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U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

INDIVIDUAL LOAD-CARRYING EQUIPMENT

1. OBJECTIVE

The objective of this procedure is to set forth test methodology and testing techniques necessary for determining whether individual load-carrying equipment meets the technical performance and safety characteristics as set forth in Qualitative Materiel Requirements (QMR's), Technical Characteristics (TC's), and as indicated by it's particular design, and to determine the suitability of the test item for service tests.

2. BACKGROUND

Engineering tests performed on individual load-carrying equipment encompasses the consideration of both subjective and objective measurement techniques. The utilization of subjective measurements is, of course, primarily related to the determination of soldier attitudes toward load-carrying equipment. The origin of the science of subjective measurement is firmly entrenched in the fields of psychology and mathematics. Through the proper employment of psychometric techniques, subjective data can be obtained that are conclusive and adequately meet the test objectives and are valid from a statistical standpoint.

Objective testing methodology, requiring the implementation of materials analysis and instrumentation, are used more frequently in determinations of specific Technical Characteristics pertaining to the fabrication of individual load-carrying equipment.

3. REQUIRED EQUIPMENT

a. Special Test Facilities Employed in Evaluating Individual Load-Carrying Equipment

1) Rain Course (GETA, Ft. Lee, Va.)
2) Combat Effectiveness Testing Facility (GETA, Camp Pickett, Va.)
3) Environmental Chamber, Large (GETA, Ft. Lee, Va.)
4) Environmental Chamber, Small (GETA, Ft. Lee, Va.)
5) Salt Spray Chamber (GETA, Ft. Lee, Va.)

NOTE: These special facilities are described in Appendix A.

b. Instrumentation Requirements for Evaluating Individual Load-Carrying Equipment.

1) Universal Tester
2) Hydrostatic Tester
3) Microscope, Dynoptic-Type

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4) Rapid Scan Infrared Camera
5) Package Tester
6) Puncture Tester
7) Abrasion Tester
8) Gloss Measurement Equipment
9) Color Difference Measurement Equipment
10) Crockmeter
11) Weather-Ometer

NOTE: These Test instrumentation devices and equipment are described in Appendix B.

c. Stop Watches
d. Calibrated Scales for weighing
e. Miscellaneous (pencils, code marking pens, small arms ammunition, dummy hand grenades, intrending tools, sleeping bags, canteens, first aid packets and/or lensatic compasses, pistols and associated carriers).
f. Performance Data Forms and Questionnaires

4. REFERENCES

A. AR 705-15, Operation of Materiel Under Extreme Conditions of Environment, Change No. 1
B. USATECOM Regulation 700-1, Value Analysis in Material Testing
C. USATECOM Regulation 705-5, Research and Development of Materiel
D. USAGETA Regulation 70-4, Human Factors and General Equipment Testing
E. USAGETA Regulation 705-4, Instrumentation Services and Materials Analysis Services
F. Cochran and Cox, Experimental Design, John Wiley and Son, 1950
G. Churchman, C. West and Ratoosh, Philburn, Measurement Definitions and Theories, John Wiley and Son, 1959
H. Technical Characteristics for Load-Carrying Equipment
I. Military Characteristics for Load-Carrying Equipment
J. FM 21-15, Care and Use of Individual Clothing and Equipment
K. U. S. Army Training Circular 10-8, Individual Load-Carrying Equipment
L. U. S. Army Training Film 10-3092, Individual Load-Carrying Equipment
M. U. S. Army Training Film 10-3593, Individual Load-Carrying Equipment
N. AR 746-10, Marking of Selected Clothing and Equipment
O. F.S. CCC-T-191B, Textile Test Methods with Change 2; 29 March 1965
P. American Society for Testing and Materials-Standards (ASTM-Standards)
Q. MIL-STD-810B, Environmental Test Methods for Aerospace and Ground Equipment
R. American Association of Textile Chemists and Colorists (AATCC)
S. MTP 10-2-500, Physical Characteristics
T. MTP 10-2-501, Operator Training and Familization

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U. MTP 10-2-505, Human Factors Evaluation
V. MTP 10-2-507, Maintenance Evaluation

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following test conducted to evaluate individual load-carrying equipment.

a. Preparation for Test - Studies conducted on the test item to: (1) determine completeness and whether it is in satisfactory condition prior to conducting the tests; (2) determine physical characteristics; (3) determine whether test participants are physically fit for test participation, and (4) ensure that participants who are familiar with the test item are available.

b. Operational Performance - An evaluation of the test item's functional suitability.

c. Laboratory Analysis - An evaluation of the physical characteristics of the test item.

d. Clothing Compatibility and Sizing - An evaluation of the compatibility of the test item with clothing and personal gear, and to obtain data pertinent to the use of a three size tariff.

e. Value Analysis - A study to determine if the test item has any unnecessary features.

f. Safety Hazards - A study to determine whether the test item has any safety hazards.

g. Maintenance Evaluation - A study to determine the maintenance requirements of the test item.

