UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TOP 8-4-005	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) US ARMY TEST AND EVALUATION COMMAND, TEST OPERATIONS PROCEDURE, COLD REGIONS ENVIRONMENTAL TEST OF NUCLEAR, BIOLOGICAL, AND CHEMICAL EQUIPMENT (ALARMS AND DETECTORS)		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 USA COLD REGIONS TEST CENTER ATTN: STECR-TA APO SEATTLE 98733-7850		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMC-R-310-6
11. CONTROLLING OFFICE NAME AND ADDRESS USA TEST AND EVALUATION COMMAND ATTN: AMSTE-TC-M ABERDEEN PROVING GROUND, MD 21005-5055		12. REPORT DATE 8 January 1986 13. NUMBER OF PAGES 36
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE NA

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

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)

Environmental Test	Alarms
Natural Environment	Detectors
Cold Regions	NBC Equipment

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

This TOP prescribes methods for evaluating the nuclear, biological and chemical (NBC) alarms and detectors in the natural cold regions environment. It contains procedures for evaluating storage, transportation, environmental performance, logistic supportability, reliability, human factors, and safety. It describes the necessary facilities and instrumentation requirements for test accomplishment.

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AC-FPP 2291-83

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP-702-102
Test Operations Procedure 8-4-005 8 January 1986
AD No.

COLD REGIONS ENVIRONMENTAL TEST OF NUCLEAR, BIOLOGICAL, AND CHEMICAL EQUIPMENT (ALARMS AND DETECTORS)

1. SCOPE.

This TOP describes tests for the evaluation of the performance of nuclear, biological, and chemical (NBC) alarms and detection equipment when used in the natural cold regions environment.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

Item	Requirement
Storage area	Secure, unsheltered storage area exposed to natural environment.

*This TOP supersedes MTP 8-4-005, dated 30 January 1969.

Item	Requirement
Vehicles	Tactical wheeled and tracked vehicles on which alarms are designed to be mounted or carried.
Test Area	Secure test area exposed to natural environment but near a building which can be used for instrumenting alarms.

2.2 Instrumentation

Item	Requirement
Stop watches	Normal 0.2 second accuracy.
Meteorological equipment	Standard surface observation data requirements (temperature, surface winds, humidity).
Air flow rate meter	0.1 liter/minute accuracy.
Event recorders or data loggers	As required, depending on parameters measured.
Noise meter	Capable of measuring A-weighted sound levels and performing octave-band analysis.

3. PREPARATION FOR TEST

3.1 Calibration. All instrumentation scheduled to be used will be calibrated and tagged.

3.2 Storage site. A secure storage site which is fully exposed to the natural environment will be located. A steel mesh cage or similar facility is suitable.

3.3 Test site. A secure test site will be identified. Ideally, benches or tables near a heated building can be used if the alarms are always attended. If not, they can be operated inside a steel mesh cage. Location should be far enough from the building that the alarms experience the natural cold conditions without being sheltered by the building. The heated building should be provided with a workbench area, storage, and have provisions for connecting cables between the alarms and any instrumentation inside the building.

3.4 Test data. A detailed test plan will be developed, coordinated, and approved prior to testing. Data forms will be developed, approved, and printed so that they are available prior to beginning test. Software needed to handle test data will also be developed prior to the start of testing.

3.5 Test documentation. In addition to the detailed test plan, a safety release, an environmental impact assessment, and a system support package and funding will be on hand before beginning testing.

4. TEST CONTROLS

4.1 Sample size. If possible, a minimum of five test items will be allocated for this test. Test items should be new, or reconditioned if shipped from another test agency, and should be representative of the population from which they were drawn.

4.2 Air temperatures. All tests will be conducted within the storage and operation temperature limits specified in the requirements documents. Missions will not be started unless temperatures are within, and expected to remain within, the required limits. If ambient air temperatures unexpectedly change during a mission, do the following: (1) continue mission to completion if temperatures rises above upper limit, or (2) stop mission and bring test items inside a building if temperatures drops below lower limit.

4.3 Test personnel. All operators and maintainers will be of the proper military occupational specialty (MOS) and will be dressed with identical types and amounts of appropriate military standard cold weather clothing when operating the alarms or detectors. Between 50 percent and 75 percent of the operation and maintenance will be done in Mission Orientated Posture (MOPP) IV, except that all decontamination testing will be done in MOPP IV.

