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20 February 1974
SUPERSEDING
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1 October 1968
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MIL-T-0023991D(TD)
30 December 1971

MILITARY SPECIFICATION

TRAINING DEVICES, MILITARY; GENERAL SPECIFICATION FOR

This specification is mandatory for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 This specification covers the general requirements for the selection of materials, parts, processes, design, and the quality assurance of training devices used for the training of personnel in military operations and technical specialties.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein

SPECIFICATIONS

Federal

J-C-175	Cable Assembly, Power, Electrical, (3-Wire, 3-Prong, Grounding Plug Connector, for 125-Volt Equipment)
L-P-504	Plastic Sheet and Film, Cellulose Acetate
O-F-506	Flux, Soldering, Paste and Liquid

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T-R-605	Rope, Manila and Sisal
W-C-596	Connector Plug, Electrical, Connector, Receptacle, Electrical
W-L-101	Lamp, Incandescent, (Electric, Large, -Tungsten-Filament)
W-L-111	Lamp; Electric Incandescent Miniature, Tungsten-Filament
W-L-116	Lamp, Fluorescent
W-L-00305	Light Set, General Illumination (Emergency)
DD-G-451	Glass, Plate, Sheet, Figured (Float, Flat, for Glazing, Corrugated, Mirrors, and Other Uses)
HH-I-595	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic, General Purpose
NN-P-530	Plywood, Flat Panel
QQ-A-591	Aluminum Alloy Die Castings
QQ-A-596	Aluminum Alloy Permanent and Semipermanent Mold Castings
QQ-A-601	Aluminum-Alloy Sand Castings
QQ-A-673	Anode, Copper
QQ-B-613	Brass, Leaded and Nonleaded, Flat Products (Plate, Bar, Sheet and Strip)
QQ-B-626	Brass, Leaded and Nonleaded Rod, Shapes, Forgings, and Flat Products with Finished Edges (Bar and Strip)
QQ-B-654	Brazing Alloys, Silver

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QQ-C-390	Copper Alloy Castings (Including Cast Bar)
QQ-C-450	Copper-Aluminum Alloy (Aluminum Bronze) Plate, Sheet, Strip, and Bar (Copper Alloy Numbers 606, 612, 613, 614 and 628)
QQ-C-502	Copper Rods and Shapes; and Flat Products with Finished Edges (Flat Wire, Strips and Bars)
QQ-C-530	Copper-Beryllium Alloy Bar, Rod, and Wire (Copper Alloy Numbers 172 and 173)
QQ-C-571	Copper, Phosphor (Alloying Additive)
QQ-C-576	Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machined Edges (Plate, Bar, Sheet, and Strip)
QQ-C-585	Copper-Nickel-Zinc Alloy Plate, Sheet, Strip and Bar (Copper Alloy Numbers 735, 745, 752, 762, 766 and 770)
QQ-C-586	Copper-Nickel-Zinc Alloy; Rod, Shapes, and Flat Products with Finished Edges (Flat Wire, Strip and Bar)
QQ-C-591	Copper-Silicon, Copper-Zinc-Silicon, and Copper-Nickel-Silicon Alloys, Rod, Wire, Shapes, Forgings and Flat Products, (Flat Wire, Strip, Sheet, Bar and Plate)
QQ-N-281	Nickel-Copper-Alloy Bars, Plate, Rod, Sheet, Strip, Wire, Forgings and Structural and Special Shaped Sections
QQ-N-286	Nickel-Copper-Aluminum Alloy, Wrought
QQ-N-288	Nickel-Copper-Alloy and Nickel-Copper-Silicon Alloy Castings
QQ-N-290	Nickel Plating (Electrodeposited)

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QQ-S-571	Solder, Tin Alloy, Lead-Tin Alloy and Lead Alloy
QQ-W-321	Wire, Copper Alloy
ZZ-R-765	Rubber, Silicone
CCC-C-428	Cloth, Duck, Cotton, Fire, Water, Weather and Mildew Resistant

Military

MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-C-17	Cables, Radio Frequency; Coaxial, Dual Coaxial, Twin Conductor, and Twin Lead
MIL-P-79	Plastic Rods and Tubes, Thermosetting, Laminated
MIL-W-80	Window, Observation, Acrylic Base, Antielectrostatic, Transparent (For Indicating Instrument)
MIL-V-95	Vibrators, Interrupter and Self-rectifying
MIL-G-174	Glass, Optical
MIL-W-530	Webbing, Textile, Cotton, General-Purpose, Natural or in Colors
MIL-I-631	Insulation, Electrical, Synthetic-Resin Composition, Nonrigid
MIL-C-675	Coating of Glass Optical Elements (Antireflection)
MIL-T-713	Twine, Impregnated, Lacing and Tying
MIL-S-862	Steel Castings, Corrosion Resisting Austenitic

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MIL-P-997	Plastic Material, Laminated, Thermosetting, Electrical Insulation· Sheets, Glass Cloth, Silicone Resin
MIL-R-1670	Rope, Tent-Lay
MIL-R-3065	Rubber, Fabricated Parts
MIL-C-3098	Crystal Unit, Quartz, General Specification For
MIL-C-3133	Cellular Elastomeric Materials, Fabricated Parts
MIL-I-3190	Insulation Sleeving, Electrical, Flexible, Treated
MIL-C-3432	Cable and Wire, Electrical (Power and Control, Semiflexible, Flexible and Extra-flexible, 300 and 600 Volts)
MIL-S-3644	Shaft Assembly, Flexible
MIL-S-3786	Switches, Rotary (Circuit-Selector, Low-Current Capacity) General Specification For
MIL-G-3787	Glass, Laminated, Flat; (Except Aircraft)
MIL-K-3926	Knobs, Control (For Use With Electronic Communications, and Allied Equipment)
MIL-S-3950	Switches, Toggle
MIL-W-4088	Webbing, Textile, Woven Nylon
MIL-B-5087	Bonding, Electrical, and Lightning Protection, For Aerospace Systems
MIL-P-5315	Packing, Preformed, Hydrocarbon Fuel Resistant

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MIL-P-5425	Plastic, Sheet, Acrylic, Heat Resistant
MIL-P-5516	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 160°F
MIL-R-5757	Relays, Electrical (For Electronic and Communication Type Equipment), General Specification For
MIL-R-6106	Relay, Electric, Aerospace, General Specification For
MIL-C-6183	Cork and Rubber Composition Sheet, For Aromatic Fuel and Oil Resistant Gaskets
MIL-N-6710	Nickel-Chromium-Iron Alloy; Bars, Rods, and Forgings
MIL-N-6840	Nickel-Chromium-Iron Alloy Plate, Sheet and Strip
MIL-R-6855	Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes
MIL-A-7021	Asbestos Sheet, Compressed, For Fuel, Lubricant, Coolant, Water, and High Temperature Resistant Gaskets
MIL-S-7124	Sealing Compound, Elastomeric, Accelerator Required, Aircraft Structure
MIL-I-7444	Insulation Sleeving, Electrical, Flexible
MIL-M-7793	Meter, Time Totalizing
MIL-B-7883	Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys
MIL-W-8160	Wiring, Guided Missile, Installation of, General Specification For

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MIL-S-8805	Switches and Switch Assemblies, Sensitive and Push, Snap Action, General Specification For
MIL-S-8834	Switches, Toggle, Positive Break, Aircraft, General Specification For
MIL-R-8903	Resistor, Variable, Linear Precision, Tappable
MIL-W-8939	Welding, Resistance, Electronic Circuit Modules (ASG)
MIL-F-9329	Filter, Light, Photographic, General Specification For
MIL-Q-9858	Quality Program Requirements
MIL-M-10304	Meters, Electrical Indicating, Panel Type, Ruggedized General Specification For
MIL-S-11030	Sealing Compound, Non-Curing, Polysulfide Base
MIL-R-11050	Rectifiers, Metallic, Selenium
MIL-S-12883	Sockets and Accessories for Plug-in Electronic Components, General Specification for
MIL-M-13508	Mirror, Front Surfaced Aluminized for Optical Elements
MIL-S-13572	Springs, Helical, Compression and Extension
MIL-O-13830	Optical Components for Fire Control Instruments; General Specification Governing the Manufacture, Assembly, and Inspection of
MIL-F-14072	Finishes for Ground Signal Equipment

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MIL-R-14224	Rectifiers, Metallic, Selenium (High Temperature)
MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)
MIL-P-15024	Plates, Identification - Information and Marking for Identification of Electrical, Electronic and Mechanical Equipment
MIL-L-15098	Lamps, Glow
MIL-I-15126	Insulation Tape, Electrical, Pressure Sensitive Adhesive and Pressure Sensitive Thermosetting Adhesive
MIL-S-15291	Switches, Rotary, Snap Action
MIL-M-16034	Meters, Electrical-Indicating (Switchboard and Portable Types)
MIL-W-16878	Wire, Electrical, Insulated, High Temperature
MIL-L-17192	Lubrication Design, Lubricants, and Lubrication Information for Electronic Equipment; General Specification
MIL-W-18142	Wood Preservative Solutions, Oil-Soluble, Ship and Boat Use
MIL-R-19648	Relay, Time Delay, Thermal, General Specification For
MIL-A-21180	Aluminum-Alloy Castings, High Strength
MIL-S-21604	Switches, Rotary, Multipole and Selector Type, 1 to 10 Ampere

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MIL-S-22885	Switch, Push Button, Illuminated, General Specification For
MIL-B-23071	Blowers, Miniature, for Cooling Electronic Equipment (10 to 500 CFM) General Specification For
MIL-R-24050	Rope, Nylon, Double-Braided
MIL-C-24066	Clip, Component, Nonelectrical; General Specification For
MIL-S-24236	Switches, Thermostatic, (Metallic and Bimetallic), General Specification For
MIL-S-24251	Shields, Retainers (Bases), and Adapters, Electron Tube, Heat Dissipating; General Specification For
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 275°F
MIL-G-25871	Glass, Laminated, Aircraft, Glazing
MIL-C-29025	Communication Systems for Training Devices, General Specification for
MIL-R-39016	Relays, Electromagnetic, Established Reliability; General Specification For
MIL-S-45743	Soldering, Manual Type, High Reliability, Electrical Connections, for Missile Systems, Procedures For
MIL-I-46058	Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-G-81704	Glass, Aircraft Instrument, Lighting Wedges and Covers
MIL-I-82356	Instruments, Simulated, for Aircraft Training Devices, General Specification for

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STANDARDS

Federal

FED-STD-66	Steel, Chemical Composition and Hardenability
FED-STD-595	Colors

Military

MIL-STD-12	Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents
MIL-STD-17	Mechanical Symbols
MIL-STD-108	Definition of and Basic Requirement For Enclosure For Electric and Electronic Equipment
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specifications and Standards; Order of Precedence for the Selection of
MIL-STD-195	Marking of Connections for Electrical Assemblies
MIL-STD-198	Capacitors, Selection and Use of
MIL-STD-199	Resistors, Selection and Use of
MIL-STD-200	Electron Tubes, Selection of
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-403	Preparation for and Installation of Rivets and Screws, Rocket and Missile Structures
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment

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MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-471	Maintainability Demonstration
MIL-STD-633	Mobile Electric Power Engine Generator Set Family Characteristic Data Sheets
MIL-STD-681	Identification Coding and Application of Hookup and Lead Wire
MIL-STD-701	Lists of Standard Semiconductor Devices
MIL-STD-710	Synchros, 60 and 400 Hertz
MIL-STD-736	Unitized Equipment Design
MIL-STD-749	Preparation and Submission of Data for Approval of Nonstandard Parts
MIL-STD-810	Environmental Test Methods
MIL-STD-838	Lubrication of Military Equipment
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment: Requirements for
MIL-STD-1130	Connections, Electrical, Solderless Wrapped
MIL-STD-1310	Shipboard Bonding and Grounding Methods for Electromagnetic Compatibility
MIL-STD-1326	Test Points, Test Point Selection and Interface Requirements for Equipments Monitored by Shipboard On-Line Automatic Test Equipment
MIL-STD-1364	Preferred General Purpose Electronic Test Equipment
MIL-STD-1399/103	Interface Standard for Shipboard Systems, Electric Power, Alternating Current, Section 103

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MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MS 3338	Lamp, Incandescent, T-1 Bulb, Based, 28 Volt, Integral Lighting
MS 18209	Lamp, Incandescent, Single Contact Midget Flanged Base (1-3/4 Bulb)
MS 91528	Knobs-Control, Plastic (Round, Concentric, Pointer, Spinner, Spinner Slip Clutch, Bar, Tactile, Knob Lock Pointer, and Knob Locks)

PUBLICATIONS

Military

MIL-HDBK-141	Optical Design
MIL-HDBK-216	RF Transmission Lines and Fittings

Department of Defense

DODISS	Department of Defense Index of Specifications and Standards

Department of the Air Force

AFSC DH 1-4	AFSC Design Handbook (Electromagnetic Compatibility)

Department of the Navy

NAVSHIPS 0367-048-1010	Maintainability Design Criteria Handbook for Designers of Shipboard Electronic Equipment

United States Communications Security Board (USCSB) National COMSEC/EMSEC Issuance System

NACSEM 5100	Compromising Emanations Laboratory Test Standard, Electromagnetics (U)

Naval Training Equipment Center (NAVTRAEQUIPCEN)

NAVSO P-2758-S4	Maintainability Handbook for Electronic Equipment Design (Supplement IV)

(Copies of specifications, standards, drawings, and publications required

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by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

2.2 Other publications.- The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H-28	Screw-Thread Standards for Federal Services

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

SURGEON GENERAL, DEPARTMENT OF THE ARMY

Lasers Safety Regulations

(Application for these regulations should be addressed to the Office of Surgeon General, Department of the Army, ATTN: MEDPS-P, Washington, D.C 20310.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM Standards

(Application for copies should be addressed to American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

AMERICAN GEAR MANUFACTURERS ASSOCIATION

AGMA Standards	American Gear Manufacturers Association Standards

(Application for copies should be addressed to American Gear Manufacturers Association, One Thomas Circle, Washington, D.C. 20005.)

