LEVEL II

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TOP-6-3-527	2. GOVT ACCESSION NO. AD-A094038	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) US Army Test and Evaluation Command Test Operations Procedure Testing of Sensor Materiel		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Tropic Test Center (STETC-TD) APO Miami 34004		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DARCOM-R-310-6
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Test and Evaluation Command (DRSTE-AD-M) Aberdeen Proving Ground, MD 21005		12. REPORT DATE 30 November 1980
		13. NUMBER OF PAGES 42
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

DTIC ELECTE JAN 23 1981 D

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Acoustic sensors	Intrusion detectors	Sensors
Audio detection sensors	Magnetic sensors	Test operations procedure
Detection ranges	Methodology	Tropic Test Center
Electromagnetic sensors	Mission length	Unattended ground sensors
False alarm rate	Seismic sensors	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Test Operations Procedure provides basic procedures for conducting tests of vehicle and personnel intrusion detectors (sensors) and related materiel in any environment. It applies to testing of all types of tactical unattended ground sensors which work on the principles of detection of an outside stimulus, logic processing of that stimulus, and transmission of a coded signal to a readout device. Included are sensors which operate on magnetic, seismic, acoustic, electromagnetic and audio detection principles.

AD A094038

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Item 20. (cont)

This document describes methods for determining operational effectiveness of sensors to include false alarm rate (susceptibility to undesired sources), detection range and a probability of detection, probability of correct classification and mission length data. Survivability of air-delivered or artillery-delivered sensors is also considered. Evaluations of readout devices are limited to probability of reception, transmission, and display of sensor messages. Common procedures such as preoperational inspection, physical characteristics, human factors, and camouflage and concealment are referenced as appropriate.

US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-105
Test Operations Procedure 6-3-527 30 November 1980
AD No.________________________

TESTING OF SENSOR MATERIEL

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1. SCOPE.

a. This Test Operations Procedure (TOP) provides basic procedures for conducting tests of vehicle and personnel intrusion detectors (sensors) and related materiel in any environment.

b. This document applies to testing of all types of tactical unattended ground sensors which work on the principles of detection of an outside stimulus, logic processing of that stimulus, and transmission of a coded signal to a readout device. Included are sensors which operate on magnetic, seismic, acoustic, electromagnetic and audio detection principles.

c. This TOP does not specifically address sensor materiel which operates on other than the general principles described above or sensor type items utilized in physical security systems, although portions of these procedures may be applicable.

d. This document describes methods for determining operational effectiveness of sensors to include false alarm rate, or susceptibility to undesired sources, detection range and a probability of detection, probability of correct classification and mission length data. Survivability of air-delivered or artillery-delivered sensors is also considered. Evaluations of readout devices are limited to probability of reception, transmission, and display of sensor messages. Common procedures such as preoperational inspection, physical characteristics, human factors, and camouflage and concealment are referenced as appropriate.

e. Testing for susceptibility to countermeasures is not addressed because of the security classification of that subject.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities

a. Typical range and test area features are illustrated in figure 1. The area should typify the terrain for the environmental area of interest but contain sufficient level terrain to allow radio frequency (RF) line-of-sight beyond expected RF ranges. The capability to establish a naturally clear (no vegetation) line-of-sight range over extended distances also may be necessary. Convenient access for an instrumentation site having good RF reception to and from the test area is required. The area should be isolated. The capability to exclude unauthorized vehicles, personnel and aircraft is essential for control of tests.

b. The vehicle test road should be relatively flat, straight, and unbroken by streams, bridges, or other irregularities for a distance of at least 1 kilometer. This is essential to permit evaluation of detection ranges under relatively controlled conditions. It is also desirable to have at least two separate test road sites in different seismically mapped areas.

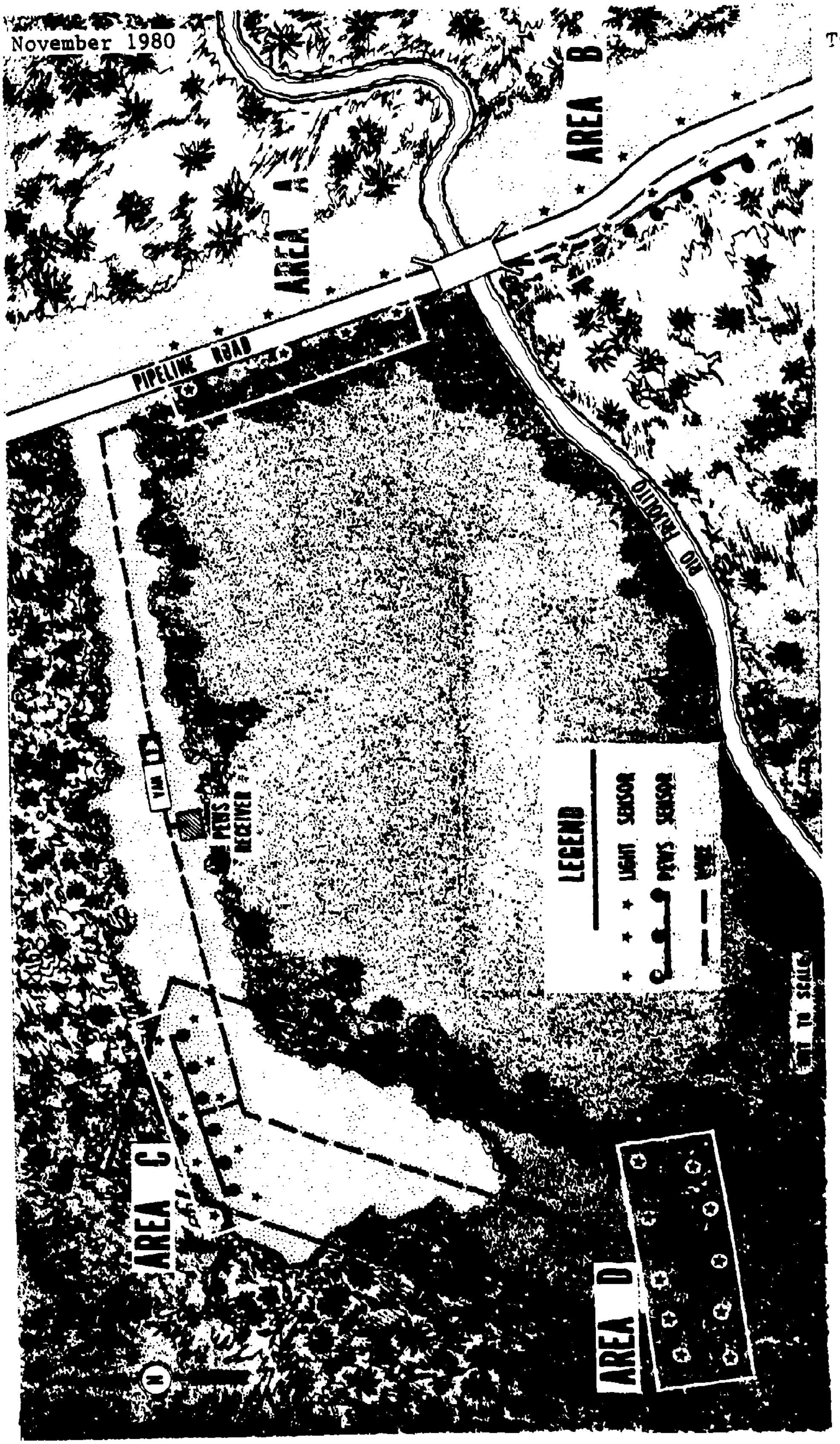

Figure 1. Typical Test Area.