5. PERFORMANCE TESTS

5.1 Preoperational Inspection

5.1.1 Method

5.1.1.1 Upon receipt, all packaging will be inspected and any damage or deterioration will be noted and photographed. The test items will then be unpackaged, thoroughly inspected, and any discrepancies in number of items expected or listed in the System Support Package (SSP) will be reported. Each major component will be measured and weighed. Identification photographs will be obtained.

5.1.1.2 If permanent serial numbers are not already present on the test items, test identification numbers will be assigned and the test items will be marked with permanent ink or by another suitable method.

5.1.2 Data Required

		Tolerances
a.	Test item dimensions	±1 cm
b.	Test item weight	±0.1 kg
c.	Test item serial numbers	NA
d.	Description of missing components	NA
e.	Description, with photographs, of damage.	NA

5.2 New Equipment Training

5.2.1 Method

Operators and maintainers will be trained on the use and maintenance of the test items. Normally this training is performed on-site by the developer or a contractor at the start of the test season. Military personnel of the proper MOS will be trained, as well as other test team personnel. The Test Officer will subjectively evaluate the adequacy of the training and will fully document any problems that occur with the training or with the operation of the test items during training. The adequacy of operator and maintenance literature, from a training standpoint, will also be evaluated.

5.2.2 Data Required

		Tolerances
a.	Number of personnel trained	NA
b.	Names and MOS's of personnel trained	NA
c.	Hours of training:	
	(1) Lectures	±0.1 hr.
	(2) Hands-on	±0.1 hr.
	(3) Maintenance	±0.1 hr.
d.	Subjective evaluation of training	NA
e.	Description of training problems	NA
f.	Hours test items operated during training	±1 hr.

5.3 Storage and Transportation

5.3.1 Method

5.3.1.1 Storage: Depending upon the availability of test items, a sample of alarms, detectors, and refill kits, if used, will be placed in secure open storage for a minimum of 60 days. As explained in paragraph 4.2, care will be taken to assure that the test items are not exposed to temperatures lower than those specified in the requirements document. All test items will be operated and then deserviced and prepared for storage in accordance with operator and maintenance instructions prior to being placed in storage. Adequacy of deservicing instructions will be evaluated, along with any evidence of deterioration or cold related malfunctions of the test item resulting from storage. Items will be inspected at least weekly during storage. At the completion of storage, the test items will be carefully inspected, photographed if necessary to document damage, serviced, and operated for a minimum of one complete mission or 8 hours, whichever is most appropriate.

5.3.1.2 Wheeled vehicle transport: If possible, at least two alarms or detectors, placed in their transport cases will be transported as cargo in accordance with instructions in the operator's manual or as loose cargo if no instructions are provided. Transport will be in the cargo area of a tactical 1¼-ton truck or equivalent. They will be transported for 300 km over snow-covered, secondary, gravel roads while the ambient air temperature is within 15 degrees F of the lower operating limit specified in the requirements document. At completion of the mileage, the test items will be thoroughly inspected, any damage photographed, and the units will be serviced and operated for one mission or 8 hours, as appropriate. If refill kits are used, they will also be transported and used after the test.

5.3.1.3 Tracked vehicle transport: Testing specified in para 5.3.1.2 for wheeled vehicle transport will be repeated using an M113A1 armored personnel carrier, or equivalent, except that mileage will be reduced to 150 km, 50 percent of which will be on cross-country trails.

5.3.1.4 Helicopter transport: Testing described in para 5.3.1.2 for wheeled vehicles will be repeated for a 2-hour flight in a UH-1 helicopter, or equivalent, during low temperature conditions.

5.3.1.5 Man-pack: Two alarms or detectors will be carried while snowshoeing and skiing. The alarms will be carried in a tactical configuration as specified in the operator's manual for at least 4 hours for each mode of carry. Difficulties in carrying or using the alarms will be fully documented by written records and video, as appropriate. If appropriate, alarms and detectors may also be carried by troops during airborne operations.

5.3.1.6 Operation during transport: Transport tests specified in paragraphs 5.3.1.2 through 5.3.1.5 are for the alarms or detectors in a non-operating mode. If the alarms are designed to be operational during transport, these transport tests will be repeated with the alarms operative during the transport. Operational checks specified in para 5.4 will be performed before, at the mid-point, and after each transport test. Care will be taken to ensure that alarms are mounted in accordance with the instructions provided in the operator's manual. All malfunctions or difficulties encountered in the tests will be fully documented.