5.2 LIMITATIONS

The equipment to be tested, utilizing this materiel test procedure, is intended for use in hot, temperate, and cold-wet regions. It is not for use in cold-dry Arctic regions. However, if so directed, this procedure may satisfy certain testing requirements for equipment intended for Arctic use.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

NOTE: Individual load-carrying test equipment, together with standard counterparts (normally used as comparison item in evaluations of newly developed personal equipage), will be visually examined by supervisory test team personnel for completeness, defects, variations in material, workmanship, or other discrepancies which might appreciably affect test results. Any item displaying evidence of incompleteness, defects, variations or other discrepancies will be withheld from testing.

Upon receipt, the test item shall be subject to the following inspection procedure:

a. Visually examine each test item's package and record the following:

1) Evidence of packaging damage or deterioration
2) Identification markings, including:

a) Name of contractor
b) Number and date of contract
c) Date of manufacture
d) Other markings pertaining to the test item

b. Weight and measure the shipping package of the test item and record the following:

1) Contents
2) Weight
3) Length, width, and height
4) Cubage

c. Unpack the test item, visually examine it and record the following:

1) Nomenclature
2) Evidence of defects:

a) Manufacturing
b) Material
c) Workmanship

3) Evidence of damage
4) Items withdrawn from testing and the reasons, i.e., incompleteness, defects, etc.

d. If possible, repair defects/damages, and record the extent of repair.

e. Obtain and retain photographs of all test items.

NOTE: Test items not having damages, defects, etc. shall be photographed for comparison with possible failures or wear conditions which might occur as testing progresses.

f. Compare the test item with standard counterparts and record the following:

1) Counterpart equipment used for comparison
2) Variation between equipment

6.1.2 Physical Characteristics

The test item shall be subject to the applicable dimensional and physical specification tests of MTP 10-2-500. Record the following:

a. Color
b. Number of components
c. Type of components, i.e., carrying straps, backboard, tie-strings, etc.
d. Dimensional measurements of each component
e. Weight of:

1) Complete set
2) Each component

f. Type of closures used

6.1.3 Coding

Each load-carrying equipment set subjected to testing will be code-marked according to a predetermined coding system for test identification purposes or indelibly coded as follows:

a. Mark each test item with an individual code.
b. Mark all components with the same code as the primary test item.

6.1.4 Medical Examination

a. Prior to the initiation of the test, the test participants shall undergo physical examinations to ensure that they are physically fit for participation in the test conduct.
b. Testing and medical officials shall ensure that local health measures (i.e., use of salt tablets, acclimatization of individuals) are taken to prevent physical injury.

NOTE: Should any physical injury occur, complete reports of the type of injury treatment rendered and conditions under which the injury occurred will be recorded in the Daily log and considered a part of the test data.

6.1.5 Personnel Training and Familiarization

Test personnel shall be oriented in all aspects of the individual load-carrying equipment as described in the applicable sections of MTP 10-2-501 and the following:

a. Each type of test equipment (test item and standard) shall be shown and demonstrated by the project officials with the apparent differences in the test item being pointed out.
b. The objectives of the test shall be explained.
c. Test activities to be engaged in during field wear shall be meticulously discussed.

d. Recently released sound motion picture training films shall be shown to the participants to visually accentuate the proper method of donning, wearing and using current standard individual load-carrying equipment.

6.2 TEST CONDUCT

6.2.1 Operational Performance

6.2.1.1 Load-Carrying Equipment Inspection

The test officer shall inspect each test item while worn by the test personnel prior to each day's activities, periodically during the day's activities, and at the end of each day's test wear. Failures and other discrepancies shall be recorded as follows for each test item:

a. When inspected
b. Item's code number
c. Type of failure
d. Location of failure
e. Time of the failure's occurrence

6.2.1.2 Donning, Doffing and Adjustment

a. Test personnel shall don, doff, and make adjustments to the test item unloaded, a minimum of 5 times. Record the following for each exercise and participant:

1) Time required to:

a) Don the equipment
b) Doff the equipment

2) Participants opinion regarding the ease of donning and doffing
3) Type of adjustments required
4) Ease of adjustment

b. If applicable, ascertain and record the causes of inability and/or excessive time required to perform donning, doffing or adjustments.

c. For comparison of time, repeat steps a and b using standard individual load-carrying equipment.

d. Repeat steps a through c with the equipment loaded. Record type and weight of load.

e. Repeat steps a through d while wearing handwear. Record type of handwear.

NOTE: The same test personnel shall be used for all trials with both test and standard equipment.

