probability a 0.5 gram source of <sup>239</sup>Pu with at least 93.5 percent enrichment containing a minimum of 99.5 percent weight plutonium and having a density of more than 19.44 gm/cm<sup>3</sup>. The <sup>240</sup>Pu content shall be less than 6.5 percent. The source shall be encapsulated in at least 0.25 mm of stainless steel or nickel. The background radiation shall be at least 0.02 mR/hr. The vehicle monitor has recently been upgraded in sensitivity and tests are currently being run. Previously it would detect a 50 gram Pu source (12 percent <sup>240</sup>Pu) minimally shielded and in a 0.125in (3.1mm) steel walled container with the detectors 24ft (7.3m) apart.

### INSTALLATIONS

## SNM DETECTION COMPONENTS

**Manufacturer** Tom Scurry Associates  
Pinebrook Hills  
Boulder, CO 80302  
(303) 444-4802

**Model** PM-203

Reference Evaluation Guide Procedure No. V-4.A NRC Identification No.

### NARRATIVE DESCRIPTION

The Tom Scurry Associates Radiation Monitor, PM-203, is a portal monitor for indoor or outdoor installation. The system monitors background radiation in 20 second intervals and updates the background display in counts per second at the end of the interval. When the occupancy monitor (sonic, switchmat or infrared) indicates the portal is occupied, the system starts counting the local radiation and the micro-processor control unit compares the count with the function  $BG + N\Sigma$ , where BG is the last background update, N is a switch selectable constant and  $\Sigma$  is the square root of BG. If the local count is higher than the function, the instrument sounds an alarm and displays the difference between local count and the function. In addition, the system compares the background level to switch selectable numbers to ensure the background remains between pre-set high and low limits. The sensing units are shielded sodium iodide (NaI) scintillation detectors located at the portal housings. The electronics are housed in standard Nuclear Instrument Modular System (NIMS) bins and can be located over a thousand feet from the detector. The system is based on a modular concept and all of the major components except the update comparator (UC-101) and the infrared personnel detector (PD-231) are off the shelf components available from several suppliers. See notes for independent evaluation information.

### PERFORMANCE DATA

<b>Probability of Detection:</b>	Manufacturer's Claim: The following specifications are based on an N setting of 4 and with a portal opening of 48in (1.2m).
<b>False Alarm Rate:</b>	1 in 15,000 walk-throughs, assuming a 2 second counting time (manufacturer's claim). See notes.
<b>Detection/Operation Time:</b>	Approximately 1 second count time.
<b>Detection/Operation Time:</b>	Approximately 1 second count time.
<b>Detection Mechanism:</b>	Array of NaI scintillators mounted in portal.
<b>Target Characteristics:</b>	See notes (Sensitivity).
<b>Area (Volume) of Coverage:</b>	Nominal spacing between scintillators, 23.7in (60cm).
<b>Alarm Presentation:</b>	Visual indicator, relay closure.
<b>Resistance to Spoofing and Tampering:</b>	Information not available.
<b>Indoor/Outdoor Operation:</b>	Suitable for both.
<b>Temperature:</b>	32 to 130F (0 to 50C). Optional detector available for extended temperature range, -40 to +130F (-40 to +50C).
<b>Humidity:</b>	Information not available.
<b>Other Environmental Characteristics:</b>	Information not available.
<b>Interface:</b>	Information not available.

### PHYSICAL DATA

<b>Size:</b>	Detectors: two enclosures, 5x12x74in (12.7x30.5x188cm); Electronics: 8 $\frac{3}{4}$ x19x16in (22x48x41cm).
<b>Weight:</b>	Total shipping weight approximately 150lb (68kg).
<b>Power (Primary/Secondary):</b>	110 or 220V ac, 47 to 65Hz.
<b>Emplacement:</b>	Information not available.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available.
<b>Parts and Repairs:</b>	Information not available.
<b>Reliability:</b>	MTBF not available.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	Information not available.
<b>Government or Professional Standards:</b>	Designed to exceed the criteria given in NRC Regulatory Guides 5.27 and 5.7, and ERDA Personnel Doorway Monitor Standards A-2-73-2-3, A-2-74-211, and A-2-75-298.
<b>Lead Time:</b>	Information not available.

### COST DATA

<b>Unit Acquisition Cost:</b>	Doorway Monitor, \$11,500. Extended temperature range model \$12,400. Quantity discount available.
<b>Unit Installation Cost:</b>	Quoted separately for each installation. An additional charge may be made for long cable runs between instrument and detector locations.
<b>Training Cost:</b>	Information not available.
<b>Maintenance Cost:</b>	Information not available.
<b>Operation Cost:</b>	Information not available.

### NOTES

The PM-203 has not been tested by the Los Alamos Scientific Laboratories (LASL) for performance under the ERDA doorway monitor standard as a commercial doorway monitor. However, the prototype for this monitor was tested by its developers, personnel of the Chemical Instrumentation Division of the ERDA Rocky Flats Plant, operated by Rockwell International. The tests were done under local conditions to obtain ERDA approval of the prototype as an existing monitor and for use at Rocky Flats only. Some of the information given here is derived from a Rockwell report on the tests and from literature and a conversation with Tom Scurry. An ERDA evaluation by LASL under the same ground rules and environment as previous commercial monitor evaluations is expected to be completed by early 1977. The Rocky Flats test procedures differed from the ERDA tests in several ways. The major differences were that the gamma radiation background was not well determined, the test sources differed in geometry and chemical form, conventions used in attaching the source to the body and in moving the source through the portal may have tended to maximize rather than minimize detection, and some results were calculated rather than observed. The results obtained for spacing of 48 in (122 cm) between detector enclosures and two narrower spacings indicated that the monitor would detect the  $^{235}\text{U}$  and  $^{239}\text{PuO}_2$  sources used 50 percent of the time. The false alarm rate was calculated; however, no justification for the method used was given. There is some question as to how accurate the method used would be, and there is a lack of any operational supporting data. The false alarm rate may not be known well enough to allow comparison with another monitor.