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA No. 70	Standards of the National Fire Protection Association (National Electrical Code)

(Application for copies should be addressed to the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110.)

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AMERICAN NATIONAL STANDARDS INSTITUTE, INC.

ANS Y32.2	Graphic Symbols for Electrical and Electronic Diagrams
ANS Y32.16	Electrical and Electronics Reference Designations

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.)

JOINT SERVICE STEERING COMMITTEE

Human Engineering Guide to Equipment Design

(Application for copies should be addressed to McGraw-Hill Publications, 330 West 42nd Street, New York, New York 10036.)

INSTITUTE OF PRINTED CIRCUITS (IPC)

IPC-R-700	RX for Repair of Printed Wiring Boards

(Application for copies should be addressed to Institute of Printed Circuits 3525 Peterson Ave., Chicago, Illinois 60645.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3 REQUIREMENTS

3.1 Materials, parts, and processes.- Unless otherwise specified in the detail specification, materials, parts, and processes used in the design and construction of training devices shall conform to applicable specifications and standards as specified herein.

3.1.1 Selection of parts.- All parts used in the construction of training equipment shall be in accordance with the requirements specified herein. The selection of parts in accordance with the following order is mandatory.

(a) Specifications, Standards, and requirements listed herein

(b) MIL-STD-143.

3.1.2 Standard materials and parts.- Except for commercially available general purpose digital computers (See 6.2.17), materials and parts specified in 3.1.4 and 3.1.5 shall be considered as standard (see 6.2.8). When this specification and the detail specification(s) do not provide applicable specifications or standards, other established specifications or standards

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in the order of precedence specified in MIL-STD-143 shall be used. Specifications and Standards of MIL-STD-143, Group I, shall require no approval prior to inclusion in the design of the training device. Materials and parts listed on the various Qualified Products Lists are preferred. Written approval of the procuring activity shall be required for selection of materials and parts from specifications and standards of MIL-STD-143, Groups II, III and IV in accordance with 3.1.3. If more than one characteristic or tolerance of a material or part is permissible under the applicable specification, the broadest characteristic or widest tolerance consistent with the required performance of the training device shall be used.

3.1.3 Nonstandard materials and parts. When it has been determined that the training device requirements cannot be met by using materials or parts specified above, the procuring activity shall be informed by the submittal of accurate identifying information as specified in 3.1.3.1. Request for approval to use nonstandard parts (See 6.2.9) shall be submitted prior to the initial procurement. Mere convenience of design, construction or procurement shall not be regarded as justification for the use of materials or parts not covered by documents specified herein.

3.1.3.1 Preparation and submission of data for approval of nonstandard materials and parts. When it has been determined that a material or part cannot be selected from the specifications and standards contained in the detail specification(s), this specification, or the DODISS (Department of Defense Index of Specifications and Standards), a request shall be submitted for nonstandard parts approval in accordance with MIL-STD-749. In addition to Figure 1 of MIL-STD-749, two copies of the specification to be used by the contractor to procure the material or part, and a drawing or electronic schematic displaying the application, characteristics, and tolerances of the material or part, shall accompany the request. Three suggested sources for the procurement of nonstandard parts shall be provided.

3.1.3.1.1 Time schedule for approval request. Request for approval to use nonstandard parts (See 6.2.9) shall be submitted prior to the initial procurement. Approval by the Government to use a nonstandard part waives the material, process, procedure, and standard composition requirements of this specification for that part number only. The part shall not be modified to make it a part peculiar.

3.1.3.1.2 Samples required for parts approval. When specified in the detail specification samples of nonstandard parts may be required by the procuring activity. These samples shall be submitted in the quantities and to the destination specified by the procuring activity for tests and examination. Sample quantities to be specified will not exceed 1 pound of any lubricant, 12 fuses, and 6 units of any other part. Sample parts submitted will not be returned to the contractor. When there is more than one supplier for a part, parts from each supplier shall be considered for separate submission.

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3.1.3.1.3 Use of military part identifiers.- Parts which require QPL approval but which have no qualified vendors may be identified with military specification-type number of AN part numbers if such parts have met the requirements and have passed the Quality Conformance inspections of the applicable specifications to the satisfaction of the procuring activity in lieu of the QPL requirements for interim qualification prior to procurement. Having a part thus identified does not entitle the part vendor to be listed on the approved QPL without obtaining official qualification by the normal procedure.

3.1.4 Materials.- Materials shall be as specified in 3.1.4.1 through 3.1.4.24.

3.1.4.1 Arc-resistant materials.- Materials that require arc-resistance properties shall conform to requirement 26 of MIL-STD-454.

3.1.4.2 Flammable materials.- Flammable materials shall not be used in the fabrication of training devices unless approved in writing by the procuring activity (See 6.2.2).

3.1.4.3 Fungus-inert materials - Fungus-inert materials shall be used and shall conform to requirement 4 of MIL-STD-454.

3.1.4.4 Toxic materials.- Materials producing harmful toxic effects shall not be used. (See 6.2.3)

3.1.4.5 Metals.- Metal parts shall be of a corrosion-resistant material (see 3.1.4.5.12) or of a material given a corrosion-resistant treatment or coating (see 3.1.6.5).

3.1.4.5.1 Aluminum.- Aluminum alloys, except castings, shall conform to or exceed American Society for Testing and Materials (ASTM) standards. Aluminum alloy castings shall conform to QQ-A-591, QQ-A-596, or alloy 43 temper F, alloy 356 or alloy 195 of QQ-A-601. Where aluminum alloy castings for high strength and high quality applications are required, they shall conform to MIL-A-21180.

3.1.4.5.2 Brass.- Brass parts and assemblies shall conform to QQ-B-613 or QQ-B-626.

3.1.4.5.3 Bronze.- Bronze parts and assemblies shall conform to QQ-C-390 or QQ-C-450.

3.1.4.5.4 Copper.- Except for copper wire, copper parts and assemblies shall conform to QQ-A-673, QQ-C-502, QQ-C-530, QQ-C-571, QQ-C-576, QQ-C-585, QQ-C-586, QQ-C-591 or QQ-N-288.

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3.1.4.5.5 Iron and steel.- Cast iron shall not be used unless authorized by the procuring activity. Where enclosures, cases, frames, panels, brackets, and miscellaneous hardware are fabricated of steel, such steel material shall be treated to prevent corrosion as specified in 3.1.6.5. Corrosion-resistant steel castings shall conform to MIL-S-867.

3.1.4.5.6 Magnesium.- The use of magnesium shall require written approval of the procuring activity.

3.1.4.5.7 Nickel alloy.- Nickel alloy parts and assemblies shall conform to QQ-N-281, QQ-N-286, QQ-N-290, MIL-N-6710, or MIL-N-6840.

3.1.4.5.8 Solder.- Solder shall conform to QQ-S-571.

3.1.4.5.9 Silver brazing alloy (silver solder).- Silver brazing alloy shall conform to QQ-B-654.

3.1.4.5.10 Spring material.- Spring material shall conform to requirement 41 of MIL-STD-454, QQ-W-321, or MIL-S-13572.

3.1.4.5.11 Wire and cable material.- Wire and cable material shall conform to requirement 20 of MIL-STD-454, MIL-W-8160 or MIL-C-3432. Wire and cable conforming to MIL-W-76 shall not be used. Wire conforming to MIL-W-16878 shall not require the polyamide jacket.

3.1.4.5.12 Corrosion-resistant metals.- The following are considered corrosion-resistant metals:

(a) Copper

(b) Brass

(c) Bronze

(d) Copper-nickel alloy

(e) Nickel-copper alloy

(f) Copper-beryllium alloy

(g) Copper-nickel zinc alloy

(h) Nickel-copper-silicon alloy

(i) Nickel-copper-aluminum alloy

(j) Austenitic corrosion-resistant steels 302, 303, 304, 304L, 309, 310, 316, 316L, 321, 322, 322A, and 347 as defined in FED-STD-66.

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3.1.4.5.13 Dissimilar metals.- The selection and protection of dissimilar metal combinations shall be in accordance with requirement 16 of MIL-STD-454.

3.1.4.6 Plastics.- Plastic materials shall be as specified in 3.1.4.6.1 through 3.1.4.6.4. Plastic materials when tested in accordance with Methods 2021, 2022 and 2023 of FED-STD-406 and judged as "nonburning by this test" or "self-extinguishing by this test" shall be considered NONFLAMMABLE and may be used. Plastic materials when tested in accordance with Methods 2021, 2022 and 2023 of FED-STD-406 and judged as "burning by this test" shall be considered FLAMMABLE and shall not be used.

3.1.4.6.1 Laminated thermosetting plastic sheets.- Where laminated thermosetting plastic sheets are used for electrical insulation, a silicone resin glass-cloth material conforming to MIL-P-997 shall be used. The use of this material shall be mandatory in equipments where either maintenance of intercircuit impedances above one megohm is required, or in equipment where temperatures greater than 110° Fahrenheit are encountered.

3.1.4.6.2 Laminated thermosetting plastic rods and tubes.- Laminated thermosetting plastic rods and tubes shall conform to MIL-P-79.

3.1.4.6.3 Plastic materials for high-frequency applications.- Where frequencies higher than 100 kilohertz (kHz) or circuit Q higher than 25 are involved or associated with circuits which operate to generate radio frequencies or are otherwise frequency determining in function, plastic materials shall conform to MIL-M-14.

3.1.4.6.4 Plastic dials and transparent and translucent parts.- Plastic for dials and other transparent and translucent plastics applications shall be in accordance with MIL-W-80. Material conforming to L-P-504 or MIL-P-5425 may be used, provided it is treated with an anti-electrostatic coating.

3.1.4.7 Cotton duck.- Cotton duck shall conform to Type II of CCC-C-428. Medium texture No. 4 shall be used for heavy duty service, hard texture No. 8 shall be used for truck covers, and texture No. 12 shall be used for services requiring light weight.

3.1.4.8 Webbing (nylon).- Nylon webbing shall conform to MIL-W-4088.

3.1.4.8.1 Webbing (cotton).- Cotton webbing shall be treated in accordance with MIL-W-530 for mildew prevention and water repellence. Inhibiting agents containing copper shall not be used where webbing may come in contact with rubber or with the skin of using personnel.

3.1.4.9 Tape (electrical).- Electrical insulating tape shall conform to requirement 11 of MIL-STD-454. Electrical insulation pressure-sensitive adhesive tape shall conform to HH-I-595 or to type AFT, EF-9, EF-20, MFT-2.5, MF-2.5, or MFT-3.5 of MIL-I-15126.

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3.1.4.10 Tape (lacing).- Lacing tape for cable harnesses and other applications shall conform to Type P, waxed, Class 2, of MIL-T-713.

3.1.4.11 Tubing and sleeving (electrical).- Nonrigid electrical tubing shall conform to MIL-I-631 or MIL-I-7444. Electrical sleeving shall conform to MIL-I-3190.

3.1.4.12 Hookup wire.- Hookup wire shall conform to requirement 20 of MIL-STD-454, except that wire in accordance with MIL-W-76 shall not be used.

3.1.4.13 Printed wiring.- Printed wiring materials shall be in accordance with requirement 17 of MIL-STD-454.

3.1.4.14 Adhesives.- Adhesive materials shall be in accordance with requirement 23 of MIL-STD-454.

3.1.4.14.1 Adhesive (glass-to-metal).- Glass-to-metal adhesives shall conform to MIL-S-11030 or MIL-S-7124.

3.1.4.15 Wood products.- Wood products shall be treated for preservation, fire-retardation, and termite protection, and shall conform to commercial Grade B or better. Plywood shall conform to NN-P-530 and shall be treated for moisture and fungus protection in accordance with MIL-W-18142.

3.1.4.16 Glass.- Glass for use in equipment for protection of instruments, meters, and cathode-ray-tube faces, and for viewing dials and indicators, shall be in accordance with MIL-G-81704. Glare-proof glass shall be used when the equipment to be viewed will be illuminated from an outside source. When design requires the use of shatterproof-type glass, Class 1, Grade A of MIL-G-3787 shall apply.

3.1.4.16.1 Glass (nonoptical).- Nonoptical glass products shall conform to MIL-G-25871 or DD-G-451.

3.1.4.16.2 Glass (optical).- Optical glass used in the fabrication of lenses, prisms, reticles, first surface reflectors, and similar elements, shall conform to MIL-G-174 or MIL-O-13830.

3.1.4.16.3 Glass (mirrors).- Glass mirrors shall conform to MIL-M-13508.

3.1.4.16.4 Plate glass (optical).- Plate glass used in any portion of the image path shall conform to Class 1, Grade C of MIL-G-174. For other applications, Type I conforming to DD-G-451 shall be used.

3.1.4.16.5 Optical filters.- Optical filters shall be selected in accordance with MIL-F-9329.

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3.1.4.17 Rubber.- Except for the cellular rubber types of 3.1.4.17.1, rubber materials used for the absorption of noise, shock, vibration, or for application where resiliency is required, shall be in accordance with MIL-R-3065.

3.1.4.17.1 Cellular rubber.- Cellular rubber used for the absorption of noise, shock, vibration, or where resiliency is required, shall be in accordance with MIL-C-3133

3.1.4.17.2 Synthetic rubber.- Where resistance to oil and fuel is required, general-purpose synthetic rubber conforming to MIL-S-6855 shall be used. Where resistance to low or high temperatures or tear resistance is required, silicone rubber conforming to ZZ-R-765 shall be used.

3.1.4.18 Rope.- Rope shall be in accordance with T-R-605 or MIL-R-1670. For outdoor use, nylon rope in accordance with MIL-R-24050 shall be used.

3.1.4.19 Lubricants.- The selection and application of lubricants shall conform to MIL-L-17192 or MIL-STD-838.

3.1.4.20 Encapsulating and embedding (potting) compounds.- Selection of encapsulating and embedding compounds shall be in accordance with requirement 47 of MIL-STD-454.

