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MILITARY STANDARD

STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

TO ALL HOLDERS OF MIL-STD-454N:

1. THE FOLLOWING PAGES OF MIL-STD-454N HAVE BEEN REVISED OR ADDED AND SUPERSEDE THE PAGES LISTED:

| NEW PAGES | DATE | SUPERSEDED PAGES | DATE |
|---|---|---|---|
| 66-1 through 66-6 | 30 Jun 93 | 66-1 through 66-6 | 30 Jun 92 |
| 77-1 through 77-2 | 30 Jun 93 | NEW REQUIREMENT | --- |

2. MAKE THE FOLLOWING PEN AND INK CHANGES:

a. Page iii, FOREWORD: Delete "MIL-I-983" and title and substitute:

"MIL-STD-2036 General Requirements for Electronic Equipment Specifications."

Delete "MIL-E-11991" in its entirety and substitute:

"MIL-STD-11991 Electrical, Electronic, and Electro-mechanical Equipment, Guided Missile and Associated Weapon Systems, General Standard for the Design of."

Delete "MIL-T-21200" in its entirety.

b. Page vi, CONTENTS: Add "Requirement 77 - Integrated Diagnostics".

c. Page 1, 1.2, delete second sentence.

d. Requirement 2, page 2-1, paragraph 4.1: Delete "MILSTD-198" and substitute "MIL-STD-198".

e. Requirement 11, page 11-1, paragraph 2: Delete "MIL-P-79" and "MIL-P-997" in their entirety and substitute:

"MIL-I-24768 Insulation, Plastics, Laminated, Thermosetting, General Specifications for."

Delete "MIL-P-15037", "MIL-P-15047", and "MIL-I-19161" in their entirety.

Page 11-2, paragraph 4.2: Delete "included" in first line.

f. Requirement 20, paragraph 2: Delete "MIL-W-5845 Wire, Electrical, Iron and Constantan, Thermocouple".

MIL-W-5846: Delete "/or" in title.

Delete "MIL-W-5908 Wire, Electrical, Copper and Constantan, Thermocouple."

MIL-W-22759: Delete "Electric" and substitute "Electrical" in title.

g. Requirement 20, page 20-7, section 5, paragraph 5.3, on second line: Delete "MIL-W-5845," and ", or MIL-W-5908".


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h. Requirement 26, page 26-1, paragraph 2: Delete "MIL-P-79" and "MIL-P-997" in their entirety and substitute:

"MIL-I-24768 Insulation, Plastics, Laminated, Thermosetting, General Specification for."

Delete: "MIL-P-15037" and "MIL-P-19161" in their entirety.

i. Requirement 41, page 41-4, table 41-1: Delete "QQ-C-586".

j. Requirement 46, page 46-2, paragraph 4.3: Delete "MIL-M-9397" and substitute "MIL-F-9397".

Delete: "MIL-M-13787", "MIL-M-17054", "MIL-M-19167", and "MIL-M-19283" in their entirety.

k. Requirement 56, page 56-1, paragraph 2: Delete "MIL-E-81512" in its entirety.

l. Requirement 62, page 62-1, paragraph 1: In first sentence following "guidance", delete "as to" and substitute "for".

m. Requirement 63, page 63-1, paragraph 2: Delete "documents" and substitute "Documents".

n. Requirement 65, page 65-1, paragraph 2, MIL-C-17: Delete "Cable" and substitute "Cables". MIL-C-22931: Delete "Cable" and substitute "Cables". MIL-L-3890: Add ", General Specification for" at end of title.

o. Requirement 68, page 68-1, paragraph 4.1: Delete "Incandescent" and substitute "Optoelectronic".

p. Requirement 72, page 72-1, paragraph 2: Delete "MIL-STD-480" in its entirety and substitute:

"MIL-STD-973 Configuration Management".

Paragraph 4.1, 4.2, and 4.3: Delete "MIL-STD-480" and substitute "MIL-STD-973" (3 places).

q. Requirement 76, page 76-1, paragraph 2: Delete "Optic" under MIL-H-24626 and insert after "Fiber".

