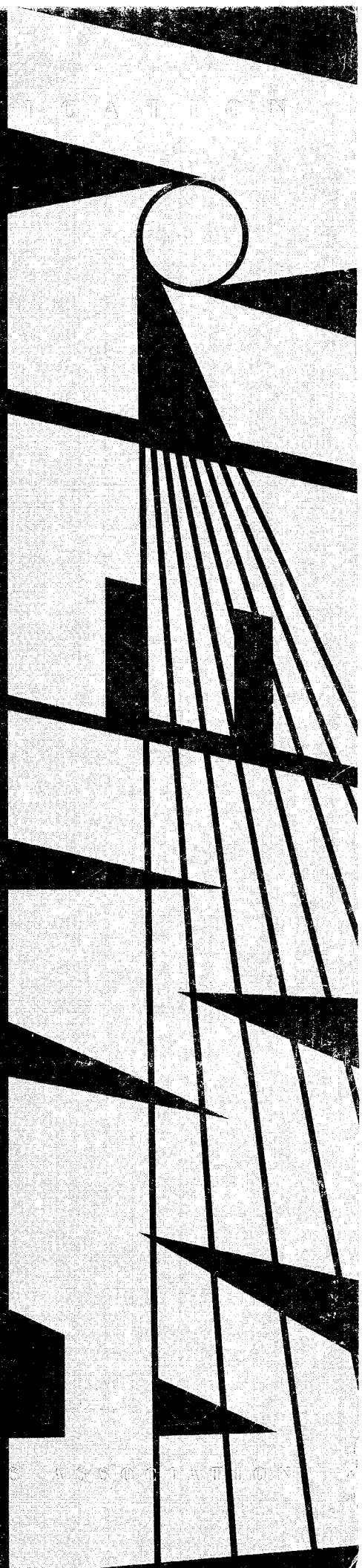
NEMA STANDARDS PUBLICATION

NEMA WC 27500

STANDARD FOR AEROSPACE AND INDUSTRIAL ELECTRICAL CABLE



NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA Standards Publication WC 27500-2000

Standard for Aerospace and Industrial Electrical Cable

Published by

National Electrical Manufacturers Association
1300 N. 17th Street
Rosslyn, Virginia 22209

FOREWORD

This standard was developed by the High Performance Wire and Cable Section of NEMA as a non-governmental standard replacement for MIL-DTL-27500 electrical cable which is widely used in aerospace and other industries.

It contains:

- Reference standards (Section 1)
- Identification methods (Section 2) and requirements (Section 3.9)
- Construction details (Sections 2, 3)
- Material requirements (Section 2)
  - Conductors
  - Primary wire
  - Shields
  - Jackets
- Electrical requirements (Section 3.8)
- Physical requirements (Section 3.8)
- Other requirements (Sections 3.10-14)
  - Color/size/weight/lengths/markings
- Test methods for above requirements (Section 4)
- Inspection/QC/process control procedures (Section 4)
- Packaging (Section 5)
- Notes/cross-reference/other data (Section 6)
- Ordering data

The requirements contained herein are consensus requirements that have been developed over the past three decades by knowledgeable engineers in the aerospace industry.

The standards or guidelines presented in a NEMA standards publication are considered technically sound at the time they are approved for publication. They are not substitutes for a product seller's or user's own judgment with respect to the particular product referenced in the standard or guideline, and NEMA does not undertake to guarantee the performance of any individual manufacturer's products by virtue of this standard or guide. Thus, NEMA expressly disclaims any responsibility for damages arising from the use, application, or reliance by others on the information contained in these standards or guidelines.

Members of NEMA High Performance Wire and Cable Section that participated in the development of this standard were:

Alcatel Electronics Cable—Elm City, NC
BICC/General Cable—Willimantic, CT
Rockbestos/Surprenant Cable—Clinton, MA
Monroe Cable—Middletown, NY
Raychem/Tyco—Palo Alto, CA
Barcel/CDT—Irvine, CA
Cable USA—Naples, FL
Judd Wire Inc.—Turner Falls, MA
Quirk Wire—West Brookfield, MA

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SCOPE

This standard contains requirements for finished cables. The component wires are covered by other referenced standards. These cables are intended for signal and low-voltage power applications with defined environment or temperature conditions found in commercial aircraft, military aircraft, and high performance vehicles.

TABLE OF CONTENTS

Section 1
REFERENCED STANDARDS

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036

American Society for Quality Control (ASQC)
611 East Wisconsin Avenue
Milwaukee, Wisconsin 53202

ANSI/ASQC Z 1.4	*Sampling Procedures and Tables for Inspection by Attributes*

American Society for Testing And Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428

ASTM A 313/A313M-98	*Standard Specification for Stainless Steel Spring Wire*
ASTM B 3-95	*Soft or Annealed Copper Wire*
ASTM B 33-94	*Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes*
ASTM B 272-96	*Copper Flat Copper Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)*
ASTM B 298-99	*Silver-Coated Soft or Annealed Copper Wire*
ASTM B 355-95	*Nickel-Coated Soft or Annealed Copper Wire*
ASTM B 624-99	*High-strength, High-conductivity Copper Alloy Wire for Electronic Application, Standard, Specification for*
ASTM D 3032-98	*Hookup Wire Insulation, Standard Methods of Testing*
ASTM D 4066-99	*Polyamide Injection and Extrusion Materials (PA) Nylon Injection and Extrusion Materials (PA)*
ASTM F 777-89e1	*Standard Test Method for Resistance of Electrical Wire Insulation Materials to Flame at 60 Degrees*

National Electrical Manufacturers Association (NEMA)
1300 N. 17th Street, Suite 1847
Rosslyn, VA 22209

NEMA WC 65-1995	*A Reasoned Approach to Solving Solderability Problems with Tin-Coated and Nickel-Coated Stranded Conductors in High Performance Wire and Cable Applications*
NEMA WC 67-1997	*Standard for Uninsulated Conductors Used in Electrical and Electronic Applications*
NEMA WC 72-1999	*Continuity of Coating Testing for Electrical Conductors*

Superintendent of Documents
US Government Printing Office
Washington, DC 20402

QQ-W-423	*Wire, Steel, Corrosion-Resisting*
H4-1	*Federal Supply Code For Manufacturers, United States and Canada, Name to Code*

H4-2 *Federal Supply Code For Manufacturers, United States and Canada. Code to Name*

Department of Defense
Standardization Document Order Desk
700 Robbins Avenue, Bldg. 4D
Philadelphia, PA 19111-5094

MIL-W-5086	*Wire, Electrical, Polyvinyl Chloride Insulated, Copper or Copper Alloy*
MIL-W-8777	*Wire, Electrical, Silicone-Insulated, Copper, 600 Volt, 200° C.*
MIL-C-12000	*Cable, Cord, and Wire, Electric; Packaging of*
MIL-W-22759	*Wire, Electric, Fluoropolymer-insulated, Copper Or Copper Alloy.*
MIL-W-25038	*Wire, Electrical, High Temperature and Fire Resistant, General Specification for*
MIL-W-81044	*Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkaneimide Polymer, or Polyarylene Insulated Copper or Copper Alloy*
MIL-DTL-81381	*Wire, Electric, Polyimide-insulated, Copper or Copper Alloy*
MIL-STD-104	*Limits for Electrical Insulation Color*
MIL-STD-202	*Test Methods Standard for Electronic and Electrical Component Parts*
MIL-STD-681	*Identification Coding and Application of Hookup and Lead Wire.*
MIL-STD-686	*Cable and Cord, Electrical; Identification Marking and Color Coding of*
MIL-STD-2223	*Test Methods for Insulated Electric Wire*
MS25471	*Wire, Electrical-Silicone, Copper, 600 Volt, 200 Deg. C, Polyester Jacket*
MS27110	*Wire, Electrical-Silicone, Copper, 600 Volt, 200 Deg. C, FEP Jacket (ASG)*

National Institute For Standards And Technology (NIST)
Publications Office
Building 101
Gaithersburg, MD 20879

NBS HDBK 100 *International Annealed Copper Standard (IACS)*

Society of Automotive Engineers (SAE)
400 Commonwealth Drive
Warrendale, PA 15096-0001 USA

SAE AS50881A *Wiring, Aerospace Vehicle*

NOTE—Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.

1.1 ORDER OF PRECEDENCE

In the event of a conflict between this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws or regulations unless a specific exemption has been obtained.

Section 2
CLASSIFICATION

2.1 GENERAL

The cable shall be one of the following types and shall be furnished in the basic wire size, type, number of wires, and shield and jacket styles, as specified. (see 6.2 and 2.2)

Unjacketed - 2 to 15 wires, spirally cabled without an overall outer jacket.

Jacketed - 2 to 15 wires, spirally cabled with an overall outer jacket.

Shielded - A single wire, or 2 to 15 wires, spirally cabled , with one or two overall shields.

Shielded and Jacketed - A single wire, or 2 to 15, wires spirally cabled with one or two shields and one or two jackets.

2.2 CABLE DESIGNATION

Cable shall be identified by a combination of digits and letters (not to exceed 16), in accordance with the following (see 3.9.2).

M27500	-	22	SD	3	T	23
Identification number	Identification method of cable wire and shield coverage (see 2.2.1)	Conductor size (see 2.2.2)	Basic wire specification (see 2.2.3)	Number of wires in cable (see 2.2.4)	Shield style and material (see 2.2.5)	Jacket material (see 2.2.6)

Example: M27500-22SD3T23 = 22 AWG, 3 conductor, tin shielded 85 %, white XLETFE jacket.

2.2.1 Identification Method Of Cable Wire (With Shield Coverage)

When an unshielded cable, or a cable with a minimum shield coverage of 85 percent, is required, specify:

"-" for the preferred identification method, Table 3-1
"F" for the preferred identification method, Table 3-2
"A" for optional identification method A, Table 3-1
"G" for optional identification method A, Table 3-2
"B" for optional identification method B, Table 3-3
"K" for optional identification method C, Table 3-4
"L" for optional identification method D
"P" for optional identification method E
"S" for optional identification method F

When a minimum shield coverage of 90 percent is required, specify;

"C" for the preferred identification method, Table 3-1
"H" for the preferred identification method, Table 3-2
"D" for optional identification method A, Table 3-1
"J" for optional identification method A, Table 3-2
"E" for optional identification method B, Table 3-3
"M" for optional identification method C, Table 3-4
"N" for optional identification method D
"R" for optional identification method E
"T" for optional identification method F

Table 2-1
IDENTIFICATION METHODS CROSS-REFERENCE

Basic wire coloring	Identification sequence	85% shield coverage or unshielded	90% shield coverage
Stripes	Colors per Table 3-1	-	C
Stripes	Colors per Table 3-2	F	H
Solids	Colors per Table 3-1	A	D
Solids	Colors per Table 3-2	G	J
By AWG, Table 3-3	Band Marks	B	E
By AWG, Table 3-3	Printed Numbers	K	M
White	Printed Numbers	L	N
White	Band Marks and Stripes	P	R
White	Color Bands	S	T

2.2.2 Conductor Size

The basic wire size shall be identified. All wires used in the cable shall be of the same size.