3.1.4.21 Flux (solder).- Flux for electrical soldering shall be of rosin or mildly activated rosin, and shall conform to type R or RMA of MIL-F-14256. No acid or acid salt shall be used in preparation for or during soldering. Flux used for mechanical (nonelectrical) joints shall conform to O-F-506.

3.1.4.22 Motion picture film.- Motion picture film materials shall conform to the requirements of the detail specification. Motion picture film base material shall be selected in the following order of precedence:

(a) Polyeste

(b) Cellulose acetate.

3.1.4.23 Sound recording magnetic tape.- Sound recording magnetic tape shall be as specified in 3.1.4.23.1 or 3.1.4.23.2, as applicable to the requirements of the detail specification.

3.1.4.23.1 Cellulose-acetate base magnetic tape.- Cellulose-acetate base magnetic tape of 1.5 mil thickness shall be used to record "master tapes" when the tapes are to be used for duplication.

3.1.4.23.2 Polyester-base magnetic tape.- Polyester-base magnetic tape of 1.0 mil thickness shall be used for all recording purposes other than as specified in 3.1.4.23.1.

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3.1.4.24 Other materials.- The following materials shall not be used unless approved by the procuring activity in accordance with the requirements specified in 3.1.3.

(a) Linen

(b) Cellulose acetate, except as specified in 3.1.4.22 and 3.1.4.23

(c) Cellulose nitrate

(d) Regenerate cellulose

(e) Jute

(f) Leather

(g) Cork

(h) Paper and cardboard

(i) Organic fiberboard

(j) Hair or wool felts

(k) Plastic materials using cotton, linen or wood flour as a filler

(l) Radioactive material.

3.1.5 Parts.- Parts shall be as specified in 3.1.5.1 through 3.1.5.32.

3.1.5.1 Batteries.- Batteries shall not be used unless specified in the detail specification. Batteries, when specified, shall conform to requirement 27 of MIL-STD-454.

3.1.5.2 Bearings.- Bearings shall conform to requirement 6 of MIL-STD-454.

3.1.5.3 Blowers.- Blowers for cooling electronic equipment shall conform to MIL-B-23071.

3.1.5.4 Capacitors.- Capacitors shall conform to MIL-STD-198.

3.1.5.5 Circuit breakers.- Circuit breakers shall conform to requirement 37 of MIL-STD-454.

3.1.5.6 Component clips.- Component clips shall conform to MIL-C-24066.

3.1.5.7 Connectors, electrical.- Electrical connectors shall conform to requirement 10 of MIL-STD-454.

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3.1.5.8 Crystal units.- Crystal units shall conform to MIL-C-3098.

3.1.5.9 Fuses and fuse holders.- Fuses and fuse holders shall conform to requirement 39 of MIL-STD-454.

3.1.5.10 Gaskets.- Gaskets intended to prevent leakage of petroleum products, glycol, alcohol, or water shall be made from materials complying with MIL-R-3065, MIL-C-6183, or MIL-A-7021, as applicable. "O" ring gaskets shall be in accordance with MIL-P-5315, MIL-P-5516, or MIL-P-25732, as applicable.

3.1.5.11 Instruments, simulated.- Simulated instruments, where applicable for training device use, shall be in accordance with MIL-I-82356.

3.1.5.12 Portable equipment power cables.- Cable assemblies used to furnish electrical power to portable items of equipment, such as test equipment, test fixtures, and trouble lights, requiring single-phase, 115V, 60 Hz, AC power, shall conform to J-C-175, type II.

3.1.5.13 Insulators.- Insulators shall be in accordance with requirement 11 of MIL-STD-454.

3.1.5.14 Knobs.- Knobs shall be in accordance with MS 91528 per MIL-K-3926.

3.1.5.15 Lamps.-

3.1.5.15.1 Incandescent.- Incandescent lamps shall conform to W-L-101. T- 1-3/4 midget flange 28-volt lamps shall be in accordance with MS 18209. T-1 bulb, based, 28 volt lamps shall be in accordance with MS 3338. Indicating lamps shall conform to W-L-111.

3.1.5.15.2 Fluorescent.- Fluorescent lamps shall conform to W-L-116.

3.1.5.15.3 Glow.- Glow lamps shall conform to MIL-L-15098.

3.1.5.15.4 Microminiature.- Designs employing microminiature lamps (categorized as 1-3V, 20-250 millilumens light output) shall be restricted to applications where a light source approximating a point light source is the primary objective with light output being a secondary factor.

3.1.5.15.5 Ultraviolet.- Ultraviolet lamps shall be selected from types whose radiant power density peaks in the near ultraviolet region (wavelengths of 365 mu or longer) of the spectrum. For general purpose ultraviolet area lighting, the Type BL fluorescent lamp or a similar low pressure mercury vapor lamp is preferred. For spot or small quantity applications, the argon glow lamp may be used. Carbon arc or tungsten filament incandescent lamps shall not be used for the production of ultraviolet radiation intended for visual display purposes.

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3.1.5.15.6 Gaseous discharge (short arc).- For visual display applications which require the use of special gaseous discharge lamps, the xenon lamp should be used. Argon-mercury, mercury-xenon, or the concentrated arc type, such as the zirconium-oxide, may be used if approved by the procuring activity.

3.1.5.16 Meters, electrical indicating.- Electrical meters used to indicate volts and amperes shall conform to MIL-M-10304 or MIL-M-16034. Electrical meters used in the manufacture of simulated instruments shall conform to the above specifications or be of the edge reading type built to commercial standards.

3.1.5.16.1 Sensitivity.- Meters which have a full-scale deflection of less than 50 microamperes shall not be used without the approval of the procuring activity.

3.1.5.16.2 Shunts, meter.- Meter shunts shall conform to requirement 40 of MIL-STD-454.

3.1.5.17 Motors, dynamotors, rotary power converters and motor-generators.- Motors, dynamotors, rotary power converters, and motor-generators shall conform to requirement 46 of MIL-STD-454.

3.1.5.18 Rectifiers, selenium.- Selenium rectifiers, when approved for use by the procuring activity, shall conform to MIL-R-11050 or MIL-R-14224.

3.1.5.19 Relays.- Relays shall conform to MIL-R-5757, MIL-R-6106 or MIL-R-39016.

3.1.5.19.1 Reed relays.- Reed relays shall conform to MIL-R-5757.

3.1.5.19.2 Thermal time delay relays.- Thermal time delay relays shall conform to MIL-R-19648.

3.1.5.20 Resistors.- Resistors shall conform to MIL-STD-199.

3.1.5.20.1 Variable, linear precision, tappable (potentiometer).- Variable, linear precision, tappable resistors shall conform to MIL-R-5903.

3.1.5.21 Semiconductors.- Semiconductors shall conform to requirement 30 of MIL-STD-454.

3.1.5.22 Shields, electron-tube.- Electron-tube heat dissipating shields shall conform to MIL-S-24251. For miniature or subminiature printed circuit application, wrap-around type tube shields, made of soft copper, silver, or aluminum held by beryllium copper spring or equivalent, shall be used.

3.1.5.23 Sockets, electron tubes and electronic components.- Sockets for electron tubes and electronic components shall conform to MIL-S-12883

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3.1.5.24 Switches.- Switches shall be as specified in 3.1.5.24.1 through 3.1.5.24.8.

3.1.5.24.1 Assemblies and actuators (push-button and limit).- Switch assemblies and actuators shall be in accordance with MIL-S-8805.

3.1.5.24.2 Push-button, lighted.- Lighted push-button switches shall conform to MIL-S-22885.

3.1.5.24.3 Push-button, and limit.- Push-button and limit switches shall conform to MIL-S-8805.

3.1.5.24.4 Rotary, low current.- Low-current rotary switches (up to two amperes) shall conform to MIL-S-3786.

3.1.5.24.5 Rotary, high current.- High-current rotary switches shall conform to MIL-S-15291 (snap-action type) or MIL-S-21604 (selector type).

3.1.5.24.6 Sensitive.- Sensitive switches shall conform to MIL-S-8805.

3.1.5.24.7 Toggle.- Toggle switches shall conform to MIL-S-3950 or MIL-S-8834.

3.1.5.24.8 Thermostatic, bimetallic.- Bimetallic thermostatic switches shall conform to MIL-S-24236

3.1.5.25 Synchros.- Synchros shall conform to MIL-STD-710.

3.1.5.26 Terminals, terminal boards and terminal strips.- Terminals, terminal boards, and terminal strips shall conform to requirement 19 of MIL-STD-454.

3.1.5.27 Transformers, inductors and coils.- Transformers, inductors, and coils shall conform to requirement 14 of MIL-STD-454. Transformers and inductors shall be Grade four or five, Class R, Life expectance X.

3.1.5.28 Tubes, electron.- Electron tubes shall conform to requirement 29 of MIL-STD-454.

3.1.5.29 Vibrators, interrupter and self-rectifying.- Interrupter and self-rectifying vibrators shall conform to MIL-V-95.

3.1.5.30 Flexible tuning shafts.- Flexible tuning shafts shall conform to MIL-S-3644.

3.1.5.31 Radiofrequency (RF) cables.- RF cables shall be in accordance with MIL-C-17.

3.1.5.32 Mobile electric power generators.- Mobile electric power generators shall be in accordance with MIL-STD-633.

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3.1.6 Processes.- Processes shall be as specified in 3.1.6.1 through 3.1.6.12.

3.1.6.1 Bonding, adhesive - Adhesive bonding shall be in accordance with requirement 23 of MIL-STD-454. Adhesive used for bonding shall develop the required strength needed for the application and shall meet the environmental requirements of the training device. Adhesives that give off volatile by-products, or vapors harmful to life, or contain corrosive substances, shall not be used.

3.1.6.2 Brazing.- Brazing of steel, copper, copper alloys, nickel, and nickel alloys shall be in accordance with MIL-B-7883.

3.1.6.3 Crimping of solderless terminal lugs.- Crimping of solderless terminal lugs shall be in accordance with requirement 19 of MIL-STD-454.

3.1.6.4 Glass coating.- All optical or nonoptical glass requiring antireflective coatings shall be treated in accordance with MIL-C-675.

3.1.6.5 Metals (coating, plating and treatment).- The finishes and coatings on equipment shall conform to requirement 15 of MIL-STD-454. Salt spray test shall not be required unless specified in the detail specification.

3.1.6.6 Painting, and preparation for.- In preparation for painting, after all machining, welding, and brazing operations are completed, the exterior and interior surfaces of all enclosures shall have all rust or other visible corrosive products and flux removed and shall be thoroughly cleaned of all grease, oil, and dirt by solvent wiping, vapor degreasing, or caustic washing and rinsing. Painting shall be in accordance with MIL-F-14072.

3.1.6.6.1 Non-skid surfaces.- On painted surfaces where personnel normally step during trainer use or maintenance, the surface shall be covered with non-skid paint or a suitable non-skid material.

3.1.6.7 Printed wiring.- Circuit card assemblies and printed wiring boards shall be fabricated in accordance with requirement 17 of MIL-STD-454 and the following:

(a) Edgeboard (single part) type connectors shall be acceptable for ground training equipment

(b) Repair of circuit card assemblies and printed wiring boards shall be in accordance with Institute of Printed Circuits Standard IPC-R-700. Approval shall be obtained from the Contracting Officer prior to repair

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(c) Design of printed wiring boards shall conform to MIL-STD-275 when specified in the detail specification. Copper conductor patterns which are not solder coated or plated shall be protected by a conformal coating, in accordance with MIL-I-46058

(d) Conformance testing shall not be required unless specified in the detail specification.

3.1.6.8 Riveting.- Riveting shall be accomplished in accordance with MIL-STD-403.

3.1.6.9 Soldering.-

3.1.6.9.1 Electrical.- Electrical soldering shall be in accordance with requirement 5 of MIL-STD-454.

3.1.6.9.2 Nonelectrical.- Nonelectrical (structural) soldering shall conform to requirement 5 of MIL-STD-454. Solder used shall be composition SN35 or SN50 of QQ-S-571.

3.1.6.10 Solderless electrical connections (wrapped).- Solderless electrical connections (wrapped) shall be in accordance with MIL-STD-1130

3.1.6.11 Welding.- Structural welding shall conform to requirement 13 of MIL-STD-454. Resistance welding for electronic modules shall conform to MIL-W-8939.

3.1.6.12 Encapsulation and embedment (potting).- Encapsulation and embedment (potting) of a part or an assembly of discrete parts shall be in accordance with requirement 47 of MIL-STD-454.

3.2 Design.-

3.2.1 General.- Training device design shall be in accordance with the applicable requirements of 3.2.1.1 through 3.2.4.5 of this specification and the design requirements of the detail specification.

3.2.1.1 Interchangeability.- Interchangeability shall be in accordance with requirement 7 of MIL-STD-454. Items performing like functions within the training device shall be interchangeable.

3.2.1.2 Safety.- A system safety program shall provide a disciplined approach to control safety aspects and evaluate the system's design; identify hazards and prescribe corrective action in a timely, cost effective manner in accordance with MIL-STD-882, requirement 1 of MIL-STD-454; the hazards and safety requirements of MIL-STD-1472 except for the edge rounding requirement, and as specified in 3.2.1.2.1 through 3.2.1.2.7, and 3.2.4.5 (a) of this specification as applicable.

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3.2.1.2.1 Emergency lighting.- When specified in the detail specification, an emergency light set, in accordance with W-L-00305, shall be provided.

3.2.1.2.2 Other safety features.- In the event that one or more design features of this specification (or the detail specification) constitute a hazard to personnel using or maintaining the training equipment, notification of this condition shall be made to the procuring activity for direction. This notification shall include recommendations for appropriate revisions to remove the hazard.

3.2.1.2.3 Meters.- Training device design incorporating the meters of 3.1.5.16 shall be in accordance with the meter safety considerations of Requirement 1 of MIL-STD-454.

