28 July 1970

Materiel Test Procedure 5-2-545
White Sands Missile Range

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

HUMAN FACTORS ENGINEERING

1. OBJECTIVE

The objective of this Test Procedure is to verify that the test item (missile or rocket system, subsystem, or component thereof) does not contain features which constitute an unnecessary personnel hazard; and to determine (1) the degree to which the test item features permit achieving safe, reliable, and effective performance; (2) the degree to which the test item optimizes the operator-machine combination; (3) the degree to which the human functions and tasks required during system operation are reflected in technical publications; and (4) the degree to which potential error-inducing equipment features are minimized.

2. BACKGROUND

Missile and rocket systems are essentially new, sophisticated weapons systems developed and procured in accordance with military specifications and standards which incorporate human engineering requirements. Thus, human factors are considered from the inception of a missile or rocket system program. Nevertheless, at the Engineering Test phase of system development, determination of the human factors engineering characteristics of the test specimen is far from unnecessary.

In a tactical situation, reduced effectiveness may occur because the individual soldier is overloaded mentally and physically. Testing preproduction prototype test items determines the degree to which materiel prevents such human overloading, and may preclude producing materiel which cannot be properly and effectively utilized.

It has long been recognized that continuing exposure to loud noises may result in permanent impairment of hearing, which may affect combat efficiency and which is a recognized physical disability under many laws in this country. Verification of noise levels in the work environment of preproduction prototype missile and rocket system test items is essential to establish whether the item is safe for use by troops during Service Tests.

Similarly minimization or outright elimination of electrical hazards is necessary. Even small intensity shocks are dangerous. This is true because many severe injuries are caused, not directly by the electric shock, but by the reflex action and consequent impact of the body or member with nearby objects. Burns or nervous system injuries result from contact with potentials exceeding 50 volts rms. Death has resulted from contact with potentials ranging from 70 to 500 volts. Therefore investigations in this area are essential during engineering tests.

Likewise minimization or outright elimination of mechanical hazards is necessary. Experience has shown that, at the preproduction prototype stage

of system development, certain unsafe features may remain which require personnel to divert considerable attention from their tasks in order to adhere to safety precautions. This in turn leads to poorly executed jobs, jobs consuming much more than the optimum time, and occasional equipment damage and personnel injuries. Therefore investigations in this area also are essential during engineering tests.

3. REQUIRED EQUIPMENT

a. Foot Candle Photoelectric Meter 0-6-- fc.
b. Brightness Photometer Meter 0.01 - 10,000 foot Lamberts.
c. Thermocouples -80° to +180°F.
d. Air Flow Meter w/probe.
e. Sling Psychrometer Sampler or Electric Hygrometer.
f. Dust Sampler (impinger-type).
g. Carbon Monoxide Detector.
h. Gas Bulb Indicator.
i. Vapotester.
j. Radiac Meter.
k. Beta-gamma Survey Meter.
l. Micro-film Reader Printer.
m. Container for Safeguarding Defense Information.
n. Common Linear Measuring Instruments, (such as scales, tape measures, folding rulers, calipers, etc.).
o. Common Weight Measuring Instruments.
p. Force Measuring Instruments (such as spring scales, torque measuring devices, etc.).
q. Timing Devices such as Stop Watches.
r. Special Protective Clothing Required (such as arctic clothing, fuel handling clothing).
s. Special Protective Equipment (such as goggles, ear plugs or similar hearing protective devices, self contained breathing devices for use in toxic fume environments, respirators for use in heavy dust concentrations, etc.).
t. Impact Sound Level Meters with Associated Oscilloscopes and Photographing Equipment.
u. Loudness and Pitch Recorders and Analyzers.
v. Steady-state Noise Recorders and Analyzers.
w. Facilities for Artificial Creation and Control of Adverse Environments (such as extreme cold, extreme heat, various relative humidity conditions, drizzle, heavy rains, freezing rain, high winds, dust, etc.).
x. Shop Space Facilities (large enough to permit accomplishing normal operation and maintenance tasks).
y. Triaxial Accelerometer (0-100Hz).
z. Multichannel Recorder.
aa. Common Electrical/Electronic Measuring Instruments (such as multimeters, electronic voltmeters, ohmmeters, etc.).

4. REFERENCES

A. HEL STANDARD S-1-63B, Maximum Noise Level for Army Materiel Command Equipment, Aberdeen Proving Ground, Maryland.
B. HEL STANDARD S-3-65, Human Factors Engineering Design Standard for Missile Systems and Related Equipment, Aberdeen Proving Ground, Maryland.
C. MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
D. MIL-STD-4543, Standard General Requirements for Electronic Equipment.
E. MIL-H-46855, Human Engineering Requirements for Military Systems, Equipment and Facilities.
F. MIL-H-81444, Human Factors Engineering Systems Analysis Data.
G. Technical Memorandum 13-67, Criteria for Assessing Hearing Damage Risk from Impulse-Noise Exposure, U. S. Army Human Engineering Laboratories, Aberdeen Proving Ground, Maryland.
H. TB MED 251, Noise and Conservation of Hearing.
I. MACE, A.E., Sample-Size Determination, Reinhold, New York, 1964.
J. Committee on Threshold Limit Values, Documentation of Threshold Limit Values, American Conference of Government Industrial Hygienists, 1014 Broadway, Cincinnati, Ohio 45202.
K. Von Gierke, H. E., On Noise and Vibration Exposure Criteria, The Archives of Environmental Health, Vol 11, Sept 1965 (AMRL-TR-65-84, reprint requests to Biodynamics and Bionics Division, 6570th Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio 45433).
L. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
M. MTP 3-1-002, Confidence Intervals and Sample Size.

5. SCOPE

5.1 SUMMARY

This MTP provides procedures for evaluating the human factors characteristics of test items as follows:

a. Dimensional Workspace - The objective of this subtest is to determine the degree to which the test item meets human performance requirements involving body dimensions, human range of motion, and human strength and handling capacity. This test will also reveal if the test item contains features which constitute an unnecessary personnel hazard.

b. Environmental Workspace - The objective of this subtest is to determine (1) the degree to which the test item optimizes the man-environment-workspace combination, and (2) the degree to which test item features minimize or nullify the ill effects (on operator personnel) of deviations from tolerable conditions in the environmental workspace.

c. Consoles - The objective of this subtest is to determine the degree to which test item console features minimize parallax in viewing displays, permit easy manipulation of controls, and provide adequate space

and supports for the operator.

d. Controls - The objective of this subtest is to determine (1) the degree of compatibility of the test item controls relative to the movement of the control and the unit being controlled, and (2) the degree to which the test item controls permit safe, reliable, and effective performance.

e. Displays - The objective of this subtest is to determine the degree to which test item displays fulfill the information requirements regarding equipment functions which should be presented to the human; and to determine if the data is presented in a direct, simple, understandable, and usable form.

f. Labeling - The objective of this subtest is to determine the degree to which test item labeling fulfills the requirements for ease of location, reading, manipulation, and identification of items and functions needed for efficient system operation.

g. Coding - The objective of this subtest is to determine the degree to which test item coding provides effective aid in the identification of controls, indicators, connectors, and similar devices.

h. Communications - The objective of this subtest is to determine the degree to which the test item voice communication system(s) provide effective methods of requesting and transmitting information.

i. Optical Instruments - The objective of this subtest is to determine the degree to which test item optical instruments permit safe and efficient accomplishment of necessary tasks.

j. Stowage - The objective of this subtest is to determine the degree to which the test item stowage provisions allow access to stored items, provide for their security during transit, avoid interference of stored items during operations, and permit placing accessory items and personnel equipment in temporary storage during march order, transit, and operating conditions.

k. Electrical Hazards - The objective of this subtest is to verify that the test item does not contain features which constitute an unnecessary electrical hazard to personnel.

l. Mechanical Hazards - The objective of this subtest is to verify that the test item does not contain features which constitute an unnecessary mechanical hazard to personnel.

In general this test is to be conducted under "nonadverse environment" or even under shop-protected conditions rather than in the field or in simulated tactical environments. However, those aspects which require adverse environment for determining the degree to which the test item features permit achieving safe, reliable, and efficient performance must of necessity be conducted under either natural or artificial adverse environments.

5.2 LIMITATIONS

This MTP does not provide procedures for noise surveys, for making noise level measurements, nor for measurement and analysis of all dynamic environments (such as vibration) which affect operability and efficiency of the man-machine system.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Acquire in-depth knowledge of the system.

1) Obtain system and subsystem performance specifications, functional flow diagrams, schematic block diagrams, interface control drawings, overall layout drawings.
2) Obtain detail design equipment drawings such as panel layout drawings, overall layout drawings, communication systems, controls and other drawings which depict equipment important to system operation by human operators.

b. Acquire in-depth knowledge of man-machine interface.

1) Identify and define operational and control functions.
2) Identify plausible human roles in the system (i.e., operator, programmer, decision maker, communicator, monitor, etc.).
3) Allocate functions to man, equipment, or man and equipment.
4) Identify and specify man-equipment performance requirements for system operation and control functions.
5) Identify tasks which are related to end items of equipment to be operated by man.
6) Identify areas where equipment involves highly critical human performance and where human performance measurements are necessary.
7) Identify tasks which require critical human performance. These critical tasks may give rise to unsafe practices and are subject to special scrutiny during the conduct of the test.
8) Define operator information requirements.
9) Define control, display, and communication requirements.

c. Acquire in-depth knowledge of system and subsystem previous test results.

1) Identify all previously encountered problem areas and constraints.
2) Identify work environments which did not foster effective procedures or work patterns.
3) Identify work environments which failed to minimize discomfort, distraction, or other factors which degraded human performance or increased error.

d. Determine which components and characteristics of the item(s) under test can be tested by review of engineering drawings.

e. Determine which components and characteristics can be tested using hardware without need for operator personnel.

f. Determine which components and characteristics of the item under

test must be tested using hardware and operator personnel.

g. Select operator personnel with the required physical and skill characteristics for the item under test.

h. Determine the work environment(s) under which the item must be tested using hardware and operator personnel. Identify and provide appropriate clothing, tools, and equipment required for accomplishment of test.

i. Determine which components and characteristics require or admit instrumentation for data collection during test condcut.

j. Determine which components and characteristics require monitors for data collection during test conduct.

k. Install and verify operational status of instrumentation.

l. Precondition test item to applicable work environment.

m. Instruct operator/monitor personnel as necessary.

n. Prepare a test item sample plan sufficient to insure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Also see reference I.

6.2 TEST CONDUCT

6.2.1 Dimensional Workspace

6.2.1.1 Preparation

a. Using information obtained per 6.1b 4), 5), and d obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1e and f.

6.2.1.2 Test Conduct

6.2.1.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on work station entrances and exits, ladders, stairs, ramps, walkways and passageways, doors, hatches, platforms, guardrails, seated workspace, standing workspace, mobile workspace, temporary shelters, human strength, and handling capacity requirements.

b. Refer to HEL Standard S-3-65 for data on manual lifting capacity, human strength, and for dimensions on: the human body, the clothed 5th and 95th percentile soldier, the helmet M1, the helmet T56-6, the gloved hand, ladders, ramps, walkways and passageways, doors, hatches, guardrails, handrails, seated workspace, standing workspace, and mobile workspace.

c. Appendix A presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

d. Record positive and negative findings adequate to answer questions in Appendix A.

c. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those identified per 6.1e and f.

6.2.1.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1e, 6.2.1.1c, and 6.2.1.2.1e obtain hardware required.

b. Obtain measurements and other required data on work station entrances and exits, ladders, stairs, ramps, walkways and passageways, doors, hatches, platforms, guardrails, seated workspace, standing workspace, mobile workspace, temporary shelters, human strength, and handling capacity requirements.

c. Refer to HEL Standard S-3-65 for data on manual lifting capacity, human strength, and for dimensions on: the human body, the clothed 5th and 95th percentile soldier, the helmet M1, the helmet T56-6, the gloved hand, ladders, ramps, walkways and passageways doors, hatches, guardrails, handrails, seated workspace, standing workspace, and mobile workspace.

d. Appendix A presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

e. Record positive and negative findings adequate to answer questions in Appendix A.

f. Identify borderline and discrepant items or findings which suggest need for verification with operator personnel. Add such items to those identified per 6.1f.

6.2.1.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information obtained per 6.1f and 6.2.1.2.2f obtain hardware required.

b. Using information obtained per 6.1, i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on work station entrances and exits, ladders, stairs, ramps, walkways and passageways, doors, hatches, platforms, guardrails, seated workspace, standing workspace, mobile workspace, temporary shelters, human strength, and handling capacity requirements.

g. Refer to HEL Standard S-3-65 for data on manual lifting capacity, human strength, and for dimensions on: the human body, the clothed 5th and 95th percentile soldier, the helmet M1, the helmet T56-6, the gloved hand, ladders, ramps, walkways and passageways, doors, hatches, guardrails, handrails, seated workspace, standing workspace, and mobile workspace.

h. Appendix A presents checksheets for specific human factors

requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix A.

j. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.1.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6. 1 h and 6.2.1.2.3 j, obtain hardware required.

b. Using information obtained per 6.1 i install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Subject the equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on work station entrances and exits, ladders, stairs, ramps, walkways and passageways, doors, hatches, platforms, guardrails, seated workspace, standing workspace, mobile workspace, temporary shelters, human strength, and handling capacity requirements.

h. Refer to HEL Standard S-3-65 for data on manual lifting capacity, human strength, and for dimensions on: the human body, the clothed 5th and 95th percentile soldier, the helmet M1, the helmet T56-6, the gloved hand, ladders, ramp, walkways and passageways, doors, hatches, guardrails, seated workspace, standing workspace, and mobile workspace.

i. Appendix A presents checksheets for specific human factors requirements applicable to areas of investigation in g above.

j. Record positive and negative findings adequate to answer questions in Appendix A.