6.2.1.3 Controlled Field Wear

NOTE: Field wear phase of testing shall be conducted to generate and compile both objective and subjective data relative to the establishment of the technical performance of the test item, and for comparison with it's standard counterpart relative to the following characteristics:

1. Improvement of the mobility and efficiency of the wearer.
2. Ability of the wearer to perform combat and related tasks including the unencumbered use of weapons, communications equipment and related items.
3. Freedom of head and torso movement and breathing.
4. Ease of laundry or cleaning the test item.
5. Life expectancy of the experimental item based on failures and changes incurred during controlled field test wear.
6. Adequacy of the soldier-item relationship, to include compatibility of the wearer and his clothing and protective equipment with the test item; unusual or excessive demands on the human capabilities; fit, comfort, interference with normal performance of combat and related tasks; and wearer acceptance of the test item.

a. Load/pack the test item with the appropriate type of load by size, material and weight.

NOTE: Unless otherwise specified, the load for the test item shall be governed by the intended use of the item and local individual weight carrying requirements. Maximum weight and contents shall be loaded on/in each test item whenever it is required to be loaded.

b. A minimum of 10 test participants, donned in the loaded test item without combat field equipment, shall traverse a course similar to the combat Effectiveness Course described in Appendix A a minimum of 12 times,or as prescribed by the testing plan.

NOTE: Test observers/recorders shall be stationed along the course to ensure that participants properly traverse the course and to observe their performance.

c. Determine and record the following for each participant and his test item:

1) Item's Code number
2) Type of load carried
3) Weight of load
4) Cubic size of load
5) Evaluation of the test item for the following:

   a) Fit
   b) Comfort
   c) Freedom of movement of head and torso and breathing

6) Time required to traverse the course
7) Time of equipment failure(s)
8) Type of equipment failure(s)
9) Ease of making adjustments while on the move
10) Difficulties encountered

d. Repeat step b and c with the participants equipped with his rifle and combat field equipment.

NOTE: Combat field equipment shall be considered articles not carried in or on the test item.

e. Repeat steps a through d with the participants donned in standard load-carrying equipment.

f. Repeat step b with the participants wearing no equipment. Record the time it takes to traverse the course.

g. Motion and still pictures shall be obtained and retained of the testing exercise.

6.2.2 Laboratory Analysis

6.2.2.1 Water Resistance

Subject a minimum of ten test items to a course similar to the USAGETA Rain Course (described in Appendix A) as follows:

a. Weigh each test item

b. Load/pack each test item with the appropriate size load prior to exposure.

c. A minimum of 10 test participants, donned in the test item shall traverse the clear track portion of the rain course for a minimum of 1 hour with a rain fall of 2 inches per hour.

NOTE: 1. The test participants will wear standard field utility clothing under the standard Army raincoat/poncho with the test item worn over the exterior of the rain wear.
2. The test participants shall start their traversals of the course at two minute intervals.

d. At the completion of exposure to rainfall, remove the test item from the particpant, unpack/unload it, weight the test item and inspect it for exposure affects.

e. Re-don the participants with the test item and have them wear it for another hour in its loaded condition to allow for partial drying. At the completion of the hour, unload the test item, weight it, and re-inspect it.

f. Record the following for each test item:

1) Item's code number
2) Weights of the test item:

a) Prior to test
b) After exposure to rainfall
c) After partial drying period

3) Inspection results:

a) After exposure to rainfall
b) After partial drying

g. If information is not available and the test plan requires the comparison of equipment evaluations, repeat steps a through f using standard individual load-carrying equipment.

h. Motion and still pictures shall be obtained and retained of difficulties encountered, as applicable.

6.2.2.2 Durability

The durability of the test item when subject to continuous strain under simulated field conditions shall be determined as follows:

a. Load a minimum of 10 test items with the appropriate load.

b. The test items shall be affixed to sandbags, adjusted and secured.

c. The ten test items affixed to the sandbags shall be placed vertically and secured to the bed of a L.A.B. Package Testing Machine (described in Appendix B).

e. Operate the testing machine continually until failures occur or the equivalent of 120 days (LINCLOE System) of wear at 10 miles a day has been attained.

f. When the test items are removed from the testing machine, examine them and record the following for each test item:

1) Item's code number
2) For items removed because of failures:

a) Type of failure(s)
b) Location of failure(s)
c) Period of testing completed
d) Number of failures

3) For items completing the programmed test:

a) Noted failures
b) Location of failures

g. Motion and still pictures shall be obtained and retained of difficulties encountered, as applicable.

6.2.2.3 Identification of Materials

Ten test items shall be subject to procedures D-276 (Photomicrographs) and D-629 (Quantitative Analysis of Textiles) of the ASTM Standards Manual.

(reference 4P).

6.2.2.5 Salt Spray Exposure

Ten test items shall be subject to procedure B-117-64 (Method of Salt Spray (Fog) Testing) of the ASTM Standards Manual. (reference 4P)

6.2.2.6 Colorfastness

Ten test items shall be subject to procedure D-1365 of the ASTM Standards Manual. (reference 4P)

6.2.2.7 Gloss

Ten test items shall be subject to procedure D-523, of the ASTM Standards Manual. (reference 4P)

6.2.2.8 Temperature and Humidity

Ten test items shall be subject to procedures 501.1 and 501.2 (Temperatures), and 507.1 (Humidity) of MIL-STD-810. (reference 4Q)

NOTE: Requirements of AN 705-15 shall apply.