3.2.1.2.4 Electrical circuitry.- The design of electrical circuitry shall conform to NFPA No. 70.

3.2.1.2.5 Equipment high temperature warning.- When electronic or hydraulic equipment may be damaged due to high temperatures, an automatic high-temperature audible warning system shall be installed. Means shall be provided to cut-off the audible warning alarm after sounding, while the equipment is secured and allowed to cool down. (See 3.2.3.10.9.4).

3.2.1.2.6 Warning marking for simulated and modified components.- Simulated or modified components which are for trainer use only, shall be suitably identified as specified in 3.2.1.2.6.1 and 3.2.1.2.6.2.

3.2.1.2.6.1 Trainer use only components.- Trainer use only precautionary labeling shall apply to the following:

(a) Instruments, components, controls, and the like, which have been modified for trainer use

(b) Instruments, components, controls, circuit breakers, and the like, which have been produced for trainer use and which have overall outward appearance substantially identical to the operational item for which it could be mistaken.

3.2.1.2.6.2 Trainer use only identification.- Trainer use only identification shall include a decalcomania or nameplate with the legend. "WARNING: FOR GROUND TRAINER USE ONLY" affixed to the component. Additionally, yellow paint shall be applied to the back, or other exposed surface of the component. Such marking shall not obscure other identification or labeling.

3.2.1.2.7 Acoustical noise.- Acoustical noise levels shall be in accordance with the hazardous noise and control requirements of MIL-STD-1472, unless otherwise specified in the detail specification.

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3.2.1.3 Mounting of parts.- Brackets, lugs, flanges, clamps, inserts, and other mounting arrangements shall securely retain components and parts when the equipment is subjected to environmental conditions as specified in the detail specification(s). Rivets shall not be used to mount parts where they may require removal for maintenance. Parts shall be mounted so that loosening or permanent separation will not occur when the equipment is subjected to shock and vibration conditions as specified in the detail specification(s). Junctions between mating surfaces shall not be employed as the sole means of preventing fixed parts from rotating. Parts shall be secured in such a manner that failure of a single screw will not free the part.

3.2.1.4 Protection of parts.- Internal parts of the training device subject to damage, change in physical characteristics, or malfunction from the accumulation of dust, soot, insects, or other contamination shall be protected from the direct path of natural or forced air circulation by filters.

3.2.1.5 Cooling.- The training equipment design shall provide for part, assembly, and cabinet operation in a thermally ambient temperature, without hot spots, when operated within the temperature and environmental conditions specified in the detail specification. When forced air cooling is used the following guidelines shall apply:

(a) Fans and blowers shall operate from the equipment power source

(b) Air filters shall be located at all intakes and shall be removable to permit cleaning without disassembly of the equipment

(c) Openings or ducts shall be provided to carry the exhaust air away from the unit. Where heated air may affect the room temperature, the heated air shall be exhausted outside

(d) All exhaust openings shall be located at the top, rear or side of the training equipment consistent with the location of associated cabinets and equipment

(e) Fans or blowers shall be placed at the intake end of the duct

(f) The maximum air velocity through the enclosures shall not exceed 900 ft/min

(g) Electronic equipment enclosures shall be of the ventilated type as defined in MIL-STD-108. All cabinet enclosures except those remotely located shall have air inlets for use with forced air ventilation

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(h) The equipment exhaust temperatures into the room shall not exceed 110°F

(i) Internal cabinet temperatures shall not exceed 110°F, measured not less than one-half (1/2) inch from the nearest heat-producing unit.

3.2.1.5.1 Climatic conditions.- Except as otherwise specified in the detail specification the training equipment shall withstand the following climatic conditions:

(a) Temperature:

(1) Operating: 60° to 110° F

(2) Nonoperating and storage: -65° to +160° F

(b) Relative humidity - Up to 90 percent condensation due to temperature changes

(c) Barometric pressure:

(1) Operating: From 31.35 to 24.9 inches of mercury

(2) Nonoperating: From 31.35 to 5.5 inches of mercury.

3.2.1.5.2 Electronic equipment thermal design.- Thermal design of electronic equipment shall be in accordance with Requirement 52 of MIL-STD-454.

3.2.1.5.3 Wattage dissipation.- Where wattage dissipation calculations indicate heat problems, the design of the affected equipment shall be governed by thermal considerations. The following are some methods of solution:

(a) Provide structural conductors to carry the heat to the extremities of the unit

(b) Provide radiating areas and, if needed, fins to permit convection of the heat

(c) Isolate heat dissipating parts and subassemblies to prevent heat flow into adjacent parts

(d) Employ completely bonded heat sinks for all heat dissipating parts

(e) Use materials and parts of proven thermal capabilities.

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3.2.1.6 Human engineering - The training device shall be designed in accordance with the principles and criteria of MIL-H-46855 and MIL-STD-1472 as applicable, unless otherwise specified in the detail specification. The Human Engineering Guide to Equipment Design shall be used in providing additional design guidance for workspace layout, consoles, controls, and displays.

3.2.1.6.1 Functional characteristics - The functional characteristics of the training device shall provide support procedures for modifying and shaping behavior, specifically affording a capability for practice in specialty and team oriented military tasks.

3.2.2 Mechanical.-

3.2.2.1 Size - Unless otherwise specified in the detail specification, all units of a training device shall be of a size to permit passage through doorways and openings enroute or encountered at the installation site in accordance with the land-based, fixed installation requirements of 3.2.2.1.1 through 3.2.2.1.3.

3.2.2.1.1 Land-based installation.- All units of the training device and auxiliary equipment, when uncrated, shall be capable of passage through a doorway 36 inches wide and 78 inches high. This requirement may be waived by the Government under the following conditions:

(a) Building in which the training device will be housed is to be constructed specifically for the training device.

(b) Building, in which the training device will be housed, can be identified and size limitations established in the detail specification.

3.2.2.1.1.1 Mobile.- The maximum size of units shall be as specified in the detail specification.

3.2.2.1.2 Surface vessel installation.- All units of the training device, including maintenance parts, and auxiliary equipment, intended for interior surface vessel installation, when uncrated, shall be capable of passage through an opening 26 inches by 45 inches (reduced further by round corners on an 8 inch radius) or through a hatch 30 inches by 30 inches (reduced further by round corners on a 7-1/2 inch radius). The overall height, including shock mounts, shall not exceed 72 inches.

3.2.2.1.3 Submarine installation.- All units of the training device, including maintenance parts, and auxiliary equipment, intended for interior submarine installation, when uncrated, shall be capable of passage through a doorway 20 inches wide by 38 inches high (reduced further by round corners on a 10 inch radius), or through a circular hatch 25 inches in diameter.

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3.2.2.2 Equipment weight.- The equipment weight shall be in accordance with the weight requirements of MIL-STD-1472 to the extent specified in the detail specification.

3.2.2.3 Enclosures (see 6.2.4.1.4).- Training device enclosures shall be constructed such as to maintain rigidity with a low center of gravity and shall be capable of being moved or shipped without the misalignment of structure or loosening of components or mounts.

3.2.2.4 Chassis mounting (see 6.2.4.1.3).- Channel-type track and roller systems or similar chassis slide-mounting methods shall be acceptable for use with sectional or modular construction to provide access to electronic components and other chassis-mounted parts and to permit withdrawal of the chassis. Chassis stops of the shock absorbing type shall be provided to reduce shock when moving chassis to either the fully opened or fully closed position. Sufficient cable slack shall be provided to electrical cables and connectors to preclude inadvertent disconnection. The slide mounting shall provide sliding action without friction or binding and permit rotation to the servicing position if such rotation is required. Each major assembly or chassis so mounted shall be completely removable from its enclosure by disconnecting appropriate electrical connectors and releasing slide catches or locks.

3.2.2.4.1 Chassis protection.- When a chassis, module or subassembly is removed from its normal rack position or housing, it shall be possible to place the chassis, module, or subassembly, on any side, except front or rear, on a smooth surface without causing damage to any of its components. It shall be possible to operate the chassis, module, or subassembly in a removed position from its housing by appropriate means provided for this purpose.

3.2.2.5 Vibration and shock protection.- Training device equipments shall be provided with vibration isolators incorporated into the design in accordance with the vibration and shock protection requirements as specified in the detail specification. Cushioned stops shall be provided that shall engage gradually under shock.

3.2.2.5.1 Shock-absorbing washers.- Shock-absorbing, stress-relief washers shall be used in mounting brittle materials or component parts, such as, glass, ceramics, and the like. The washers, and installation thereof, shall meet the "fastening of brittle materials" requirements of MIL-STD-454, Requirement 12.

3.2.2.5.1.1 Washers for ceramic and vitreous surfaces.- Buffer washers of suitable metallic or fibrous material shall be used between the otherwise facing surfaces of a ceramic or vitric insulator or vitreous enamel resistor and a metal part, whenever practicable. Buffer washers

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of soft copper or other suitable material shall be used whenever the heat resulting from soldering or like operations during assembly, or internal heat resulting from normal operation of the equipment, is of such degree as to cause deterioration of fiber washers in any manner.

3.2.2.5.2 Vibration isolation.- Items constituting sources of vibration, when installed in the trainer frame, shall be mounted with vibration isolators to prevent the transmission of vibration into the trainer structure. Where vibration isolator mountings are used, means shall be provided to secure each such trainer mounting for shipment.

3.2.2.5.3 Shock mounting.- Hard shock mounts shall be used in mounting cabinets, consoles, and other items susceptible to damage from shock loads imposed by transit conditions.

3.2.2.6 Lubrication.- Training device lubrication design shall be in accordance with MIL-L-17192. Lubrication fittings shall be located such that damage will not result to assemblies from dripping oil.

3.2.2.7 Front panels and removable cover plates.- Front panels and removable cover plates shall employ captive-type screws or similar devices for screw retention. A chain fastened to the equipment shall be used on removable covers for which no convenient location for depositing the cover is available during maintenance. The captive fasteners shall employ slotted heads or knurled and slotted heads and shall be designed to allow individual loosening prior to movement of the part to which the fasteners are captive. Design of panels and removable cover plates shall be such as to provide for their self-alinement with their retaining nuts, blocks, or inserts without sticking and without damage to threads. Where parts or assemblies are mounted on hinged doors, panels, or covers, electrical ground return shall not depend on hinge contact for electrical continuity. A separate grounding means shall be provided for the electrical ground return.

3.2.2.8 Gears and gear trains.- Gears and gear trains shall provide continuous tooth contact without interference, tight spots, loose spots, or other irregularities. Where friction is a critical consideration, planetary or epicyclic gearing shall be preferred to worm gearing. Gears shall be manufactured in accordance with American Gear Manufacturers Association (AGMA) standards. The class of gear shall be determined according to its application. Except for commercially available gear boxes which are integral with motors, high-speed geared transmissions shall include permanently lubricated bearings.

3.2.2.9 Contact springs.- Contact springs shall be in accordance with the spring performance and design criteria as specified in requirement 41 of MIL-STD-454.

3.2.2.10 Knobs and handles.- Knobs and handles shall be secured to shafts by two slotted or recessed hexagon head setscrews located

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90 degrees apart. Plastic knobs shall have metal inserts for setscrew installation. When rotational forces so dictate (i.e. force magnitude, stepping forces), or where the knob indexing must match the shaft angle, both the shaft and knob shall be splined, or the shaft shall be flatted and the knob fitted for mating with the shaft. Pointer-type nonparallax knobs shall be used for all control functions involving discrete position setting. For control functions and continuous positioning, circular-type knobs shall be used.

3.2.2.11 Fasteners and fastenings.- The application of fasteners and fastenings shall be in accordance with requirement 12 of MIL-STD-454 and as specified in 3.2.2.11.1 through 3.2.2.11.7 of this specification.

3.2.2.11.1 Locking devices.- Locking devices shall be capable of retaining the controls in any given setting within the range of control. The locking and unlocking action shall not affect the setting of the control. Where vernier are used, the locking device shall operate on both main and vernier controls.

3.2.2.11.2 Clamps.- All plug-in electronic parts and electron tubes shall be securely retained by clamps where necessary to meet the shock and vibration requirements of the detail specification. Clamps, when used, shall be capable of being easily released for item replacement.

3.2.2.11.3 Threads, special- Unless approved by the procuring activity, parts with threads other than those specified in requirement 12 of MIL-STD-454 shall not be used.

3.2.2.11.4 Threaded adjusting devices.- Threaded devices used for adjustment purposes shall conform to either the unified-coarse or fine-thread series in accordance with National Bureau of Standards, Handbook H28.

3.2.2.11.5 Flathead screws- Flathead screws shall not be used in sheet or thin-walled meterial having a thickness of less than one and one-half times the height of the head of the screw. Wherever flathead screws are used, the screw head shall be completely seated in the material.

3.2.2.11.6 Panel-mounting screws- Panel-mounting screws shall be limited to oval-head or recessed flush-head screws.

3.2.2.11.7 Commercial utility parts.- Commercial utility parts, such as: screws, bolts, nuts, washers, pins, rivets and similar small parts having suitable properties may be used provided that:

(a) They can be replaced by standard parts (MS or AN) without alteration

(b) The corresponding MS or AN standard part number is referenced in the part list and on the training device drawings.

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3.2.2.12 Indicator windows.- Where operating controls require the reading of dials through windows in the panels or the control housing, the windows shall be of a size to enable the operator to read three sets of figures so as to maximize detection of indication changes.

3.2.3 Electrical and electronic.

3.2.3.1 Unitized design.- Training device equipment shall be of unitized design incorporating repairable modular assemblies (see 6.2.4.1.6) of the types and sizes in accordance with MIL-STD-736.

3.2.3.2 Printed circuit construction.- The design and construction of printed circuits and printed circuit boards shall conform to MIL-STD-736 and MIL-STD-275.