c. Personnel trails should be located as near as possible to the test road sites to facilitate ease of instrumentation. Personnel trails should have a surveyed grid with markers establishing a 20- to 50-meter grid array. The areas should be seismically mapped so that later detection data can be compared to the seismic quality of the area. The above-mentioned grid facilitates mapping of the area and also allows for location of air-dropped sensors using the towers described below.

d. Three towers are used to locate, by triangulation, the impact points for air-delivered sensors and also to make it possible to control activities within the grid.

e. An instrumentation and support area contains instrumentation and storage facilities for support equipment. Permanent or mobile shelters for instrumentation and commercial electrical power facilities are also desirable. All activities relative to other parts of the test area should be staged from this location to facilitate control.

f. Rotary wing, propeller-driven fixed-wing, and jet fixed-wing aircraft may be needed (paragraph 5.5.2a(1)).

g. A facility will be needed for use of artillery simulators (paragraph 5.5.2a).

2.2 Instrumentation

a. Instrumentation for sensor testing can range from use of existing devices for generating and receiving sensor messages, including field equipment and actual sensors, to sophisticated automatic data collection systems. If field equipment is to be used, the reliability of the equipment must be proven prior to the start of trials, and periodically during testing, using a calibrated message source. Manual collection and reduction of data are tedious and time consuming; therefore, maximum possible utilization of automatic data processing techniques is recommended.

b. It is desirable to compare sensor performance in the field with the actual magnetic, seismic, electromagnetic and acoustic signals received by the sensor. Therefore, it will be necessary to use field detection equipment for measuring magnetic field variations, seismic disturbances, and possibly electromagnetic fields and acoustic disturbances. Figure 1, above, shows the location of instrumentation used on PEWS DT II testing.[1]

c. Typical instrumentation for field testing is listed below:

Magnetometer	*Develco Model 9210
Visicorder	*Honeywell 1508B
Amplifiers (4 ea)	*Accudata 117
Geospace Geophones	*Geospace
Amplifiers	*Burr Brown Model 110
Target Position Location System	
	*Or equal instrumentation

1 USATTC Development Test II (Tropic Phase) of Platoon Early Warning System (PEWS), TECOM Project No. 6 ES 305 PEW 004, July 1978.

d. Typical instrumentation for laboratory baseline is listed below:

Decade Resistor	*Heathkit
Multimeter	*Fluke 8600A
Function Generator	*Wavetek Model 162
Helmholtz Coil	Laboratory manufactured
Mu Metal Shield	

*Or equal instrumentation

3. PREPARATION FOR TEST.

3.1 Prerequisites

a. Perform the procedures prescribed by the appropriate TOPs as prerequisites to conducting other required subtests.[2 3 4]

b. Items which require build-up from common modules are assembled in accordance with applicable technical manuals. Common modules are tested on go, no-go test equipment. Components are adjusted or rejected as required.

c. Assembled test items are checked on go, no-go test equipment to confirm that the test items are operational. Test items which fail are rejected and subjected to failure analysis.

d. Units are normally emplaced for subtests in accordance with applicable technical manuals under strict test officer/NCO supervision. This avoids introduction of variables caused by incorrect emplacement and allows collection of required unit data. If desired, human factors subtests can be conducted concurrently. If air-delivered test items are to be evaluated, it is desirable to implant a portion of the sample by means of the intended delivery mode and hand emplace the remainder of the sample in the same area for comparison of performance.

e. Intrusion detectors under test are usually implanted at 5- to 10-meter intervals, parallel to the road or trail to be used for detection range tests (paragraph 6.2). The offset from the road or trail centerline prescribed for the device is generally used; however, it may be varied. Other array configurations may be used if objectives so dictate; however, the linear array is the most convenient for analysis. Although 5- to 10-meter intervals are not

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2 TOP 1-3-505, Preoperational Inspection, 30 June 1972.
3 TOP 1-2-504, Physical Characterisitcs, 31 October 1972.
4 TOP 3-3-501, Personnel Training, 24 July 1970.

tactically realistic, the closer spacing simplifies position location and speeds conduct of repetitive trials. Units should not, however, be emplaced so close as to cause unit-to-unit interference. For tests of readout devices or total intrusion detector systems, a tactically sound and realistic array should be developed with intervals based on the expected detection range and operating characteristics of the test items.

f. Movement of test items after initial implant should be avoided until all subtests, excluding the mission length test, are completed.

g. In most test areas there should be a cycle of storage and of field testing. It is necessary then to determine if degradation or failure has resulted from environmental storage conditions, i.e., extreme cold, fungus, humidity, or rainfall. To do this, laboratory baseline testing is required prior to and after return from the field to examine changes in performance parameters.

h. The instrumentation facility should be prepared to record required data on digital tape and, if used, analog tape. Receiver channels are set, necessary patching is accomplished, and all instrumentation is tested.

i. Laboratory baseline tests should be performed in accordance with paragraph 5.13, below. Testing should be conducted prior to, and upon return from field trials.

j. A meteorological observation station should be established within sight of the sensor array but well out of the expected detection range of the test items. The observer collects meteorological data (wind speed at surface and treetop, temperature, relative humidity, and precipitation) and reports the occurrence to the instrumentation facility and, once reported, the disappearance of the following:

Winds above preselected speeds [e.g., light wind, 9km/hr (5 knots); heavy wind, 28km/hr (15 knots)].

Precipitation (light and heavy as defined in requirements documents).

Thunder.

Animals.

Personnel.

Vehicles.

Aircraft.

Explosions, weapon firing or other loud noises.

Other parameters, as prescribed by the nature of the test item.

Other unusual occurrences.

k. The type of soil (sandy, clay, etc.) will be identified before the start of the test. (Type of soil affects seismic propagation.)

3.2 Data Required

a. Data prescribed in the following TOPs, as appropriate:

(1) TOP 1-3-505, Preoperational Inspection, 30 June 1972.

(2) TOP 1-2-504, Physical Characteristics, 31 October 1972.

(3) TOP 3-3-501, Personnel Training, 24 July 1970.

(4) TOP 10-3-507, Safety, 1 December 1970.

(5) TOP 10-3-506, Man Portability/Transportability, 7 May 1971.

(6) TOP 1-2-610, Human Factors Engineering, Part I and Part II, 20 Dec 1977.

(7) TOP 1-2-611, Cold Regions Human Factors Engineering, Part I & II, 20 Jan 78.

(8) TOP 1-2-502, Durability Testing, 14 September 1972; and Change 1, 13 August 1973.

(9) TOP 7-3-512, Airdrop, 24 July 1970.

b. Tabulated data, as follows:

(1) Test item nomenclature and model.

