

INCH-POUND

MIL-DTL-23971C
20 August 2001
SUPERSEDING
MIL-P-23971B
2 December 1977

DETAIL SPECIFICATION

POWER DIVIDERS, POWER COMBINERS, AND POWER DIVIDER/COMBINERS,

GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for power dividers, power combiners, and power divider/combiners. Specific requirements tailored for "space flight" components are included.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-DTL-85	-	Waveguides, Rigid, Rectangular, General Specification for.
MIL-DTL-3922	-	Flanges, Waveguide, General Purpose, General Specification for.
MIL-C-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-A-8625	-	Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-F-14072	-	Finishes for Ground Based Electronic Equipment.
MIL-C-22750	-	Coating, Epoxy, High Solids.
MIL-PRF-23586	-	Sealing Compound (With Accelerator) , Silicone Rubber, Electrical.
MIL-C-26074	-	Coatings, Electroless Nickel, Requirements for.
MIL-H-28719	-	Header, Hermetically Sealed.
MIL-C-39012	-	Connectors, Coaxial, Radio Frequency, General Specification for.

(See supplement 1 for list of associated specifications).

Beneficial comments (recommendations, additions, deletions) and any pertinent data of use in improving this document should be addressed to: (Defense Supply Center, Columbus, ATTN: DSCC-VAT, Post Office Box 3990, Columbus, OH 43216-5000), by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-DTL-23971C

STANDARDS

FEDERAL

FED-STD-H28 - Screw Thread Standards for Federal Services.

DEPARTMENT OF DEFENSE

MIL-STD-129 - Military Marking.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-461 - Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.
MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-889 - Dissimilar Metals.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-454 - General Guidelines for Electronic Equipment.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automation and Production Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI NCSL Z540-1 - Laboratories, Calibration, and Measuring and Test Equipment, General Requirements.

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-A240/A240M - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
ASTM-A484 - Bars, Billets and Forgings, Stainless and Heat-Resisting, General Specification for.
ASTM-A582 - Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished.
ASTM-A666 - Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
ASTM-A693 - Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
ASTM-A967 - Standard Specified for Chemical Passivation Treatments for Stainless Steel Parts.
ASTM-B36 - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM-B121/B121M - Standard Specification for Leaded Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM-B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM-B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

MIL-DTL-23971C

ASTM-B241/B241M	-	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
ASTM-B545	-	Tin, Electrodeposited Coatings of.
ASTM-B700	-	Standard Specification for Electrodeposited Coating of Silver for Engineering Use.
ASTM-D1457	-	PTFE Molding and Extrusion Materials, Specification for.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE-AMS-I-23011	-	Iron-Nickel Alloys for Sealing to Glasses and Ceramics.
SAE-AMS-2422	-	Plating, Gold, Electronic and Electrical Applications.
SAE-AMS-QQ-A-250	-	Aluminum and Aluminum-Alloy, Plate and Sheet, General Specification for.
SAE-AMS-QQ-P-35	-	Passivation Treatments for Corrosion-Resistant Steel.
SAE-AMS-QQ-S-763	-	Steel Bars, Wire, Shapes and Forgings, Corrosion-Resistant.

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheets, the latter shall govern.

3.2 First article. Items furnished under this specification shall be products that have been tested and passed first article inspection (see 4.5 and 6.3).

3.3 Material. The material shall be as specified (see 3.1). When a definite material is not specified, a material shall be used which will enable the items to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Metals. Metals shall be of corrosion resistant type or suitably processed to resist corrosion.

3.3.1.1 Metal sheet. Unless otherwise specified, the material shall be selected from the following:

- a. Aluminum alloy sheets shall conform to composition 6061 of SAE-AMS-QQ-A-250 and ASTM-B209.
- b. Extruded aluminum alloy shall conform to composition 6063 (refer to ASTM-B221 and ASTM-B241/B241M) or composition 6061 of SAE-AMS-QQ-A-250.
- c. Corrosion-resisting steel, sheets, and strips shall conform to ASTM-A240/A240M, ASTM-A666 and ASTM-A693.
- d. Corrosion-resisting steel bar, shapes, and forgings shall conform to SAE-AMS-QQ-S-763, ASTM-B484, and ASTM-A582
- e. Copper alloy sheet shall conform to ASTM-B36, ASTM-B121/B121M, ASTM-B16/B16M, and ASTM-B124.

3.3.1.2 Iron nickel. Iron nickel alloys shall conform to SAE-AMS-I-23011.

3.3.1.3 Gold. Gold shall conform to SAE-AMS-2422.

MIL-DTL-23971C

3.3.1.4 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals as defined in MIL-STD-889 shall not be in intimate contact.

3.3.2 Plastic. Plastic shall conform to ASTM-D1457.

3.3.3 Rubber. Rubber shall conform to MIL-PRF-23586.

3.3.4 Fungus. Material used in the construction of these items must be fungus inert in accordance with guideline 4 of MIL-HDBK-454.

3.4 Design and construction. Items furnished under this specification shall be of the design, construction, and physical dimensions specified (see 3.1).

3.4.1 Impedance. The nominal impedance shall be as specified (see 3.1).

3.4.2 Operating frequency range. The frequency range shall be as specified (see 3.1).

3.4.3 Ambient temperature. The ambient temperature shall be as specified (see 3.1).

3.4.4 Headers. When headers are required (see 3.1), they shall conform to MIL-H-28719.

3.4.5 Terminals and pins. External terminations shall be aligned and identified as specified (see 3.1).

3.4.6 Coaxial connectors. The material design and construction of coaxial connectors, when required (see 3.1), shall conform to MIL-PRF-39012.