5.3.2 Data Required

		Tolerances
a.	Storage duration	±0.5 day
b.	Storage temperatures:	
	(1) Daily range	±1°F
	(2) Daily average	±1°F
c.	Transportation data:	
	(1) Date and place	NA
	(2) Type transport	NA
	(3) Test item serial numbers	NA
	(4) Mileage (km)	±0.5%
	(5) Terrain description	NA
	(6) Snow type and depth	±0.5 cm
d.	Daily log forms (Appendix B)	NA
e.	Description of all malfunctions	NA
f.	Photographs of damage	NA

5.4 Environmental Performance

5.4.1 Method

5.4.1.1 The environmental performance test is for evaluating the ability of the alarms or detectors to perform satisfactorily on a sustained basis under natural cold regions conditions. It provides most of the data for

evaluating reliability. The maximum number of alarms available should be used in this test. If different operational configurations are used (e.g. detectors only, detectors with remote alarms, automatic vs. manual, etc.) the tests will be designed such that the test items are rotated through the different modes so as to accumulate approximately the same time in each mode for each alarm. The alarms will be set up and operated in an unsheltered area near a heated building that can be used as a warm-up and to house any test instrumentation. If a mission profile is provided, it will be followed as closely as possible.

5.4.1.2 Alarms and detectors will be serviced and placed into operation in accordance with the operator's manual. As a part of the servicing procedure, each alarm will be challenged with an agent simulant. This is a qualitative test which is only an indicator of proper performance. Up to three challenges will be made at start-up to get a proper response. If an alarm does not respond, troubleshooting procedures will be followed as prescribed in the operator and maintenance manuals. Upon completion of each mission, the alarms will again be challenged with the test simulant and training simulant or standard test simulant as described above. The results will be recorded on the daily log form (Appendix B). Operation during each mission will be continuously monitored and the relevant data recorded on the daily log form. Any alarm functioning during a mission will be fully documented, noting any unusual conditions existing at alarm activation. All mission stoppages, for whatever reason, will be handled as prescribed in the operator's manual and recorded on the daily log forms. The total number of missions to be conducted will be dependent upon reliability criteria contained in the requirements document. A portion of the missions will be followed by decontamination of the alarms.

5.4.2 Data Required

		Tolerances
a.	Daily log form data (Appendix B):	
	(1) Test identification data	NA
	(2) Time to service	±1 min
	(3) Warm-up time	±1 min
	(4) Simulant response time	±1 sec
	(5) Number of simulant tries	NA
	(6) Ambient air temperature	±1°C
	(7) Atmospheric conditions	NA
	(8) Malfunctions	NA

	Tolerances
(9) Remarks	NA
b. Total number of malfunctions	NA
c. Total number of false alarms	NA
d. Total test time	±1 hr
e. Problems encountered in decontamination.	NA

5.5 Logistic Supportability: Logistic supportability testing will be performed in accordance with TOP 8-4-015, Cold Regions Logistic Supportability Testing of Chemical, Biological, and Radiological Defense Equipment.

5.6 Reliability

5.6.1 Method

Reliability data will be accumulated from all testing, but especially from the Environmental Performance subtest (para 5.4). Data recorded on the daily log forms will be used. All failures, stoppages, or malfunctions will be scored using RAM scoring criteria.

5.6.2 Data Required

a. Daily log forms

b. Documentation of each failure, to include:

(1) Unit serial number

(2) Date and time

(3) Operating time at failure

(4) Operating configuration

(5) EPR reference number

(6) Description of failed part

(7) Symptoms of failure

(8) Perceived cause of failures

c. Failure analysis and scoring.

5.7 Human Factors

5.7.1 Method

5.7.1.1 All of the testing performed in the afore described testing will be monitored by a qualified human factors engineer to observe and evaluate human factors characteristics and to obtain data for completion of the human factors checklists (Appendix A). In addition, test personnel will continuously observe and comment on the ease of preparation, servicing, operation, transport, and maintenance of the test items. Special attention will be given to observing the ease of operation and maintenance while wearing appropriate components of the cold-dry uniform and/or CB protective clothing, including different types of handwear.

5.7.1.2 Human factors questionnaires, examples of which are at Appendix C, will be administered to all operators at mid-test and again at test completion. If questionnaires are included in the independent evaluation plan or test design plan, they will also be included and administered.