3.2.3.3 Circuit design.- Circuit design shall be in accordance with MIL-STD-736 as applicable to the requirements of the detail specification. When design dictates the use of matched electronics parts, the contractor shall notify the procuring activity in writing

3.2.3.3.1 Microcircuits.- Microcircuits shall be in accordance with requirement 64 of MIL-STD-454. Specific written approval of the procuring activity shall be required for the use of microcircuits which have uncontrolled performance parameters. The required performance of a microcircuit shall not depend upon the unique characteristics of an individual part selected. Microcircuit devices selected from multiple sources shall be mechanically and electrically compatible.

3.2.3.3.1.1 Semiconductors.- The choice and application of semiconductor devices in the design of training devices shall be in accordance with requirement 30 of MIL-STD-454.

3.2.3.3.1.2 Interconnection accessibility.- Except for throwaway units, individual modules shall be attached by wiring planes in a manner permitting replacement of individual packs by solder-dipping or an equivalent process.

3.2.3.3.1.3 Mounting.- The mounting configuration shall be such as to provide optimum heat dissipation to insure that the device temperature rating is not exceeded.

3.2.3.3.1.4 Shielding.- Shielding shall be provided to protect low-power level signal circuits against the electromagnetic interference effects of conducted or radiated radiofrequency energy. Shielding shall not prevent replacement of defective wafers.

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3.2.3.3.1.5 Plug-in modules.- Mating male and female plug-in modules shall be provided with a positive keying safety arrangement to preclude insertion of a module into the wrong receptacle.

3.2.3.3.1.6 Reference designators.- Reference designators for microcircuits and microcircuit modules (for equipment covered by this specification) shall contain the prefix "U".

3.2.3.3.1.7 Drawing identification.- Microcircuits, microcircuit modules, and similar units identifiable as a functional entity shall be identified by reference designator and nomenclature on all trainer drawings. Electrical performance characteristics or parameters necessary for normal operation, test or repair, shall be identified on the appropriate drawings. Whenever possible, circuit functions shall be represented by equivalent discrete electrical components. This requirement is applicable to only Air Force procurements.

3.2.3.4 Circuit protective devices.- Circuits shall be protected by fuses or circuit breakers or other protective devices in accordance with requirement 1, and requirement 8 Class 1 of MIL-STD-454. All power protective devices shall be placed in the load side of the circuit. Multiphase equipment shall be protected by phase-reversal relays and drop-phase protective relays.

3.2.3.5 Electron tubes and semiconductors.- Electron tubes shall be selected from the types listed in MIL-STD-200. Semiconductors shall be selected from the types listed in MIL-STD-701.

3.2.3.5.1 Electron-tube and semiconductor sockets.- Electron-tube and semiconductor sockets shall be of the single unit type.

3.2.3.5.2 Electron-tube shields.- The heat-dissipating electron-tube shields of 3.1.5.22 shall be so mounted as to provide positive electrical contact between: (a) the shield base and supporting chassis and, (b) the shield and the supporting shield base. The dc resistance between contact surfaces of (a) and (b) shall meet the test requirements of 4.4.2.2.10.

3.2.3.5.3 Filament and heater connections.- Electron-tube heaters and filaments shall be connected in parallel.

3.2.3.5.4 Tube cooling.- Tube location and environment shall ensure that tube temperature ratings are not exceeded. Tubes other than pulse types shall be operated at not more than 80 percent of their maximum rated plate dissipation. Heat dissipation means shall be provided. Heat dissipating shields shall be used where electrostatic shielding of electron tubes is required.

3.2.3.6 Resistors - Selection and use of resistors shall be in accordance with MIL-STD-199.

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3.2.3.6.1 Variable, linear precision, tappable (potentiometers).- Shunting resistors used with variable linear precision, tappable potentiometers of 3.1.5.20.1, shall not be mounted on the potentiometer terminal board.

3.2.3.7 Capacitors.- Selection and use of capacitors shall be in accordance with MIL-STD-198.

3.2.3.8 Relays.- The use of relays shall be limited to areas of design wherein solid-state devices are not feasible. Where the use of relays is required, the relays shall be selected from the types cited in 3.1.5.19 of this specification.

3.2.3.8.1 Contact load currents.- Steady-state contact load currents shall not exceed 75 percent of the maximum rated current assigned by the relay manufacturer for noninductive loads. In circuits employing motors, lamps, and the like, where the surge current may greatly exceed steady-state current, relays shall have contacts of a size and material capable of carrying the surge current without overheating. Parallel operation of relay contacts shall not be used to increase the current-carrying capacity of the relay.

3.2.3.8.2 Arc suppression (relay contacts). Arc suppression of relay contacts shall be provided. Where space permits, a series capacitor-resistor combination is preferred to diode suppression.

3.2.3.8.3 Mercury-wetted contact relays.- Mercury-wetted contact relays shall not be used in applications which are subject to shock or vibration during normal operation. The use of mercury-wetted contact relays in any application shall be subject to the approval of the procuring activity.

3.2.3.8.4 Mounting of sensitive relays.- Sensitive relays subject to adverse effects of external magnetic fields shall not be mounted on a base of magnetic material, held by brackets made of a magnetic material, or mounted within 4 inches of any transformer, inductor, or similar device producing magnetic fields that would adversely affect relay operation.

3.2.3.8.5 Logic applications of relays.- Relays used in logic applications shall be of the sensitive type and have a life of not less than 10^8 operations (one operation is considered as one complete ON-OFF cycle).

3.2.3.8.6 Stepping relays.- Stepping relays shall be installed in dust-tight enclosures or covers.

3.2.3.8.7 Motor-control relays.- Motor control relays shall be provided with alternating current motors of 1/2 hp or larger. Motor control relays shall be used with motors of 1/6 hp up to 1/2 hp where repeated starting and stopping is required.

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3.2.3.9 Waveguide and coaxial assemblies.- Copper-alloy flanges shall be silver plated after assembly when used with silver-plated waveguide. MIL-HDBK-216 shall be used as a guide in the selection and use of waveguides and coaxial assemblies.

3.2.3.10 Primary power source (line voltage and frequency).- The equipment shall be designed to operate from the primary power source line voltage and frequency specified in the detail specification. The equipment shall meet the performance limits of operation over the steady-state tolerance of plus or minus ten percent in voltage from nominal value specified. For equipments which will be required to operate with mobile electric power generating sources, the requirements of MIL-STD-633B shall apply. When the application of MIL-STD-633B is required, the contractor shall advise the procuring activity in writing.

3.2.3.10.1 Voltage transient.- Maximum permissible transient voltage variation is expressed in percent of nominal utilization equipment voltage rating. (See 6.2.13).

3.2.3.10.2 Voltage transient limits.- The equipment shall withstand line-to-ground voltage transients of double amplitude of peak voltage when at the nominal value (see 3.2.3.10). The transients shall not cause failure of any part, prevent resumption of normal operation, or require the equipment to recycle when the transients have ceased.

3.2.3.10.3 Frequency transient limits.- The equipment shall be capable of operation during transients of plus or minus three percent of nominal frequency, of which not more than one percent is outside the steady-state tolerance band of plus or minus five percent, and recovering to the steady-state tolerance band within two seconds. (See 6.2.14).

3.2.3.10.4 Power interruption and transients.- The equipment shall be protected from permanent damage, modification of characteristics, and loss or change of analog or computer stored memory information, resulting from the following nonsimultaneous conditions of its power source:

(a) An interruption with power restored within 3 to 30 seconds occurring not more than once every five minutes

(b) A voltage transient of three and one-half (3.5) times nominal voltage to one-tenth (0.1) of normal voltage but short duration (less than one cycle)

(c) A frequency variation of plus or minus 15 percent for periods up to ten seconds occurring not more than once every five minutes.

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3.2.3.10.5 Power supplies.- Power supplies shall not be operated at more than 80 percent of rated full load capacity.

3.2.3.10.6 Pulsed loads.- Equipments which impose random or cyclic loads (such as radar or sonar) on the primary power sources shall comply with the requirements for pulsed loads of MIL-STD-1399, Section 103.

3.2.3.10.7 Power factor.- A power factor of not less than 80 percent shall be maintained in the training device under normal operating conditions.

3.2.3.10.8 Balance.- Three-phase power shall be balanced, during normal operating conditions, so that the current in any leg does not deviate by more than 7.5 percent from the average current in each of the three legs

3.2.3.10.9 Power distribution equipment.- A power distribution unit shall be provided to selectively distribute power to the trainer area. The unit shall constitute the trainer interface with the facility primary and utility power service. Operational control of power distribution shall be implemented at a power distribution control panel in accordance with 3.2.3.10.9.2. A keyswitch shall be provided to enable power distribution and the time totalizing meter. A red emergency power control shall be provided at the power control panel and at the other equipment locations of the trainer, and when operated shall totally remove power from the entire trainer. The power distribution unit shall consist of controls, indicators, bus bars, power relays, circuit protection devices, and the like, to implement the electrical and electronic requirements of 3.2.3.10.9.1.

3.2.3.10.9.1 Power distribution and cables.- Individual feeders from distribution panels to equipment cabinets shall be contained in conduit, duct, or armored cable. Cables shall not be spliced. Power cables shall handle power sources in accordance with maximum power demand based upon the following criteria

Maximum Demand	Power Sources
2300 Watts or less	115 volt, 1-phase, 3-wire, 60 Hz (including equipment ground wire)
Greater than 2300 watts but less than 3450 Watts	230 volt, 1-phase, 3-wire, 60 Hz or 115/230 volt, 1-phase, 3-wire 60 Hz
3450 Watts or more	120/208, 3-phase, 4-wire, 60 Hz or 230 volt, 3-phase, 3-wire, 60 Hz, when specified

3.2.3.10.9.2 Power distribution panel.- A power distribution panel shall be provided and shall contain the electrical busses and disconnects The power distribution panel shall electrically isolate the training equipment from the power mains The utility circuits shall be separately fused.

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3.2.3.10.9.3 Phase-warning light.- In addition to the safety requirements of 3.2.1.2, and when specified in the detail specification, a red warning light shall be installed on or near the power distribution panel to visually indicate incorrect phase rotation for three-phase service.

3.2.3.10.9.4 Temperature sensing alarms.- Temperature sensing devices shall be located in all equipment cabinets of the trainer Alarms shall be activated when the temperature rises above limits for safe operation (see 3.2.1.2.5). Alarms shall be located on the power distribution panel with means to identify the area producing the alarm.

3.2.3.11 Internal supply voltages.- Preferred values of positive or negative DC regulated supply voltages, shall be 1.5, 3, 5, 6, 12, 20, 28, 50, 100, 150, 250 and 300 volts.

3.2.3.12 Electrical bonding.- The electrical bonding practices specified in MIL-B-5087 and MIL-STD-1310 shall be used as guides in the design of electrical bonding for training devices.

3.2.3.12.1 Cabinet bonding.- Equipment cabinets shall be electrically bonded by use of bonding strap ground connectors. Bonding strap connections shall not reduce the spraytight, drippproof or watertight characteristics of the equipment. Bonding studs shall not interfere with the extraction or insertion of the equipment into the cabinet.

3.2.3.13 Grounding and grounding systems.- Grounding system design shall provide three separate and isolated reference grounding systems to control ground-return conducted interference, provide effective shielding, and protect personnel from electric shock hazard. These are:

(a) Primary power grounding

(b) Signal grounding

(c) Chassis grounding.

3.2.3.13.1 Primary power grounding.- Primary power circuits shall not be directly grounded within the training device. All neutrals shall be made common at the power source neutral bus. The neutral bus of the power source shall be routed through equipment power panels to earth potential at one point.

3.2.3.13.1.1 Power line interference filters.- Where required power line interference filters shall be referenced to chassis ground. Power line interference filters shall meet the electromagnetic compatibility requirements of the detail specification.

3.2.3.13.2 Signal grounding.-

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3.2.3.13.2.1 Low-frequency signal grounding.- Signal frequencies of 150 kHz or less and pulsed signals with rise and fall times equal to or greater than five microseconds shall utilize a grounding system insulated from the chassis and prime power ground within the training device. Analog systems which have frequencies less than 20 kHz shall use a grounding system that is referenced to a single point to avoid duplicate and common signal ground return paths.

3.2.3.13.2.2 High-frequency signal grounding.- Signal frequencies greater than 150 kHz and pulsed signals with rise and fall times less than five microseconds may utilize chassis as signal ground. Signal interfaces with equipments not in this category shall be properly isolated to ensure noncompromise of the lower-frequency equipment signal ground system High-frequency grounding (bonding) straps shall have a length-to-width ratio of 5 1 and a minimum thickness of 0.025 inches.

3.2.3.13 2.3 Signal ground bus bar.- Cabinets, consoles, and racks containing electronic equipment shall have a full-length signal ground bus bar for the ground reference The bus bar shall provide a low impedance path for the equipment transient and steady-state signal current. The bus bar shall be connected to each equipment signal ground point requiring a reference and the overall enclosure signal ground point

3.2.3.13.2.4 Signal ground point. Cabinets, consoles, racks, and equipment shall have a signal ground point isolated from chassis. The signal ground point shall be located less than two inches from the chassis ground point. The junction resistance between the signal ground bus and a signal ground point shall be no greater than 0.5 milliohm.

3.2.3.13.3 Chassis grounding.- Equipment cases, cabinets, racks, and enclosures shall be referenced to the chassis grounding system. The chassis grounding system shall provide for a fault-current return path for personnel shock hazard safety and a low impedance path for RF currents for the training device electrical or electronic equipments. The resistance between any two chassis ground interfaces shall be less than 2.5 milliohm. Plugs and convenience outlets for use with portable tools and equipment shall have provisions for automatically grounding frame, case, or housing of tools and equipment, for personnel shock hazard safety, when the plug(s) is mated with a receptacle(s) that conforms to W-C-596.

3.2.3.13.4 Shield grounding.- Cable and wire shield grounding termination practices shall be consistent with the frequencies and the interference and susceptibility levels of wires and cables being shielded. The following shield grounding methods shall be used:

(a) Shields used for low-frequency signal lines shall be terminated at one end only

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(b) Shields used for high-frequency signal lines may be terminated at each end

(c) Coaxial cable shields for low-frequency, low-level signal lines shall be floated from chassis

(d) Conduit and external metallic sheath used for overall cable shielding shall be terminated to chassis ground at each end by direct contact around the periphery of the shield

(e) Shields used for restricting high-frequency interference and relay lines shall be terminated to chassis ground at each end.