3.4.7 Waveguide flanges. Unless otherwise specified (see 3.1), flanges shall mate electrically and mechanically with flanges covered by MIL-DTL-3922.

3.4.8 Connector caps. All waveguide and coaxial connections shall be sealed with push-on caps to prevent damage and the entrance of moisture or foreign material during storage.

3.4.9 Waveguide. The material design and construction of waveguides used in the items, when required (see 3.1), shall conform to MIL-DTL-85.

3.4.10 Finish.

3.4.10.1 Mating surfaces. Unless otherwise specified (see 3.1), the finish of mating surfaces shall be of gold, nickel, silver, or tin in accordance with the appropriate specifications: SAE-AMS-2422, MIL-C-26074, ASTM-B700, ASTM-B545 or ASTM-B339. Nickel shall be used only if other materials are unable to meet performance requirements of this specification.

3.4.10.2 External surfaces. If an external surface is painted, it shall be painted with semigloss or dull black enamel in accordance with type II of MIL-F-14072, or primed in accordance with MIL-PRF-22750 and coated in accordance with best manufacturing practice (see 3.1). Aluminum alloy surfaces shall be chemically treated in accordance with MIL-C-5541, anodic coatings or passivation treatments in accordance with MIL-A-8625 and ASTM-A967 or SAE-AMS-QQ-P-35, respectively.

3.4.11 Threaded parts. All threaded parts shall have screw threads in the unified screw thread series in accordance with FED-STD-H28.

3.4.12 Weight. The weight, when required, shall be as specified (see 3.1).

3.4.13 Life. The manufacturer shall submit to the acquiring activity evidence that items are designed to operate for a period of 5 years and that electrical performance characteristics degradation for this period of 5 years shall not exceed the specified limits (absolute maximum or minimum ratings, see 3.1). This evidence shall be in the form of a certificate to the acquiring activity on each item for which first article is requested and a written guarantee to the acquiring activity on each awarded contract. Any acquired item that fails to meet this life requirement shall be replaced by the manufacturer at no cost to the Government.

3.5 Electrical performance.

3.5.1 Average coupling. When the items are tested as specified in 4.7.3, the arithmetic average of the measured coupling (dB) to the outputs shall be as specified (see 3.1) at any frequency over the specified frequency range.

3.5.2 Voltage standing wave ratio (VSWR). When the items are tested as specified in 4.7.4, the VSWR of each port shall be not greater than the value specified (see 3.1).

3.5.3 Insertion loss. When the items are tested as specified in 4.7.5, the insertion loss (dB) shall not exceed the value specified (see 3.1).

3.5.4 Isolation. When the items are tested as specified in 4.7.6.1, 4.7.6.2, or 4.7.6.3, the isolation (dB) shall be not less than the value specified (see 3.1).

3.5.5 Phase balance. When the items are tested as specified in 4.7.7.1, 4.7.7.2, or 4.7.7.3, the phase balance (°) shall be as specified (see 3.1).

3.5.6 Amplitude balance. When the items are tested as specified in 4.7.8.1 or 4.7.8.2, the amplitude balance (dB) shall be as specified (see 3.1).

3.5.7 Power level. When the items are tested as specified in 4.7.9, there shall be no evidence of breakdown, charring, or arcing. Following this test, the VSWR, the insertion loss, and isolation values shall be as specified (see 3.1).

3.5.8 Electromagnetic interference (when specified, see 3.1). When the items are tested as specified in 4.7.10, the electromagnetic interference shall be within the limits of MIL-STD-461.

3.6 Environmental.

3.6.1 Seal. The sealing method shall be as specified (see 3.1).

3.6.1.1 Hermetic seal (when specified, see 3.1). When the items are tested as specified in 4.7.2.1, the leakage rate shall not exceed the following:

<u>Sealed volume case</u>	<u>Maximum allowable leakage</u>
Greater than 2 cubic inches	10^{-6} atm cm ³ /s
2 cubic inches or less	10^{-8} atm cm ³ /s

The volume shall be computed using the external dimensions of the case, disregarding any mounting (screws, stud, etc.). Following this test, the VSWR, insertion loss, and isolation values shall be as specified in 3.5.2, 3.5.3, and 3.5.4, respectively.

3.6.1.2 O-ring, solder seal, or encapsulated seal (when specified, see 3.1). When the items are tested as specified in 4.7.2.2, the VSWR, insertion loss, and isolation values shall be as specified in 3.5.2, 3.5.3, and 3.5.4, respectively.

3.6.1.3 Dust-cover seal (when specified, see 3.1). When the items are tested as specified in 4.7.2.3, the VSWR, insertion loss, and isolation values shall be as specified in 3.5.2, 3.5.3, and 3.5.4, respectively.

3.6.2 Barometric pressure (unless otherwise specified, see 3.1). When the items are tested as specified in 4.7.11, there shall be no evidence of breakdown, charring, or arcing. Following this test, the VSWR, insertion loss, isolation, and phase, amplitude balance values shall be as specified in 3.5.2, 3.5.3, 3.5.4, 3.5.5, and 3.5.6, respectively.

3.6.3 Thermal shock (unless otherwise specified, see 3.1). When the items are tested as specified in 4.7.12, the VSWR, insertion loss, and isolation values shall be as specified in 3.5.2, 3.5.3, and 3.5.4, respectively.