6.2.2.9 Static Electric Charge

Ten test items shall be subject to procedure 76-1964 of the AATCC Manual. (reference 4R)

6.2.2.10 Immersion

Ten test items shall be subject to procedure D-570 (Water Absorption of the ASTM Standards Manual. (reference 4P)

6.2.2.11 Flammability

Ten test items shall be subject to procedure D-1230 of the ASTM Standards Manual. (reference 4P)

6.2.2.12 Fungus

Ten test items shall be subject to procedure D-862 of the ASTM Standards Manual. (reference 4P)

6.2.2.13 Puncture

Ten test items shall be subject to procedure D-781 (Basic Test) of the ASTM Standards Manual. (reference 4P)

NOTE: Other puncture analysis involving the use of high speed equipment such as instron tester, etc., may be required

by test plan.

6.2.2.14 Crocking

Ten test items shall be subject to procedure 5650-1 of F.S. CCC-T-191B or procedure 8-1961 of the AATCC Manual. (reference 4O and 4R)

6.2.2.15 Breaking Strength

Ten test items shall be subject to procedure 1682 of the ASTM Standards Manual. (reference 4Q)

6.2.2.16 Tear Strength

Ten test items shall be subject to procedures D-1424 or D-2262 of the ASTM Standsrds Manual. (reference 4P)

6.2.2.17 Accelerated Aging

Ten test items shall be subject to procedure E-42, E-239, D-1920, and E-240 of the ASTM Standard Manual. (reference 4P)

6.2.3 Clothing Compatibility and Sizing

a. Under the supervision of a clothing technologist, process a minimum of 10 test participancs through a sizing procedure which shall include weight, height, chest, waist, and other torso measurements. Using these measurements, fit the test applicants with proper size experimental load-carrying equipment over the following:

1) Appropriate standard field utility uniform
2) Armor vest
3) CB protective clothing
4) Rain gear

b. While donned in the test equipment, fit the participants with the standard gas mask and helmet.

c. The test participants, donned in the test equipment, shall engage in gross motor performance tests while wearing the aforementioned clothing and equipment with each test and comparison load-carrying equipment.

NOTE: 1. Gross motor performance shall consist of conducting various body movements to reveal restrictions and/or ease of movement while donned in the test item.
2. On completion of these tests, participants shall fill out questionnaires.

d. Record the following for each participant:

1) Body measurements
2) Size required in each type of clothing

3) For each type of load-carrying equipment:

a) Size of test equipment required for participant
b) Compatibility of test equipment with the following:

(1) Hot weather clothing
(2) Cold weather clothing (including leather glove shells and woolen insert handwear combinations).
(3) Cold-wet weather clothing
(4) CB protective clothing
(5) Armor Vest
(6) Rain gear

c) Time required to don equipment over each type of clothing
d) Time required to doff the equipment while wearing each type of clothing.
e) Compatibility of gas mask with test items:

(1) Ease of donning
(2) Ease of adjustment
(3) Ease of clearing
(4) Ease of removing

f) Participants opinion regarding the ease of donning, doffing, and adjusting the test item.
g) Types of equipment adjustments made
h) Type of load packed in/on the test item
i) Weight of load packed in/on the test item

6.2.4 Value Analysis

Determine whether or not the test item has any nonfunctional, costly, or nice-to-have features as described in USATECOM Regulation 700-1.

a. During the conduct of paragraphs 6.2.1 through 6.2.3, observations shall be made for features which could be eliminated without adversely affecting essential performance requirements, reliability. or safety.

b. Question test personnel and test director for features of the test item that may be eliminated without decreasing the functional value of the test item.

c. Record the following:

1) Now functional features
2) Costly features
3) Nice-to-have features
4) Comments of test personnel and test director

6.2.5 Safety Hazards

Determine whether or not the test item has any safety hazards as follows

a. Throughout the conduct of testing conduct investigations to define and record any potential safety hazards to the wearer.

b. Question test personnel and test director for comments as to any possible hazards relative to wearing the test item.

6.2.6 Maintenance Evaluation

a. During the conduct of this MTP, maintenance evaluation shall be determined as described in applicable sections of MTP 10-2-507.

b. Throughout the conduct of the testing, clean and laundry the test item as it becomes soiled. Determine and record the following:

NOTE: Prior to cleaning or laundrying any test items the literature provided with the test item shall be checked to ensure that there are no restrictions or specific methods required. Such as, some fabrics may only be cleaned by brushing the dirt off, others may require only clear water for cleaning, etc.