6.2.2 Environmental Workspace

6.2.2.1 Test Conduct

6.2.2.1.1 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 b 4), 5), 6), 7); 6.1 c 2), 3); and 6.1 e, obtain hardware required.

b. Obtain measurements and other required data on atmospheric environment, surface temperatures, humidity, ventilation, atmospheric contaminants, illumination, color, dark adaptations, noise, and vibration.

c. Refer to

1) HEL Standard S-3-65 for data on: effects on skin in contact

with surfaces at different temperatures; effective temperatures under varying relative humidities; typical concentrations of dust associated with Army activities; the composition of the exhaust of multi-fuel engines; illumination requirements; dark adaptation; effect of noise on voice communication; maximum noise level for Army Materiel Command equipment; maximum steady state noise level for nonelectrically aided person to person communication; and human reaction to vertical vibration.

2) The latest issue of Threshold Limit Values of the American Conference of Government Industrial Hygienists and reference L for data on maximum allowable concentrations of gases, vapors, fumes, dusts, etc.
3) The Surgeon General, ATTN: MEDPS-PO, Department of the Army, for special assistance in conducting noise surveys, and for latest available data on health hazards of radiation.
4) HEL Standard S-1-63B for noise level measurements.

d. Appendix B presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

e. Record positive and negative findings adequate to answer questions in Appendix B.

f. Identify borderline and discrepant items or findings which suggest need for verification on hardware with operator, and add such items to those identified per 6.1 f.

6.2.2.1.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information obtained per 6.1 f and 6.2.2.1.1 f, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on atmospheric environment, surface temperatures, humidity, ventilation, atmospheric contaminants, illumination, dark adaptation, noise, and vibration.

g. See 6.2.2.1.1 c for references to consult on certain human factors requirements applicable to areas of investigation in f above.

h. Appendix B presents checksheets for specific requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix B.

j. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.2.1.3 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.2.1.2 j, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Subject the equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on atmospheric environment, surface temperatures, humidity, ventilation, atmospheric contaminants, illumination, dark adaptation, noise and vibration.

h. See 6.2.2.1.1 c for references to consult on certain human factors requirements applicable to areas of investigation in g above.

i. Appendix B presents checksheets for specific requirements applicable to areas of investigation in g above.

j. Record positive and negative findings adequate to answer questions in Appendix B.

6.2.3 Consoles

6.2.3.1 Preparation

a. Using information per 6.1 b 4), 5), and d, obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.3.2 Test Conduct

6.2.3.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on display surfaces, control surfaces, work surfaces, control display relationship, and emergency indications.

b. Refer to HEL Standard S-3-65 for console dimensions, console configurations, viewing areas, control display relationship layouts, and frequency characteristics of auditory master warning signals.

c. Appendix C presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

d. Record positive and negative findings adequate to answer questions in Appendix C.

e. Identify borderline and discrepant items or findings which

suggest need for verification with hardware and add such items to those identified per 6.1 e and f.

6.2.3.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.3.2.1 e, obtain hardware required.

b. Obtain measurements and other required data on display surfaces, control surfaces, work surfaces, control display relationship, and emergency indications.

c. Appendix C. presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

d. Refer to HEL Standard S-3-65 for console dimensions, console configurations, viewing areas, control display relationship layouts, and frequency characteristics of auditory master warning signals.

e. Record positive and negative findings adequate to answer questions in Appendix C.

f. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.3.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information obtained per 6.1 f and 6.2.3.2.2 f obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on display surfaces, control surfaces, work surfaces, control display relationship, and emergency indications.

g. Refer to HEL Standard S-3-65 for console dimensions, console configurations, viewing areas, control display relationship layouts, and frequency characteristics of auditory master warning signals.

h. Appendix C presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix C.

j. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.3.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.3.2.3 j, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Subject equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on display surfaces, control surfaces, work surfaces, control display relationship, and emergency indications.

h. Refer to HEL Standard S-3-65 for console dimensions, console configurations, viewing areas, control display relationship layouts, and frequency characteristics of auditory master warning signals.

i. Appendix C presents checksheets for specific human factors requirements applicable to areas of investigation in g above.

j. Record positive and negative findings adequate to answer questions in Appendix C.

6.2.4 Controls

6.2.4.1 Preparation

a. Using information per 6. 1 b 4), 5) and d, obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.4.2 Test Conduct

6.2.4.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on hand cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

b. Refer to HEL Standard S-3-65 for data on conventional control movements, recommended manual controls, and characteristics for cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

c. Appendix D presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

d. Record positive and negative findings adequate to answer questions in Appendix D.

e. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those

identified per 6.1 e and f.

6.2.4.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.4.2.1 e, obtain hardware required.

b. Obtain measurements and other required data on hand cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

c. Refer to HEL Standard S-3-65 for data on conventional control movements, recommended manual controls, and characteristics for cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

d. Appendix D presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

e. Record positive and negative findings adequate to answer questions in Appendix D.

f. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.4.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information obtained per 6.1 f, and 6.2.4.2.2 f, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j, get personnel required.

d. Instruct operator/monitor personnel as required.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on hand cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

g. Refer to HEL Standard S-3-65 for data on conventional control movements, recommended manual controls, and characteristics for cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

h. Appendix D presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix D.

j. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add usch items to those identified per 6.1 h.

6.2.4.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.4.2.3 j, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Subject equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on hand cranks, handwheels, key-operated switches, knobs, legand switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

h. Refer to HEL Standard S-3-65 for data on conventional control movements, recommended manual controls, and characteristics for cranks, handwheels, key-operated switches, knobs, legend switches, levers, pedals, push buttons, rotary selector switches, and toggle switches.

i. Appendix D presents checksheets for specific human factors requirements applicable to areas of investigation in g above.

j. Record positive and negative findings adequate to answer questions in Appendix D.

6.2.5 Displays

6.2.5.1 Preparation

a. Using information per 6.1 b 4), 5), and d, obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.5.2 Test Conduct

6.2.5.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on cathode-ray tubes, radar display symbols, counters, indicator lights, plotters, printers, scalar indicators, and pointers.

b. Refer to HEL Standard S-3-65 for data on radar display coding forms, meanings of coding techniques, minimum satisfactory sizes for visual symbols, coding methods for symbols, counter character dimensions, scale numerical progressions, and scale dimensions.

c. Appendix E presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

d. Record positive and negative findings adequate to answer questions in Appendix E.

e. Identify borderline and discrepant items or findings which suggest need for verification with hardware and add such items to those identified per 6.1 e and f.

6.2.5.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.5.2.1 e, obtain hardware required.

b. Obtain measurements and other required data on cathode-ray tubes, radar display symbols, counters, indicator lights, plotters, printers, scalar indicators, and pointers.

c. Refer to HEL Standard S-3-65 for data on radar display coding forms, meanings of coding techniques, minimum satisfactory sizes for visual symbols, coding methods for symbols, counter character dimensions, scale numerical progressions, and scale dimensions.

d. Appendix E presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

e. Record positive and negative findings adequate to answer questions in Appendix E.

f. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.5.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information obtained per 6.1 f, and 6.2.5.2.2 f, obtain hardware required.

b. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j get personnel required.

d. Instruct operator/monitor personnel as required.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on cathode-ray tubes, radar display symbols, counters, indicator lights, plotters, printers, scalar indicators, and pointers.

g. Refer to HEL Standard S-3-65 for data on radar display coding forms, meanings of coding techniques, minimum satisfactory sizes for visual symbols, coding methods for symbols, counter character dimensions, scale numerical progressions, and scale dimensions.

h. Appendix E presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix E.

j. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.5.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.5.2.3 j obtain hardware required.

b. Using information obtained per 6.1 i install and verify operational status of instrumentation.

c. Using information obtained per 6.1 g and 6.1 j get personnel required.

d. Instruct operator/monitor personnel as necessary.

e. Subject equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on cathode-ray tubes, radar display symbols, counters, indicator lights, plotters, printers, scalar indicators, and pointers.

h. Refer to HEL Standard S-3-65 for data on radar display coding forms, meanings of coding techniques, minimum satisfactory sizes for visual symbols, coding methods for symbols, counter character dimensions, scale numerical progressions, and scale dimensions.

i. Appendix E presents checksheets for specific human factors requirements applicable to areas of investigation in g above.

j. Record positive and negative findings adequate to answer questions in Appendix E.

6.2.6 Labeling

6.2.6.1 Preparation

a. Using information per 6.1 b 4), 5), and d, obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.6.2 Test Conduct

6.2.6.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on numerals and letters, content, labeling for identification, instruction plates, test points, and safety hazards.

b. Refer to HEL Standard S-3-65 for data on recommended type fonts, character size, and viewing distance.

c. Appendix F presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

d. Record positive and negative findings adequate to answer questions in Appendix F.

e. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those identified per 6.1 e and f.

6.2.6.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.6.2.1 e obtain hardware required.

b. Obtain measurements and other required data on numerals and letters, content, labeling for identification, instruction plates, test points, and safety hazards.

c. Refer to HEL Standard S-3-65 for data on recommended type fonts, character size, and viewing distance.

d. Appendix F presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

e. Record positive and negative findings adequate to answer questions in Appendix F.

f. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.6.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f, and 6.2.6.2.2 f obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.

c. Instruct operator/monitor personnel as necessary.

d. Operate the equipment and perform necessary tasks.

e. Obtain measurements and other required data on numerals and letters, content, labeling for identification, instruction plates, test points, and safety hazards.

f. Refer to HEL Standard S-3-65 for data on recommended type fonts, character size, and viewing distance

g. Appendix F presents checksheets for specific human factors requirements applicable to areas of investigation in e above.

h. Record positive and negative findings adequate to answer questions in Appendix F.

i. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.6.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.6.2.3 i, obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, get personnel required.

c. Instruct operator/monitor personnel as necessary.

d. Subject equipment to the required adverse environment.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on numerals and letters, content, labeling for identification, instruction plates, test points, and safety hazards.

g. Refer to HEL Standard S-3-65 for data on recommended type fonts, character size, and viewing distance.

h. Appendix F presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix F.

6.2.7 Coding

6.2.7.1 Preparation

a. Using information per 6.1 b 4), 5) and d, obtain applicable engineering drawings.
b. Insure that drawings depict the item under test.
c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.7.2 Test Conduct

6.2.7.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on controls, displays, connectors, and conductors.
b. Refer to HEL Standard S-3-65 for data on coding of displays, coding of connectors, and cable coding.
c. Appendix G presents checksheets for specific human factors requirements applicable to areas of investigation in a above.
d. Record positive and negative findings adequate to answer questions in Appendix G.
e. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those identified per 6.1 e and f.

6.2.7.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.7.2.1 e, obtain hardware required.
b. Obtain measurements and other required data on controls, displays, connectors, and conductors.
c. Refer to HEL Standard S-3-65 for data on coding of displays, coding of connectors, and cable coding.
d. Appendix G presents checksheets for specific human factors requirements applicable to areas of investigation in b above.
e. Record positive and negative findings adequate to answer questions in Appendix G.
f. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.7.2.3 Hardware with Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f, and 6.2.7.2.2 f, obtain hardware required.
b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.
c. Instruct operator/monitor personnel as necessary.
d. Operate the equipment and perform necessary tasks.
e. Obtain measurements and other required data on controls, displays, connectors, and conductors.

f. Refer to HEL Standard S-3-65 for data on coding of displays, coding of connectors, and cable coding.

g. Appendix G presents checksheets for specific human factors requirements applicable to areas of investigation in e above.

h. Record positive and negative findings adequate to answer questions in Appendix G.

i. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.7.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.7.2.3 i, obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.

c. Instruct operator/monitor personnel as necessary.

d. Subject equipment to the required adverse environment.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on controls, displays, connectors, and conductors.

g. Refer to HEL Standard S-3-65 for data on coding of displays, coding of connectors, and cable coding.

h. Appendix G presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

i. Record positive and negative findings adequate to answer questions in Appendix G.

6.2.8 Communications

6.2.8.1 Test Conduct

6.2.8.1.1 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e, obtain hardware required.

b. Obtain measurements and other required data on telephones, announcing systems or intercoms, receivers and headsets, talkers, radio sets, radio antennas, control boxes, audio accessories, and cable routing.

c. Appendix H presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

d. Record positive or negative findings adequate to answer questions in Appendix H.

e. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.8.1.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f, and 6.2.8.1.1 e, obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.

c. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

d. Instruct operator/monitor personnel as necessary.

e. Operate the equipment and perform necessary tasks.

f. Obtain measurements and other required data on telephones, announcing systems or intercoms, receivers and headsets, talkers, radio sets, radio antennas, control boxes, audio accessories, and cable routing.

g. Appendix H presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

h. Record positive and negative findings adequate to answer questions in Appendix H.

i. Identify borderline and discrepant items, operations, or findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.8.1.3 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.8.1.2 i, obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.

c. Using information obtained per 6.1 i, install and verify operational status of instrumentation.

d. Instruct operator/monitor personnel as necessary.

e. Subject equipment to the required adverse environment.

f. Operate the equipment and perform necessary tasks.

g. Obtain measurements and other required data on telephones, announcing systems, or intercoms, receivers and headsets, talkers, radio sets, radio antennas, control boxes, audio accessories, and cable routing.

h. Appendix H presents checksheets for specific human factors requirements applicable to areas of investigation in g above.

i. Record positive and negative findings adequate to answer questions in Appendix H.