(2) Serial number.

(3) Gain setting.

(4) Channel identification code (ID).

(5) Disposable switch settings for safe recovering (if required).

(6) Results of go, no-go tests of assembled test items.

(7) Disposition of failed test items.

(8) Implant location of test items (reference position location markers) in three dimensions.

(9) Other pertinent information, such as diurnal switch setting for units so equipped.

(10) Separate listings indicating serial numbers of components and results of laboratory checks of components.

4. TEST CONTROLS.

4.1 Seismic Activity

It is essential that all seismic activity, other than that generated by test subjects during intrusion testing, be kept to a minimum. This prevents unwanted seismic signals from giving false alarms because of signals from test control personnel or equipment.

4.2 Acoustic Activity

Acoustic sensors can be very sensitive; therefore, in addition to controlling test personnel and vehicles in the area, care must be taken to choose an area which does not have an extremely high amount of indigenous noise (insects, civilization sounds, etc.) during personnel and field testing. A high rate of indigenous noise may, however, be a valid test condition if test objectives include documenting false alarm rates (FAR) caused by naturally occuring noise.

4.3 Electromagnetic Activity

A spectrum analysis of electromagnetic activity in the area should be performed to assure that false alarms will not be generated by radio frequency activity during personnel and field testing. RF activity may, however, be used as a valid FAR test objective.

5. PERFORMANCE TESTS.

5.1 False Alarm Rate (FAR)

5.1.1 Objectives

a. Determine the characteristic rate at which test items activate from sources other than intended targets.

b. Establish that the FAR of the test item and overall operation will permit further testing.

5.1.2 Method

a. The FAR test should be the first test run to determine that a high FAR rate will not adversely affect further testing. The test sample is emplaced in an array which will be used for future testing (paragraph 2, above). Proper operation is confirmed by conducting several passes by intended targets and monitoring sensor activations at the instrumentation facility. NOTE: This procedure will be referred to in the future as confirmation.

b. All access to the sensor array is controlled to preclude approach of unintended targets in the vicinity of the sensor array. The presence of unintended targets within 10 to 20 times the detection range of the sensor could raise background energy levels to the point where the test item will show an abnormal FAR.

c. The instrumentation facility monitors all sensor activations and records on digital tape the activations by channel and ID and the time of each activation. Also, the location at all times of personnel or vehicles on the test course is recorded on digital tape. Any data from additional field instrumentation, i.e., seismic, magnetic or electromagnetic sensors, are recorded on digital or analog tape. Any observations or phenomena not recorded on digital tape are recorded in a log and placed on analog tape (if used) and, if not, recorded automatically from communications links.

d. The test items are examined periodically during the test period. The presence and the nature of the target are noted during these periods.

e. Recommended duration for FAR testing is 72 to 96 hours. A minimum of 72 hours should be conducted in three complete diurnal cycles. If test scheduling dictates, portions of this subtest may be operated at 24-hour intervals throughout the test period; however, a minimum of 24 hours of FAR testing should be conducted in one complete diurnal cycle before further testing is attempted. This will confirm suitability of the test item for further testing and identify sources to which the test item is susceptible.

5.1.3 Data Required

a. Digital tape record of sensor activations, observations on the sensor array, times of activations and observations, and meteorological data.

b. Log record of observations not on digital tape.

5.2 Detection Range

5.2.1 Objectives

a. Determine the target-to-test item range at which various targets or groups of targets are detected.

b. Determine the probability of detection of a given target.

5.2.2 Method

a. Target configuration is determined by test criteria. Typical targets may vary from one test subject to multiple test subjects (with the test subjects at specified intervals) and from one vehicle to multiple vehicle convoys. Different types of vehicles should be tested, because they have different seismic, magnetic, electromagnetic and acoustic properties.

b. Repetitive trials are conducted holding target conditions constant. Normally, 22 trials are desired (10 trials minimum) under specific target conditions (nature of the target, interval, speed, direction of approach).

c. Separate groups of trials are conducted for each direction of approach of interest. Factors which govern direction of approach are the nature of the sensing technique (omnidirectional, unidirectional, or having a varied directional pattern, depending on the orientation of the test item) and the nature of the target.

For example, omnidirectional detectors, such as a seismic geophone, may show variations in detection range for opposite directions of approach because of terrain irregularities, such as slope, which may affect the output of the target. For such detectors, the use of two directions of approach is adequate and convenient as the target can challenge the test item in a series of round trips, with each round trip consisting of two trials, each trial having varied the conditions of direction of approach. This variable can be controlled by assignment of odd trial numbers to one direction and treated separately during the analysis.

Test items employing sensing techniques which have nonuniform detection patterns may be challenged in a series of trial groups with direction of approach varied 90 degrees. This can be conveniently accomplished by conducting one series of round trips along one path and a second series along a perpendicular path.

Detectors which are unidirectional in nature may or may not be sensitive to direction of approach. Test design for such test items must be established on the basis of the nature of the detector.

Certain targets may produce nonuniform stimulus patterns which are independent of terrain. For example, seismic energy patterns for helicopters vary significantly with direction of approach. Trials for such targets should be conducted in separate groups as described above.

d. Data for target location can be collected manually, but with great difficulty and with poor precision. The recommended method uses the instrumentation shown in figure 1. Light sensors are placed along a line parallel to the sensors. The light sensors consist of a sealed beam light on one side of an intrusion path and a light sensor on the other side. This creates a light beam across the intrusion path which when broken by personnel or vehicles, will cause the light sensor to send a signal to a central recording station to be placed on tape. By assuming a constant speed between light sensors, the location of a target on the path can be evaluated at any time. By comparing this location with the time at which the sensor activated, the slant range detection distance is calculated.

e. Aircraft trials are conducted in a similar manner. The altitude and ground speed of the aircraft are controlled as closely as possible. The aircraft flies on a predetermined heading which crosses over the sensor array. Three surveyed points are selected; marked along the heading by panel markers, balloons, or terrain features; and designated as the initial point (IP), on-top (OT) and final point (FP). As the aircraft crosses these points, the events are reported as described above. With suitable radar equipment, and if the desired altitudes are above terrain masking, radar control techniques can improve the precision of such trials at high altitudes.

f. All possible sources for false alarms, except test targets, are excluded from the test area during detection range testing. Detection range trials are not conducted during adverse weather, unless required by test objectives, or during periods when the test items show or could be expected to show a FAR which is significantly higher than that determined in paragraph 5.1.

g. The instrumentation facility automatically records test item activations and times of activations on digital tape. Instrumentation facility operators will manually log trial numbers and position location data. Events or circumstances not so recorded, such as weather conditions, uncommon FAR and instrumentation problems, are logged and recorded on analog tape.

5.2.3 Data Required

a. The location of target paths in three dimensions.

b. Digital tape recordings of sensor activations by trial number, time of activations, and target locations as a function of time.

c. Instrumentation operator's log.

5.3 <u>Probability of Detection</u>

5.3.1 Objective. Determine the probability of detecting a target by a given sensor or system.

5.3.2 Method. A log is kept of total intrusion and total sensor activations. The probability of detection is then calculated according to paragraph 6. Systems should be tested for various configurations of personnel at various speeds, i.e., running, walking, jogging. They should also be tested for various vehicle speeds and directions of approach.

