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Volume IIA
Revision A

KENNEDY APPROVED PARTS LIST (KAPL)

# ELECTRICAL GROUND SUPPORT EQUIPMENT CABLES HANDBOOK

## VOLUME IIA OF III

(KAPL-E)

August 1999

## ENGINEERING DEVELOPMENT DIRECTORATE

National Aeronautics and
Space Administration

**John F. Kennedy Space Center**

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**GP-864**
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# ELECTRICAL GROUND SUPPORT EQUIPMENT CABLES HANDBOOK

## VOLUME IIA OF III

(KAPL-E)


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# FOREWORD

This document establishes the specifications, standards and drawings that shall be used in the design of electrical cables/connectors used at the John F. Kennedy Space Center (KSC), NASA. This document applies to those KSC engineering drawings used to fabricate, construct, install, modify, test, operate, maintain and otherwise utilize ground support equipment (GSE) and facilities at KSC. This document does not cover certain types of facility and payloads communication cables such as RF cables and ribbon cables, etc.

Requests for information or for making corrections or additions to this handbook should be directed to the Engineering Development Directorate, Mail Code: MM, Kennedy Space Center, Florida 32899. Requests for additional copies of this handbook should be sent to the Forms Warehouse, Kennedy Space Center, Florida 32899.

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AC, ac | alternating current |
| AHJ | Authority Having Jurisdiction |
| Al | alumel |
| AMP | ampere |
| APPROX | approximately |
| AR | as required |
| ARR | arrangement |
| AWG | American Wire Gauge |
| C.E. | Canadian Electric |
| Ch | chromel |
| CM | centimeter |
| CM | circular mill |
| Con | constantan |
| COND | conductor |
| CU | cubic |
| Cu | copper |
| DC, dc | direct current |
| DIA, Dia | diameter |
| e.g. | for example |
| ESR | Engineering Support Request |
| etc. | and so forth |
| FL | fluid |
| FSCM | Federal Supply Code for Manufacturers |
| FSN | Federal Stock Number |
| FT, ft. | foot |
| GA | gauge |
| GAL | gallon |
| GSE | ground support equipment |
| HIM | hardware interface module |
| ICD | interface control document (or drawing) |
| ID | inside diameter |
| IDENT | identification |
| i.e. | that is |
| IN, in. | inch |
| INS | insulation |
| Ir | iron |
| KAPL | Kennedy Approved Parts List |
| KG, kg | kilogram |
| KM | kilometer |
| KSC | John F. Kennedy Space Center |

ABBREVIATIONS AND ACRONYMS (cont.)

| | |
|---|---|
| LB, lb. | pound |
| LH | left hand |
| LNG | length |
| MAX | maximum |
| M, m | meter |
| MCM | thousand circular mills |
| MI | mile |
| MI | mineral insulated |
| MIL | military |
| MM | Engineering Development Directorate |
| mm | millimeter |
| MS | military standard |
| MSFC | George C. Marshall Space Flight Center |
| N | newton |
| NASA | National Aeronautics and Space Administration |
| NEC | National Electric Code |
| NFPA | National Fire Protection Association |
| NO, No. | number |
| NSL | not stock listed |
| OD | outside diameter |
| OZ | ounce |
| P/N | part number |
| PVC | polyvinyl chloride |
| REF | reference |
| REV | revision |
| rf | radio frequency |
| RFI | radio frequency interference |
| RH | right hand |
| RTV | room temperature vulcanized |
| SPEC | specification |
| SQ | square |
| STD | standard |
| STR | strands |
| UL | underwriters laboratory |
| °C | degree Celsius |
| °F | degree Fahrenheit |

# SECTION I

# INTRODUCTION

## 1.1 SCOPE

Various NASA programs at KSC make maximum use of existing ground support equipment (GSE). Consequently, the designer must determine whether existing cables can be used as is or be modified or if new cables are required. This handbook addresses all presently designed standard KSC cable subassemblies and information for selecting components for new requirements to interface with existing or new equipment. Data and ground communications system cables are excluded from this handbook.

## 1.2 DESIGN CRITERIA

1.2.1 This handbook contains a list of specifications, standards, and reference documents that shall be used in the design of GSE cables. All cable assemblies and subassemblies shall be documented per 79K19600 and shall be fabricated in accordance with established KSC procedures.

1.2.2 The remainder of this handbook contains cross-reference and pictorial indexes of cables and connectors used at KSC.

1.2.3 Designers should use connectors with the preferred insert arrangements shown in this document. General-purpose connectors shall comply with MIL-C-5015; miniature quick-disconnect connectors shall comply with MIL-C-26482; and heavy-duty connectors shall comply with MIL-C-22992. Although KSC normally does not use MIL-C-38999 connectors in the design of equipment, some cables that interface with vehicle hardware must be produced using these connectors. Also, cables using various George C. Marshall Space Flight Center (MSFC) specification connectors are produced for vehicle interfacing hardware. Miscellaneous information regarding wire characteristics is shown in Appendix B, and Ohm's Law and Conversion Tables are shown in Appendix C.

1.2.4 Where MS3109 boots are called out in the drawing, polyurethane molding is authorized without Engineering Support Request (ESR) or contract change. Where molding is called out, the usage of heat shrink boots may be authorized only by ESR or contract change. The system engineer should be consulted before substitution.

1.2.5 Polyurethane and molding techniques make it unnecessary to prepot with epoxy. Prepotting solder-type connectors is necessary when shrink boots are used. Crimp-type connectors with rear grommets need not be prepotted. When the back-shell is installed on the connector, proper torquing per torque table shown in KSC-STD-132 is imperative to prevent rotation.

## 1.3 APPLICABLE DOCUMENTS

### 1.3.1 GOVERNMENTAL

#### 1.3.1.1 Specifications

John F. Kennedy Space Center (KSC), NASA

| | |
|---|---|
| KSC-E-165 | Electrical Ground Support Equipment Fabrication, Specification for |
| KSC-SPEC-E-0020 | AC Power Cable, Mineral Insulated, 600 Volt, 60 Hertz, Procurement of, Specification for |
| KSC-SPEC-E-0024 | Electrical Cable, Shielded, Jacketed for Harness Assemblies, General Specification for |
| KSC-SPEC-E-0029 | Compound, Potting and Molding, Elastomeric, Specification for |
| KSC-SPEC-E-0031 | Electrical Cables, General Specification for |

George C. Marshall Space Flight Center (MSFC), NASA

| | |
|---|---|
| MSFC-SPEC-222 | Resin Compounds, Electrical and Environmental Insulation, Epoxy |
| MSFC-SPEC-515 | Material, Potting and Molding, Elastomeric, Urethane |

Federal

| | |
|---|---|
| QQ-B-575 | Braid, Wire (Copper, Tin Coated, or Silver Coated, Tublar or Flat) |
| QQ-P-416 | Plating, Cadmium (Electrodeposited) |
| L-T-100 | Tape, Pressure-Sensitive Adhesive, Polyester Film |

Military

| | |
|---|---|
| MIL-C-5015 | Connectors, Electrical, Circular Threaded AN Type, General Specification for |
| MIL-C-22992 | Connectors, Plugs and Receptacles, Electrical, Waterproof, Quick Disconnect, Heavy Duty Type, General Specification for |
| MIL-C-26482 | Connectors, Electrical, (Circular, Miniature, Quick Disconnect, Environment Resisting), Receptacles and Plugs, General Specification for |
| MIL-C-26500 | Connectors, General Purpose, Electrical, Miniature, Circular, Environment Resisting, General Specification for |
| MIL-C-38999 | Connector, Electrical, Circular, Miniature, High Density, Quick Disconnect, (Bayonet, Threaded and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for |
| MIL-C-83723 | Connector, Electrical, Circular, Environment Resistant, Receptacles and Plugs, General Specification for |
| MIL-I-23053 | Insulated Sleeving, Electrical Heat Shrinkable |
| MIL-R-46846 | Performance Specification, Rubber, Synthetic, Heat - Shrinkable |

| | |
|---|---|
| MIL-W-5086 | Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy |
| MIL-W-16878 | Wire, Electrical, Insulated, General Specification for |

1.3.1.2 Standards

National Aeronautics and Space Administration ( NASA)

| | |
|---|---|
| NASA-STD-8739.3 | Soldered Electrical Connectors |

John F. Kennedy Space Center (KSC), NASA

| | |
|---|---|
| KSC-STD-132 | Potting and Molding Electrical Cable Assembly Terminations, Standard for |

1.3.1.3 Drawings

John F. Kennedy Space Center (KSC), NASA

| | |
|---|---|
| 75M04097 | Adapter - Connector to Conduit |
| 75M13302 | Connector Inspection Specification |
| 75M13303 | Molding Adapter, General Purpose Connector |
| 75M13676 * | Shield Rings |
| 75M13706 | Protection Cap, Miniature Connector, Bayonet Lock (Mates Plug) |
| 76M13707 | Protection Cap, Miniature Connector, Bayonet Lock (Mates Receptacle) |
| 79K04613 | Electrical Cable and Shield Termination |
| 79K06110 | Procedure for MI Cable Termination |
| 79K19600 | Electrical Cable Fabrication Requirements |

* Refer to drawing for appropriate dash number.

| | |
|---|---|
| 79K24801 | Backshell Connector, Electrical |
| 80K52525 | Potting Adapter for MS347X Series Shell Size 12 Connectors |
| 80K56934 | Adapter Connector Molding |

George C. Marshall Space Flight Center (MSFC), NASA

| | |
|---|---|
| 40M38277 | Connectors, Electrical, Circular, Miniature, High Density Environmental Resistant, NLS Connectors |
| 40M38298 | Connector, Electric, Special Circular, Miniature, Environmental Resistant, 200°C, NBS Connectors |
| 40M39569 | Connector, Electric, Circular, Miniature, Environmental Resistant, 200°C, NB Connectors |

Military

| | |
|---|---|
| MS3180 | Cover, Protective, Electrical Connector Plug, Bayonet Coupling for MIL-C-26482 Connectors |
| MS3181 | Cover, Protective, Electrical Connector Receptacle, Bayonet Coupling for MIL-C-26482 Connectors |
| MS20659 | Terminal, Lug, Crimp Style, Copper, Ring Tongue, Uninsulated, Type I, Class I |
| MS25036 | Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell Mouthed, Type II, Class I |
| MS25274 | Cap, Electrical, Wire End, Crimp Style, Type II, Class I |

# SECTION II

# BULK CABLE

## 2.1 CABLE-TYPE DESIGNATION METHOD

EXAMPLE. 60(5TTSI#14, 2QTS#12, 1#0, 4PT#8, 28SS#14)OSDB

- Total of 60 conductors excluding shields
- Five sets of triplets twisted, shielded, and insulated size 14 conductors
- Two sets of quads twisted and shielded size 12 conductors
- One size 1/0 conductor unshielded
- Four sets of pairs twisted size 8 conductors
- 28 single-shielded size 14 conductors
- Overall double-braided shield

60 (5TTSI#14 2QTS#12 1#0 4PT#8 28SS#14) OSDB

No symbol for unshielded conductor. All conductors are considered to be insulated. No symbol for standard neoprene sheath with no overall shield or other covering.

ABBREVIATIONS USED IN CABLE-TYPE DESIGNATIONS.

| | |
|---|---|
| MI | Mineral-insulated cable (solid copper tubing shield) |
| OS | Overall braided shield |
| OSDB | Overall double-braided shield |
| PT | Two conductors twisted |
| PTS | Two conductors twisted and shielded |
| PTSI | Two conductors twisted, shielded, and insulated |
| QT | Four conductors twisted |
| QTS | Four conductors twisted and shielded |
| QTSI | Four conductors twisted, shielded, and insulated |
| SH | Shield |
| SO | Service with oil-resistant jacket |
| SPC | Silver plated copper |
| SS | Single conductor shielded |
| TC | Tinned copper |
| TCSH | Tinned copper shield |
| TFE | Extended polytetrafluoroethylene |
| TT | Three conductors twisted |
| TTS | Three conductors twisted and shielded |
| TTSI | Three conductors twisted, shielded, and insulated |
| 5 | Use number in this position for five or more conductors |

Table 2-1. KSC-SPEC-E-0031 Specification Sequence Index

| KSC-SPEC-E-0031/ | CODE | CABLE DESCRIPTION | MAX OD OVER SHIELD 1 mm (in.) 1 | MAX OD OVER SHEATH mm (in.) | APPROX kg/m (lbs/ft) |
|---|---|---|---|---|---|
| 1 | B | 2(2#4) | 18.796 (.74) | 26.416 (1.04) | .744 (.50) |
| 2 | C87 | 2(2#20) | 3.556 (.14) | 8.382 (.33) | .149 (.10) |
| 3 | F | 3(3#6) | 17.018 (.67) | 23.876 (.94) | .967 (.65) |
| 4 | B | 3(3#10) | 10.160 (.40) | 16.002 (.63) | .446 (.30) |
| 5 | B | 3(3#20) | 3.810 (.15) | 8.636 (.34) | .179 (.12) |
| 6 | C28 | 4(4#8) | 16.510 (.65) | 23.368 (.92) | 1.042 (.70) |
| 7 | B/C167 | 4(#12)OSBD | 8.890 (.35) | 16.510 (.65) | 1.042 (.70) |
| 8 | D | 4(4#10) | 11.430 (.45) | 17.526 (.69) | .595 (.40) |
| 9 | B | 4(4#6) | 19.050 (.75) | 27.940 (1.10) | 1.042 (.70) |
| 10 | A | 4(4#20) | 4.318 (.17) | 9.398 (.37) | .193 (.13) |
| 11 | A | 10(10SS#20) | 9.652 (.38) | 14.986 (.59) | .446 (.30) |
| 12 | F | 18(18SS#20) | 12.192 (.48) | 17.780 (.70) | .595 (.40) |
| 13 | B | 19(19#20) | 9.652 (.38) | 14.986 (.59) | .446 (.30) |
| 14 | F | 39(37#20, 2#16) | 13.208 (.52) | 18.542 (.73) | .893 (.60) |
| 15 | A | 39(39#20) | 13.462 (.53) | 18.542 (.73) | .818 (.55) |
| 16 | B | 60(20TTS#20) | 23.876 (.94) | 32.512 (1.28) | 2.381 (1.6) |
| 17 | A | 60(60SS#20) | 21.844 (.86) | 29.972 (1.18) | 2.530 (1.7) |
| 18 | A | 61(61#20) | 16.764 (.66) | 23.114 (.91) | .476 (.32) |
| 19 | F | 2(2#18) | 4.572 (.18) | 10.414 (.41) | .179 (.12) |
| 20 | F | 3(3#18) | 4.826 (.19) | 10.668 (.42) | .193 (.13) |
| 21 | A | 3(3#8) | 14.732 (.58) | 21.590 (.85) | .893 (.60) |
| 22 | B | 4(4#18) | 5.588 (.22) | 11.430 (.45) | .298 (.20) |
| 23 | F | 4(4#0000)OS | 44.704 (1.76) | 56.388 (2.22) | 6.250 (4.2) |
| 24 | C167 | 4(4#12) | 8.890 (.35) | 14.732 (.58) | .893 (.60) |
| 25 | A | 4(4#0)OS | 33.274 (1.31) | 43.688 (1.72) | 3.274 (2.2) |
| 26 | A | 4(4#4)OS | 22.606 (.89) | 31.242 (1.23) | 1.488 (1.0) |
| 27 | F | 4(4#6)OS | 19.050 (.75) | 27.686 (1.09) | 1.191 (.80) |
| 28 | A | 4(4#8)OS | 16.510 (.65) | 24.130 (.95) | 1.191 (.80) |
| 29 | F | 5(5#18) | 6.096 (.24) | 11.938 (.47) | .327 (.22) |
| 30 | C129 | 6(6#18) | 6.858 (.27) | 12.954 (.51) | .372 (.25) |
| 31 | F | 7(7SS#18) | 9.906 (.39) | 16.002 (.63) | .580 (.39) |
| 32 | B | 7(1#8, 3 PTS#8) | 34.798 (1.37) | 44.450 (1.75) | 2.083 (1.4) |
| 33 | B | 7(7#8)OS | 22.860 (.90) | 31.496 (1.24) | 1.637 (1.1) |
| 34 | F | 8(8#18)OS | 8.382 (.33) | 14.986 (.59) | .446 (.30) |
| 35 | C161 | 8(8#20)OS | 6.604 (.26) | 12.192 (.48) | .446 (.30) |
| 36 | A | 10(10#16)OS | 10.160 (.40) | 17.018 (.67) | .372 (.25) |
| 37 | A | 60(20TTS#14)OSI | 40.640 (1.60) | 53.848 (2.12) | 3.572 (2.4) |
| 38 | F | 10(10#18) | 9.144 (.36) | 14.986 (.59) | .268 (.18) |
| 39 | F | 19(19SS#18) | 15.748 (.62) | 22.098 (.87) | .595 (.40) |
| 40 | A | 30(30SSI#14)OS | 29.464 (1.16) | 41.402 (1.63) | 2.232 (1.5) |
| 41 | F | 37(37#18) | 16.764 (.66) | 24.130 (.95) | 1.339 (.90) |
| 42 | F | 36(36SS#18) | 20.320 (.80) | 27.940 (1.10) | 1.488 (1.0) |
| 43 | B | 37(37#12) | 27.432 (1.08) | 36.576 (1.44) | 1.786 (1.2) |
| 44 | F | 40(20PTSI#18) | 32.004 (1.26) | 40.640 (1.60) | 1.488 (1.0) |
| 45 | A | 45(15TTSI#14)OS | 40.460 (1.60) | 52.832 (2.08) | 2.976 (2.0) |

1 Bundle diameter, if unshielded

Table 2-1. (Cont.) KSC-SPEC-E-0031 Specification Sequence Index

| KSC-SPEC-E-0031/ | CODE | CABLE DESCRIPTION | MAX OD OVER SHIELD 1 mm (in.) [1] | MAX OD OVER SHEATH mm (in.) | APPROX kg/m (lbs/ft) |
|---|---|---|---|---|---|
| 46 | F | 47(1#8, 1PTSI#12, 4QTSI#12, 4#12, 24#18) | 34.798 (1.37) | 45.720 (1.80) | 3.572 (2.4) |
| 47 | F | 57(SPL) | 27.686 (1.09) | 38.862 (1.53) | 2.679 (1.8) |
| 48 | B/D | 60(60#18) | 20.574 (.81) | 29.718 (1.17) | 1.339 (.90) |
| 49 | B/C51 | 60(60SS#18) | 26.416 (1.04) | 35.814 (1.41) | 1.786 (1.2) |
| 50 | B | 60(60#16) | 22.860 (.90) | 31.496 (1.24) | 1.786 (1.2) |
| 51 | A | 60(60SS#16) | 28.702 (1.13) | 38.354 (1.51) | 2.083 (1.4) |
| 52 | F | 60(15SS#18, 18PTS#18, 3TTS#18) | 33.020 (1.30) | 43.180 (1.70) | 2.679 (1.8) |
| 53 | F | 60(60S#18)OSDB | 20.574 (.81) | 31.750 (1.25) | 1.935 (1.3) |
| 57 | A | 60(30PTS#14) OSI | 45.974 (1.81) | 59.182 (2.33) | 3.572 (2.4) |
| 58 | A | 60(60SS#14)OSI | 34.544 (1.36) | 47.752 (1.88) | 4.018 (2.7) |
| 59 | A | 60(60#14)OS | 28.956 (1.14) | 39.370 (1.55) | 2.530 (1.7) |
| 60 | B | 60(15QTS#14)OSI | 39.878 (1.57) | 53.340 (2.10) | 2.828 (1.9) |
| 61 | A | 60(30PTS#20) | 26.924 (1.06) | 33.528 (1.32) | 2.381 (1.6) |
| 63 | B | 21(21#8)OSDB | 38.862 (1.53) | 51.562 (2.03) | 2.679 (1.8) |
| 64 | F | 4(4#0)OSDB | 33.274 (1.31) | 45.720 (1.80) | 3.274 (2.2) |
| 65 | F | 5(5#12)OS | 10.160 (.40) | 17.018 (.67) | 1.191 (.80) |
| 66 | B/C36 | 8(8#18) | 8.382 (.33) | 14.478 (.57) | .372 (.25) |
| 67 | C36 | 10(10#16) | 10.160 (.40) | 16.002 (.63) | .298 (.20) |
| 68 | A | 3(3#12) | 8.128 (.32) | 13.716 (.54) | .744 (.50) |
| 69 | F | 54(54#18) | 19.812 (.78) | 28.956 (1.14) | 1.488 (1.0) |
| 70 | C129 | 6(6#18)OS | 6.858 (.27) | 13.716 (.54) | .446 (.30) |
| 71 | F | 10(10#18)OS | 9.144 (.36) | 16.256 (.64) | .298 (.20) |
| 72 | A | 15(15#18)OS | 10.922 (.43) | 17.780 (.70) | .521 (.35) |
| 73 | F | 13(13#18)OS | 10.160 (.40) | 17.272 (.68) | .446 (.30) |
| 74 | F | 13(13#20) | 7.620 (.30) | 12.954 (.51) | .372 (.25) |
| 75 | A | 18(18#20)OS | 8.890 (.35) | 14.732 (.58) | .521 (.35) |
| 77 | A | 60(60#20)OS | 16.002 (.63) | 23.622 (.93) | 1.786 (1.2) |
| 79 | B | 7(3PTS#16, 1#16) | 13.716 (.54) | 19.050 (.75) | .744 (.50) |
| 80 | E | 7(7#16)OS | 8.636 (.34) | 14.986 (.59) | .298 (.20) |
| 81 | A | 7(7#20)OS | 6.096 (.24) | 11.938 (.47) | .298 (.20) |
| 83 | A | 20(20#16)OS | 13.716 (.54) | 20.320 (.80) | .595 (.40) |
| 84 | C15 | 32(32#20) | 11.938 (.47) | 17.272 (.68) | .744 (.50) |
| 87 | A | 2(2#20)OS | 3.556 (.14) | 9.398 (.37) | .179 (.12) |
| 88 | A | 3(3#20)OS | 3.810 (.15) | 9.398 (.37) | .193 (.13) |
| 89 | C21 | 2(2#8) | 13.716 (.54) | 21.336 (.84) | .372 (.25) |
| 90 | A | 2(2#0) | 27.686 (1.09) | 36.576 (1.44) | 1.786 (1.2) |
| 91 | C129 | 3(3#16) | 5.588 (.22) | 11.176 (.44) | .208 (.14) |
| 92 | B | 2(2#16) | 5.080 (.20) | 10.668 (.42) | .179 (.12) |
| 93 | F | 6(6#16) | 7.620 (.30) | 13.208 (.52) | .208 (.14) |
| 94 | C129 | 4(4#16) | 6.096 (.24) | 11.938 (.47) | .223 (.15) |
| 95 | E | 37(37#16)OSDB | 18.796 (.74) | 29.210 (1.15) | 1.488 (1.0) |
| 96 | F | 10(2PTS#16, 6#16) | 12.192 (.48) | 18.796 (.74) | .595 (.40) |
| 97 | A | 10(10#20) | 7.112 (.28) | 12.192 (.48) | .223 (.15) |
| 98 | C138 | 40(20PTSI#14)OS | 42.418 (1.67) | 54.102 (2.13) | 2.976 (2.0) |