6.2.9 Optical Instruments

6.2.9.1 Preparation

a. Using information per 6.1 b 4), 5), and d, obtain applicable engineering drawings.

b. Insure that drawings depict the item under test.

c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.9.2 Test Conduct

6.2.9.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements

and other required data on interpupillary distance, focusing, filters, boresight knobs, sight mounts, eyepieces and eyecups, and sights for night operation.

b. Appendix I presents checksheets for specific human factors requirements applicable to areas of investigation in a above.

c. Record positive and negative findings adequate to answer questions in Appendix I.

d. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those identified per 6.1 e and f.

6.2.9.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.9.2.1 d, obtain hardware required.

b. Obtain measurements and other required data on interpupillary distance, focusing, filters, boresight knobs, sight mounts, eyepieces and eyecups, and sights for night operation.

c. Appendix I presents checksheets for specific human factors requirements applicable to areas of investigation in b above.

d. Record positive and negative findings adequate to answer questions in Appendix I.

e. Identify borderline and discrepant items or findings which suggest need for verification with operator and add such items to those identified per 6.1 f.

6.2.9.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f, obtain hardware required.

b. Using information obtained in 6.1 g and 6.1 j, assign personnel required.

c. Instruct operator/monitor personnel as necessary.

d. Operate the equipment and perform necessary tasks.

e. Obtain measurements and other required data on interpupillary distance, focusing, filters, boresight knobs, sight mounts, eyepieces and eyecups, and sights for night operation.

f. Appendix I presents checksheets for specific human factors requirements applicable to areas of investigation in e above.

g. Record positive and negative findings adequate to answer questions in Appendix I.

h. Identify borderline and discrepant items, operations, or findings which suggest need for verification with other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.9.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.9.2.3 h, obtain hardware required.

b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.

c. Instruct operator/monitor personnel as necessary.
d. Subject equipment to the required adverse environment.
e. Operate the equipment and perform necessary tasks.
f. Obtain measurements and other required data on interpupillary distance, focusing, filters, boresight knobs, sight mounts, eyepieces and eyecups, and sights for night operation.
g. Record positive and negative findings adequate to answer questions in Appendix I.
h. Appendix I presents checksheets for specific human factors requirements applicable to areas of investigation in f above.

6.2.10 Stowage

6.2.10.1 Preparation

a. Using information per 6.1 b 4), 5) and d, obtain applicable engineering drawings.
b. Insure that drawings depict the item under test.
c. Note hardware versus drawing discrepancies and add discrepant items to those identified per 6.1 e and f.

6.2.10.2 Test Conduct

6.2.10.2.1 Software and Drawing Investigation

a. Review drawings to the level necessary to obtain measurements and other required data on interference, utilization of stowage space, retaining devices, missile stowage, and missile transfer.
b. Appendix J presents checksheets for specific human factors requirements applicable to areas of investigation in a above.
c. Record positive and negative findings adequate to answer questions in Appendix J.
d. Identify borderline and discrepant items or findings which suggest need for verification with hardware, and add such items to those identified per 6.1 e and f.

6.2.10.2.2 Hardware Without Operator Personnel Investigation

a. Using information obtained per 6.1 e and 6.2.10.2.1 d, obtain hardware required.
b. Obtain measurements and other required data on interference, utilization of stowage space, retaining devices, missile stowage and missile transfer.
c. Appendix J presents checksheets for specific human factors requirements applicable to areas of investigation in b above.
d. Record positive and negative findings adequate to answer questions in Appendix J.
e. Identify borderline and discrepant items or findings which suggest need for verification with personnel, and add such items to those identified per 6.1 f.

6.2.10.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f, and 6.2.10.2.2 e obtain hardware required.
b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.
c. Instruct operator/monitor personnel as necessary.
d. Operate the equipment and perform necessary tasks.
e. Obtain measurements and other required data on interference, utilization of stowage space, retaining devices, missile stowage, and missile transfer.
f. Appendix J presents checksheets for specific human factors requirements applicable to areas of investigation in e above.
g. Record positive and negative findings adequate to answer questions in Appendix J.
h. Identify borderline and discrepant items, operations, and findings which suggest need for verification under other than nonadverse environment. Add such items to those identified per 6.1 h.

6.2.10.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

a. Using information obtained per 6.1 h and 6.2.10.2.3 h, obtain hardware required.
b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.
c. Instruct operator/monitor personnel as necessary.
d. Subject equipment to the required adverse environment.
e. Operate the equipment and perform necessary tasks.
f. Obtain measurements and other required data on interference, utilization of stowage space, retaining devices, missile stowage, and missile transfer.
g. Appendix J presents checksheets for specific human factors requirements applicable to areas of investigation in f above.
h. Record positive and negative findings adequate to answer question in Appendix J.

6.2.11 Electrical Hazards

6.2.11.1 Test Conduct

6.2.11.1.1 Hardware Without Operator Personnel Investigation

a. Using information recorded in 6.1 e, obtain hardware required.
b. Perform necessary examination of hardware to answer the questions in Appendix K, checksheets for electrical hazards.
c. Record positive and negative findings adequate to answer questions in Appendix K.
d. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.11.1.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f and 6.2.11.1.1 d, obtain hardware required.
b. Using information obtained per 6.1 g and 6.1 j, assign personnel required.
c. Instruct operator/monitor personnel as necessary.
d. Operate the equipment and perform necessary tasks.
e. Perform necessary examination of hardware and operations to answer the questions in Appendix K, checksheets for electrical hazards.
f. Record positive and negative findings adequate to answer question in Appendix K.

6.2.12 Mechanical Hazards

6.2.12.1 Test Conduct

6.2.12.1.1 Hardware Without Operator Personnel Investigation

a. Using information recorded in 6.1 e, obtain hardware required.
b. Perform necessary examination of hardware to answer the questions in Appendix L, checksheets for mechanical hazards.
c. Record positive and negative findings adequate to answer questions in Appendix L.
d. Identify borderline and discrepant items or findings which suggest need for verification with operator, and add such items to those identified per 6.1 f.

6.2.12.1.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

a. Using information recorded in 6.1 f and 6.2.12.1.1 d, obtain hardware required.
b. Using information obtained in 6.1 g and 6.1 j, assign personnel required.
c. Instruct operator/monitor personnel as necessary.
d. Operate the equipment and perform necessary tasks.
e. Perform necessary examination of hardware and operations to answer the questions in Appendix L, checksheets for mechanical hazards.
f. Record positive and negative findings adequate to answer questions in Appendix L.

6.3 TEST DATA

6.3.1 Preparation for Test

a. Data derived is personal knowledge. Therefore, no specifics can be prescribed.
b. Data derived is personal knowledge. However, much of the data can be recorded under the headings outlined in 1) through 9) of 6.1 b. Charts

or lists prepared for quick reference are highly desirable. The developer frequently requires these studies during earlier stages of research and development. Therefore these data may already be available to the testing agency in published form.

c. Data derived is personal knowledge. However the information is a matter of record. Subsequent summaries which may be felt to be valuable for reference in chart or listing formats cannot be prescribed, but are highly desirable.

d. Data derived under 6.1 d through 6.1 j is personal knowledge. However it is highly desirable that charts or lists reflecting the overall findings of the tasks outlined in 6.1 d through 6.1 j be prepared.

6.3.2 Dimensional Workspace

6.3.2.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix A: 1 a; 2 c, d, e, k; 3 b, c, d, f, g, h, i, j, k; 4 a, b, c, d; 5 a, b; 6 a, b, c, d, e, g; 7 a, c, e; 8 a, f, g,; 9 b, e, g, h, j, k; 10 e, f, g, h; 11 e, g, j, o; 12 b; 13 c, d, e, f.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.2.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix A: 1 d, e; 2 a, b, f, g, h, i, j; 3 l, m; 7 b, d; 8 b, c, d, e; 9 a, c, d, f, i; 10 a, b, c, d, g; 11 a, b, c, d, f, h, i, k, l, m, n; 12 a; 13a, b, g, h, i, j, k, l; 14a, b, c, d, e; 15d.

6.3.2.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix A: 1 b, c, f, g, h; 3 a, e; 15 a, c, e.

6.3.2.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix A: 1 b, c, g, h; 2 g, i; 3 k, l; 8 b, c, d, e; 15 a, b, c, e.

6.3.3 Environmental Workspace

6.3.3.1 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix B: 1 a 3), 4); 2 a, b, c; 3 a, b; 4 a, b, c; 5 a, c, e; 6 b, c; 7 a, b; 8 a, b, c; 9 a, b, c, d, e, f; 10 a, b.

6.3.3.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix B: 1 a; 3 a, b; 4 a, b, c; 5 c, d, e; 6 a; 9 g.

6.3.3.3 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix B: 1 a, b; 2 b, c, d, e, f; 3 a, b; 4 a, b, c; 5 a, b, c, d, e.

6.3.4 Consoles

6.3.4.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix C: 1 a, b, c, g, i, j; 2 a, c, d, e, f, l, m, n; 3 a, b, c; 4 a 1), f), b 1), 2), 3), 4), 5), 6), 7), c 1), 2), 3), 4), 5), 6); 5 f 1), 2), 5), g.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.4.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix C: 1 d, e, f, h; 2 b, g, h, i, j, k; 4 a 1) a), b), c), d), e), g), h) 2), 3), 4), b 8) a), b), c), d), e), c 7); 5 a, c, d, e, 1), 3), 5), f 3), 4), g 1), 2), 3), 4).

6.3.4.3 Hardware with Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix C: 5 b, e 2), e 4).

6.3.4.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix C which previous investigations identified as requiring verification under adverse environment.

6.3.5 Controls

6.3.5.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix D: 1 g, h; 2 c, d; 3 a, d, f; 4 a, c, d, e; 5 a, e, f; 6 a, c; 7 a, f; 8 a; 9 a, b, f, g; 10 a, e, f; 11 a, b, c, f, h, i; 12 a, c, d, e, f, g.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.5.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix D: 1 c, e, f, i, j, k; 2 b; 3 b, c, d, e; 4 b; 5 b, c, d; 6 b, d, e; 7 b, c, d, e; 8 b, c,

f g, h; 9 c, d, e; 10 b, c; 11 d, e, g, j; 12 b.

6.3.5.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix D: 1 a, b, d; 8 d, e; 10 d.

6.3.5.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix D which previous investigations identified as requiring verification under adverse environment.

6.3.6 Displays

6.3.6.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix E: 1 e, f, g, h, i, j, k, l, n, o; 3 g, h; 4 c, d; 5 d; 7 a 1); 8 d; 9 a, b, f, h, j; 10 a, b, c; 11 a, b, c, d, g.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.6.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix E: 1 a, m, p, q, r; 3 a, b, c, d, e, f; 5 b, c; 6 a, b, c; 7 a 2), 3), 4), 5), 6); 8 a, c; 9 c, d, e, g, i; 10 d; 11 e, f, h.

6.3.6.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix E: 1 b, c, d; 2 a, b, c, d, e, f; 4 a, b, e, f; 5 a; 6 b, d; 7 b, c, d; 8 b; 10 e, f.

6.3.6.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix E which previous investigations identified as requiring verification under adverse environment.

6.3.7 Labeling

6.3.7.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix F: 1 a, c, d, e, h, i, j; 2 a, b, c, d; 3 a, b, c, d, e; 4 a, c, e. f; 5 a, b, c; 6 a, b; 8 b, c.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.7.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix F: 1 b, f, g; 4 b, d; 5 d; 7 a, b, c; 8 a.

6.3.7.3 Hardware With Operator Personnel Investigation (Nonadverse and Adverse Environments)

Record data adequate to answer questions in Appendix F which previous investigations identified as requiring verification with operator under non-adverse and adverse environments.

6.3.8 Coding

6.3.8.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix G: 3 c, d; 4 a; 5 a, b, c.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.8.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix G: 1 a, b; 2 a, b, c, d; 3 f, g; 4 b, c.

6.3.8.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix G: 3 a, b, e.

6.3.8.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix G which previous investigations identified as requiring verification with operator under adverse environment.

6.3.9 Communications

6.3.9.1 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix H: 1 d; 2 b, c, d, e; 3 b, c, d; 5 a, b, c; 6 a, c, d, e, f, g; 7 a, b, c; 8 a, c, d, e; 9 a; 10 a, b, c, d.

6.3.9.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix H: 1 a, b, c; 2 a; 3 a; 4 a, b; 6 b; 8 b; 9 b.

6.3.9.3 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer questions in Appendix H which previous investigations identified as requiring verification under adverse environment.

6.3.10 Optical Instruments

6.3.10.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix I: 1; 2 a, b; 3 a, b, c, d, e; 5 a; 6 a, b; 7 e.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.10.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix I: 4 a, b, c; 5 b; 6 c, d; 7 a, b, c, d.