#### Sensitivity:

Uranium 235 — The portal monitor will detect with a greater than 60 percent probability a 10 gram bare spherical source of  $^{235}\text{U}$  of at least 93 percent enrichment containing 99.75 percent weight uranium in a background of at least 0.02 mR/hr.

Plutonium 239 — The portal monitor will detect with a greater than 90 percent probability a 0.5 gram source of  $^{239}\text{Pu}$  with at least 93.5 percent enrichment containing a minimum of 99.5 percent weight plutonium and having a density of more than 19.44 gm/cm<sup>3</sup>. The  $^{240}\text{Pu}$  content shall be less than 5.5 percent. The source shall be encapsulated in at least 0.25 mm of stainless steel or nickel. The background radiation shall be at least 0.02 mR/hr.

### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

An X-ray package inspection system has four principal components: X-ray source, image converter, protective enclosure and parcel-transport mechanism. In operation, the package to be inspected is placed in front of the image converter and illuminated with X-rays. To an extent depending on the mass and X-ray absorbing properties of the package materials and its contents, the X-rays are attenuated, producing a shadow on the image converter. The converter, a fluoroscopic screen, converts the X-ray shadow pattern to a visible image. This may be viewed directly or may first require amplification by an image intensifier. The image may also be scanned by a television camera and displayed on a monitor. The components are enclosed within a shielded cabinet or housing which protects the operator from X-ray exposure.\* The transport mechanism for exposing single or multiple objects may be either a simple manual loading arrangement or a mechanized conveyor system.

The primary parameters of an X-ray system are dosage, exposure time, resolution and contrast. Three levels of X-ray dosage are commonly discussed in the literature: high-dose, low-dose and film-safe-dose. A high-dose system is one which operates at an X-ray flux rate at the fluorescent screen on the order of 10,000 to 100,000 R/hr. At such a high-flux rate the image produced on the fluorescent screen can be viewed with the naked eye. High-dose systems are characterized by their "refrigerator-type" cabinets, which are heavily shielded. They are typically used to inspect large parcels or dense objects.

\*The maximum permissible level of X-ray leakage from cabinet X-ray systems is 0.5 milliRoentgens per hour (mR/hr). The regulatory authority for X-ray equipment of this type is the Bureau of Radiological Health, Rockville, MD.

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In low-dose systems the X-ray flux is less than that of high-dose systems by four or five orders of magnitude, less than 10 R/hr. As a result, the fluoroscopic image intensity is much less, and a light-amplifying device (image intensifier) is incorporated to provide compensation. As a result of the low-flux rate and attendant low X-ray scattering, these low-dose units require only lightly shielded cabinets, making it possible to use high throughput transport mechanisms. Low-dose units are also smaller, lighter and more easily used than high-dose units. Most X-ray systems used in security applications are of the low-dose type.

A film-safe system is one in which the X-ray exposure per article inspection is less than 1 mR (0.001 R)\*. By comparison, in a high-dose system an article would receive a dose of several Roentgens during a nominal inspection time of a few seconds. All photographic film is sensitive to X-ray exposure. At the film-safe level, however, the amount of film fogging produced by as many as five exposures will be undetectable on amateur-type photographic emulsions. Most low-dose X-ray systems used in security applications today meet the film-safe exposure specification.

There are three basic low-dose X-ray techniques: continuous, pulsed and scanning X-ray. A continuous X-ray system operates with a low-level X-ray beam which, when activated, illuminates the parcel. The image produced on the screen is of low intensity and must be amplified by a multistage light amplifier. The image produced by the amplifier may be viewed directly, or can be scanned by a closed-circuit television camera and displayed on a monitor either at the system control console or at any other remote location.

\*The film-safe exposure limit is specified by the National Association of Photographic Manufacturers, Inc., Harrison, NY.

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In a pulsed X-ray system, the article being inspected is illuminated by a low-level, short-duration pulse of X-rays, and the shadow image is formed on a fluoroscopic screen. During the short time that the screen is illuminated, the shadow image is intensified and then scanned by a closed-circuit television camera. The video image is stored in an electronic storage device and is available for display on a television monitor. Before another article is scanned, the stored television image must be cleared from the storage device.

Scanning X-ray beam systems use a combination of X-ray beam scan along one axis and parcel motion along an axis at  $90^{\circ}$  to the scanning beam to produce a two-dimensional image of the parcel. The scanning beam is produced by a slotted rotating disk and detected by a sodium iodide (NaI) scintillator detector. The electrical signal produced in this fashion is converted to a television image signal and displayed on a monitor.

A given X-ray system's ability to enable an operator to identify weapons, contraband, explosives, etc., depends on the X-ray optics design (X-ray energy spectrum, uniformity of package coverage, distortion); on the method of transport and operator control; and most importantly, on the viewed image quality (brightness, resolution, contrast, etc.). X-ray systems for security applications should be capable of resolving a 24-gauge (0.02 in (0.5 mm) diameter) copper wire and be capable of distinguishing 10 shades of gray. In general low-dose units produce poorer-quality images than high-dose units, but have superior display systems and may have better detection than the high-dose units.

X-ray systems should be considered as screening systems rather than detection systems, because combinations of circumstances prevent them from fully imaging all the contents of a package. For example, items can be concealed in the metal frame of a handbag; items can be concealed within heavy-metal containers of various shapes; and

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low-atomic-number materials (substances composed of carbon, oxygen and nitrogen) may not always be clearly imaged. Therefore, it is often necessary to perform a hands-on inspection of suspect articles rather than to rely solely on viewing an X-ray image.