5.7.1.3 Steady-state noise levels will be measured in accordance with TOP 1-2-608, if appropriate.

5.7.2 Data Required

a. Demographic data on test participants.

b. Completed human factors checklists (Appendix A).

c. Summary of the results of observations, interviews, questionnaires, and checklists completed during test.

d. Photographs depicting typical human factors design and performance problems that increase human error or cause problems in performing necessary operator or maintenance tasks.

e. Anthropometric measurements and description of problems experienced in handling test items.

f. Steady-state noise levels of test items in normal operation and in the alarm condition.

5.8 Safety

5.8.1 Method

5.8.1.1 Operation and maintenance of the test item will be observed throughout testing to identify any features which constitute a safety hazard.

5.8.1.2 The safety aspects of any safety documentation and the operator's and maintenance manuals will be analyzed for adequacy and completeness.

5.8.1.3 All instances of injury, accidents, or potential or actual safety hazards will be documented.

5.8.2 Data Required

a. Identification and description of safety hazards encountered in test.

b. Adequacy of safety instructions and warning plates.

c. Verification of the adequacy of safety documentation and manuals provided by the developer.

6. DATA REDUCTION AND PRESENTATION

6.1 Preoperation Inspection. The data, observations, and photographs will be used to determine and document receipt condition of the test items and to establish that all test items are in suitable condition to begin testing. Data will be presented in narrative and tabular format to summarize results.

6.2 New Equipment Training. The adequacy of the training will be subjectively determined and fully documented in the report in narrative form.

6.3 Storage and Transportation. Quantitative data will be recorded on the daily log forms and then tabulated and summarized in tables. Additionally, if sufficient data are available, statistical comparisons of data will be made to determine if specific modes of transport resulted in increased failures or other operational anomalies. Damage, malfunctions, or difficulties will be reported narratively and by use of appropriate photographs.

6.4 Environmental Performance. Data recorded on the daily log forms will be tabulated and grouped by specific environmental parameters such as temperature category, atmospheric condition, wind speed, etc., to see if the results were affected by those environmental factors. Statistical techniques will be used that are appropriate to the amount and distribution of data. The results will be discussed narratively in the report and will be used to evaluate the test criteria.

6.5 Logistic Supportability. Data reduction and presentation will be as specified in TOP 8-4-015.

6.6 Reliability. Data will be compiled from the daily logs and presented in tabular form. All operational hours will be accumulated and combined for reliability calculations. As a minimum, and if appropriate, the point estimates of the mean-time-between- failures and mean-time-between-false

alarms will be calculated, along with confidence limits as specified in the system requirements document.

6.7 Human Factors. Data obtained from checklists and questionnaires will be summarized and presented in narrative form. Questionnaires will be summarized with average ratings presented. Noise levels will be tabulated and compared to the standards in TOP 1-2-608. Additionally, all human factor observations will be reported narratively, with photographs, if applicable.

6.8 Safety. All safety hazards or incidents will be fully documented and reported narratively. Safety incidents will be classified as to severity and frequency in accordance with MIL-STD-882B. Figure 1 will be used as a guide in categorizing incidents as deficiencies, shortcomings as acceptable.

Recommended changes to this publication should be forwarded to Commander, US Army Test and Evaluation Command, ATTN: AMSTE-TC-M, Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Commander, US Army Cold Regions Test Center, ATTN: STECR-TA, APO Seattle WA 98733-7850. Additional copies are available from the Defense Technical Information Center, Cameron Station, Alexandria, VA 22304-6145. This document is identified by the accession number (AD No.) printed on the first page.

APPENDIX A - HUMAN FACTORS ENGINEERING TASKS CHECKLIST

Test Item_____ Observer_____ Date_____

The following tasks will be observed, performance will be rated as follows:

S = Satisfactory
M = Marginal
U = Unsatisfactory
NA = Not Applicable

Man/Item Tasks	S	M	U	NA	Remarks
1. Read/interpret instructions/ technical manuals.					
2. Identify parts.					
3. Connect components.					
4. Mate components to unit.					
5. Make connections.					
6. Tighten/loosen fasteners.					
7. Set/adjust controls.					
8. Open/close access covers.					
9. Read and observe warning labels.					
10. Grasp door handles/latches.					
11. Unlock or relock doors.					
12. Unlatch or relatch doors.					
13. Push or pull door open or closed.					
14. Visually inspect external operating components.					
15. Verify adjustments, structural integrity, and/or general operational readiness manually, with tools, or with test devices.					