6.3.10.3 Hardware With Operator Personnel Investigation (Nonadverse and Adverse Environment)

Record data adequate to answer questions in Appendix I which previous investigations identified as requiring verification with operator under non-adverse and adverse environment.

6.3.11 Stowage

6.3.11.1 Software and Drawing Investigation

a. Record data adequate to answer questions in Appendix J: 1 d, f, g, h; 3 a; 5 c, e, h; 6 c.

b. Accurate and thorough records in this phase of the investigation can lead to optimum utilization of resources during the remaining phases of the test.

6.3.11.2 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix J: 1 a, b, c, e; 2b, c, d; 3b, c, d; 4a, b; 5b, f, g; 6 a, b.

6.3.11.3 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix J: 2 a; 5 a, d; 6 d.

6.3.11.4 Hardware With Operator Personnel Investigation (Adverse Environment)

Record data adequate to answer question 4 c in Appendix j, plus other

questions therein which previous investigations identified as requiring verification under adverse environment.

6.3.12 Electrical Hazards

6.3.12.1 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix K: 1 a, b, c, d, e, f, g, h, i, j, k, l, m, n, o.

6.3.12.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix K which previous investigations identified as requiring verification with operator.

6.3.13 Mechanical Hazards

6.3.13.1 Hardware Without Operator Personnel Investigation

Record data adequate to answer questions in Appendix L: 1 a, b, c, d, e, f, g, h, i, j, k, l, m.

6.3.13.2 Hardware With Operator Personnel Investigation (Nonadverse Environment)

Record data adequate to answer questions in Appendix L which previous investigations identified as requiring verification with operator.

6.4 DATA REDUCTION AND PRESENTATION

Analyze failures occuring during this test to differentiate between failures due to equipment alone, man-equipment incompatibilities, and those due to human error. Present the results of this analysis in chart or tabular form.

Analyze deficiencies and shortcomings exposed during this test, and group them in the order of their relative importance according to their projected or actual effect on equipment and on personnel. An order of importance based on the following considerations is suggested.

a. Personnel

1) Fatality: death.
2) Temporary total disablement: knocked unconscious for more than a very brief moment, hurt so as to require evacuation from combat or mission.
3) Permanent partial disablement: blinded, maimed, permanent impairment of function.
4) Temporary partial disablement: temporary blindness, temporary loss of hearing, temporary impairment of function.

5) Severe discomfort.
6) Degradation of performance.

b. Equipment

1) Permanent total disablement.
2) Temporary total disablement.
3) Permanent partial disablement.
4) Temporary partial disablement.

Further analyze, group, and quantitize data in relation to the elements enumerated in paragraph 1, objective. Present the data in chart or tabular form and give positive as well as negative findings.

THIS PAGE INTENTIONALLY LEFT BLANK

GLOSSARY

1. Critical Human Performance: (1) Human performance which, if not accomplished in accordance with system requirements, will most likely have adverse effects on cost, system reliability, efficiency, effectiveness, or safety; (2) Human performance is considered critical whenever test item characteristics demand performance which exceeds human capabilities, and which thereby significantly contributes to the occurrence of one of more of the following conditions:

   a. Jeopardized performance of an authorized mission.
   b. Degradation of the Circular Error Probability to an unacceptable level.
   c. Delay of a mission beyond acceptable time limits.
   d. Improper operation resulting in a system "no-go", inadvertent weapons firing, or failure to achieve operational readiness alert.
   e. The exceeding of predicted times for maintenance tasks.
   f. Degradation of system equipment below reliability requirements; i.e., mean time between failure (MTBF) is reduced.
   g. The damaging of system equipment resulting either in a return to a maintenance facility for major repair, or in unacceptable costs, spare requirements, or system downtime.
   h. A serious compromise of weapon system security.
   i. Injury to personnel.

2. Effective Temperature: Effective temperature of an environment is an arbitrary index numerically equal to the temperature of still saturated air which would induce the same sensation.

3. Equipment Failure: An equipment failure is the cessation of the ability to meet the minimum performance requirements of the equipment specifications. Further, equipment failure shall imply that the minimum specified performance is not reobtainable through permissible readjustment of operator controls.

4. Human Factors Engineering Criteria: The summation of available knowledge which defines the nature and limits of human capabilities as they relate to the checkout, operation, maintenance, or control of systems or equipment, and which may be applied during engineering design to achieve optimum compatibility between equipment and human performance.

5. Overall Layout Drawings: System design drawings which include: (1) the configuration and arrangement of items of equipment for manned stations; (2) the configuration and arrangement of items of equipment (such as modular racks or maintenance ground equipment) which may not be part of a manned station for operation, but which require man-equipment access for maintenance; (3) the arrangement of interior lighting for operating or maintaining the equipment, and (4) labels identifying general panel content.

6. Panel Layout Drawings: Equipment detail drawings which include (but are not necessarily limited to): (1) a scale layout of the controls and displays on each panel of an item of equipment; (2) a description of all symbols used; (3) identification of the color coding used for displays and controls.

7. Percentile: The 5th percentile for a particular dimension is a value such that 5% of the personnel are smaller than the value expressed and 95% of the personnel are larger. Conversely, the 95th percentile for a particular dimension is a value such that 95% of the personnel are smaller than the value expressed and 5% of the personnel are larger.

APPENDIX A

CHECKSHEETS FOR DIMENSIONAL WORKSPACE

1. Work Station Entrance and Exit

a. Are entrances and exits provided for enclosed work areas?
b. Do entrances and exits permit unrestricted flow for all anticipated traffic?
c. Are entrances and exits located so that using personnel will not accidentally come into contact with equipment controls?
d. Are auxiliary entrances required and provided?
e. Are emergency exits required and provided?
f. Is sufficient space allowed for rapid exit of all occupants?
g. Is sufficient space allowed for rapid exit of occupants wearing bulky protective clothing?
h. Is sufficient space allowed for rapid exit of occupants carrying essential items of equipment?

2. Stairs, Ladders, and Ramps

a. Are stairs, ladders, or ramps provided at all locations where personnel are required to change elevation abruptly by more than 12 inches?
b. Are stairs, ladders, and ramps provided to effect the most immediate and efficient access to and between work places and areas?
c. Are stairs, ladders, and ramps constructed of materials which are lightweight, non-conductive, splinterproof, waterproof, humidity resistant, and resistant to chemical action?
d. Are stairs, ladders, and ramps made strong enough to withstand the combined weight, using 250 pounds per man, of the largest anticipated number of personnel and equipment to be on them at any one time?
e. Are stairs, ladders, and ramps provided with nonskid surfaces on all areas where personnel are expected to step, walk, or stand?
f. Are stairs, ladders, and ramps cleared of obstructions, edges, notches, or burrs which could injure personnel or damage hoses and cables?
g. Are stairs, ladders, and ramps adequately lighted?
h. Are stairs, ladders, and ramps adequately marked against dangers involved in their use?
i. Can movable stairs, ladders, and ramps be carried, handled, and positioned by one or not more than two men?
j. Are stairs and ramps provided to permit safe and easy passage over low objects such as pipes, lines, ridges, etc.?
k. Do stairs, ladders, and ramps conform to the preferred angles of incline for these structures?

1) Ramps 7° to 15° (optimum); 0° to 20° (critical)
2) Stairs 30° to 35° (optimum); 20° to 50° (critical)
3) Stair ladders 50° to 60° (optimum); 60° to 75° (critical)
4) Ladders 75° to 85° (optimum); 85° to 90° (critical)

3. Ladders

a. Are stair ladders provided for frequent passage?
b. Do stair ladders provide clearance for one person only?
c. Are separate UP and DOWN stair ladders provided for simultaneous two-way traffic?
d. Are side by side UP and DOWN stair ladders provided with a double center handrail having a minimum of 6 inches between rails?
e. Are portable ladders provided only for emergency functions or infrequent maintenance tasks?
f. Are ladders which are used between floors offset and provided with guarded landings at every floor?
g. Are ladder cages provided for fixed ladders over 20 feet long?
h. Are ladders for use in nonfreezing weather provided with rubber cleated, pivoted feet?
i. Are ladders for use in ice or snow provided with steel cleated, pivoted feet?
j. Are hinges and locks used for assembly of two-section, extension ladders?
k. Are safety devices provided on either fixed or portable ladders whenever length, use, or operating conditions require? For example, are pole lashing devices provided for ladders to be used against poles, or carrier rails and safety belts for long ladders to be used in adverse weather or under emergency conditions?
l. Are catches and other mechanisms required for folding ladders simple, easy to release and maintain?
m. Where one man is required to lift and store ladders manually, is the maximum weight within the following limits?

1) Lift distance 5 feet, weight 25 pounds
2) Lift distance 6 feet, weight 20 pounds

4. Stairs

a. Is the riser height (distance between steps or stairs) uniform?
b. Is the distance between steps and landings not less than 5 inches nor more than the uniform riser height?
c. Are landings provided for every 8-12 foot elevation?
d. Are deep treads (12 inches) and low risers (5 inches) provided when loads over 20 pounds are to be carried?

5. Ramps

a. Are ramps for pedestrian traffic provided with a handrail?
b. Are horizontal strips of non-skid material, at least 6 inches wide and spaced no more than 6 inches apart, applied to the entire ramp width?

6. Walkways and Passageways

a. Is a one-man passage sideward at least 13 inches wide?
b. Is a one-man passage forward at least 30 inches wide?

c. Is a two-man or two direction passage at least 48 inches wide?

d. When a door opens into a passageway, is the overall corridor at least 66 inches wide?

e. When facing doors open into a passageway, is the overall corridor at least 84 inches wide?

f. Are passageway boundaries identified by prominent markings?

g. Are passageways provided with non-skid surfaces?

7. Doors

a. Is there a clearance of at least 4 inches between the door and wall?

b. Is there a clearance of at least 3 inches between the open door-leaf and equipment?

c. Is the door opening at least 80 inches high and 32 inches wide?

d. Are sliding doors provided where large vehicles or large pieces of equipment have to be moved into and out of compartments?

e. When a sliding door is used, is a separate hinged door in the sliding door provided for personnel use?

8. Hatches

a. Are wall hatches flush with the floor?

b. Is it possible to open the hatch with a single motion of the hand or foot?

c. When a handle is used for opening the hatch is the force required no greater than 30 pounds?

d. When a push operation is used for opening, do overhead position hatches require a force no greater than 50 pounds?

e. When an emergency hatch is placed in the overhead position is it capable of operation by the 5th percentile man? Does it utilize the force of gravity in opening? Does it weigh no more than 50 pounds?

f. Are wall hatches at least 60 inches high and 20 inches wide?

g. Are dimensions of emergency entrance and exit hatches at least as follows:

1) Rectangular hatch opening 15 x 21 inches
2) Square hatch opening 18 inches
3) Circular hatch opening 22 inches

9. Platforms

a. Are platforms provided to bring personnel within at least tolerable working distance of equipment requiring operation/maintenance?

b. Are platforms at least 2 feet wide and 3 feet long?

c. Do platforms permit personnel to have both hands free for work?

d. Do platforms provide a continuing work surface around or between related portions of the work area?

e. Do platforms have a capacity in excess of the heaviest combination of men and equipment to be supported at any one time? (250 pounds per man should be used to calculate the load.)

f. Do platforms conform closely to the shape of the equipment surface?

1) Is the general conformation within 2 inches?
2) Are contact plates, cushions, bumpers, or pads provided to protect equipment surfaces?

g. Are wheel locks or brakes provided for platforms on wheels?
h. Are portable platforms fully collapsible and constructed of lightweight material?
i. Do platforms have provisions for resting test equipment at a convenient operating level?
j. Are platforms provided with handrails or grips?
k. Are platforms provided with at least two guardrails to insure safe work areas?

10. Guardrails

a. Are guardrails provided to prevent personnel from falling from elevated work places?
b. Are guardrails provided to prevent personnel from falling through floor openings, manholes, etc.?
c. Are guardrails provided to keep personnel within bounds while passing through hazardous areas?
d. Are guardrails provided to assist personnel in climbing inclines, stairs, etc.?
e. Are guardrails constructed of material 3/4 inch diameter minimum to 3 inch diameter maximum?
f. Are guardrails 42 inches high with a crossmember 21 inches high?
g. Is the opening between the guardrail structure and a work surface or area at least 24 inches wide?
h. Are guardrails supplemented with screening or latticework in their lower 21 inch structure?

11. Seated Workspace

a. Does the seat provide enough body stabilization so the operator can best carry out his task?
b. Are cushioned chairs provided whenever personnel are required to perform in the sitting position for more than one hour at a time?
c. Are stools or benches provided whenever personnel are required to perform in the sitting position less than 20% of the time?
d. Are cushioned seats flat and firm, but soft enough to allow limited deformation?
e. Do cushioned seats provide shock-absorber effect by resilient material under the cushion?
f. Do seats support body weight primarily on the two bony points of the pelvis?
g. Are seats tilted backwards 5-7 degrees to allow seat rather than muscles to support the back.
h. Do backrests follow inward curve of the lower back to relieve

back muscles?

i. Do backrests provide adequate support for the small of the back?

j. Are seats perforated or ventilated to prevent "hotness" or "sweatiness"?

k. Do seats allow sitter to shift positions?

l. Are arm rests provided to help elbows support some of the upper body weight?

m. Are footrests provided wherever seat height exceeds 18 inches, work surface height exceeds 30 inches, and where there are extended periods of operation?

n. Where space constraints preclude the use of a permanent seat, is a temporary "swing-away" seat provided?

o. Do seated workspace dimensions conform to the following:

1) Chair dimensions

a) Arm rests: length 10 inches, width 2 inches, height 8 inches, separation 18 inches.
b) Seat: width 16 inches, height 18 inches adjustable ±2 inches, depth 16 inches.
c) Back rest: space 6 inches adjustable ±2 inches, width 16 inches, height 15 inches.
d) Footrests: from center 7 inches, width 6 inches, length 10 inches.