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## X-RAY INSPECTION EQUIPMENT

**Manufacturer** American Science and  
Engineering, Inc.  
955 Massachusetts Ave.  
Cambridge, MA 02139  
(617) 868-1600

**Model** 240/240E

Reference Evaluation Guide Procedure No. V-3.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The X-Ray inspection of hand-carried objects is accomplished with AS&E's Micro-Dose™ X-Ray Inspection System Model 240/240E. This desk style inspection system utilizes AS&E's patented Flying Spot concept of combining high image quality with ultra-low radiation exposures. The Micro-Dose System poses no health hazard and causes no damage to film. Security personnel can use the Micro-Dose System to detect packages, weapons and bombs hidden in compartments of sealed packages, and locate items undetectable by physical inspection. Attache cases, purses and briefcases can be safely checked for guns, explosive devices and other contraband.

### PERFORMANCE DATA

**Maximum Parcel/Baggage**

**Size:**

Height 17in (43cm). Length 24in (61cm) — (unlimited in RUN INTERMITTENT mode). Thickness 12in (30cm). Weight 45lb (20kg).

**Conveyor Belt Speed:**

240: 6.0in (15cm) per second (nominal). 240E: 4.8in (12cm) per second (nominal).

**Inspection Time:**

Information not available.

**Minimum Detectable Wire:**

26 AWG (0.16in/0.4mm dia. copper wire).

**Grey Scale:**

At least 10 distinguishable steps, log-related scale.

**Radiation Exposure:**

To parcel, 0.005mR per inspection (over 200 inspections before film fog). To operator, 0.1 mR per hour (approx. 1/5 of U.S. Federal Standard for cabinet X-ray systems).

**X-Ray Data:**

Power source 100kV, peak.

**Display:**

Standard 9in (23cm) TV monitor.

**Safety Standards:**

Complies in full with all requirements of U.S. Federal performance standards for cabinet X-ray systems (21CFR, Part 1020.40).

### PHYSICAL DATA

**Dimensions:**

Height, 29½in (75cm). Length, 79½in (202cm). Width, 36½in (93cm).

**Weight:**

Approximately 1300lb (585kg).

**Electrical Power:**

240: 120V ac, 60±0.5Hz, 2.75kVA single phase. 240E: 220V ac, 50±0.5Hz, 2.75kVA single phase.

**Ambient Temperature:**

50 to 90F (10 to 32C).

**Relative Humidity:**

20 to 90 percent (non-condensing).

### SUPPLY/LOGISTICS DATA

**Documentation and Training:**

Operator's manual includes maintenance guidance; two-week maintenance training offered free of charge.

**Parts and Repairs:**

Service contracts available from AS&E (field service group).

**Reliability:**

MTBF not available.

**Maintainability:**

Maintenance checks for radiation required every 6 months. MTTR not available.

**Warranty Information:**

Information not available.

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### COST DATA

**Unit Cost:** Approximately \$50,000., F.O.B. Cambridge MA. (Price includes installation).

### NOTES

#### Accessories:

American Science and Engineering, Inc. offers an Automatic Threat Alert (ATA) with their Micro-Dose X-ray Inspection Systems. ATA is designed to accomplish the following:

1. Automatically detect the presence of a potential threat, particularly guns, in an object being inspected.
2. Alert the operator when an object being inspected contains a threat by triggering audio and visual alarms.
3. Aid the operator in investigating the threat by using a split screen TV image to highlight the location and shape of the suspicious objects.

ATA is an option which can be added to any new or existing AS&E Micro-Dose X ray System.

### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

**Manufacturer** American Science and  
Engineering, Inc.  
965 Massachusetts Ave.  
Cambridge, MA  
(617) 868-1600

**Model** 222/222E

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

American Science and Engineering, Inc.'s Micro-Dose<sup>SM</sup> X-Ray Inspection System Model 222/222E is designed for high volume, detailed examination of articles (parcels, mail, etc.) at ultra-low X-ray exposure levels. The unit is modular in construction, and includes two conveyors and a movable control/monitor console. The main conveyor can be used for large-sized packages and parcels for routine screening. The smaller conveyor can be used for extra high quality inspection of "suspect" items (e.g., letters, flats, and small parcels).

### PERFORMANCE DATA

**Maximum Parcel/Baggage Size (Main Conveyor):** Height 28in (71cm) (56in (142cm) with a second inspection). Length 37in (94cm) (unlimited in RUN INTERMITTENT Mode). Thickness 36in (91cm). Weight: \*300lb (135kg).

**Maximum Parcel/Baggage Size (Small Conveyor):** Height 9in (22cm) (18in (46cm) with a second inspection). Length 22: 14in (36cm) (unlimited in RUN INTERMITTENT Mode). 222E: 12in (30cm). Weight 45lb (20kg).

**Conveyor Belt Speed:** Main Conveyor 4.6in (12cm) per second (nominal). Small Conveyor 22: 1/2in (5cm) per second (nominal). 222E: 1.4in (4cm) per second (nominal).

**Inspection Time:** Information not available.

**Minimum Detectable Wire:** Main Conveyor — at least 24 AWG (0.20in/0.5 mm dia.) copper wire. Small Conveyor — at least 26 AWG (0.016in/0.4 mm dia.) copper wire.

**Grey Scale:** At least 10 distinguishable steps, log-related scale.

**Radiation Exposure:** To parcel, 0.005 mR per inspection (over 200 inspections before film fog). To operator, 0.1 mR per hour (approx. 1/5 of U.S. Federal Standard for cabinet X-ray systems).