5.3.3 Data Required. See paragraph 5.4.3.

5.4 Probability of Correct Recognition

5.4.1 Objective. Determine the probability of a complex system to correctly classify the type of target.

5.4.2 Method. The method used is the same as that described in paragraph 5.3.2.

5.4.3 Data Required. A log of test data to include date, intrusion area, type of target, intrusion number, total number of detections, and the target classification for each detection.

5.5 Susceptibility to Sources Other than Desired Targets

Test items which have acceptable FAR and detection characteristics may be susceptible to performance degradation from specific sources other than intended targets. For example, certain types of seismic detectors intended for use against personnel and vehicles also detect aircraft and artillery fire which cause an increase in FAR. Other types will have detection range and probability reduced in the presence of other sources. The former case can, as a rule, be sufficiently evaluated with respect to environmental sources, such as rain or wind, during FAR testing; however, additional testing for sources such as aircraft and artillery fire will normally be required to permit accurate descriptions of the extent of susceptibility. The latter case requires conduct of additional detection range and probability testing in the presence of the degrading sources. The need for such testing is established by test item characteristics, suitability criteria and availability of funds.

5.5.1 Objectives

a. Evaluate performance degradation in terms of the range at which signals that are not of interest degrade test item performance by significantly increasing FAR.

b. Evaluate the extent of degradation of detection characteristics in the presence of extraneous sources.

5.5.2 Method

a. (Objective 5.5.1a) Rotary-wing, propeller-driven fixed-wing, and jet fixed-wing aircraft are utilized.

(1) Trials are normally conducted to collect data at a range of altitudes directly over and parallel to the sensor array, with a minimum of two approach headings separated by 180 degrees. Trials may also be run at other approach headings, separated by 90 degrees, to determine the effect of aircraft orientation. Trials may be conducted at various offset distances, parallel to the axes of the sensor array, at various altitudes. Generally, a minimum of five

passes is made at each altitude, offset, and aircraft orientation. If no sensor activations are observed in five passes under a given set of conditions, further trials which would result in increased slant ranges at the same aircraft orientation are unnecessary.

(2) Data for determining susceptibility to munitions are collected by using artillery simulators at various ranges from the sensor array. Multiple trials of several different blast groups should be conducted. Examples of blast groups are:

One blast, 1 minute quiet--repeated three times.

Two blasts, separated by 1 second, followed by 1 minute of quiet --repeated three times.

Variation in the number of blasts and intervals, as described above.

b. (Objective 5.5.1b) Desired target detection range and probability trials are conducted in the presence of extraneous sources. Worst-case conditions, such as a helicopter slowly passing over the target as the target passes the sensor array or simulating artillery fire close to the sensor array, as described in paragraph 5.2.2d, above, will usually be adequate to verify test item performance criteria in the presence of extraneous sources. Worst-case examples of environmental conditions are moderate-to-high winds in dense vegetation and moderate-to-heavy rainfall.

5.5.3 Data Required

a. Digital tape record of sensor activations and times of activations (objectives 5.5.1a and b).

b. Digital tape or manual record of position locations data for extraneous sources (objectives 5.5.1a and b).

c. Quantitative description of environmental sources present during detection trials as a function of time, if possible (objective 5.5.1b).

d. Instrumentation operator's log of events not recorded above.

5.6 Mission Length

Generally, intrusion detectors and relays are designed to become electronically disabled when batteries lose power. Many sensors also have timing options which will disable the device after a specific time period. Evaluations of test items with timing options would challenge all options. In addition, it may be desirable to evaluate sensor performance over the longer life period.

5.6.1 Objectives

a. Determine the mean life of the test item at various timing options (if available).

b. Evaluate sensor performance over the expected mission length.

c. Confirm proper operation of disable mechanisms at the end of the mission length.

d. Determine the cause of unit failure if disable mechanisms fail to function.

5.6.2 Method

a. Test items used for previous operational performance evaluation are returned to the laboratory and bench tested to determine operational condition. New batteries are installed and timers are set, if required.

b. Units are emplaced, with the disable mechanisms engaged, in an area in which typical target traffic can be expected within detection range. The quantity and location of traffic are not controlled throughout the test; however, it may be desirable to determine the number of activations which occur daily. Simple activation counters can be designed for this purpose, using sensors which operate on principles similar to those of the test items.

c. Test items are confirmed at emplacement, and daily thereafter, by a specific number of passes (typically six) of an intended target. If a unit fails to confirm on a specific percentage of passes (typically 50 percent) for a specified number of consecutive days (typically 3 days), it is considered to have failed. The day of failure is the 1st day in the consecutive series that the unit failed to confirm.

d. Performance over the life of the test item may be evaluated by conducting FAR (12 hours) and detection range/probability trials (vehicle trials with five round trips) at intervals (typically weekly) throughout the expected test item life.

e. Failed units are returned to the sensor laboratory after field examination. Disabled mechanisms are disengaged, if possible, prior to removing the test item from its emplacement site.

f. If field examination and corrective action reactivate the unit, it is generally still removed from the test for purposes of collecting life data, after noting the circumstances causing irrational performance. However, if the cause was environmental, such as blockage of an infrared line-of-sight, the unit may remain for collection of additional environmental data. Inclusion of such data in analysis, however, should be considered carefully to avoid faulty conclusions.

g. Laboratory analysis can be accomplished on automated test equipment, if available, or the causes of failure can be isolated to a specific component using go, no-go test equipment. Detailed analysis on failed components is recommended if facilities are available. As a minimum, confirmation of activation of the disable mechanism should be made.

5.6.3 Data Required

a. Results of pre-emplacement laboratory tests.

b. Results of daily confirmations.

c. Daily or average daily activation count.

d. FAR, detection range, and probability data, as specified in paragraphs 5.1, 5.2 and 5.3 for each performance test series.

e. Results of field examination of failed units.

f. Results of failure analysis.

g. Summaries of meteorological data during the test period.

5.7 <u>Air Delivery, Survivability and Emplacement</u>

5.7.1 Objective. Evaluate penetration or hang-up in forested areas, implant characteristics, and survivability of test items when air-delivered under simulated tactical conditions.

5.7.2 Method

a. The target areas can be marked with helium-filled balloons or, if in an open area, by aircraft panel markers to facilitate delivery and observation.

b. The test items are delivered using the operational delivery method into a target area applicable to other operational subtests (see paragraph 3.1e).

c. The soil and vegetation in the target area should be typical of the environment of interest.

d. If practicable, the deployment and trajectory of the test items will be observed from three points and azimuths recorded to the implant point. These data, when reduced to a grid location by resection, will facilitate locating the test items.

e. Units are confirmed after completing delivery of all test items. Test personnel then locate units and record their observations on implant or hang-up characteristics, damage sustained, and electronic survivability.