2) Work surface dimensions

a) Kneehole depth 18 inches.
b) Kneehole width 20 inches.
c) Kneehole height 25 inches.
d) Desk to wall 32 inches.
e) Table to wall 24 inches.
f) Lateral work clearance: shoulders 23 inches, elbows 25 inches, over-all 40 inches.
g) Height of work surface 29 inches.
h) Width of work surface: elbow rest alone 4 inches minimum, writing surface 12 inches minimum, desk work surface 36 inches.
i) Depth of work area 30 inches.

12. Standing Workspace

a. Can routine, frequent, or short term operations be performed from a standing position?

b. Do standing workspace dimensions conform to the following:

1) Standard type work benches

a) Height above floor 36 inches
b) Width 39 inches maximum

2) Podium type work benches

a) Height above floor 41 inches
b) Width 36 inches maximum

3) Work clearances

a) Passing body depth (sideward passage) 13 inches minimum
b) Standing space 30 inches minimum
c) Foot space 4 inches high and 4 inches deep
d) Overhead clearance 73 inches minimum
e) Maximum overhead reach 76 inches
f) Walking space width 12 inches minimum
g) Passing body width (forward passage) 20 inches minimum

13. Mobile Workspace

When personnel are required to work in or pass through limited spaces which preclude accomplishment of tasks in either a sitting or standing position, do workspace dimensions conform to the following:

a. Two men passing abreast 42 inches minimum
b. Two men passing facing 30 inches minimum
c. Catwalk dimensions

1) Height 63 inches minimum
2) Shoulder width 22 inches minimum
3) Walking width 12 inches minimum

d. Vertical entry hatch

1) Square 18 inches minimum
2) Round 22 inches minimum

e. Horizontal entry hatch

1) Shoulder width 21 inches minimum
2) Height 15 inches minimum

f. Crawl through pipe round or square 25 inches minimum
g. Supine workspace (lying on the back)

1) Height 20 inches minimum
2) Length 73 inches minimum

h. Prone work or crawl space (lying face downward)

1) Height 17 inches minimum
2) Length 96 inches minimum

i. Squatting workspace

1) Height 48 inches minimum
2) Width 27 inches minimum
3) Display area 27 inches minimum
4) Control area 19 inches minimum

j. Stooping workspace

1) Width 26 inches minimum
2) Display area 32 inches minimum
3) Control area 24 inches minimum

k. Kneeling workspace

1) Width 42 inches minimum
2) Height 56 inches minimum
3) Display area 20 inches minimum
4) Control area 20 inches minimum

l. Kneeling crawl space

1) Height 31 inches minimum
2) Length 59 inches minimum

14. Human Strength and Handling Capacity

When personnel are required to lift or exert force in the accomplishment of tasks, do features of the equipment allow performance within the following limits:

a. Manual lifting capacity (using both hands)

1) 150 pounds a maximum of 2 feet from floor
2) 100 pounds a maximum of 3 feet from floor
3) 50 pounds a maximum of 3-1/2 feet from floor
4) 25 pounds a maximum of 5 feet from floor

b. Arm strength

1) With 180° elbow flexion (arm fully extended forward)

a) Pull 50 pounds maximum
b) Push 40 pounds maximum
c) Up 9 pounds maximum
d) Down 13 pounds maximum
e) In 13 pounds maximum
f) Out 8 pounds maximum

2) With 150° elbow flexion

a) Pull 40 pounds maximum
b) Push 30 pounds maximum

c) Up 15 pounds maximum
d) Down 18 pounds maximum
e) In 15 pounds maximum
f) Out 8 pounds maximum

3) With 120° elbow flexion

a) Pull 34 pounds maximum
b) Push 26 pounds maximum
c) Up 17 pounds maximum
d) Down 21 pounds maximum
e) In 20 pounds maximum
f) Out 10 pounds maximum

4) With 90° elbow flexion

a) Pull 32 pounds maximum
b) Push 22 pounds maximum
c) Up 17 pounds maximum
d) Down 21 pounds maximum
e) In 16 pounds maximum
f) Out 10 pounds maximum

5) With 60° elbow flexion

a) Pull 24 pounds maximum
b) Push 22 pounds maximum
c) Up 15 pounds maximum
d) Down 18 pounds maximum
e) In 16 pounds maximum
f) Out 10 pounds maximum

c. Leg push

1) Momentary hold 380 pounds maximum
2) Sustained hold 200 pounds maximum

d. Hand grip

1) Momentary hold 63 pounds maximum
2) Sustained hold 38 pounds maximum

e. Thumb-finger grip

1) Momentary hold 12 pounds maximum
2) Sustained hold 12 pounds maximum

15. Temporary Shelters

a. Are temporary shelters provided to inclose and protect personnel and equipment during major maintenance and operational tasks?

b. Does shelter provide adequate protection in terms of the environment in which the shelter is to be used?

c. Are ventilation and environmental conditions in the shelter controlable within tolerance limits considering the type of clothing to be worn?

d. Can shelters be used side by side?

e. Are shelters compatible with associated support equipments such as cranes, stands, slings, etc.?

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B

CHECKSHEETS FOR ENVIRONMENTAL WORKSPACE

1. Atmospheric Environment

a. Does equipment provide suitable control of the atmospheric environment (for operator/maintenance personnel)?

1) Is heating equipment properly allocated and utilized?
2) Is cooling equipment properly allocated and utilized?
3) Is ventilating equipment properly allocated and utilized?
4) Are personnel work areas adequately insulated or protected to provide a tolerable atmospheric environment?

b. Where it is not feasible to provide control over atmospheric environment is the following true?

1) Are there adequate individual protective measures for adverse environments?
2) Is there adequate supplemental equipment for adverse environments?
3) Do technical publications provide for rotation of personnel at their work stations under adverse environments?
4) Do technical publications provide for decreased workloads under adverse environments?
5) Do technical publications provide for increased workspace allotment under adverse environments?

2. Surface Temperatures

a. Are components of mobile missile systems adequately insulated as required?

1) Are personnel protected from excessive surface contact with highly localized heat?
2) Are personnel protected from excessive ambient heat?

b. Is the ambient effective temperature for operator/maintenance personnel within the following range?

1) For accomplishing light work in a warm climate or in summer 70°-80°F?
2) For accomplishing light work in a colder climate or in winter 65°-75°F?
3) For accomplishing reliable human performance a maximum of 85°F.

c. Is heating provided within personnel enclosures (which are utilized for detailed work or occupied during extended periods of time) if the

dry bulb temperature drops below 50°F?

d. Are provisions made such that personnel engaged in tasks requiring manual dexterity are not exposed to prolonged exposure to temperatures below 55°F?

e. Is the temperature of an enclosed area (provided with heating and cooling equipment) relatively uniform?

f. Is the temperature of the air at floor level and at head level within 10°F?

3. Humidity Requirements

a. Is a relative humidity above 30% and below 70% maintained when temperatures range between 70°-80°F in a warm climate or in summer?

b. Is a relative humidity above 30% and below 70% maintained when temperatures range between 65°-75°F in a colder climate or in winter?

4. Ventilation and Circulation

a. Do ventilation facilities provide a minimum supply of 1000 cubic feet of fresh air per person per hour?

b. Is air circulation around the operator less than 100 feet per minute?

c. Is the air discharge from hot or cold forced air systems not directed on personnel?

5. Atmospheric Contaminants

a. Are dust concentrations for operator/maintenance personnel within the threshold limit values?

b. Are personnel provided with adequate protective devices where dust concentrations exceed the threshold limit values?

c. Are gases, vapors, and fumes for operation/maintenance personnel within the threshold limit values?

d. Are personnel provided with adequate protective devices where gases, vapors, and fumes exceed the threshold limit values?

e. Are compartments provided with sufficient ventilation to maintain exhaust products of multi-fuel engines below an eye irritating and nauseating level?

6. Illumination

a. Are illumination levels for specific tasks at least the minimum prescribed by HEL Standard S-3-65?

b. Has proper attention been given to the brightness contrast between each visual task object and its background?

1) Is the contrast ratio between points on a console surface 3:1 maximum?
2) Is the contrast ratio between task and adjacent surroundings 5:1 minimum?
3) Is the contrast ratio between task and remote surfaces 10:1

maximum?

4) Is the contrast ratio between the immediate work area and the remainder of the environment 40:1 maximum?
5) Is the equipment painted such as to avoid sharp differences in brightness of paint?

c. Has proper attention been given to glare from light sources and work surfaces?

1) Is the light source within the visual work field properly controlled?

a) Absence of bright light sources within 60° of the central visual field?
b) Use of indirect lighting?
c) Use of a greater number of less intense light sources rather than a few intense ones?
d) Use of polarized light shields, hoods or visors to block the source in confined areas?

2) Are reflecting bright surfaces within the visual field properly controlled?

a) Use surfaces which diffuse rather than specularly reflect incident light?
b) Arrangement of direct light sources so that the viewing angle of the visual work area is not equal to the angle of incidence from the source.

d. Are nonsaturated colors such as tints, pastels, and warm grays used on all large surface areas?

7. Color

a. Are interior areas and equipments painted with FED-STD-595 colors (or equal) as indicated?

1) Ceiling, white (37875).
2) Console exterior, green (24410).
3) Console interior, white (37875) or economical internal protective finish.
4) Floors, gray (36118).
5) Handles, black (37038).
6) Lettering, black (37038).
7) Panels, gray (26492).
8) Walls, green (24410).

b. Is the exterior of equipment painted with FED-STD-595 colors (or equal) as indicated?

1) Covers, olive drab (24087).

2) Handles, black (37038).
3) Lettering, black (37038) or white (37875) on olive drat surfaces.
4) Panels, gray (26492).

8. Dark Adaptation

a. Where maximum dark adaptation is required, is a low brightness red light provided?

b. Where dark adaptation is a requirement, are instrument or display markings provided with red light?

c. Is the brightness of instrument or display markings not less than 0.02 foot lamberts nor more than 0.1 foot lamberts?

9. Noise

a. Have sound level meter tests been made at all locations where noise makes it difficult for two persons with good hearing to converse at close range?

b. Has a noise survey been conducted with the assistance of The Surgeon General?

c. If the noise analysis reveals levels for the various octave bands in excess of those shown in TB MED 251, has a hearing conservation program been initiated?

d. Is the maximum steady state noise level for noise sources present in the environment less than the levels shown in HEL Standard S-1-63B and S-3-65?

e. Where continuous person to person (nonelectrically aided) communication is required, is the steady state noise level below that shown in HEL Standard S-3-65?

f. Have adequate engineering control measures been taken (under competent acoustical engineers or consultants) for the environmental control of noise exposure?

g. Where environmental noise levels exceed permissible levels, have personal protective measures for personnel been provided per TB MED 251?

10. Vibration

a. Is vibration minimized?

1) Is vibration reduced or controlled by use of shock mountings, fluid couplings, etc.?
2) Are rotating elements of equipment properly balanced?
3) Are damping materials provided for standing personnel?
4) Are cushioned seats provided for seated personnel?

b. Is vibration kept below the "strongly noticeable" range shown in HEL Standard S-3-65?

APPENDIX C

CHECKSHEETS FOR CONSOLES

1. Display Surfaces

a. Are primary visual surfaces on consoles or instrument panels reserved for frequently used displays or for displays which are critical to successful operation?

b. Are secondary visual surfaces used for infrequently utilized displays?

c. Are frequently monitored displays within the operator's preferred viewing area?

d. Are indicators which are used for long, uninterrupted periods in the preferred position?

e. Is the viewing distance to displays 26 inches minimum?

f. Are displays requiring accurate readout closer to the operator than those requiring gross monitoring?

g. Are displays requiring accurate reading perpendicular to the line of sight?

h. Are all instruments and legends readable from the normal head position of the operator?

i. Are all displays necessary to support an operator activity or sequence of activities grouped together?

j. Are displays which are located in the maximum viewing area of the visual field infrequently used displays?

2. Control Surfaces

a. Are controls placed in the optimum space?

1) Are controls placed to permit rapid and accurate identification, reaching, and activation?
2) Are controls located near the visual displays?

b. Are primary controls located between shoulder level and waist height?

c. Are frequently operated controls located to the left front or right front of the operator?

d. Are controls located so that simultaneous operation of two controls will not necessitate a crossing or interchanging of hands?

e. Are frequently used controls grouped together?

f. Are frequently used controls located for right-hand operation?

g. Are frequently used controls within a 16 inch radius from the normal working position?

h. Are infrequently used controls within a 28 inch radius?

i. Are controls located so that personnel can visually check their positions regardless of the angle from which they are viewed?

j. Are all controls within reach of the operator?

k. Are controls which require fine adjustment located closer to the

operator than those which require gross positioning?

l. When displays must be monitored and controls manipulated simultaneously, are the controls located close to and centered below their corresponding displays?

m. Are infrequently used controls covered or located to one side, especially if they might be inadvertently activated?

n. Are occasionally used controls mounted behind hinged doors or recessed in the panel to prevent inadvertent actuation?