**X-Ray Data:** Power source 100 kV, peak.

**Display:** Standard 16in (41cm) TV monitor.

**Safety Standards:** Information not available.

**Ambient Temperature:** 50 to 90F (0 to 32C).

**Relative Humidity:** 20 percent to 90 percent (noncondensing).

### PHYSICAL DATA

**Dimensions:** Height, 77in (195cm). Length, 120in (305cm). Width, 53in (134cm).

**Weight:** Approximately 2,000lb (900kg) packaged for shipment.

**Electrical Power:** 222: 120V ac 60±0.5Hz, 2.75 kVA single phase. 220V ac 50±0.5Hz, 2.75 kVA single phase.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operator's manual includes maintenance guidance; two week maintenance training offered free of charge.  
**Parts and Repairs:** Service contracts available from AS&E (field service group).  
**Reliability:** MTBF not available.  
**Maintainability:** Radiation check required every 6 months. MTTR not available.  
**Warranty Information:** Information not available.

### COST DATA

**Unit Cost:** Approximately \$50,000 F.O.B., Cambridge, MA. (Price includes installation).

### NOTES

American Science and Engineering, Inc. offers an Automatic Threat Alert (ATA) with their Micro-Dose X-ray Inspection Systems. ATA is designed to accomplish the following:

1. Automatically detect the presence of a potential threat, particularly guns, in an object being inspected.
2. Alert the operator when an object being inspected contains a threat by triggering audio and visual alarms.
3. Aid the operator in investigating the threat by using a split screen TV image to highlight the location and shape of the suspicious objects.

ATA is an option which can be added to any new or existing AS&E Micro-Dose X-Ray Inspection System.

### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

**Manufacturer** American Science and  
Engineering, Inc.  
965 Massachusetts Ave.  
Cambridge, MA 02139  
(617) 868-1600

**Model** 230/230E

**Reference Evaluation Guide Procedure No.** V-5.A      **NRC Identification No.**

### NARRATIVE DESCRIPTION

American Science and Engineering, Inc.'s Micro-Dose<sup>™</sup> X-Ray Inspection System Model 230/230E is primarily intended for airline sterile concourse and gate screening inspection applications. The equipment meets the overall objectives of positive inspection of large volumes of hand-carried luggage for the presence of weapons, explosive devices, and other lethal objects. The AS&E Micro-Dose<sup>™</sup> X-Ray Inspection System Model 230/230E is configured for easy transportability and set up (plugs into standard power); it provides for high through-put, detailed examination of carry-on luggage (attache cases, ladies' purses, shopping bags, gift packages, etc.) by non-technical operating personnel.

### PERFORMANCE DATA

**Maximum Parcel/Baggage**

**Size:** Height 28in (71cm) (56in (142cm) with a second inspection). Length 37in (94cm) (unlimited in RUN INTERMITTENT mode). Thickness 19in (48cm). Weight 70lb (28kg).

**Conveyor Belt Speed:** 230: 9¼in (23.5cm) per second (nominal). 230E: 7½in (19cm) per second (nominal).

**Inspection Time:** Information not available.

**Minimum Detectable Wire:** 24 AWG (0.020in/0.5 mm dia.) copper wire.

**Grey Scale:** At least 10 distinguishable steps, log-related scale.

**Radiation Exposure:** To parcel, 0.003 mR per inspection (over 300 inspections before film fog). To operator, 0.1 mR per hour (approx. 1/5 of U.S. Federal Standard for cabinet X-ray systems).

**X-Ray Data:** Power source 100 kV, peak.

**Display:** Standard 16in (41cm) TV monitor.

**Safety Standards:** Complies in full with all requirements of U.S. Federal performance standards for cabinet X-ray systems (21CFR, Part 1020, 40).

**Ambient Temperature:** 50 to 90F (10 to 32C).

**Relative Humidity:** 20 to 90 percent (non-condensation).

### PHYSICAL DATA

**Dimensions:**

	Open	Closed
Height	74in (188cm)	59in (150cm)
Length	76in (193cm)	76in (193cm)
Width	90in (229cm)	40in (102cm)

**Weight:** Approximately 1,700lb (765kg).

**Electrical Power:** 230: 120V ac, 60±0.5Hz, 2.75 kVA single phase. 230E: 220V ac, 50±0.5Hz, 2.75 kVA single phase.

#### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operator's manual includes maintenance guidance; Two week maintenance training offered free of charge.  
**Parts and Repairs:** Service contracts available from AS&E (field service group).  
**Reliability:** MTBF not available.  
**Maintainability:** Radiation level checks required every 6 months. MTTR not available.  
**Warranty Information:** Information not available.

#### COST DATA

**Unit Cost:** Information not available.

#### NOTES

American Science and Engineering, Inc. offers an Automatic Threat Alert (ATA) with their Micro-Dose X-Ray Inspection Systems. ATA is designed to accomplish the following:

1. Automatically detect the presence of a potential threat — particularly guns — in an object being inspected.
2. Alert the operator when an object being inspected contains a threat by triggering audio and visual alarms.
3. Aid the operator in investigating the threat by using a split screen TV image to highlight the location and shape of the suspicious objects.

#### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

<b>Manufacturer</b>	Astrophysics Research Corp. 1526 W. 240th St. Harbor City, CA 90710 (213) 543-4370	
<b>Model</b>	Scanray Mark II	
<b>Reference Evaluation Guide Procedure No.</b>	V-5.A	<b>NRC Identification No.</b>

### NARRATIVE DESCRIPTION

The Scanray Mark II, Model 01-0466, is a low cost, manual baggage loading system which is composed of two sections: an electrical cabinet which contains the X-ray system, and an optical cabinet which includes the operator's viewing screen and controls; a platform between these units is the inspection well. The X-ray beam is projected horizontally through the baggage, and its contents are displayed on a ten-inch screen. It is equipped with casters for ease of relocation. The principle of operation is low intensity X-ray source/fluoroscopic screen with image intensifier.