5.7.3 Data Required

a. Descriptions of vegetation and soil in the target area including vegetation density.

b. Aircraft type and method of release, airspeed, and altitude above ground level.

c. Visual record (motion or still) of test item deployment, and impact or entry into canopy.

d. Results of confirmation.

e. Observations by test personnel of implant or hang-up characteristics to include implant angle, visible damage and, for suspended units, height above ground level.

f. Location in three dimensions.

g. Color photographs of emplaced test items and damage, if any.

5.8 <u>Tests of Relay Systems</u>

5.8.1 Objective. Evaluate the effectiveness of intrusion detector relay systems.

5.8.2 Method. Relay systems are tested in a manner similar to intrusion detectors. Recommended operational subtests are false transmission rates (FTR), FAR, RF ranging, and a life test. Tests should also be conducted to evaluate delivery means.

a. After emplacement and confirmation, a false transmission subtest is conducted. This subtest is to determine the reliability of the relay system by measuring the percentage of signals received and not transmitted. A sensor or sensor simulator and a readout device are situated near a relay unit. A total of 100 signals are sent by the sensor or sensor simulator. The readout device is on the channel of the relay and is monitored to determine the number of signals transmitted by the relay.

b. A FAR subtest is conducted to determine the false alarm characteristics of the relay transmitter. All reception channels are monitored at the instrumentation facility, and data are recorded on digital tape in the same manner as in sensor FAR subtests (paragraph 5.1).

c. Sample size will be severely limited by the reception capability of the instrumentation facility. For convenience, one channel may be used for relay reception; however, different channels must be used to monitor relay output to identify the test item which is transmitting. Generally, RF spectrum analyses of the relay reception channel are made periodically to identify the nature of background energy.

d. RF ranging trials are conducted as described in paragraph 5.12, below. In conjunction with RF ranging, data are also collected to validate reception and transmission of valid sensor messages, that is, identification of source and corresponding relay outputs over repeated source activations.

e. The mission length is conducted as described in paragraph 5.6 using a 100 percent reliable sensor simulator as input to the relay system. If desired, any sensor may be used in lieu of a simulator; however, appropriate measures should be taken to confirm that the sensor has activated properly.

5.8.3 Data Required

a. For the FTR subtest, the number of signals sent by the sensor or sensor simulator and the number of signals sent by the relay are recorded.

b. FAR subtest data requirements and analyses are the same as those for sensor FAR. Background spectrum analyses of the reception channel are considered, as well as environmental factors, in determining factors affecting FAR.

c. RF ranging analysis techniques are found in paragraph 5.12, below. Source and relay outputs over repeated source activations are also analyzed to determine the reliability of the relay in receiving and retransmitting the desired sensor message.

d. Mission length test data requirements and analysis for relay systems are similar to those used for intrusion detectors (paragraph 5.6).

5.9 Tests of Audio Systems

Acoustic sensors and audio components or auxiliary devices to intrusion detectors, which operate on another type of input principle, are often used to confirm the presence of suspected targets by listening to activity in the vicinity of sensor arrays. This subtest provides general procedures for testing such devices.

5.9.1 Objective. Evaluate the effectiveness of audio components of intrusion detectors and commandable audio sensors.

5.9.2 Method

a. The devices are emplaced in a tactically sound sensor array. Commandable audio sensors are emplaced in conjunction with other types of sensors.

b. Personnel, trained to operate the sensor readout equipment, monitor the activations received from the array and then operate the audio devices as prescribed in applicable technical manuals. The entire system is challenged with a variety of types of targets, target activity, and target sizes at various times during the day and night, and under various weather conditions in accordance with fixed scenarios. Examples of targets and activities are dismounted troops moving quietly, dismounted troops moving without regard to noise discipline, convoys of wheeled vehicles, convoys of tracked vehicles, mixed convoys, troops in a bivouac area, and truck-park activities.

c. Operators monitor each prescribed activity under simulated combat conditions, both with and without the aid of the audio device, and interpret the sensor readout. If possible, operators also monitor the same activities under varied weather conditions and numbers of times a day.

d. Operators are not permitted to monitor execution of the same scenario more than once each shift. Consistent with realism, each operator monitors as many types of activity as possible during each shift. A sufficient amount of "quiet time" is randomly dispersed throughout each shift to provide realistic conditioning for each operator and normal appearance of false alarms. For example, in one 4-hour shift, 1 1/2 hours of "quiet time" could be followed by passage of a convoy. Five minutes later a column of troops could pass. After another 2-hour "quiet period," a second column of troops could approach within detection range of the array and remain for a short period of time, simulating a break. During the break, another convoy could pass.

e. Operators record all pertinent activation data and analyze the data for target type, size, speed, and direction of movement and activity.

f. Analog tape recordings of the execution of scenarios under various conditions may be made for further study and for replay to other operators. This procedure controls the input under which different operators are challenged, and conserves resources required to execute scenarios for a significant number of different operators.

5.9.3 Data Required

a. Scenarios used to challenge the sensor readout device operator system.

b. For each scenario:

Operator identification and experience.

Weather conditions and time.

If audio devices were monitored.

Operator interpretations of sensor activations and audio monitoring, to include type and size of target and target activity.

5.10 Tests of Readout Systems

5.10.1 Objective. Evaluate the effectiveness of readout systems.

5.10.2 Method. Readout system evaluations are conducted in a manner similar to those for relay systems and audio devices. Operational tests should include realistic challenges of the test item and trained operators by passing typical targets past tactically emplaced sensor arrays, in order to ensure that received activations can be reliably interpreted.

a. Conduct 72 to 96 hours of false display rate trials on clear channels in a manner similar to that for relay systems. Spectrum analyses of background energy should be made periodically throughout the period. Proper reception and display should be confirmed periodically using a sensor simulator or by activating an intrusion detector.

b. RF ranging (for reception) is conducted in accordance with paragraph 5.12.

c. Because readout devices are not left unattended, a life test is not conducted.

d. Trained readout device operators run the equipment during exercises designed to challenge the man-machine relationship under simulated combat conditions. Scenarios are developed using typical targets and intrusion detectors. Operators who have no knowledge of the contents of the scenario, but know the location and capabilities of the intrusion detectors, collect and interpret activation data. If appropriate, operators spend equal amounts of time using the test item and previously adopted equipment against the same situations for the purpose of comparing both types of equipment.

5.10.3 Data Required. False reception rate data are collected and analyzed in a manner similar to that for FAR (paragraph 5.1.2). Spectrum analysis of reception channels as well as environmental data are utilized to determine susceptibility of the equipment to presenting false displays under various conditions.

5.11 Tests of Command Systems

5.11.1 Objective. Evaluate the effective range and reliability of command systems.

5.11.2 Method. RF ranging (for reception) is conducted in accordance with instructions in paragraph 5.12.

a. The command link is challenged by placing the commandable sensor in proximity to the instrumentation facility and sending commands from a command transmitter at variable ranges. The instrumentation facility transmits a status command after each command transmittal by the test command transmitter (except in cases when the test transmitter is sending a "status" command), and records the intrusion detector response and test command transmitter command for each trial.

b. The response link is challenged by increasing the range between the test commandable intrusion detector and the instrumentation facility, and then by activating the response message with a command transmitter in proximity to the intrusion detector.

c. A command system (i.e., command transmitter and receiver combination) may be challenged by combining the procedures above.