[1] Bundle diameter, if unshielded

Table 2-1. (Cont.) KSC-SPEC-E-0031 Specification Sequence Index

| KSC-SPEC-E-0031/ | CODE | CABLE DESCRIPTION | MAX OD OVER SHIELD 1 mm (in.) 1 | MAX OD OVER SHEATH mm (in.) | APPROX kg/m (lbs/ft) |
|---|---|---|---|---|---|
| 99 | A | 30(30SSI#20)OS | 20.574 (.81) | 29.972 (1.18) | 1.265 (.85) |
| 100 | A | 40(20PTSI#20)OS | 26.416 (1.04) | 34.290 (1.35) | 1.399 (.94) |
| 101 | E | 45(15TTSI#20)OS | 24.384 (.96) | 34.544 (1.36) | 1.339 (.90) |
| 102 | F | 48(12QTSI#14)OS | 39.370 (1.55) | 51.816 (2.04) | 3.274 (2.2) |
| 103 | F | 48(12QTSI#20)OS | 23.622 (.93) | 33.020 (1.30) | 2.530 (1.7) |
| 104 | B | 48(12QTSI#18)OS | 28.702 (1.13) | 40.386 (1.59) | 2.679 (1.8) |
| 105 | F | 40(20PTSI#18)OS | 32.004 (1.26) | 41.656 (1.64) | 2.381 (1.6) |
| 106 | B | 45(15TTSI#18)OS | 29.718 (1.17) | 41.656 (1.64) | 1.637 (1.1) |
| 107 | F | 30(30SSI#18)OS | 23.622 (.93) | 34.290 (1.35) | 1.339 (.90) |
| 108 | F | 48(12QTSI#16)OS | 30.988 (1.22) | 43.180 (1.70) | 2.828 (1.9) |
| 109 | A | 40(20PTSI#16)OS | 34.544 (1.36) | 44.196 (1.74) | 2.530 (1.7) |
| 110 | F | 45(15TTSI#16)OS | 32.258 (1.27) | 43.434 (1.71) | 2.083 (1.4) |
| 111 | F | 30(30SSI#16)OS | 25.400 (1.00) | 35.306 (1.39) | 1.414 (.95) |
| 112 | F | 3(3#4) | 20.066 (.79) | 27.686 (1.09) | 1.116 (.75) |
| 113 | C68 | 3(3#14) | 7.112 (.28) | 12.700 (.50) | .521 (.35) |
| 114 | F | 3(3#2) | 23.622 (.93) | 31.496 (1.24) | 1.488 (1.0) |
| 115 | F | 37(37#16) | 18.796 (.74) | 28.448 (1.12) | 1.488 (1.0) |
| 116 | F | 3(3#00) | 32.512 (1.28) | 42.418 (1.67) | 2.679 (1.8) |
| 117 | F | 60(15QTS#20) | 23.114 (.91) | 30.998 (1.22) | 2.381 (1.6) |
| 118 | F | 60(20TTS#16) | 31.750 (1.25) | 42.418 (1.67) | 1.935 (1.3) |
| 119 | F | 30(30SSI#20) | 20.320 (.80) | 28.194 (1.11) | 1.191 (.80) |
| 120 | F | 60(15QTS#16) | 30.988 (1.22) | 41.656 (1.64) | 1.935 (1.3) |
| 121 | F | 32(16PTS#20) | 17.780 (.70) | 23.876 (.94) | 1.042 (.70) |
| 122 | F | 60(30PTS#16) | 31.750 (1.25) | 41.402 (1.63) | 2.083 (1.4) |
| 123 | C26 | 4(4#4) | 22.606 (.89) | 30.226 (1.19) | 1.339 (.90) |
| 124 | F | 9(3#8, 6#12)OS | 19.558 (.77) | 28.194 (1.11) | 1.786 (1.2) |
| 125 | F | 5(5#8)OS | 18.542 (.73) | 26.924 (1.06) | 1.339 (.90) |
| 126 | F | 3(3#8)OS | 14.732 (.58) | 22.352 (.88) | .967 (.65) |
| 127 | F | 5(5#4)OS | 25.400 (1.00) | 34.798 (1.37) | 1.935 (1.3) |
| 128 | F | 5(5#0)OS | 37.338 (1.47) | 48.768 (1.92) | 3.572 (2.4) |
| 129 | A | 6(6#16)OS | 7.366 (.29) | 12.954 (.51) | .223 (.15) |
| 130 | A | 60(60#16)OS | 21.844 (.86) | 27.940 (1.10) | 1.488 (1.0) |
| 131 | C135 | 60(60SS#16)OSI | 27.432 (1.08) | 36.830 (1.45) | 1.935 (1.3) |
| 132 | F | 60(30PTSI#16)OS | 28.702 (1.13) | 37.084 (1.46) | 1.860 (1.25) |
| 133 | F | 60(20TTSI#16)OS | 35.306 (1.39) | 43.688 (1.72) | 1.935 (1.3) |
| 134 | F | 60(15QTSI#16)OS | 34.036 (1.34) | 42.418 (1.67) | 1.860 (1.25) |
| 135 | B | 60(60SSI#16)OS | 34.290 (1.35) | 42.672 (1.68) | 2.009 (1.35) |
| 136 | B | 60(2TTSI#14, 3PTSI#14, 48#14)OS | 34.290 (1.35) | 41.656 (1.64) | 2.976 (2.0) |
| 137 | F | 60(3PTSI#14, 3TTSI#14, 45SSI#14)OS | 42.164 (1.66) | 50.800 (2.00) | 2.976 (2.0) |
| 138 | B | 60(30PTSI#14)OS | 36.322 (1.43) | 44.704 (1.76) | 2.828 (1.9) |
| 139 | B | 60(20TTSI#14)OS | 43.434 (1.71) | 52.070 (2.05) | 2.828 (1.9) |
| 140 | B | 60(15QTSI#14)OS | 43.180 (1.70) | 51.816 (2.04) | 2.679 (1.8) |
| 141 | A | 6(6#8)OS | 20.574 (.81) | 28.956 (1.14) | 1.488 (1.0) |
| 142 | C28 | 4(3#8, 1#16)OS | 13.716 (.54) | 19.558 (.77) | 1.191 (.80) |



1 Bundle diameter, if unshielded

Table 2-1. (Cont.) KSC-SPEC-E-0031 Specification Sequence Index

| KSC-SPEC-E-0031/ | CODE | CABLE DESCRIPTION | MAX OD OVER SHIELD 1 mm (in.) 1 | MAX OD OVER SHEATH mm (in.) | APPROX kg/m (lbs/ft) |
|---|---|---|---|---|---|
| 143 | F | 5(5#12) | 9.652 (.38) | 14.478 (.57) | 1.042 (.70) |
| 144 | F | 40(5QTSI#10, 20#14)OS | 35.814 (1.41) | 44.196 (1.74) | 3.274 (2.2) |
| 145 | F | 60(5PTSI#14, 50SSI#14)OS | 39.878 (1.57) | 48.514 (1.91) | 2.828 (1.9) |
| 146 | B | 35(3#0, 6#7, 13PTSI#14)OS | 43.180 (1.70) | 54.356 (2.14) | 3.274 (2.2) |
| 147 | F | 29(4#2, 9#6, 16#14)OS | 45.466 (1.79) | 52.070 (2.05) | 3.274 (2.2) |
| 148 | F | 60(6TTSI#14, 17PTSI#14, 8SSI#14)OS | 42.418 (1.67) | 49.276 (1.94) | 2.828 (1.9) |
| 149 | B | 60(5PTSI#14, 50#14) | 32.766 (1.29) | 40.386 (1.59) | 2.828 (1.9) |
| 150 | F | 60(4TTSI#14, 12PTSI#14, 24SSI#14)OS | 43.688 (1.72) | 51.562 (2.03) | 2.828 (1.9) |
| 151 | F | 10(1PTSI#12, 4PTSI#16)OS | 12.192 (.48) | 19.050 (.75) | .893 (.60) |
| 152 | A | 8(1PT#12, 3PTSI#16)OS | 10.922 (.43) | 17.526 (.69) | .744 (.50) |
| 153 | A | 100(50PT#18)OS | 32.258 (1.27) | 42.672 (1.68) | 2.232 (1.5) |
| 154 | B | 60(60SSI#14)OS | 40.132 (1.58) | 50.292 (1.98) | 2.976 (2.0) |
| 155 | A | 15(1PTSI#16, 13#16)OS | 13.462 (.53) | 21.082 (.83) | .595 (.40) |
| 156 | E | 6(3PTSI#20) | 10.414 (.41) | 15.494 (.61) | .372 (.25) |
| 157 | F | 12(6PTSI#20) | 14.478 (.57) | 20.574 (.81) | .446 (.30) |
| 158 | C129 | 3(3#16)OS | 5.334 (.21) | 10.922 (.43) | .223 (.15) |
| 159 | E | 6(3PTSI#16)OS | 13.462 (.53) | 20.320 (.80) | 2.679 (1.8) |
| 160 | E | 12(6PTSI#16)OS | 18.796 (.74) | 27.178 (1.07) | .595 (.40) |
| 161 | F | 10(10#20)OS | 7.112 (.28) | 12.700 (.50) | .298 (.20) |
| 162 | F | 61(61#20)OS | 16.764 (.66) | 23.622 (.93) | 1.339 (.90) |
| 163 | E | 6(3PTSI#20)OS | 10.414 (.41) | 16.256 (.64) | .387 (.26) |
| 164 | E | 12(6PTSI#20)OS | 14.478 (.57) | 21.336 (.84) | .521 (.35) |
| 165 | F | 18(18SSI#20)OS | 15.748 (.62) | 22.352 (.88) | .595 (.40) |
| 166 | F | 3(3#12)OS | 7.620 (.30) | 13.208 (.52) | .893 (.60) |
| 167 | A | 4(4#12)OS | 8.890 (.35) | 15.748 (.62) | 1.042 (.70) |
| 168 | F | 3(3#4)OS | 20.066 (.79) | 28.702 (1.13) | 1.191 (.80) |
| 169 | F | 3(3#0)OS | 29.464 (1.16) | 39.370 (1.55) | 2.232 (1.5) |
| 170 | F | 3(3#0000)OS | 39.878 (1.57) | 51.562 (2.03) | 3.869 (2.6) |
| OTHER | | | | | |
| 75M10204 | B | 4RG214, 1RG62/OS | 30.480 (1.20) | 36.322 (1.43) | .893 (.60) |
| 75M13864 | B | 2(2#0)OS | 25.400 (1.00) | 33.020 (1.30) | 1.488 (1.0) |
| 75M14074 | B | 7(7RG180/U)OS | 15.240 (.60) | 18.288 (.72) | .223 (.15) |
| 75M14078 | A | 1-500MCM/OS | 34.290 (1.35) | 38.100 (1.5) | 3.572 (2.4) |
| 75M16819 | B | 7(7RG58C/U)OS | 30.480 (1.20) | 36.830 (1.45) | .446 (.30) |
| TV-39 | A | 20(2RG59B/U, 1RG62B/U, 7#20, 9#18, 1#16)OS | 22.860 (.90) | 27.940 (1.1) | 1.042 (.70) |
| T-43 | A | 2(2#16) | 8.890 (.35) | 12.700 (.50) | .446 (.30) |

CODE LEGEND:

1 Bundle diameter, if unshielded

A To be maintained in stock
B To be used until supply depleted
Cxx (NSL) Substitute KSC-SPEC-E-0031/xxx
D (NSL) Substitute type SO of like buildup
E (NSL) Use shop fabricated cable
F (NSL) Not used in Shuttle program

Table 2-2. Cable Description to Specification Cross Reference

| CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M | CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M | CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M |
|---|---|---|---|---|---|
| 1(500MCM)OS | 75M14078 | 6(3PTSI#20)OS | 0031/163 | 30(30SSI#20) | 0031/119 |
| 2(2#20) | 0031/2 | 6(6#18) | 0031/30 | 30(30SSI#20)OS | 0031/99 |
| 2(2#20)OS | 0031/87 | 6(6#18)OS | 0031/70 | 30(30SSI#18)OS | 0031/107 |
| 2(2#18) | 0031/19 | 6(6#16) | 0031/93 | 30(30SSI#16)OS | 0031/111 |
| 2(2#16) | 0031/92 | 6(PTSI#16)OS | 0031/159 | 30(30SSI#14)OS | 0031/40 |
| 2(2#8) | 0031/89 | 6(6#16)OS | 0031/129 | 32(32#20) | 0031/84 |
| 2(2#4) | 0031/1 | 6(6#8)OS | 0031/141 | 32(16PTS#20) | 0031/121 |
| 2(2#0) | 0031/90 | 6(4RG214/U, | 75M10204 | 35(3#0, 6#7, | 0031/146 |
| 2(2#0)OS | 75M13864 | 1RG62A/U, | AND | 13PTSI#14)OS | |
| 3(3#20) | 0031/5 | 1#12)OS | 75M13860 | 36(36SS#18) | 0031/42 |
| 3(3#20)OS | 0031/88 | 7(7#20)OS | 0031/81 | 36(18 VIDEO | 75M15075 |
| 3(3#18) | 0031/20 | 7(7SS#18) | 0031/31 | PAIRS #16)OS | |
| 3(3#16) | 0031/91 | 7(3PTS#16, 1#16) | 0031/79 | 37(37#18) | 0031/41 |
| 3(3#16)OS | 0031/158 | 7(7#16)OS | 0031/80 | 37(37#16)OSDB | 0031/95 |
| 3(3#14) | 0031/113 | 7(7#8)OS | 0031/33 | 37(37#16)OS | 0031/115 |
| 3(3#12) | 0031/68 | 7(1#8, 3PTS#8) | 0031/32 | 37(37#12) | 0031/43 |
| 3(3#12)OS | 0031/166 | 7(7RG180/U)OS | 75M14074 | 39(39#20) | 0031/15 |
| 3(3#10) | 0031/4 | 7(7RG58C/U)OS | 75M16819 | 39(2#16, 37#20) | 0031/14 |
| 3(3#8) | 0031/21 | 8(8#20)OS | 0031/35 | 40(20PTSI#20)OS | 0031/100 |
| 3(3#8)OS | 0031/126 | 8(8#18)OS | 0031/34 | 40(20PTSI#18) | 0031/44 |
| 3(3#6) | 0031/3 | 8(8#18) | 0031/66 | 40(20PTSI#18) | 0031/105 |
| 3(3#4) | 0031/112 | 8(1PT#12, | 0031/152 | 40(20PTSI#16)OS | 0031/109 |
| 3(3#4)OS | 0031/168 | 3PTSI#16)OS | | 40(20PTSI#14)OS | 0031/98 |
| 3(3#2) | 0031/114 | 9(3#8, 6#12)OS | 0031/124 | 40(5QTSI#10, 20#14)OS | 0031/144 |
| 3(3#0)OS | 0031/169 | 10(10#20)OS | 0031/161 | 45(15TTSI#20)OS | 0031/101 |
| 3(3#00) | 0031/116 | 10(10SS#20) | 0031/11 | 45(15TTSI#18)OS | 0031/106 |
| 3(3#0000)OS | 0031/170 | 10(10#20) | 0031/97 | 45(15TTSI#16)OS | 0031/110 |
| 4(4#20) | 0031/10 | 10(10#18) | 0031/38 | 45(15TTSI#14)OS | 0031/45 |
| 4(4#18) | 0031/22 | 10(10#18)OS | 0031/71 | 47(1PTSI#12, 4QTSI#12, | 0031/46 |
| 4(4#16) | 0031/94 | 10(10#16)OS | 0031/36 | 4#12, 24#18) | |
| 4(4#12)OSDB | 0031/7 | 10(10#16) | 0031/67 | 47(1#8, 22#12, | 0031/47 |
| 4(4#12) | 0031/24 | 10(2PTS#16, 6#16) | 0031/96 | 24#16)OSDB | |
| 4(4#12)OS | 0031/167 | 10(1PTSI#12, | 0031/151 | 48(12QTSI#20)OS | 0031/103 |
| 4(4#10) | 0031/8 | 4PTSI#16)OS | | 48(12QTSI#18)OS | 0031/104 |
| 4(4#8) | 0031/6 | 12(6PTSI#20) | 0031/157 | 48(12QTSI#16)OS | 0031/108 |
| 4(4#8)OS | 0031/28 | 12(6PTSI#20)OS | 0031/164 | 48(12QTSI#14)OS | 0031/102 |
| 4(4#6) | 0031/9 | 12(6PTSI#16)OS | 0031/160 | 48(4SSI#4, 11TTS#14, | 75M11004 |
| 4(4#6)OS | 0031/27 | 13(13#20) | 0031/74 | 5PTSI#14, | |
| 4(4#4)OS | 0031/26 | 13(13#18)OS | 0031/73 | 1SSI#14)OS | |
| 4(4#4) | 0031/123 | 15(15#18)OS | 0031/72 | 50(25PT#22)OS | 75M14677 |
| 4(4#0)OS | 0031/25 | 15(1PTSI#16, | 0031/155 | 50(54#18) | 0031/69 |
| 4(4#0000)OS | 0031/23 | 13#16)OS | | 60(20TTS#20) | 0031/16 |
| 4(3#8, 1#16)OS | 0031/142 | 18(18SS#20) | 0031/12 | 60(15QTS#20) | 0031/117 |
| 4(4#00)OS | 75M15002 | 18(18#20)OS | 0031/75 | 60(60SS#20) | 0031/17 |
| 5(5#18) | 0031/29 | 18(18SSI#20)OS | 0031/165 | 60(30PTS#20) | 0031/61 |
| 5(5#12)OS | 0031/65 | 19(19#20) | 0031/13 | 60(60#20)OS | 0031/77 |
| 5(5#12) | 0031/143 | 19(19SS#18) | 0031/39 | 60(60#18) | 0031/48 |
| 5(5#8)OS | 0031/125 | 20(20#16)OS | 0031/83 | 60(60SS#18) | 0031/49 |
| 5(5#4)OS | 0031/127 | 21(21#8)OSDB | 0031/63 | 60(15SS#18, 18PTS#18, | 0031/52 |
| 5(5#0)OS | 0031/128 | 29(4#2, 9#6, | 0031/147 | 3TTS#18) | |
| 6(3PTSI#20) | 0031/156 | 16#14)OS | | 60(60#18)OSDB | 0031/53 |

Table 2-2. (Cont.) Cable Description to Specification Cross Reference

| CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M | CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M | CABLE DESCRIPTION | KSC-SPEC E-0031 OR 75M |
|---|---|---|---|---|---|
| 60(60#16) | 0031/50 | 60(60#14)OS | 0031/59 | 60(5PTSI#14, 50#14)OS | 0031/149 |
| 60(60SS#16) | 0031/51 | 60(15QTS#14)OSI | 0031/60 | 60(4TTSI#14, 12PTSI#14, 24SSI#14)OS | 0031/150 |
| 60(20TTS#16) | 0031/118 | 60(3PTSI#14, 3TTSI#14, 45SSI#14)OS | 0031/137 | | |
| 60(15QTS#160 | 0031/120 | | | | |
| 60(30PTS#16) | 0031/122 | | | | |
| 60(60#16)OS | 0031/130 | 60(30PTSI#14)OS | 0031/138 | 60(60SSI#14)OS | 0031/154 |
| 60(60SS#16)OSI | 0031/131 | 60(30PTSI#20)OS | 75M13861 | 60(2TTSI#14, 3PTSI#14, 48#14)OS | 0031/136 |
| 60(30PSI#16)OS | 0031/132 | 60(20TTSI#14)OS | 0031/139 | | |
| 60(20TTSI#16)OS | 0031/133 | 60(15QTSI#14)OS | 0031/140 | | |
| 60(15QTSI#16)OS | 0031/134 | 60(5PTSI#14, 50SSI#14)OS | 0031/145 | 61(61#20) | 0031/18 |
| 60(60SSI#16)OS | 0031/135 | 60(6TTSI#14, 17PTSI#14, 8SSI#14)OS | 0031/148 | 61(61#20)OS | 0031/162 |
| 60(20TTS#14)OSI | 0031/37 | | | 100(50PT#18)OS | 0031/153 |
| 60(30PTS#14)OSI | 0031/57 | | | | |
| 60(60SS#14)OSI | 0031/58 | | | | |

Table 2-3. 75M to KSC-SPEC-E-0031 Cross Reference

| 75M NO. | 0031 NO. | 75M NO. | 0031 NO. | 75M NO. | 0031 NO. |
|---|---|---|---|---|---|
| 10180 | -129 | 10196 | - 36 | 13858 | - 60 |
| 10181 | -130 | 10197 | -141 | 13859 | - 37 |
| 10182 | -131 | 10198 | -142 | 13868 | - 26 |
| 10186 | -135 | 10200 | - 25 | 14073 | -148 |
| 10187 | -136 | 10201 | - 18 | 14075 | - 50 |
| 10189 | - 33 | 10202 | - 84 | 14076 | -149 |
| 10190 | - 77 | 10203 | - 21 | 14077 | - 63 |
| 10191 | - 59 | 11005 | -145 | 14079 | - 45 |
| 10192 | - 58 | 11006 | -146 | 15073 | - 28 |
| 10193 | -138 | 11007 | -147 | 17103 | -153 |
| 10194 | -139 | 11008 | - 98 | 18788 | -154 |
| 10195 | -140 | 13856 | - 57 | 18798 | -152 |
| | | | | 18810 | -155 |

## 2.2 CONDUCTORS AND CONDUCTOR SETS FOR FABRICATING CABLES REQUIRING UNIQUE CONDUCTOR GROUPING

KSC GSE requirements call for a large number of electrical cable configurations that are not presently in KSC-SPEC-E-0031, General Specification, Electrical Cables. This document provides guidelines to hand-fabricate special bulk cable that meets the most acceptable military specifications for the conductors or conductor groupings and, with overall MIL-SPEC braided shield and polychloroprene heat shrinkable tubing applied, approaches the general qualifications of KSC-SPEC-E-0031 and KSC-E-165.

The designer may select conductor sets from the tables in this document by specifying vendor part numbers that meet his requirements. Several manufacturers are listed for information purposes, but this does not preclude selection from another manufacturer of a like product. Also, KSC-SPEC-E-0024 provides for a number of conductor configurations.

The quantity column of the cable subassembly drawing will show a 1▷, which signifies the length as described later on the assembly drawing by a dash number. The ordering parts list length requirement will require that the number of like sets of conductors will be multiplied by the dash number length plus about 15%.

The conductor buildup shall be laid out to scale using the outside diameter (OD) shown in the tables to determine the overall shield size (if applicable). The length of the shield should be specified about 10% longer than the dash number to allow for possible shortening of the shield due to braid expansion if a slight miscalculation on OD is made.

Heat-shrinkable tubing per MIL-I-23053 (see paragraph. 4.23) should have a recovered diameter slightly smaller that the calculated overall diameter of the conductor bundle with the overall shield applied. The length specified should be 10% greater than the dash number to allow for length shrinkage due to heating.

For short cables, under 4.572 m (15 feet), hand-twisting of the multiple conductor bundle may be done without tangling. The lay shall be unidirectional right hand with a length of 8 to 16 times the OD of the multiple. The individual conductors or the conductor sets shall be relieved as the multiple is twisted so that the sets will not be twisted. For cable over 4.572 m (15 feet), a simple fixture may be used that prevents tangling and gives a uniform twist.

All single-conductor insulated wire for sizes AWG 24, 22, 20, 16, and 14 shall be per MIL-W-16878/, white with a minimum of 19 strands. Nylon jacket is not required but may be used.

Wire callout example: M-W-16878/ 17 - A - E - E - 9

Basic Specification
Specification Sheet
Conductor material
Color code
Conductor strands
AWG wire size

All single-conductor insulated wire for sizes AWG 12 through 4/0 shall be per MIL-W-5086, type 2, white, with standard stranding.

Wire callout example: M5086/ 2 - 8 - 9

Basic Spec
Type
Color code
AWG wire size

## 2.3 MULTI-CONDUCTOR SHIELDED SETS

All multi-conductor shielded sets shall be specified by vendor callout and selected as required from the table below.

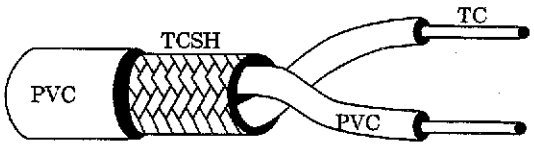



Figure 2-1. MIL-W-16878/ Shielded

Conductor: 19 Strand Tinned Copper
Insulation: 0.254 mm (0.010") PVC, 800 V, -50° to +115° C with Nylon Jacket
Shield (overall): Braided Tinned Copper, 90% coverage
Jacket (overall): 0.254 mm (0.010") White PVC

Table 2-4. Multi-Conductor Shielded Sets

| COND | AWG | OD mm (in.) | ALPHA | BELDEN | DABURN | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|---|
| 1 | | 2.337 (.092) | 3210 | 9971 | 2541 | 262401 | |
| 2 | 24 | 3.861 (.152) | 3211 | 9972 | 2541/2 | 262402 | |
| 3 | | 4.089 (.161) | 3212 | 9973 | 2541/3 | 262403 | |
| 4 | | 4.369 (.172) | 3213 | 9974 | 2541/4 | 262404 | 00-387-5459 |
| 1 | | 2.540 (.100) | 3220 | 9965 | 2542 | 262201 | |
| 2 | 22 | 4.267 (.168) | 3221 | 9966 | 2542/2 | 262202 | |
| 3 | | 4.521 (.178) | 3222 | 9967 | 2542/3 | 262203 | 00-258-6977 |
| 4 | | 4.928 (.194) | 3223 | 9968 | 2542/4 | 262204 | |
| 1 | | 2.692 (.106) | 3230 | 9961 | 2543 | 262001 | 00-729-9270 |
| 2 | 20 | 4.724 (.186) | 3231 | 9962 | 2543/2 | 262002 | 00-931-7273 |
| 3 | | 4.978 (.196) | 3232 | 9963 | 2543/3 | 262003 | |
| 4 | | 5.537 (.218) | 3233 | 9964 | 2543/4 | 262004 | |
| 1 | | 3.480 (.137) | 3245 | 9951 | 2545 | 261601 | |
| 2 | 16 | 5.994 (.236) | 3246 | 9952 | 2545/2 | 261602 | |
| 3 | | 6.096 (.240) | 3247 | 9953 | 2545/3 | 261603 | 00-112-1445 |
| 4 | | 6.960 (.274) | 3248 | 9954 | 2545/4 | 261604 | |

## 2.4 TYPE SO CABLE

Type SO cable may be substituted for some requirements not covered by KSC-SPEC-E-0031. Cable may be specified by vendor callout and selected as required from the table below, or by SO and description callout, such as: 3#12, type SO.