Man/Item Tasks	S	M	U	NA	Remarks
16. Input test signals to displays; read and interpret results.					
17. Manually determine control readiness.					
18. Turn on start switch.					
19. Check operating displays.					
20. Manipulate controls to correct incorrect settings.					
21. Operate environmental controls.					
22. Perform manual or tool assisted operations.					

HUMAN FACTORS DESIGN CHECKLIST

OPERATION

The following items or conditions were observed and the adequacy was rated in accordance with the following scale:

S = Satisfactory
M = Marginal
U = Unsatisfactory
NA = Not Applicable

Man/Item Tasks	S	M	U	NA	Remarks
1. Access:					
a. Latch handles are accessible from normal approach positions.					
b. All normal access doors/ covers are free from obstruction, operate easily, and possess a means of latching and securing.					
2. Controls:					
a. The most important and most frequently used controls are located in the optimum manual areas.					
b. Control movements are consistent for all equipment used by a single operator.					
c. All primary and emergency controls are easily identifiable both visually and nonvisually.					
d. Continuous controls provide operating resistance consistent with performance requirements for speed, accuracy, and smoothness of operation.					
e. Discrete controls provide positive stop action such as detents or clicks.					
f. All controls can be operated by personnel wearing arctic clothing.					

Man/Item Tasks	S	M	U	NA	Remarks
g. The method used to prevent accidental activation of the control, if any, does not increase the time required to operate the control to such an extent that it is unacceptable.					
h. Activation of the control does not obscure visual display or control markings.					
3. Displays:					
a. The display can be read easily from the normal operator's position(s).					
b. The information presented is necessary for the decisions or actions required of the operator.					
c. The information is presented in the most immediately meaningful form, i.e., no interpretation or decoding is required.					
d. The information is displayed to the accuracy required by the decisions or actions of the operator.					
e. If scale interpolation is required, it does not introduce a probability for operator errors that is greater than his tasks permit.					
f. Information for different types of activities, e.g., operation and maintenance, is not combined unless the activities require the same information.					
g. Information is current, (i.e., lag is minimized).					
h. Failure is clearly shown or the operator is otherwise warned.					

Man/Item Tasks	S	M	U	NA	Remarks
i. The contrast ratio and illumination of controls and/or displays are sufficient under all expected light conditions.					
j. Warning devices are provided to indicate operational anomalies.					
4. Miscellaneous:					
a. Vibration and noise are kept below levels that might impair the efficiency of personnel.					
b. Aural and visual warning signals are clearly noticeable by operators.					
c. Procedures for handling chemicals are safe.					
d. Illumination is sufficient for the operators to carry out necessary tasks in darkness.					
e. Vibrations do not affect operator performance in reading displays and manipulating controls.					
f. The interior of the alarms do not contain any sharp, pointed, or hazardous projections that jeopardize the safety of tne test operators.					
5. Labels, Manuals, Markings:					
a. Identification labels are placed above control, displays, functional groups.					
b. Instruction labels are not obscured by adjacent components.					
c. Hazard alerting devices are used where applicable.					
d. Conspicuous placards are adjacent to equipment which presents a personnel hazard.					

HUMAN FACTORS ENGINEERING TASK CHECKLIST

MAINTENANCE

Test Item_____ _____Observer_____Date_____

The following items or conditions will be observed. The adequacy of design will be rated as follows:

S = Satisfactory
M = Marginal
U = Unsatisfactory
NA = Not Applicable

Man/Item Tasks	S	M	U	NA	Remarks
1. Covers, Cases and Access Doors:					
a. Hinges are used, where possible, to reduce the number of fasteners required.					
b. Structural members or other components do not interfere with removal of a cover.					
c. Provision is made for adequate bonding of plastic or rubber stripping and seals so that if a cover comes into contact with, or must slide over such material, the seal will not be damaged or the cover jammed.					
d. Where feasible, guides, tracks, and stops are provided to facilitate handling and to prevent damage to components.					
e. Hinged doors or covers are provided with captive, quick-opening fasteners.					
f. The number and type of fasteners must be commensurate with the need for compensation of stress, bonding, etc.					
g. When possible, the size and type of fasteners used for all covers, cases, and access doors are the same.					