2.2.3 Basic Wire Specification

A letter symbol shall be used to designate the basic wire specification in accordance with Table 2-2.

Table 2-2
BASIC WIRE SPECIFICATION

Symbol sequence				Specification sequence			
A	MIL-W-5086/1[1]	NK	MIL-W-81381/21[3]	MIL-W-5086/1[1]	A	MIL-W-22759/43	SP
AA	MIL-W-5086/5[1]	NL	MIL-W-81381/22[3]	MIL-W-5086/2[1,2]	B	MIL-W-22759/44	SR
AB	MIL-W-5086/6[1]	P	MIL-W-5086/4[1]	MIL-W-5086/3[1,2]	C	MIL-W-22759/45	SS
AD	MIL-W-5086/7[1]	RA	MIL-W-22759/3	MIL-W-5086/4[1]	P	MIL-W-22759/46	ST
B	MIL-W-5086/2[1,2]	RB	MIL-W-22759/4	MIL-W-5086/5[1]	AA	MIL-W-22759/80[3]	WB
C	MIL-W-5086/3[1,2]	RC	MIL-W-22759/11	MIL-W-5086/6[1]	AB	MIL-W-22759/81[3]	WC
CA	MIL-W-22759/13	RE	MIL-W-22759/12	MIL-W-5086/7[1]	AD	MIL-W-22759/82[3]	WE
CB	MIL-W-22759/14	SA	MIL-W-22759/7	MIL-W-8777, MS25471[2]	H	MIL-W-22759/83[3]	WF
CC	MIL-W-22759/15	SB	MIL-W-22759/32	MIL-W-8777, MS27110	F	MIL-W-22759/84[3]	WG
E	MIL-W-22759/2	SC	MIL-W-22759/33	MIL-W-22759/1	EA	MIL-W-22759/85[3]	WH
EA	MIL-W-22759/1	SD	MIL-W-22759/34	MIL-W-22759/2	E	MIL-W-22759/86[3]	WJ
F	MIL-W-8777, MS27110	SE	MIL-W-22759/35	MIL-W-22759/3	RA	MIL-W-22759/87[3]	WK
H	MIL-W-8777, MS25471[2]	SM	MIL-W-22759/41	MIL-W-22759/4	RB	MIL-W-22759/88[3]	WL
JA	MIL-W-25038/1	SN	MIL-W-22759/42	MIL-W-22759/5	VA	MIL-W-22759/89[3]	WM
JB	MIL-W-22759/28	SP	MIL-W-22759/43	MIL-W-22759/6	WA	MIL-W-22759/90[3]	WN
JC	MIL-W-22759/29	SR	MIL-W-22759/44	MIL-W-22759/7	SA	MIL-W-22759/91[3]	WP
JD	MIL-W-22759/30	SS	MIL-W-22759/45	MIL-W-22759/8	TA	MIL-W-22759/92[3]	WR
JE	MIL-W-22759/31	ST	MIL-W-22759/46	MIL-W-22759/9	LE	MIL-W-25038/1	JA
JF	MIL-W-25038/3	TA	MIL-W-22759/8	MIL-W-22759/10	LH	MIL-W-25038/3	JF
LE	MIL-W-22759/9	TE	MIL-W-22759/16	MIL-W-22759/11	RC	MIL-W-81044/5[2]	MD
LH	MIL-W-22759/10	TF	MIL-W-22759/17	MIL-W-22759/12	RE	MIL-W-81044/6	ME
MD	MIL-W-81044/5	TG	MIL-W-22759/18	MIL-W-22759/13	CA	MIL-W-81044/7	MF
ME	MIL-W-81044/6	TH	MIL-W-22759/19	MIL-W-22759/14	CB	MIL-W-81044/8[2]	MG
MF	MIL-W-81044/7	TK	MIL-W-22759/20	MIL-W-22759/15	CC	MIL-W-81044/9	MH
MG	MIL-W-81044/8	TL	MIL-W-22759/21	MIL-W-22759/16	TE	MIL-W-81044/10	MJ
MH	MIL-W-81044/9	TM	MIL-W-22759/22	MIL-W-22759/17	TF	MIL-W-81044/11[2]	MK
MJ	MIL-W-81044/10	TN	MIL-W-22759/23	MIL-W-22759/18	TG	MIL-W-81044/12	ML
MK	MIL-W-81044/11	VA	MIL-W-22759/5	MIL-W-22759/19	TH	MIL-W-81044/13	MM
ML	MIL-W-81044/12	WA	MIL-W-22759/6	MIL-W-22759/20	TK	MIL-W-81381/7[3]	MR
MM	MIL-W-81044/13	WB	MIL-W-22759/80	MIL-W-22759/21	TL	MIL-W-81381/8[3]	MS
MR	MIL-W-81381/7[3]	WC	MIL-W-22759/81	MIL-W-22759/22	TM	MIL-W-81381/9[3]	MT
MS	MIL-W-81381/8[3]	WE	MIL-W-22759/82	MIL-W-22759/23	TN	MIL-W-81381/10[3]	MV
MT	MIL-W-81381/9[3]	WF	MIL-W-22759/83	MIL-W-22759/28	JB	MIL-W-81381/11[3]	MW
MV	MIL-W-81381/10[3]	WG	MIL-W-22759/84	MIL-W-22759/29	JC	MIL-W-81381/12[3]	MY
MW	MIL-W-81381/11[3]	WH	MIL-W-22759/85	MIL-W-22759/30	JD	MIL-W-81381/13[3]	NA
MY	MIL-W-81381/12[3]	WJ	MIL-W-22759/86	MIL-W-22759/31	JE	MIL-W-81381/14[3]	NB
NA	MIL-W-81381/13[3]	WK	MIL-W-22759/87	MIL-W-22759/32	SB	MIL-W-81381/17[3]	NE
NB	MIL-W-81381/14[3]	WL	MIL-W-22759/88	MIL-W-22759/33	SC	MIL-W-81381/18[3]	NF
NE	MIL-W-81381/17[3]	WM	MIL-W-22759/89	MIL-W-22759/34	SD	MIL-W-81381/19[3]	NG
NF	MIL-W-81381/18[3]	WN	MIL-W-22759/90	MIL-W-22759/35	SE	MIL-W-81381/20[3]	NH
NG	MIL-W-81381/19[3]	WP	MIL-W-22759/91	MIL-W-22759/41	SM	MIL-W-81381/21[3]	NK
NH	MIL-W-81381/20[3]	WR	MIL-W-22759/92	MIL-W-22759/42	SN	MIL-W-81381/22[3]	NL

1 Not for use in aerospace applications
2 Inactive for new design
3 Not for Naval Air Systems Command usage

2.2.4 Number Of Wires Per Cable

The number of wires per cable shall be as designated and shall be 1 to 15 for shielded or shielded and jacketed cables, and 2 to 15 for unshielded unjacketed or unshielded jacketed cables. Cables with 10 to 15 conductors shall be limited to 12 AWG and smaller.

2.2.5 Shield Style And Material

The shield style and material of the overall shields shall be designated by a single letter or symbol in accordance with Table 2-3.

Table 2-3
SHIELD MATERIAL

Errata (reformatted from previous version)

Symbol single shield style	Symbol double shield style	Shield Material	Maximum temperature Limit for shield material (information only)
U	---	No shield	---
T	V	Tin-coated copper, round	150°C (302°F)
S	W	Silver-coated copper, round	200°C (392°F)
N	Y	Nickel-coated copper, round	260°C (500°F)
F	Z	Stainless Steel, round	400°C (752°F)
C	R	Nickel-clad copper, round	400°C (752°F)
M	K	Silver-coated high strength copper alloy, round	200°C (392°F)
P	L	Nickel-coated high strength copper alloy, round	260°C (500°F)
G	A	Silver-coated copper, flat	200°C (392°F)
H	B	Silver-coated high strength copper alloy, flat	200°C (392°F)
*	#	Nickel-coated copper, flat	260°C (500°F)
J	D	Tin-coated copper, flat	150°C (302°F)
E	X	Nickel-coated high strength copper alloy, flat	260°C (500°F)
I	Q	Nickel-chromium alloy, flat	400°C (752°F)

2.2.6 Jacket Material, Color, and Temperature Rating

The single jacket symbol shall be used for cables with an outer jacket only. The double jacket symbol shall be used in conjunction with a double shield symbol to describe constructions with a jacket in between two shields with another jacket over the outer shield. The single jacket symbol shall be used in conjunction with the double shield symbol to describe constructions with two overlaid shields with a single outer jacket. Unless otherwise specified (see 6.2.1, g), jacket colors shall be as specified under the jacket materials in accordance with Table 2-4.

Table 2-4
JACKET MATERIAL AND COLOR

Single jacket symbol	Double jacket symbol	Jacket material	Maximum temperature rating for jacket material (information only)
00	00	No Jacket	---
01	51[1]	Extruded white polyvinyl chloride (PVC)	90° C (194°F)
02	52[2]	Extruded clear polyamide	105°C (221°F)
03	53	White polyamide braid impregnated with clear polyamide finisher over a polyester tape	105°C (221°F)
04	54	Polyester braid impregnated with high temperature finishers over polyester tape	150°C (302°F)
05	55	Extruded clear fluorinated ethylene propylene (FEP)	200°C (392°F)
06	56	Extruded or taped and heat sealed white polytetrafluoroethylene (PTFE)	260°C (500°F)
07	57	White polytetrafluoroethylene (PTFE) treated glass braid impregnated and coated with polytetrafluoroethylene finisher over presintered polytetrafluoroethylene tape	260°C (500°F)
08[3]	58[3]	Cross linked white extruded polyvinylidene fluoride (PVF_2)	150°C (302°F)
09	59	Extruded white fluorinated ethylene propylene (FEP)	200°C (392°F)
10[3]	60[3]	Extruded clear polyvinylidene fluoride (PVF_2)	125°C (257°F)
11[4]	61[4]	Tape of natural polyimide combined with clear fluorinated ethylene propylene (FEP) wrapped and heat sealed with (FEP) outer surface	200°C (392°F)
12[4]	62[4]	Tape of natural polyimide combined with fluorinated ethylene propylene (FEP) wrapped and heat sealed with polyimide outer surface	200°C (392°F)
14	64	Extruded white ethylene-tetrafluoroethylene copolymer (ETFE)	150°C (302°F)
15	65	Extruded clear ethylene-tetrafluoroethylene copolymer (ETFE)	150°C (302°F)
16	66	Braid of aromatic polyamide with high temperature finisher over presintered polytetrafluoroethylene (PTFE) tape	200°C (392°F)
17[5]	67[5]	White extruded ethylene chlorotrifluoro-ethylene (ECTFE)	150°C (302°F)
18[5]	68[5]	Clear extruded ethylene chlorotrifluoro-ethylene (ECTFE)	150°C (302°F)

[1] Polyvinyl chloride materials shall not be used for aerospace applications.
[2] Jacket material 02 is not to be used for cables having a diameter of 0.251 inch or greater.
[3] Jacket materials 08, 58, 10, and 60 are not to be used for cables having a diameter of 0.401 inch or greater.
[4] Not for Naval Air Systems Command Usage.
[5] Inactive for new design.