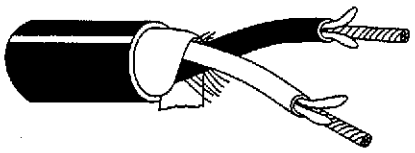


Figure 2-2. Type SO Cable

Table 2-5. Type SO Stranded Copper Conductors, Synthetic Rubber, Color Coded Insulation, Filler, Separator and Black Neoprene Jacket, 600V, 60°C

| COND | AWG | STR | OD mm (in.) | BELDEN | DABURN | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|---|
| 2 | | | 10.185 (.401) | 19203 | 2894 | 4162 | 00-284-0080 |
| 3 | 16 | 65 | 10.820 (.426) | 19208 | 2894/3 | 4163 | 00-284-0079 |
| 4 | | | | | 2894/4 | 4164 | 01-291-2941 |
| 2 | | | 13.411 (.528) | 19202 | 2895 | 4142 | 00-269-2388 |
| 3 | 14 | 41 | 14.173 (.558) | 19207 | 2895/3 | 4143 | 00-295-0851 |
| 4 | | | 15.316 (.603) | 19217 | 2895/4 | 4144 | 01-291-2912 |
| 2 | | | 15.215 (.599) | 19201 | 2896 | 4122 | 01-291-2940 |
| 3 | 12 | 65 | 16.104 (.634) | 19206 | 2896/3 | 4123 | 00-548-1243 |
| 4 | | | 17.526 (.690) | 19216 | 2896/4 | 4124 | 00-519-2821 |
| 2 | | | 16.332 (.643) | 19200 | 2897 | 4102 | |
| 3 | 10 | 105 | 17.501 (.689) | 19205 | 2897/3 | 4103 | 00-295-0855 |
| 4 | | | 19.558 (.770) | 19215 | 2897/4 | 4104 | |
| 2 | | | | | 2898 | 4082 | |
| 3 | 8 | 132 | 22.149 (.872) | 19210 | 2898/3 | 4083 | 00-K01-5018 |
| 4 | | | 24.638 (.970) | 19214 | 2898/4 | 4084 | |
| 2 | | | | | 2899 | 4062 | |
| 3 | 6 | 132 | 24.409 (.961) | 19211 | 2899/3 | 4063 | |
| 4 | | | 27.686 (1.090) | 19213 | 2899/4 | 4064 | |

## 2.5 OVERALL SHIELD

Overall shield braid shall be specified by vendor callout and selected as required from the table below.

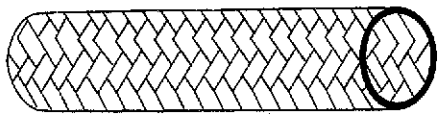


Figure 2-3. Overall Shield

Table 2-6. Shield, Braided, Tinned Copper Tubular per FED-SPEC QQ-B-575. 95% coverage

| ID mm (in.) | STRANDS | AWG | ALPHA | BELDEN | CONSOLIDATED | DABURN | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|---|---|
| 6.350 (.250) | 384 | 36 | 2171 | 8663 | 1319 | 2350-1/4 | 92171 | |
| 7.114 (.281) | 120 | 30 | 2171/1 | | 1320 | 2350-9/32 | | |
| 9.525 (.375) | 384 | 36 | 2172 | 8661 | 1321 | 2350-3/8 | 92172 | 00-194-9829 |
| 11.113 (.437) | 240 | 30 | 2173 | | 1322 | 2350-7/16 | | 00-EG3-8310 |
| 12.700 (.500) | 528 | 36 | 2174 | 8669 | 1323 | 2350-1/2 | 92174 | 00-220-9660<br>00-K27-7762 |
| 14.288 (.563) | 480 | 30 | 2175 | | 1324 | 2350-9/16 | 92175 | 00-194-9841 |
| 15.875 (.625) | | | | 8672 | 1325 | | | |
| 16.669 (.656) | 768 | 30 | 2175/1 | | | 2350-21/32 | | |
| 17.463 (.688) | | | | | | 2350-11/16 | | |
| 19.050 (.750) | | | | 8670 | | | | |
| 19.844 (.781) | 864 | 36 | 2176 | 8662 | 1326 | 2350-25/32 | 92176 | 00-548-2925 |
| 22.225 (.875) | 336 | 30 | 2177 | | | 2350-7/8 | 92177 | 00-445-6643 |
| 25.400 (1.000) | 384 | 30 | 2178 | 8671 | | 2350-1 | 92178 | 00-155-5262 |
| 28.575 (1.125) | 432 | 30 | 2179 | | | 2350-1-1/8 | 92179 | |
| 31.750 (1.250) | 480 | 30 | 2180 | | | 2350-1-1/4 | 92180 | |
| 34.925 (1.375) | 525 | 30 | 2181 | | | 2350-1-3/8 | 92181 | |
| 38.100 (1.500) | 576 | 30 | 2182 | | | 2350-1-1/2 | 92182 | |

## 2.6 HEAT SHRINKABLE TUBING

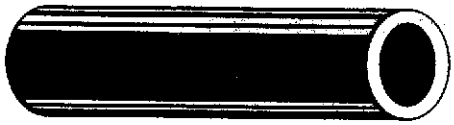


Figure 2-4. Heat Shrinkable Tubing

Table 2-7. Polychloroprene Heat Shrinkable Tubing (Black) MIL-R-46846 and MIL-I-23053B/1 50% Shrink at 71.1°C (160°F)

| OD mm (in.) | ID mm (in.) | WALL mm (in.) | DABURN | ALPHA |
|---|---|---|---|---|
| 6.350 (.250) | 3.175 (.125) | 0.889 (.035) | SH162-1/4 | FIT-600-1/4 |
| 9.525 (.375) | 4.775 (.188) | 1.016 (.040) | SH162-3/8 | FIT-600-38 |
| 12.700 (.500) | 6.350 (.250) | 1.219 (.048) | SH162-1/2 | FIT-600-1/2 |
| 15.875 (.625) | 7.950 (.313) | 1.321 (.052) | SH162-5/8 | FIT-600-5/8 |
| 19.050 (.750) | 9.525 (.375) | 1.448 (.057) | SH162-3/4 | FIT-600-3/4 |
| 22.225 (.875) | 11.125 (.438) | 1.651 (.065) | SH162-7/8 | FIT-600-7/8 |
| 25.400 (1.000) | 12.700 (.500) | 1.778 (.070) | SH162-1 | FIT-600-1 |
| 31.750 (1.250) | 15.875 (.625) | 2.210 (.087) | SH162-1 1/4 | FIT-600-1 1/4 |
| 38.100 (1.500) | 19.050 (.750) | 2.413 (.095) | SH162-1 1/2 | FIT-600-1 1/2 |
| 44.450 (1.750) | 22.225 (.875) | 2.718 (.107) | SH162-1 3/4 | FIT-600-1 3/4 |
| 50.800 (2.000) | 25.400 (1.000) | 2.794 (.110) | SH162-2 | FIT-600-2 |
| 76.600 (3.000) | 38.100 (1.500) | 3.175 (.125) | SH162-3 | FIT-600-3 |
| 101.600 (4.000) | 50.800 (2.000) | 3.556 (.140) | SH162-4 | FIT-600-4 |

## 2.7 MIL-W-5086 TYPE II UNSHIELDED CONDUCTOR

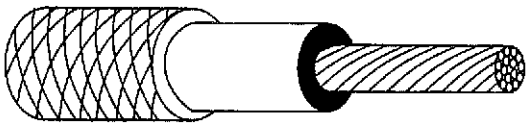


Figure 2-5. Type II Unshielded Conductor

Conductor: Tinned Copper
Insulation: White PVC, 600V, -55 to +105°C
Jacket: White Glass Braid, Flame Retardant Lacquered Nylon Braid Overall

Table 2-8. MIL-W-5086 Type II Unshielded

| AWG | STR | OD mm (in.) | ALPHA | BELDEN | CONSOLIDATED | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|---|
| 14 | 19 | 3.175 (.125) | 1345 | 8555 | 9710 | 111419 | 00-578-6604 |
| 12 | 19 or 37 | 3.632 (.143) | 1346 | 8554 | 9711 | 111219 | 00-578-7514 |
| 10 | 49 | 4.801 (.189) | 1387 | 8553 | 9713 | 111049 | 00-578-7513 |
| 8 | 133 | 6.096 (.240) | 1388 | 8552 | 9714 | 118133 | 00-284-0657 |
| 6 | 133 | 7.442 (.293) | 1389 | 8551 | 9715 | 116133 | 00-578-6594 |
| 4 | 133 | 9.017 (.355) | 1389/4 | 8550 | 9716 | 114133 | 00-578-6595 |
| 2 | 665 | 10.795 (.425) | 1389/2 | 8549 | 9717 | 112665 | |
| 0 | 1045 | 13.335 (.525) | 1389/0 | 8548 | 9718 | 110001 | 00-578-6601 |
| 00 | 1330 | 14.986 (.590) | 1389/00 | 8547 | 9719 | 110002 | 00-578-6600 |
| 000 | 1661 | 16.383 (.645) | 1389/000 | | | 110003 | |
| 0000 | 2104 | 18.161 (.715) | 1389/0000 | | | 110004 | |

## 2.8 SINGLE CONDUCTOR UNJACKETED CABLE

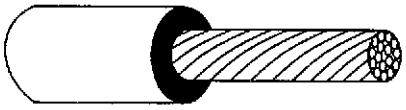


Figure 2-6. Single Conductor Unjacketed cable

Conductor: 19 Strand Silver Plated Copper
Insulation: .254 mm (.010") Extruded TFE, 600V, -65 to +200°C
Color: Specify White only

Table 2-9. MIL-W-16878 Type E (Teflon)

| AWG | OD mm(in.) | ALPHA | BELDEN | CONSOLIDATED | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|
| 24 | 1.143 (.045) | 2854 | 83003 | 9605 | 12419 | |
| 22 | 1.295 (.051) | 2855 | 83006 | 9607 | 12219 | 00-062-5700 |
| 20 | 1.499 (.059) | 2856 | 83007 | 9609 | 12019 | 00-088-0404 |
| 16 | 1.956 (.077) | 2858 | 83010 | 9613 | 11619 | 00-295-2812 |
| 14 | 2.388 (.094) | 2859 | | 9614 | 11419 | 00-295-2813 |
| 12 | 2.870 (.113) | 2859/12 | | 9615 | 11219 | 00-295-2814 |

## 2.9 NINETEEN STRAND SILVER PLATED COPPER SHIELDED CABLE

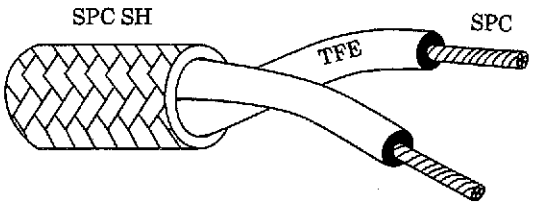



Figure 2-7. Nineteen Strand Silver Plated Copper Shielded Cable

Conductors: 19 Strand Silver Plated Copper
Insulation: .254 mm (.010") Extruded TFE, 600V, -65 to +200°C
Shield (Overall): Braided Silver Plated Copper, 90° Coverage

Table 2-10. MIL-W-16878 Type E Shielded

| COND | AWG | OD mm(in.) | ALPHA | CONSOLIDATED | DABURN | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|---|
| 1 | | 1.753 (.069) | 2809 | 9800 | 2435 | 42401 | |
| 2 | 24 | 2.845 (.112) | 2809/2 | 9801 | 2435/2 | 42402 | |
| 3 | | 3.048 (.120) | 2809/3 | 9802 | 2435/3 | 42403 | |
| 4 | | 3.353 (.132) | 2809/4 | 9803 | 2435/4 | 42404 | |
| 1 | | 1.905 (.075) | 2812 | 9804 | 2436 | 42201 | |
| 2 | 22 | 3.150 (.124) | 2812/2 | 9805 | 2436/2 | 42202 | |
| 3 | | 3.353 (.132) | 2812/3 | 9806 | 2436/3 | 42203 | |
| 4 | | 3.708 (.146) | 2812/4 | 9807 | 2436/4 | 42204 | |
| 1 | | 2.108 (.086) | 2815 | 9808 | 2437 | 42001 | |
| 2 | 20 | 3.607 (.142) | 2815/2 | 9809 | 2437/2 | 42002 | |
| 3 | | 3.835 (.151) | 2815/3 | 9810 | 2437/3 | 42003 | 00-375-5197 |
| 4 | | 4.267 (.168) | 2815/4 | 9811 | 2437/4 | 4204 | |
| 1 | | 2.616 (.103) | 2807 | | 2439 | 41601 | |
| 2 | 16 | 4.674 (.184) | 2807/2 | | 2439/2 | 41602 | |
| 3 | | 4.369 (.172) | 2807/3 | | | 41603 | |
| 4 | | 4.877 (.192) | 2807/4 | | | 41604 | |

## 2.10 NINETEEN STRAND SILVER PLATED COPPER SHIELDED AND JACKETED CABLE

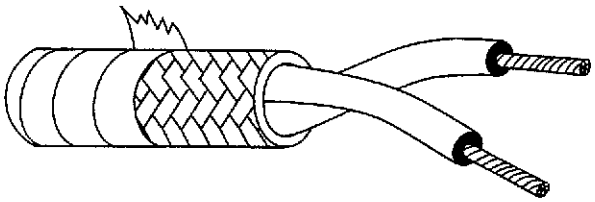


Figure 2-8. Nineteen Strand Silver Plated Copper Shielded and Jacketed Cable

| | |
|---|---|
| Conductors: | 19 Strand Silver Plated Copper |
| Insulation: | .254 mm (.010") Extruded TFE, 600V, -65 to +200°C |
| Shield (Overall): | Braided Silver Plated Copper, 90° Coverage |
| Jacket (Overall): | White Teflon Tape Wrap .318 mm (.0125") |

Table 2-11. MIL-W-16878 Type E Shielded & Jacketed

| COND | AWG | OD mm(in.) | BELDEN | CONSOLIDATED | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|
| 1 | 24 | 2.413 (.095) | 2821 | 9820 | 62401 | |
| 2 | | 3.556 (.140) | 2821/2 | 9821 | 62402 | |
| 3 | | 3.734 (.147) | 2821/3 | 9822 | 62403 | |
| 4 | | 4.039 (.159) | 2821/4 | 9823 | 62404 | |
| 1 | 22 | 2.591 (.102) | 2824 | 9824 | 62201 | |
| 2 | | 3.912 (.154) | 2824/2 | 9825 | 62202 | |
| 3 | | 4.115 (.162) | 2824/3 | 9826 | 62203 | |
| 4 | | 4.470 (.176) | 2824/4 | 9827 | 62204 | |
| 1 | 20 | 2.794 (.110) | 2827 | 9828 | 62001 | |
| 2 | | 4.318 (.170) | 2827/2 | 9829 | 62002 | |
| 3 | | 4.572 (.180) | 2827/3 | 9830 | 62003 | |
| 4 | | 4.953 (.195) | 2827/4 | 9831 | 62004 | |
| 1 | 16 | 3.302 (.130) | 2826 | 9836 | 61601 | |
| 2 | | 5.334 (.210) | 2826/2 | 9837 | 61602 | |
| 3 | | 5.156 (.203) | | 9838 | 61603 | |
| 4 | | 5.588 (.220) | | 9839 | 61604 | |

## 2.11 SINGLE CONDUCTOR UNJACKETED

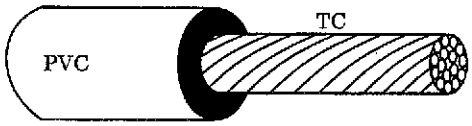



Figure 2-9. Single Conductor Unjacketed

Conductor: 19 Strand Tinned Copper
Insulation: .254 mm (.01") PVC, 600V, -50 to +105°C
Color: Specify White Only

Table 2-12. MIL-W-16878 Type B Single Conductor Unjacketed

| AWG | ID mm(in.) | ALPHA | BELDEN | CONSOLIDATED | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|
| 24 | 1.092 (.043) | 1854/19 | 8509 | 9304 | 172419 | 00-K02-7905 |
| 22 | 1.270 (.050) | 1855/19 | 8508 | 9306 | 172219 | |
| 20 | 1.473 (.058) | 1856/19 | 8507 | 9308 | 172019 | 00-652-1441 |
| 16 | 1.956 (.077) | 1858/19 | 8500 | 9312 | 171619 | |
| 14 | 2.311 (.091) | 1859/19 | | | 171419 | |

## 2.12 SINGLE CONDUCTOR NYLON JACKET

Figure 2-10. Single Conductor Nylon Jacket

Conductor: 19 Strand Tinned Copper
Insulation: .254 mm (.01") PVC, 600V, -50 to +105°C
Color: Specify White Only

Table 2-13. MIL-W-16878 Type B Single Conductor Nylon Jacket

| AWG | ID mm(in.) | ALPHA | BELDEN | CONSOLIDATED | DEARBORN | FSN 6145- |
|---|---|---|---|---|---|---|
| 24 | 1.245 (.049) | 1864/19 | 8519 | 9317 | 182419 | 00-952-1734 |
| 22 | 1.422 (.056) | 1865/19 | 8518 | 9319 | 182219 | 00-844-2808 |
| 20 | 1.626 (.064) | 1866/19 | 8517 | 9321 | 182019 | 00-583-3789 |
| 16 | 2.159 (.085) | 1868/19 | 8510 | 9325 | 181619 | 00-578-6072 |
| 14 | 2.515 (.099) | 1869/19 | | | 181419 | 00-052-3278 |

## 2.13 MINERAL INSULATED (MI) CABLE - 600 VOLTS[1], 79K06110

Table 2-14. Mineral Insulated (MI) Cable - 600 Volts

| NUMBER OF CONDUCTORS | CONDUCTOR SIZE (AWG) | CURRENT RATING (AMPERES)[2] | CABLE OUTSIDE DIA [mm (in.)] | CABLE REFERENCE NO[3] [mm (in.)] | EQUIVALENT CONDUIT SIZE [mm (in.)] |
|---|---|---|---|---|---|
| ONE | 1/0 | 245 | 13.792 (.543) | 13.792/1 (543/1) | 19.050 (.750) |
| | 250 MCM | 424 | 18.948 (.746) | 18.948/1 (746/1) | 25.400 (1.000) |
| TWO | 16 | - | 8.636 (.340) | 8.636/2 (340/2) | 12.700 (.500) |
| | 14 | 15 | 9.423 (.371) | 9.423/2 (371/2) | 12.700 (.500) |
| | 12 | 20 | 10.211 (.402) | 10.211/2 (402/2) | 12.700 (.500) |
| | 10 | 30 | 11.405 (.449) | 11.405/2 (449/2) | 19.050 (.750) |
| | 8 | 50 | 13.005 (.512) | 13.005/2 (512/2) | 19.050 (.750) |
| | 6 | 70 | 14.986 (.590) | 14.986/2 (590/2) | 19.050 (.750) |
| | 4 | 90 | 17.374 (.684) | 17.374/2 (684/2) | 25.400 (1.000) |
| THREE | 16 | - | 9.017 (.355) | 9.017/3 (355/3) | 12.700 (.500) |
| | 14 | 15 | 9.830 (.387) | 9.830/3 (387/3) | 12.700 (.500) |
| | 12 | 20 | 11.024 (.434) | 11.024/3 (434/3) | 12.700 (.500) |
| | 10 | 30 | 12.192 (.480) | 12.192/3 (480/3) | 19.050 (.750) |
| | 8 | 50 | 13.792 (.543) | 13.792/3 (543/3) | 19.050 (.750) |
| | 6 | 70 | 15.773 (.621) | 15.773/3 (621/3) | 19.050 (.750) |
| | 4 | 90 | 18.542 (.730) | 18.542/3 (730/3) | 25.400 (1.000) |

Table 2-14 (Cont.) Mineral Insulated (MI) Cable - 600 Volts

| NUMBER OF CONDUCTORS | CONDUCTOR SIZE (AWG) | CURRENT RATING (AMPERES)[2] | CABLE OUTSIDE DIA [mm (in.)] | CABLE REFERENCE NO[3] [mm (in.)] | EQUIVALENT CONDUIT SIZE [mm (in.)] |
|---|---|---|---|---|---|
| FOUR | 16 | - | 9.830 (.387) | 9.830/4 (387/4) | 12.700 (.500) |
| | 14 | 15 | 10.617 (.418) | 10.617/4 (418/4) | 19.050 (.750) |
| | 12 | 20 | 11.811 (.465) | 11.811/4 (465/4) | 19.050 (.750) |
| | 10 | 30 | 13.386 (.527) | 13.386/4 (527/4) | 19.050 (.750) |
| | 8 | 50 | 14.986 (.590) | 14.986/4 (590/4) | 19.050 (.750) |
| | 6 | 70 | 17.374 (.684) | 17.374/4 (684/4) | 25.400 (1.000) |
| SEVEN | 16 | - | 11.405 (.449) | 11.405/7 (449/7) | 19.050 (.750) |
| | 14 | 12 | 12.598 (.496) | 12.598/7 (496/7) | 19.050 (.750) |
| | 12 | 16 | 13.792 (.543) | 13.792/7 (543/7) | 19.050 (.750) |
| | 10 | 24 | 15.773 (.621) | 15.773/7 (621/7) | 25.400 (1.000) |

NOTES:

1. Reference KSC procedure for MI cable termination 79K06110.
2. Current rating for single conductor cables is that designated by the C.E. code Part 1 for cables in free air.
3. Cable reference number = cable O.D. in millimeters/no. (thousandths of an inch/no.) of conductors. Reference KSC procurement SPEC-E-0020.

## 2.14 PLENUM CABLE POLICY

This is the formal policy by which all organizations are to comply for installation of plenum rated and general purpose cabling. This policy is neither a replacement for nor alters the requirements of the National Fire Protection Association, NFPA 70 (National Electric Code), but is an interpretation of that code approved by the KSC Authority Having Jurisdiction (AHJ) (FF-S1-A).

### 2.14.1 GROUND RULES

2.14.1.1 All areas that house essential electronic equipment shall have fire suppression water sprinklers

2.14.1.2 The boundaries of "computer fire areas" shall be a minimum 1 hr. fire rated assembly and be approved by the AHJ (FF-S1-A).

2.14.1.3 All cables shall be UL rated and have jacket stamping showing that rating.

2.14.1.4 Openings created by any cable penetration(s) shall be sealed by appropriate fire stopping material, to maintain the fire resistance rating of the fire partition.

### 2.14.2 GUIDELINES

2.14.2.1 Plenum rated cables, or general purpose cables run in a raceway, shall be used:

a. for all cables routed between designated fire areas.
b. for power cables routed from a breaker box to electrical outlets within a designated fire area.

2.14.2.2 General purpose cables may be used:

a. for power cables routed from an electrical outlet to a piece of equipment (routing through a raised floor plenum does not change the intent of this requirement).
b. for data/signal cables routed within a designated fire area.

### 2.14.3 PROCEDURES FOR CHANGE OR DEVIATION APPROVAL

2.14.3.1 Changes to or deviations from this policy will require the approval of the AHJ and/or the KSC Fire Risk Review Board.