Page 76-3, paragraph 2: Delete "Systems" under MIL-HDBK-415 and insert after "Communications".

Delete - "IEEE-STD-812-84" and substitute:

"MIL-STD-2196(SH) Glossary, Fiber Optics"

3. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

4. Holders of MIL-STD-454N will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

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CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - AS
Air Force - 11

Review activities:
Army - AR, AV, CR, ME, MI, PT, TE
Navy - EC, OS, SH
Air Force - 17, 19, 85, 99

Other:
DLA - ES
FAA

Preparing activity:
Air Force - 10

Agent:
DLA - ES

(Project GDRQ-0121)

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REQUIREMENT 66

CABLE, MULTICONDUCTOR

1. Purpose. This requirement establishes criteria for selection and application of electrical multiconductor cable for use within electronic equipment.

* 2. Documents applicable to Requirement 66:

| | |
|---|---|
| QQ-W-343 | Wire, Electrical, Copper (Uninsulated) |
| MIL-C-17 | Cables, Radio Frequency, Flexible and Semirigid, General Specification for |
| MIL-C-442 | Cable (Wire), Two Conductor, Parallel |
| MIL-C-3432 | Cable (Power and Special Purpose) and Wire, Electrical (300 and 600 Volts) |
| MIL-W-5086 | Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy |
| MIL-W-5846 | Wire, Electrical, Chromel and Alumel, Thermocouple |
| MIL-C-7078 | Cable, Electric, Aerospace Vehicle, General Specification for |
| MIL-W-8777 | Wire, Electrical, Silicone-Insulated, Copper, 600 Volt, +200°C |
| MIL-C-13777 | Cable, Special Purpose, Electrical: General Specification for |
| MIL-W-16878 | Wire, Electrical, Insulated, General Specification for |
| MIL-C-19547 | Cable, Electrical, Special Purpose, Shore Use |
| MIL-W-22759 | Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy |
| MIL-C-23437 | Cable, Special Purpose, Electrical |
| MIL-C-24640 | Cable, Electrical, Lightweight, for Shipboard Use, General Specification for |
| MIL-C-24643 | Cable and Cord, Electrical, Low Smoke, for Shipboard Use, General Specification for |
| MIL-W-25038 | Wire, Electrical, High Temperature and Fire Resistant, General Specification for |
| MIL-C-27072 | Cable, Power, Electrical and Cable, Special Purpose Electrical, Multiconductor and Single Shielded, General Specification for |
| MIL-C-27500 | Cable, Electrical, Shielded and Unshielded, General Specification for |
| MIL-C-49055 | Cable, Electrical (Flexible, Flat, Unshielded) (Round Conductor), General Specification for |
| MIL-C-55021 | Cable, Electrical, Shielded Singles, Shielded and Jacketed Singles, Twisted Pairs and Triples, Internal Hookup, General Specification for |
| MIL-W-81044 | Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy |
| MIL-W-81381 | Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy |
| ASTM A580 | Wire, Steel, Stainless and Heat Resisting |
| ASTM B33 | Tinned Soft or Annealed Copper Wire for Electrical Purposes |

3. Definitions. Not applicable.

4. Requirements.

4.1 Selection and application. Selection and application of multiconductor cable shall be in accordance with table 66-I.

4.2 Solid or stranded. Either solid or stranded conductors may be used (within the restrictions of the particular wire or cable specification) except that (a) with the exception of thermocouple and flat cable wire, only stranded wire shall be used in aerospace applications, and (b) for other applications stranded wire shall be used when so indicated by the equipment application. Specifically, with the exception of flat multiconductor flexible cable, stranded wire shall be used for wires and cables which are normally flexed in use and servicing of the equipment, such as cables attached to the movable half of detachable connectors.

4.3 Application restrictions.

4.3.1 Cable containing MIL-W-16878 wire. Cable containing MIL-W-16878 wire shall not be used for Air Force or Navy aerospace applications.

4.3.2 Polyvinyl chloride insulation. Cables with polyvinyl chloride insulation shall not be used in aerospace applications. Use of these cables in any other application requires prior approval of the procuring activity.