3.2.3.14 Wiring and cabling.- Wire and cabling routing shall provide the isolation required to meet the electromagnetic compatibility requirements of the detail specification. Interconnecting cables between cabinets and enclosures shall enter from the rear, top, or bottom of cabinets or enclosures.

3.2.3.14.1 Wire and cable classification.- Interference-producing or interference-sensitive wires and cables classified below shall meet the electromagnetic interference (EMI) criteria specified in the detail specification:

(a) Class I - Class I consists of wires and cables between equipments or circuits that are not interference-producing. Examples of this class are:

(1) AC power wiring

(2) Relay and stepping-motor wiring

(3) Actuating power wiring

(4) Motor wiring

(5) Flashing incandescent and fluorescent light wiring

(b) Class II - Class II consists of wires and cables that, in themselves, are not interference-producing but are connected to interference-sensitive equipments or circuits. Examples of this class are:

(1) Microphone circuits

(2) Audio and video outputs

(3) Metering and bridge circuits

(4) Transducer outputs

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(5) DC and AC reference voltages

(6) Receiver inputs.

(c) Class III - Class III wiring consists of wires and cables that are connected to equipments that are both interference-producing and interference-sensitive. Examples of this class are the Pulse Inputs and Outputs of digital equipments.

(d) Class IV - Class IV wiring consists of those wires which carry classified information.

3.2.3.14.2 Wiring.- The selection and application of interconnecting wires and cables between chassis racks or cabinets shall be in accordance with requirement 20 of MIL-STD-454. Wire shall have a minimum of seven strands. Solderless wrapped connections shall be in accordance with MIL-STD-1130.

3.2.3.14.3 Hookup wire temperatures.- The hookup wire temperature requirements of MIL-W-8160 and requirement 20 of MIL-STD-454 shall apply. Methods compatible with limiting insulation temperature and the ambient temperature of a given area may be utilized to achieve a savings in weight, provided substantiating data are submitted to the procuring activity for approval.

3.2.3.14.4 Current-carrying capacity.- Current-carrying capacity of wires and cables shall be in accordance with MIL-W-8160.

3.2.3.14.5 Voltage-drop.- The voltage-drop requirements of MIL-W-8160 shall apply.

3.2.3.14.6 Slack.- For flexible conductors, including those within cables terminating in multiterminal headers or receptacles, slack shall be provided to permit not less than two replacements of the part, with the exception of radiofrequency (RF) leads, where the length must be made as short as possible for electrical reasons.

3.2.3.14.7 Insulation protection.- Where wires are run through holes in metal partitions (shields and the like) less than 1/8 inch in thickness, the holes shall be equipped with grommets for mechanical protection of the insulation. Holes in panels of 1/8 inch or more in thickness shall either have grommets or the hole edges shall be rounded to a radius equal to one-half of the thickness of the panel. Grommets for wires operating at RF potentials shall be of ceramic, styrene, or phenolic material, except for coaxial cables, where rubber or neoprene grommets are acceptable.

3.2.3.15 Connections.-

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3.2.3.15.1 Mechanical.- Mechanical connections shall be supported to prevent breakage and changes in performance due to vibration, inclination, or shock encountered under specific service conditions specified in the detail specification. Wire terminations shall be in accordance with the mechanical connections requirements of MIL-S-45743.

3.2.3.15.2 Shielded wire.- Conductors using metallic shielding unprotected by an outer insulation shall be secured so as to prevent the shielding from coming into contact with exposed terminals or conductors. Shielding shall be terminated at a suitable distance to ensure adequate insulation from the exposed conductor to prevent shorting or arcing between the conductor and the shielding.

3.2.3.16 Identification of conductors.-

3.2.3.16.1 Coding of conductors.- Conductors shall be coded in accordance with MIL-STD-681.

3.2.3.16.2 Lacquer-insulated wire leads.- Lacquer-insulated wire leads in excess of four inches shall be color-coded by means of colored lacquer spotted near terminals, except where the leads terminate at marked terminals or where the terminal designations and the placement of the leads provide easy lead identification.

3.2.3.16.3 Wire terminal ends.- The terminal ends of each conductor of a jacketed cable or hookup wire harness shall be marked for identification purpose by use of tubing markers in accordance with Type F, Grade A, Form U, Class 1 of MIL-I-631.

3.2.3.17 Component identification.-

3.2.3.17.1 Identification.- Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130.

3.2.3.17.2 Method of marking.- Identification markings shall be permanent and legible. The markings on plastic or metallic materials shall be accomplished by ink stamping, embossing, engraving, silk screening, or stenciling with a smudgeproof ink.

3.2.3.17.3 Reference symbol designations.- Reference symbol designations shall be assigned to electrical and electronic component assemblies in accordance with ANS Y32.16. Mechanical symbols shall be in accordance with MIL-STD-17. Symbols for electrical and electronic diagrams shall be in accordance with ANS Y32.2.

3.2.3.17.4 Terminals, boards, and strips.- Terminals, boards, and strips shall be identified in a permanent manner to facilitate replacement of connections. Where space limitations prohibit marking on the terminal, strip or board, the marking shall be on the chassis adjacent to the terminal, strip or board.

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3.2.3.17.5 Cable and wire marking.- Wire terminal points and cables shall be identified by a combination of letters and numbers showing the "to-from" terminations imprinted on markers or tubular sleeves as illustrated in Figure 1. Cable assemblies and harnesses shall be numbered consecutively starting with the designation W-1 (See Figure 1). Cable identification shall be made by means of a sleeve marker or wrap-around plastic tape (See 3.2.3.16.3). The identification method used shall not damage the wire and shall be located such that shielding ties, clamps, or supporting devices will not have to be removed in order to read the identification. Wires and cables shall be identified within three inches of each terminating point. The following are individual wires that shall be marked:

(a) All lugged leads

(b) Wires attached by screws or nuts with the following exceptions.

(1) The termination point of the wire is obvious and unmistakable should it be removed for service or maintenance

(2) Two or more such wires could be connected interchangeably without altering the electrical circuit (for example: all connect to ground)

3.2.3.17.5.1 The following are individual wires that need not be marked:

(a) Point to point wiring

(b) Wires terminating with soldered connections (other than lugs), taper pins, wire wrap, or termi-point

3.2.3.17.5.2 Cable assemblies are defined to be more than one wire, enclosed throughout the entire length by a common insulation, sheathing, packing, or armor, fabricated as a unit. Cable harnesses are defined as a bundle of wires, bound as a group by lacing, ties, or similar means. Reference designations of cable assemblies shall be in accordance with ANS Y32.16. These identification requirements do not apply to soldered or other type terminations which are not normally subject to disassembly for maintenance, repair, or shipping. The characters on the sleeve shall be legible and permanent.

3.2.3.17.6 Electron tube, semiconductor, and socket identification.- The type designation of each electron tube, semiconductor, and sockets, including their circuit designation, shall be marked in accordance with ANS Y32.16, and as indicated in 3.2.3.17.6.1.

3.2.3.17.6.1 Markings.- Markings shall be adjacent to the tube/semiconductor socket on the tube/semiconductor side of the chassis or supporting structure for ready identification of the particular tube or semiconductor. The circuit reference designation used to identify the tube/semiconductor socket and the type designation of the tube or semiconductor shall be

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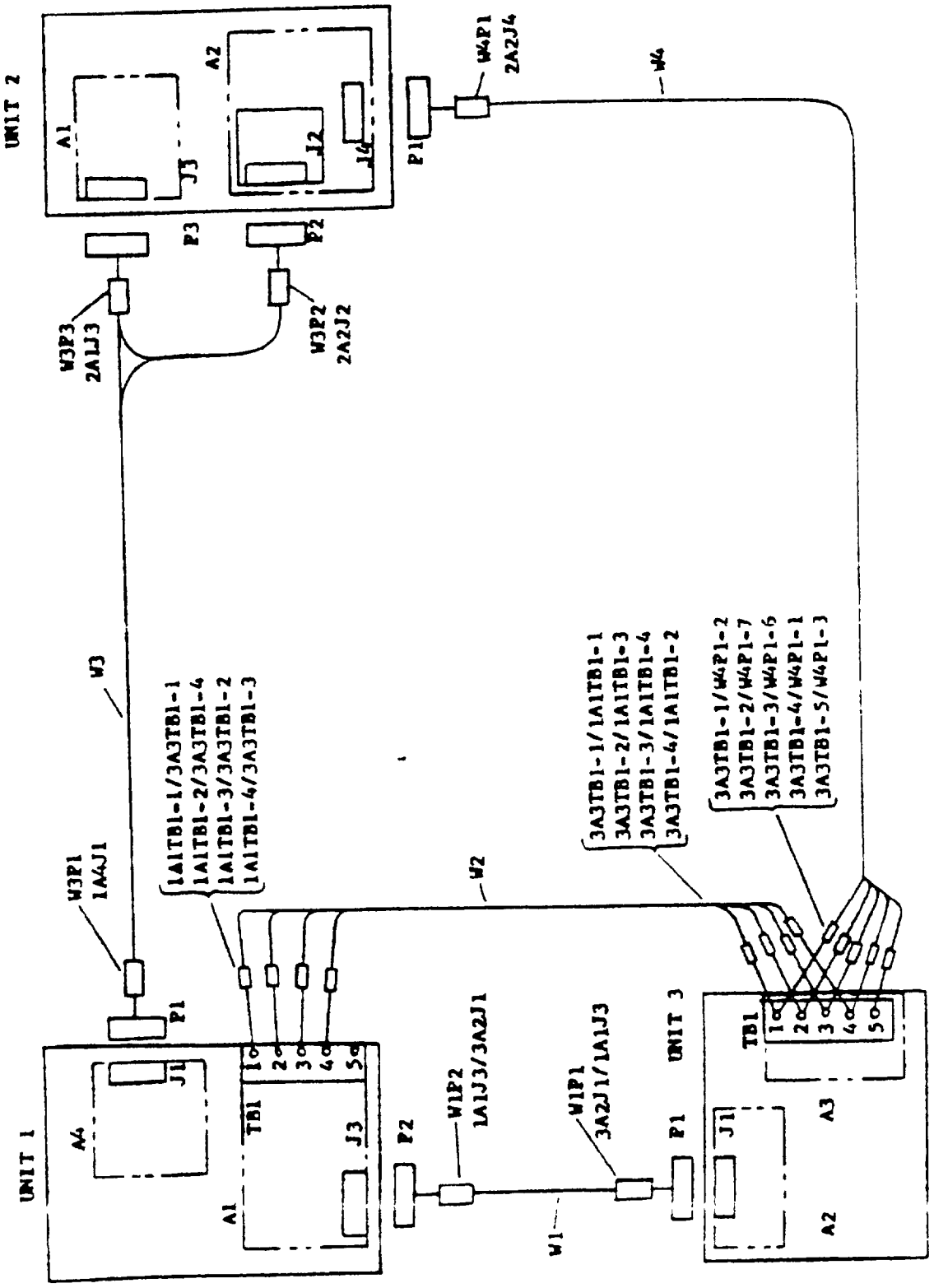

Figure 1

WIRE IDENTIFICATION SYSTEM

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marked on the reverse side of the chassis adjacent to the respective sockets. If available space will not permit such marking of tube/semiconductor type and circuit reference designations, a diagram showing the locations of the tubes, semiconductors and their respective sockets shall be placed where it will be visible when viewing from either top or bottom.

3.2.3.17.7 Item markings - Items of the training device requiring markings, such as dial controls, graduations, on-off switches, push-pull controls, or markings, including test points, shall be identified, graduated and numbered. Intervals used for calibration shall be determined by the range of coverage and scale length. The marking and mounting of all dials and scales shall be such that at least three identifying figures will be visible at all times. The operating panel surface adjacent to controls, indicators, jacks, and the like shall be marked, with a phrase or abbreviation in accordance with MIL-STD-12, to indicate function of the item. Each chassis shall be marked with its identifying schematic designation.

3.2.3.17.8 Rotary electrical devices and power supplies.- Connection markings, of rotating electrical devices, such as: alternating-current and direct-current motors and generators, synchronous converters, and the like, as well as power-transformers, and metallic-rectifier types of power supplies, shall be in accordance with MIL-STD-195. Irreversible motors shall be marked in a permanent manner to show direction of rotation

3.2.3.17.9 Training equipment nomenclature - Training equipment nomenclature shall be as specified by the procuring activity.

3.2.4 Optical systems.- MIL-HDBK-141 shall be used as a guide in the design of optical systems (see 6.2.12)

3.2.4.1 Image quality.- The definition and quality of the complete optical and associated system shall be as specified in the detail specification.

3.2.4.2 Reflection and reflection reduction.-

3.2.4.2.1 First-surface mirrors.- First-surface reflecting surfaces shall be of evaporated aluminum or equivalent, with adhesion to the substrate, without visible discontinuities that affect the field of view as seen with the eye in the normal viewing position. First-surface mirrors shall be protected by a thin uniform coat or film of silicon monoxide or other materials of equal performance quality, free from holes, voids, or foreign matter, and without perceptible variations in density of the deposited material. Where silicon monoxide coatings cannot be prepared or are not warranted, a magnesium fluoride coating in accordance with MIL-C-675 or a similar protective coating of an equivalent uniformity will be acceptable.

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3.2.4.2.2 Internal reflection coatings - Internal reflecting surfaces shall be of chemically deposited silver, or, if justified by special requirements, an equivalent process or material. Silver surfaces on the outside of a prism or mirror shall be backed with copper and a black finish. Surface uniformity shall be such that no discontinuities or unevenness shall affect the field-of-view by an observer in the normal viewing position.