5.11.3 Data Required. RF ranging data (paragraph 5.12) for the following situations:

a. Command Link:

Location of command transmitter for each series of trials.

Location of the intrusion detector and instrumentation facility.

Number of commands transmitted.

Number of commands correctly received, as indicated by a correct response to the command.

b. Response Link:

Location of test items for each series of trials.

Location of instrumentation facility.

Number of commands or responses correctly received at instrumentation facility.

5.12 Radio Frequency Range

5.12.1 Objective. Determine the RF receiving/transmission range between sensors and readout facilities, sensors and relays, and relays and readout facilities. The tests may be conducted in open terrain and in a forested environment to determine the effect of distance on RF range and the effect of foliage on signal attenuation.

5.12.2 Method

a. Sensor-to-readout:

RF ranging tests for the sensor-to-readout conditions are conducted with the sensor located a specified distance from the readout facility within the expected range of the sensor. The sensor is turned on and stimulated to transmit 100 messages. The number of messages transmitted can be counted by visually observing an RF indicator light placed on the sensor antenna or by counting the number of messages shown on a portable readout device placed near the sensor. Transmissions are counted manually or readout devices may be modified to count messages automatically.

Sensor messages are monitored at the readout facility and counted either manually or automatically. The readout facility operator records the start and stop times and trial number.

After each set of 100 messages is sent, the sensor is moved farther from the readout facility until the sensor is beyond the effective range. At least five different ranges should be used to insure enough data points sufficient to determine the range beyond which a certain percent transmission is lost.

b. Sensor-to-relay:

RF ranging tests for the sensor-to-relay condition are conducted similarly. A sensor simulator may be used in place of an actual sensor, if the system message characteristics are identical to typical sensors, because the purpose of this test is to measure the receiving range of the relay rather than the transmission range of the sensor. The sensor simulator sends messages at regular intervals which may be counted at the source in the same manner as described in paragraph 5.12.2a, above.

The readout facility is placed as close as possible to the relay to minimize any effect of relay-to-readout distance and to monitor both sensor and relay transmissions.

The procedures used to determine range beyond which a certain percentage of messages is lost are conducted as described in paragraph 5.12.2a, above.

c. Relay-to-readout:

RF ranging tests for the relay-to-readout condition are conducted similarly. A sensor simulator is placed near the relay, and 100 messages are transmitted to the relay. Simulator and relay messages are counted at the source as described in paragraph 5.10.2, above.

The readout facility is located a specific distance from the relay within the expected range (if known) of the relay.

In this test the readout facility is moved rather than the relay. The readout facility is moved after each set of 100 messages in the manner described for sensor movement in paragraph 5.10.2, above.

d. In RF ranging tests, a minimum of four sensors (or relays) should be used for comparison of data. This can be done for sensors by using two units on different channels. Two relays can receive on the same channel but must transmit on different channels. In order to distinguish the different test items, the readout facility must receive messages on a different channel from each sensor or relay.

e. To determine the maximum range a sensor or relay will transmit when, because of terrain, it is not practicable to move the transmitter from the receiver a sufficient distance:

Place the transmitter (either sensor or relay with counter attached) at a distance from the receiver so that it is well within the anticipated range.

Stimulate the sensor to transmit a series of 100 message blocks. Each 100-message block should be transmitted at half the power level of the previous block. This is done by increasing the attenuation on a variable coaxial attenuator attached to the transmitter's antenna at 3-decibel steps. The attenuation is increased in 3-decibel steps until the signal is lost or the percent of messages received is below the prescribed level.

Move the transmitter/counter, by increments, away from the receiver and repeat step 2 starting with 0-decibel attenuation in each place.

As the range between the transmitter and the receiver is increased, the amount of attenuation required to lose the signal will become less. Continue until data have been taken at as many locations as practical (generally more than five).

The attenuation is introduced to make the sensor signal sufficiently weak at close ranges so that the automatic gain control circuit in the receiver is at maximum sensitivity. Thus, the gain in the receiver, which is a variable, is eliminated.

The variation of percent correct reception as a function of time, weather, and local simulator position is sometimes desired. The effects of time of day and weather conditions are measured by sending 100 messages at each attenuator setting from a given location under the conditions desired. The effects of local simulator position can be measured by sending sets of 100 messages while moving the position of the simulator antenna between sets of messages.

5.12.3 Data Required

a. Location of each sensor, relay and readout device.

b. Distances of each sensor/relay to the readout facility.

c. Time of day and weather conditions for each message set.

d. Attenuator setting when simulator is used.

e. Number of messages sent by the source and number of signals received by the readout facility.

f. Terrain profile charts, showing ground level and vegetation level for each transmission path.

5.13 Laboratory Baseline Data

5.13.1 Objective. Determine the effect of environmental testing on performance parameters and assist in classifying failure data as to cause of failure.

5.13.2 Method. Each detection method will need to be evaluated as to the effect of harsh environments on the performance of that method and results to the system of that change in performance.

a. Seismic. Quantitative measurements of the output will be taken under normal "quiet" laboratory conditions and under extreme environmental conditions. It is important that any unwanted external seismic stimulus be eliminated while performing laboratory and environmental evaluations. A typical means of accomplishing this is to make all measurements on a "vibration free" table equipped with vibration isolators. In the absence of that, some success has been achieved by using air or water bag isolators under the equipment to be tested to isolate it from unwanted vibration sources. Vibration excitation may be provided by a "programmed" vibration table or other suitable means.

b. Magnetic. Quantitative measurements of the output of the magnetic sensing element also must be made in a laboratory condition and in extreme environments (simulated or real). Shielding from unwanted magnetic fields can be accomplished by using a double-walled mu-metal chamber of sufficient size to allow for ease of movement of the test item. Magnetic field stimulation can be accomplished through the use of a Helmholtz coil which provides a magnetic field proportional to the current through the coil.

c. Acoustic. Isolation can be provided by a soundproof room and excitation provided by audio oscillators and speakers. Sensing elements should be evaluated at different frequencies to determine their response.

d. Electromagnetic. Isolation can be provided by RF-shielded rooms with excitation provided by RF generators at different frequencies.

5.13.3 Data Required

a. Seismic. Stimulus intensity, noise background, sensing element output data and sensor numbers.

b. Magnetic. Helmholz coil current, frequency, magnetic field background, sensing element output data and sensor number.

c. Acoustic. Noise background, stimulus intensity, sensing element output data and sensor number.

d. Electromagnetic. RF generator output, center frequency, bandwidth, sensing element output data and sensor number.

6. DATA REDUCTION AND PRESENTATION.

6.1 False Alarm Rate (FAR)

The FAR is normally reported as the number of false activations per unit time. The definition of what is considered a false activation should be specified in the equipment specification. If the definition of the FAR is not in the equipment specification, an agreement should be reached between the test agency and the user, and the definition included in the test plan.