Man/Item Tasks	S	M	U	NA	Remarks
h. Maximum use is made of tongue-and-slot catches to minimize the number of fasteners required.					
i. Captive nuts and bolts are used where feasible.					
j. If instructions applying to a covered unit are lettered on a hinged door, the lettering is properly oriented for reading when the door is open.					
k. Hand-operated fasteners are preferred; those requiring standard hand tools are acceptable; fasteners requiring nonstandard tools should not be used.					
2. Accessibility:					
a. Information placed at each access includes the nomenclature of accessible items and warning of hazardous or critical operations.					
b. Edges of accesses have internal fillets or other protection if they might otherwise cause injury to hands or arms.					
c. Access provisions are located on easily accessible surfaces.					
d. Components are placed neither in recesses nor behind or under stress members, floor boards, seats, hoses, pipes, or other items that are difficult to remove.					
3. Location of replaceable components:					
a. Large components that are difficult to remove are mounted so they do not prevent access to other components.					

Man/Item Tasks	S	M	U	NA	Remarks
b. Components are located so that each replacement unit can be removed through a single access panel.					
c. Components are placed to allow sufficient space for the use of test equipment and other required tools without difficulty or hazard.					
d. All throwaway components are accessible without removal of other components.					
e. Structural members of the chassis do not prevent access to components.					
f. Delicate components are so located or guarded that they will not be damaged while the unit is being handled or repaired.					
g. Components are located so that blind adjustments are not necessary.					
h. Components of the same or similar form, such as seals, are mounted with a standard orientation throughout, but are readily identifiable and distinguishable.					
i. Equipment is modularized so that rapid and easy removal and replacement of malfunctioning modules or components can be done by one technician.					
j. Components can be checked and adjusted separately and then connected together into the system with minimum adjustment.					
4. Component Mounting:					
a. Whenever possible, components are located so that no other equipment must be removed to gain access to or remove the components.					

Man/Item Tasks	S	M	U	NA	Remarks
b. If it becomes necessary to place one component behind another, the component requiring less frequent access is placed in the rear.					
c. Components frequently removed from their normal installed position for checking are mounted on roll-out racks, slides, or hinges.					
d. Limit stops are provided on roll-out racks and drawers; override of these limit stops is easy.					
e. Field removable components are replaceable with common hand tools.					
f. Components are mounted to the housing rather than attached to each other so that only the component to be replaced has to be removed.					
g. Removal of any replaceable component required opening or removal of a minimum number of covers or panels (preferably one).					
h. Components are laid out so that a minimum of place-to-place movement by the operator is required during check out.					
i. Components are located and mounted so that access to them may be achieved without danger to personnel, e.g., from electrical charge, heat, sharp edges and points, moving parts, and chemical contamination.					
j. Access to a unit maintained by one operator does not require removal of equipment by a second (higher skilled) operator.					

Man/Item Tasks	S	M	U	NA	Remarks
5. Conductors, Cables, and Conduits:					
a. Long conductors, cables, and conduits internal to equipment are secured to the chassis by cable clamps.					
b. Cables are long enough so that each functioning component can be checked in a convenient place or, if this is not feasible, extension cables are provided.					
c. Cables are long enough to permit jockeying or moving components when it is difficult to connect or disconnect other cables.					
d. Cables and conduits are easily accessible for inspection and repair.					
e. If feasible, individual conductors of all cables are color-coded their entire length.					
6. Connectors:					
a. One-turn or other quick-disconnect plugs are used.					
b. When dirt and moisture are a problem, plugs have an attached cover.					
c. Connectors are located far enough apart so they can be grasped firmly for connecting and disconnecting.					
d. The rear of plug connectors is accessible for test and service, except where this is precluded by potting, sealing, etc.					
e. Plugs or receptacles are provided with aligning pins or other alignment devices.					

Man/Item Tasks	S	M	U	NA	Remarks
f. Plugs are so designed that it is impossible to insert them in a wrong receptacle.					
g. The socket (rather than plug) contacts are "hot."					
h. Connectors and their associated labels are positioned for full view by maintenance personnel.					
i. Connecting plugs and receptacles are identified by color or shape or other acceptable means.					
j. Plugs and receptacles have painted stripes, arrows, or other indications to show proper insertion of aligning pins.					
7. Test Points:					
a. Test points, to determine that a unit is malfunctioning, are provided.					
b. Appropriate test points are provided when a component is not completely self-checking.					
c. Lower-maintenance-category test points are located and coded so they are readily distinguished from higher-maintenance-category test points.					
8. Fuzes and Circuit Breakers:					
a. Fuzes and circuit breakers are so located that they can be seen easily and replaced or activated quickly.					
b. Fuze replacement is not hampered by other components.					
c. No special tools are required for fuze replacement.					