3.6.4 Terminal strength. When terminals are tested in accordance with 4.7.13, there shall be no mechanical damage or evidence of loosening or rupturing. Bends shall not be considered as damage unless surface cracking is evident.

3.6.5 Resistance to solvents. When the items are tested in accordance with 4.7.14, there shall be no evidence of mechanical damage and the marking shall remain legible.

3.6.6 Resistance to soldering heat. When the items are tested in accordance with 4.7.15, there shall be no evidence of mechanical damage and the VSWR, insertion loss, and phase and amplitude balance values shall be as specified in 3.5.2, 3.5.3, 3.5.4, 3.5.5, and 3.5.6, respectively.

3.6.7 Solderability. When terminations are tested for solderability as specified in 4.7.16, they shall meet the evaluation criteria of the cited test method.

3.6.8 Vibration. When items are tested as specified in 4.7.17, there shall be no evidence of physical damage and the VSWR, insertion loss, isolation, and phase and amplitude balance values shall be as specified in 3.5.2, 3.5.3, 3.5.4, 3.5.5, and 3.5.6, respectively.

3.6.9 Shock. When items are tested as specified in 4.7.18, the VSWR, insertion loss, isolation, phase and amplitude balance values shall be as specified in 3.5.2, 3.5.3, 3.5.4, 3.5.5, and 3.5.6, respectively.

3.6.10 Moisture resistance. When items are tested as specified in 4.7.19, the phase and amplitude balance, and power level values shall be as specified in 3.5.5, 3.5.6, and 3.5.7, respectively.

3.6.11 Salt spray (unless otherwise specified, see 3.1). This test may be performed on empty flatpacks or pin packages. When the items are tested as specified in 4.7.20, there shall be no evidence of destructive corrosion.

3.6.12 Sand and dust. When the items are tested as specified in 4.7.21, there shall be no sand and dust accumulation within the enclosure and the phase and amplitude balance, and power level values shall be as specified in 3.5.5, 3.5.6, and 3.5.7, respectively.

3.6.13 Explosion (when applicable, see 3.1). When the items are tested as specified in 4.7.22, there shall be no ignition of the ambient atmosphere.

3.6.14 Temperature cycling screen. When items are tested as specified in 4.7.23, VSWR (4.7.4), insertion loss (4.7.5), and isolation (4.7.6) tests shall be conducted following the temperature cycling screen, to confirm success or failure.

3.7 Marking. The items shall be marked in accordance with MIL-STD-1285, method I, with the part or identifying number (PIN) and the manufacturer's source code (CAGE). Marking characters shall be approximately .125 inch (0.32 mm) in height. The marking shall be placed on the identification plate, using a method which will provide legible and permanent marking for the life of the item. The manufacturer's name or trademark may also be included in the marking provided such is not expressly forbidden in the contract. When space does not permit use of an identification plate or when component usage (eg. space applications) forbids use of a label or plate, marking may be applied directly on a flat or cylindrical surface of the body. Letter size may be reduced to accommodate the following:

PREFERRED	M23971/	military designator and specification number
PIN	XX-YY	specification sheet (XX) and dash (YY) no.
	ZZZZZ	Manufacturer's source code (CAGE)
PERMISSIBLE	M	military designator
PIN	23971/	specification number
	XX-YY	specification sheet (XX) and dash (YY) no.
	ZZZZZ	Manufacturer's source code (CAGE)

3.7.1 Special marking. When acquisition requirements (see 6.2) specify, items shall be specially marked with a four digit date code denoting the last two digits of the calendar year (first two digits) and the week of the calendar year (last two digits) when the item was manufactured. Date code marking facilitates process improvement, failure analysis and reliability enhancement.

3.8 Serialization. When the contract requires the items be serialized, each item shall be marked with a unique serial number assigned consecutively within the inspection lot, allowing traceability to the item and test results.

3.9 Workmanship. The items shall be manufactured and processed in such a manner as to be uniform in quality, and external surfaces shall be free from tool marks, burrs, deep scratches, and other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI NCSL Z540-1.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Materials inspections (see 4.3).
- b. First article inspection (see 4.5).
- c. Conformance inspection (see 4.6).

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table I, used in fabricating the items are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE I. Materials inspection.

Material	Requirement paragraph	Applicable specification
Aluminum	3.3.1.1	ASTM-B221, ASTM-B241/B241M, SAE-AMS-QQ-A-250, ASTM-B209
Copper alloy	3.3.1.1	ASTM-B121/B121M, ASTM-B36, ASTM-B16/B16M, ASTM-B124
Steel bar, shapes, and forgings	3.3.1.1	SAE-AMS-QQ-S-763, ASTM-A484, ASTM-A582
Steel sheets and strips	3.3.1.1	ASTM-A240/A240M, ASTM-A666, ASTM-A693
Iron nickel alloy (KOVAR)	3.3.1.2	SAE-AMS-I-23011
Gold	3.3.1.3	SAE-AMS-2422
Plastics	3.3.2	ASTM-D1457
Rubber	3.3.3	MIL-PRF-23586

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.5 First article inspection. First article inspection shall be performed by the contractor, after award of the contract and prior to production, at a location acceptable to the Government. First article inspection shall be performed on sample units which have been produced with equipment and procedures normally used in production. First article approval is valid only on the contract under which it is granted unless extended by the Government to other contracts (see 6.3).

4.5.1 Sample size. Four samples shall be subjected to first article inspection.

4.5.2 Inspection routine. The samples shall be subjected to the inspections specified in table II in the order shown. All sample units shall be subjected to the inspection of group I. The sample shall be divided into 2 groups of 2 units each as specified in table II for groups II and III.