## 2.15 ELECTRICAL/ELECTRONIC CONNECTORS, CABLING AND WIRING

### 2.15.1 GUIDELINES

2.15.1.1 All cables and wiring shall be clamped and supported to remain clear of sharp edges and moving parts.

2.15.1.2 All cables and wiring shall be clamped and supported to eliminate mechanical stress on wires, terminations, and connectors.

2.15.1.3 All cables and wiring shall be marked to clearly indicate the correct mating connecting or termination point to preclude phase reversal or cross-connection.

2.15.1.4 All A.C. power cables shall have an independent, noncurrent-carrying ground conductor.

2.15.1.5 All electrical/electronic wiring shall be located and clamped to eliminate any possibility of contact with liquid lines.

2.15.1.6 A.C. power and signal wiring shall not be routed through the same cable or wiring harness to ensure that voltage will not be induced into signal circuits.

2.15.1.7 Overall shields over conductor groupings in instrumentation cables used for transmitting dc and ac power, analog and digital signals, shall be grounded at both ends. Shields over individual conductors shall be grounded as the interface dictates. Coaxial and balanced pair cables used for rf and video transmission and outside plant telephone cables are excluded.

2.15.1.8 Drip loops shall be designed into wire harness installation to prevent fluids from flowing down the wires to the connector.

2.15.1.9 Electrical wiring or cabling shall not be bundled with fluid system lines or hoses.

2.15.1.10 Electrical/electronic components and wiring shall be installed above fluid system lines to minimize exposure to leaking fluids.

2.15.1.11 Connectors with unkeyed symmetrical pin arrangements shall not be used.

2.15.1.12 Only female connectors shall be used to terminate sources of power. Control circuits using terminal distributors, patch distributors, etc., which are located in closed racks or cabinets, are excluded.

2.15.1.13 All ground equipment cables which connect to prototype or critical hardware will have connectors which are individually keyed, sized, or shaped, making them compatible with the mating receptacle.

2.15.1.14 High voltage wiring or power cables shall not be routed near voltage-sensitive equipment or high temperature sources.

2.15.1.15 Electrical circuits shall not be routed through the saw connector if a short circuit between them would constitute a failure that would jeopardize crucial systems/controls. (Does not apply where design will allow testing, in a safe mode, of all functions passing through the connector.)

2.15.1.16 Primary and redundant circuits shall not be routed through the same connector or cable on critical equipment.

2.15.1.17 Connectors shall be sized to prevent improper connection or shall be marked with a reference designator system to indicate proper connection.

2.15.1.18 Miniature quick disconnect connectors shall not be used in areas subject to water intrusion.

2.15.1.19 All connectors except those with sealing grommets shall be prepotted with epoxy and all connectors shall be molded with polyurethane or an MS3109 boot shall be installed.

2.15.1.20 Connectors subject to frequent disconnect and connectors which, on disconnect, are exposed to harmful environments shall have attached caps, plugs, or covers for use to protect the connectors from damage or contamination while unmated.

2.15.1.21 Connectors, cabling, and wiring shall be located in a manner to permit connecting and disconnecting without damage to the connector ring, abrasion or stress on the cable, or injury to the personnel performing the work. Where required, sufficient space shall be provided to allow use of strap or spanner wrenches without damage to adjacent cabling or components.

2.15.1.22 All terminals, insulators, sleeves, identifiers, decals, etc., shall be of material compatible with solvent, oil mixture, other reactive fluids, and heat in the operating environment.

2.15.1.23 Receptacles connecting to circuits having different voltages, frequencies, or types of current (ac or dc) shall be of such design that attachment plugs and such circuits are not interchangeable.

2.15.1.24 Power receptacle and plug connector types shall be of the type that the grounding connection pin is made before the current-carrying connections.

2.15.1.25 Grounding-type devices shall be of the type that grounding members of attachment plugs cannot be brought into contact with current-carrying parts of receptacles or cord connectors.

2.15.1.26 Location and type of batteries and battery enclosure should preclude personnel or equipment hazards associated with battery malfunctions.

2.15.1.27 All battery vents, blowout plugs, and relief outlets shall be located so that escaping gas will be ventilated to preclude damage to adjacent equipment or injury to operating.

2.15.1.28 Batteries shall have decals or markers that indicate the type of electrolyte and special safety precautions.

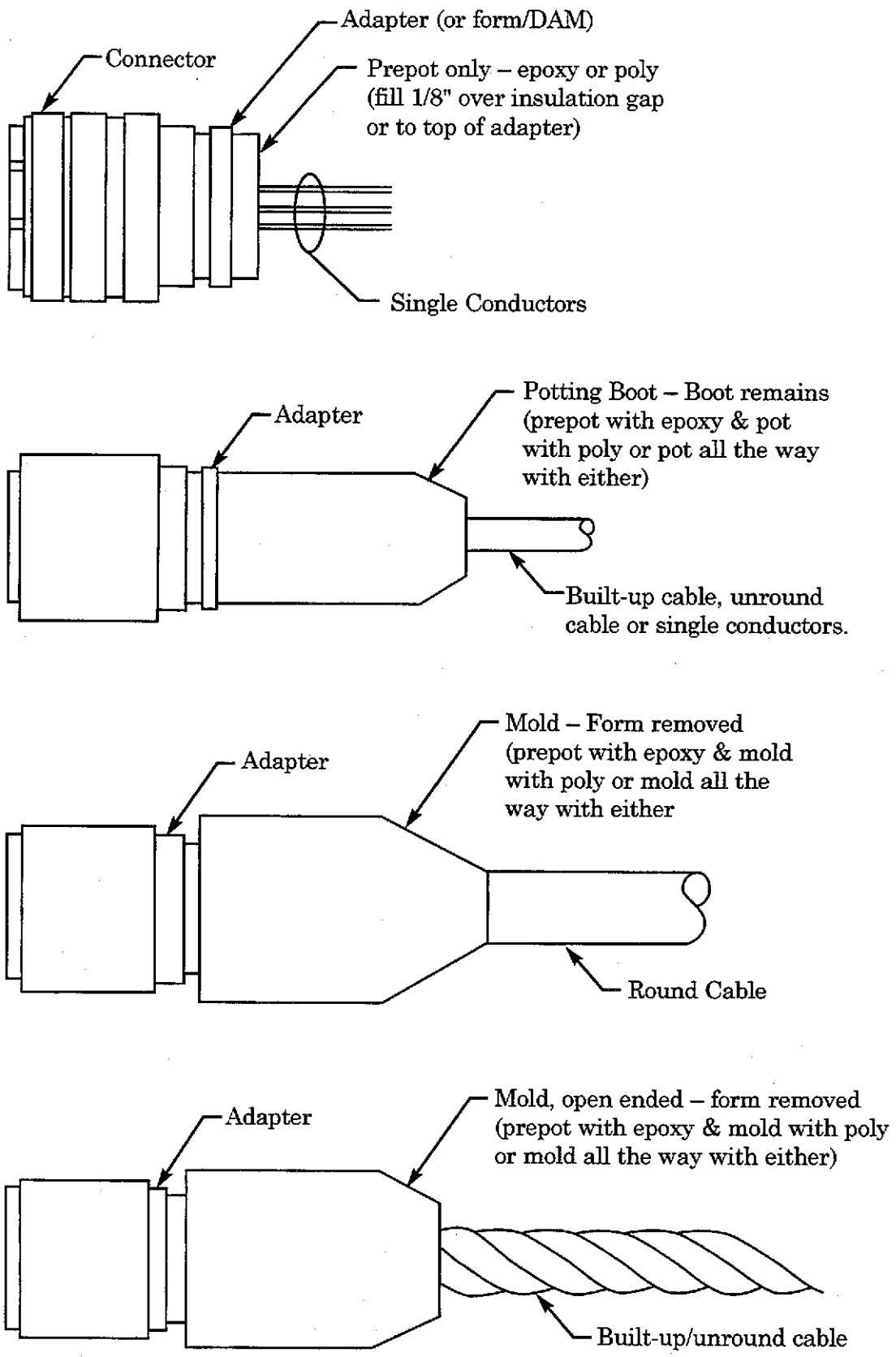


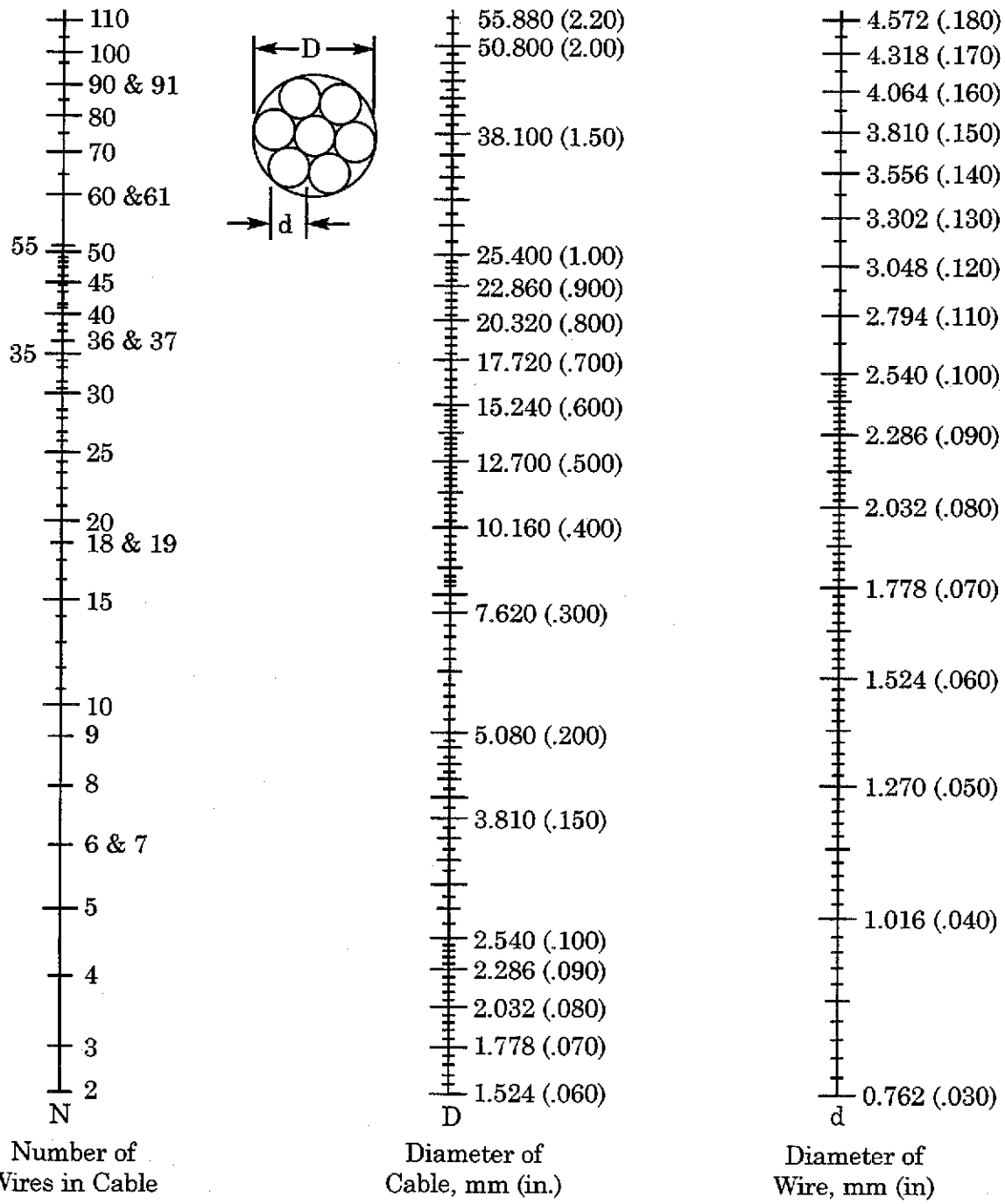

Figure 2-11. Connector Potting/Boot Adapters

## 2.16 HARNESS BUNDLE DIAMETER TABLES

$D = d(1 + \sqrt{N \div 0.907})$
D = Diameter of Enclosing Circle
d = Diameter of Enclosed Circles
N = No. of enclosed Circles

Example:
10 wires of 1.778 mm (.070 in.) diameter form 6.858 mm (.270 in.) diameter bundle

Table 2-15. Nomograph for Estimating Bundle Diameter



FABRICATE PER THIS DRAWING AND THE FOLLOWING INSTRUCTIONS OF 79K19600 (20)

| | | | |
|---|---|---|---|
| (1) | 5 | 9 | 13 |
| 2 | 6 | 10 | 14 |
| 3 | 7 | 11 | 15 |
| 4 | 8 | 12 | 16 |

AUTHORIZED SUBSTITUTIONS: (19)

(18) BENCH STOCK MATERIALS
*(See general requirements of 79K19600)*

- SOLDER, SEE NASA-STD-8739.3
- WIRE, B, 19 STRAND, MIL-W-16878/1
- TAPE, POLYESTER, TYPE 1, L-T-100, 3/4 IN.
- EPOXY (SEE INSTRUCTION 6)
- POLYURETHANE (SEE INSTRUCTION 7)
- MARKER TAPE (SEE INSTRUCTION 13)
- TUBING, VINYL, MIL-I-23053/2

(24)

REVISIONS

| SYM | DESCRIPTION | DATE | APPROVAL |
|---|---|---|---|
| | (21) | | |

(22)

(23)

| FIND NO | DESCRIPTION | PART NUMBER | MFR CODE | NO REQD | STOCK SIZE | MATL SPEC | SPL NOTES |
|---|---|---|---|---|---|---|---|
| 9 | | | | | | | |
| 8 | | | | | | | |
| 7 | | | | | | | |
| 6 | | | | | | | |
| 5 | | | | | | | |
| 4 | | | | | | | |
| 3 | | | | | | | |
| 2 | | | | | | | |
| 1 | (11) | (12) | (13) | (1) (14) | (15) | (16) | (17) |

LIST OF MATERIALS

ORIGINAL DATE OF DRAWING (4)
DRAFTSMAN (5)
ENGINEER/CHECKER (6)
SYSTEM ENGINEER (7)
APPROVED (8) (9)
*Do Not Initial Last Name* (10)

**CABLE SUBASSEMBLY**
(3)

JOHN F. KENNEDY SPACE CENTER, NASA
KENNEDY SPACE CENTER FLORIDA 32899

DWG SIZE **A**
(1)
SHEET 1 OF (2)

KSC FORM 21-2F

Figure 2-12. Cable Subassembly Drawing Cover Sheet

## 2.17 CHECKLIST FOR DRAWING CABLE SUBASSEMBLIES

1. Drawing Number.
2. Number of Sheet.
3. Buildup of cable, eg. 60 (60 #20) 0S.
4. If revised, use date from old drawing, if new enter present date.
5. Type name of original draftsman.
6. Signature of present Engineer/Checker.
7. Type name of system engineer.
8. For revised drawing type in name from old drawing – for new drawing leave blank.
9. Type organization department number on right side of this line.
10. Optional.
11. List basic components in order: CABLE, CONNECTOR, (End A preferably the pin contact type), CONNECTOR (End B preferably the socket contact), CONNECTOR (End C, etc., if applicable, BACKSHELL (END A), BACKSHELL (END B, etc), DUST CAP (END A), DUST CAP (END B, etc.) SHIELD RING (Inner), SHIELD RING (Outer) other special material as required except BENCH STOCK. USE SHUTTLE CONNECTOR LIST to select connectors, backshells and dust caps. Use 75M13676, Table II to select overall shield rings and Table III to select shield rings for conductor sets.
12. Call out MS or NASA part numbers where possible (vendor part numbers are to be used only where MS or NASA specifications are not appropriate).
13. Enter manufacturer's code for all vendor part numbers.
14. Enter quantity followed by END used on, e.g., 1 A.
15. Enter information such as cable buildup, number of contacts, I.D. for shield rings, etc.
16. Enter specifications such as KSC-SPEC-E-0031/XX, MIL-C-22992 etc.
17. Where substitution may be made per 79K19600, S1 thru S21, enter this S number. If special notes are required enter 2 etc. as required.
18. Enter X (All ends), A (END A), B (END B) etc. for all bench stock material required.
19. List all authorized substitution numbers, S3 e.g.

20. Place X for all ends, A for End A or B for End B, etc. for all instructions of 79K19600 that apply except for 8-- which will be the dash number of 79K04613 that applies. 1 is always X.

| | |
|---|---|
| 1. X. length | 9. Shield rings |
| 2. 75M13302 insp. | 10. Isolate shields |
| 3. Dust caps | 11. Barrier tape |
| 4. Mating connectors | 12. Boots |
| 5. Solder | 13. Marker tape |
| 6. Potting | 14. Splicing instructions |
| 7. Molding | 15. Crimp contact terminations |
| 8. -- dash No. of 79K04613 | |

21. Enter standard revision information.
22. Draw simple schematics or schematics that use contact to like contact wiring showing only the first and last contacts that are connected by conductors.
    Also show any shielding. If schematic is complicated use A size continuation sheet (KSC Form 21-2D) and use space 22 for any required detail.
23. If continuation sheet is used type: SHEET 2 FOR WIRING SCHEMATIC.
24. Use this space as required for special notes, details etc.

# SECTION III

# CONNECTORS

## 3.1 CONNECTORS USED AT KSC FOR GROUND SUPPORT EQUIPMENT (GSE)

Four basic families of connectors are used at KSC, depicted in Figure 3-2, which support the KSC GSE requirements. It is the policy of KSC, when selecting connectors, to specify normal insert positions. Alternate insert positions, sometimes called clocking, will only be specified for connectors mating with vehicle interface or equipment built by others that dictates alternate positions. KSC controls correct mating by cable marker tapes and receptacle J numbers, which must match.

## 3.2 MIL-C-5015 CONNECTORS, ELECTRICAL, CIRCULAR, THREADED

These connectors are used primarily for connecting end item components to component distributors. Example below:

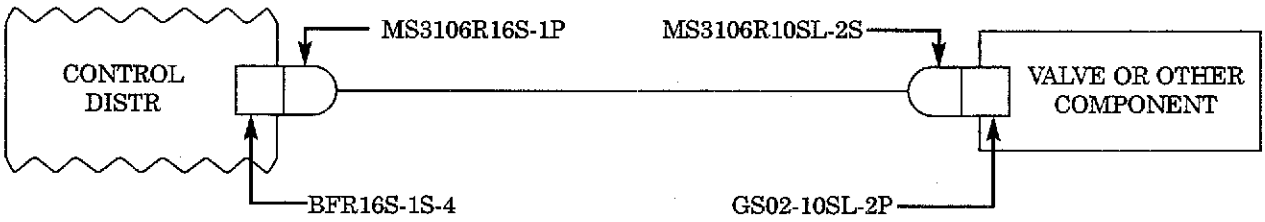



Figure 3-1. Connectors used at KSC for GSE

This MIL SPEC lists three series of connectors:

a. MS3100 - Solder contact, recommended for general use.

b. MS3400 - Crimp contact, front release. Not recommended because of limited source.

c. MS3450 - Crimp contact, rear release, recommended for field termination where soldering and potting are impractical.

Some vendor part numbers that offer special configurations not available in MS numbers are also listed.

NOTE:

See paragraph. 3.7 thru 3.7.4 for complete MIL-C-5015 listing.

## 3.3 MIL-C-22992 CONNECTORS, PLUGS AND RECEPTACLES, ELECTRICAL, WATERPROOF, QUICK DISCONNECT, HEAVY DUTY TYPE

These connectors are used primarily on longer runs of AWG 14 wire, or larger, and running between distributors in outside environments. They are ignition proof and where subject to lightning-induced environment provide a continuity of the overall shield through to facility ground.

NOTE:

See paragraph. 3.8 thru 3.8.3 for complete MIL-C-22992 listing.

## 3.4 MIL-C-26482 CONNECTORS, ELECTRICAL (CIRCULAR, MINIATURE, QUICK DISCONNECT, ENVIRONMENT RESISTING), RECEPTACLES AND PLUGS

This specification lists two series:

a. Series 1 are MS311x solder contact and MS312x crimp contact and are not recommended for new design but may be substituted until supply is exhausted.

b. Series 2 are MS347x crimp contact and MS344x solder contact. The MS347x is recommended because it requires no soldering or potting and the insert holds the contacts in line.

MSFC Specification 40M39569 (NB Types) are equivalent to Series 2 for ground use.

MSFC Specification 40M38298 (NBS Type) has no military equivalent. Cannon series KPDR are part numbers equivalent to NBS.

NOTE:

See paragraph. 3.9 thru 3.9.5 for complete MIL-C-26482 listing.

## 3.5 MIL-C-38999 CONNECTORS, ELECTRICAL CIRCULAR, MINIATURE, HIGH DENSITY, QUICK DISCONNECT (BAYONET, THREADED AND BREECH COUPLING), ENVIRONMENT RESISTANT, REMOVABLE CRIMP AND HERMETIC SOLDER CONTACTS

This specification lists two series:

a. Series I (Scoop-proof) has a feature to prevent bending pins when mating connectors. They are designated MS27466, etc., or Bendix LJT.

b. Series II high-density connector designated as MS27472, etc., MSFC Specification 40M38277 (NLS types), and Bendix JT.

This connector will only be specified where it is necessary to satisfy the requirements of a flight article.

NOTE:

See paragraph. 3.10 and 3.10.1 for complete MIL-C-38999 listing.

## 3.6 MIL-C-83723 CONNECTORS, ELECTRICAL, CIRCULAR, ENVIRONMENT RESISTANT, RECEPTACLES AND PLUGS

This specification is intended to unify three different connector specifications into one all-encompassing specification. All connecters under MIL-C-83723 are to have rear release removable crimp contacts.

This specification lists three series:

a. Series I replaced MIL-C-26482
b. Series II replaced MIL-C-5015
c. Series III replaced MIL-C-26500

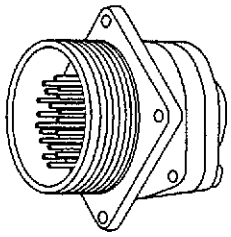
During preliminary work on Military Standard 1353, the need for a removable rear release crimp contact became apparent and it was felt that Series I and II should be included in the original connector specification, as follows:

Series I is inactive for new design: use MIL-C-26482
Series II is inactive for new design: use MIL-C-5015
Series III is current for new design: replaces MIL-C-26500

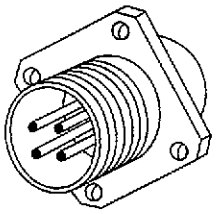
NOTE:

The rear accessory threads of MIL-C-83723 series II connectors are different from those of MIL-C-5015. Hence the M83723 Series II backshells will not fit the MS3450 thru MS3459 connectors of MIL-C-5015.