### PERFORMANCE DATA

<b>Maximum Parcel/Baggage Size:</b>	Length, 30in (76cm). Width, 30in (76cm). Height, 18in (46cm).
<b>Conveyor Belt Speed:</b>	Not applicable.
<b>Inspection Time:</b>	3.2 seconds average (based on 600,000 inspections).
<b>Minimum Detectable Wire:</b>	26 gauge copper wire, 0.016in (.41 mm) dia.
<b>Grey Scale:</b>	10 shades, log related.
<b>Radiation Exposure:</b>	10 parcel, 72 mR/hr. To operator, per inspection, 0.07mR (3.5 seconds). Maximum leakage 0.45 mR/hr.
<b>X-Ray Data:</b>	Peak Voltage, 65kV. Filament Current, 30 microamperes. Radiation Output, 72 mR/hr. Duty Cycle, 33 percent. Beam Orientation, Horizontal.
<b>Display:</b>	Intensifier gain, $5 \times 10^6$ . Resolution, 20 line pairs per mm (equiv. to 1,000 TV lines).
<b>Safety Standards:</b>	Complies fully with 21CFR 1020.40; approved by FAA.

### PHYSICAL DATA

<b>Dimensions:</b>	Length, 96in (244cm). Width, 36in (91cm). Height, 58in (147cm).
<b>Weight:</b>	1,200lb (545kg).
<b>Electrical Power:</b>	100W, 100 to 240V ac, 50/60Hz.
<b>Ambient Temperature:</b>	Information not available.
<b>Relative Humidity:</b>	Information not available.

### SUPPLY/LOGISTICS DATA

<b>Documentation and Training:</b>	Information not available.
<b>Parts and Repairs:</b>	Information not available.
<b>Reliability:</b>	MTBF greater than one year.
<b>Maintainability:</b>	MTTR not available.
<b>Warranty Information:</b>	One year warranty.

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**COST DATA**

Unit Acquisition Cost:	Information not available.
Unit Installation Cost:	Information not available.
Training Cost:	Information not available.
Maintenance Cost:	Information not available.
Operation Cost:	Information not available.

**NOTES**

**INSTALLATIONS**

## X-RAY INSPECTION EQUIPMENT

**Manufacturer:** Astrophysics Research Corp.  
1526 W. 240th St.  
Harbor City, CA 90710  
(213) 534-4370

**Model:** Scanray Mark III (01-0465)

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Scanray Mark III, Model 01-0465, employs a conveyor to transport the baggage through the inspection area, where the X-ray beam is projected vertically downward through the baggage (satisfactory for inspection of non-rigid baggage such as suit bags, etc.). Low dosage (film-safe) X-rays produce an image on a fluorescent screen which is then intensified and presented to the operator. Leakage of radiation is controlled at baggage entrance and exit points by lead-impregnated curtains. This unit can inspect up to 1,200 bags per hour. Principle of operation is low energy X-ray source/fluoroscopic screen with image intensifier.

### PERFORMANCE DATA

#### Maximum Parcel/Baggage

**Size:** Length, any. Width, 25in (64cm). Height, 29in (74cm).  
**Conveyor Belt Speed:** Variable; 0 to 100 feet per minute (30.5m per sec).  
**Inspection Time:** 3.2 seconds average.  
**Minimum Detectable Wire:** 26 gauge copper wire 0.016in (0.41 mm) dia.  
**Grey Scale:** 10 shades, log related.  
**Radiation Exposure:** To parcel, 280 mR per hr. To operator, 0.27mR per inspection (3.5 seconds).  
Maximum Leakage 0.25 mR per hr.

#### X-Ray Data:

Peak Voltage, 65 kV. Filament Current, 110 microamperes. Radiation Output, 280 mR per hr. Duty Cycle, 75 percent. Beam Orientation, Vertical.

#### Display:

Intensifier gain,  $5 \times 10^6$ . Resolution, 20 line pairs per mm (equivalent to 1,000 TV lines). Display brightness, 50 foot-lamberts (highlights).

#### Safety Standards:

Complies fully with 21CFR 1020.40; approved by FAA.

#### Ambient Temperature:

Information not available.

#### Relative Humidity:

Information not available.

### PHYSICAL DATA

#### Dimensions:

Length, 156in (396cm). Width, 60in (152cm). Height, 84in (213cm).

#### Weight:

2,000lb (909kg).

#### Electrical Power:

200W, 100 to 240V ac, 50/60Hz.

#### Documentation and Training:

Information not available; operable by unskilled attendants.

#### Parts and Repairs:

Information not available.

#### Reliability:

MTBF not available.

#### Maintainability:

MTTR not available.

#### Warranty Information:

One year warranty.



**COST DATA**

**Unit Cost:**

Information not available.

**NOTES**

**INSTALLATIONS**

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## X-RAY INSPECTION EQUIPMENT

**Manufacturer** Astrophysics Research Corp.  
1526 W. 240th St.  
Harbor City, CA 90710  
(213) 534-4370

**Model** Scanray Mark IV  
(01-0467)

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Scanray Mark IV, Model 01-0467, is capable of examining all shapes and sizes of carry-on items as well as dense items such as wooden boxes. This unit employs advanced electronics and is basically the Scanray Mark II horizontal unit fitted with a high quality stainless steel conveyor. A sliding lead-glass door is provided over the inspection area so the operator may observe the item being inspected and, when necessary, reposition the item for a better view. Scattered radiation is minimized by stainless steel tunnels at the entry and exit ports of the inspection well, and lead-impregnated curtains inside the tunnels. The Mark IV is available with optional TV display at no additional cost. Principle of operation is low-energy X-ray source/fluoroscopic screen with image intensifier viewer of TV display.