Table 2-4
JACKET MATERIAL AND COLOR (*continued*)

Single jacket symbol	Double jacket symbol	Jacket material	Temperature rating for jacket material (information only)
20	70	Extruded white perfluoroalkoxy (PFA)	260°C (500°F)
21	71	Extruded clear perfluoroalkoxy (PFA)	260°C (500°F)
22	72	Tape of polyimide combined with clear fluorinated ethylene propylene (FEP) wrapped and heat sealed with opaque polyimide outer surface	200°C (392°F)
23	73	White, crosslinked, extruded, modified, ethylene-tetrafluoroethylene copolymer (XLETFE)	200°C (392°F)
24	74	Tape layer of white polytetrafluoroethylene (PTFE) wrapped over a tape layer of natural polyimide combined with FEP heated and fused	260°C (500°F)

Section 3
REQUIREMENTS

3.1 CONSTRUCTION

Construction shall comply with the designation given in 2.2. This standard covers a wide variety of possible primary wires, shields, and jacket combinations. Appendix A provides design parameters that should be considered in determining which combination is appropriate for a specific application. It is strongly recommended that consultation between users and cable manufacturers be made in order to assure the most suitable cable.

3.2 BASIC WIRE

Wire used in the construction of the cable shall be qualified to the basic wire specification (Table 2-2) before cabling. The producer of the finished cable shall be a qualified source under the applicable basic wire specification, or shall ensure that qualified wire from a qualified source was used in the construction of the cable and be required to furnish on request a test report from the manufacturer of the basic wire, plus a letter certifying that the component wire meets all the individual component wire specification requirements from the builder of the cable. Color added to the insulation (such as a helical stripe or circumferential band) for the purpose of wire number identification shall not degrade the insulation as evidenced by failure to meet the requirements herein. Unless otherwise specified (see 6.2.1), the manufacturer of cable is responsible for assuring that the basic wire meets the wire specification requirements prior to being fabricated into cable.

3.3 IDENTIFICATION OF CABLE WIRE

The basic wire insulation for single or multi-conductor cables shall provide a method of determining the wire number. Unless otherwise specified (see 6.2.1), the preferred identification method (see 3.3.1) shall be used. Stripes, tracers, and background insulation colors on the basic wires shall meet the requirements of MIL-STD-104 Class I, unless otherwise indicated or allowed by the basic wire specification.

3.3.1 Preferred Identification Method

The insulation of wire used in the cable shall be white (or basic color or natural color) with one or two colored spiral stripes in accordance with Table 3-1 or Table 3-2 as applicable. The color stripe(s) may be applied by an inking process or be incorporated in the textile braid when the braid is employed in the basic wire. When the inking process is used, the stripe(s) shall be in accordance with MIL-STD-681 except the stripe color and sequence shall be as specified herein. For wire diameters larger than .300 inch, a longitudinal ink strip is acceptable in lieu of a spiral stripe. When the braid is used, colored fibers shall be used for two parallel and adjacent carriers of the braid. The color identification fibers shall be woven in the opposite direction of any identification marker.

3.3.2 Optional Identification Method A

The insulation shall be a solid color in accordance with Table 3-1 or Table 3-2 as applicable. Solid coloring shall be done by the manufacturer of the wire, and the coloring shall meet the requirements of the basic wire specification.

Table 3-1
CIRCUIT IDENTIFICATION COLORS FOR BASIC WIRES

No. of wires in cable	Identification colors for respective wires in cable (see 3.3.1 or 3.3.2)														
	Wire Number														
	1[1]	2	3	4	5	6	7[2]	8	9	10[3]	11[4]	12[4]	13[4]	14[4]	15[4]
1	Basic (white)														
2	White	Blue													
3	White	Blue	Orange												
4	White	Blue	Orange	Green											
5	White	Blue	Orange	Green	Red										
6	White	Blue	Orange	Green	Red	Black									
7	White	Blue	Orange	Green	Red	Black	Yellow								
8	White	Blue	Orange	Green	Red	Black	Yellow	Violet							
9	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray						
10	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown					
11	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown	Blue/Blue				
12	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown	Blue/Blue	Orange/Orange	Green/Green		
13	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown	Blue/Blue	Orange/Orange	Green/Green		
14	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown	Blue/Blue	Orange/Orange	Green/Green	Red/Red	
15	White	Blue	Orange	Green	Red	Black	Yellow	Violet	Gray	Brown	Blue/Blue	Orange/Orange		Red/Red	Black/black

[1] Except where preferred color on basic wire specification sheet is not white.
[2] Where basic wire is MIL-DTL-81381, a brown helical stripe shall be used.
[3] Where basic wire is MIL-DTL-81381, a brown and white helical stripes shall be used.
[4] For cables having more than 10 conductors, the wires shall be identified by double tracers. (Blue/Blue indicates a white base wire with double blue tracers.)

Table 3-2
CIRCUIT IDENTIFICATION COLORS FOR BASIC WIRES[1]

No. of wires in cable	Identification colors for respective wires in cable (see 3.3.1 or 3.3.2)
1	Basic (white)
2	Red, blue
3	Red, blue, yellow
4	Red, blue, yellow, green
5	Red, blue, yellow, green, basic
6	Red, blue, yellow, green, basic, black
7	Red, blue, yellow, green, basic, black, brown
8	Red, blue, yellow, green, basic, black, brown, orange
9	Red, blue, yellow, green, basic, black, brown, orange, violet
10	Red, blue, yellow, green, basic, black, brown, orange, violet, gray
11	Red, blue, yellow, green, basic, black, brown, orange, violet, gray, red/ white[2]
12	Red, blue, yellow, green, basic, black, brown, orange, violet, gray, red/ white, blue/white[2]
13	Red, blue, yellow, green, basic, black, brown, orange, violet, gray, red/ white, blue/white, yellow/white[2]
14	Red, blue, yellow, green, basic, black, brown, orange, violet, gray, red/ white, blue/white, yellow/white, green/white[2]
15	Red, blue, yellow, green, basic, black, brown, orange, violet, gray, red/ white, blue/white, yellow/white, green/white, black/white[2]

[1] This color code was originally intended for basic wires in accordance with MIL-W-5086 and associated replacement wire and cable.

[2] Color designation indicates a solid color with stripe (red/white - solid red insulation with a white stripe).

3.3.3 Optional Identification Method B

The insulation on each wire in the cable shall be the same solid color. The color shall denote wire size in accordance with Table 3-3. In order to identify each wire in the cable, color bands shall be applied in accordance with Table 3-4. Color of the bands shall be contrasting to the base color of the insulation. The narrow bands shall be 0.030 inch to 0.120 inch wide. The wide bands shall be twice the width of the narrow bands and spaced 0.030 inch to 0.120 inch apart in a group. Group separation shall be 0.38 to 1.50 inch . The distance between the beginning of one group and the end of the next group shall be 3.0 inches maximum.

3.3.4 Optional Identification Method C

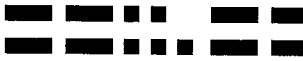
The insulation on each wire in the cable shall be the same solid color. The color shall denote wire size in accordance with Table 3-3. In order to identify each wire in the cable, the use of numbers imprinted on the insulation of the primary wire shall be used. The color of the numbers shall be a contrasting color to the base color of the insulation. The distance between the printed numbers shall be 3.0 inches maximum.

Table 3-3
COLOR OF INSULATION FOR IDENTIFICATION OF WIRE SIZES (SEE 3.3.3, 3.3.4 & 3.3.6), IN ACCORDANCE WITH MIL-STD-686

Wire size	Insulation color (solid)
26	Black
24	Blue
22	Green
20	Red
18	White[1]
16	Blue
14	Green
12	Yellow
10	Brown
8	Red
6	Blue
4	Yellow
2	Red
1	White
0	Blue
00	Green

[1] For MIL-DTL-81381 basic wire, the insulation color may be opaque dark yellow or unpigmented polyimide resin color and for MIL-DTL-22759/80 - /92 basic wire, the color purple (violet) may be used if called out for in the ordering data.

Table 3-4
CIRCUMFERENTIAL BAND CONFIGURATION FOR WIRE NUMBER IDENTIFICATION (see 3.3.3, 3.3.6, & 3.3.7)

Wire number	Band group configuration	Number of bands
1	No marking	None
2		2 Narrow
3		3 Narrow
4		4 Narrow
5		5 Narrow
6		6 Narrow
7		7 Narrow
8		1 Wide 1 Narrow
9		1 Wide 2 Narrow
10		1 Wide 3 Narrow
11		1 Wide 4 Narrow
12		1 Wide 5 Narrow
13		2 Wide 1 Narrow
14		2 Wide 2 Narrow
15		2 Wide 3 Narrow

3.3.5 Optional Identification Method D

The insulation on each wire in the cable shall be white or natural. In order to identify each wire in the cable, the use of numbers imprinted on the insulation of the primary wire shall be used. The color of the numbers shall be contrasting to the base color of the insulation. The distance between the printed numbers shall be 3.0 inches maximum.

3.3.6 Optional Identification Method E

The insulation on each wire shall be white with the same colored helical stripe. The color of the stripe shall denote the wire size in accordance with Table 3-3. In order to identify each wire in the cable, color bands shall be applied in accordance with Table 3-4. The color of the bands shall be contrasting to the base color of the insulation. The narrow bands shall be 0.030 to 0.120 inch wide. The wide bands shall be twice the width of the narrow bands and spaced 0.030 to 0.120 inch apart in a group. Group separation shall be 0.38 to 1.50 inch . The distance between the beginning of one group and the end of the next group shall be 3.0 inches maximum.

3.3.7 Optional Identification Method F

The insulation on each wire shall be white. In order to identify each wire in the cable, color bands shall be applied in accordance with Table 3-4. The color of the bands shall be contrasting to the base color of the insulation. The narrow bands shall be 0.030 to 0.120 inch wide. The wide bands shall be twice the width of the narrow bands and spaced 0.030 to 0.120 inch apart in a group. Group separation shall be 0.38 to 1.50 inches . The distance between the beginning of one group and the end of the next group shall be 3.0 inches maximum.