3. Work Surfaces

a. Are surfaces which serve primarily as work or writing surfaces horizontal or nearly horizontal?

b. When a horizontal work surface and a control panel are combined, is the depth 16 inches maximum?

c. Is the depth of a work surface 10 inches minimum?

4. Control Display Relationship

a. Location of controls and displays

1) Are the most important controls and displays located in the optimal visual and manual workspaces on the panel or consoles?

a) Are frequently used controls and displays located in optimal workspaces?
b) Are controls and displays which require accuracy and speed in reading and activation located in optimal workspaces?
c) Are controls and displays which would cause a decrease in system performance (if errors are made or delays encountered in using the control or display) located in optimal workspaces?
d) Are controls and displays which would cause a decrease in personnel or equipment safety (if errors are made or delays encountered in using the control or display) located in optimal workspaces?
e) Are controls which require ease of manipulation, precision, and speed located in optimal workspaces?
f) Where primary controls and displays must be used by two operators, are duplicate sets provided?
g) Where space constraints preclude duplicate sets of primary controls and displays (which must be used by two operators) are controls and displays centered between the operators?
h) Where direction-of-movement relationships are important, are controls and displays located so that both operators face in the same direction?

2) Are secondary controls and displays placed within the limit-

ing areas for visual and manual workspaces so that they are readily accessible when required?

3) Where secondary controls and displays must be used by two operators, are the controls and displays centered between the operators if equally important to each?
4) Where secondary controls and displays must be used by two operators, are the controls and displays placed nearer the operator who has the principal requirement for their use?

b. Arrangement and spacing between controls and displays

1) Does the arrangement of controls and displays aid in the identification of the control to be used with a particular display?
2) Where a control is associated with a specific display, is the control located so that the operator's hand does not obscure the display?

   a) Is each control located directly beneath its associated display?
   b) Are the displays arrayed in rows from left to right?
   c) Where all displays are located in the upper portion of the panel and all controls in the lower portion are displays and controls arranged in rows from left to right on the panel?
   d) Do the controls occupy the same positions relative to one another as do the corresponding displays?

3) Where controls must be arranged in fewer rows than the displays:

   a) Are controls affecting the top row of displays positioned at the far left?
   b) Are controls affecting the second row of displays positioned just to the right of those for the first row, and so on?

4) Where a horizontal row of displays must be associated with a vertical column of controls, or vice versa, does the left-most display (control) correspond to the top control (display)?
5) Where both panels are mounted at approximately the same angle relative to the operator, are the relative positions of controls and displays the same?
6) Where one panel is at or near the vertical and the other is at or near the horizontal, are the relative positions of controls and displays the same?
7) Are separate control and display panels arranged so that they do not face each other?
8) Are controls spaced such that effective operation is possible when:

a) Controls must be used simultaneously?
b) Controls must be used sequentially?
c) The size of the control and the amount of movement required during its manipulation is considered?
d) The control must be reached and grasped without seeing it?
e) The part of the body required for its activation is considered?

c. Grouping of controls and displays

1) When there is no definite sequence of operation, are controls and displays grouped by function?

a) Are controls and displays which are identical in function grouped together?
b) Are controls and displays which are used together in a specific task grouped together?
c) Are controls and displays related to one equipment or system component grouped together?

2) Are functional groups of displays and their associated controls spatially organized so that the relationship between the function is apparent to the operator?
3) Are all displays which are to be used together at the same viewing distance?
4) For purposes of ready identification, are noncritical functional groups outlined by black lines, 1/16 inch wide using color number 37038 of Federal Standard 595 (or equal)?
5) For purposes of ready identification, are emergency or extremely critical functional areas set apart by a 3/16 inch red border, using color 31136 of Federal Standard 595 (or equal)?
6) When displays are observed in sequence are they arranged so that:

a) They can be viewed from left to right when displays are arranged horizontally?
b) They can be viewed from top to bottom when displays are arranged vertically?
c) They are grouped, arranged, and located as close together as possible?

7) When controls are operated sequentially are they arranged so that:

a) The operator moves his arm horizontally from one control to the next when the same hand is used for the controls?
b) Controls operated by the same hand are aligned horizontally and operated from left to right?

c) Controls operated by the same hand are aligned vertically and operated from top to bottom?

5. Emergency Indications

a. When an emergency condition occurs, does an auditory signal sound accompanied by a flashing light?

b. Must the operator acknowledge the emergency condition by silencing the auditory warning?

c. Is there a circuit which will change the flashing light condition to a steady "ON" condition when the auditory warning is silenced?

d. When corrective action for the emergency condition has been successfully completed, does the steady "ON" condition return to the normal "OFF" operating condition?

e. Do auditory warning signals indicate the existence of hazardous conditions requiring immediate corrective action?

1) Are auditory warning signals only in addition to a warning light?
2) Are auditory warning signals sufficiently different from the background noises so as to be easily recognizable?
3) Is the frequency of the warning sound as indicated in HEL Standard S-3-65?
4) Are warning signals of greater amplitude than the ambient noise for immediate detection and identification?
5) Are warning signals below 130 db?

f. Are the physical characteristics and location of visual warning indicators such that:

1) The master warning indicator is within 30° of the line of sight?
2) Indicators for emergency situations are visually larger than general status indicators?
3) Indicators have a minimum brightness contrast to the immediate background of 5:1?
4) Indicators have a minimum illumination intensity as that of the brightest light source on the same console?
5) Warning indicators are colored red and located not more than 60° from the line of sight?

g. Where extreme danger to personnel or equipment exists, is the warning indicator flashing red and:

1) Flash at a rate of 3 to 5 pulses per second?
2) Have flashing "ON" time approximately equal to "OFF" time?
3) Constructed so that if the "flashing" device fails, the light comes on steadily?
4) Provides "word" warning?

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D

CHECKSHEETS FOR CONTROLS

1. General

a. Are the movement and location of the control compatible with the unit controlled?

b. Can the operator utilize the control and display combinations efficiently?

c. Are controls oriented, located, and of the proper type to be in accordance with normal work habit patterns, customary reactions, and human reflexes?

d. Is the direction of movement of the control consistent with the movement of the controlled unit or with the moving portion of the display?

e. Are controls distributed so that no one limb is overburdened?

f. Are controls used for performing the same function for different equipment consistent in size and shape?

g. Is the function of the control identified on the control or control panel?

h. Is the method of operation of the control shown on the control or on the control panel if it is not readily identifiable?

i. Are controls easily identifiable by the visual or tactile senses?

j. Are controls clearly distinguishable from each other by color, size, shape or location?

k. Unless controls are purposely inter-locked, are they free from interference from other controls while in use?

2. Selection Considerations

a. Where rapid or precise adjustments are required, are controls hand operated?

b. Are detent type controls provided for performance requirements which can be adjusted in a limited number of discrete steps?

c. When controls require large or continuous forward application of force are they foot operated?

d. When force and range of settings are important, do controls conform to HEL Standard S-3-65 for manual controls?

3. Hand Crank

a. Are hand crank characteristics per HEL Standard S-3-65?

b. Does the handle shape allow maximum contact with the hand?

c. Does the handle turn freely?

d. Is the hand crank between 36-48 inches above the floor for the standing operator?

e. Is the spacing between the outside edge of crank handle and any obstruction 3 inches minimum?

f. When cranks are to be turned rapidly, are they mounted so that the turning axis lies within the range from perpendicular to 60° from the

frontal plane of the body?

4. Handwheels

a. Are handwheel characteristics per HEL Standard S-3-65?
b. Are handwheels which require constant two-hand operation restricted to a 120° arc displacement?
c. Is the handwheel gripping surface indented or knurled to aid in grasping?
d. Are handwheels which are used as valve controls clearly labeled to show function performance?
e. Are handwheels which are used as valve controls clearly labeled to show direction of movement?

5. Key-Operated Switch

a. Are key-operated switch characteristics per HEL Standard S-3-65?
b. Are keys shaped so the proper method of insertion is obvious to the operator?
c. Are keys retained in the lock in all positions but the "OFF" position?
d. Are keys which have a single row of teeth inserted with the teeth pointing in the UP or forward position?
e. Are keys which have teeth on both edges coded to insure proper insertion?
f. Are the "ON" and "OFF" positions labeled?

6. Knobs

a. Are knob characteristics per HEL Standard S-3-65?
b. Are the smaller knobs used for coarse adjustments?
c. Are knobs serrated or knurled to prevent slipping?
d. Do knobs which perform the same function have the same shape?
e. Is resistance large enough so that inadvertent touching or outside forces will not change the setting?

7. Legend Switch

a. Are legend switch characteristics per HEL Standard S-3-65?
b. Are legend switches located within a 30° cone along the normal line of sight?
c. Is the legend switch provided with a detent or click for positive indication of switch activation?
d. Are lamps within the legend switch replaceable from the front?
e. Is the legend legible when only one lamp is operating within the switch?
f. Where the legend switch does not contain dual bulbs, does the legend switch circuit include a lamp test capability?

8. Lever/Joystick

a. Are lever/joystick characteristics per HEL Standard S-3-65?
b. Where levers are mounted on and perpendicular to the floor, are their handles between waist and shoulder height?
c. Where levers are parallel to the floor, are their hand grips located 28 inches above the floor for the standing operator?
d. Where accuracy is a requirement, is the lever pushed?
e. Where rapid operation of a lever is a requirement, is a fore-and-aft operation used?
f. Where grouped levers in front of the operator pivot about a common axis, do they move in fore-and-aft direction?
g. Are discrete position levers provided with detent pressure?
h. When fine adjustments are made with small levers:

1) Is elbow support provided for large hand movements
2) Is forearm support provided for small hand movements
3) Is wrist support provided for precise finger movements

9. Pedals

a. Are pedal characteristics per HEL Standard S-3-65?
b. Where the application of a great deal of force and displacement are required, is a foot pedal used?
c. Do pedals utilize normal limb action?
d. Does spring tension support the weight of the foot resting on the pedal?
e. Is the motion of the operator's leg simple and direct?
f. Is a non-skid surface provided on the face of the pedal?
g. Is the distance between the pedal centerline and a wall or obstruction 5 inches minimum?

10. Push Buttons

a. Are push button characteristics per HEL Standard S-3-65?
b. Are a definite feel and an audible click provided to indicate that the push button is activated?
c. Do push buttons have an elastic resistance which gradually increases and then drops to indicate that the control has been activated?
d. Is there a definite feedback of the equipment response to the operator when a push button is activated?
e. Is the surface of push buttons concave to fit the shape of the finger?
f. Are push buttons safeguarded against accidental activation?

1) Are channel or cover guards used
2) Are push buttons flush mounted
3) Are push buttons recess mounted
4) Are mechanical or electro-mechanical interlocks used
5) Are button guards used

11. Rotary Selector Switch

a. Are rotary selector switch characteristics per HEL Standard S-1-65?

b. Are switch positions 15° apart minimum?

c. Are switch positions 45° apart maximum?

d. Where non-visual positioning is required, are switch positions 30° apart minimum?

e. Do detent stops offer enough resistance to movement so that settings can be made by touch alone?

f. Does a rotary selector switch incorporate 24 positions maximum?

g. Where the switch is not intended to be used for continuous sequencing through 360°, are stops provided at the beginning and end of the range of control positions?

h. Does clockwise rotation result in numerical or alphabetical increase of the scale associated with it?

i. Do rotary selector switches use a moving pointer knob with a fixed scale?

j. Is the position of the pointer knob in relation to the scale such as to minimize parallax between pointer index and scale markings?

12. Toggle Switches

a. Are toggle switch characteristics per HEL Standard S-3-65?

b. Do toggle switches have flip-type operation and snap-action contact?

c. Are momentary-contact switches spring loaded to the off or neutral position?

d. Are vertically oriented switches "ON" in the up position?

e. Are horizontally oriented switches "ON" to the right?

f. Are toggle switches guarded against accidental activation?

g. Are three position toggle switches restricted to non-critical system functions?

APPENDIX E

CHECKSHEETS FOR DISPLAYS

1. General

a. Do displays present only those types of information essential for adequate job performance?

b. Is the display information limited only to that degree of accuracy required for the decisions and control actions necessary to accomplish assigned tasks?

c. Is information presented in such a manner that any failure or malfunction in the display will become immediately apparent?

d. Is information presented in the most direct, understandable, and usable form?

e. Are displays easily located and identified?

f. Are displays functionally or sequentially grouped?

g. Are displays properly illuminated, coded, and labeled as to function?

h. Do scales start at zero?

i. Do scale graduations progress by 1, 5, or 10 units, or decimal multiples thereof?

j. Does the increase of numerical progression read clockwise, from left to right, or from the bottom up?

k. Are whole numbers used in numbering major graduation marks?

l. Is the number of minor graduation marks nine or less?

m. Is optimum visual contrast provided between scale face and markings?

n. Are all numbers oriented upright on stationary scales?

o. On moving scales, are numbers oriented upright at the reading position?

p. Does the control or display pointer just meet, but not overlap, the shortest graduation marks?

q. Is the pointer mounted as close as possible to the face of the dial?

r. Are displays constructed, arranged, and mounted so as to minimize the reflectance of ambient illumination from the glass or plastic display cover?