### PERFORMANCE DATA

**Maximum Parcel/Baggage**

**Size:** Length, any. Width, 30in (76cm). Height, 25in (64cm).

**Conveyor Belt Speed:** Variable, 0 to 60 feet per minute (30.5cm per sec).

**Inspection Time:** 3.2 seconds average.

**Minimum Detectable Wire:** 26 gauge copper wire 0.016in (0.4 mm) dia.

**Grey Scale:** 10 Shades, log related.

**Radiation Exposure:** To parcel, 240 mR per hr. To operator, 0.23 mR per inspection. Maximum Leakage 0.10 mR per hr.

**X-Ray Data:** Peak Voltage, 65 kV. Filament Current, 100 microamperes. Radiation, Output, 240 mR per hr. Duty Cycle, 100 percent. Beam Orientation, Horizontal.

**Display:** Intensifier gain,  $5 \times 10^6$ . Resolution, 20 line pairs per mm (equivalent to 1,000 TV lines). TV display, information not available.

**Safety Standards:** Complies fully with 21CFR 1020.40; FAA approved.

**Ambient Temperature:** Information not available.

**Relative Humidity:** Information not available.

### PHYSICAL DATA

**Dimensions:** Length, 180in (457cm). Width, 96in (244cm). Height, 58in (147cm).

**Weight:** 1,700lb (773kg).

**Electrical Power:** 200W, 100 to 240V ac, 50/60Hz.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Information not available; operable by unskilled attendants.

**Parts and Repairs:** Information not available.

**Reliability:** MTBF not available.

**Maintainability:** MTTR not available.

**Warranty Information:** One year warranty.

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**COST DATA**

Unit Cost:

Information not available.

**NOTES**

**INSTALLATIONS**

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## X-RAY INSPECTION EQUIPMENT

**Manufacturer:** Astrophysics Research Corp.  
1526 W. 240th St.  
Harbor City, CA 90710  
(213) 534-4370

**Model:** Scanray Mark V  
(01-0468)

Reference Evaluation Guide Procedure No. V-5 A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Scanray Mark V, Model 01-0468, is a modification of the Scanray Mark II manual system. The modification consists of a lead-lined cover over the inspection well and lead-impregnated curtains at the entry and exit ports of the inspection area. Lead windows are provided to enable the operator to easily position the article for inspection or reposition it to change viewing angle. The Mark V can be operated at a higher radiation level than the Mark II to enable manual inspection of dense objects (wooden boxes, duffle bags). Photoelectric interlocks are retained to prevent operator's hand, etc., from entering the X-ray beam. Television display is available as a no-cost option. Principle of operation is a continuous X-ray source/fluoroscopic screen intensifier viewer or TV display.

### PERFORMANCE DATA

**Maximum Parcel/Baggage**

**Size:** Length, 30in (76cm). Width, 30in (76cm). Height, 18in (46cm).  
**Conveyor Belt Speed:** Not applicable.  
**Inspection Time:** 3.2 seconds average.  
**Minimum Detectable Wire:** 26 gauge copper wire 0.016in (0.41 mm) dia.  
**Grey Scale:** 10 shades.  
**Radiation Exposure:** To parcel, 150 mR per hr. To operator, 0.145 mR per inspection. Maximum leakage 0.10 mR per hr.  
**X-Ray Data:** Peak Voltage, 65kV. Filament Current, 60 microamperes. Radiation Output, 150 mR per hr. Duty Cycle, 100 percent. Beam Orientation, Horizontal.  
**Display:** Intensifier gain,  $5 \times 10^6$ . Resolution, 20 line pairs per mm (equivalent to 1,000 TV lines). TV display, information not available.  
**Safety Standards:** Complies fully with 21 CFR 1020.40; FAA approved.  
**Ambient Temperature:** Information not available.  
**Relative Humidity:** Information not available.

### PHYSICAL DATA

**Dimensions:** Length, 96in (244cm). Width, 36in (91cm). Height, 58in (147cm).  
**Weight:** 1,400lb (636kg).  
**Electrical Power:** 100 W, 100 to 240V ac, 50/60Hz.

### SUPPLY/LOGISTICS DATA

**Operation and Training:** Information not available; operable by unskilled attendants.  
**Field Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** Information not available.  
**Warranty Information:** Information not available.

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**COST DATA**

Unit Cost:

Information not available.

**NOTES**

Recommended for use in low to medium density throughout operations.

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## X-RAY INSPECTION EQUIPMENT

**Manufacturer** Astrophysics Research Corp.  
1526 W. 240th St.  
Harbor City, CA 90710  
(213) 534-4370

**Model** Scanray Mark VI  
(01-0470)

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Scanray Mark VI, Model 01-0470, is a manually-operated baggage inspection system. The entire unit is supported on casters to facilitate positioning during installation and allow moving to other areas. A foot lock is provided for stationary positioning. The system is composed of the following elements: X-ray subsystem, electronic subsystem, optical subsystem, TV camera, and TV monitor. This system employs a continuous X-ray source and is intended for low density airport usage. Principle of operation is low energy continuous X-ray source/intensified vidicon TV imaging.

### PERFORMANCE DATA

**Maximum Baggage/Parcel**

**Size:** Height, 20in (51cm). Length, 26in (66cm). Width, 10in (25cm).

**Conveyor Belt Speed:** Not applicable.

**Inspection Time:** 3.2 seconds average inspection time per bag.

**Minimum Detectable Wire:** 26 gauge copper wire 0.016in (0.41 mm) dia. (in briefcase).

**Grey Scale:** 9 shades, log related.

**Radiation Exposure:** To parcel, 0.42 mR per hr. To operator, worst case leakage 0.25 mR per hr.

**X-Ray Data:**

Peak Voltage	65kV.
Filament Current	150 microamperes.
Filtering	8mm Aluminum.
Beam Strength	600 mR per hr.
Duty Cycle	100 percent (continuous).
Beam Orientation	Horizontal.

**Display:** Display provides unobstructed view of a bag 16x2x10in (40.7x5x25.4cm).

Image Intensifier Gain      8x10<sup>4</sup>

TV Camera      Resolution 600 TV lines.

Shades of Grey      10

Scanning      525 lines, 60Hz, 2:1 interlace.