3.2.4.2.3 Reflectance.- Unless otherwise specified, reflectance shall not be less than 89 percent.

3.2.4.2.4 Use of reflection-reducing coatings.- Reflection-reducing coatings or films shall be on all glass-to-air optical surfaces except the following

(a) Surfaces which lie in or very near to an image plane

(b) Both surfaces of elements bearing reticle graduations

(c) Surfaces of elements not in the direct image transmission path

(d) Surfaces reflecting by total internal reflection or other reflecting surfaces, including partial reflecting (beam splitting) surfaces

(e) Surfaces specified not to be coated

3.2.4.2.5 Quality of reflection-reducing coatings.- Reflection-reducing coatings shall meet the requirements of MIL-C-675 except that, under the following conditions, coating requirements shall be as specified in the detail specification

(a) When an optimization of reflection reduction from a principal direction of light is different from a zero degree angle of incidence

(b) When a highly efficient (multilayer) antireflection coating is warranted

(c) When a spectral distribution differs essentially from the one considered in MIL-C-675, (i.e., ultraviolet or infrared radiation)

3.2.4.3 Stray light (unwanted scattered light).- No stray or scattered light, or reflections from surfaces within the optical system shall be

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permitted in the field of view or enter the exit pupil, or be visible in the vicinity of the exit pupil when the pupil is viewed from a distance equal to the normal viewing distance along the extended ocular axis. Internal surfaces of mechanical parts from which stray or scattered light might be reflected shall be threaded, knurled, or scored to prevent reflection. Surfaces from which troublesome reflections might occur, shall be darkened by chemically oxidizing the surface or treatment with a nonreflecting black paint. Where warranted, light baffles shall be used, the surfaces of which shall be treated as specified above.

3.2.4.4 Environmental factors.- To the extent specified in the detail specification, provisions for the inhibition of environmental factors, such as: temperature, moisture, pressure, foreign particles, and vibration, shall be incorporated in the design of the optical systems.

3.2.4.4.1 Condensation.- Condensation shall be prevented from forming on viewing glasses or windows due to temperature differentials.

3.2.4.4.2 Vibration and acceleration.- Design of optical systems that are subjected to vibration and acceleration shall meet the vibration and acceleration environmental tolerances required by the detail specification.

3.2.4.5 Lasers.- When Lasers are used in, or as training devices, the following shall apply.

(a) Personnel safety.

(1) When Lasers operate in the visible or near visible regions of the spectrum, possible eye hazards shall be evaluated as specified in the detail specification and the Lasers Safety Regulations of the Office of the Surgeon General, Department of the Army

(2) When Lasers operate outside the visible or near visible regions of the spectrum, evaluation shall be made of hazards to personnel consisting of radiant energy burns and electric shock

(b) Spectral output.

(1) When Lasers are used in displays for human viewing, the spectral Laser lines shall be chosen with regard to energy or power and luminosity function

(2) When Lasers are used in non-human viewing situations, consideration shall be given to utilizing spectral lines outside the visible or near visible regions of the spectrum to minimize personnel hazards

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(c) Pulse Lasers : Consideration shall be given to spectral output, pulse energy, peak pulse power, beam divergence, and mode characteristics

(d) CW (continuous wave) Lasers . Consideration shall be given to spectral output, peak pulse power, beam divergence, and mode characteristics.

3.3 Reliability.- Unless otherwise specified in the detail specification, reliability (see 6.2.7) shall be in accordance with the Government-approved Reliability Program Plan of the contract and as specified in 3.3.1 through 3.3.3 of this specification.

3.3.1 Qualitative requirements.- The following reliability factors shall be considered for component part selection and application.

(a) Useful life expectancy

(b) Failure rate from established sources

(c) Operating characteristics

(d) Mechanical, electrical, and thermal stress levels

(e) Environmental conditions.

3.3.1.1 Fabrication techniques.- Fabrication, assembly, and workmanship methods employed shall not degrade the inherent reliability of the components and assemblies.

3.3.1.2 Usage.- Consideration of operating and maintenance procedures, effects of maintenance, and deterioration under storage conditions shall be considered in design for reliability.

3.3.2 Scheduled availability.- Scheduled availability for training time shall be 99% unless otherwise specified in the detail specification and shall be based on the model,

$$A_S = \frac{\Sigma t}{\Sigma T} \times 100\% = \frac{\Sigma T - \Sigma t_{tr}}{\Sigma T} \times 100\%$$

ΣT = The sum of all planned (scheduled) training time for a complete training course

Σt = The sum of all satisfactory operational on-time during the scheduled training periods of a complete training course ($\Sigma T - \Sigma t_{tr}$)

Σt_{tr} = The sum of all active repair times, and excludes logistics time and administrative time for repairs

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A_s = Scheduled availability expressed as percentage

3.3.3 Time totalizing meter.- A time totalizing meter shall be utilized on the power distribution panel of 3.2.3.10.9.2 and shall indicate the cumulative length of time the training equipment is on. Time totalizing meters shall also be installed on the major subsystems which may be used independently of each other for fractions of the total trainer time. The meters shall have at least five digits in increments of one hour The meters shall be in accordance with MIL-M-7793.

3.3.4 Quantitative index - The quantitative reliability index shall be as specified in the detail specification

3.4 Maintainability.- Unless otherwise specified in the detail specification, the maintainability requirements shall be in accordance with the Government-Approved Maintainability Program Plan of the contract and as specified in 3.4.1 through 3.4.7.4 of this specification.

3.4.1 Ease of maintenance. The training device shall be designed so that it can be maintained by organizational and intermediate level maintenance personnel. The training device shall follow the design-for-maintainability guides outlined in NAVSO P-3758-S4 and NAVSHIPS 0367-048-1010.

3.4.2 Accessibility - Accessibility requirements shall conform to Requirement 36 of MIL-STD- - and as specified in 3.4.2.1 through 3.4.2.8 of this specification.

3.4.2.1 Assemblies.- Channel-guided sections with tracks, rollers, or pivots, or a combination thereof shall be used for providing accessibility to units, assemblies, subassemblies and parts (see 3.2.2.4). Automatically operated locking devices shall be provided to lock the chassis in the servicing position as well as in the fully opened and fully closed positions. The design of each major assembly, subassembly, and unit of the training device, shall permit access to its interior components and parts for maintenance. It shall not be necessary to displace or remove wires, cables, subassemblies or assemblies in order to gain access to mounting screws, test points, adjustment points, lubricating points, and the like. Where visual inspection is necessary and open access is not feasible, transparent access panels shall be used. The placement of parts shall be such as to provide space for the use of test probes and soldering tools. Assemblies subject to replacement or servicing shall not be permanently secured.

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3.4.2.2 Wiring board extender cards.- Where connector termination points are not accessible for testing extender cards shall be provided. Extender cards shall have a matching indexing system and shall be identified with their corresponding wiring boards. Varnish or other insulating materials shall not be applied to the conducting surfaces.

3.4.2.3 Covers, panels and doors.- Hinged covers and doors shall be retained in their open positions and when opened, shall not cause the equipment to become unbalanced. A chain fastened to the equipment shall be used on removable covers for which no convenient location for depositing the cover is available during maintenance. Front panels which contain parts requiring maintenance such as instruments, switches, potentiometers and the like, shall be hinged. Where parts or assemblies are mounted on hinged doors, panels or covers, electrical ground return shall not depend on hinge contact for electrical continuity. A separate grounding means shall be provided for the electrical ground return. Locking devices shall be installed on the panels to retain them in the open position to permit accessibility to all parts mounted on the panel and to prevent damage to the panel or injury to personnel performing maintenance.

3.4.2.4 Handles - Handles or hand grips shall be provided for removing units or chassis from enclosures. Handles on enclosures shall be recessed.

3.4.2.5 Replacement of modular assemblies.- Plug-in techniques shall be used to permit replacement of modular assemblies. All modular assemblies shall be designed so that they can be inserted into the equipment in one position only. Sockets shall be oriented in the same direction and positioned so that the sockets are visible. Modular circuits shall be grouped in functional units.

3.4.2.6 Mismating of electrical connectors .- Means shall be provided to prevent the mismating of electrical connectors.

3.4.2.7 Replacement of parts and microelectronic functional devices.- Where the design requires the use of electromechanical assemblies, modular parts and subassemblies shall be mounted so as to permit removal and decoupling from the mechanical portion of the assembly. The arrangement of parts shall be such that replacement of any part is possible without removal of adjacent parts. Microelectronic functional devices making up microelectronic construction shall be replaceable and shall be grouped in functional units.

3.4.2.8 Adjustment and calibration.- The time required for adjustment and calibration due to the replacement of an assembly or part shall be consistent with the specified quantitative maintainability requirements.

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Adjustable parts, such as, potentiometers and variable capacitors, shall be adjustable with the chassis in an operating position.

3.4.3 Utility receptacle.- To facilitate maintenance, 60 Hz, 120-volt, grounding-type utility duplex receptacles conforming to W-C-596 Style D, shall be installed at locations as specified in the detail specification.

3.4.4 Maintenance intercommunications system.- When specified by the detail specification a maintenance intercommunications system, conforming to MIL-C-29025, shall be installed.

3.4.5 Special tools.- Special tools requirements shall conform to Requirement 63 of MIL-STD-454

3.4.6 Test points, test facilities, and test equipment.- Test points, test facilities, and test equipment (see 6.2.1) requirements shall conform to Requirement 32 of MIL-STD-454 and as specified in 3.4.6.1 through 3.4.6.6 of this specification.

3.4.6.1 Test points.- Test points shall be provided and identified for checking waveforms and voltages and for the injection of test signals Each assembly or subassembly of the training device shall be provided with test input and output connections to permit the application of externally generated test signals and external measurement and indication of response to the test signals The test points shall be brought out through one or more pins of a connector, terminating on the outside of the total unit enclosure. Primary test points shall be grouped in a line or matrix that reflects the sequence of tests to be made. When test points require voltages or waveforms to be measured against ground potential, at least one grounded test point shall be provided. Test point(s) shall be marked with a warning placard when the application of conventional test equipment probes could cause damage to internal circuits (such as, integrated circuits).

3.4.6.2 Built-in test facilities.- When specified in the detail specification, built-in test facilities shall provide for calibration, fault detection, fault isolation, and performance monitoring functions. The built-in test facilities shall be designed so that assessment of test results may be achieved and malfunctions isolated to the assembly level.

3.4.6.2.1 Test procedures.- The test procedures using the built-in test facilities shall provide functions, such as:

(a) Detection of performance degradation and incipient failure

(b) Assessment of overall training device integrity

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(c) Elimination of the necessity of taking measurements under hazardous conditions.

3.4.6.2.2 Automatic techniques.- When specified in the detail specification, complex functions, such as test-point scanning, stimuli control, signal conditioning, and signal comparison and readout, shall be accomplished by automatic techniques in accordance with MIL-STD-1326. (See 6.2.18).

3.4.6.2.3 Manual techniques.- Panel meters and monitor scopes shall be provided for measuring parameters, such as; power supply voltages and critical waveforms, which require periodic observations. Selector switches shall be provided with each monitor scope to allow display of multiple critical waveforms. In such cases, overlays which show acceptable waveforms and associated tolerances shall be provided. Indicators shall be provided which measure pneumatic or hydraulic pressures. A blown-fuse indicator light for each fuse installed in accordance with 3.1.5.9 shall be located at the front of the associated equipment rack such that the indication of the blown fuse is evident.

3.4.6.3 Test equipment.- Training devices shall be so designed as to be capable of being maintained, tested, aligned, adjusted, calibrated and repaired using standard test equipment.

3.4.6.4 Assembly tester.- When specified in the detail specification, an off-line assembly tester shall be provided with the training device. The unit shall check dynamically all removable assemblies, including modular assemblies and printed circuit boards. Assemblies of the same type which are used in the training device five or more times shall be capable of being checked on the assembly tester automatically or semiautomatically. Assemblies of the same type which are used in the training device less than five times may be checked manually utilizing standard test equipment. The assembly tester shall supply all necessary test voltages and test signals for the purpose of isolating a malfunction to the piece part within the assembly under test. The test voltages, signals, and loads provided shall include those which are applied to the assembly under normal operating conditions and shall also include provisions for varying critical voltages, signal amplitudes, and time durations for marginal testing. Plug-in provisions shall be incorporated for testing all plug-in modular assemblies, microelectronic functional devices and repairable assemblies used in the training device. The assembly tester shall incorporate an on-off switch and shall contain its own circuit protective devices. The use of the assembly tester shall not affect the operation of the training device.

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3.4.6.5 Test-recorder provisions.- A panel containing outputs for the recordings of parameters necessary for static and dynamic checkout of the training device shall be provided.

3.4.6.6 General-purpose electronic test equipment (GPETE).- All GPETE for use with training devices shall be selected from the preferred list of MIL-STD-1364.

3.4.7 Maintenance provisions for digital systems.- When specified in the detail specification, the following provisions shall be made in digital systems including peripheral, auxiliary, and interface equipments.

3.4.7.1 Maintenance console.- A computer maintenance console shall be provided. The console shall incorporate provisions for manual insertion of instructions and data and shall contain displays, such as, (but not limited to) accumulator, registers, instruction, and data, to enable the maintenance checks. The maintenance console shall include a work-surface area.

3.4.7.2 Marginal-check feature.- A marginal-check feature or its equivalent for the computer system shall be provided in the event a special purpose computer is required. The marginal-check shall be used in conjunction with diagnostic and test programs to detect incipient, transient, or other malfunctions. A marginal-check feature may be incorporated in the training device in the event a general-purpose computer is used.

3.4.7.3 Display registers.- Display registers shall be provided to permit selection and visual examination of the content of any element of program and data storage.

3.4.7.4 Single-step provisions.- Means shall be provided to permit single instruction execution of the computer program for aid in locating computer or program troubles. Register content readout as specified in 3.4.7.3 shall be available to check computational progress.

3.4.8 Quantitative index.- The quantitative maintainability index shall be as specified in the detail specification.

3.5 Transportability.- The transportability of the training device shall be as specified in the detail specification.

3.6 Performance.- The performance of the training device shall be as specified in the detail specification.

3.7 Details of components.- Details of components, such as: instructor console, computer, and the like, shall be as specified in the detail specification.