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4.3.3 Single polytetrafluoroethylene insulation. MIL-W-22759 wire with only single polytetrafluoroethylene insulation used in Air Force space and missile applications shall require the approval of the acquiring activity.

4.3.4 Silver plated copper wire. Silver plated copper wire shall not be used in applications involving Army missile systems.

5. Information for guidance only. Not applicable.

TABLE 66-1. Cable, multiconductor.

| No. | Title | Basic Wire Specs | Conductor | | | Shield Braid 3/ | | | Jacket 3/ | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. of Cond. | Volts RMS | Temp 2/ | Strand Material | Strand Coating | Percent Coverage | Material 1/ | Type | |
| MIL-C-442 | Cable, (Wire), Two Conductor, Parallel | QQ-W-343 and Insulation | 2 | 300 | Flexibility at -40°C or -55°C | | | | Vinyl-polymer or synthetic (styrene butadiene) rubber or natural rubber | | Lead wire for firing explosive charges |
| MIL-C-3432 | Cable (Power and Special Purpose) and Wire, Electrical (300 V and 600 V) | QQ-W-343 and Insulation | Unlimited and mixed sizes 4/ 5/ | 300 and 600 | -40°C to +65°C or -55°C to +75°C | None or Copper | Tin | 85 | Styrene butadiene rubber, chloroprene rubber, ethylene-propylene dinne, rubber, polyurethane thermoplastic elastomer, or natural rubber | Extruded or vulcanized | |
| MIL-C-7078 | Cable, Electric, Aerospace Vehicle | M5086/1<br>M5086/2<br>M5086/3 | 2-7<br>1-7<br>1-7 | 600 | +105°C | Copper<br>Copper | Tin<br>Tin | | None<br>Polyamide (Nylon) | Extruded or InpregBraid | (a) Fluorinated ethylene propylene<br>(b) Polytetrafluoroethylene |
| | | M22759/12<br>M22759/23 | 1-7<br>1-7 | | +260°C<br>+260°C | Copper<br>Copper | Nickel<br>Nickel | 85<br>85 | (a)<br>(b) | Extruded<br>Extruded or tape | |
| | | M81044/9 | 1-7 | | +110°C | Copper | Tin | 85 | Polyvinylidene fluoride | Extruded | |
| | | M81381/8 /10 and /14 | 2-7<br>1-7 | | +200°C<br>+200°C | Copper | Nickel | 85 | FEP/polyimide | Film Tape | |
| | | M81381/11<br>M81381/12<br>M81381/13 | 2-7<br>1-7<br>1-7 | | +200°C<br>+150°C<br>+200°C | Copper<br>Copper | Tin<br>Nickel | 85<br>85 | FEP/polyimide | Film Tape | |
| MIL-C-13777 | Cable, Special Purpose Electrical | MIL-C-17<br>QQ-W-343<br>ASTM-A580<br>and Insulation | 2-78<br>6/ | 600 | -53°C to +71°C | Copper | Tin | 80 | Sheath Polychloroprene<br>Primary Insulation Polyethylene | Extruded and vulcanized<br>Extruded | See Note 7 |



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TABLE 66-1. Cable, multiconductor - Continued.