2. Selection Considerations

a. Are dials, scales, gages, or meters used:

1) To indicate direction of movement or orientation in space?
2) To distinguish increasing or decreasing trend of the values measured?
3) When only an approximate reading is important?
4) When check-reading rather than continuous monitoring?

b. Are direct-reading counters used:

1) For rapid and accurate reading of stationary or slowly changing quantitative information?
2) For multirevolution indication?

c. Are cathode-ray tubes used:

1) For continuous monitoring activities?
2) To monitor direction of movement of another object?
3) To monitor or check-read frequency or amplitude waves?

d. Are lights used:

1) For qualitative go-no-go indicators, on-off indicators, malfunction indicators, emergency warning indicators, inoperative equipment indicators, caution indicators?
2) Warm-up indicators?

e. Are auditory displays such as buzzers, bells, etc., used:

1) As emergency or warning devices
2) When the immediate operator reaction is important?

f. Are auditory displays used with (or as alternatives to) lights:

1) When environmental-lighting conditions are such that lights might go unseen?
2) When the operator is occupied monitoring lights, dials, counters, etc.?
3) When extreme redundance is required?

3. Cathode-Ray Tube

a. Is the scope face mounted perpendicular to the operator's line of sight or tilted 30° maximum?
b. Is the scope viewing distance 12 inches minimum for normal monitoring tasks?
c. Is the scope viewing distance 6 inches minimum for short periods when checking very small or very dim presentations?
d. Is the scope diameter 5 to 7 inches for nonplotting tasks?
e. Is the scope diameter 10 to 12 inches for plotting tasks?
f. Are 2 to 5 inch diameter scopes limited for infrequent calibration or tuning tasks?
g. Do PPI presentation scopes use a round frame?
h. Do A-scan presentation scopes use a rectangular frame?

4. Radar Display Symbols

a. Are symbols large enough for good legibility and small enough to prevent clutter or interference with readout of other information?
b. Do the symbol and the event symbolized have a natural relation; i.e., does the symbol/event association conform to well established habits?

c. Do numeral and letter symbols conform to the following:

1) Are symbols 1/40 inch high minimum ?
2) Are symbols oriented upright ?
3) Are numerals per MIL-M-18012 (or equal) ?
4) Are letters per MS 33558 (or equal) ?

d. Do geometric symbols conform to the following:

1) Are symbols either circles, rectangles, crosses, or triangles?
2) Are unique symbols such as swastika, anchor, flag, rocket, airplane used only in specific situations?
3) Is symbol stroke width 0.02 inch minimum and 0.14 inch maximum?
4) Is symbol stroke width/height ratio 1:8 to 1:10?

e. Does flicker conform to the following:

1) Is flicker reserved for emergency situations only ?
2) Are flicker rates either 20/min, 1/sec, or 4/sec ?
3) Is flicker 50 percent on-off ?

f. Does inclination conform to the following:

1) Is line length between 0.2 and 0.3 inches ?
2) Is inclination either 0°, 90°, 180°, or 270° ?

5. Counters

a. Except in odometers and hour meters, do numbers change by snap action?

b. Are counters mounted as close as possible to the panel surface?

c. Does clockwise rotation of the counter reset knob reset the counter or increase the counter indication?

d. Do counter character dimensions conform to HEL Standard S-3-65 requirements?

6. Flags

a. Are flags in high contrast with the background ?
b. Do flags operate by snap action ?
c. Are flags as close to the surface of the panel as possible ?
d. Are provisions made to test proper operation of the flags ?

7. Indicator Lights

a. Does color coding conform to the following:

1) Are colors per Type I of MIL-C-25050 (or equal)?
2) Does green indicate satisfactory operation of equipment?

3) Does white indicate items which imply neither success nor failure of system conditions?
4) Does yellow alert to situations where caution, recheck, or delay is necessary?
5) Does red alert to situations which make the system inoperative?
6) Is blue used only when a fifth color is necessary?

b. Does flash coding conform to the following:

1) Is flashing white used as an alerting signal on communications call boards?
2) Is flashing red used to indicate extreme danger to equipment or personnel?
3) Is the flashing rate within 3 to 5 flashes per second with approximately equal amount on "on" and "off" time?

c. Do simple indicator lights conform to the following:

1) Are indicator lights used to display qualitative information?
2) Are indicator lights used to display information which requires immediate operator reaction?
3) Are indicator lights used to display information which calls operator's attention to an important system status?
4) Is a master light test control provided when single bulb indicator lights are installed on a control panel?
5) Are indicator lights used to display equipment response and not merely control position?
6) Is the indicator light immediately associated with its control?
7) When an indicator light is used under varied ambient illumination, is the dimming control so limited that the light will still be visible under the brightest expected ambient illumination?
8) Are warning lights integral with or adjacent to the lever, switch, or other control device by which action is to be taken?
9) Are master caution, master warning, and summing lights for the entire subsystem larger than the lights which show the status of the subsystem components?

d. Do legend lights conform to the following:

1) Does the legend light illuminate immediately upon the occurrence of the event described by the legend?
2) Does the legend light go out upon the termination of the event described by the legend?
3) Does the legend light display qualitative information?
4) Is the frontal area adequate for the legend requirements?
5) Do legend lights operate in a fail-safe fashion?
6) Are legend lights provided with dual filament lamps or

with dual lamps?

7) Is optimum visual contrast provided between the lettering and its background?

8. Plotters

a. Is the plotting point readily visible and not obstructed by the pen assembly and arm?

b. Does the plotted function provide optimum contrast with the background?

c. Is there a take-up provision for plotting materials?

d. Are overlays or similar aids provided for interpretation of graphic data?

9. Printers

a. Is hard finish matte paper used?

b. Are paper hold-downs provided to reduce paper vibration?

c. Is accordion-fold paper used?

d. Is a take-up provision for finished copy available?

e. Is a paper advance control provided to permit reading the most recently printed line?

f. Is a cutting edge provided?

g. Is an indication of the paper supply provided?

h. Are instructions for reloading of paper, ribbon, ink, etc., provided in an instruction plate attached to the printer?

i. Can reloading of paper or ribbon be accomplished without extensive disassembly?

j. Is storage space provided for spare paper, ribbon, etc.?

10. Scalar Indicators

a. Are graduation interval values appropriate for the accuracies required?

b. Are scale numerical progressions per HEL Standard S-3-65?

c. Are scale markings and scale dimensions per HEL Standard S-3-65?

d. Is the pointer position at twelve o'clock for right-left directional information, and at nine o'clock for up-down information?

e. Do moving pointer circular fixed scale indicators conform to the following:

1) Does clockwise movement of the pointer increase the magnitude of the reading?

2) In cases where positive and negative values around a zero are displayed, is the zero at nine or twelve o'clock position?

3) In cases where positive and negative values around a zero are displayed, do positive values increase with clockwise movement of the pointer and negative values increase with counterclockwise movement?

f. Do moving pointer vertical and horizontal fixed scale indicators

[illegible] to the following:

1) Does the pointer move up or to the right to indicate an increase?
2) Are the numbers located on the side of the graduation marks opposite the pointer?
3) Are the graduation marks aligned on the side of the pointer and stepped on the side of the numbers?
4) Is the pointer to the right of vertical scales and at the bottom of horizontal scales?

11. Pointers

a. Are full visibility pointers on scalar indicators provided with a fine tip having a long taper that starts at the center of the dial?

b. Is the pointer tip the same width as the width of the smallest graduation mark?

c. For vertical and horizontal straight scalar indicators, is a flag, spade or target pointer used?

d. Are pointers located to the right on vertical scales and at the bottom on horizontal scales?

e. Is distance between pointer and scale graduation mark 1/16 inch maximum?

f. Does pointer meet but not overlap the shortest scale graduation mark?

g. Is the pointer the same color as the numbers and scale divisions?

h. Are reciprocal pointer ends easily distinguishable?

APPENDIX F

CHECKSHEETS FOR LABELING

1. General

a. Does the label give the information needed to perform the task?
b. Are labels located in a consistent manner throughout the equipment?
c. Are labels composed of familiar words?
d. Is wording on labels as brief as possible, omitting punctuation?
e. Are labels oriented for horizontal reading?
f. Are labels large enough to be easily read at the anticipated reading distance?
g. Are labels placed on the item or very near to it?
h. Is labeling etched or embossed into the surface rather than stamped, stenciled, or printed?
i. Where etching or embossing into the surface is impractical, are decals used?

2. Numerals and Letters

a. Are type fonts in accordance with HEL Standard S-3-65?
b. Is the height to stroke width ratio as follows:

1) Where panel labels are illuminated by ambient or local lighting, is the ratio within the range 6:1 to 8:1?
2) For transilluminated markings or labies on panel surfaces is the ratio within the range 10:1 to 12:1?
3) Under dark adaptation conditions is the ratio within the range 12:1 to 20:1?

c. Is the average width of characters between 65% and 85% of their height?
d. Are the spacing and size as follows:

1) Are letters and numerals so spaced that the area between adjacent characters is equal?
2) Is the spacing between groups of letters and numerals equal to the average character width of the type font used?
3) Is the spacing between lines of characters equal to the height of the capital characters?
4) For a 28 inch viewing distance does the character size conform to the following:

a) Is the size 1/4 inch for console or panel titles?
b) Is the size 3/16 inch for subdivision titles?
c) Is the size 1/8 inch for component titles?

5) Where the viewing distance exceeds 28 inches does the

character size conform to HEL Standard S-3-65?

3. Content

a. Are labels brief, but not so cryptic as to be ambiguous or confusing?

b. Are common words used on labels?

c. Are abbreviations and symbols avoided?

d. Where space constraints require use of abbreviations, are they per MIL-STD-12?

e. Where symbols are used, are they meaningful and in common usage?

4. Labeling for Identification

a. Do labels for assembly identification:

1) Specify the overall system of which the assembly is a part
2) Include the assembly's popular name and function
3) Include a stock number for requisitioning purposes

b. Are labels for assembly identification:

1) Located in such a position that they are not obscured by adjacent assemblies?
2) Located on the flattest, most uncluttered surface available?
3) Located on a main chassis of the assembly?
4) Located so as to prevent accidental removal, obstruction, or handling damage?

c. Do labels for access openings:

1) Indicate their precise function?
2) Have nomenclature indicating the specific items accessible through that opening?
3) Have nomenclature indicating the auxiliary equipment which will be used through that opening?
4) Have nomenclature giving scheduled time periods for accomplishing servicing or maintenance operations?

d. Are "line-up" markings included to indicate the proper orientation for insertion of the tool where screw adjustments may be made through access openings?

e. Does each permanently installed receptacle have a label indicating type of output and the appropriate connector?

f. Is the label adjacent to the receptacle, aperture or connector for clear identification?

5. Instruction Plates

a. Are instruction plates as brief as possible without distorting the intended meaning?

b. Are instructions provided in a step-by-step manner?

c. Are instruction plates permanently attached to the applicable item?

d. Is the print engraved such that the instructions can be read when the marking paint has worn away?

6. Lift Points

a. Are lift or hoist points clearly marked and accompanied by weight or stress limitations?

b. Are lift or hoist point labels located on the body member at the point of lift?

7. Test Points

a. Is each test point labeled for ready recognition?

b. Is nomenclature unique for every point?

c. Do test point labels contain precise indications of the function and expected reading at each point?

8. Safety Hazards

a. Are there safety labels wherever hazards to personnel or equipment exist?

b. Are safety labels brief and uncluttered?

c. Do safety labels consist of no more than two or three words?

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX G

CHECKSHEETS FOR CODING

1. General

a. Is coding used to aid in the identification of controls, indicators, connectors, and other devices which perform the same function or which are consistently used together?

b. Is coding used to make various unrelated devices readily distinguishable from each other?

2. Controls

a. Does color coding of controls conform to the following:

1) With the exception of emergency controls, is color coding held to a minimum?
2) Is color coding used only when vision is unrestricted and when the level of lighting is sufficient to permit reliable color discrimination?
3) Are the colors selected for critical controls in sharp constrast to those selected for noncritical controls?
4) Do the colors used differ considerably among themselves?

b. Does shape coding of controls conform to the following:

1) Are all shapes used in a particular application sufficiently different from each other to avoid confusion?
2) Are controls used for a similar purpose or function of the same shape?
3) When the control must be distinguished by touch alone, are the minimum dimensions 0.25 inch side view or depth, 0.50 inch top view or width, and 0.50 inch front view or length?
4) Does the shape surface in contact with the hand have smooth edges and corners?

c. Does size coding of controls conform to the following:

1) Is size coding used when only two or three controls are to be coded?
2) Are controls which perform the same function on different items of equipment coded consistently?

d. Does location coding of controls conform to the following:

1) Are controls located forward of the operator?
2) Are controls located in areas lower than the level of the operator's shoulders?
3) When controls are located in the forward area, is there a

separation of 6 to 8 inches?

4) When controls are located to the side or toward the back of the operator, is there a separation of 12 to 16 inches?

3. Displays

a. Is color coding of transilluminated indicators used to indicate the type of action or response as well as to indicate the status of equipment?

b. Are color coded displays for use under white illumination only?

c. Are color codes, markings, and bands for display scale zones per HEL Standard S-3-65?

d. Is shape coding of displays per HEL Standard S-3-65?

e. Are indicator lights used to indicate emergency, failure, and master summation larger than general status indicators?

f. Are displays positioned or spaced in groups so that they are distinguishable from each other?

g. Are outlines provided around each unique display group?