Tube      4625 (1 inch Vidicon).

TV Monitor      Resolution 700 TV lines.

linearity less than 2 percent.

Lens      25mm focal length, f/0.95 aperture.

**Safety Standards:** Complies fully with 21-CFR-1020.40, for cabinet X-ray systems; approved by FAA.

**Ambient Temperature:** Information not available.

**Relative Humidity:** Information not available.

### PHYSICAL DATA

**Dimensions:** Height, 42in (107cm). Length, 84in (213cm). Width, 32in (81cm).

**Weight:** 900lb (408kg).

**Electrical Power:** 300W, 110V, 60Hz, or 220V, 50 Hz.

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**SUPPLY/LOGISTICS DATA**

**Documentation and Training:** Information not available; operable by unskilled attendants.  
**Parts and Repairs:** Information not available.  
**Reliability:** MTBF not available.  
**Maintainability:** MTTTR not available.  
**Warranty Information:** One year warranty.

**COST DATA**

**Unit Cost:** Information not available.

**NOTES**

**INSTALLATIONS**

The pages listed below contain proprietary material and are excluded from this report. They will be printed under separate cover.

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## X-RAY INSPECTION EQUIPMENT

**Manufacturer** Philips Electronics Instruments, Inc.  
750 S. Fulton Ave.  
Mt. Vernon, NY 10550  
(914) 664-4500

**Model** Dynafluor IV

**Reference Evaluation Guide Procedure No.** V-5.A      **NRC Identification No.**

### NARRATIVE DESCRIPTION

The Philips Dynafluor IV is a high volume conveyor-operated X-Ray cargo inspection system which provides film safe and/or high penetration X-ray baggage inspection. The system is available in models for carry-on size luggage, and for oversized baggage. The Dynafluor IV employs a continuous X-Ray source with a fluorescent display screen which is monitored by a choice of plumbicon or vidicon TV camera. It is designed to be capable of 800 to 1200 inspections per hour, and the item is under complete control of the operator until inspected. The Dynafluor IV carry-on system is a conveyor belt loading system with sloping entrance conveyor and is available with optional 3-meter luggage pickup exit conveyors and luggage dump and for any specified voltage or frequency. The checked luggage system features an extra large opening for conveyor belt loading and optional entrance and exit conveyors.

### PERFORMANCE DATA

**Maximum Parcel Baggage**

Size:	Conveyor Unit	Checked Baggage Unit
Width	27in (68cm).	31in (79cm).
Height	13in (33cm).	24in (61cm).

<b>Duty Cycle:</b>	Continuous.
<b>Conveyor Belt Speed:</b>	Information not available.
<b>Inspection Time:</b>	3 sec minimum.
<b>Minimum Detectable Wire:</b>	0.02in (0.5 mm) diameter (24 gauge), see notes.
<b>Grey Scale:</b>	Information not available.
<b>Radiation Exposure:</b>	To parcel, high dosage mode, information not available; low dosage mode, information not available. To operator, less than 0.5 mR per hr with 2in (5cm) from any external surface.
<b>X-Ray Data:</b>	Peak voltage information not available.
<b>Display:</b>	Fluorescent screen viewed by either plumbicon or vidicon TV camera. Video scene displayed on 14in (36cm) diagonal TV monitor.
<b>Safety Standards:</b>	Complies in full with requirements of National Bureau of Radiological Health.
<b>Ambient Temperature:</b>	Information not available.
<b>Relative Humidity:</b>	Information not available.

### PHYSICAL DATA

Dimensions:	Main Cabinet	Entrance Conveyor	Exit Conveyor
Length	13ft, 6in (411.5cm)	8ft (243.8cm) or 6ft (182.9cm)	9ft, 6in (289.6cm) or 8ft (243.8cm)
Width	42in (106.7cm)	40in (101.6cm)	40in (101.6cm)
Height	96in (243.8cm)	28.5in (72.9cm)	29in (73.6cm)

<b>Maximum Length:</b>	31ft (945cm) long.
<b>Weight:</b>	Maximum, 6,575lb (2,983kg).
<b>Electrical Power:</b>	220V, 24A, 50Hz; 220V, 30A, 60Hz.

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### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operation and service manuals available; training program available.  
**Parts and Repairs:** Service contracts available.  
**Reliability:** Information not available.  
**Maintainability:** Information not available.  
**Warranty Information:** One year on parts.

### COST DATA

**Unit Cost:** Dynafuor IV, 27x14in opening, vidicon camera, \$50,900. Dynafuor IV, 32x25in opening, vidicon camera, \$67,675.00, includes remote console for TV and control. Exit conveyor, 9ft, 6in long, \$2,592.00. Luggage dump, 5ft long, \$900.00. Remote console for TV and control, \$1,200.

### NOTES:

Dynafuor IV meets FAA requirement of distinguishing 24 gauge insulated solid copper wire.

Accessories include an x-ray test pattern (Catalog number 650-903-01, price \$50.00).

### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

**Manufacturer** Philips Electronics Instruments,  
Inc.  
750 S. Fulton Ave.  
Mt. Vernon, NY 10550  
(914) 664-4500

**Model** Dynafluor VI

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Dynafluor VI is a continuous X-ray source inspection system available in four configurations, (see note 1). Viewing may be direct or televised, and the system is low-dose and film-safe. This unit is caster-mounted for ease of relocation. A real time image is observed rather than a stored picture, so that parcels may be observed in motion when using the conveyORIZED models.

### PERFORMANCE DATA

#### Maximum Parcel/Baggage

##### Size:

	Models DM/TM	Models DC/TC
Width	30in (76cm).	17in (43cm).
Length	17in (43cm).	info. not avail.
Height	info. not avail.	22in (56cm).

#### Duty Cycle:

Continuous.

#### Conveyor Belt Speed:

Information not available.