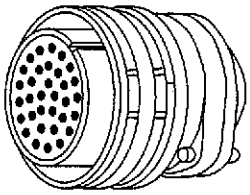
## MIL-C-5015 GENERAL PURPOSE ELECTRICAL CONNECTORS



MS3100R WALL MOUNT

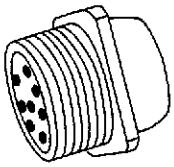


MS3102R BOX MOUNT

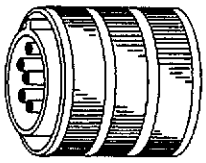


MS3106R STRAIGHT PLUG

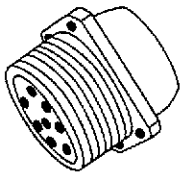
## MIL-C-22992 HEAVE DUTY ELECTRICAL CONNECTORS



MS17343R WALL MOUNT

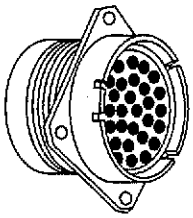


MS17344R STRAIGHT PLUG

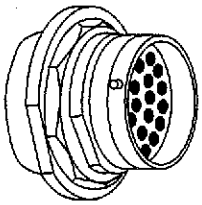


MS17346R BOX MOUNT

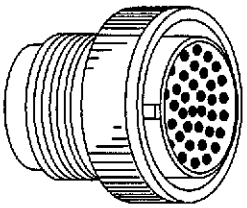
## MIL-C-26482 MINIATURE CIRCULAR ELECTRICAL CONNECTORS



MS3470L WALL MOUNT

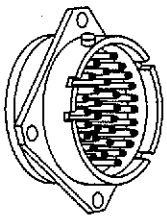


MS3474L JAM NUT

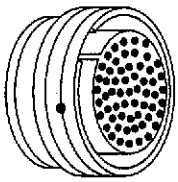


MS3476L STRAIGHT PLUG

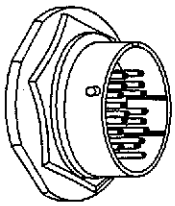
## MIL-C-38999 MINIATURE CIRCULAR ELECTRICAL CONNECTORS



MS27472T WALL MOUNT



MS27473T STRAIGHT PLUG



MS27474T JAM NUT

Figure 3-2. Typical Connectors used at KSC

Table 3-1. Military Specification Index

| LEGEND I | LEGEND II | |
|---|---|---|
| A = MIL-C-5015 | P = PLUG | S = BACKSHELL |
| B = MIL-C-22992 | R = RECEPTACLE | I = INACTIVE |
| C = MIL-C-26482 | T = TOOL | H = HEAT SHRINKABLE BOOT |
| D = MIL-C-38999 | K = CAP | N = CONTACTS |
| E = TERMINALS | S/R = STRAIN RELIEF | IA = INSERT ARRANGEMENTS |

| MS NO. | I | II | MS NO. | I | II | MS NO. | I | II |
|---|---|---|---|---|---|---|---|---|
| 3057 | A | S | 3181 | C | K | 3454 | A | R |
| 3100 | A | R | 3184 | C | S | 3456 | A | P |
| 3101 | A | R | 3186 | C | NUT | 3459 | A | P |
| 3102 | A | R | 3187 | C | SEAL-PLUG | 3460 | C | T |
| 3103 | A | R | 3188 | A | S90° | 3461 | C | T |
| 3105 | A | R | 3189 | A | S45° | 3462 | C | T |
| 3106 | A | P | 3191 | A/B/C/D | T | 3470 | C | R |
| 3107 | A | P | 3192 | C | N | 3471 | C | R |
| 3108 | A | P | 3193 | C | N | 3472 | C | R |
| 3109 | A/C | H | 3197 | A/B/C | T | 3473 | C | R |
| 3110 | C | R | 3198 | C | T | 3474 | C | R |
| 3111 | C | R | 3316 | E | T | 3475 | C | P |
| 3112 | C | R | 3400 | A | R | 3476 | C | P |
| 3113 | C | R | 3401 | A | R | 3477 | C | R |
| 3114 | C | R | 3402 | A | R | 3479 | C | R |
| 3115 | C | R | 3404 | A | R | 3480 | A | T |
| 3116 | C | P | 3406 | A | P | 3481 | C | T |
| 3117 | A/C | H | 3408 | A | P | 3507 | A | P |
| 3118 | A | S | 3409 | A | P | 14054 | B | IA |
| 3119 | C | R | 3412 | A | R | 14055 | B | IA |
| 3120 | C | R | 3415 | A | S45 | 14056 | B | N |
| 3121 | C | R | 3416 | A/C | S | 14057 | D | IA |
| 3122 | C | R | 3417 | A/C | S | 17340 | B | S |
| 3124 | C | R | 3418 | A/C | S90 | 17341 | B | S |
| 3126 | C | P | 3419 | A/C | S | 17342 | B | S |
| 3127 | C | R | 3420 | A | S | 17343 | B | R |
| 3128 | C | R | 3436 | A | P | 17344 | B | P |
| 3142 | A | R | 3437 | A | S | 17345 | B | P |
| 3143 | A | R | 3438 | A | IA90 | 17346 | B | R |
| 3152 | A/C | S | 3439 | A | IS45 | 17347 | B | R |
| 3153 | A/C | S45° | 3440 | C | R | 17348 | B | R |
| 3154 | A/C | S90° | 3441 | A | P | 17349 | B | K |
| 3155 | A/C | S | 3442 | C | R | 17350 | B | K |
| 3158 | A/C | S | 3443 | C | R | 18062 | B | R |
| 3160 | A/B/C/D | T | 3447 | A/C | T | 20047 | D | K |
| 3161 | A/C | S | 3448 | C | T | 20048 | D | K |
| 3162 | A | N | 3449 | C | R | 22520 | A/B/C/D | T |
| 3163 | A | N | 3450 | A | R | 23747 | B | S |
| 3165 | A | T | 3451 | A | | 24256 | C | T |
| 3180 | C | K | 3452 | A | R | 25042 | A | K/P |

Table 3-1. (Cont.) Military Specification Index

| LEGEND I | LEGEND II | |
|---|---|---|
| A = MIL-C-5015 | P = PLUG | S = BACKSHELL |
| B = MIL-C-22992 | R = RECEPTACLE | I = INACTIVE |
| C = MIL-C-26482 | T = TOOL | H = HEAT SHRINKABLE BOOT |
| D = MIL-C-38999 | K = CAP | N = CONTACTS |
| E = TERMINALS | S/R = STRAIN RELIEF | IA = INSERT ARRANGEMENTS |

| MS NO. | I | II | MS NO. | I | II | MS NO. | I | II |
|---|---|---|---|---|---|---|---|---|
| 25043 | A | K/P | 27500 | D | P | 33686 | B | IA |
| 25183 | A | P | 27501 | D | K | 33687 | B | IA |
| 25251 | A | END SEAL | 27502 | D | K | 33688 | B | IA |
| 27342 | D | S | 27503 | D | R | 33689 | B | IA |
| 27352 | D | K | 27504 | D | R | 33690 | B | IA |
| 27353 | D | K | 27505 | D | R | 33691 | B | IA |
| 27466 | D | R | 27506 | D | S | 33695 | A | N |
| 27467 | D | P | 27507 | D | S/R | 33708 | C | |
| 27468 | D | R | 27508 | D | R | 33709 | C | |
| 27469 | D | R | 27510 | D | K | 33710 | C | |
| 27470 | D | R | 27511 | D | K | 33711 | C | |
| 27471 | D | R | 27512 | D | NUT | 33712 | C | |
| 27472 | D | R | 27513 | D | R | 33713 | C | |
| 27473 | D | P | 27514 | D | NUT | 33714 | C | |
| 27474 | D | R | 27515 | D | R | 33715 | C | |
| 27475 | D | R | 27534 | A/C/D | T | 33716 | C | |
| 27476 | D | R | 27535 | D | N | 90294 | C | |
| 27477 | D | R | 27536 | D | N | 90376 | A/C | K |
| 27478 | D | R | 27652 | D | R | PLASTIC | | |
| 27479 | D | R | 27653 | D | P | 90453 | A | N |
| 27480 | D | P | 27654 | D | R | 90454 | A | N |
| 27481 | D | R | 27655 | D | N | 90455 | A | T |
| 27482 | D | R | 27656 | D | R | 90456 | A | T |
| 27483 | D | R | 27661 | D | P | 90555 | B | R |
| 27484 | D | P | 27662 | D | R | 90556 | B | P |
| 27485 | D | S | 27663 | D | S | 90557 | B | P |
| 27486 | D | H | 27664 | D | R | 90558 | B | R |
| 27487 | D | S | 27666 | D | S | 90559 | B | N |
| 27488 | C/D | PLUG SEAL | 27667 | D | R | 90560 | B | N |
| 27489 | D | S | 27668 | D | S/R | 90561 | B | S/R |
| 27490 | D | N | 27669 | D | S/R45° | 90562 | B | T |
| 27491 | D | N | 27670 | D | S/R90° | 90563 | B | K |
| 27492 | D | N | 28900 | A | PACKING | 90564 | B | K |
| 27493 | D | N | 33678 | A | R | 90565 | B | IA |
| 27494 | D | N | 33679 | A | R | 90567 | B | IA |
| 27495 | D | T | 33681 | B | IA | 90568 | B | S |
| 27496 | D | R | 33682 | B | IA | 90569 | B | S |
| 27497 | D | R | 33683 | B | IA | 90570 | B | S |
| 27498 | D | P | 33684 | B | IA | 90571 | B | S |
| 27499 | D | R | 33685 | B | IA | | | |

Table 3-2. Military to Equivalent Commercial Part Numbers

| MILITARY PART NO. | MILITARY SPECIFICATION | AMPHENOL | BENDIX | BURNDY | ITT CANNON | CINCH | DEUTSCH | FLIGHT | PYLE NATIONAL | MATRIX | G & H |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MS3100A | | | | | CA3100A | | | | | | |
| MS3101A | | 97-3100A | | | CA3101A | | | | | | |
| MS3106A | | 97-3101A | | | CA3106A | | | | | | |
| MS3100 E&R | | 97-3106A | 10-720** | | CA3100E,R | | | | | | |
| MS3101 E&R | MIL-C-5015 'D' | | 10-721** | | CA3101E,R | | | | | | |
| MS3106 E&R | | | 10-726** | | CA3106E,R | | | | | | |
| MS3100R | CLASS A,E,R | 97-3100R | | | | | | | | | |
| MS3101R | | 97-3101R | | | | | | | | | |
| MS3106R | | 97-3106R | | | | | | | | | |
| MS3400 | | | | | CV3406 | | | | | | |
| MS3401 | | | | | CV3401 | | | | | | |
| MS3404 | | | | | CV3404 | | | | | | |
| MS3406 | MIL-C-5015 'G' | | | | CV3406 | | | FF01 | | | |
| MS3450 | | | | | CV3450 | | | FF04 | | 9440 | |
| MS3451 | CLASS D,K,L,U,W | | | | CV3451 | | | FF06 | | 9441 | |
| MS3454 | | | | | CV3454 | | | | | 9444 | |
| MS3456 | | | | | CV3456 | | | | | 9446 | |
| MS3470 | | 118-20 | PTS00DR | | PV3470 | | AFD50 | | | | |
| MS3471 | MIL-C-26482 | | PTS01DR | | PV3471 | | AFD51 | | | | |
| MS3474 | SERIES 2 | 118-23 | PTS07DR | | PV3474 | | AFD54 | | | | |
| MS3475 | CLASS E,L | | | | PV3475 | | | | | | |
| MS3476 | | 118-26 | PTS06DR | | PV3476 | | AFD56 | | | | |
| M83723/1&2 | | | | | PV0**B | | AFD50 | | | | |
| M83723/8 | MIL-C-83723 | | | | PV4**B | | AFD51 | | | | |
| M83723/5&6 | SERIES 1 | | | | PV7**B | | AFD54 | | | | |
| M83723/13&14 | | | | | PV6**B | | AFD56 | | | | |
| M83723/71&72 | | 518-71&72 | | | | | 83760R | | | MB30* | |
| M83723/73&74 | | 518-73&74 | | | | | 83764R | | | MB34* | |
| M83723/75&76 | | 518-75&76 | | | | | 83766R | | | MB36* | |
| M83723/77&78 | MIL-C-83723 | 518-77&78 | | | | | 83768R | | | MB38* | |
| M83723/82&83 | SERIES 3 | 518-82&83 | | | | | 83730R | | | MT30* | |
| M83723/84&85 | | 518-84&85 | | | | | 83734R | | | MT34* | |
| M83723/86&87 | | 518-86&87 | | | | | 83736R | | | MT36* | |
| NAS1641 | | | | | KV0**T | | DBA30 | | ET-17 | | |
| NAS1642 | | | | | KV7**T | | DBA34 | | ET-19 | | |
| NAS1643 | | | | | KV6**T | | DBA36 | | ET-11 | | |
| NAS1650 | NAS1599 | | | | PV0**B | | DBA50 | | EB-16 | | |
| NAS1651 | | | | | PV4**B | | DBA58 | | EB-19 | | |
| NAS1652 | | | | | PV7**B | | DBA54 | | EB-11 | | |
| NAS1653 | | | | | PV6**B | | DBA56 | | | | |
| MS24264 | MIL-C-26500 | 48-00 | | | | 48-00 | | | ZZW/L-A-17 | | |
| MS24265 | MIL-C-38300 | 48-03 | | | | 48-03 | | | ZZW/L-A-15 | | |
| MS24266 | CLASS G,R | 48-06 | | | | 48-06 | | | ZZW/L-A-10 | | |
| MS3110 | | | PT00 | BT00 | KPT00 | | LPT00 | | | | |
| MS3111 | MIL-C-26482 | | PT01 | BT01 | KPT01 | | LPT01 | | | | |
| MS3116 | CLASS A,E,F,P | | PT06 | BT06 | KPT06 | | LPT06 | | | | |
| MS3120 | SERIES 1 | | PT00SE | L**T**0 | KPTM00 | | | | | | |
| MS3121 | | | PT01SE | L**T**1 | KPTM01 | | BTK06 | | | | |
| MS3126 | | | PT06SE | L**T**6 | KPTM06 | | | | | | |
| MS27466 | MIL-C-38999 | 418-66 | LJT00R | | | | | | | | |
| MS27467 | CLASS 'T' | 418-67 | LJT06R | | KJL6 | | | | | | |
| MS27468 | SERIES 1 | 418-68 | LJT07R | | KJL7 | | | | | | |
| MS27472 | | 418-72 | JT00R | CT00 | KJ0 | | | | | | |
| MS27473 | | 418-73 | JT06R | CT06 | KJ6 | | | | | | |
| MS27474 | MIL-C-38999 | 418-74 | JT07R | CT07 | KJ7 | | | | | | |
| MS27479 | CLASS 'T' | 418-79 | JTS00R | CT00 | | | | | | | |
| MS27480 | SERIES 2 | 418-80 | JJS06R | CT06 | KJ07 | | | | | | |
| MS27481 | | 418-81 | JTS07R | CT07 | KJG00 | | | | | | |
| MS27484 | | 418-84 | JTG06R | CTG06 | | | | | | | |
| D38999/20 | MIL-C-38999 | | TVP*00 | | | | | | | | |
| D38999/24 | SERIES 3 | | TV*07 | | | | | | | | |
| D38999/26 | CLASS C,F,K,W | | TV*06 | | | | | | | | |
| D38999/40 | | | | | | | | | | | BL00* |
| D38999/44 | MIL-C-38999 | | | | | | | | | | BL07* |
| D38999/46 | SERIES 4 | | | | | | | | | | BLG6* |
| D38999/47 | CLASS C,F,K,W | | | | | | | | | | BL06* |
| M81511/01 | | 348-20 | | | | 348-20 | | | | | |
| M81511/05 | 50% NO SCOOP | 348-21 | | | | 348-21 | | | | | |
| M81511/03 | SERIES 2 | 348-23 | | | | 348-23 | | | | | |
| M81511/06 | | 348-26 | | | | 348-26 | | | | | |
| M81511/21 | | 348-30 | | | | 348-30 | | | | | |
| M81511/23 | 100% NO SCOOP | 348-31 | | | | 348-31 | | | | | |
| M81511/25 | SERIES 1 | 348-33 | | | | 348-33 | | | | | |
| M81511/26 | | 348-36 | | | | 348-36 | | | | | |
| | MIL-C-81511 | | | | | | | | | | |
| M81511/41 | | | | | | | B815 10 | | | | |
| M81511/44 | 100% NO SCOOP | | | | | | B815 14 | | | | |
| M81511/45 | SERIES 3 | | | | | | B815 13 | | | | |
| M81511/46 | | | | | | | B815 16 | | | | |
| M81511/51 | | | | | | | A815 10 | | | | |
| M81511/54 | 50% NO SCOOP | | | | | | A815 14 | | | | |
| M81511/55 | SERIES 4 | | | | | | A815 13 | | | | |
| M81511/56 | | | | | | | A815 16 | | | | |
| MS17343 | | | 10-2560 | | CWLD00 | | | | | | |
| MS17344 | MIL-C-22992 | | 10-2566 | | CWLD01 | | | | | | |
| MS17345 | CLASS J,R | | 10-2561 | | CWLD06 | | | | | | |
| ~~MS17346~~ | | | ~~10-2562~~ | | ~~CWLD09~~ | | | | | | |
| MS3132 | | | | | | | DM9606 | | | | |
| MS3134 | MIL-C-26482 | | | | | | DM9601 | | | | |
| MS3137 | CLASS E,P | | | | | | DM9703 | | | | |
| MS3138 | | | | | | | 14946 | | | | |
| MS3140 | | | | | | | DD00 | | | | |
| MS3144 | MIL-C-26482 | | | | | | DD04 | | | | |
| MS3147 | CLASS E | | | | | | DD07 | | | | |
| MS3148 | | | | | | | 12942 | | | | |
| MS27497 | MIL-C-38999 | | JTP00RE | CPT0 | KJ3 | | | | | | |
| CLASS T | | | | | | | | | | | |
| MS3124 | MIL-C-26482 | | PT07SE | | | | | | | | |
| MS3114 | | | PT07A | | | | | | | | |
| MS24264 | MIL-C-26500 | | | | | | | | ZZW/L-R-17* | | |
| MS24265 | MIL-C-38300 | | | | | | | | ZZW/L-R-15* | | |
| MS24266 | CLASS E | | | | | | | | ZZW/L-R-10* | | |
| M83723/17&18 | MIL-C-83723 | | | | CV1* | | | | | M72301 | |
| M83723/19&20 | SERIES 2 | | | | CV0* | | | | | M72300 | |
| M83723/23&24 | | | | | CV6* | | | | | M72306 | |
| MS3400 | | 246-3400 | | | FRF1 | | | FC3400 | | | |
| MS3401 | MIL-C-005015 | 246-3401 | | | | | | | | | |
| MS3406 | REV E | 246-3406 | | | FRF6 | | | FC3406 | | | |

Table 3-3. MIL-C-5015 General Purpose Connector Substitutions

| MILITARY STANDARD | MILITARY STANDARD | BENDIX CORP. | ITT CANNON | OTHER ACCEPTABLE MILITARY STANDARDS | KSC | TYPE |
|---|---|---|---|---|---|---|
| MS3106R10SL | MS3456L10SL | MS3106R10SL | MS3106R10SL | MS3406L10SL | C75M13310 | CABLE PLUG |
| MS3106R12 | MS3456L12 | MS3106R12 | MS3106R12 | MS3406L12 | C75M13312 | CABLE PLUG |
| MS3106R12S | MS3456L12S | MS3106R12S | MS3106R12S | MS3406L12S | C75M13312 | CABLE PLUG |
| MS3106R14 | MS3456L14 | MS3106R14 | MS3106R14 | MS3406L14 | C75M13314 | CABLE PLUG |
| MS3106R14S | MS3456L14S | MS3106R14S | MS3106R14S | MS3406L14S | C75M13314 | CABLE PLUG |
| MS3106R16 | MS3456L16 | MS3106R16 | MS3106R16 | MS3406L16 | C75M13316 | CABLE PLUG |
| MS3106R16S | MS3456L16S | MS3106R16S | MS3106R16S | MS3406L16S | C75M13316 | CABLE PLUG |
| MS3106R18 | MS3456L18 | MS3106R18 | MS3106R18 | MS3406L18 | C75M13318 | CABLE PLUG |
| MS3106R20 | MS3456L20 | MS3106R20 | MS3106R20 | MS3406L20 | C75M13320 | CABLE PLUG |
| MS3106R22 | MS3456L22 | MS3106R22 | MS3106R22 | MS3406L22 | C75M13322 | CABLE PLUG |
| MS3106R24 | MS3456L24 | MS3106R24 | MS3106R24 | MS3406L24 | C75M13324 | CABLE PLUG |
| MS3106R28 | MS3456L28 | MS3106R28 | MS3106R28 | MS3406L28 | C75M13328 | CABLE PLUG |
| MS3106R32 | MS3456L32 | MS3106R32 | MS3106R32 | MS3406L32 | C75M13332 | CABLE PLUG |
| MS3106R36 | MS3456L36 | MS3106R36 | MS3106R36 | MS3406L36 | C75M13336 | CABLE PLUG |
| MS3106R40 | MS3456L40 | MS3106R40 | MS3106R40 | MS3406L40 | C75M13340 | CABLE PLUG |
| MS3100R10SL | MS3450L10SL | MS3100R10SL | MS3100R10SL | MS3400L10SL | C75M13410 | WALL MOUNT |
| MS3100R12 | MS3450L12 | MS3100R12 | MS3100R12 | MS3400L12 | C75M13412 | WALL MOUNT |
| MS3100R12S | MS3450L12S | MS3100R12S | MS3100R12S | MS3400L12S | C75M13412 | WALL MOUNT |
| MS3100R14 | MS3450L14 | MS3100R14 | MS3100R14 | MS3400L14 | C75M13414 | WALL MOUNT |
| MS3100R14S | MS3450L14S | MS3100R14S | MS3100R14S | MS3400L14S | C75M13414 | WALL MOUNT |
| MS3100R16 | MS3450L16 | MS3100R16 | MS3100R16 | MS3400L16 | C75M13416 | WALL MOUNT |
| MS3100R16S | MS3450L16S | MS3100R16S | MS3100R16S | MS3400L16S | C75M13416 | WALL MOUNT |
| MS3100R18 | MS3450L18 | MS3100R18 | MS3100R18 | MS3400L18 | C75M13418 | WALL MOUNT |
| MS3100R20 | MS3450L20 | MS3100R20 | MS3100R20 | MS3400L20 | C75M13420 | WALL MOUNT |
| MS3100R22 | MS3450L22 | MS3100R22 | MS3100R22 | MS3400L22 | C75M13422 | WALL MOUNT |
| MS3100R24 | MS3450L24 | MS3100R24 | MS3100R24 | MS3400L24 | C75M13424 | WALL MOUNT |
| MS3100R28 | MS3450L28 | MS3100R28 | MS3100R28 | MS3400L28 | C75M13428 | WALL MOUNT |
| MS3100R32 | MS3450L32 | MS3100R32 | MS3100R32 | MS3400L32 | C75M13432 | WALL MOUNT |
| MS3100R36 | MS3450L36 | MS3100R36 | MS3100R36 | MS3400L36 | C75M13436 | WALL MOUNT |
| MS3100R40 | MS3450L40 | MS3100R40 | MS3100R40 | MS3400L40 | C75M13440 | WALL MOUNT |
| | MS3454L10SL | 10-87311 | BFR10SL | MS3404L10SL | C75M13311 | JAM NUT |
| | MS3454L12 | 10-87312 | BFR12 | MS3404L12 | C75M13313 | JAM NUT |
| | MS3454L12S | 10-87313 | BFR12S | MS3404L12S | C75M13313 | JAM NUT |
| | MS3454L14 | 10-87314 | BFR14 | MS3404L14 | C75M13315 | JAM NUT |
| | MS3454L14S | 10-87315 | BFR14S | MS3404L14S | C75M13315 | JAM NUT |
| | MS3454L16 | 10-87316 | BFR16 | MS3404L16 | C75M13317 | JAM NUT |
| | MS3454L16S | 10-87317 | BFR16S | MS3404L16S | C75M13317 | JAM NUT |
| | MS3454L18 | 10-87318 | BFR18 | MS3404L18 | C75M13319 | JAM NUT |
| | MS3454L20 | 10-87320 | BFR20 | MS3404LL20 | C75M13321 | JAM NUT |
| | MS3454L22 | 10-87322 | BFR22 | MS3404L22 | C75M13323 | JAM NUT |
| | MS3454L24 | 10-87324 | BFR24 | MS3404L24 | C75M13325 | JAM NUT |
| | MS3454L28 | 10-87328 | BFR28 | MS3404L28 | C75M13329 | JAM NUT |
| | MS3454L32 | 10-87332 | BFR32 | MS3404L32 | C75M13333 | JAM NUT |
| | MS3454L36 | 10-87336 | BFR36 | MS3404L36 | C75M13337 | JAM NUT |
| | MS3454L40 | 10-87340 | BFR40 | MS3404L40 | C75M13341 | JAM NUT |
| | | TBF10SL | TBF10SL | | C75M13351 | THRU BHD |
| | | TBF12 | TBF12 | | C75M13353 | THRU BHD |
| | | TBF12S | TBF12S | | C75M13353 | THRU BHD |
| | | TBF14 | TBF14 | | C75M13355 | THRU BHD |