TABLE II. First article inspection.

Inspection	Requirement paragraph	Test method paragraph
Group I (all samples)		
Visual and mechanical -----	3.1, 3.3-3.4.9, 3.7, 3.8	4.7.1
Seal -----	3.6.1	4.7.2
Average coupling-----	3.5.1	4.7.3
VSWR -----	3.5.2	4.7.4
Insertion loss-----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Phase balance -----	3.5.5	4.7.7
Amplitude balance -----	3.5.6	4.7.8
Group II (2 samples)		
Power level-----	3.5.7	4.7.9
Electromagnetic interference <u>1/</u> -----	3.5.8	4.7.10
Barometric pressure -----	3.6.2	4.7.11
Thermal shock -----	3.6.3	4.7.12
Terminal strength <u>5/</u> -----	3.6.4	4.7.13
Resistance to solvents -----	3.6.5	4.7.14
Group III (2 samples)		
Solder heat <u>6/</u> -----	3.6.6	4.7.15
Solderability <u>6/</u> -----	3.6.7	4.7.16
Vibration -----	3.6.8	4.7.17
Shock -----	3.6.9	4.7.18
Moisture resistance <u>2/</u> -----	3.6.10	4.7.19
Salt spray <u>4/</u> -----	3.6.11	4.7.20
Sand and dust <u>3/</u> -----	3.6.12	4.7.21
Explosion <u>4/</u> -----	3.6.13	4.7.22

1/ When specified.

2/ Applicable to enclosed type (to exclude sand and dust) and immersion proof only.

3/ Applicable to enclosed type (to exclude sand and dust) only.

4/ Applicable to hermetic seal and immersion proof only.

5/ Applicable to plug-in and solder terminals.

6/ Applicable to items with solder terminals.

4.5.3 Failures. One or more failures shall be cause for refusal to grant first article approval.

4.5.4 Disposition of first article sample units. Sample units which have been subjected to first article testing shall not be delivered on any contract or purchase order. The Government reserves the right to retain the sample units or to require the supplier to furnish the sample units with the first article test report.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.6.1.1 Inspection lot. An inspection lot shall consist of all items covered by a single specification sheet produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table III, in the order shown.

TABLE III. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph
Visual and mechanical - - - - -	3.1, 3.3, 3.4, 3.7, 3.8, 3.9	4.7.1
Temperature cycling screen- - -	3.6.14	4.7.23
Average coupling - - - - -	3.5.1	4.7.3
VSWR - - - - -	3.5.2	4.7.4
Insertion loss - - - - -	3.5.3	4.7.5
Isolation- - - - -	3.5.4	4.7.6
Phase balance - - - - -	3.5.5	4.7.7
Amplitude balance - - - - -	3.5.6	4.7.8
Seal - - - - -	3.6.1	4.7.2

4.6.1.2.1 Group A Sampling plan. Statistical sampling and inspection shall be performed on an inspection lot basis with a random sample of components selected in accordance with table IV. The acceptance levels shall be based upon the zero defective sampling plan. No failures shall be permitted.

TABLE IV. Group A sampling plan.

Lot size	Sample size	"Space Flight" power dividers
1 - 13	100 percent	100 percent
14 - 150	13	100 percent
151-280	20	100 percent
281-500	29	100 percent
501-1,200	34	100 percent
1,201-3,200	42	100 percent
3,201-10,000	50	100 percent

4.6.1.2.2 Group A Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.6.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table V, in the order shown, and the sample shall be selected from inspection lots that have passed group A inspection.

4.6.1.3.1 Group B Sampling plan. Statistical sampling and inspection shall be performed on an inspection lot basis with a random sample of components selected in accordance with table VI. Acceptance shall be based upon the zero defective sampling plan. No failures shall be permitted.

TABLE VI. Group B sampling plan.

Lot size	Sample size	"Space Flight" power dividers
2-25	1	100 percent
26-150	2	100 percent
151-10,000	4	100 percent

TABLE V. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Power level- -----	3.5.7	4.7.9
VSWR -----	3.5.2	4.7.4
Insertion loss -----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Electromagnetic interference <u>1/</u> -----	3.5.8	4.7.10
Thermal shock- -----	3.6.3	4.7.12
VSWR -----	3.5.2	4.7.4
Insertion loss -----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Terminal strength <u>4/</u> -----	3.6.4	4.7.13
Resistance to solvents -----	3.6.5	4.7.14
Solderability <u>5/</u> -----	3.6.7	4.7.16
Vibration -----	3.6.8	4.7.17
VSWR -----	3.5.2	4.7.4
Insertion loss -----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Phase balance -----	3.5.5	4.7.7
Amplitude balance -----	3.5.6	4.7.8
Shock -----	3.6.9	4.7.18
VSWR -----	3.5.2	4.7.4
Insertion loss -----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Phase balance -----	3.5.5	4.7.7
Amplitude balance -----	3.5.6	4.7.8
Moisture resistance <u>2/</u> -----	3.6.10	4.7.19
VSWR -----	3.5.2	4.7.4
Insertion loss -----	3.5.3	4.7.5
Isolation -----	3.5.4	4.7.6
Phase balance -----	3.5.5	4.7.7
Amplitude balance -----	3.5.6	4.7.8
Salt spray <u>3/</u> -----	3.6.11	4.7.20

1/ When specified.

2/ Applicable to enclosed type (to exclude sand and dust) and immersion proof only.

3/ Applicable to hermetic seal and immersion proof only.