6.2 Detection Range

a. The target-to-sensor range at which a sensor will detect various targets is a critical criterion in the evaluation of intrusion detection systems. The relation of targets to emplaced units at a given time must be determined accurately in three dimensions for analysis of detection range and probability data.

b. Sensor locations are usually described in two dimensions for ground-emplaced items. For airdropped systems, it is more practical to describe sensor locations in terms of three dimensions because it is probable that they will be emplaced above ground level.

c. Frequently, position, location, and sensor activation data are reduced to provide a record of the slant range from the target to the sensor for each activation. Further analysis produces statistically significant detection ranges.

d. The slant range detection distance is calculated from a linear sensor deployment as in figure 1. The sensors are deployed on a centerline and intrusion paths run parallel to the deployment line. The perpendicular distance from the centerline to the intrusion line is denoted as "C." The parallel distance from the test subject to the sensor at the time of activation is denoted "B" and the slant range "A" is calculated by the equation $A=(B^2 + C^2)^{1/2}$.

e. An important element of the above equation is the location of the test subject on the course at all times because distance "B" is derived from that location (refer to paragraph 5.2 for the method for that location).

6.3 Probability of Detection

a. The probability of detection may be reported as a percentage and is calculated by the formula:

(total detections/total intrusions) x 100.

b. The probability of detection may be described as a system concept, i.e., the probability of detection of the system as a whole; or it can be described as a component concept, i.e., the probability of detection by each separate sensor of the system. The probability of detection definition must be agreed upon by the developer and user prior to testing, and must be included in the test plan.

6.4 Probability of Correct Classification

a. The total number of intrusions, as gathered from section 5.4, and the total number of correct classifications will be used in the following formula to obtain the percent correct classifications:

(total correct classification/total intrusions) x 100.

6.5 Susceptibility to Sources Other than Desired Target

a. From paragraphs 5.5 and 6.1, a FAR will be derived without the presence of the external sources listed in paragraph 5.1.2b. The FAR will then be derived (paragraph 6.1) in the presence of these noise sources and any deviation from the alarm rate originally measured (10 percent) may be reported as "susceptible" or "not susceptible."

b. The presence of undesired noise sources listed in paragraph 5.1.2b may also affect the ability of the system to detect desired targets. Any deviation (10 percent) of the probability of detection in the presence of these sources from the probability of detection without these sources may be reported as "susceptible" or "not susceptible."

6.6 Mission Length

a. Mean mission length of test items for each timing option can be predicted using a Weibull distribution of failure times.

b. Plots of FAR and detection range/probabilities versus time should be made throughout the test item's life to report the variation of performance in time.

c. Mean mission length and standard deviation should be computed for each sensor type, and then an appropriate significant variation chosen in mean life which exists between the different types of sensors.

d. Daily or average daily activations are compared with criteria or design frequency of activation over the mission length period to insure activation frequency has not been below or above expected frequency levels.

6.7 Air Delivery and Survivability

a. The reliability for successful delivery of the units for the speed of a specific air vehicle and type of vegetation can be calculated using a binomial distribution.

b. Differences in operational characteristics, based on comparison of FAR and detection range probability of hand-emplaced and airdropped test items, can be established objectively and weighed to determine the effect of air delivery on sensor performance.

6.8 Tests of Relay Systems

a. RF ranging analysis techniques are described in paragraph 6.11. Source and relay outputs over repeated source activations are also analyzed to determine the reliability of the relay in receiving and retransmitting the desired sensor message.

b. Life test data requirements and analysis for relay systems are similar to those used for intrusion detectors.

6.9 Tests of Audio Systems

a. The accuracy of each operator's interpretations is calculated for each scenario, application (with or without use of audio device), and condition (time of day, weather). Results of interpretations for all operators are compared for given conditions and applications to establish operator-to-operator variation.

b. Accuracy of interpretations of all operators and all conditions is compared for each of the two applications (with and without audio) to establish a degree of increased accuracy of intrepretations through use of audio devices.

c. Accuracy of interpretations of all operators under given conditions (time of day, weather) is compared for each application to establish the effect of conditions on the degree of increased accuracy from use of audio devices.

d. A "learning curve" for both types of detection (with and without radio) can be established to determine the percentage of accuracy increase with experience.

6.10 Tests of Readout Systems

a. Spectrum analysis of reception channels including environmental data is utilized to determine the susceptibility of the equipment to presenting false displays under various conditions.

b. RF ranging data (for reception) are analyzed in accordance with paragraph 6.12.

c. Operational test data (actual target nature, size of target group, target speed and direction) versus operator interpretation are subjectively analyzed to establish the ease and accuracy with which operators can interpret readout from the test item. Other types of readout equipment are made, if appropriate, to determine which can be interpreted more accurately. A log of equipment problems also should be maintained.

6.11 Tests of Command Systems

RF range data (for reception) are analyzed in accordance with paragraph 6.12.

6.12 Radio Frequency Range

a. The percent reception correctly received versus range for each sensor is plotted. From these plots the maximum range for the desired percent correct reception can be otained by a go, no-go analysis of each sensor using the cumulative form of binomial distribution.

b. When attenuation has been used at the transmitting antenna, the percent of correct reception versus range for each attenuator setting is plotted.

c. The above will result in a family of curves which demonstrates that, as the range is increased, the amount of attenuation required to maintain the percentage of correct transmission is reduced. From these data the position of the zero continuation curve can be extrapolated by calculating an attenuation-versus-distance function. The resulting function can be used to plot the zero attenuation curve for each sensor. From these zero attenuation plots, the maximum range for the desired percent correct reception can be obtained by a go, no-go analysis of each sensor using the cumulative binomial distribution.

6.13 Laboratory Baseline Data

Analysis is accomplished by analysis of variance procedures on performance parameters.

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APPENDIX A. TEST CHECKLISTS

This appendix contains a series of sample task checklists for sensors (TOP 1-2-610). This sample should be used as a guide only. Inappropriate items should be deleted and items added as appropriate.

A-1. TASK CHECKLIST FOR SENSOR TRANSPORTABILITY

Test Title ____

Test Project No. ______________________ Date ______________

Man/Item Tasks	YES	NO	N/A	Comments
1. Position and lock movable components.				
2. Remove and secure loose and projecting components.				
3. Apply protective covering.				
4. Remove expendable liquids.				
5. Connect or remove auxiliary equipment (fording or winterizing kits).				
6. Disassemble item elements.				
7. Obtain or construct package.				
8. Insert item into package.				
9. Insert shock proofing materiel.				
10. Anchor item.				
11. Close package.				
12. Apply labeling.				