1) Ease of cleaning
2) Ease of laundry
3) Type of cleaning performed
4) Difficulties encountered

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

a. Visual inspection of the shipping package:

1) Evidence of packaging damage or deterioration
2) Identification markings:

a) Name of contractor
b) Number and date of contract
c) Date of manufacture
d) Other marking pertaining to the test item

b. Weight and measurements of the shipping package:

1) Contents
2) Weight, in pounds
3) Length, weight, in pounds
4) Cubage, in feet^3

c. Visual inspection results of the test item:

1) Nomenclature
2) Evidence of defects

a) Manufacturing
b) Material
c) Workmanship

3) Evidence of damage
4) Items withheld from testing and the reasons

d. When applicable, repair defects/damages, and the extent of repair.

e. Results of comparing test item with standard counterparts:

1) Counterpart equipment used for comparing
2) Variation between equipment

6.3.1.2 Physical Characteristics

Data shall be collected and recorded as described in applicable sections of MTP 10-2-500 and/or the following:

a. Color
b. Number of components
c. Type of components
d. Dimensional measurements of each component
e. Weight of:

1) Complete set
2) Each component

f. Type of closures used

6.3.1.3 Coding

Not applicable

6.3.1.4 Medical Examination

Retain the medical data form/record for each test participant showing the results of all medical examinations and treatment related to this MTP.

6.3.2 <u>Test Conduct</u>

6.3.2.1 Operational Performance

6.3.2.1.1 Load-Carrying Equipment Inspection -

Record the following for each test item:

a. When inspected (initial, end of 3rd day, after 3 hours of testing on 1st day)

b. Items code number
c. Type of failures
d. Location of failure
e. Time of the failure's occurrence

6.3.2.1.2 Donning, Doffing and Adjustments -

Record the following for each exercise and participant:

a. Equipment (test item or standard individual load-carrying equipment)
b. When performed
c. Time required to:

1) Don the equipment
2) Doff the equipment

d. Participants opinion regarding the ease of donning and doffing.
e. Type of adjustments required
f. Ease of adjustments
g. If applicable, causes of inability and/or excessive time required to perform donning, doffing or adjustments
h. Type of load
i. Weight of load, in pounds
j. Type of closures used
k. Type of handwear

6.3.2.1.3 Controlled Field Wear -

Record the following for each participant and each exercise:

a. Item's code number
b. Type of load carried
c. Weight of load, in pounds
d. Cubic size of load, in ft^3
e. Evaluation of the test item for:

1) Fit
2) Comfort
3) Freedom of movement of head, torso and breathing
4) Ease of adjustment while on the move

f. Time, in minutes, required to traverse the course
g. Time of equipment failure(s) (2nd, 4th, 11th time)
h. Type of equipment failure(s)
i. Difficulties encountered

6.3.2.2 Laboratory Analysis

6.3.2.2.1 Water Resistance -

Record the following for each test item:

a. Item's code number
b. Weights of the test item

1) Prior to test
2) After exposure to rainfall
3) After partial drying period

NOTE: All weights will be recorded by test officials on the individual load-carrying equipment Wet Data Form.

c. Inspection results:

1) After exposure to rainfall (i.e., water soaked through the outer covering, water caused adjustment straps to slip, hardboard surfaces to peel, no adverse effects were noted, etc.).
2) After partial drying (i.e., shrinkage of carrying straps occurred as the item began to dry, the test item showed no adverse effects.).

6.3.2.2.3 Identification of Materials -

Data shall be collected and recorded as described in procedure D-276 and D-629, ASTM Standards Manual.

6.3.2.2.4 Abrasion -

Data shall be collected and recorded as described in procedure D-1379, ASTM Standards Manual.

6.3.2.2.5 Salt Spray -

Data shall be collected and recorded as described in procedure B-117-64, ASTM Standards Manual.

6.3.2.2.6 Colorfastness -

Data shall be collected and recorded as described in procedure D-1365, ASTM Standards Manual.

6.3.2.2.7 Gloss -

Data shall be collected and recorded as described in procedure D-523, ASTM Standards Manual.

6.3.2.2.8 Temperature and Humidity -

Data shall be collected and recorded as described in procedure 501.1 and 501.2 (Temperatures), and 507.1 (Humidity), MIL-STD-810.

6.3.2.2.9 Static Electric Charge -

Data shall be collected and recorded as described in procedure 76-1964, AATCC Manual.

6.3.2.2.10 Immersion -

Data shall be collected and recorded as described in procedure D-570, ASTMS Standards Manual.

6.3.2.2.11 Flammability -

Data shall be collected and recorded as described in procedure D-1230, ASTMS Standards Manual.

6.3.2.2.12 Fungus -

Data shall be collected and recorded as described in procedure D-862, ASTMS Standards Manual.

6.3.2.2.13 Puncture -

Data shall be collected and recorded as described in procedure D-781, ASTM Standards Manual.

6.3.2.2.14 Crocking -

Data shall be collected and recorded as described in test procedure 5650-1 of F.S. CCC-T-191B or procedure 8-1961, AATCC Manual.

6.3.2.2.15 Breaking Strength -

Data shall be collected and recorded as described in procedure 1682, ASTM Standards Manual.