Man/Item Tasks	S	M	U	NA	Remarks
9. On-Equipment Tools:					
a. The variety of tools is held to a minimum.					
b. As few special tools as possible are required.					
c. Tools are of dull finish to avoid glare in strong light.					
d. Speed and ratchet-type tools are provided when necessary.					
e. Shock-proof tools are provided when required.					
10. Lubrication:					
a. Equipment containing mechanical components either has provision for lubrication without disassembly or does not require lubrication.					
b. When lubrication is required, the type of lubricant and the frequency of lubrication are specified on a nearby label.					

HUMAN FACTORS ENGINEERING TASK CHECKLIST

SAFETY CONSIDERATION

Test Item_____ Observer_____ Date_____

The following safety considerations will be observed. The adequacy of design will be rated as follows:

S = Satisfactory
M = Marginal
U = Unsatisfactory
NA = Not Applicable

Man/Item Tasks	S	M	U	NA	Remarks
1. Mechanical:					
a. Are accesses and other openings free of hazards from improperly designed catches, hinges, supports, fasteners, and stops?					
b. Are access doors made whatever shape is necessary to permit passage of components and implements which must pass through?					
c. Are handles and/or grab points provided for manual handling?					
d. Are handles recessed rather than extended where they might be hazardous?					
e. Is the equipment free of sharp or overhanging edges and corners that might cause injury to personnel?					
f. Are all exposed rotating or reciprocating parts that are so located as to become a hazard to operating personnel adequately enclosed or properly guarded?					
g. Are the air inlets protected from ingestion of debris?					

Man/Item Tasks	S	M	U	NA	Remarks
h. Are proper tools and test equipment furnished with the test item?					
i. Are potential chemical hazards adequately treated in the instruction manual?					
2. General:					
a. Are the items equipped with all necessary safety devices including rupters, circuit breakers, relays, temperature switches, and protective enclosures and guards?					
b. Is the item equipped with instructions plates including warnings, diagrams, and cautions conspicuously describing any special or important procedures to be followed in operating and servicing the item?					
c. Are warning signs coded and colored in accordance with Army regulations?					
3. Health:					
Are personnel free from any toxic or electrical hazards while in operation?					
4. Electrical:					
a. Are all exposed parts that are energized electrically insulated, adequately enclosed, or otherwise rendered safe?					
b. Are components, conductors, and shielding appropriately located such that overheating, arcing, and shorting is avoided?					
c. Are wires and cables adequately supported and terminated to prevent shock and fire hazard?					

Man/Item Tasks	S	M	U	NA	Remarks
d. Are wires and cables properly protected at points where they pass through metal partitions?					
e. Are electrical protective devices included to protect the alarm from over current damage caused by maladjustment of the controls, short or open circuits, or failure of circuit parts?					
f. Are controls located away from voltage points?					
g. Are all motors equipped with adequate over-current and over-temperature protection and disconnect means?					
h. Are electrical enclosures suitable or their intended environment (watertight/splashproof/explosion proof, etc.)?					
i. Are potential electrical hazards adequately treated in the instructional manual?					

APPENDIX B - DAILY LOG FORM (SAMPLE)

DAILY LOG FORM

Date_____ Test Site_____

Alarm Serial No._____ Operating Hours: Start_____

Operator(s)_____ Finish_____

_____ Power Source_____

_____ Refill Kit No._____

Sampler No._____

Remote No._____

Time to Service_____minutes Warm-up Time_____minutes

Simulant Response:

Mission Startup:_____seconds on_____try.

Mission Finish:_____seconds on_____try.

Ambient Air Temperature: Range_____°F to _____°F; Average_____°F

Atmospheric Conditions (specify duration in minutes):

_____Clear	_____Dusty	_____Blowing Snow
_____Rain	_____Wet Fog	_____Hail
_____Falling snow	_____Ice Fog	_____Other (specify)

Malfunctions (check as appropriate and explain in remarks):

_____Main Air (RED)	_____Tape Mtn (RED)	_____Power Failure
_____Tape Air (RED)	_____Clean (YLW)*	_____Leakage
_____Liq Flow (RED)	_____Cell Temp (RED)	_____Other (specify)
_____Temp Low (YLW)*	_____Fast Prime (WHT)*	
_____Logic (RED)	_____False Alarm (RED)	

*Status indicators Check only if light does not function when it should.