| Spec. No. | Title | Basic Wire Specs | Conductor | | | Shield Braid 3/ | | | Jacket 3/ | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. of Cond. | Volts RMS | Temp 2/ | Strand Material | Strand Coating | Percent Coverage | Material 1/ | Type | |
| MIL-C-19547 | Cable, Electrical, Special Purpose, Shore use | ASTM B33-74 and Insulation | Multiple twisted pairs, 6 - 100 pairs | 600 | +75°C | Corrugated Aluminum | | 100 | Polyethylene | Extruded | For use as telephone and telegraph signal cables in shore communications |
| MIL-C-23437 | Cable, Electrical, Shielded Pairs | MIL-W-16878/1 | Shielded and jacketed pairs 1 pair-104 pairs | 600 | +105°C | Copper | Tin | 90 | PVC | Extruded | For use within shore communications stations, not to be used on board ship |
| | | | | | | Note: Shield applied over each pair | | | | | |
| MIL-C-24640 | Cable, Electrical, Lightweight, for shipboard use | MIL-W-81044 | 2-77 pair | 600 | +150°C | Copper tape | Tinned | 85 | Cross-linked, polyalkene, cross-linked alkane-imid, polymer, or polyarylene | Extruded | |
| MIL-C-27072 | Cable, Special Purpose Electrical, Multi-conductor | MIL-C-17 | 2-36 | Various | Not Spec | Copper | Tin, Silver | 85 | Sheath of PVC, polyethylene, polychloroprene, polyamide, TFE-Teflon, or FEP-Teflon | | Flexible multi-conductor cable for use in protected areas: tunnels, wire ways, instrument racks, and conduit. Polyethylene jacketed cable suitable for underwater or direct burial applications only. M16878/6 and /13 not for aerospace applications. |
| | | MIL-W-5846 | | Various | Not Spec | | | | | | |
| | | M16878/1 | | 600 | +105°C | | | | | | |
| | | M16878/2 | | 1,000 | +105°C | | | | | | |
| | | M16878/3 | | 3,000 | +105°C | | | | | | |
| | | M16878/4 | | 600 | +200°C | | | | | | |
| | | M16878/5 | | 1,000 | +200°C | | | | | | |
| | | M16878/6 | | 250 | +200°C | | | | | | |
| | | M16878/10 | | 600 | +75°C | | | | | | |
| | | M16878/13 | | 250 | +200°C | | | | | | |
| | | | | | | Note: MIL-C-27072 applicable detail specification sheets control materials for each specific cable configuration | | | | | |



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TABLE 66-I. Cable, multiconductor - Continued.

| Spec. No. | Title | Basic Wire Specs | Conductor | | | Shield Braid 3/ | | | Jacket 3/ | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. of Cond. | Volts RMS | Temp 2/ | Strand Material | Strand Coating | Percent Coverage | Material 1/ | Type | |
| MIL-C-27500 | Cable, Electrical, Shielded and Unshielded, Aerospace | MIL-W-8777 | 1-7 | 600 | +200°C | Various | Various | 85 | Various | Braided | For general aerospace flight vehicle applications |
| | | MIL-W-22759 | 1-7 | Various | Various | Various | Various | 85 | Various | Extruded or Braided | |
| | | MIL-W-25038 | 1-7 | 600 | +260°C | Various | Various | 85 | TFE coated glass fiber | Braided | |
| | | MIL-W-81044 | 1-7 | 600 | +150°C | Various | Various | 85 | Various | Extruded | |
| | | MIL-W-81381 | 1-7 | 600 | Various | Various | Various | 85 | Various | Tape | |
| MIL-C-49055 | Cables, Power Electrical, (Flexible, Flat, Unshielded), (Round Conductor), General Specification for | MIL-C-49055/1<br>MIL-C-49055/11<br>MIL-C-49055/12<br>MIL-C-49055/13<br>MIL-C-49055/14<br>MIL-C-49055/15<br>MIL-C-49055/16<br>MIL-C-49055/17 | Note: MIL-C-49055 applicable detail specification sheets control the number of conductors and materials for each specific cable configuration. | | | | | | | | |
| MIL-C-55021 | Cable, Twisted Pairs and Triples, Internal Hookup, General Specification for | MIL-W-16878 | 2-3 | 600 to 1,000 | -40°C to +105°C or -65°C to +200°C | None or Copper | Tin, Silver or Nickel | 90 | None<br>PVC,<br>Nylon<br>TFE-Teflon | Extruded<br>Extruded or Tape | |



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TABLE 66-I. Cable, multiconductor - Continued.

1/ Polyester: Polyethylene terephthalate
TFE-Teflon: Polytetrafluoroethylene
PVC: Polyvinyl chloride (not to be used in airborne applications)
KEL-F: Polymonochlorotrifluorethylene
FEP-Teflon: Fluorinated ethylene propylene
PVF: Polyvinylidene fluoride

2/ See applicable detail specification sheet for temperature limitation.

3/ See applicable detail specification sheet for materials control of specific cable configurations.