YES = Adequate NO = Inadequate N/A = Not Applicable

Sensor Transportability (cont)

Man/Item Tasks	YES	NO	N/A	Comments
13. Attach or remove hooks and cables to lifting points on item or package.				
14. Engage item with materiel handling components (forks).				
15. Emplace item on or in pallets, cargo nets, slings or other lifting and loading devices.				
16. Attach item where required--lifting, sliding or rolling item to do so.				
17. Secure ties to item.				
18. Secure ties to carrier.				
19. Increase or decrease tension of ties during or after initial task.				
20. Check out tie-downs during transit to verify connection and tension.				
21. Check wheels; lock tracks.				
22. Open package.				
23. Remove item or components.				
24. Assemble item.				
25. Clean, lubricate, etc.				
26. Install, set up, and distribute item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

A-2. TASK CHECKLIST FOR PORTABILITY/USABILITY
(Sensor Compatibility)

Test Title ______________________________

Test Project No. ______________________ Date ____________

Man/Item Tasks	YES	NO	N/A	Comments
1. Put on or take off shirt, gloves, boots, trousers and protective clothing.				
2. Button, snap, and tie clothing.				
3. Attach or emplace load into or onto pack, load carrier or carrying case.				
4. Buckle straps, snap catches, or otherwise attach portable gear to body, cartridge belt, or pack harness.				
5. Wear clothing.				
6. Wear personal equipment items (backpack, cartridge belt, etc.).				
7. Carry item on back or body (no hands).				
8. Adjust carrying elements (straps and holders).				
9. Carry item in one or both hands.				
10. Carry item by one or more men.				
11. Fasten item securely to body to prevent flapping or interference.				

YES = Adequate NO = Inadequate N/A = Not Applicable

Portability/Usability (cont)

Man/Item Tasks	YES	NO	N/A	Comments
12. Discard item in emergency (snagged on vegetation or barbed wire).				
13. Disconnect or raise item for wading if wetting is a problem.				
14. Carry item while performing various combat tasks.				
15. Eliminate noise sources caused by or relative to the item.				
16. Cover or modify visible or reflecting surfaces to insure camouflage.				
17. Open access flaps or covers.				
18. Remove item from case.				
19. Connect components.				
20. Extend and fasten collapsible and folding components.				
21. Manipulate adjustment controls.				
22. Verify operational status.				
23. Clean and adjust optics.				
24. Put on and adjust item (goggles, life preserver, etc.).				
25. Use item as designed (dig, illuminate, etc.).				

YES = Adequate NO = Inadequate N/A = Not Applicable

A-3. TASK CHECKLIST FOR OPERABILITY
(Electronics/Signals, Sensors and Detectors)

Test Title ______________________________

Test Project No. ____________________ Date ____________

Man/Item Tasks	YES	NO	N/A	Comments
1. Read special handling instructions.				
2. Identify sensor.				
3. Retrieve from storage.				
4. Unpackage.				
5. Handle sensor.				
6. Deploy parts.				
7. Assemble parts.				
8. Select modes of operation.				
9. Prepare interfaces and connections.				
10. Select technical parameters.				
11. Connect lines, cables, etc.				
12. Perform static checkout.				
13. If stationary: emplace, position or orient.				
14. If moving: attach to locomotion device.				
15. Point or aim.				

YES = Adequate NO = Inadequate N/A = Not Applicable

Operability (cont)

Man/Item Tasks	YES	NO	N/A	Comments
16. Conceal or camouflage, as required.				
17. Reorient, as required.				
18. Activate sensor.				
19. Verify activation.				
20. Follow safety procedures.				
21. Read instructions.				
22. Communicate.				
. Perform dynamic checkout.				
24. Perform quick deactivation.				
25. Control location, position, operation, and feedback of data.				
26. Control rate of motion and field of view.				
27. Activate displays.				
28. quire and interpret sensed data.				
29. Verify validity of sensed data.				
30. Inte rate data from different se sors.				
31. A s data quality.				
32. Assess data quantity.				
33. Identify problems.				
34. Isolate problems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

A-4. TASK CHECKLIST FOR MAINTAINABILITY
(Electronics/Signals)

Test Title ______________________________

Test Project No. ______________________ Date ______________

Man/Item Tasks	YES	NO	N/A	Comments
1. Access components.				
2. Tighten components.				
3. Clean components.				
4. Align components.				
5. Adjust components.				
6. Calibrate components.				
7. Remove components.				
8. Replace components.				
9. Acquire checklist.				
10. Access components.				
11. Adjust controls.				
12. Read displays.				
13. Read labels.				
14. Activate controls.				
15. Acquire performance aids.				
16. Read displays.				
17. Access test points.				

YES = Adequate NO = Inadequate N/A = Not Applicable

Maintainability (cont)

Man/Item Tasks	YES	NO	N/A	Comments
18. Activate test equipment.				
19. Read signals.				
20. Make decisions.				
21. Identify component.				
22. Break connections.				
23. Remove component.				
24. Repair component.				
25. Align component.				
26. Replace component.				
27. Make connection.				
28. Verify connection.				
29. Remove and replace module.				
30. Acquire job performance.				
31. Prepare test equipment.				
32. Mate component with test equipment.				
33. Control inputs.				
34. Read outputs.				
35. Check calibration charts.				
36. Verify repair.				

YES = Adequate NO = Inadequate N/A = Not Applicable

APPENDIX B. DATA COLLECTION SHEET FOR TESTING OF SENSOR MATERIEL

Test Item: ____________ Model: ____________ Serial No: ____________

Gain Setting: ____________ Channel/Identification Code: ____________

Results of go, no-go test: ____________

Implant Location: ____________ Other Pertinent Information: ____________

Date	Intrusion Number	Intrusion Area	Type of Target	Detection (success/ failure)	Detection Distance (closest distance to target for non-detections)	Target Classification	Remarks

APPENDIX C. SUBJECTIVE OPINION QUESTIONNAIRE

This appendix represents a series of sample subjective opinion questionnaire items related to sensors. This sample should be used as a guide with inappropriate items deleted and relevant items included. The format may be altered to satisfy particular purposes. Recommend that the questionnaire be used to identify potential problem areas for further exploration.

Date ______________________

Name ____ SSN ______________________

Rank __________ Unit ____

Your opinions concerning the employment of this sensor will assist in the evaluation process.

You are to rate a series of tasks and some general features of the sensor.

The rating scale that you will use is a 1 to 5 scale. The numbers relate to words as:

1 = Very Satisfactory
2 = Satisfactory
3 = Borderline
4 = Unsatisfactory
5 = Very Unsatisfactory

There will be a brief discussion of the rating process prior to filling out the questionnaire. When you complete the questionnaire, turn it over and sit quitely.

Task/Item	Training The training for task was: (circle one)	Manuals The manuals provided to assist in performing this task are: (circle one)	Tools The tools provided to perform this task are: (circle one)	Sensor The design of the sensor for this task is: (circle one)
Stowing Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Unstowing Sensor	1 2 2 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Assembling Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Select Mode of Operation	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Prepare Interfaces/ Connections	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Select Technical Parameters	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Connect Lines/Cables/etc.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Perform Static Checkout	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Emplace Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Point or Aim Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Conceal/Camouflage Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Reorientation of Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Activate Sensor	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Verify Sensor Activation	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Follow Safety Procedures	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Read the Instructions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Indicate your overall rating of the sensor.

Overall, the sensor is: (circle one)

1 - Very Satisfactory

2 - Satisfactory

3 - Borderline

4 - Unsatisfactory

5 - Very Unsatisfactory

SAFETY

Were the warning tables adequate? (circle one)

Yes No

Comments:____

Were any unsafe conditions noted? (circle one)

Yes No

Comments:____

Were you injured while using the sensor? (circle one)

Yes No

Comments:____

Preceding Page

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Original doc.