Remarks:_____

_____ _____

APPENDIX C - HUMAN FACTORS SUBJECTIVE QUESTIONNAIRE

Test Item_____

Observer_____ Date_____

Question 1:
Reading warning or instruction labels was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments:_____

_____

_____

Question 2:
Servicing the alarm was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments:_____

_____

_____

Question 3:
Reading display panels was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 4:
Connecting and disconnecting electrical cables was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 5:
Accessibility of hand controls was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 6:
Use of the remote alarm was:

6 - Extremely Easy ____
5 - Very Easy ____
4 - Easy ____
3 - Difficult ____
2 - Very Difficult ____
1 - Extremely Difficult ____

Comments: _____

_____

_____

Question 7:
During operation, the noise level was:

6 - Hardly Any Noise ____
5 - Some Noise ____
4 - Average Noise Level ____
3 - Somewhat Loud ____
2 - Moderately Loud ____
1 - Extremely Loud ____

Comments: _____

_____

_____

Question 8:
Protection of the operator from moving parts or electrical shock was:

6 - Excellent ____
5 - Very Good ____
4 - Adequate ____
3 - Not Quite Adequate ____
2 - Poor ____
1 - Extremely Poor ____

Comments: _____

_____

_____

Question 9:
Understanding the before, during, and after operation instructions is:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments:_____

_____

_____

Question 10:
Space provided for servicing the alarm was:

6 - Excellent _____
5 - Very Satisfactory _____
4 - About Average _____
3 - Needs Improvement _____
2 - Not Very Satisfactory _____
1 - Very Poor _____

Comments:_____

_____

_____

Question 11:
How would you rate the overall ease of using the system?

6 - Extremely Good _____
5 - Very Good _____
4 - Good _____
3 - Poor _____
2 - Very Poor _____
1 - Extremely Poor _____

Comments:_____

_____

_____

Question 12:
How would you rate the overall effectiveness of the warning systems?

6 - Extremely Good _____
5 - Very Good _____
4 - Good _____
3 - Poor _____
2 - Very Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

HUMAN FACTORS ENGINEERING MAINTENANCE QUESTIONNAIRE

Test Item_____

Observer_____ Date_____

Question 1:
Determining the nature of the malfunction or service to be performed was:

6 - Extremely Easy	_____
5 - Very Easy	_____
4 - Easy	_____
3 - Difficult	_____
2 - Very Difficult	_____
1 - Extremely Difficult	_____

Comments:_____

_____

_____

Question 2:
Troubleshooting and/or maintenance procedures in the maintenance manuals was:

6 - Extremely Easy	_____
5 - Very Easy	_____
4 - Easy	_____
3 - Difficult	_____
2 - Very Difficult	_____
1 - Extremely Difficult	_____

Comments:_____

_____

_____

Question 3:
Assembly or disassembly of components was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 4:
Access to parts, components was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 5:
Mating of parts, components, replaced, and/or services was:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments: _____

_____

_____

Question 6:
Did personnel clothing or special purpose clothing interfere with performance or maintenance:

6 - Hardly Any Interference _____
5 - Very Little Interference _____
4 - About Average _____
3 - Some Interference _____
2 - Moderate Interference _____
1 - Extreme Interference _____

Comments:_____

_____

_____

Question 7:
Procedures that require excessive physical effort, such as lifting without adequate handles and grasp area, space needed, angle of lift or twist were:

6 - Extremely Easy _____
5 - Very Easy _____
4 - Easy _____
3 - Difficult _____
2 - Very Difficult _____
1 - Extremely Difficult _____

Comments:_____

_____

_____

Question 8:
Workspace clearance during maintenance was:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments:_____

_____

_____

Question 9:
Fatigue producing body or limb positions imposed during performing maintenance occur:

6 - Hardly Ever _____
5 - On Occasion _____
4 - About Average _____
3 - With Some Frequency _____
2 - Very Frequently _____
1 - Always _____

Comments: _____

_____

_____

Question 10:
Maintenance check points were:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

Question 11:
Space and/or clearances for torque wrenches requiring 50 ft. lb. or more was:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

Question 12:
Lubrication points (accessibility and/or visibility) were:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

Question 13:
Fuzes and circuit breakers are designed and located so that replacing and resetting them is:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

Question 14:
Built-in circuit testing features are:

6 - Excellent _____
5 - Very Good _____
4 - Adequate _____
3 - Not Quite Adequate _____
2 - Poor _____
1 - Extremely Poor _____

Comments: _____

_____

_____

Make any additional comments about improvements to the alarm based upon your experience with it.