Table 3-3. (Cont.) MIL-C-5015 General Purpose Connector Substitutions

| MILITARY STANDARD | MILITARY STANDARD | BENDIX CORP. | ITT CANNON | OTHER ACCEPTABLE MILITARY STANDARDS | KSC | TYPE |
|---|---|---|---|---|---|---|
| | | TBF14S | TBF14S | | C75M13355 | THRU BHD |
| | | TBF16 | TBF16 | | C75M13357 | THRU BHD |
| | | TBF16S | TBF16S | | C75M13357 | THRU BHD |
| | | TBF18 | TBF18 | | C75M13359 | THRU BHD |
| | | TBF20 | TBF20 | | C75M13361 | THRU BHD |
| | | TBF22 | TBF22 | | C75M13363 | THRU BHD |
| | | TBF24 | TBF24 | | C75M13365 | THRU BHD |
| | | TBF28 | TBF28 | | C75M13369 | THRU BHD |
| | | TBF32 | TBF32 | | C75M13373 | THRU BHD |
| | | TBF36 | TBF36 | | C75M13377 | THRU BHD |
| | | TBF40 | TBF40 | | C75M13381 | THRU BHD |
| | | TBFR10SL | | | C75M13350 | THRU BHD |
| | | TBFR12 | | | C75M13362 | THRU BHD |
| | | TBFR12S | | | C75M13352 | THRU BHD |
| | | TBFR14 | | | C75M13354 | THRU BHD |
| | | TBFR14S | | | C75M13354 | THRU BHD |
| | | TBFR16 | | | C75M13356 | THRU BHD |
| | | TBFR16S | | | C75M13356 | THRU BHD |
| | | TBFR18 | | | C75M13358 | THRU BHD |
| | | TBFR20 | | | C75M13360 | THRU BHD |
| | | TBFR22 | | | C75M13362 | THRU BHD |
| | | TBFR24 | | | C75M13364 | THRU BHD |
| | | TBFR28 | | | C75M13368 | THRU BHD |
| | | TBFR32 | | | C75M13372 | THRU BHD |
| | | TBFR36 | | | C75M13376 | THRU BHD |
| | | TBFR40 | | | C75M13380 | THRU BHD |
| MS3101R10SL | MS3451L10SL | | | MS3401L10SL | | CA RCPT |
| MS3101R12 | MS3451L12 | | | MS3401L12 | | CA RCPT |
| MS3101R12S | MS3451L12S | | | MS3401L12S | | CA RCPT |
| MS3101R14 | MS3451L14 | | | MS3401L14 | | CA RCPT |
| MS3101R14S | MS3451L14S | | | MS3401L14S | | CA RCPT |
| MS3101R16 | MS3451L16 | | | MS3401L16 | | CA RCPT |
| MS3101R16S | MS3451L16S | | | MS3401L16S | | CA RCPT |
| MS3101R18 | MS3451L18 | | | MS3401L18 | | CA RCPT |
| MS3101R20 | MS3451L20 | | | MS3401L20 | | CA RCPT |
| MS3101R22 | MS3451L22 | | | MS3401L22 | | CA RCPT |
| MS3101R24 | MS3451L24 | | | MS3401L24 | | CA RCPT |
| MS3101R28 | MS3451L28 | | | MS3401L28 | | CA RCPT |
| MS3101R32 | MS3451L32 | | | MS3401L32 | | CA RCPT |
| MS3101R36 | MS3451L36 | | | MS3401L36 | | CA RCPT |
| MS3101R40 | MS3451L40 | | | MS3401L40 | | CA RCPT |
| MS3102R10SL | MS3452L10SL | | | MS3402L10SL | | BOX MOUNT |
| MS3102R12 | MS3452L12 | | | MS3402L12 | | BOX MOUNT |
| MS3102R12S | MS3452L12S | | | MS3402L12S | | BOX MOUNT |
| MS3102R14 | MS3452L14 | | | MS3402L14 | | BOX MOUNT |
| MS3102R14S | MS3452L14S | | | MS3402L14S | | BOX MOUNT |
| MS3102R16 | MS3452L16 | | | MS3402L16 | | BOX MOUNT |
| MS3102R16S | MS3452L16S | | | MS3402L16S | | BOX MOUNT |
| MS3102R18 | MS3452L18 | | | MS3402L18 | | BOX MOUNT |

Table 3-3. (Cont.) MIL-C-5015 General Purpose Connector Substitutions

| MILITARY STANDARD | MILITARY STANDARD | BENDIX CORP. | ITT CANNON | OTHER ACCEPTABLE MILITARY STANDARDS | KSC | TYPE |
|---|---|---|---|---|---|---|
| MS3102R120 | MS3452L20 | | | MS3402L20 | | BOX MOUNT |
| MS3102R22 | MS3452L22 | | | MS3402L22 | | BOX MOUNT |
| MS3102R24 | MS3452L24 | | | MS3402L24 | | BOX MOUNT |
| MS3102R28 | MS3452L28 | | | MS3402L28 | | BOX MOUNT |
| MS3102R32 | MS3452L32 | | | MS3402L32 | | BOX MOUNT |
| MS3102R26 | MS3452L36 | | | MS3402L36 | | BOX MOUNT |
| MS3102R40 | MS3452R40 | | | MS3402L40 | | BOX MOUNT |

NOTES:

1. MS310X Series "E" may be used but "R" Series is preferred. Do not use MS310X Series with letter suffixes other than "R" or "E".

2. Do not specify alternate insert arrangement (offset key way) unless Space Shuttle interface connectors dictate.

3. Specify MS345X Series for use where field termination is necessary and prevents soldering, potting and molding the field.

Table 3-4. MIL-C-26482 Miniature Quick Disconnect Connector Substitutions

| MILITARY STANDARD | MILITARY STANDARD | MILITARY STANDARD | BENDIX CORP. | ITT CANNON | BURNDY CORP. | KSC | TYPE |
|---|---|---|---|---|---|---|---|
| MS3476L08 | MS3116*08 | | PT06P08 | KPTO6P08 | BTO6P8 | C75M13708 | CABLE PLUG |
| MS3476L10 | MS3116*10 | MS3126*10 | PT06P10 | KPTO6P10 | BTO6P10 | C75M13710 | CABLE PLUG |
| MS3476L12 | MS3116*12 | MS3426*12 | PT06P12 | KPTO6R12 | BTO6P12 | C75M13712 | CABLE PLUG |
| MS3476L14 | MS3116*14 | MS3126*14 | PT06P14 | KPT06P14 | BTO6P14 | C75M13714 | CABLE PLUG |
| MS3476L16 | MS3476*16 | MS3126*16 | PT06P16 | KPTO6P16 | BTO6P16 | C75M13716 | CABLE PLUG |
| MS3476L18 | MS3476*18 | MS3126*18 | PT06P18 | KPTO6P18 | BTO6P18 | C75M13718 | CABLE PLUG |
| MS3476L20 | MS3476*20 | MS3126*20 | PT06P20 | KPTO6R20 | BTO6P20 | C75M13720 | CABLE PLUG |
| MS3476L22 | MS3476*22 | MS3136*22 | PT06P22 | KPT06P22 | | C75M13722 | CABLE PLUG |
| MS3476L24 | MS3116*24 | MS3126*24 | PT06P24 | KPTO6P24 | BTO6P24 | C75M13724 | CABLE PLUG |
| MS3476L08 | MS3114*08 | | PT07P08 | KPTO7P08 | BTO7P8 | C75M13709 | JAM NUT |
| MS3476L10 | MS3114*10 | MS3124*10 | PT07P10 | KPTO7P10 | BTO7P10 | C75M13711 | JAM NUT |
| MS3476L12 | MS3114*12 | MS3124*12 | PT07P12 | KPT07P12 | BTO7P12 | C75M13713 | JAM NUT |
| MS3476L14 | MS3114*14 | MS3124*14 | PT07P14 | KPTO7P14 | BTO7P14 | C75M13715 | JAM NUT |
| MS3476L16 | MS3114*16 | MS3124*16 | PT07P16 | KPTO7P16 | BTO7P16 | C75M13717 | JAM NUT |
| MS3476L18 | MS3114*18 | MS3124*18 | PT07P18 | KPTO7P18 | BTO7P18 | C75M13719 | JAM NUT |
| MS3476L20 | MS3114*20 | MS3124*20 | PT07P20 | KPT07P20 | BTO7P20 | C75M13721 | JAM NUT |
| MS3474L22 | MS3114*22 | MS3124*22 | PTO7P22 | KPTO7P22 | | C75M13723 | JAM NUT |
| MS3474L24 | MS3114*24 | MS3124*24 | PTO7P24 | KPTO7P24 | BTO724 | C75M13725 | JAM NUT |
| | | | PTBJ08 | KPTBJ08 | | C75M13728 | THRU BHD |
| | | | PTBJ10 | KPTBJ10 | | C75M13730 | JAM NUT |
| | | | PTBJ12 | KPTBJ12 | | C75M13732 | THRU BHD |
| | | | PTBJ14 | KPTBJ14 | | C75M13734 | JAM NUT |
| | | | PTBJ16 | KPTBJ16 | | C75M13736 | JAM NUT |
| | | | PTBJ18 | KPTBJ18 | | C75M13738 | JAM NUT |
| | | | PTBJ20 | KPTBJ20 | | C75M13740 | JAM NUT |
| | | | PTBJ22 | KPTBJ22 | | C75M13742 | JAM NUT |
| | | | PTBJ24 | KPTBJ24 | | C75M13744 | THRU BHD |
| | | | PTB08 | KPTB08 | | C75M13729 | THRU BHD |

* Class may be any letter (E, P, ETC.)

Table 3-4. (Cont.) MIL-C-26482 Miniature Quick Disconnect Connector Substitutions

| MILITARY STANDARD | MILITARY STANDARD | MILITARY STANDARD | BENDIX CORP. | ITT CANNON | BURNDY CORP. | KSC | TYPE |
|---|---|---|---|---|---|---|---|
| | | | PTB10 | KPTB10 | | C75M13731 | THRU BHD |
| | | | PTB12 | KPTB12 | | C75M13733 | THRU BHD |
| | | | PTB14 | KPTB14 | | C75M13735 | THRU BHD |
| | | | PTB16 | KPTB16 | | C75M13737 | THRU BHD |
| | | | PTB18 | KPTB18 | | C75M13739 | THRU BHD |
| | | | PTB20 | KPTB20 | | C75M13741 | THRU BHD |
| | | | PTB22 | KPTB22 | | C75M13743 | THRU BHD |
| | | | PTB24 | KPTB24 | | C75M13745 | THRU BHD |
| MS3470L08 | MS3110*08 | | | KPT00*08 | BT00*08 | | WALL MOUNT |
| MS3470L10 | MS3110*10 | MS3120*10 | PT00*10 | KPT00*10 | BT00*10 | | WALL MOUNT |
| MS3470L12 | MS3110*12 | MS3120*12 | PT00*12 | KPT00*12 | BT00*12 | | WALL MOUNT |
| MS3470L14 | MS3110*14 | MS3120*14 | PT00*14 | KPT00*14 | BT00*14 | | WALL MOUNT |
| MS3470L16 | MS3110*16 | MS3120*16 | PT00*16 | KPT00*16 | BT00*16 | | WALL MOUNT |
| MS3470L18 | MS3110*18 | MS3120*18 | PT00*18 | KPT00*18 | BT00*18 | | WALL MOUNT |
| MS3470L20 | MS3110*20 | MS3120*20 | PT00*20 | KPT00*20 | BT00*20 | | WALL MOUNT |
| MS3470L22 | MS3110*22 | MS3120*22 | PT00*22 | KPT00*22 | BT00*22 | | WALL MOUNT |
| MS3470L24 | MS3110*24 | MS3120*24 | PT00*24 | KPT00*24 | BT00*24 | | WALL MOUNT |

* Class may be any letter (E, P, ETC.)

Table 3-5. MIL-C-22992 Heavy Duty Connector Substitutions

| BENDIX HK SERIES* | BENDIX HK SERIES** | BENDIX CORP. | ITT CANNON | KSC | TYPE |
|---|---|---|---|---|---|
| HK06L12 | HK06P12 | 10-323612 | CWLD06R12 | C75M14312 | CABLE PLUG |
| | | 10-323613 | CWLD06R12S | C75M14312 | CABLE PLUG |
| HK06L14 | HK06P14 | 10-323614 | CWLD06R14 | C75M14314 | CABLE PLUG |
| | | 10-323615 | CWLD06R14S | C75M14314 | CABLE PLUG |
| HK06L16 | HK06P16 | 10-323616 | CWLD06R12 | C75M14316 | CABLE PLUG |
| | | 10-323617 | CWLD06R16S | C75M14316 | CABLE PLUG |
| HK06L18 | HK06P18 | 10-323618 | CWLD06R18 | C75M14318 | CABLE PLUG |
| HK06L20 | HK06P20 | 10-323620 | CWLD06R20 | C75M14320 | CABLE PLUG |
| HK06L22 | HK06P22 | 10-323622 | CWLD06R22 | C75M14322 | CABLE PLUG |
| KH06L24 | KH06P24 | 10-323624 | CWLD06R24 | C75M14324 | CABLE PLUG |
| HK06L28 | HK06P28 | 10-323628 | CWLD06R28 | C75M14328 | CABLE PLUG |
| HK06L32 | HK06P32 | 10-323632 | CWLD06R32 | C75M14332 | CABLE PLUG |
| HK06L36 | HK06P36 | 10-323636 | CWLD06R36 | C75M14336 | CABLE PLUG |
| KH06L40 | KH06P40 | 10-323640 | CWLD06R40 | C75M14340 | CABLE PLUG |
| HK06L12 | HK00P12 | 10-323012 | CWLD00R12 | C75M14372 | WALL MOUNT |
| | | 10-323013 | CWLD00R12S | C75M14372 | WALL MOUNT |
| HK00L14 | HK00P14 | 10-323014 | CWLD00R14 | C75M14374 | WALL MOUNT |
| | | 10-323015 | CWLD00R14S | C75M14374 | WALL MOUNT |
| HK00L16 | HK00P16 | 10-323016 | CWLD00R16 | C75M14376 | WALL MOUNT |
| | | 10-323017 | CWLD00R16S | C75M14376 | WALL MOUNT |
| HK00L18 | HK00P18 | 10-323018 | CWLD00R18 | C75M14378 | WALL MOUNT |
| HK00L20 | HK00P20 | 10-323020 | CWLD00R20 | C75M14380 | WALL MOUNT |
| HK00L22 | HK00P22 | 10-323022 | CWLD00R22 | C75M14382 | WALL MOUNT |
| HK00L24 | HK00P24 | 10-323024 | CWLD00R24 | C75M14384 | WALL MOUNT |
| HK00L28 | HK00P28 | 10-323028 | CWLD00R28 | C75M14388 | WALL MOUNT |
| HK00L32 | HK00P32 | 10-323032 | CWLD00R32 | C75M14392 | WALL MOUNT |
| HK00L36 | HK00P36 | 10-323036 | CWLD00R36 | C75M14396 | WALL MOUNT |
| HK00L40 | HK00P40 | 10-323040 | CWLD00R40 | C75M14400 | WALL MOUNT |
| | HK09P12 | 10-323912 | CWLD07R12 | C75M14313 | JAM NUT |
| | | 10-323913 | CWLD07R12S | C75M14313 | JAM NUT |
| | HK09P14 | 10-323914 | CWLD07R14 | C75M14315 | JAM NUT |
| | | 10-323915 | CWLD07R14S | C75M14315 | JAM NUT |
| | HK09P16 | 10-323916 | CWLD07R16 | C75M14317 | JAM NUT |
| | | 10-323917 | CWLD07R16S | C75M14317 | JAM NUT |
| | HK09P18 | 10-323918 | CWLD07R18 | C75M14319 | JAM NUT |
| | HK09P20 | 10-323920 | CWLD07R20 | C75M14321 | JAM NUT |
| | HK09P22 | 10-323922 | CWLD07R22 | C75M14323 | JAM NUT |
| | HK09P24 | 10-323924 | CWLD07R24 | C75M14325 | JAM NUT |
| | HK09P28 | 10-323928 | CWLD07R28 | C75M14329 | JAM NUT |
| | HK09P32 | 10-323932 | CWLD07R32 | C75M14333 | JAM NUT |
| | HK09P36 | 10-323936 | CWLD07R36 | C75M14337 | JAM NUT |
| | HK09P40 | 10-323940 | CWLD07R40 | C75M14341 | JAM NUT |
| | | 10-248442 | | C75M14342 | THRU BHD JAM NUT |
| | | 10-248444 | | C75M14344 | THRU BHD JAM NUT |

Table 3-5. (Cont.) MIL-C-22992 Heavy Duty Connector Substitutions

| BENDIX HK SERIES* | BENDIX HK SERIES** | BENDIX CORP. | ITT CANNON | KSC | TYPE |
|---|---|---|---|---|---|
| | | 10-248446 | | C75M14346 | THRU BHD JAM NUT |
| | | 10-248447 | | C75M14348 | THRU BHD JAM NUT |
| | | 10-248448 | | C75M14350 | THRU BHD JAM NUT |
| | | 10-248449 | | C75M14352 | THRU BHD JAM NUT |
| | | 10-248450 | | C75M14354 | THRU BHD JAM NUT |
| | | 10-248451 | | C75M14358 | THRU BHD JAM NUT |
| | | 10-248452 | | C75M14362 | THRU BHD JAM NUT |
| | | 10-248453 | | C75M14366 | THRU BHD JAM NUT |
| | | 10-248454 | | C75M14370 | THRU BHD JAM NUT |
| | HKTBF12 | 10-194412 | | C75M14343 | THRU BHD JAM NUT |
| | | 10-194413 | | C75M14343 | THRU BHD |
| | HKTBF14 | 10-194414 | | C75M14345 | THRU BHD |
| | | 10-194415 | | C75M14345 | THRU BHD |
| | HKTBF16 | 10-194416 | | C75M14347 | THRU BHD |
| | | 10-194417 | | C75M14347 | THRU BHD |
| | HKTBF18 | 10-194418 | | C75M14349 | THRU BHD |
| | HKTBF20 | 10-194420 | | C75M14351 | THRU BHD |
| | HKTBF22 | 10-194422 | | C75M14353 | THRU BHD |
| | HKTBF24 | 10-194424 | | C75M14355 | THRU BHD |
| | HKTBF28 | 10-194428 | | C75M14359 | THRU BHD |
| | HKTBF32 | 10-194432 | | C75M14363 | THRU BHD |
| | HKTBF36 | 10-194436 | | C75M14367 | THRU BHD |
| | HKTBF40 | 10-194440 | | C75M14371 | THRU BHD |

NOTES:

* With molding adapter.

** Suffix (014) to HK0XL connectors provides cadmium-over-nickel finish.

Suffix (403) provides cadmium-over-nickel without gross shield adaptor (call out adaptors separately).

Suffix (443) provides cadimum-over-nickel finish with gross shield adaptors.

## 3.7 MIL-C-5015 CONNECTORS, ELECTRICAL, CIRCULAR, THREADED, GENERAL SPECIFICATION FOR

These connectors are recommended for indoor or outdoor use principally for interconnecting from component distributor to components.

Shell sizes 10SL, 14S, and 16S are the most common; however, if interfacing equipment beyond the design control of KSC dictates, other shell sizes may be used.

Intermateability of like insert arrangements is as follows: (insert arrangement is an example).

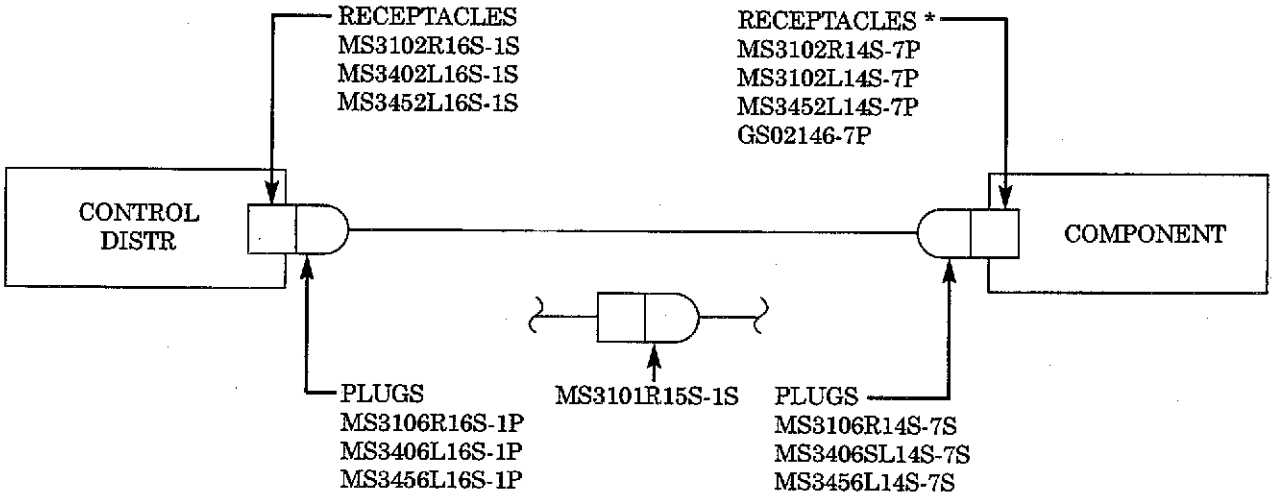



Figure 3-3. Intermateability of Like Insert Arrangements

NOTE:

*The connector supplied with the component is usually interchangeable with the component manufacturer as long as it will mate with the plugs shown.

MS3100R, MS3400L, or MS3450L receptacles may be substituted for the above receptacles, especially if they require backshells for molding or potting boots as in bulkhead plate mounting. They may also be substituted for MS3101, etc., types for inline cable receptacles.

Jam nut receptacles may be used if the distributor is designed for them.

All plugs mate with all receptacles with the same insert arrangements and opposite gender.

| | | |
|---|---|---|
| MS3106, MS3108<br>MS3406, MS3408<br>MS3456 | Mate with | MS3100, MS3101, MS3102,<br>BFR MS3400, MS3401, MS3402<br>MS3404, MS3450, MS3451<br>MS3452, MS3454, GS02 |

Standardization of connector use is very cost effective from the standpoint of logistics and in quantity procurement. Always specify the MS310xR series for component application and select from the insert arrangements shown in Table 3-7 unless otherwise dictated by interfaces beyond the control of KSC.

For applicable molding adapters or backshells and protection caps or dust covers, refer to Section IV, Accessories.

NOTE:

Back threads on certain shell size MS3100 series are different than back threads on MS3400 and MS3450 series connectors of the same shell size.

### 3.7.1 MIL-C-5015 GENERAL PURPOSE CONNECTOR

| Part No. Breakdown | MS3106 | R | - | 10SL | - | 2 | P | W |
|---|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

NOTE:

When writing part number, omit spaces between letters and numbers.

| Code 1. Basic Part No. | Type |
|---|---|
| *MS3100 | Receptacle, wall mount, solder contact |
| MS3400 | Receptacle, wall mount, crimp contact, front release |
| MS3412 | Receptacle, wall mount, crimp contact, front release, accessory thread |
| MS3450 | Receptacle, wall mount, crimp contact, rear release |
| *MS3101 | Receptacle, cable connect, solder contact |
| MS3401 | Receptacle, cable connect, crimp contact, front release |
| MS3451 | Receptacle, cable connect, crimp contact, rear release |
| *MS3102 | Receptacle, box mount, solder contact |
| MS3142 | Receptacle, box mount, solder contact, hermetic |
| MS3402 | Receptacle, box mount, crimp contact, front release |
| MS3452 | Receptacle, box mount, crimp contact, rear release |
| MS3103 | Receptacle, potting seal, solder contact |
| MS3143 | Receptacle, solder mount, solder contact, hermetic |
| MS3404 | Receptacle, jam nut mount, crimp contact, front release |
| MS3454 | Receptacle, jam nut mount, crimp contact, rear release |
| MS33678 | Receptacle, integral mount |
| MS33679 | Receptacle, integral mount |
| *MS3106 | Plug, straight cable, solder contact |
| MS3406 | Plug, straight cable, crimp contact, front release |
| *MS3456 | Plug, straight cable, crimp contact, rear release (For Field Term) |
| MS3107 | Plug, quick disconnect |
| MS3507 | Plug, quick disconnect, solder contact, utility |
| MS3108 | Plug, 90° backshell, solder contact |
| MS3408 | Plug, 90° cable, crimp contact, front release |
| MS3409 | Plug, 45° cable, crimp contact, front release |
| MS3436 | Plug, utility, solder contact |
| MS3441 | Plug, utility |
| MS3459 | Plug, self locking coupling nut, crimp contact, rear release |
| MS25183 | Plug, potting seal, solder contact |

*Preferred

Code 2. Table 3-6. MIL-C-5015 Connector Class

| CLASS | MS3100 SERIES | MS3400 SERIES | MS3450 SERIES |
|---|---|---|---|
| A - Solid Shell (not rec. for new design) | | | |
| B - Split Shell (not used at KSC) | | | |
| C - Pressurized (inactive) | | | |
| D - High Impact Shock | | a | |
| E - Environmental (inactive) | a | | |
| F - With Clamp | a | | |
| H - Hermetic | a | | |
| J - Gland Seal for Jacketed Cable | | | |
| K - Firewall | | a | a |
| L - Fluid Resistant | | a | * |
| P - Potting Seal | a | | |
| R - Grommet Seal without Clamp | * | | |
| U - Inactive | | | |
| W - General Purpose | | a | a |
| DJ - High Impact Shock with Backshell | | a | |

* = preferred a = allowable, depending on the application

Code 3. MATERIAL DESIGNATOR.
S - Stainless Steel
T - Ferrous Alloy, Cadmium Plate
*No Letter - Aluminum Alloy

Code 4. SHELL SIZE. Shell size denotes mating thread diameter in 1.588 of a mm (16ths of an inch). Shell sizes run from 8 (12.7 mm [1/2"]) to 24 (38.1 mm [1 1/2"]) in consecutive even numbers and 28, 32, and 40.