6.3.2.2.16 Tear Strength -

Data shall be collected and recorded as described in procedures D-1424 or D-2262, ASTM Standards Manual.

6.3.2.2.17 Accelerated Aging -

Data shall be collected and recorded as described in procedures E-42, E-239, D-1920 and E-240, ASTM Standards Manual.

6.3.2.3 Clothing Compatibility and Sizing

Record the following for each participant:

a. Body measurements
b. Size required in each type of clothing
c. For each type of load-carrying equipment:

1) Size of test equipment required for participant
2) Compatibility of test equipment with the following:

   a) Hot weather clothing
   b) Cold weather clothing
   c) Cold-wet weather clothing
   d) CB protective clothing
   e) Armor vest
   f) Rain gear

3) Time, in seconds, required to don the equipment over each type of clothing
4) Time, in seconds, required to doff the equipment while wearing each type of clothing
5) Compatibility of gas mask with test item:

   a) Ease of donning
   b) Ease of adjustment
   c) Ease of clearing
   d) Ease of removing

6) Participants opinion regarding the ease of donning, doffing and adjusting
7) Type of equipment adjustments made
8) Type of load packed in/on the test item
9) Weight of load packed in/on the test item, in pounds

6.3.2.4 Value Analysis

Record the following:

a. Non-functional features
b. Costly features
c. Nice-to-have features
d. Comments of test team personnel and users

6.3.2.5 Safety Hazards

a. Record any potential safety hazards to the wearer.
b. Comments of test team personnel and users pertaining to possible hazards relative to wearing the test item.

6.3.2.6 Maintenance Evaluation

a. Data shall be collected and recorded as described in applicable sections of MTP 10-2-507.
b. Record the following for cleaning and laundrying:

1) Ease of cleaning
2) Ease of laundrying
3) Type of cleaning performed

4) Difficulties encountered in each of the above instances

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Donning, Doffing and Adjustments

Data obtained on load-carrying equipment inspections, and donning and doffing shall be summarized to reveal significant deficiencies, donning and doffing ease and time requirements, and ease of making adjustment.

6.4.2 Controlled Field Wear

Data obtained on individuals traversing the Combat Effectiveness Testing Facility are analyzed using appropriate statistical methods to determine whether differences exist between performance levels when wearing the standard item and performance levels when wearing the experimental load-carrying equipment. If a difference exists, a point estimate and an internal estimate of the differences are determined. The data obtained during controlled field wear are used collectively in determining the characteristics of the experimental individual load-carrying equipment.

6.4.3 Physical Characteristics

Physical Testing Methods described in Professional Testing Handbooks i.e., ASTM's, AATCC's and Federal Standards CCC-191b, are used to determine differences in the standard and experimental individual load-carrying equipment. These differences, if they exist, are correlated with any differences observed during the controlled field wear test.

6.4.4 Clothing Compatibility and Sizing

Professional fitters and sizers determine the acceptability of the fit and the compatibility of the many individual items of clothing with standard and experimental load-carrying equipment. Data are analyzed to determine what levels of differences exist in fit and compatibility between the two systems with the various items of clothing and protective equipment in the field system including CB, cold-wet weather, and hot weather types and the armor vest.

6.4.5 Value Analysis

Value Analysis data shall summarize the comments collected pertaining to nonfunctional, costly, or nice-to-have features.

6.4.6 Safety

Data obtained on safety hazards shall be summarized showing the suitability of the test item from the safety standpoint.

6.4.7 Maintenance Evaluation

Maintenance evaluation data shall be presented as described in MTP 10-2-507 and information included on cleaning and laundrying of the test item.

APPENDIX A

SPECIAL TEST FACILITIES

1. THE USAGETA RAIN COURSE

The USAGETA Rain Course is designed to simulate natural rainfall, which the soldier would encounter in the performance of his field duties, for testing the adequacy of foul weather garments, tentage, and other types of general military materiel and equipment.

Man-made rain, anything from a slight drizzle to a torrential downpour, can be produced here with no more effort than a twist of the tap. High-pressure showerheads projecting from parapets thirty feet high produce simulated natural rainfall of varying intensities from one-tenth of an inch to three inches per hour.

The course covers an area of 86 feet by 50 feet. It is composed of two tracks - an obstacle track 278 feet in length and a class track 300 feet long. On the obstacle track personnel wearing test clothing cross obstacles and other obstructions simulating a dozen physical situations that confront troops in combat. The clear track of this course is designed for testing the water resistance of individual clothing.

Stationary equipment, such as tents, shelters, filling cabinets, typewriter cases, and food containers may also be tested on this course.

2. COMBAT EFFECTIVNESS TESTING FACILITY

The primary objective of this Testing Facility is to determine the effect of personal clothing and equipment on the combat effectiveness of the individual soldier.

The Facility, located at Camp Pickett, Virginia, consists of seven individual courses, two of which are divided into two subcourses, each measuring pertinent but different aspects of the individual combat task involved. The courses include: Maneuver, Fire and Reload, March/Move, Grenade, Compass, Hasty Fighting Positions, and Reconnaissance.