4. Connectors

a. Are all connectors coded to their mates?

b. When connectors are color coded, do they conform to the following:

1) Are parts protected to prevent wearing, fading, and disappearance of color?
2) Are permanent methods used?
3) Are colors assigned for identification of connectors consistent in meaning with those used elsewhere in the system?

c. When electrical connectors are coded, do they conform to the following:

1) Are the face of the receptacle and the base of the plug coded the same color?
2) In an area immediately adjacent to the receptacle coded the same color as a band on the plug?
3) Are connectors coded by matching plugs and receptacles of various shapes?
4) Are connectors coded by using different sizes?

5. Conductors

a. Where numerals are used to code conductors, are the numerals placed at least 2 inches apart throughout the length of the conductor?

b. Are the individual wires of all cabling color coded over their entire lengths?

c. Are cables coded per HEL Standard S-3-65?

APPENDIX H

CHECKSHEETS FOR COMMUNICATIONS

1. General

a. Does the communications system provide adequate intellibility?

1) Is the frequency response ±3 db over the range of 300 cps to 4500 cps?
2) Does the gain control provide sufficient dynamic range to make the voice message 15 db more intense than the background noise but not to exceed 105 db voice level at the ear?

b. Is communication equipment located to insure the maximum audibility in the area served?

c. When two or more items of communications equipment are present in a space (such as telephone, radio, intercom) does each have a distinct tone?

d. In those cases where voice messages arrive at one central point from several sources do the communications systems conform to the following:

1) Are loudspeakers separated by more than 10 degrees in the horizontal plane measured from the listener?
2) Are indicator lights used to show the channel calling?
3) Are facilities provided for switching to a loudspeaker from ear phones or the reverse?

2. Telephone

a. Is a telephone provided when ambient noise and speech interference level (SIL) are high?

b. Is a telephone provided when messages are from one person to one person?

c. Is a handset provided when the operator is in a fixed position and his hands are free?

d. Is a headset provided if the operator's hands must be occupied?

e. Is a headset and a long extension cord provided if the operator must be mobile within a limited area?

3. Announcing System or Intercom

a. Is an announcing system or intercom provided in a low-level ambient noise station?

b. Is an announcing system provided when it is desirable to transmit to several stations simultaneously?

c. Is an announcing system provided when it is desirable for several persons within a space to receive simultaneously?

d. Is an announcing system provided when a person moving about

within a space must receive?

4. Receiver and Headset

a. Do the receiver and headset have a gain control with dynamic range sufficient to make the voice message 15 db more intense than the noise but not to exceed 105 db at the ear?

b. Is the frequency response of the receiver and headset ±3 db between 300 cps and 4500 cps?

5. Talker

a. Is a talker provided when an individual is likely to receive a number of messages arriving on different channels?

b. Is a talker provided when an individual is likely to receive so many telephone messages on a single channel as to distract him from his task?

c. Is a talker provided when an individual must move about in a space to the extent that an extension between him and a fixed jackbox is impractical?

6. Radio Set

a. Is the radio set located in an area which offers maximum protection from system operational damage or inadvertent crew damage?

b. Is the radio set located such that it does not interfere with the normal range of movement of the crew?

c. Is the radio set control panel visible and readily accessible?

d. Is it possible to change frequency without disamantling any portion of the system?

e. Is provision made for visual checks of protective devices such as overload and excessive heating?

f. Are all external metal parts at ground potential?

g. Is each component with exposed terminals in medium or high-voltage portions of a circuit protected from short circuit, grounding, or accidental contact by personnel?

7. Radio Antenna

a. Is the location of radio antennas such as to minimize the possibility of RF hazards to personnel?

b. On mobile missile systems having fully rotating launchers, is the antenna located so that it will not be within the field of fire of the missile?

c. Are antennas at ground potential except with regard to the energy to be radiated?

8. Control Box

a. Are radio control boxes located for ease of access to all controls?

b. Are control boxes located so as not to interfere with normal

personnel movements?

c. Are control boxes located such that they cannot be used as steps or footrests?

d. Are control boxes installed a maximum of 30 inches from the responsible crewman's normal working area?

e. Are control box signal or warning lights within the responsible crewman's field of vision?

9. Audio Accessories

a. Are storage hooks provided in the general area of each crew member for storing audio accessories?

b. Are storage hooks out of the normal path of movement of crew members?

10. Cable Routing

a. Are communication cables routed to minimize the possibility of their use as hand holds or steps?

b. Is a protective guard placed over communication cables which might be used as hand holds or steps?

c. Are interconnecting cables routed in a neat manner, eliminating droop and unnecessary loops?

d. Are cable clamps spaced about 12 inches apart?

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX I

CHECKSHEETS FOR OPTICAL INSTRUMENTS

1. Interpupillary Distance

Do binocular type instruments have provisions for adjustment of the spacing between the eyepieces from 57 to 72 millimeters?

2. Focusing

a. Do instruments with magnifying power of more than 4X have focusing provisions for the eyes of the individual observer?
b. Do focusing eyepieces have a graduated scale and a range of adjustment of at least plus 4 to minus 4 diopters?

3. Filters

a. Are smoked (neutral) filters provided for observations against or in the close vicinity of the sun or a bright light?
b. Are yellow and amber filters provided for observations against reflection of sunlight on water and other general conditions of glare?
c. Are amber and red filters provided for observations under various conditions of fog and ground haze?
d. Are blue filters provided as an aid in detecting the outlines of camouflaged objects?
e. Are polarized filters provided to decrease light intensity and glare?

4. Boresight Knobs

a. Are boresight knobs provided with a positive lock?
b. Do boresight adjustment knob lock and unlock with a maximum of 10 pounds resistance?
c. Can boresight adjustment knobs be unlocked, adjusted, and locked by the 5th to the 95th percentile soldier's hand?

5. Sight Mounts

a. Is final positioning of mounts accomplished by key and keyway, eccentric and keyway, or single dowel?
b. Are leveling vial supports strong enough to prevent the displacement of the bubble under slight pressure?

6. Eyepieces and Eyecups

a. Are fire control instruments provided with eyepieces or eyecups?
b. Are eyepieces made of soft rubber or equivalent cushioning material?
c. Do eyeshields exclude stray light from the eyes?

d. Is the eyepiece compatible with the helmet, gas mask or other ancillary equipment?

7. Sights for Night Operation

a. Where continuous use of a sight will exceed one minute, is the sighting instrument equipped with two eyepieces?

b. Where an illuminated sight is used, is it possible to lower the brightness until it is extinguished?

c. Where an illuminated sight is used, does the level of brightness remain at the adjusted intensity under all conditions of vibration?

d. Is the sight reticle evenly illuminated?

e. Is the night sight reticle a simple circle with tabs added to the sides?

APPENDIX J

CHECKSHEETS FOR STOWAGE

1. General

a. Are there provisions for securing stowed items (such as straps and brackets) to allow cross-country operation without endangering personnel or displacing the stored item?

b. Are stowed inflammable items adequately protected from engines, generators, exhaust components, etc.?

c. Are stowed items which are subject to damage by leakage of lubricants, fuels, or water adequately protected against such hazards?

d. Are stowage locations provided with adequate drainage?

e. Are stowage locations provided with drain holes so arranged that they will not be blocked by normal stowage?

f. Are there adequate provisions for preventing pilferage of stowed equipment?

g. Are mission critical items stowed within easy reach?

h. Is the location for stowed items clearly and permanently labeled with the identity of the item?

2. Interference

a. Are provisions for stowage such that stowed items will not interfere with entrance, exit, escape, movement or operations of personnel?

b. Are provisions for stowage such that stowage will not interfere with system functions?

c. Can stowed items be removed and replaced without the removal or replacement of other stowed items or components of the system?

d. Can the 5th through the 95th percentile man wearing gloves stow and unstow storable items?

3. Utilization of Stowage Space

a Is dead space utilized to the maximum extent possible for stowage of items?

b. Is stowage available for individual weapons, small arms ammunition, rations, and the M1 helmet and liner?

c. Does the stowage of equipment follow the functional utilization of each item?

d. Are items for a particular task requirement stowed in a convenient location within the functional area of the task?

4. Retaining Devices

a. Are retaining devices simple and capable of quick removal and replacement?

b. Can items be stowed and unstowed by hand, requiring no tools?

c. Can items be stowed and unstowed under all conditions of environment?

5. Missile Stowage

a. Can missiles be placed in and removed from stowage racks easily?
b. Are missiles protected from falling out of stowage racks?
c. Are missiles in stowage protected from contacting each other?
d. Are missile stowage racks located to minimize interference with the working area?
e. Are missile rack latching mechanisms of the quick-release type?
f. Do missile rack latching mechanisms require no more than 12 pounds for operation?
g. Is it obvious when missile rack latching mechanisms are locked but not secure?
h. Do vertically stowed missiles weighing over 40 pounds have a floor retainer with sufficient clearance for missile placement and removal by the 95th percentile hand?

6. Missile Transfer

a. Where a hoist is used, are there provisions for preventing the missile from swinging?
b. Does the hoist clamp prevent accidental release of missiles?
c. Does the hoist have provisions for manual operation in case of power failure?
d. Is there unobstructed workspace for transferring missiles from stowage to the launcher?

APPENDIX K

CHECKSHEETS FOR ELECTRICAL HAZARDS

General

a. Does test item protect personnel from accidental contact with voltages in excess of 30 volts rms or DC?

b. Are means provided so that power may be cut off while installing, replacing or interchanging an equipment, assembly or part thereof?

c. Are personnel protected from capacitor discharges and when changing fuses and tubes?

d. Is a main power on-off switch provided to cut off all power to the complete equipment?

e. Are all external parts, surfaces, and shields (exclusive of antenna and transmission line terminals) at ground potential at all times?

f. Are ground connections mechanically secured by soldering to a spot welded terminal lug or secured with screw nut and lock washer?

g. When guards are removed, are interlocks provided to shut off potentials in excess of 70 volts rms or DC?

h. Are grounding rods and grounding studs provided for equipment where voltages are in excess of 70 volts rms?

i. Are guards and barriers provided to protect personnel from contact with voltages between 70 and 500 volts rms and DC?

j. Are warning markers provided on all devices having potentials in excess of 500 volts rms and DC and clearly marked "DANGER HIGH VOLTAGE (MAXIMUM VOLTAGE APPLICABLE) VOLTS"?

k. Are meters provided with provisions for overload by pass or alternate protection to eliminate high voltage potential at terminals in event of meter failure?

l. If the potential to be measured is in excess of 100 volts peak, are test points provided such as to permit measurement of that voltage reduced to a relatively low potential level?

m. Are discharge devices provided to protect personnel from voltages in excess of 250 volts?

n. Are connectors selected so that it is impossible to insert the wrong plug in a receptacle?

o. Are safety switches provided to deactivate associated mechanical drive units without disconnecting other parts of the equipment?

APPENDIX L

CHECKSHEETS FOR MECHANICAL HAZARDS

General

a. Is suitable protection provided to prevent contact with moving mechanical parts such as gears, fans, and belts while the equipment is operating?

b. Are cabinets, doors, and similar items free of sharp projections?

c. Are doors and hinged covers provided with stops to hold them open?

d. Do rack mounted drawers and equipment components include features which preclude accidentally pulling out such items?

e. Are mechanical linkages, pneumatic lines, hydraulic lines, fuel lines, fittings, and couplings provided with a means to prevent inadvertent mismating of such items?

f. Where failure of a mechanism will cause a hazardous condition, is the mechanism provided with guards which will permit its inspection?

g. Are tools for use in an explosive atmosphere nonsparking?

h. Is equipment for use in an explosive atmosphere explosion-proof type?

i. Are jacking and hoisting points clearly, conspicuously, and unambiguously identified?

j. Are components located and mounted so that access may be achieved without danger to personnel from electrical charge, heat, sharp edges, points, and moving parts?

k. Where mechanical components use heavy springs, are there provisions such that the springs cannot be inadvertently dislodged?

l. Are warning plates provided where methanical assemblies, linkages, springs, etc., are under constant strain or load?

m. Are adjustment screws and commonly replaced parts located away from high voltages or hot parts?

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1 ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP ---

3 REPORT TITLE
U. S. Army Test and Evaluation Command Materiel Test Procedure 5-2-545, Common Engineering Test Procedure, - "Human Factors Engineering".

4 DESCRIPTIVE NOTES (Type of report and, inclusive dates)
Final

5 AUTHOR(S) (First name, middle initial, last name)
---

6 REPORT DATE 28 July 1970	7a. TOTAL NO. OF PAGES 86	7b. NO. OF REFS 13
8a. CONTRACT OR GRANT NO DA-18-001-AMC-1045(R) b. PROJECT NO AMCR 310-6 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) MTP 5-2-545 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ---	

10 DISTRIBUTION STATEMENT
This document is subject to special export controls and each transmittal to foreign governments or foreign nationals,-WITH THE EXCEPTION OF AUSTRALIA, CANADA, AND UNITED KINGDOM,-may be made only with prior approval of HQ,USATECOM.

11 SUPPLEMENTARY NOTES ---	12 SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005

13 ABSTRACT
This Army Service Test Procedure describes test methods and techniques for evaluating the human factors characteristics of missile or rocket systems (or components thereof) during service testing, and for determining their suitability, in this regard, for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification
A-31408

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Army Service Test						
Human Factors Engineering						
Missile and Rocket Systems						
Test Procedures						
Test Methods and Techniques						

DD FORM 1 NOV 65 1473 (BACK)

UNCLASSIFIED
Security Classification