Code 5. TERMINATION.
* (-) Normal. For (H) class terminations use: C - Solder Cup or Y - Eyelet

Code 6. INSERT ARRANGEMENT. This number in conjunction with the shell size denotes the insert arrangement (number and size of contacts and their pattern). This number is not necessarily the number of contacts. See Table 3-7.

Code 7. CONTACT DESIGNATOR.
P - Pin
S - Socket
C - Feedthru Contacts (inactive)

Code 8. INSERT POSITION. Insert position relative to the polarization key in the shell. No letter designates normal key position. W, X, Y, and Z designate alternate insert positions. ONLY normal position should be specified unless interface dictates otherwise. Refer to vendor's catalog for clocking availability

NOTE:

Some connectors have a C suffix after S; e.g., MS3106R10SL-2SC. This was used to signify closed entry socket contacts and is no longer significant.

### 3.7.2 TYPICAL APPLICATION DIAGRAM OF BODY STYLES

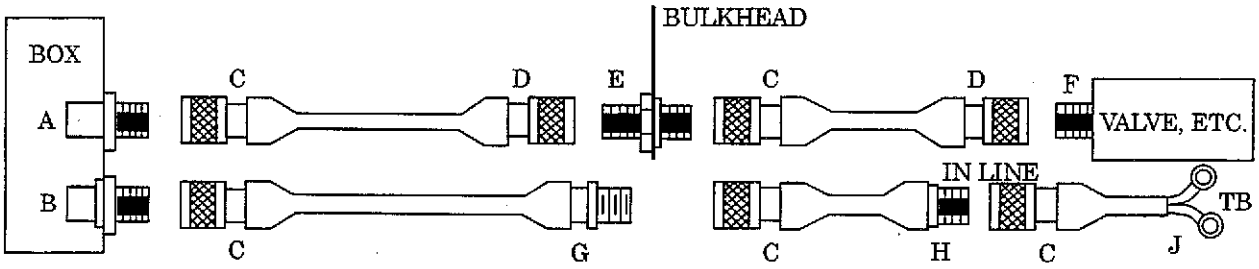



Figure 3-4. Typical Application Diagram of Body Styles

A. MS3102Rxx-xS. Used as box mounted receptacles (may be S or P Contacts).

B. RFTxx-xS (Cannon) or 10-873-xS (Bendix) should be used where harness assemblies with terminal boards are prefabricated. This jam nut connector will install from the inside of the box. The cutout is different from "A".

C. MS3106Rxx-xP. Used to terminate cables connecting to all receptacles.

D. MS3106Rxx-xS. Same as "C" except socket inserts.

E. TBF-xx-xPS. Used on bulkheads for connecting plugs to both sides.

F. This connector is normally installed by the component manufacturer and is usually specified as a connector that "MATES" with a specific MS3106R connector.

G. MS3100Rxx-xS for bulkhead panels 3.175 mm (0.125") or less thick. BFR-xx-xS (Cannon) or 10-874xx-xS (Bendix) for bulkhead panels up to 6.350 mm (0.250") or less thick.

H. MS3101Rxx-xS. Used to terminate cables connecting to cable plugs.

J. Pigtail leads with MS25036-xxx lugs for connecting to a screw type terminal board.

NOTE:

See Code 2 Class in Table 3-6 for acceptable substitutes.

## 3.7.3 MIL-C-5015 INSERT ARRANGEMENTS

Table 3-7. Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8S-1 | 1 | 16 | | 3 | 12 | *-29 | 17 | 16 | -6 | 8 | 12 |
| 10S-2 | 1 | 16 | -14 | 1 | 4 | -30 | 13 | 16 | -7 | 2 | 12 |
| *10SL-3 | 3 | 16 | | 1 | 16 | -33 | 11 | 16 | | 14 | 16 |
| *10SL-4 | 2 | 16 | -15 | 4 | 12 | 22-1 | 2 | 8 | -9 | 2 | 4 |
| 12S-3 | 2 | 16 | -16 | 1 | 12 | *-2 | 3 | 8 | -10 | 7 | 8 |
| -4 | 1 | 16 | -17 | 2 | 12 | -4 | 2 | 8 | -11 | 3 | 8 |
| 12-5 | 1 | 12 | | 5 | 16 | | 2 | 12 | | 6 | 12 |
| *14S-2 | 4 | 16 | -19 | 10 | 16 | -5 | 2 | 12 | -12 | 2 | 4 |
| -4 | 1 | 16 | -20 | 5 | 16 | | 4 | 16 | | 3 | 12 |
| *-5 | 5 | 16 | -22 | 3 | 16 | -6 | 2 | 8 | -16 | 1 | 8 |
| *-6 | 6 | 16 | -24 | 10 | 16 | | 1 | 16 | | 3 | 12 |
| *-7 | 3 | 16 | -29 | 5 | 16 | -7 | 1 | 0 | | 3 | 16 |
| -9 | 2 | 16 | -30 | 5 | 16 | -8 | 2 | 12 | -17 | 2 | 12 |
| -10 | 4 | 16 | -31 | 5 | 16 | -9 | 3 | 12 | | 3 | 16 |
| -12 | 3 | 16 | 20-3 | 3 | 12 | -10 | 4 | 16 | -20 | 2 | 12 |
| 14-3 | 1 | 8 | *-4 | 4 | 12 | -11 | 2 | 16 | | 9 | 16 |
| *16S-1 | 7 | 16 | -6 | 3 | 16 | -12 | 2 | 8 | -21 | 1 | 8 |
| -3 | 1 | 16 | -7 | 8 | 16 | | 3 | 16 | | 9 | 16 |
| -4 | 2 | 16 | -8 | 2 | 8 | -13 | 4 | 12 | -22 | 4 | 8 |
| -5 | 3 | 16 | | 4 | 16 | | 1 | 16 | -27 | 7 | 16 |
| -6 | 3 | 16 | -9 | 1 | 12 | *-14 | 19 | 16 | -28 | 24 | 16 |
| -8 | 5 | 16 | | 7 | 16 | -15 | 5 | 12 | 26-1 | 3 | 8 |
| 16-2 | 1 | 12 | -11 | 13 | 16 | | 1 | 16 | | 6 | 12 |
| -7 | 1 | 8 | -12 | 1 | 4 | -16 | 3 | 12 | -2 | 2 | 12 |
| | 2 | 16 | | 1 | 16 | | 6 | 16 | | 12 | 16 |
| -9 | 2 | 12 | -14 | 2 | 8 | -17 | 1 | 12 | -3 | 3 | 8 |
| | 2 | 16 | | 3 | 12 | | 8 | 16 | -4 | 2 | 12 |
| -10 | 3 | 12 | -15 | 7 | 12 | -18 | 8 | 16 | | 7 | 16 |
| -11 | 2 | 12 | -16 | 2 | 12 | 22-19 | 14 | 16 | -5 | 2 | 4 |
| -12 | 1 | 4 | | 7 | 16 | -20 | 9 | 16 | | 1 | 12 |
| -13 | 2 | 12 | -17 | 5 | 12 | -21 | 1 | 0 | | 2 | 16 |
| *18-1 | 10 | 16 | | 1 | 16 | | 2 | 16 | -6 | 3 | 4 |
| -3 | 2 | 12 | -18 | 3 | 12 | *-22 | 4 | 8 | -7 | 2 | 4 |
| -4 | 4 | 16 | | 6 | 16 | -23 | 8 | 12 | -8 | 2 | 12 |
| -5 | 2 | 12 | -19 | 3 | 8 | -24 | 2 | 12 | | 10 | 16 |
| | 1 | 16 | -20 | 1 | 4 | | 4 | 16 | -9 | 6 | 12 |
| -6 | 1 | 4 | | 3 | 12 | -27 | 1 | 8 | | 6 | 16 |
| -7 | 1 | 8 | -21 | 1 | 12 | | 8 | 16 | -10 | 2 | 4 |
| -8 | 1 | 12 | | 8 | 16 | -28 | 7 | 12 | | 2 | 8 |
| | 7 | 16 | -22 | 3 | 8 | -33 | 7 | 16 | | 3 | 12 |
| -9 | 2 | 12 | | 3 | 16 | -34 | 3 | 12 | -11 | 4 | 12 |
| | 5 | 16 | -23 | 2 | 8 | | 2 | 16 | | 18 | 16 |
| *-10 | 4 | 12 | -24 | 2 | 8 | 24-2 | 7 | 12 | 28-12 | 26 | 16 |
| -11 | 5 | 12 | | 2 | 16 | -3 | 2 | 12 | -13 | 26 | 16 |
| -12 | 6 | 16 | -25 | 13 | 16 | | 5 | 16 | -15 | 35 | 16 |
| -13 | 1 | 8 | -27 | 14 | 16 | -5 | 16 | 16 | *-16 | 20 | 16 |

Table 3-7. (Cont.) Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -17 | 15 | 16 | | 2 | 12 | 36-1 | 4 | 12 | | 5 | 12 |
| -18 | 12 | 16 | | 16 | 16 | | 18 | 16 | | 6 | 16 |
| -19 | 4 | 12 | -7 | 7 | 12 | -3 | 3 | 0 | -15 | 35 | 16 |
| | 6 | 16 | | 23 | 16 | | 3 | 12 | -16 | 7 | 12 |
| -20 | 10 | 12 | -8 | 6 | 12 | -4 | 3 | 0 | | 40 | 16 |
| | 4 | 16 | | 24 | 16 | * -5 | 4 | 0 | -17 | 7 | 12 |
| -21 | 37 | 16 | -9 | 2 | 4 | -6 | 2 | 0 | | 40 | 16 |
| -22 | 3 | 4 | | 12 | 16 | | 4 | 4 | -18 | 1 | 4 |
| | 3 | 16 | -10 | 2 | 4 | -7 | 7 | 12 | | 2 | 8 |
| 32-1 | 2 | 0 | | 2 | 8 | | 40 | 16 | | 14 | 12 |
| | 3 | 12 | | 3 | 16 | -8 | 1 | 12 | | 14 | 16 |
| -2 | 3 | 4 | -12 | 5 | 12 | | 46 | 16 | -20 | 2 | 8 |
| | 2 | 16 | | 10 | 16 | 36-9 | 1 | 4 | | 2 | 12 |
| -3 | 1 | 0 | -13 | 5 | 12 | | 2 | 8 | | 30 | 16 |
| | 2 | 4 | | 18 | 16 | | 14 | 12 | 40-1 | 6 | 12 |
| | 2 | 12 | -15 | 2 | 0 | | 14 | 16 | | 24 | 16 |
| | 4 | 16 | | 6 | 12 | -10 | 48 | 16 | -9 | 1 | 8 |
| -4 | 2 | 12 | -16 | 2 | 4 | -11 | 48 | 16 | | 22 | 12 |
| | 12 | 16 | | 3 | 8 | -12 | 48 | 16 | | 24 | 16 |
| -5 | 2 | 0 | | 2 | 12 | -13 | 2 | 12 | | | |
| -6 | 2 | 4 | | 16 | 16 | | 15 | 16 | | | |
| | 3 | 8 | *-17 | 4 | 4 | -14 | 5 | 8 | | | |

*Preferred Arrangements

### 3.7.4 THERMOCOUPLE CONNECTORS SIMILAR TO MIL-C-5015

Table 3-8. Thermocouple Connectors Similar to MIL-C-5015

| INSERT ARRANGE | CONTACTS #16 | | | | | ROT. | |
|---|---|---|---|---|---|---|---|
| | Al | Ch | Con | Cu | Ir | | |
| 10SL-51 | | | B | | A | 45° | Since thermocouple connectors are not specifically listed in the MIL-C-5015 spec., the MS number cannot be specified. Since the connector meets all specs of 5015 except the contacts, the MS letters are reversed; e.g., SM3106R10SL-55P. The larger connectors are used to connect multi thermocouples and some have copper contacts for multi use. This practice is impractical on KSC GSE because of the small usage requirement of special cable. |
| -52 | | | B | A | | 45° | |
| -53 | A | B | | | | 45° | |
| -54 | | | B | C | A | N | |
| *-55 | A | B | | C | | N | |
| *-56 | A | B | | | | N | |
| *-57 | | A | B | | | N | |
| -58 | B | A | | C | | N | |
| -59 | B | A | | | | N | |
| *-60 | | | B | | A | N | |
| *-61 | | | B | A | | N | |
| -62 | B | | | A | C | N | |
| -64 | B | A, C | | | | N | |

Other insert arrangements are shown below but are not recommended except where interface dictates.

12S - 51, 54 through 62
14S - 51 through 61, 63, 64, 65, 67 through 78
16S - 52, 54, 55
16 - 52, 53, 55, 56, 57, 58, 60, 62
18 - 51, 52, 53, 54, 56, 57, 59, 60, 61, 62, 63, 65 through 74
20 - 52, 56, 60, 61, 62, 64, 65, 67, 68, 69, 70, 71, 74, 75, 77, 80, 81, 82
22 - 57, 60, 62, 68, 69, 71 through 79
24 - 56, 57, 62, 63, 64, 68, 81
28 - 53, 58, 61, 63 through 70, 77, 81
32 - 51, 55
36 - 53, 56, 57, 58, 61, 62, 82
40 - 58, 59, 77, 78
44 - 57

*Preferred

## 3.8 MIL-C-22992 CONNECTORS, PLUGS AND RECEPTACLES, ELECTRICAL, WATERPROOF, QUICK DISCONNECT, HEAVY DUTY TYPE, GENERAL SPECIFICATION FOR

These connectors are recommended for outdoor use in lightning susceptible areas, for interconnecting distributors. They are also used indoors where AWG 14 conductors are required.

Shell size 40 is the most common, however, interface may dictate usage of other sizes.

Intermateability of like insert arrangements is as follows: (insert arrangement is an example.

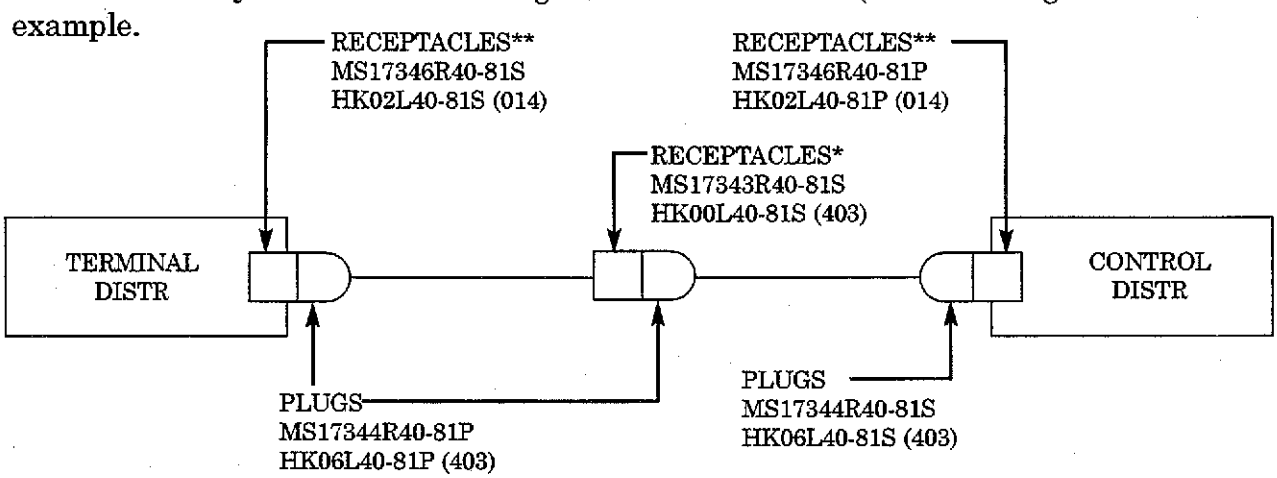



Figure 3-5. MIL-C-22992 Heavy Duty Electrical Connectors

NOTES:

*1. To avoid stocking of MS17345 connectors (inline cable receptacles), specify the wall mount shown and ignore the flange mount.

**2. This receptacle is part of the distributor and may be other than shown; e.g., MS17347, MS17348, HK03, or HK09.

Interchangeability of MIL-C-22992 connectors is shown in Table 3-11.

Due to the high cost and long lead time, jam nut, feedthrough, and "inline" receptacles should be avoided.

For applicable molding adapters or backshells and protection caps or dust covers, refer to Section IV, Accessories. Backthreads are left-handed and are identical for all part number versions of the same shell size.

### 3.8.1 MIL-C-22992 CONNECTORS (QWLD SERIES)

| Part No. Breakdown | HK06 | L | 40 | | - | 81 | P | W | (403) |
|---|---|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | | | 5 | 6 | 7 | 4 |
| | MS17344 | R | 40 | | | C | 81 | P | W |
| | 1 | 2 | 3 | | | 4 | 5 | 6 | 7 |
| | 88 | - | 1946 | 40 | - | | 81 | P | W |
| | 4 | | 1 | 3 | | | 5 | 6 | 7 |
| | 88 | - | 3236 | 40 | - | | 81 | P | W |
| | 4 | | 1 | 3 | | | 5 | 6 | 7 |

NOTE:

When writing part number, omit spaces between letters and numbers. These part numbers are examples of a cable plug and 40-81P insert arrangement with a W insert rotation.

Code 1.

Table 3-9. MIL-C-22992 Part Number Types

| BASIC PART NO. | COMMERCIAL PART NUMBERS | | | | TYPE |
|---|---|---|---|---|---|
| MS17343 | 10-1940xx | HK00 | 88-1940 | 88-3230 | Receptacle, wall mount |
| MS17344 | 10-1946xx | HK06 | 88-1946 | 88-3236 | Plug, cable |
| MS17345 | 10-1941xx | HK01 | 88-1941 | 88-3231 | Receptacle, cable |
| MS17346 | 10-1942xx | HK02 | 88-1942 | 88-3232 | Receptacle, box mount |
| MS17347 | 10-1943xx | HK03 | 88-1943 | 88-3233 | Receptacle, jam nut, wall mount |
| MS17348 | 10-1949xx | HK09 | 88-1949 | 88-3239 | Receptacle, jam nut, box mount |
| - | 10-1944xx | HKTBF | 88-1944 | 88-3234 | Receptacle, thru-bulkhead |

Code 2. SERVICE CLASS.

HK Series

L - Locking, New Class for HK Series connectors, in shell sizes 22 and 40, which provides locking teeth, lockwire holes, and better contact insertion integrity. Available in HKOX only.

NOTE:

Not to be confused with Class L in MIL-C-22992 SPEC, which describes MS9055x AC power connectors.

P - Primed for potting. This class is being phased out in favor of Class L, but is substitutable until the present supply is exhausted, if a conductive finish is not desired.

MS Series
C - Pressurized
R - Environmental resisting

194x and 323x Series
Are equivalent to the "P" in the HK Series

Code 3. SHELL SIZE. Available from 12 through 44 - with the exception of the HK Series with the "L" service class, which is only available in 22 and 40 shell size at the present time.

Code 4. SHELL FINISH
HK Series
(014) - HK02L and HKTBF connectors with conductive finish.
(403) - HK00L and HK06L connectors with conductive finish and no backshell hardware.
(443) - HK00L and HK06L connectors with conductive finish and largest cable entry 360° shield clamp backshell.

NOTE:

This suffix is being phased out in preference to (403) for commonality of stockage with backshells for 360° shielding called out separately for various cable entry size. See adapters.

(457) - HKxxL connector with separate crimp contacts supplied with a (403) type connector. (See special application below.)

SPECIAL APPLICATION: (For use when a few Constantan contacts are required in the connector.)

1. HK02L40-82S(457) like HK02L40-81S(014) except gold plated. #16 crimp socket contacts are furnished loose.
2. HK06L40-82P(457) like HK06L40-81P(403) except gold plated. #16 crimp pin contacts are furnished loose.
3. Constantan gold plated #16 crimp contacts are: 10-248995-4P (pins) and 10-24899-4S (sockets). (order separately)

194x and 323x Series
- 10 - Solder, Silver Plate Contacts
- 75 - Crimp, Silver Plate Contacts
- 81 - Crimp, 100P, N.C. Gold over Silver
- 82 - Crimp, Silver Plate Contacts
- 85 - Crimp, 50P, N.C. Gold over Silver
- 88 - Solder, Silver, N.C. Cadmium over Nickel Shell

NOTE:

All are Alumilite non-conductive, except 88.

MS Series
- C - Conductive (preferred whether necessary or not for standardization)
- N - Non-conductive

Code 5. INSERT ARRANGEMENT. (used in conjunction with Code 3). Consult Bendix catalog for insert arrangements not listed here that must mate with interfaces not controlled by KSC. Below are insert arrangements used at KSC.

Table 3-10. MIL-C-22992 Insert Arrangements at KSC

| INSERT ARRANGEMENT | CONFIGURATION | INSERT ARRANGEMENT | CONFIGURATION |
|---|---|---|---|
| 22-1 | 2#8 | 24-67 | 19#12 |
| 22-8 | 2#12 | 24-85 | 7#8(RG180B/U) |
| 22-19 | 14#16 | 28-8 | 10#16, 2#12 |
| 22-22 | 4#8 | 36-83 | 7#4 (RG-58B/U) |
| 22-23 | 8#12 | 40-56 | 85#16 |
| 22-33 | 7#16 | 40-75 | 4#0, 1#12 |
| 22-91 | 2#8 (#6 solder cup) | 40-81 | 62#16 (#14 solder cup) |
| 24-9 | 2#4 | 44-52 | 104#16 |

NOTE:

All contacts are identified alphabetical except 40-75 and 40-81, which are numerical. 40-75S arrangement may be substituted for 40-57S arrangement.

Code 6. CONTACT TYPE.

P - Male, or pin, contacts
S - Female, or socket, contacts
PS - Designation for through bulkhead connectors with pins on one side and sockets on the other side.

Code 7. ALTERNATE INSERT ROTATION.

Blank - Normal position
W, X, Y, Z are alternates

NOTE:

DO NO SPECIFY alternate insert positions unless the interface connector, beyond the control of KSC dictates.

### 3.8.2 COMPARISON OF VARIOUS MIL-C-22992 CONNECTOR PART NUMBERS

All of the connectors listed below are identical with respect to mateability and are substitutable when shell conductivity and backshell configurations are not factors. No. 1 is the preferred part number.