3.4 CABLE LAY-UP

The required number of wires for multi-conductor construction determined by the cable designation shall be cabled with a left-hand lay. The lay of the individual wires shall be not less than 6 nor more than 16 times the outside major axis diameter of the unshielded, unjacketed cable as calculated in 4.4. The basic wire shall not be spliced. When cables are cut, wires shall not splay more than twice the diameter of the cable.

3.5 FILLERS AND BINDER TAPES

Fillers and binder tapes, if used, shall be of a fungus resistant material with a temperature equivalent to , or higher than, the cable rating without fillers and tape. They shall also be easily removable from the finished cable without adherence to the underlying insulation.

3.6 SHIELD

When the cable designation specifies that a shield is to be incorporated into the cable construction, either a closely woven braid of round strands or a closely woven braid of flat strands shall be applied over the basic wire or cable. The shield strands shall be free from lumps, kinks, abrasions, scraped or corroded surfaces, and surface impurities. The strand coating shall be smooth, continuous, and adherent to the underlying material.

3.6.1 Round Shield

3.6.1.1 Round Shield Strand Material

3.6.1.1.1 Round Copper Shield Strands

Before shielding, the copper strands used in the shields shall be annealed or soft-drawn copper wire from commercially pure copper and shall conform to ASTM B 3. Before application to the cable, individual tin, silver, or nickel coated copper strands shall have a minimum elongation of 6 percent.

3.6.1.1.2 Round Copper Alloy Shield Strands

Before shielding, the high strength copper alloy strands shall conform to ASTM B624 except the minimum tensile strength shall be 55,000 lbf/in^2, the minimum elongation shall be 6 percent, and the conductivity shall be 80 percent (minimum) as stated in NBS Handbook 100.

3.6.1.1.3 Stainless Steel Shield Strands

Before shielding, the stainless steel strands shall conform to ASTM A313.

3.6.1.2 Round Shield Strand Coating

3.6.1.2.1 Tin-Coated Copper Strands

When the cable designation specifies a tin-coated shield, the individual strands shall be coated uniformly with a smooth continuous layer of commercially pure tin. Prior to braiding, strands shall meet the requirements of ASTM B33. The thickness of the tin coating shall be 250 microinches maximum.

3.6.1.2.2 Silver-Coated Copper and Copper Alloy Strands

When the cable designation specifies a silver-coated shield, the individual strands shall be coated uniformly with a smooth continuous layer of commercially pure silver. Prior to braiding, silver-coated copper strands shall meet the requirements of ASTM B298. Silver-coated high strength copper alloy strands shall meet the requirements of 3.6.1.1.2 and the adhesion and the continuity of coating requirements of ASTM B298. The thickness of the silver shall not be less than 40 microinches.

3.6.1.2.3 Nickel-Coated Copper and Copper Alloy Strands

When the cable designation specifies a nickel-coated shield, the individual strands shall be coated uniformly with a smooth continuous layer of commercially pure nickel. The thickness of the nickel coating shall be not less than 50 microinches, nor greater than 250 microinches. The nickel-coated copper strands shall meet the coating requirements of ASTM B355 prior to braiding. Nickel-coated high strength copper alloy strands shall meet the requirements of 3.6.1.1.2 and the adhesion and continuity of coating requirements of ASTM B 355.

3.6.1.2.4 Nickel-Coated Copper 27%

When the cable designation specifies a nickel clad copper shield, the individual strands shall have a nickel coating having a cross-sectional area that is 27 percent minimum of the total cross-sectional area of the drawn strand. The wire shall meet the coating requirements of ASTM B355 prior to braiding.

3.6.1.3 Round Shield Strand Size

3.6.1.3.1 Round Copper or Copper Alloy Strand Size

Cables with braided shields using round copper or round copper alloy strands shall conform to the shield group A or B. The core diameter referred to in group A or B shall be the nominal outside core diameter of the unshielded, unjacketed cable equal to the basic wire nominal diameter multiplied by factor A for filled cables and factor G for unfilled cables from Table 3-6. The following basic wires MIL-W-22759/11, /12, /16-/19, /22, /23, /28-/35, /41-/46, /80-/92, and all specification sheets of MIL-DTL-81381 and MIL-W-81044, shall conform to shield group B. All other braided shields with round shield strands shall conform to shield group A.

Table 3-5
ROUND SHIELD STRAND SIZE

Group A Cable core diameter	Group B Cable core diameter	Shield strand size
0.000 to 0.060 inch	0.000 to 0.250 inch	38 AWG
0.061 to 0.310 inch	0.251 to 0.400 inch	36 AWG
0.311 to 0.750 inch	0.401 to 1.00 inch	34 AWG
0.751 inch and larger	1.001 inches and larger	32 AWG

Table 3-6
CABLE AND GEOMETRY FACTORS

Number of conductors	A[1]	B[2]	G[3]
1	1.00	1.0	1.00
2	2.00	1.8	1.64
3	2.16	2.1	1.95
4	2.73	2.4	2.27
5	3.00	2.7	2.59
6	3.00	3.0	2.87
7	3.00	3.0	2.91
8	3.72	3.4	3.38
9	4.05	3.6	3.55
10	4.08	3.8	3.65
11	4.16	4.1	3.95
12	4.16	4.1	3.95
13	4.75	4.4	4.27
14	4.75	4.4	4.27
15	5.00	4.7	4.59

[1] Geometry factor for cables filled to round (see 3.6.1.3.1, 4.3.5, and 4.4).
[2] Geometry factor for cable weight calculation (see 4.5).
[3] Geometry factor for unfilled cables (see 3..6.1.3.1 and 4.3.5).

3.6.1.3.2 Round Stainless Steel Shield Size

On cable with the outside diameter (under the shield) of less than 0.060 inch, the strand size shall be 40 AWG. On cable with an outside diameter of 0.060 to 0.120 inch, the strand size shall be 38 AWG. On cable with an outside diameter of 0.121 inch and larger, the strand size shall be 36 AWG.

3.6.2 Flat Shield

3.6.2.1 Flat Shield Strand Material

3.6.2.1.1 Flat Copper Shield Strands

Flattened copper wire shall meet the requirements of ASTM B272 except the wire shall be made by flattening round wire.

3.6.2.1.2 Flat Copper Alloy Shield Strands

Flat high strength copper alloy wire shall be made by flattening round wire. The flattened wire tensile strength shall be not less than 55,000 lbf/in^2, and the elongation shall be one (1) percent minimum after flattening.

3.6.2.2 Flat Shield Strand Coating

3.6.2.2.1 Tin-Coated Copper Strands

Tin-coated copper strands before flattening shall conform to ASTM B33. Flattened wire strands shall meet the continuity of coating test of ASTM B33. The thickness of the coating shall be 250 microinches maximum.

3.6.2.2.2 Silver-Coated Copper and Copper Alloy Strands

Silver-coated copper and silver-coated high strength copper alloy strands before flattening shall conform to ASTM B298. Flattened wire strands shall meet the continuity of coating requirements of ASTM B298. The thickness of coating shall be 40 microinches minimum after flattening.

3.6.2.2.3 Nickel-Coated Copper and Copper Alloy Strands

Nickel-coated copper and nickel-coated high strength copper alloy strands before flattening shall conform to ASTM B355. Flattened wire strands shall meet the continuity of coating requirements of ASTM B355. The thickness of coating shall be 50 microinches minimum after flattening.

3.6.2.3 Flat Shield Strand Size

Flat wire shields shall be braided of copper, high-strength copper alloy, or nickel chromium alloy. The flattened wire shall be 0.0015 inch ± 0.0004 inch in thickness.

3.6.3 Braid Angle

The shield braid shall be a push-back type. The angle of the carriers of the braid with the axis of the cable in woven wire shields shall be not less than 18° nor more than 40°. When the major diameter of the cable beneath the braid is greater than 0.31 inches, the above braid angle restriction shall not apply. In this case, the shield shall be suitably applied to provide good push-back characteristics. For determination of braid angle, see 4.3.5.

3.6.4 Shield Coverage

The shield braid shall be applied in such a manner as to provide 85 or 90 percent minimum coverage for each individual shield (see 4.3.5) as specified by the part number (see 2.2).

3.6.5 Shield Splices

If splices are used in the shield, they shall not affect the geometry of the finished cable. No more than one carrier may be spliced at any one point in the shield.

3.7 JACKET

3.7.1 Jacket Requirements

3.7.1.1 Wall Thickness

The wall thickness of the jacket shall be as specified in Table 3-7 for the applicable material. The thickness of the jacket between the shields in a double shielded and double-jacketed cable shall be 75 percent of the values specified in Table 3-7.

3.7.1.2 Extruded Jacket Concentricity

The concentricity of extruded jackets shall not be less than 70 percent when tested in accordance with 4.3.17.

3.7.1.3 Jacket Color

Unless otherwise specified in ordering data, cable jacket color shall be in accordance with Table 2-4.

3.7.1.4 Strippability

The jacket shall be removable from the finished cable without adherence to the underlying shield or cable. After stripping, tape-wrapped jackets (styles 06, 56, 11, 61, 12, 62, 22, 72, 24, and 74) shall not delaminate.

3.7.2 Jacket Material

3.7.2.1 Extruded Polyamide

Extruded polyamide jackets shall be limited in application to cables having a major diameter not greater than 0.25 inch prior to application of the jacket. The polyamide shall be in accordance with ASTM D4066 type PA 622, grade E22.

3.7.2.2 Polyamide Braid and Polyamide Finishers

Jackets shall be constructed with polyamide fibers, 210 denier, woven in such a manner as to provide complete coverage and shall be impregnated with a clear polyamide finisher.

3.7.2.3 Polyester Fiber Braid with High Temperature Finishers

Braided polyester fiber jackets shall be constructed with the fiber woven in such a manner as to provide complete coverage and shall be impregnated with a high temperature finisher. The color of the finished braids shall be white or tan. After subjection to the heat aging test, the finisher shall show no indications of decomposition.

3.7.2.4 Extruded or Taped Polytetrafluoroethylene

If polytetrafluoroethylene tapes are used, they shall be unsupported and shall be a minimum of two contrahelically wrapped tapes, each applied with a 25 percent minimum overlap. The tapes shall subsequently be thermally sealed and shall meet the requirements of 4.3.18.

3.7.2.5 Extruded Polyvinyl Chloride

The tensile strength and elongation of the jacket shall be 2000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.3.14. **Polyvinyl chloride shall not be used for aerospace purposes**.

3.7.2.6 Extruded Fluorinated Ethylene Propylene

The tensile strength and elongation of the jacket shall be 3000 lbf/in^2 minimum and 200 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.7 Glass Braid with Polytetrafluoroethylene Finishers

Braided polytetrafluoroethylene coated glass fiber jackets shall be constructed with treated glass fiber containing not less than 15 percent by weight of polytetrafluoroethylene and woven in a manner that will provide complete coverage. The braid shall be impregnated and coated with a polytetrafluoroethylene finisher.