3. ENVIRONMENTAL CHAMBER (LARGE, WALK-IN TYPE)

This chamber has an interior capacity of 560 feet of unobstructed usable space: the cabinet is prefabricated in sections, so that any section can pass through any size opening and be assembled on the chamber site desired.

The temperature range of this chamber is adjustable from -80° F to 160°F. Temperature accuracy is plus or minus 1°F. Humidity Range is 20 percent to 100 percent relative humidity of a temperature range of +34 F to + 160 F. Control tolerance is plus or minus 2 percent relative humidity deviation from a set point of the control instrument. Temperature and humidity are automatically controlled and recorded with provisions for programming

varying temperature and humidity conditions. The chamber is designed for continuous or intermediate operation.

4. ENVIRONMENTAL CHAMBER (SMALL)

A small Environmental Chamber is equipped with port arms for use in manipulating test items within its chamber. The chamber is designed for use in evaluating properties of food products, paper, paper products, and plastics used in food packaging, metals, and fabric samples. It can be programmed for continuous or intermediate operation. Its upper and lower limits are from 0 to 200 degree Fahrenheit, 20 to 100 percent relative humidity. The dimensions of the small Environmental Chamber are: 4 feet by 4 feet by 2 feet deep front to rear.

5. SALT SPRAY CHAMBER

This chamber is used in testing to determine the effect of salt water or salt spray on any type of material or equipment that can be placed within its 3 x 4 x 3 foot chamber. Continuous slat spray action can be precisely programmed for days and weeks. The following paragraphs indicate the composition of the chamber and salt spray.

A. Chamber

The salt spray chamber and accessories shall be constructed of materials which do not react with and are not affected by the corrosiveness of the salt spray (fog) and do not react with or affect the test specimens. The chamber shall be of adequate size with respect to the amount and size of items being tested. The top of the chamber shall be included to prevent dripping of condensed liquid upon the specimens. The door opening must be capable of being sealed to prevent loss of fog. A drain shall be provided at the low point to remove condensed salt fog and also prevent its return to the salt solution reservoir. A vent should be located in the wall of the chamber as far from the atomizer as practicable. A salt solution reservoir shall be located inside the exposure chamber and shall be adequately covered to prevent condensed fog from returning to the reservoir. The reservoir should hold at lease a 72-hour supply of salt solution.

The air temperature in the chamber shall be controlled between 92° and 97°F by heating the wall and floor surfaces. This can be obtained by water-jacketing, or, the chamber may be placed in a room with the room temperature controlled to maintain a chamber temperature within the previously specified limits.

Salt spray (fog) shall be produced by blowing humidified air through an atomizer or nozzle to produce a stream of fine particles. The nozzle shall be so located or baffled as to prevent direct impingement on the test specimens.

Compressed air used for the fog nozzles shall be reasonably free from dust, oil, or excessive liquid - water particles and any foreign gases.

The air shall contain sufficient water vapor to be in equilibrium with the atmosphere in the chamber which has an 84% relative humidity at a temperature of 95°F. It may be preconditioned by passing through a saturator. The size of the air bubbles and the water temperature are the most important controlling factors to condition the air properly. This or any other system may be used provided the compressed air has a relative humidity of 84 to 90% at a temperature of 95°F when released inside the chamber. The compressed air should be saturated with water vapor according the following table:

Air Pressure p.s.i. ----------	12 14 16 18
Water Temperature °F ---------	110 112 115 117

A therometer shall be provided which will indicate or record the air temperature inside the chamber while in operation. Provisions shall be made to read the temperature without opening the chamber.

B. Salt Solution

The salt solution shall be prepared by dissolving 20± 2 parts by weight of salt in 80 parts by weight of distilled water or water containing not more than 200 parts per million of total solids. The salt used shall be sodium chloride containing on the dry basis not more than 0.1 percent of sodium iodide and not more than 0.2 percent of total impurities. The p^H of the solution shall be maintained at 6.5 to 7.2. The p^H measurement shall be made electrometrically using a glass electrode with a saturated potassium chloride bridge; or colorimetrically, provided the results obtained compare with the electrometric method. The concentration of the solution in the reservoir shall be maintained within the limits set forth above. In addition, before the solution is atomized, it shall be freed from suspended solids.

The sodium chloride concentration shall be collected by using at least two clean fog collectors placed within the exposure zone so that no drops of solution from the test item or any other source are collected. The collectors shall be placed in the proximity of the test item(s), one nearest to any nozzle and the other farthest from all nozzles. The fog shall be such that for each 80 sq. cm. of horizontal collecting area there will be collected in each collector from 0.5 to 0.3 cc of solution per hour based on the average of a run of at least 16 hours.

APPENDIX B

INSTRUMENTATION DEVICES AND EQUIPMENTS

1. UNIVERSAL TESTER

The Universal Tester has the capability of providing a direct readout of tension breaking strength, compression, and bursting strength of plastics, flexible food packaging, paper, and paper products, and other materials.