4/ Applicable to plug-in and solder terminals.

5/ Applicable to items with solder terminals.

4.6.1.3.2 Group B Rejected items. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.6.1.3.3 Disposition of sample units. Sample items which have been subjected to group B inspection shall not be delivered on the contract.

4.7 Methods of inspection.

4.7.1 Visual and mechanical inspection. The items shall be examined to verify that the material, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.7, and 3.9).

MIL-DTL-23971C

4.7.2 Seal.

4.7.2.1 Hermetic seal (see 3.6.1.1). Hermetically sealed items shall be tested in accordance with MIL-STD-202, method 112. The following apply:

- a. Test conditions letter: C.
- b. Procedure: III.
- c. Degree of leakage rate sensitivity (see 3.6.1.1).

4.7.2.2 O-ring, solder seal, or encapsulated seal (see 3.6.1.2). O-ring seal, solder seal, or encapsulated sealed items shall be tested in accordance with MIL-STD-202, method 104. The following applies:

Test condition letter: B.

4.7.2.3 Dust cover seal (see 3.6.1.3). Dust cover sealed items shall be tested in accordance with MIL-STD-202, method 103. The following apply:

- a. Magnitude of test voltage: As specified (see 3.1).
- b. Nature of potential: As specified (see 3.1).
- c. Points of application: As specified (see 3.1).
- d. Minimum kilovoltampere rating of high voltage source: As specified (see 3.1).
- e. Limiting value of surge current: As specified (see 3.1).
- f. Maximum leakage current: As specified (see 3.1).
- g. Test condition letter: As specified (see 3.1).

NOTE: The seal tests of 4.7.2 shall be followed by the VSWR, insertion loss, and isolation tests specified in 4.7.4, 4.7.5, and 4.7.6, respectively.

4.7.3 Average coupling (see 3.5.1). The average coupling of the item shall be determined by the sweep frequency technique over the specified frequency range (see 3.1) using the test setup of figure 1 or equivalent. The nominal coupling loss for each type of toroidal power divider shall be as follows:

Type of toroidal power divider	Nominal coupling loss (dB)
2-Way	3.01
Resistive Loaded 2-Way	6.0
3-Way	4.77
4-Way	6.02
6-Way	7.78
8-Way	9.03
12-Way	10.80
16-Way	12.04
24-Way	13.80

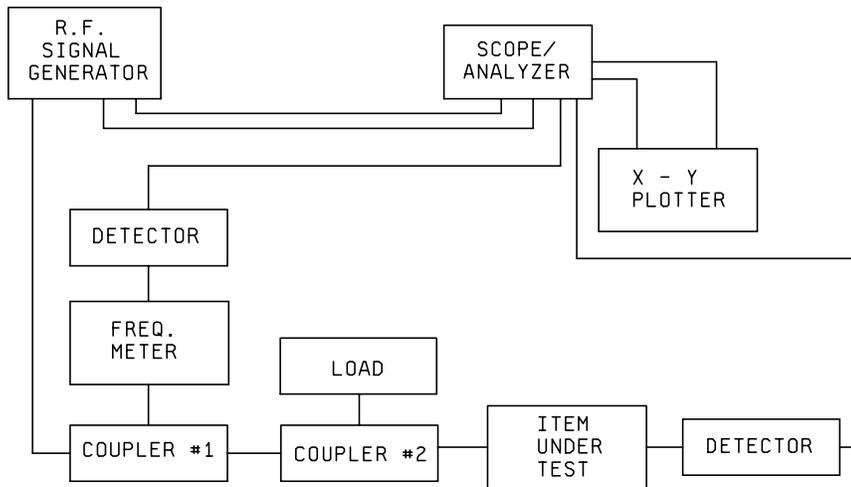


FIGURE 1. Sweep frequency coupling test setup.

4.7.4 VSWR (see 3.5.2). The VSWR of each port shall be measured across the full frequency range (see 3.1) using sweep frequency technique and the test setup of figure 2 or equivalent. Each unused port shall be terminated in a matched load. The VSWR may be measured at fixed frequencies using figure 3 or equivalent, at 7 equally spaced points across the frequency range (see 3.1). The accuracy of each measurement shall be within .1 dB.

4.7.5 Insertion loss (see 3.5.3). The insertion loss shall be determined by subtracting the nominal value of the divider from the measured average coupling value (see 4.7.3).

4.7.6 Isolation (see 3.5.4). The isolation (in dB) shall be measured using the sweep frequency technique across the full frequency range (see 3.1) of the item, using the test setup of figure 4 or equivalent. The isolation may be measured at 7 equally spaced points across the frequency range of the items (see 3.1). The accuracy of each measurement shall be within .1 dB. The procedures for measuring the isolation of the various items are as follows.

4.7.6.1 Power divider, quadrature. The isolation shall be measured between any selected port and adjacent isolated port with the opposite output ports terminated with matched loads (VSWR of 1.02). Repeat the measurement for each remaining port.

4.7.6.2 Power combiner. The isolation shall be measured between two input ports with the output port and any additional input ports (if any) terminated with matched loads (VSWR of 1.02). Repeat the measurement for each additional input port.

4.7.6.3 Power divider-combiner. The isolation shall be measured between the symmetric and anti-symmetric ports with the output ports terminated with loads matched to each other (VSWR of 1.02) or in open circuits if matched loads are not obtainable. Next, the isolation shall be measured between two output ports with the remaining output ports, if any, and the symmetric and anti-symmetric ports terminated in matched loads (VSWR of 1.02).