#### Inspection Time:

4 sec minimum for conveyor units.

#### Minimum Detectable Wire:

0.02in (0.5 mm) diameter (24 gauge).

#### Grey Scale:

Information not available.

#### Radiation Exposure:

To parcel, information not available. To operator, less than 0.5 mR per hour at 2in (5cm) from any external surface.

#### X-Ray Data:

Peak voltage information not available.

#### Display:

Direct viewing fluorescent screen (DM, DC); televised image by plumbicon or vidicon (TM, TC).

#### Safety Standards:

Complies with requirements of National Bureau of Radiological Health.

#### Ambient Temperature:

Information not available.

#### Relative Humidity:

Information not available.

### PHYSICAL DATA

#### Dimensions:

Models DM/TM Length 7ft 7in (231cm); width 31in (79cm). Models DC/TC Length 7ft 7in (231cm); width 31in (79cm). Inspection Counter, 34in (86cm) high. Cabinet 45in (114cm) high. Cabinet and Viewer/TV 64in (162cm) high. Conveyor runs through cabinet to make overall width 11ft (335cm).

#### Weight:

Models DM/TM 850lb (386kg). Models DC/TC 1,150lb (522kg).

#### Electrical Power:

115V, 8A, 60Hz; 23V, 6A, 50Hz.

### SUPPLY/LOGISTICS DATA

#### Documentation and Training:

Operation and service manuals available; training program available.

#### Parts and Repairs:

Service contracts available.

#### Reliability:

Information not available.

#### Maintainability:

Information not available.

#### Warranty Information:

One year on parts.

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### COST DATA

**Unit Cost:** Dynafluor VI, DM, direct viewing, manual loading, \$25,465.00. Dynafluor VI, DC, direct viewing, conveyor loading, \$29,825.00. Dynafluor VI, TM, vidicon TV, manual loading, \$36,450.00. Dynafluor VI, TC, vidicon TV, conveyor loading, \$40,356.00. Entrance/exit conveyor, 11ft long, \$2,594.00. Entrance/exit conveyor, 5ft long, \$2,250.00. Luggage dump, \$350.00

### NOTES

**Model Descriptions:**

**Model DM** — Horizontal counter-type unit. Viewing device can swivel around a vertical axis and tilt for proper viewing by a particular operator. The unit can be loaded from either side. For low to medium volume operations.

**Model TM** — Similar to Model DM, except that viewing is accomplished by means of a TV monitor mounted on the viewing console. For low to medium volume operations.

**Conveyorized Models** — DC, TC — (D = direct viewing; T = televised viewing); baggage placed on conveyor is carried through a radiation shield into the X-ray chamber. As the item passes through the X-ray beam, the image of its contents appear on the direct viewer (DC) or TV monitor (TC). After the item is cleared by the operator, it passes through a second radiation shield to a pickup area. The conveyor is controllable; it may be stopped to enable a more thorough examination by the operator. "Conveyor" and "X-Ray On" switches are provided for this purpose.

Dynafluor VI meets FAA requirements of distinguishing 24 gauge insulated copper wire.

Accessories include an X-ray test pattern (Catalog number 650-903-01, price \$50.00).

### INSTALLATIONS

## X-RAY INSPECTION EQUIPMENT

**Manufacturer** Philips Electronics Instruments  
Inc.  
750 S Fulton Ave.  
Mt. Vernon, NY 10550  
(914) 664-4500

**Model** Dynafluor X

Reference Evaluation Guide Procedure No. V-5.A      NRC Identification No.

### NARRATIVE DESCRIPTION

The Philips Dynafluor X is a compact, high resolution, low dosage X-ray system designed and developed for passenger baggage screening. In operation, the operator inserts the package into the device, presses the control button and inspects a bright, detailed picture which appears instantly on the viewer. The object being inspected remains under security control until released. Personnel safety is assured by careful shielding and interlocks so that the unit meets all Bureau of Radiological Health (BRH) Inspection System guidelines and X-ray cabinet standards.

### PERFORMANCE DATA

**Maximum Baggage/Parcel Size:** Height, 12in (30cm). Width, 22in (56cm). Depth, 24in (61cm).  
**Duty Cycle:** Continuous.  
**Conveyor Belt Speed:** Not applicable.  
**Inspection Time:** 9 sec minimum or 400 items per hr.  
**Minimum Detectable Wire:** 0.02in (0.5 mm) diameter (24 gauge).  
**Grey Scale:** Information not available.  
**Radiation Exposure:** To parcel, less than 0.5 mR per inspection, see notes. To operator, less than 0.5 mR per hr. (0.00014 mR per second).  
**X-Ray Data:** Peak voltage information not available.  
**Display:** Direct view fluorescent screen.  
**Safety Standards:** Complies with requirements of Bureau of Radiological Health.  
**Ambient Temperature:** Information not available.  
**Relative Humidity:** Information not available.

### PHYSICAL DATA

**Dimensions:** Height, 54in (138cm). Width, 36in (91cm). Depth, 31in (85cm).  
**Weight:** 450lb (200kg).  
**Electrical Power:** 115V, 2A, 60Hz; 220V, 1A, 50Hz.

### SUPPLY/LOGISTICS DATA

**Documentation and Training:** Operation and service manuals available; training program available.  
**Parts and Repairs:** Service contracts.  
**Reliability:** Information not available.  
**Maintainability:** Information not available.  
**Warranty Information:** One year on parts.

### COST DATA

**Unit Cost:** Dynafluor X, film safe unit, \$13,500.00. Auxiliary loading table, \$325.00.  
Additional Charge for special formica, \$100.00

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### NOTES

Photographic film will not exceed exposure requirement of the National Photographic Manufacturers Association in 5 to 10 inspections.

Accessories include an X-ray test pattern (Catalog number 650-903-01, cost \$50.00).

### INSTALLATIONS