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3.8 Electromagnetic interference suppression.- Electromagnetic interference emission and susceptibility of the training device (see 6.2.6) shall meet the MIL-STD-461 electromagnetic interference suppression requirements stated in the detail specification.

3.8.1 Design guidelines.- The design guidelines in AFSC DH 1-4 (Electromagnetic Compatibility) shall be used in meeting the electromagnetic interference emission and susceptibility suppression requirements of 3.8.

3.9 Dimensions.- Dimensions and tolerances shall be in accordance with the detail specification requirements.

3.10 Weight.- The weight requirements of the training device shall be in accordance with the detail specification.

3.11 Color.- Selection of colors for training devices shall be limited to the semigloss series of FED-STD-595. The selection of specific colors for a training device shall be as specified by the procuring activity.

3.12 Finish.- Finish shall be in accordance with the detail specification and as specified in 3.1.6.5 and 3.1.6.6.

3.13 Nameplates or product markings.- Unless otherwise specified by the procuring activity a training device nameplate shall be affixed to the training device in a location to be designated by the procuring activity. The training device nameplate, other identification, instruction, and information plates shall be in accordance with MIL-P-15024. Assemblies, subassemblies, and parts shall be marked in accordance with MIL-STD-130.

3.14 Government-furnished property (GFP) (See 6.2.15).- Government-furnished property shall be as specified by the Procuring Contracting Officer.

3.14.1 Modification of operational equipment.- When operational equipment (GFP or contractor-acquired) is to be modified, modifications shall be external to the operational equipment and easily detachable. When it is necessary to modify the operational equipment internally, written approval of the procuring activity shall be required.

3.15 Workmanship.- Workmanship shall be in accordance with requirement 9 of MIL-STD-454.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- An organized quality assurance program shall be established by the contractor in accordance with MIL-Q-9858. The program shall ensure quality throughout all areas of the specification

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requirements including: design, development, fabrication, processing, assembly, inspection, test, maintenance, preparation for delivery, shipping, storage, and site installation. Certain requirements herein, such as testing, may be considered common to the Quality, Reliability, and Maintainability Programs. The contractor's quality assurance program shall be planned and utilized in a manner to effectively support the contractor's Reliability and Maintainability Programs.

4.2 Responsibility for inspection.- Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.3 Facilities - The contractor shall furnish any facilities, equipment or personnel that the Government may require to ensure that the training device meets the requirements of this specification and the detail specification.

4.4 Classification of inspections.- Inspections to be performed are classified as follows:

(a) In-process inspection

(b) Quality conformance inspection.

4.4.1 In-process inspection.- In-process inspection shall include such visual, electrical and mechanical examinations and testing of materials, subassemblies, parts and accessories (including purchased items) during the manufacturing process of the training device as may be required to assure conformance to all requirements of this specification and the detail specification.

4.4.2 Quality conformance inspection.- Quality conformance inspection shall consist of the examinations of 4.4.2.1 and tests of 4.4.2.2 through 4.4.2.2.10.

4.4.2.1 Examinations.- The training device shall be visually examined for conformance to the requirements of the detail specification and the following requirements of this specification:

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(a) Materials

(b) Parts (standard/nonstandard)

(c) Design

(d) Processes (Construction)

(e) Assembly and fit

(f) Wire markings

(g) Dimensions and tolerances

(h) Size and weight

(i) Color

(j) Finish (corrosion protection and treatment)

(k) Nameplates and product markings

(l) Safety

(m) Workmanship.

4.4.2.2 Tests.- Each training device shall be subjected to the following tests to the extent specified in the detail specification:

(a) Functional

(b) Trainer operation

(c) Structural

(d) Electrical

(e) Grounding and grounding systems

(f) Human-factors engineering compliance

(g) Reliability

(h) Environmental

(i) Electromagnetic interference suppression.

4.4.2.2.1 Functional tests.- Functional tests shall consist of all tests necessary to determine compliance with the performance requirements of the detail specification.

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4.4.2.2.2 Trainer operation tests.- The training device shall be tested to determine the suitability of controls and control circuits for satisfactory mechanical and electrical operation.

4.4.2.2.3 Structural tests.- Structural tests shall be as required by the detail specification.

4.4.2.2.4 Electrical tests.- Electrical tests shall be performed as necessary to determine compliance with the electrical requirements specified in 3.2.3.10 through 3.2.3.12.1.

4.4.2.2.5 Grounding and grounding systems tests.- Grounding and grounding systems tests shall be performed to determine compliance with the grounding and grounding systems requirements specified in 3.2.3.13 through 3.2.3.13.4.

4.4.2.2.6 Human-factors engineering compliance tests.- The human-factors engineering compliance tests shall consist of an evaluation of the training device design characteristics by personnel of the procuring activity to determine compliance with the human-factors engineering requirements of this specification and the detail specification.

4.4.2.2.7 Reliability tests.- Reliability tests shall be as required by the detail specification and shall be subject to the following criteria.

(a) Monitoring instruments shall be used to observe essential operating characteristics and to determine the time of failure

(b) A failure shall be considered to have occurred whenever the training device requires corrective maintenance action in order to perform its function within specified limits

(c) A pattern failure shall be considered to have occurred when two or more failures of the same part in identical or equivalent application exceeds their combined predicted failure rate. Necessary corrective action at no cost to the Government shall be required, including retrofitting of equipment already accepted under the same contract.

4.4.2.2.7.1 Test conditions.- The test shall consist of a number of test periods in accordance with a list of training exercises. The training exercises should be similar to the actual training use of the device. The test periods are to be arranged to cycle the equipment to provide cool down periods and restarts representative of actual usage. During the off periods, for cool down, the planned and permissible preventive maintenance schedule may be followed. If the time lost for unscheduled repair during the planned test (course) period requires that additional test time be expended to complete the planned test, such time will not count as operational on-time. The summations of the satisfactory

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operational on-times and planned training times will be substituted into the model described in 3.3.2 to determine compliance with the scheduled availability.

4.4.2.2.7.2 Test duration. The duration of the test shall be one complete training course unless otherwise stated in the detail specification.

4.4.2.2.8 Environmental tests.- Environmental tests shall be performed as necessary to establish durability and reliability of the training device materials and components under specified environmental operating conditions. These tests shall be those required by the detail specification and shall be in accordance with MIL-STD-810.

4.4.2.2.9 Electromagnetic interference suppression tests.- The training device shall be tested to determine conformance to the electromagnetic interference suppression and compromising emanation suppression requirements of 3.8 by use of Test Methods of MIL-STD-462 and NACSEM 5100 to the extent specified in the detail specification.

4.4.2.2.10 Electron-tube shield electrical contact.- The contact resistance of mating surfaces (a) and (b) of 3.2.3.5.2 shall not be greater than 1 ohm when measured with an ohmmeter having an accuracy of ± 3 percent of indication or better.

4.5 Extent of testing and test conditions.- The extent of testing and test conditions required to determine quality assurance for any particular type of training device, system, or subassembly, shall be as specified in the detail specification.

4.6 Material to accompany training devices.- Training devices submitted by the contractor for Government inspection shall be accompanied by an adequate amount of maintenance parts to ensure the completion of the tests. In addition preliminary operating instructions, including interconnection diagrams, schematic diagrams, and test data, shall be provided.

4.7 Demonstrations.- When specified in the detail specification or contract, reliability and maintainability demonstrations shall be conducted by the contractor and shall commence following the satisfactory completion of examinations and testing of the training device.

4.7.1 Reliability demonstration.- The Reliability demonstration shall be performed in accordance with the Government-approved contractor-prepared demonstration plan. The demonstration plan shall include the necessary collection of operation and failure data in order to assess achieved reliability and availability, subject to the criteria of 4.4.2.2.7.

4.7.2 Maintainability demonstration.- A maintainability demonstration shall be performed at the installation site of the trainer in accordance with the Maintainability Demonstration requirements of MIL-STD-471 and the Government-approved contractor-prepared demonstration plan.

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4.7.2.1 Conduct of the demonstration.- The demonstration shall be conducted by Government personnel who have successfully completed the on-site contractor-conducted training program, using only those tools, equipment, data, training personnel and material resources which have been programed and provided as a result of the trainer contract. Conduct of the demonstration shall be predicated upon the natural operation of the trainer during training situations. However, if natural operation of the trainer does not result in a conclusive accept or reject decision, simulated failures may be used to supplement actual failures in order to arrive at a conclusion (subject to approval of the Procuring Contracting Officer).

(a) Contractor participation during conduct of the demonstration shall be limited to the following:

(1) Preparation of demonstration plan

(2) Training cognizant demonstration personnel in the objectives of the program and the techniques which will be used to gather required data

(3) Observation of demonstration tests, recording all data and preparation of the Maintainability Demonstration Report

(b) Government participation during conduct of demonstration will include the following:

(1) Conduct of maintainability demonstration

(2) Performance of maintenance services during the demonstration period.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery and marking for shipment shall be as specified in the detail specification.

6. NOTES

6.1 Intended use.- This specification sets forth the general requirements for materials, parts, processes, design and quality assurance that are common to all types of major training devices.

6.2 Definitions.- For the purpose of this specification, the definitions of 6.2.1 through 6.2.19 shall apply.

6.2.1 Standard test equipment.- An item of test equipment defined by a current Government approved specification or drawing, or off-the-shelf

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commercial test equipment currently in the Government inventory, for which procurement data is available.

6.2.2 Flammable material.- Materials which will support combustion or which are capable of causing an explosion when the materials are subjected to the environmental conditions specified in the detail specification.

6.2.3 Toxic material.- Materials which are capable of producing dangerous gases or other harmful toxic effects under conditions encountered in service, including fire.

6.2.4 Terms for equipment divisions.- The definition of part, subassembly, assembly, unit, group, set, or system, as well as the ancillary terms (accessory and attachment) are defined in MIL-STD-280.

6.2.4.1 Division of terms, special categories.- The special categories of 6.2.4.1.1 through 6.2.4.1.6 shall apply to the terms of 6.2.4.

6.2.4.1.1 Replaceable assembly.- An assembly that is capable of being easily removed and replaced as an integral item. Where applicable, any of the divisions indicated in 6.2.4 may be used with the term "replaceable".

6.2.4.1.2 Unitized construction.- A type of unit construction consisting predominantly of replaceable assemblies.

6.2.4.1.3 Chassis.- The physical structure which retains and electrically interconnects any grouping of electronic assemblies or components which have an identifiable function.

6.2.4.1.4 Enclosures.- Enclosures are defined as: a combination of external housing and racks that provide mechanical support for the chassis, interconnecting cables, equipment-cooling blower motors, and other ancillary equipments.

6.2.4.1.5 Modular assembly.- A replaceable assembly of discrete, conventional electronic, electromechanical or microelectronic devices performing one or more distinct functions in an electronic or electromechanical equipment or subassembly.

6.2.4.1.6 Modular construction.- A type of unitized construction consisting predominantly of modular assemblies, with one or preferably two dimensions of each modular assembly fixed for any set or unit. Variations in the size between individual assemblies shall be obtained by varying the other dimension(s) in integral multiples of the module.

6.2.5 Microelectronics - Microelectronics terms and definitions are defined in MIL-STD-1313 and AFSC Design Handbook DH 1-8 (Microelectronics).

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6.2.6 Electromagnetic interference.- Electromagnetic terms and definitions are defined in MIL-STD-463.

6.2.7 Reliability, maintainability, human-factors and safety.- Unless otherwise specified in the detail specification, reliability, maintainability, human-factors, and safety definitions are defined in MIL-STD-721.

6.2.8 Standard parts.- Standard parts, as defined by the Department of Defense Standardization Manual 4120.3-M, are: "a material, part, component, subassembly, or equipment identified or described in Military or adopted Federal and Industry standards". DOD adopted Federal and Industry Specifications and Standards are listed in the DOD Index of Specifications and Standards (DODISS).

6.2.9 Nonstandard parts.- A nonstandard part is an item not covered by a specification or standard listed in the DODISS. Such parts are commercial off-the-shelf items and, in general, are company standards.

6.2.10 Models.- The types and definitions of models are defined in MIL-STD-280.

6.2.11 Training device terms.- Terms and definitions peculiar to the general field of training devices are defined in MIL-HDBK-220.

6.2.12 Optical terms and definitions.- Optical terms and definitions are defined in MIL-STD-1241.

6.2.13 Voltage transient.- A voltage transient is the changing condition of the voltage which goes beyond the steady state-limits and returns to the steady-state voltage limits within a specified time period (recovery time).

6.2.14 Frequency transient.- A frequency transient is a sudden change in frequency wherein the initial and final values are within the steady-state limits, and the frequency during the change may or may not go outside the steady-state limits. Transient frequency variation is expressed in percent of nominal system frequency rating.

6.2.15 Government-furnished property (GFP).- GFP is defined as property in the possession of, or acquired directly by the Government and delivered to or otherwise made available to a contractor, and includes Government-furnished material and Government-loaned property.

6.2.16 Point-to-point wiring.- Point-to-point wiring is wiring of circuits, on the same chassis or frame, where the wire is the shortest practicable distance and which is not part of a cable or harness.

6.2.17 Digital computers - A general purpose digital computer may consist of all or various combinations of, the following items:

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(a) Central Processing Unit

(b) Core Memory

(c) Input/Output Processors

(d) Rapid Access Disc

(e) Card Reader

(f) Line Printer

(g) Magnetic Tape Unit

(h) Typewriter or Teletypewriter

(i) Card Punch

(k) Key Punch

(l) Paper Tape Unit.

6.2.18 Automatic tests.- Terms for automatic electronic testing and checkout are defined in MIL-STD-1309.

6.2.19 Reference data.- Reference data are reports or other documents furnished to a contractor to be used during the performance of a contract for reference in the design and fabrication of the training device

6.3 Ordering data.- Ordering data shall be as specified in the detail specification.

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5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

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