4.7.7 Phase balance (see 3.5.5). The phase balance shall be measured at the low end, middle, and high end of the frequency range (see 3.1) using the test setup of figure 5 or equivalent. The test procedure for the various items is as follows.

4.7.7.1 Power divider, quadrature. The phase balance of the item shall be measured between the output ports with the other co-linear output port and the adjacent isolated port terminated in matched loads (VSWR of 1.02). Repeat the measurement for any remaining ports.

4.7.7.2 Power combiner. The phase balance of the item shall be measured as the difference at the output between in-phase signals at two input ports with the remaining input ports terminated in matched loads (VSWR of 1.02). Repeat the measurement for each remaining input port.

4.7.7.3 Power divider-combiner. The phase balance of the item shall be measured between the symmetric port and an output port with the anti-symmetric port and remaining output ports terminated in matched loads (VSWR of 1.02). Repeat the measurement for each remaining output port. Next, measure the phase balance between the anti-symmetric port and an output with the remaining output ports terminated in matched loads (VSWR of 1.02). Repeat the measurements for each output port.

4.7.8 Amplitude balance (see 3.5.6).

4.7.8.1 Power divider, quadrature. Use the test procedure of 4.7.7 and 4.7.7.1 except read the amplitude balance.

4.7.8.2 Power combiner. Use the test procedure of 4.7.7 and 4.7.7.2 except read the amplitude balance.

4.7.9 Power level (see 3.5.7). The specified peak and average power shall be applied simultaneously at any frequency within the specified range (see 3.1). When no peak power is specified, apply 1.5 times rated average power. Power shall be maintained for a period of 15 minutes after the item has reached thermal equilibrium. It is considered that thermal equilibrium has been reached when the temperature of the item has not changed by more than 5°C over a period of 5 minutes. For pressurized items, the internal pressure shall be as specified (see 3.1). Following the exposure, the VSWR, insertion loss, and isolation shall then be measured as specified in 4.7.4, 4.7.5, and 4.7.6, respectively.

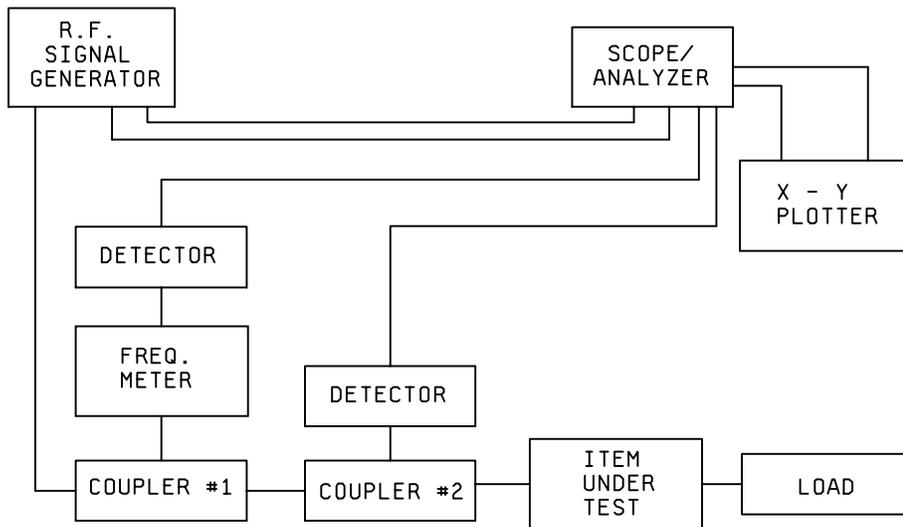


FIGURE 2. Sweep frequency VSWR test setup.

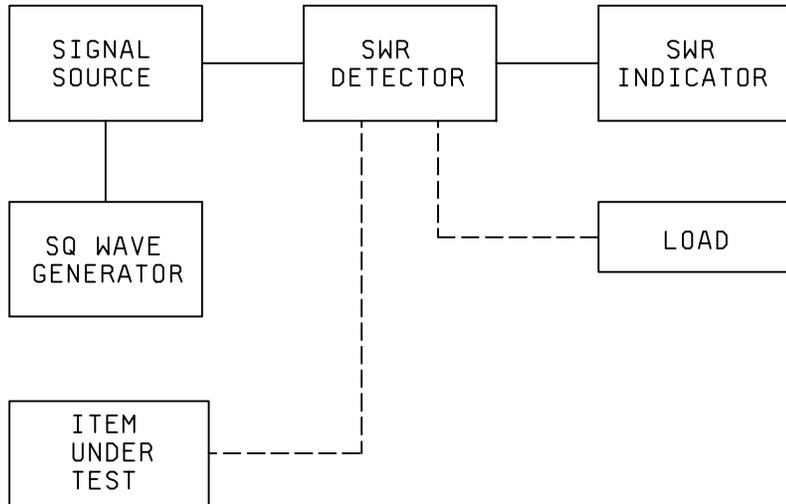


FIGURE 3. VSWR test setup, fixed point method.