3.7.2.8 Extruded Crosslinked Polyvinylidene Fluoride

The tensile strength and elongation of the jacket shall be 4000 lbf/in^2 minimum and 200 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.9 Polyvinylidene Fluoride

The tensile strength and elongation of the jacket shall be 5000 lbf/in^2 minimum and 225 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.10 Taped Polyimide/Fluorinated Ethylene Propylene

The jackets of polyimide/fluorinated ethylene propylene tapes shall consist of two or more tapes. The inner tape shall be a one-side polyimide/fluoropolymer coated tape applied with not less than 20 percent overlap and with the polyimide side facing the shield or component wires. Succeeding tapes shall be applied in alternating directions and with not less than 30 percent overlap. The tapes shall be thermally sealed together.

3.7.2.11 Ethylene-Tetrafluoroethylene Copolymer

The tensile strength and elongation of the jacket shall be 5000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.12 Ethylene Chlorotrifluoroethylene Copolymer (Inactive for New Design)

The tensile strength and elongation of the jacket shall be 5000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.13 Extruded Perfluoroalkoxy

The tensile strength and elongation of the jacket shall be 3000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.14 Extruded, Crosslinked, Modified, Ethylene-Tetrafluoroethylene

The tensile strength and elongation of the jacket shall be 5000 lbf/in^2 minimum and 50 percent minimum, respectively, and shall be tested in accordance with 4.3.14.

3.7.2.15 Taped Polyimide/Polytetrafluoroethylene

The jackets of Polyimide/Polytetrafluoroethylene shall consist of two tapes. The first shall be a fluoropolymer/polyimide/fluoropolymer coated tape (1 mil minimum thickness) applied with a minimum 50 percent overlap. The second tape shall be an unsintered polytetrafluoroethylene (PTFE) tape (2 mil thickness) applied in the opposite direction (cross-wrapped) to the first tape and with a minimum of 50 percent overlap. Additional cross-wrapped PTFE tape layers may be used to meet wall thickness requirements of Table 3-7. The PTFE tape material shall be formulated in such a manner to achieve a minimum 62 percent contrast level when marked by a UV laser source. This requirement can be satisfied by certification from the PTFE tape supplier.

Table 3-7
JACKET WALL THICKNESS

Diameter of cable beneath jacket (inches)	Jacket material designation[1]								
	01	02	06	05, 09, 14 15, 17, 18 20, 21	08, 10	11	12, 22	23	24
Up to 0.150	0.010 to .020	0.005 to .009	0.010 to .015	0.007 to .015	0.005 to .010	0.0035 to .0055	0.003 to .0055	0.005 to .010	0.005 to 0.009
0.151 to 0.200	0.015 to .025	0.006 to .010	0.010 to .015	0.010 to .020	0.006 to .012	0.0035 to .0055	0.003 to .0055	0.006 to .011	0.005 to 0.009
0.201 to 0.250	0.020 to .030	0.007 to .011	0.010 to .015	0.010 to .020	0.007 to .014	0.0035 to .0055	0.003 to .0055	0.007 to .012	0.006 to 0.010
0.251 to 0.300	0.025 to .035		0.010 to .015	0.010 to .020	0.007 to .014	0.0035 to .0055	0.003 to .0055	0.007 to .013	0.006 to 0.010
0.301 to 0.400	0.030 to .040		0.015 to .025	0.013 to .020	0.007 to .014	0.006 to .009	0.0045 to .0075	0.008 to .014	0.006 to 0.010
0.401 to 0.500	0.040 to .050		0.015 to .025	0.013 to .020		0.006 to .009	0.0045 to .0075	0.009 to .017	0.006 to 0.010
.0501 to 0.600	0.050 to .065		0.020 to .030	0.020 to .030		0.0095 to .0135	0.007 to .011	0.010 to .018	0.008 to 0.012
.0601 to 0.700	0.060 to .075		0.020 to .030	0.020 to .030		0.0095 to .0135	0.007 to .011	0.012 to .022	0.008 to 0.012
.0701 to .0750	0.070 to .085		0.020 to .030	0.020 to .030		0.0095 to .014	0.007 to .011	0.014 to .024	0.008 to 0.012
0.751 to 0.800	0.075 to .090		0.020 to .030	0.020 to .035		0.0095 to .014	0.007 to .011	0.014 to .024	0.008 to 0.012
0.801 to 1.000	0.080 to .095		0.020 to .030	0.020 to .035		0.0095 to .014	0.007 to .011	0.016 to .030	0.008 to 0.012
Over 1.000	10 - 12.5 % of diameter of cable beneath jacket		0.020 to .030	0.020 to .035				0.020 to .040	0.008 to 0.012

[1] Jacket materials not shown shall have a minimum wall thickness of .010 inch.

3.8 FUNCTIONAL CHARACTERISTICS

3.8.1 Dielectric Withstand

3.8.1.1 Dielectric Withstand - Component Wire

One hundred percent of all finished cable shall be tested in accordance with 4.3.3.1. During this test, there shall be no evidence of electrical breakdown or arcing. For unshielded, unjacketed cables, with four or less conductors, this test shall not be required.

3.8.1.2 Dielectric Withstand - Inner Jacket

One hundred percent of all finished cable with inner jackets shall be tested in accordance with 4.3.3.2. During this test, there shall be no evidence of electrical breakdown or arcing.

3.8.1.3 Dielectric Proof Test (for Unshielded/Unjacketed Configuration)

One hundred percent of all finished unshielded and unjacketed, multi-conductor cable (except MIL-W-8777 and MIL-W-25038), 2-7 conductors, sizes 14-26 AWG and 2-5 conductors, size 12 AWG, shall pass the impulse dielectric test in accordance with 4.3.3.3. There shall be no evidence of dielectric failure.

3.8.2 Jacket Flaws (Shielded and Jacketed Cables Only)

One hundred percent of all finished cable shall be tested in accordance with 4.3.4. All flaws shall be removed or marked consistent with the requirements for packaging (see 5.1).

3.8.3 Conductor Continuity

All conductors in all lengths of finished cable shall withstand the conductor continuity test of 4.3.8 without indication of discontinuity.

3.8.4 Cold Bend (Jacketed and Shielded-and-Jacketed Cables Only)

All finished jacketed and shielded-and-jacketed types of cable shall withstand the cold bend test of 4.3.6 without evidence of cracking of jackets. Shielded and jacketed cable with jacket material listed in 4.3.6 shall then pass the voltage withstand test of 4.3.7 without electrical breakdown (see 4.2).

3.8.5 Thermal Shock

All finished cable with jacket materials listed in Table 3-9 shall withstand the thermal shock test of 4.3.9 without cracking of the jacket (see 4.2).

3.8.6 Aging Stability

All finished cable with jacket styles listed in Table 3-9 shall withstand the aging stability test of 4.3.10 without cracking of the jacket (see 4.2).

Table 3-9
THERMAL SHOCK AND AGING STABILITY

Jacket materials[1]	Thermal shock and aging stability temperature
01	136°C
02, 03, 04, 10	150°C
14, 15,17, 18	180°C
05, 09, 11, 12, 16, 22, 24	230°C
06, 07, 20, 21	285°C

[1] Double jacketed cable shall be tested to the same temperatures as the corresponding single layer jacket material listed.

3.8.7 Blocking

Adjacent layers of cable with all jacket materials shall not stick together nor to the metal mandrel when subjected to the test for blocking in 4.3.16 at rated temperature of the jacket or basic wire, whichever is lower, for 6 hours.

3.8.8 Flammability

Cable specimens with all jacket materials loaded with sufficient weight to remain taut throughout test shall not burn for more than 30 seconds, nor more than 3.0 inches when tested in accordance with 4.3.20.

3.8.9 Lamination Sealing

Cable specimens with tape wrapped jacket materials 11, 12, 22, 24, 61, 62, 72, or 74 shall exhibit no separation of layers either along the insulation or at the ends when tested in accordance with 4.3.15.

3.8.10 Crosslinked Verification

All finished cable with jacket material 08, 23, 58, and 73 shall withstand the test of 4.3.11 without cracking of the jacket or dielectric breakdown as applicable (see 4.2). Normal oxidation of the conductor coating or shield strand coating shall not be cause for rejection.

3.8.11 Shield Solderability

Solderability shall be evaluated using Test C of MIL-STD-202, Method 208 after the braided shields are tested in accordance with paragraph 4.3.19. The requirement is applicable to tin and silver coated shields only (single shield symbols T, S, M, G, H, and J; and double shield symbols V, W, K, A, B, and D).

3.8.12 Temperature Rating

The temperature rating of the cable shall be defined as the lowest rating of the basic specification wire (2.2.3), the shield material (2.2.5), or the jacket material (2.2.6).

3.9 IDENTIFICATION OF PRODUCT

3.9.1 Wire Product Identification

The wire product identification shall appear on all individual basic wires when required by the basic specification. The wire product identification may be omitted on wire number 1 when this wire carries the cable product identification (see 3.9.2., 3.9.2.2, 3.9.2.3, and 3.9.2.4).

3.9.2 Cable Product Identification

The cable product identification shall consist of the cable designation as determined by 2.2 and by the cable manufacturer's code designation in accordance with publication H4-1 and H4-2. No other identification marking shall be applied by the manufacturer unless otherwise specified.

The cable product identification shall not be applied by hot stamp or any other method which reduces the insulation and/or jacket thickness at the point of the mark. The printed marking shall be durable, legible, and shall be black in color, except where black is difficult to read against the color of the insulation, in which case the color of the printing shall be white. The size of the printed characters shall be consistent with the magnitude of the surface upon which it is printed. The distance between the end of one marker and the beginning of next shall be:

a. 6 to 18 inches if printed on the jacket (see 3.9.2.1, 3.9.2.3, and 3.9.2.4)

b. A maximum of 3 inches if on a marker tape (see 3.9.2.2, 3.9.2.3, and 3.9.2.4)

c. A maximum of 12 inches if on wire number 1 (see 3.9.2.1, 3.9.2.2, 3.9.2.3, & 3.9.2.4)

The printed marking shall be applied with the vertical axis of the printed characters lengthwise on cable (or wire) whose nominal diameter is 0.050 inch or smaller. The vertical axis of the printed characters may be crosswise or lengthwise on cable (or wire) whose nominal diameter is 0.051 inch, or larger, or whenever tape is used (see 3.9.3).