Its accuracy is better than plus 0.5 percent. It is programmable for either extension or compression. It has an extremely high response time. The tester's ranges are from 0 to 10,000 pounds compression or tension. Crosshead speeds are from 0.002 to 20 inches per minute. The tester has been modified to include a reversible load design.

Accessory equipment provided for the Instron Tester includes jaws, jaw faces, jigs, fixtures, load weighing accessories, and chart control accessories. Other miscellaneous equipment provided includes an Automatic Integrator; Marker Pip Control; Preset Cycle Counter; and a Ball Burst and Spike Penetrating Fixture.

2. HYDROSTATIC TESTER

The Hydrostatic burst tester uses a distilled water system without a diaphragm, and is used in determining the bursting strength or water permeability of coated fabrics, webbing, paper and paper products. The ranges of the tester are 0 to 1,000 pounds per square inch.

3. DYNOPTIC MICROSCOPE (METALURGIGAL WITH MONOCULAR BODY)

This enlarging device provides for dark field, bright field, and polarized light. It is equipped with a 4-pole nose piece, yellow, green, and blue filters, polarize and cap analyzer. It can be used in a wide variety of microscopic examinations of fabrics, webbing, and for other experimental materials.

4. RAPID-SCAN MOBILE INFRARED CAMERA

A rapid scanning heavy duty mobile infrared camera used for photographic display of surface temperature distribution of any object by the process of Thermography which detects infrared radiation in the spectrum range of 3.5 - 6.0 range. This equipment consists of a scanner (Infrared Spot Size - 3.5 milliradians); two control units; power supply; thermo-electric cooler power supply; Oscilloscope-Camera Display; mobile base and cabinet; and a scanner stand.

5. L.A.B. PACKAGE TESTING MACHINE

The L.A.B. Package Testing Machine (shaker table) is used for testing new or experimental packaging (meal cartons, shipping containers, etc.), fuel

and water containers and other small equipment by subjecting these items submmtted to GETA for evaluation to various G-forces and amplitude of frequencies.

It has a capacity of 5000 pounds and can be operated in the vertical plane or in a circular synchronous motion to introduce vertical, longitudinal or lateral motion.

The tester's table measures five feet in width and eight feet in length. It has an amplitude of one-half inch (one inch total flow) and a variable frequency.

The machine is powered by a standard 7½ horsepower, 60 cycle, 220/440 volt 3 phase electrical motor (constant maximum speed of 1750 RPM).

Dimensions: approximately 70 inches wide by 96 inches long, not including variable speed drive at side of table.

6. PUNCTURE TESTER

This tester is designed for the purpose of measuring resistance to puncture, or the stiffness of fiberboard, wallboard, vulcanized fiber, thin plywood, very heavy paper, fabrics, and similar materials. Measurements obtained are used to determine the ability of a material to meet military specifications requirements, and for rejecting grades unfit for their intended purpose.

Data obtained with this tester is also useful in evaluating various elements of design, materials and fabrication and their relationship to serviceability.

7. ABRASION TESTER

This is a standard abraser used for the quality control testing of experimental standard fabrics, webbing, metals, paper, paper products, linoleums, glass, plastics, paints, varnishes, and other finishes.

8. GLOSS MEASUREMENT EQUIPMENT

Five glossmeters provide geometries of 20°, 45°, 60°, 75°, 85°, as specified in ASTM Methods and Federal Test Methods and Specifications (FTMS) for the comparison of specular gloss.

These new lens-type glossmeters are equipped with high-sensitivity microammeters or lightmeters that provide for accurate gloss value which cannot be obtained by reflector-type glossmeters.

9. COLOR DIFFERENCE MEASUREMENT EQUIPMENT

Color Difference Meter - used for establishing color standards or deviation from color standards. This meter is also used for controlling the color of dyestuffs,pigment and printing inks; for measuring the color difference of solids, powders, and liquids. Additionally, it will quantitatively compare

two or more colors in terms of a three digit designation. Reflectance, transmission and gloss measurements may also be made with this instrument.

10. CROCKMETER (AATCC)

The AATCC Crockmeter is the standard machine for Colorfastness to Crocking (Rubbing) used in AATCC Test Method 8-1957 and ASA No. 1 14.72-1960. It is also used for determining the amount of powdering produced by wax finishes. The amount of color transferred from the surface of one material to another by either wet or dry rubbing is measured under controlled and reproducible test conditions.

11. WEATHER-OMETER

Laboratory-type apparatus used for ascertaining at a greatly accelerated speed the trend of reactions occurring to all types of experimental products in outdoor exposures. The item is a self-contained machine employing the three principal weathering agents: Synthetic Sunlight, Moisture, and Temperature Changes. Automatic control, regulation, and application of these weathering agents makes it possible to establish standard test conditions which can be duplicated and reproduced at any time or place.