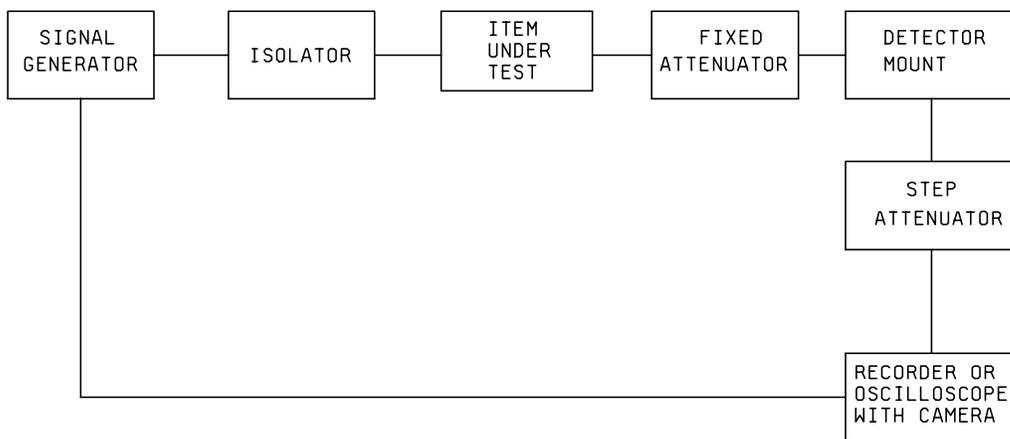


FIGURE 4. Isolation measurement test setup.

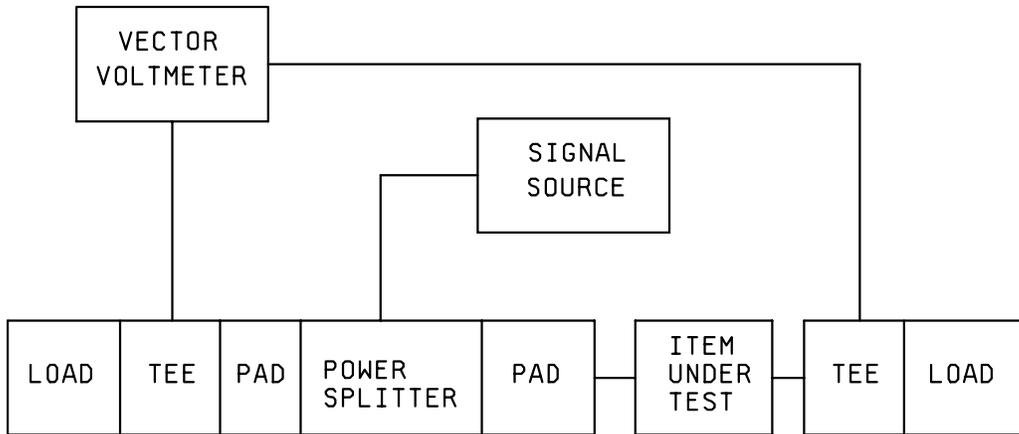


FIGURE 5. Output phase and amplitude balance test setup.

MIL-DTL-23971C

4.7.10 Electromagnetic interference (see 3.5.8). When specified (see 3.1), the electromagnetic interference shall be measured in accordance with CE101, CE102, CS101, and RE101 of MIL-STD-461.

Conducted emission, 30 Hz to 20 kHz, power leads
Conducted emission, 20 kHz to 50 MHz, power leads
Conducted emission, 20 kHz to 50 MHz, control and signal leads
Conducted susceptibility, 30 Hz to 50 kHz, power lead
Conducted susceptibility, 50 kHz to 400 MHz, power lead
Radiated emission, 30 Hz to 30 kHz, magnetic field

4.7.11 Barometric pressure (reduced) (see 3.6.2). The items shall be tested for barometric pressure in accordance with method 105 of MIL-STD-202. The following details shall apply:

- a. Mounting: Not applicable.
- b. Test condition: D (100,000 feet), unless otherwise specified (see 3.1).
- c. Test during subjection to pressure: 125 percent of rated power shall be applied between the terminals for not less than 1 second or more than 5 seconds.
- d. Final measurements: VSWR, insertion loss, isolation, phase balance, and amplitude balance tests as specified in 4.7.4, 4.7.5, 4.7.6, 4.7.7, and 4.7.8, respectively.

4.7.12 Thermal shock (see 3.6.3). The items shall be tested in accordance with method 107 of MIL-STD-202, test condition A. Before and after cycling, the VSWR, insertion loss, and isolation tests as specified in 4.7.4, 4.7.5, and 4.7.6, respectively shall be performed.

4.7.13 Terminal strength (see 3.6.4). The items shall be tested in accordance with method 211 of MIL-STD-202, test condition A, with a 2 pound pull.

4.7.14 Resistance to solvents (see 3.6.5). The item shall be tested in accordance with method 215 of MIL-STD-202. Two test solvents may be selected from those defined in method 215, and applied one to each sample. After the final immersion and brushing, it shall be allowed to dry. When dry, there shall be no evidence of mechanical damage and the marking shall remain legible.

4.7.15 Resistance to soldering heat (see 3.6.6). The item shall be tested in accordance with method 210 of MIL-STD-202, test condition D, followed by the VSWR, insertion loss, isolation, phase balance, and amplitude balance tests as specified in 4.7.4, 4.7.5, 4.7.6, 4.7.7, and 4.7.8, respectively.

4.7.16 Solderability (see 3.6.7). The item shall be tested in accordance with method 208 of MIL-STD-202.

4.7.17 Vibration (see 3.6.8). Unless otherwise specified (see 3.1), the item shall be tested in accordance with method 204 of MIL-STD-202, test condition A, followed by the VSWR, insertion loss, phase balance, and amplitude balance tests as specified in 4.7.4, 4.7.5, 4.7.6, 4.7.7, and 4.7.8, respectively.