3.9.2.1 Unshielded, Unjacketed Cable, Shielded Singles, and Shielded and Jacketed Singles

The cable product identification shall be imprinted on the insulation of wire number 1 (see 3.9.1) except on shielded and jacketed single constructions having jacket styles 08, 23, 24, 58, 73, and 74, which shall have the cable product identification marked on the surface of the jacket. The cable product identification shall not be required on insulation of wire number 1 when the product identification is not required by the basic wire specification for that size wire.

3.9.2.2 Shielded Cable (2 to 15 Wires)

The cable product identification shall be imprinted on the insulation of wire number 1. If the detailed specification for the primary wires does not permit printing of the wire, a marker tape shall be used (see 3.9.3).

3.9.2.3 Jacketed Cable (2 to 15 Wires)

The cable product identification shall be imprinted on the outer surface of the following jacket styles: 08, 23, 58, and 73. For jacket styles 24 and 74, the cable product identification shall be imprinted on the insulation of wire number 1. All other jacket styles shall have cable product identification imprinted on a marker tape placed beneath the jacket (see 3.9.3).

3.9.2.4 Shielded and Jacketed Cable (2 to 15 Wires)

The cable product identification shall be imprinted on the outer surface of the following jacket styles: 08, 23, 58, and 73. For jacket styles 24 and 74, the cable product identification shall be imprinted on the insulation of wire number 1. All other jacket styles shall have cable product identification imprinted on a marker tape placed beneath the shield or jacket.

3.9.3 Identification Marker Tape

When tape is used for carrying the imprinted cable product identification, the tape shall be one continuous length of electrically non-conductive, non-adhesive type material with a temperature rating equivalent to, or higher than, the cable temperature rating. The color of the tape shall be white except when polyimide tape is used, in which case the natural color of the polyimide is allowable.

3.10 CABLE DIAMETER

The major diameter of the cable shall be determined as specified in 4.4 and shall not exceed the maximum diameter calculated in accordance with 4.4.

3.11 CABLE WEIGHT

The maximum weight of the cable shall be determined as specified in 4.5. The measured weight shall not exceed the calculated weight.

3.12 CONTINUOUS LENGTHS

When inspected in accordance with paragraph 4.6, the individual continuous lengths of finished cable in each inspection lot shall conform to the continuous length requirements listed below:

85 % of the lengths shall be greater than 100 feet.
100 % of the lengths shall be greater than 50 feet.

Unless otherwise specified in the contract or order, the footage of the individual continuous lengths in each spool or reel shall be marked on the spool or reel in the sequence in which the lengths will be unwound by the user.

3.13 WORKMANSHIP

The finished cable shall exhibit uniform quality throughout, without visible irregularities when viewed with the unaided eye.

Section 4
VERIFICATION

4.1 CLASSIFICATION OF INSPECTION

The inspection requirements specified herein are classified as follows:

a. Quality conformance inspection (see 4.2.1)
b. Process control tests (see 4.2.2)

4.2 CONDITIONS OF INSPECTION

Unless otherwise specified, all inspections shall be performed under the test conditions specified in MIL-STD-2223.

4.2.1 Quality Conformance Inspection

Quality conformance tests shall consist of the tests listed in Table 4-1.

Table 4-1
QUALITY CONFORMANCE INSPECTION

Test[1]	Requirement	Test Method
Cable Lay-up	3.4	4.3.1
Shield Coverage	3.6.4	4.3.5
Braid angle	3.6.3	4.3.5
Identification of product	3.9	4.3.1
Jacket wall thickness and Concentricity	3.7.1.1 & 3.7.1.2	4.3.13 & 4.3.17
Cable jacket removability	3.7.1.4	4.3.1
Cable diameter		
Cable weight	3.10	4.4
Lamination sealing	3.11	4.5
Cold bend	3.8.9	4.3.15
Thermal Shock	3.8.4	4.3.6
Aging stability	3.8.5	4.3.9
Jacket, tensile strength elongation	3.8.6	4.3.10
Blocking	3.7.2	4.3.14
Flammability	3.8.7	4.3.16
Crosslinked verification	3.8.8	4.3.20
Shield solderability	3.8.10	4.3.11
	3.8.11	4.3.19

[1] When required

4.2.1.1 Lot

A lot shall consist of all cable of a single cable designation offered for inspection at one time, except that the lot shall not exceed 1,000,000 feet or one week's production, whichever is less. The lot size shall be expressed in units of thousands of feet (total footage in lot divided by 1,000).

4.2.1.2 Sample

A sample shall consist of individual lengths of cable chosen at random from any one lot for the purpose of inspection or test. The sample size or number of lengths to be chosen from each lot shall be determined by the sampling plan.

4.2.1.3 Sample Unit

A sample unit shall consist of one of the individual lengths of the sample.

4.2.1.4 Specimen

A specimen shall consist of the portion of one sample unit upon which a particular inspection or test is to be made.

4.2.1.5 Sampling

A random sample of the size specified shall first be selected from the lot. A specimen of sufficient length shall then be selected from each sample unit for all specified tests. Sampling inspection shall be in accordance with ANSI/ASQC Z1.4, inspection level S-4, acceptance number 0 (single sampling plan).

4.2.1.6 Resubmitted Inspection Lots

ANSI/ASQC Z1.4 shall apply except that a resubmitted lot shall be inspected by the manufacturer using tightened inspection.

4.2.2 Process Control Tests

The process control tests are either of such nature that they cannot be performed on finished cable submitted for inspection and therefore must be conducted at the most appropriate stage of manufacturing operation, or they are tests conducted on 100 percent of the finished cable. The process control tests shall consist of the tests listed in Table 4-2.

Table 4-2
PROCESS CONTROL TEST

Test	Requirement	Test Method
Copper shield round strand material	3.6.1.1.1	4.3.1
Stainless steel shield material	3.6.1.1.3	4.3.1
High-strength copper alloy shield round strand material	3.6.1.1.2	4.3.1
Thickness of shield strand coating	3.6	4.3.2.2.1
Continuity of shield strand coating	3.6	4.3.2.2.2
Shield Strand elongation	3.6	4.3.2.1
Dielectric withstand component wires (100%)	3.8.1.1	4.3.3.1
Dielectric withstand inner jacket (100%)	3.8.1.2	4.3.3.2
Dielectric proof test (100%)	3.8.1.3	4.3.3.3
Jacket flaws (100%)	3.8.2	4.3.4
Conductor continuity (100%)	3.8.3	4.3.8
Basic wire acceptance	3.2	Basic wire specification
Continuous lengths (100%)	3.12	4.6
Workmanship	3.13	4.3.1

4.2.2.1 Sampling for Process Control Tests.

4.2.2.1.1 Sampling for Shield Material

From every 100 pounds of individual shield strand, three 10-foot lengths of each style of shield strand representative of the material to be used in the finished cable shall be selected. The material of the shield strands, its coating and strand elongation shall be verified.

4.2.2.1.2 Basic Wire

Sampling of the basic wire shall be in accordance with the sampling plan of the basic wire specification. Additional impulse dielectric testing in accordance with the basic wire specification shall be performed when a potentially degrading operation, either thermal, mechanical, or chemical has been performed subsequent to the original test.

4.2.3 Disposition of Rejections

When the sample selected from a production run fails to meet the specified tests, no items still on hand or later produced shall be accepted until the extent and cause of failure have been determined and corrected.

4.3 METHODS OF INSPECTION

4.3.1 Inspection of Product

All samples of cable shall be inspected for all requirements of this specification. Due to size limitations of chambers, mandrels, and cables, it is allowable to obtain permission of the acquiring activity to omit particular tests, such as cold bend (4.3.6), thermal shock (4.3.9), aging stability (4.3.10), crosslinked verification (4.3.11), and jacket blocking (4.3.16).

4.3.2 Shield Strands

4.3.2.1 Elongation

Elongation tests on the coated copper strand shall be conducted in accordance with MIL-STD-2223, method 5002, using a 12-inch specimen, 10-inch bench marks, and a 10-inch initial jaw separation. The test shall be run on 3 specimens.

4.3.2.2 Coating

4.3.2.2.1 Thickness

The thickness of the coating shall be determined by the electronic determination method of ASTM B298 or ASTM B355.

4.3.2.2.2 Continuity of Tin, Silver, and Nickel Coating

Continuity of tin, silver, and nickel coating tests shall be conducted in accordance with ASTM B 33, ASTM B 298, or ASTM B 355 as applicable. There shall be no evidence of exposed copper.

4.3.3 Dielectric Withstand

4.3.3.1 Dielectric Withstand-Component Wires

The finished cable shall be tested in accordance with MIL-STD-2223, method 3005, except that immersion is not required. Each conductor, in turn, shall be tested against all others tied together with the (inner) shield (if any). The test voltage shall be 1,500 V rms for 600-volt rated basic wire and 2,500 V rms for 1,000 volt rated basic wire. The time of electrification shall not be less than 15 or more than 30 seconds.

4.3.3 2 Dielectric Withstand-Inner Jacket

The inner jacket of a double shielded cable shall be subjected to a dry dielectric test. A potential of 500 V rms shall be applied to the inner shield with the outer shield grounded. The time of electrification shall not be less than 15 or more than 30 seconds.

4.3.3.3 Dielectric Proof Test (for Unshielded/Unjacketed Cable Configuration)

The dielectric proof test shall be performed in accordance with MIL-STD-2223, method 3002 at 6 kV (peak) or in accordance with MIL-STD-2223, method 3008 at 4.25 kV rms.

4.3.4 Jacket Flaws

One-hundred percent of all finished shielded and jacketed cable shall be tested in accordance with MIL-STD-2223, method 3001 or 3008, with a minimum potential voltage of 1500 volts rms between the electrode and the cable shield.

4.3.5 Braid Angle and Shield Coverage

The braid angle and the percent coverage of the braid shall be determined by the following formula:

$$\text{Tan } \alpha = 2 \pi (D + 2d_1) P/C$$
$$K = 100 (2F-F^2)$$

Where:

K	=	percent coverage
F	=	$EPd_2/\sin \alpha$
P	=	picks per inch of cable length
α	=	angle of braid with axis of cable
E	=	number of strands per carrier
d_1	=	diameter of one of the round shield strands or thickness of flattened strand
d_2	=	diameter of one of the round shield strands or width of flattened strands
D	=	diameter of cable under shield
D	=	Gb (for cables with no fillers, cable factor from column G of Table 3-6)
D	=	Ab (for cables with fillers to round, use cable factor A of Table 3-6)
C	=	number of carriers
n	=	number of basic wires (see Table 3-6)
b	=	basic wire diameter

4.3.6 Cold Bend

The ends of previously untested samples of finished cable shall be secured to a mandrel in a cold chamber. The other end of each specimen shall be secured to separate load weights sufficient to keep the cable vertical and tangent to the mandrel during the bending operation. The mandrel size shall be as specified in Table 4-3. The temperature of the chamber shall be lowered to $-55^{\circ}C \pm 5^{\circ}C$ at a rate not to exceed $50^{\circ}C$ per minute. The specimen and the mandrel shall be conditioned at this temperature for 4 hours. At the end of this period, while both mandrel and specimen are still at this low temperature, the cable shall be wrapped around the mandrel for 180^{0} without opening the chamber. The time required for bending around 180° of the mandrel shall be one-half minute at a uniform rate of speed. A revolving mandrel operated externally from the chamber shall be used. The specimens shall then be removed from the mandrel and visually inspected, without magnification, for cracks. Specimens of shielded and jacketed types of cable with jacket material 01, 02, 05, 06, 08 through 12, 14 through 18, 20, 22, 23, 24, and equivalent double jackets shall be subjected to the voltage withstand test specified in 4.3.7. After being subjected to the cold bend test or voltage withstand test of the jacket, all specimens shall be dissected. The individual wires shall then be immersed within 3 inches of their ends for 1 hour in a 5 percent salt solution. At the end of this period, a potential of 1000 V rms at commercial frequency shall be applied for 1 minute from each conductor to the salt solution.