4/ Although the specification does not limit the number of conductors in a cable, the size, weight, and flexibility are determining factors.

5/ Available in three classifications:

Class L: Light duty: To withstand severe flexing and frequent manipulation.

Class M: Medium duty: To withstand severe flexing and mechanical abuse.

Class H: Heavy duty: To withstand severe flexing and mechanical abuse and ability to withstand severe service impacts such as to be run over by tanks or trucks.

6/ See applicable detail specification sheet for mechanical test requirements for cold bend, cold bend torque, impact bend, and twist.

7/ For use under abusive mechanical conditions and where resistance to weather, oil, and ozone are requirements.

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REQUIREMENT 77

INTEGRATED DIAGNOSTICS

1. Purpose. This requirement establishes a design process for integrating all elements which constitute a weapon system's diagnostic capability. It does not establish requirements, and must not be referenced in contractual documents. Engineering analyses, qualitative and quantitative requirements, design analysis, demonstration and maturation requirements must be specified in the contract or system/equipment specification, as appropriate.

2. Documents applicable to Requirement 77:

| | |
|---|---|
| MIL-H-46855 | Human Engineering Requirement for Military Systems, Equipment and Facilities |
| MIL-STD-415 | Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for |
| MIL-STD-470 | Maintainability Program for Systems and Equipment |
| MIL-STD-471 | Maintainability Verification/Demonstration/Evaluation |
| MIL-STD-499 | Engineering Management |
| MIL-STD-2165 | Testability Program for Electronic Systems and Equipments |
| MIL-STD-1814 | Integrated Diagnostics |
| MIL-STD-1326 | Test Point, Test Point Selection and Interface Requirements for Equipments Monitored by Shipboard On-line Automatic Test Equipment |
| MIL-STD-1388-1 | Logistics Support Analysis |
| AFGS-87256 | AF Guide Specification on Integrated Diagnostics |
| ASTM-F-1166 | Standard Practices for Human Engineering Design for Marine Systems, Equipment, and Facilities |

3. Definitions.

3.1 Integrated diagnostics process. Integrated diagnostics is defined as a structured process which maximizes the effectiveness of diagnostics by integrating pertinent elements, such as testability, automatic and manual testing, training, maintenance aiding, and technical information as a means for providing a cost-effective capability to detect and unambiguously isolate all faults known or expected to occur in weapon systems and equipment and to satisfy weapon system mission requirements. This emphasis on the design and acquisition of the diagnostic capability is required because this capability tends to become fractionated. MIL-STD-2165 is the overall document for testability. However, because it is a multidisciplined process, reference to other portions of military documents that may be invoked or may be cited directly as a basis for contract requirements are MIL-STD-470, MIL-STD-471, MIL-STD-499, MIL-STD-1814, MIL-STD-1388-1, MIL-H-46855, AFGS-87256, and ASTM-F-1166.

4. Requirements. Not applicable.

5. Information for guidance only.

5.1 Test provisions.

5.1.1 Testability programs. When specified by the acquiring activity, a testability program should be implemented in accordance with MIL-STD-2165.

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5.1.2 Built-in-test devices. Built-in test devices should maintain their accuracy under all operating conditions required by the equipment under test. These devices should be provided with connections or access for their operational checkouts or calibration.

5.1.3 Test provisions. Test provisions should provide means for monitoring performance, calibration, and fault isolation in accordance with MIL-STD-415. Equipment which is required to be tested by on-line automatic test equipment (ATE) should provide test points in accordance with MIL-STD-1326.

5.1.4 Test cables. Test cables and extender cards should be provided and fitted with connectors to allow removable subassemblies to be electrically reconnected for maintenance.

5.1.5 External test points. Protection should be provided in the test point circuitry to prevent equipment damage caused by the external grounding of test points.

5.1.6 Failure effect. Provisions for testing should be designed that any failure of built-in test devices will not degrade equipment operation or cause equipment shut down.

5.2 Safety criteria. Safety criteria should be applied during equipment hardware design, selection, end construction to eliminate or control hazards that could cause injury to personnel during transportation, storage, installation, operation, maintenance or disposal, or damage to equipment or property.