4.7.18 Shock (see 3.6.9). Unless otherwise specified (see 3.1), the item shall be tested in accordance with method 213 of MIL-STD-202, test condition G, followed by the VSWR, insertion loss, isolation, phase balance, and amplitude balance tests as specified in 4.7.4, 4.7.5, 4.7.6, 4.7.7, and 4.7.8, respectively.

4.7.19 Moisture resistance (see 3.6.10). With all connections capped, the item shall be tested in accordance with method 106 of MIL-STD-202, 1,000 megohms minimum (unless otherwise specified, see 3.1) at +25°C measured after drying followed by the phase balance, amplitude balance, and power level tests as specified in 4.7.7, 4.7.8, and 4.7.9, respectively. Polarization and load voltage is not applicable.

4.7.20 Salt spray (see 3.6.11). This test may be performed on empty flatpacks or pin packages. The item shall be tested in accordance with method 101 of MIL-STD-202.

- a. Apply salt solution: 5 percent.
- b. Test condition: B.
- c. After test, dry specimens for 24 hours \pm .5 at 40°C.
- d. Inspect item for corrosion.

4.7.21 Sand and dust (see 3.6.12). The item shall be tested in accordance with method 110 of MIL-STD-202, test condition A. At completion of the exposure period, the device shall be tested for phase balance, amplitude balance, and power level as specified in 4.7.7, 4.7.8, and 4.7.9, respectively.

4.7.22 Explosion (see 3.6.13). The item shall be tested in accordance with method 109 of MIL-STD-202 under rated load (see 3.1).

4.7.23 Temperature cycling screen (see 3.6.14). Temperature cycling screen test shall be conducted using an air atmosphere test chamber, in accordance with MIL-STD-810, and with the following guidelines. Number of temperature cycles shall be ten (10). Each temperature cycle (see figure 6) includes hot and cold temperature soaks, wherein the test item temperature stabilizes within $\pm 2^\circ\text{C}$ of high and low temperature extremes (maximum and minimum storage temperatures (see 3.1), respectively). Temperature extremes are separated by part cool down and warm up temperature change rate periods of 20°C per minute, chamber permitting. Warm up is included in the "5 hours" interval of the 8 hour cycle. Test items should be non-operating during temperature cycling. VSWR (4.7.4), insertion loss (4.7.5) and isolation (4.7.6) tests should be conducted following the temperature cycling screen to confirm success or failure.

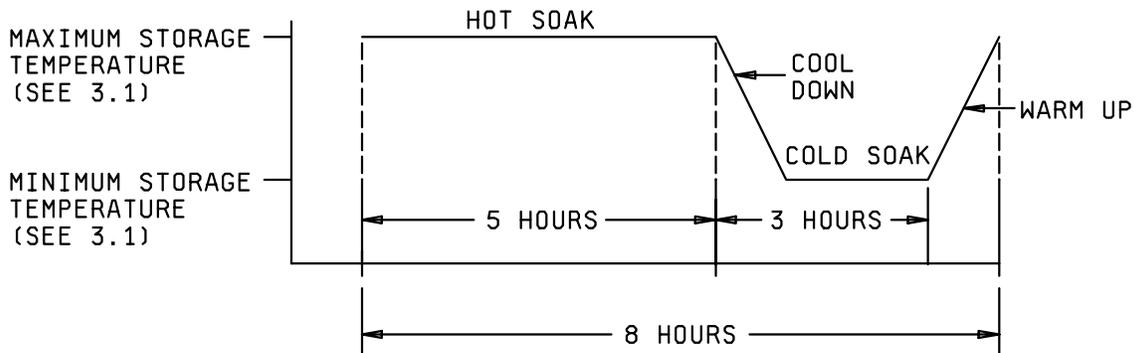


FIGURE 6. Temperature cycling profile.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Items covered by this specification are intended for use in military systems for signal splitters, signal combiners, power adders, homing systems radio direction finding, phase networks, and communication systems.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. Packaging requirements (see 5.1).
- d. Special marking, if required (see 3.7.1).

6.3 First article. Invitations for bids should provide that the Government (Defense Supply Center Columbus Code DSCC-VQ, P.O. Box 3990, Columbus, OH 43216-5000) reserves the right to waive the requirement for first article samples as to those bidders offering products which have been previously acquired or tested by the Government and that bidders offering such products who wish to rely on such production or tests must furnish evidence with the bid that prior Government approval is presently appropriate for the pending acquisition.

6.4 Subject (key word) list:

amplitude	insertion loss
coaxial	isolation
communication systems	metals
connectors	phase balance
corrosion-resisting	phase networks
coupling	power
electrical	quadrature
finish	seal
first article	signal splitters
flanges	solderability
frequency range	terminals
headers	VSWR
hermetic	waveguides

MIL-DTL-23971C

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC
(Project 5985-1227)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-DTL-23971C

2. DOCUMENT DATE (YYMMDD)
010820

3. DOCUMENT TITLE

POWER DIVIDERS, POWER COMBINERS, AND POWER DIVIDER/COMBINERS, GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
(1) Commercial

(2)DSN
(if applicable)

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Supply Center,
Code DSCC-VAT

b. TELEPHONE (Include Area Code)
(1) Commercial (2) DSN
614-692-0510 850-0510

c. ADDRESS (Include Zip Code)
P.O. Box 3990,
Columbus, OH 43216-5000

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Standardization Program Office (DLSC-LM)
8725 John J. Kingman Road, Suite 2533
Fort Belvoir, Virginia 22060-6221
Telephone (703) 767-6888 DSN 427-6888