4.3.7 Voltage Withstand, Jacket

Specimens shall be formed into the shape of a U. All conductors shall be electrically connected together with the shields (if any) on both ends of the specimen. The specimens shall be tested in accordance with MIL-STD-2223, method 3005, except the time of immersion shall be 1 hour minimum. The test voltage shall be 1,000 V rms, and the time of electrification shall be 1 minute. The test voltage shall be applied between the conductors (plus shield) and the immersion liquid.

4.3.8 Conductor Continuity

Each basic wire in 100 percent of all finished cable in shipment reels or coils shall be tested for conductor continuity with an ohmmeter or other suitable testing device. There shall be no indication of discontinuity.

4.3.9 Thermal Shock

Specimens of finished cable with jacket materials listed in Table 3-7 shall be wrapped around a mandrel for at least six close turns with the ends of the specimens tied to the mandrel. The mandrel diameter shall be as specified in Table 4-3. The specimens on the mandrel shall be subjected to a temperature within 5°C of the values specified in Table 3-7 for 4 hours, except for jacket material 02, which will be tested for 30 minutes. At the end of this period, the specimen shall be inspected visually for cracks without the aid of magnification (see 3.8.5).

4.3.10 Aging Stability

Specimens of finished cable with jacket styles listed in Table 3-9 shall be aged for 96 hours at temperatures within 5°C of the values specified in Table 3-9 in a forced draft air oven. These specimens shall then be removed from the oven, allowed to cool at room temperature for 30 minutes, and wrapped at a uniform rate of 15 ± 3 rpm at room temperature around a mandrel as specified in Table 4-3. At the end of this period, the specimens shall be removed from the mandrel as a helical coil and inspected visually for cracks without the aid of magnification (see 3.8.6).

4.3.11 Crosslinked Verification

Twenty-four inch specimens of finished cable with crosslinked jackets (jacket symbols 08, 23, 58, and 73) shall have 1 inch of insulation removed from each end of each conductor. The conductors of each end shall be tied together and loaded with weights equal to one half the test load weight specified on the basic wire specification sheet times the number of conductors. This shall be done at each end of the specimen. The central portion of the specimen shall then be bent over the horizontally positioned smooth stainless steel mandrel of the diameter specified in Table 4-3. To prevent sticking of the wire to the mandrel, the mandrel may be coated with polytetrafluoroethylene in the form of either enamel or wrapped tape, provided that the diameter of the mandrel after coating is still in conformity with Table 4-3. This specimen so prepared on the mandrel shall be placed in an air-circulating oven and maintained for 6 hours at 200°C ± 5°C for 08 and 58 jackets and 300°C ± 5°C for 23 and 73 jackets. After completion of the air oven exposure, the specimen shall be allowed to cool to between 20°C and 25°C (68°F to 77°F). When cooled, the wire shall be freed from tension, removed from the mandrel, and straightened. The specimen shall then be subjected to the bend test (4.3.12). The voltage withstand test procedure of 4.3.7 shall be conducted for shielded and jacketed specimens only.

4.3.12 Bend Test

In a temperature maintained between 20°C and 25°C, one end of the specimen shall be secured to the mandrel and the other end to the load weight specified in 4.3.11. The mandrel shall be rotated until the full length of the specimen is wrapped around the mandrel and is under the specified tension with adjoining coils in contact. The mandrel shall then be rotated in reverse direction until the full length of the cable, which was outside during the first wrap, is next to the mandrel. This procedure shall be repeated until two bends in each direction have been formed in the same section of the cable. The outer surface of the cable shall then be examined for cracking of the jacket.

4.3.13 Jacket Wall Thickness

Specimens of finished cable with jacket material listed in Table 3-7 shall be measured for wall thickness of jacket in accordance with MIL-STD-2223, method 6003.

4.3.14 Jacket Tensile Strength and Elongation

Jacket materials requiring tensile strength and elongation testing (see 3.7.2) shall be tested in accordance with ASTM D3032, using 1-inch bench marks, a 1-inch initial jaw separation, and a jaw separation speed of 2-inch per minute.

4.3.15 Lamination Sealing (Tape-Wrapped Jacket, Materials 11, 12, 22, 24, 61, 62, 72, 74)

Specimens shall be tested in accordance with MIL-STD-2223, method 4006, except the heat exposure shall be for 6 hours at 230°C ± 5°C. The jacket shall be visually inspected for delamination. Any separation of layers either along the insulation or at the ends shall constitute failure.

4.3.16 Jacket Blocking

One end of the continuous length of finished cable shall be fixed to a mandrel. The other end of the specimen shall be secured to separate load weights sufficient to keep the cable vertical and tangent to the mandrel during the bending operation. The mandrel size shall be as specified in Table 4-3. The cable shall then be spirally wound around the mandrel in at least three close turns in contact with each other. The winding shall be continued until there are a total of three layers, each on top of the other. The mandrel and cable shall then be placed within an air oven at the specified temperature for the specified time period (see 3.8.7). After removal from the oven, the mandrel and cable shall be cooled to room temperature, and the cable shall be unwound. There shall be no adhesion or sticking of adjacent turns or layers during the unwinding process.

Table 4-3
TEST MANDREL DIAMETERS
(in inches)

Finished cable diameter	Cold bend (4.3.6) crosslinked verification (4.3.11) jacket blocking (4.3.16)	Finished cable diameter	Thermal shock (4.3.9) aging stability (4.3.10)
0 to 0.125	3	0 to 0.083	0.750
		0.084 to 0.111	1.0
0.126 to 0.250	6	0.112 to 0.139	1.250
		0.140 to 0.194	1.750
0.251 to 0.360	10	0.195 to 0.250	2.250
		0.251 to 0.334	3.00
0.361 to 0.750	18	0.335 to 0.444	4
		0.445 to 0.556	5
0.751 to 1.200	30	0.557 to 0.667	6
		0.668 to 0.889	8
1.201 to 2.000	48	0890 to 1.111	10
		1.112 to 1.556	14
		1.557 to 2.000	18

4.3.17 Concentricity

The concentricity of extruded cable jackets only shall be tested in accordance with MIL-STD-2223, method 6003, paragraph 4.2.2.

4.3.18 PTFE Tape Wrapped Jacket Delamination

The contrahelically wrapped PTFE jackets, styles 06 and 56, shall be visually examined for signs of delamination. No instruments or tools shall be used to induce separation of the tape layers.

4.3.19 Shield Solderability

Cables with tin and silver coated shields (single shield symbols T, S, M, G, H, J, and double shield symbols V, W, K, A, B, D) shall be tested in accordance with MIL-STD-202, method 208 with the following additions and exceptions:

a. The cable specimen shall be at least seven inches long.
b. The shield shall be exposed for at least 3 inches on the specimen sample under test.
c. A nominal seven inch long standard copper wrapping wire shall be applied to the exposed shield with a spiral wrap around the circumference of the shield. The gap space of the turns of the spiral wrap shall be 0.125 - 0.250 inches and the distance between the end of the exposed shield, and the wrapping wire shall be at least 0.50 inches.
d. Do not steam age the sample before solder immersion.

4.3.20 Flammability

Finished cable shall be tested in accordance with ASTM D 3032, method 21 . The period of flame application shall be 30 seconds for cables having components of size 10 AWG or smaller. Cables with larger components shall not be tested. (Note: ASTM F 777 60° Flame Test, as referenced in MIL-DTL-27500 Revision H, has been incorporated into ASTM D 3032, method 21.)

4.4 CABLE DIAMETER

Finished cable diameter, as measured in 4.4.1 through 4.4.3, shall not exceed the maximum cable diameter calculated as follows:

Unshielded, shielded and single jacketed cables:
Maximum O.D. = (b x A) + (4.45 x d) + (4 x t) (inches)

Double shielded and jacketed cables:
Maximum O.D. = (b x A) + (9.90 x d) + (7 x t) (inches)

Double shielded and single jacketed cables:
Maximum O.D. = (b x A) + (9.90 x d) + (4 x t) (inches)

Where O.D. = outside diameter of the cable

b = Maximum diameter of basic wires in inches.
A = Cable factor from column A of Table 3-6.
d = Round shield wire diameter or thickness of flat shield wire in inches (=0 for unshielded cables).
t = Minimum jacket wall thickness as listed in Table 3-7 (=0 for unjacketed cables).

4.4.1 For all constructions, except three-conductor cables, the measured diameter of the finished cable shall be directly determined with a micrometer, caliper, or dial micrometer as the greatest straight line dimension of a cross-section of the cable.

4.4.2 For three-conductor unshielded-unjacketed cable, increase the caliper or dial micrometer reading by 7.7 percent to obtain finished cable diameter.

4.4.3 For three-conductor shielded, jacketed, or shielded and jacketed cable, increase the caliper or dial micrometer reading by 15 percent of the specified nominal or median diameter of the basic wire, as given in the applicable wire specification, to obtain finished cable diameter.

4.5 CABLE WEIGHT

4.5.1 Measured

The finished cable shall be weighed in accordance with MIL-STD-2223, method 6002.

4.5.2 Calculated

The finished cable maximum weight shall be calculated by the following procedures. If fillers/binder tapes are used, the maximum calculated cable weight shall be increased by 7 percent.

a. Unshielded and single shield cables.

Cable weight (lbs/1000 ft) =

$$(W \times 1.02 \times n) + K \times d\,(2.23 \times d + b \times B) + 2720 \times t \times S\,(b \times B + 4.45 \times d + 2 \times t)$$

b. Double shielded and jacketed cables.

Cable weight (lbs/1000 ft) =

$$(W \times 1.02 \times n) + K \times d\,(8.91 \times d + 2 \times b \times B + 3 \times t) + 4760 \times t \times S\,(7 \times d + b \times 6 + 3.5 \times t)$$

c. Double shielded single jacket.

Cable weight (lbs/1000 ft) =

$$(W \times 1.02 \times n) + Kx\ d\ (2.23 \times d + b \times B) + K \times d\ (6.68 \times d + b \times B) + 2720 \times t \times S\ (b \times B + 8.90 \times d + 1.5 \times t)$$

Where:

W = Maximum weight of component wires, pounds/1000 feet
b = Maximum dimensions of components wires in inches
n = Number of conductors in the cable
d = Shield wire diameter, in inches, or 0.0019 for flat strands, and 0.0 for unshielded
t = Minimum jacket wall thickness from Table 3-7 (=0 for unjacketed cables)
B = Effective geometry factor from column B of Table 3-6
S = Effective specific gravity of jacket material from Table 4-4
K = 14,570 (18,500 for flat strands) for copper shields and 12,750 (16,200 for flat strands) for stainless steel shields (90% minimum shield coverage) or 12,750 for copper shields and 11,150 (14200 for flat strands) for stainless steel shields (85% minimum shield coverage)

Table 4-4
SPECIFIC GRAVITY FOR JACKETING MATERIALS

Jacket styles	Specific gravity
01,02, 03, 04,	1.4
05, 06, 07, 09, 16, 20, 21	2.2
08, 10	1.8
11, 12, 22	1.6
14, 15, 17, 18, 23	1.7
24	1.9

4.6 Continuous Lengths

Unless otherwise specified in the ordering data (see 6.2), the inspection requirements for continuous lengths (see 3.12) shall be satisfied by the suppliers certificate of conformance and the presence of the required individual length markings on the spools or reels when required by the acquisition requirements (see 6.2.1 h).

Section 5
PACKAGING

5.1 General

For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). Shipment reels shall have all cable ends exposed, unless otherwise specified in ordering data.

Section 6
NOTES

6.1 APPENDICES

Appendix A contains cable design guidelines (see 3.1). Appendix B covers superceded symbols and manned aerospace replacements.

6.2 ORDERING DATA

6.2.1 Acquisition Requirements

Acquisition documents should specify the following:

a. Title, number, and date of this specification
b. Cable designation (see 2.2)
c. Quantity of cable required
d. Exceptions, if any, to the provisions of this specification
e. Requirements for supplemental test reports, certifications, or source inspection
f. Applicable levels of, packaging, and packing (see 5.1)
g. Jacket color (if other than specified in 2.2.6)
h. Any special requirements for spool size, spool type, or spool labeling

No other identification marking shall be applied to the cable by the manufacturer unless otherwise specified.

Appendix A
CABLE DESIGN GUIDELINES

A.1 INTRODUCTION

In selecting a cable construction from WC 27500, primary wires, shielding, and jacket material need to be considered. Note these particular features of this specification:

a. All conductors in a cable must be of the same wire size.
b. All wires must be from the same specification sheet of the same base specification.
c. These cables are intended for aerospace use. Primary performance features include minimal size and weight. Features not intended to be found with these constructions include UV resistance, resistance to extreme mechanical abuse, and specific electrical characteristics such as characteristic impedance and attenuation.

A.2 ELEMENTS OF PRIMARY WIRE SELECTION

A.2.1 Conductor Size

SAE AS 50881 provides the best guidance for selection of the appropriate AWG for a given application. Its ampacity tables and derating factors provide a conservative basis for conductor size selection.

A.2.2 Conductor Type

The coatings of the conductors are dependent on temperature rating and how the conductors will be terminated. Tin-coated conductors can be rated up to 150°C, silver-coated up to 200°C, and nickel-coated up to 260°C. Silver and tin solder more easily than nickel. However, the solderability of tin-coated conductors degrades with time. Further information on conductors can be found in NEMA WC 65, WC 67, and WC 72

A.2.3 Insulation Type

The main factors for insulation selection are temperature rating, physical environment, and project/vehicle guidelines. Every military specification wire type available for use in WC 27500 constructions has a temperature rating. This temperature rating should be compatible with the conductor rating and the application. SAE AS 50881 provides some guidance for the use of different insulation types and construction for military aerospace applications. For other high performance applications, it is recommended that cable manufacturers be consulted for their experience of a given design in a specific environment.

A.3 ELEMENTS OF SHIELD SELECTION

A.3.1 Material

Temperature rating and method of termination should determine the choice of shield material. The temperature ratings of shield strand types are the same as for conductor coating types.

A.3.2 Flat vs. Round Strands

The standard braided shield consists of round strands. For applications where finished cable diameter or weight must be as low as possible, flat shield strands provide the best alternative. Note that mechanical termination (clamp/crimp) of flat shields is not desirable.

A.3.3 Shield Coverage

This standard offers the choice between 85% and 90% minimum shield coverage. This does not necessarily correlate directly to better EMI/RFI performance, however, 90% minimum coverage is the better option for frequencies below 100 kilohertz due to lower shield resistance. The 85% coverage provides cables that are substantially lower in weight.

A.4 ELEMENTS OF JACKET SELECTION

a. The jacket material needs to be compatible with the insulation material of the primary wire insulation. Usually, the most advantageous jacket material is the same as the insulation of the primary wires.
b. Crosslinked jackets should not be applied over non-crosslinked wires.
c. Tape-wrapped jackets are not recommended over melt extruded primary wires.
d. High temperature jackets should not be applied over lower temperature primary wires. The heats used in applying these jackets can cause deterioration of the primary wire insulation or shielding materials. For example, do not use PTFE jackets with tin plated conductors and shields.

A.5 CABLE IDENTIFICATION AND COLOR CODES

It is recommended that, if no specific color code system is required by the procuring authority, the system in Table 3-1 be used. However, many programs and end users have their own guidelines for color coding. The majority of these are embodied in this document.

A.6 CONSULTATION

Any questions about cable design to this specification should be resolved by consultation between a cable manufacturer and the user prior to finalization of a design.

Appendix B
SUPERSESSIONS AND REPLACEMENTS

B.1 SUPERSEDED SYMBOLS

The following is a list of superseded basic wire specifications and symbols and their replacements which appear in Table I of MIL-C-27500E (USAF).

Table B-1
CROSS REFERENCE OF CANCELED WIRE SYMBOLS AND SPECIFICATIONS.

Canceled military document	Former Table 1 symbol	Table 1 symbol replacement wire	Active military document
MIL-W-7139 Class 1	D	EA	MIL-W-22759/1
MS17411	V	VA	MIL-W-22759/5
MS17412	W	WA	MIL-W-22759/6
MS18000	S	SA	MIL-W-22759/7
MS18001	T	TA	MIL-W-22759/8
MS18104	LC	JB	MIL-W-22759/28
MS18105	LD	JC	MIL-W-22759/29
MS18113	LA	LE	MIL-W-22759/9
MS18114	LB	LH	MIL-W-22759/10
MS21985	R	RC	MIL-W-22759/11
MS21986	L	RE	MIL-W-22759/12
MIL-W-22759/24	TT	No replacement	-- -- -- -- -- -- --
MIL-W-22759/25	TP	No replacement	-- -- -- -- -- -- --
MIL-W-22759/26	TR	No replacement	-- -- -- -- -- -- --
MIL-W-22759/27	TS	No replacement	-- -- -- -- -- -- --
MIL-W-22759/28[3]	SA	JB	MIL-W-22759/28
MIL-W-22759/29[3]	SB	JC	MIL-W-22759/29
MIL-W-22759/30[3]	SC	JD	MIL-W-22759/30
MIL-W-22759/31[3]	SE	JE	MIL-W-22759/31
MIL-W-22759/36	SF	No replacement	-- -- -- -- -- -- --
MIL-W-22759/37	SG	No replacement	-- -- -- -- -- -- --
MIL-W-22759/38	SJ	No replacement	-- -- -- -- -- -- --
MIL-W-22759/39	SK	No replacement	-- -- -- -- -- -- --
MIL-W-22759/40	SL	No replacement	-- -- -- -- -- -- --
MS24284	K	RE	MIL-W-22759/12
MS27125	J	JA	MIL-W-25038/1
MIL-W-27300	K	RE	MIL-W-22759/12
MIL-W-81044/1	M	ME	MIL-W-81044/6
MIL-W-81044/2	MA	ME	MIL-W-81044/6
MIL-W-81044/3	MB	ML	MIL-W-81044/12
MIL-W-81044/4	MC	ML	MIL-W-81044/12
MIL-W-81044/14	MN	MH	MIL-W-81044/9
MIL-W-81044/15	MP	MJ	MIL-W-81044/10
MIL-W-81044/16	BA	MW[1]	MIL-W-81381/11
MIL-W-81044/17	BB	NA	MIL-W-81381/13
MIL-W-81044/18	BC	MR[1]	MIL-W-81381/7
MIL-W-81044/19	BE	MT	MIL-W-81381/9

Canceled military document	Former Table 1 symbol	Table 1 symbol replacement wire	Active military document
MIL-W-81044/20	BF	MW[1] or	MIL-W-81381/11
		ME	MIL-W-81044/6
MIL-W-81044/21	BG	MW	MIL-W-81381/11
MIL-W-81044/22	BH	NA	MIL-W-81381/13
MIL-W-81044/23	BJ	RE	MIL-W-22759/12
MIL-W-81044/24	BK	TN	MIL-W-22759/23
MIL-W-81044/25	BL	MR[1] or	MIL-W-81381/7
		ML	MIL-W-81044/12
MIL-W-81044/26	BM	MR[1] or	MIL-W-81381/7
		RC	MIL-W-22759/11
MIL-W-81044/27	BN	MH	MIL-W-81044/9
MIL-W-81044/28	BP	RE	MIL-W-22759/12
MIL-W-81044/29	BR	TN	MIL-W-22759/23
MIL-W-81044/30	MR[2]	No replacement	-- -- -- -- -- --
MIL-W-81044/31	MT[2]	No replacement	-- -- -- -- -- --
MIL-W-81381/1	Y	MW[1] or	MIL-W-81381/11
		MR[1]	MIL-W-81381/7
MIL-W-81381/2	YA	MY[1] or	MIL-W-81381/12
		MS[1]	MIL-W-81381/8
MIL-W-81381/3	YB	MW[1]	MIL-W-81381/11
MIL-W-81381/4	YC	MY[1]	MIL-W-81381/12
MS90294	N	RB	MIL-W-22759/4

[1] These wires are not suitable for contact with missile propellants.
[2] Duplicate symbols assigned to other specifications are now currently assigned to specification MIL-W-81381.
[3] These specification sheets are not canceled; only the designation symbol has been changed.

B.2 MANNED AEROSPACE REPLACEMENTS

For manned aerospace applications, the following substitutions are suggested for new design.

Replaceable symbols	Replacing symbol
A	ME
AA	CA
AB	MM
AD	CA
B	AA
C	AB
P	NONE