Table 3-11. Interchangeability of Various MIL-C-22992 Connector Part Numbers

| NO. | CONNECTOR P/N | FEATURES | | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | HK06L40-81P (403) | A | D | E | H | * | L | M | N | PREFERRED |
| 2 | HK06L40-81P (443) | A | D | E | H | J | L | M | N | FOR LARGE CABLES |
| 3 | HK06L40-81P | B | D | E | H | K | L | M | N | |
| 4 | HK06P40-81P | B | D | E | H | K | | | | |
| 5 | HKC06P40-81P | B | C | E | H | K | | | | |
| 6 | 10-194640-81P | B | D | E | H | - | | | | SAME AS 13 & 24 |
| 7 | 75-194640-81P | B | C | E | H | - | | | | SAME AS 9, 14 & 16 |
| 8 | 81-194640-81P | B | C | E | G | - | | | | SAME AS 10, 11, 15, 17 & 18 |
| 9 | 82-194640-81P | B | C | E | H | - | | | | SAME AS 7, 14 & 16 |
| 10 | 83-194640-81P | B | C | E | G | - | | | | SAME AS 8, 11, 15, 17 & 18 |
| 11 | 85-194640-81P | B | C | E | G | - | | | | SAME AS 8, 10, 15, 17 & 18 |
| 12 | 88-194640-81P | A | D | E | H | - | | | | SAME AS 19 & 22 (GOLD) |
| 13 | 10-323640-81P | B | D | E | H | - | | | | SAME AS 6 & 24 |
| 14 | 75-323640-81P | B | C | E | H | - | | | | SAME AS 7, 9 & 16 |
| 15 | 81-323640-81P | B | C | E | G | - | | | | SAME AS 8, 10, 11, 17 & 18 |
| 16 | 82-323640-81P | B | C | E | H | - | | | | SAME AS 7, 9 & 14 |
| 17 | 83-323640-81P | B | C | E | G | - | | | | SAME AS 8, 10, 11, 15 & 18 |
| 18 | 85-323640-81P | B | C | E | G | - | | | | SAME AS 8, 10, 11, 15 & 17 |
| 19 | 88-323640-81P | A | D | E | H | - | | | | SAME AS 12 & 22 (GOLD) |
| 20 | MS17344C40C81P | A | D | F | G | - | | | | PRESSURIZED |
| 21 | MS17344C40N81P | B | D | F | G | - | | | | PRESSURIZED |
| 22 | MS17344R40C81P | A | D | E | G | - | | | | SAME AS 12 & 19 (SILVER) |
| 23 | MS17344R40N81P | B | D | E | G | - | | | | SAME AS 6, 13 & 24 |
| 24 | 75M14340-17 | B | D | E | H | - | | | | SAME AS 6, 13 & 23 |
| 25 | 79K80259-3 | B | D | E | H | J | L | M | N | SAME AS 2 |

FEATURES

| | |
|---|---|
| A. CONDUCTIVE SHELL | G. GOLD OVER SILVER CONTACTS |
| B. NON-CONDUCTIVE SHELL | H. SILVER PLATED CONTACTS |
| C. CRIMP CONTACTS | J. 360° RFI SHIELD BACKSHELL |
| D. SOLDER CONTACTS | K. MOLDING ADAPTER SUPPLIED |
| E. ENVIRONMENTAL | L. SERRATED LOCKING TEETH ON SHELL |
| F. PRESSURIZED | M. CLOSER TOLERANCES ON CONTACTS |
| | N. LOCK WIRE HOLES IN COUPLING NUTS |

NOTE:

* Connectors with a (403) suffix are preferred over (443) to provide the flexibility of calling out a 10-560555-xxx backshell to fit the cable size used, e.g., HK06L40-81P (443) = HK06L40-81P (403) + 10-560555-401 (for 50.8 mm [2"] cable). See RFI backshells for appropriate sizes of backshells.

### 3.8.3 MIL-C-22992 INSERT ARRANGEMENTS

Table 3-12. MIL-C-22992 Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12-5 | 1 | 12 | -30 | 5 | 16 | -5 | 2 | 12 | -7 | 2 | 12 |
| -48 | 3 | 16 | -31 | 5 | 16 | | 4 | 16 | | 14 | 16 |
| -49 | 2 | 16 | 20-2 | 1 | 0 | -6 | 2 | 8 | *-9 | 2 | 4 |
| *14-3 | 1 | 8 | -3 | 3 | 12 | | 1 | 16 | -10 | 7 | 8 |
| -53 | 6 | 16 | *-4 | 4 | 12 | -7 | 1 | 0 | -11 | 3 | 8 |
| 16-2 | 1 | 12 | -6 | 3 | 16 | *-8 | 2 | 12 | | 6 | 12 |
| -7 | 1 | 8 | -7 | 8 | 16 | -9 | 3 | 12 | -12 | 2 | 4 |
| | 2 | 16 | -8 | 2 | 8 | -10 | 4 | 16 | | 3 | 12 |
| -9 | 2 | 12 | | 4 | 16 | -11 | 2 | 16 | -16 | 1 | 8 |
| | 2 | 16 | -9 | 1 | 12 | -12 | 2 | 8 | | 3 | 12 |
| *-10 | 3 | 12 | | 7 | 16 | | 3 | 16 | | 3 | 16 |
| -11 | 2 | 12 | -11 | 13 | 16 | -13 | 4 | 12 | -17 | 2 | 12 |
| -12 | 1 | 4 | -12 | 1 | 4 | | 1 | 16 | | 3 | 16 |
| -13 | 2 | 12 | | 1 | 16 | *-14 | 19 | 16 | -20 | 2 | 12 |
| *-61 | 7 | 16 | -14 | 2 | 8 | -15 | 5 | 12 | | 9 | 16 |
| 18-1 | 10 | 16 | | 3 | 12 | | 1 | 16 | *-21 | 1 | 8 |
| -3 | 2 | 12 | -15 | 7 | 12 | -16 | 3 | 12 | | 9 | 16 |
| *-4 | 4 | 16 | -16 | 2 | 12 | | 6 | 16 | -22 | 4 | 8 |
| -5 | 2 | 12 | | 7 | 16 | -17 | 1 | 12 | -27 | 7 | 16 |
| | 1 | 16 | 20-17 | 5 | 12 | | 8 | 16 | -28 | 24 | 16 |
| -6 | 1 | 4 | | 1 | 16 | -18 | 8 | 16 | *-51 | 2 | 10 |
| -7 | 1 | 8 | -18 | 3 | 12 | *-19 | 14 | 16 | | 3 | 8 |
| -8 | 1 | 12 | | 6 | 16 | -20 | 9 | 16 | -67 | 19 | 12 |
| | 7 | 16 | -19 | 3 | 8 | -21 | 1 | 0 | 28-1 | 3 | 8 |
| -9 | 2 | 12 | -20 | 1 | 4 | | 2 | 16 | | 6 | 12 |
| | 5 | 16 | | 3 | 12 | *-22 | 4 | 8 | -2 | 2 | 12 |
| -10 | 4 | 12 | -21 | 1 | 12 | -23 | 8 | 12 | | 12 | 16 |
| -11 | 5 | 12 | | 8 | 16 | -24 | 2 | 12 | -3 | 3 | 8 |
| -12 | 6 | 16 | -22 | 3 | 8 | | 4 | 16 | -4 | 2 | 12 |
| -13 | 1 | 8 | | 3 | 16 | -27 | 1 | 8 | | 7 | 16 |
| | 3 | 12 | *-23 | 2 | 8 | | 8 | 16 | -5 | 1 | 12 |
| -14 | 1 | 4 | -24 | 2 | 8 | -28 | 7 | 12 | | 2 | 16 |
| | 1 | 16 | | 2 | 16 | *-33 | 7 | 16 | -6 | 3 | 4 |
| -15 | 4 | 12 | -25 | 13 | 16 | -34 | 3 | 12 | -7 | 2 | 4 |
| -16 | 1 | 12 | -27 | 14 | 16 | | 2 | 16 | *-8 | 2 | 12 |
| -17 | 2 | 12 | -29 | 17 | 16 | -36 | 8 | 16 | | 10 | 16 |
| | 5 | 16 | -30 | 13 | 16 | *22-91 | 2 | 8 | -9 | 6 | 12 |
| -19 | 10 | 16 | -33 | 11 | 16 | 24-2 | 7 | 12 | | 6 | 16 |
| -20 | 5 | 16 | *22-1 | 2 | 8 | -3 | 2 | 12 | -10 | 2 | 4 |
| -22 | 3 | 16 | -2 | 3 | 8 | | 5 | 16 | | 2 | 8 |
| -24 | 10 | 16 | -4 | 2 | 8 | -5 | 16 | 16 | | 3 | 12 |
| -29 | 5 | 16 | | 2 | 12 | -6 | 8 | 12 | -11 | 4 | 12 |

* Preferred Arrangements

Table 3-12. (Cont.) MIL-C-22992 Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18 | 16 | | 3 | 8 | | 24 | 16 | | | |
| -12 | 26 | 16 | | 2 | 12 | -9 | 1 | 8 | | | |
| -13 | 26 | 16 | | 16 | 16 | | 22 | 16 | | | |
| -15 | 35 | 16 | -17 | 4 | 4 | | 24 | 16 | | | |
| *-16 | 20 | 16 | -73 | 46 | 16 | -10 | 4 | 4 | | | |
| -17 | 15 | 16 | -75 | 7 | RG180 | | 9 | 8 | | | |
| -18 | 12 | 16 | *-76 | 19 | 12 | | 16 | 16 | | | |
| -19 | 4 | 12 | -87 | 7 | RG58 | -53 | 60 | 16 | | | |
| | 6 | 12 | 36-1 | 4 | 12 | *-56 | 85 | 16 | | | |
| -20 | 10 | 12 | | 18 | 16 | -57 | 4 | 0 | | | |
| | 4 | 16 | -3 | 3 | 0 | -61 | 1 | 8 | | | |
| -21 | 37 | 16 | | 3 | 12 | | 3 | 12 | | | |
| 28-22 | 3 | 4 | -4 | 3 | 0 | | 55 | 16 | | | |
| | 3 | 16 | -5 | 4 | 0 | -62 | 60 | 16 | | | |
| *-51 | 12 | 12 | -6 | 2 | 0 | -63 | 61 | 14 | | | |
| 32-1 | 2 | 0 | | 4 | 4 | -64 | 36 | SPL | | | |
| | 3 | 12 | -7 | 7 | 12 | -66 | 4 | RG63 | | | |
| -2 | 3 | 4 | | 40 | 16 | -67 | 10 | RG62 | | | |
| | 2 | 16 | -8 | 1 | 12 | | 1 | 16 | | | |
| -3 | 1 | 0 | | 46 | 16 | -68 | 21 | 8 | | | |
| | 2 | 4 | -9 | 1 | 4 | -70 | 61 | 16 | | | |
| | 2 | 12 | | 2 | 8 | -72 | 10 | RG214 | | | |
| | 4 | 16 | | 14 | 12 | | 1 | 16 | | | |
| -4 | 2 | 12 | | 14 | 16 | -73 | 61 | 16 | | | |
| | 12 | 16 | -10 | 48 | 16 | -74 | 4 | RG214 | | | |
| -5 | 2 | 0 | 36-11 | 48 | 16 | | 1 | RG62 | | | |
| -6 | 2 | 4 | -12 | 48 | 16 | | 1 | 12 | | | |
| | 3 | 8 | -13 | 2 | 12 | *-75 | 4 | 0 | | | |
| | 2 | 12 | | 15 | 16 | | 1 | 12 | | | |
| | 16 | 16 | -14 | 5 | 8 | -80 | 10 | 4 | | | |
| -7 | 7 | 12 | | 5 | 12 | | 1 | 16 | | | |
| | 28 | 16 | | 6 | 16 | *-81 | 62 | 14 | | | |
| -8 | 6 | 12 | -15 | 35 | 16 | -82 | 62 | 16 | | | |
| | 24 | 16 | -16 | 7 | 12 | *-85 | 60 | 14 | | | |
| -9 | 2 | 4 | | 40 | 16 | -86 | 4 | RG115 | | | |
| | 12 | 16 | -17 | 7 | 12 | -87 | 7 | 4 | | | |
| 32-10 | 2 | 4 | | 40 | 16 | *44-52 | 104 | 16 | | | |
| | 2 | 8 | -18 | 1 | 4 | | | | | | |
| | 3 | 16 | | 2 | 8 | | | | | | |
| -12 | 5 | 12 | | 14 | 12 | | | | | | |
| | 10 | 16 | | 14 | 16 | | | | | | |
| -13 | 5 | 12 | -20 | 2 | 8 | | | | | | |
| | 18 | 16 | | 2 | 12 | | | | | | |
| -15 | 2 | 0 | | 30 | 16 | | | | | | |
| | 6 | 12 | -52 | 52 | 16 | | | | | | |
| -16 | 2 | 4 | 40-1 | 6 | 12 | | | | | | |

* Preferred Arrangements

## 3.9 MIL-C-26482 CONNECTORS, ELECTRICAL (CIRCULAR, MINIATURE, QUICK DISCONNECT, ENVIRONMENT RESISTING), RECEPTACLES AND PLUGS, GENERAL SPECIFICATION FOR

These connectors are recommended for indoor use for interconnecting distributors, Hardware Interface Modules (HIM), patch distributors, and in some cases, instrumentation components.

Where vendor components used in outdoor environments require these connectors, a coating of silicone Room Temperature Vulcanized (RTV) must be used to prevent water intrusion and corrosion when electroless nickel shells are used. The RTV must be free of acetic acid. Intermateability of like insert arrangements is as follows:

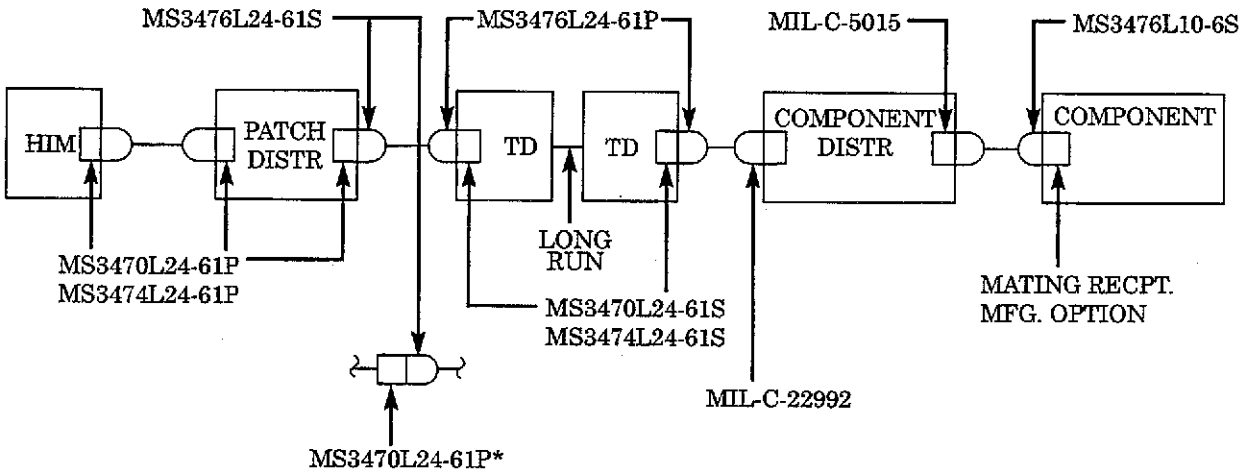



Figure 3-6. MIL-C-26482 Circular, Miniature, Electrical Connector

NOTES:

1. If 16 AWG wire is used, a PT06P24-61x(113) must be specified.

*2. Substitute for MS3471xxxx inline receptacle.

For applicable backshells, refer to Section IV, Accessories. Backthreads are right-hand and vary in size between series I and II up to shell size 18. Where substitutions are made, the backshell must be substituted also if size 16 or smaller.

### 3.9.1 MIL-C-26482 CONNECTOR, ELECTRICAL, CIRCULAR, MINIATURE

SERIES 2 CONNECTOR TYPES.

| Part No. Breakdown | MS3476 | W | 24 | - | 61 | P | W |
|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Code 1.

| Basic Part No. | Type |
|---|---|
| *MS3470 | Receptacle, wall mount |
| MS3473 | Receptacle, solder mount |
| MS3477 | Receptacle, box mount, hermetic |
| MS3471 | Receptacle, cable connect |
| MS3472 | Receptacle, wide flange |
| *MS3474 | Receptacle, jam nut |
| MS3479 | Receptacle, jam nut, hermetic |
| MS3475 | Plug, RFI shielded |
| *MS3476 | Plug, straight |

NOTES:

1. When writing part numbers, omit spaces between letters and numbers.

2. Series 2 connectors are preferred. See Table 3-14 for Series 1 connectors, which are interchangeable and intermateable with these connectors. MS3472 is not interchangeable with MS3122 due to mounting dimensions.

Code 2. CLASS.

E - Obsolete for new design
H - Hermetic, Solder
L - Fluid resistant, 200° C, conductive electroless nickel finish
N - Hermetic, Crimp
*W - Fluid resistant, 175° C, olive drab cadmium over nickel, conductive finish, 500 hour salt spray

Code 3. SHELL SIZE.

8, 10, 12, 14, 16, 18, 20, 22, 24

Code 4. TERMINATION TYPE AND SHELL MATERIAL.

*(-) - All except Hermetic seal
C - Solder cup ferrous alloy shell
D - Crimp termination ferrous alloy shell

Code 5. INSERT ARRANGEMENT

Table 3-13. MIL-C-26482 Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|
| 6-1 | 1 | 20 | *16-8 | 8 | 16 | 22-7 | 7 | #8COAX |
| *8-2 | 2 | 20 | -23 | 22 | 20 | *-12 | 12 | 12 |
| *8-3 | 3 | 20 | | 1 | 16 | *-21 | 21 | 16 |
| *8-4 | 4 | 20 | *-26 | 26 | 20 | -32 | 32 | 20 |
| *8-33 | 3 | 20 | 18-8 | 8 | 12 | -34 | 34 | 20 |
| 8-98 | 3 | 20 | *-11 | 11 | 16 | -36 | 36 | 20 |
| *10-6 | 6 | 20 | -30 | 29 | 20 | -41 | 27 | 20 |
| -98 | 6 | 20 | | 1 | 16 | | 14 | 16 |
| *12-3 | 3 | 16 | *-32 | 32 | 20 | *-55 | 55 | 20 |
| *-8 | 8 | 20 | -80 | 6 | 20 | 24-19 | 19 | 12 |
| *-10 | 10 | 20 | | 2 | #8COAX | -31 | 31 | 16 |
| 14-4 | 4 | 12 | *20-16 | 16 | 16 | *24-61 | 61 | 20 |
| -5 | 5 | 16 | -24 | 24 | 20 | -100 | 10 | #8COAX |
| -12 | 8 | 20 | 20-25 | 25 | 20 | | | |
| | 4 | 16 | -27 | 27 | 20 | | | |
| -15 | 14 | 20 | *-39 | 37 | 20 | | | |
| | 1 | 16 | | 2 | 16 | | | |
| *-18 | 18 | 20 | *-41 | 41 | 20 | | | |
| *-19 | 19 | 20 | | | | | | |
| -91 | 3 | 20 | | | | | | |

*Preferred Arrangements

Code 6. CONTACT DESIGNATOR.

P - Pin
S - Socket
C - Feedthrough Contacts (C may not appear on the connector or may be designated as PS)

Code 7. INSERT POSITION.

Blank is normal. W, X, Y, and Z are alternates.

NOTE:

Do not specify alternate insert positions unless the interface connector dictates.

### 3.9.2 MIL-C-26482 SERIES 2 TO SERIES 1 CROSS REFERENCE

Table 3-14. MIL-C-26482 Series 2 to Series 1 Cross Reference

| MIL-C-26482 | | |
|---|---|---|
| SERIES 2 | SERIES 1 | |
| CRIMP | SOLDER | CRIMP |
| MS3476L08 | MS3116*08 | - |
| MS3476L10 | MS3116*10 | MS3126*10 |
| MS3476L12 | MS3116*12 | MS3126*12 |
| MS3476L14 | MS3116*14 | MS3126*14 |
| MS3476L16 | MS3116*16 | MS3126*16 |
| MS3476L18 | MS3116*18 | MS3126*18 |
| MS3476L20 | MS3116*20 | MS3126*20 |
| MS3476L22 | MS3116*22 | MS3126*22 |
| MS3476L24 | MS3116*24 | MS3126*24 |
| MS3474L08 | MS3114*08 | - |
| MS3474L10 | MS3114*10 | MS3124*10 |
| MS3474L12 | MS3114*12 | MS3124*12 |
| MS3474L14 | MS3114*14 | MS3124*14 |
| MS3474L16 | MS3114*16 | MS3124*16 |
| MS3474L18 | MS3114*18 | MS3124*18 |
| MS3474L20 | MS3114*20 | MS3124*20 |
| MS3474L22 | MS3114*22 | MS3124*22 |
| MS3474L24 | MS3114*24 | MS3124*24 |
| MS3470L08 | MS3110*08 | - |
| MS3470L10 | MS3110*10 | MS3120*10 |
| MS3470L12 | MS3110*12 | MS3120*12 |
| MS3470L14 | MS3110*14 | MS3120*14 |
| MS3470L16 | MS3110*16 | MS3120*16 |
| MS3470L18 | MS3110*18 | MS3120*18 |
| MS3470L20 | MS3110*20 | MS3120*20 |
| MS3470L22 | MS3110*22 | MS3120*22 |
| MS3470L24 | MS3110*24 | MS3120*24 |

*Class may be any letter (E, P, etc.)

### 3.9.3 MSFC SPECIFICATION 40M39569 CONNECTOR, ELECTRICAL, MINIATURE, CIRCULAR, ENVIRONMENT RESISTING, 200°C (SIMILAR TO MIL-C-26482)

Part No.
Breakdown

NB 6 E 24 - 61 P N T 3

- 3 — Temperature class
  - Blank - General purpose connector: -101.1° to +200°C (-150° to +392°F)
  - 2 - Vacuum low temperature connector: -156° to +200°C (-250° to +392°F)
  - 3 - Atmospheric low temperature connector: -156° to +200°C (-250° to +392°F)
- T — Backshell accessory (class E only)
  - C - Straight backshell without strain relief
  - R - 90° backshell with strain relief
  - S - Straight backshell with strain relief
  - T - Connector without backshell
- N — Polarizing position ( Refer to vendor's catalog for clocking availability)
  - Positions: N is normal; W, X, Y and Z are alternates
- P — Contact type
  - P - Pins
  - S - Sockets
  - CP - Shielded pins (available in #12 contact only)
  - CS - Shielded sockets (available in #12 contact only)
- 61 — Insert Arrangements (See Table 3.13 for NB Connector Inserts presently used on Shuttle)
- 24 — Shell size
  - Sizes: 8, 10, 12, 14, 16, 18, 20, 22 and 24
- E — Service class
  - E - Environmental
  - H - Hermetic
- 6 — Shell style
  - 0 - Narrow flange receptacle (class E & H)
  - 3 - Solder mount receptacle (class H)
  - 4 - Wide flange receptacle (class E)
  - 5 - Thru-bulkhead receptacle (class H)
  - 6 - Straight plug (class E)
  - 66 - RFI grounding straight plug (class E)
  - 6M - Straight plug without coupling ring (class E)
  - 6MG - RFI grounding straight plug without coupling ring (class E)
  - 7 - Jam-nut receptacle (class E & H)
  - 8 - Jam-nut extended pin receptacle (class H)
- NB — Prefix

NOTE:

MIL-C-26482 Connectors are substitutable for non-flight use (preferably Series 2).

## 3.9.4 MSFC SPECIFICATION 40M39569 INSERT ARRANGEMENTS

Table 3-15. MSFC Specification 40M39569 Insert Arrangements With Polarizing Positions

| INSERT ARR. | CONTACTS | INSERT POLARIZING POSITIONS ROTATION DEGREES | | | | |
|---|---|---|---|---|---|---|
| | | N | W | X | Y | Z |
| 8-98 | 3#20 | 0 | | | | |
| 10-6 | 6#20 | 0 | 90 | | | |
| 12-3 | 3#16 | 0 | | | 180 | |
| 12-8 | 8#20 | 0 | 90 | 112 | 203 | 292 |
| 12-10 | 10#20 | 0 | 60 | 155 | 270 | 295 |
| 14-4 | 4#12 | 0 | 45 | | | |
| 14-5 | 5#16 | 0 | 40 | 92 | 184 | 273 |
| 14-12 | 8#20, 4#16 | 0 | 43 | 90 | | |
| 14-15 | 14#20, 1#16 | 0 | 17 | 110 | 155 | 234 |
| 14-18 | 18#20 | 0 | 15 | 90 | 150 | 270 |
| 14-19 | 19#20 | 0 | 30 | 165 | 315 | |
| 16-8 | 8#16 | 0 | 54 | 152 | 180 | 331 |
| 16-23 | 22#20, 1#16 | 0 | 158 | 270 | | |
| 16-26 | 26#20 | 0 | 60 | | 275 | 338 |
| 18-8 | 8#12 | 0 | 180 | | | |
| 18-11 | 11#16 | 0 | 62 | 119 | 241 | 340 |
| 18-30 | 29#20, 1#16 | 0 | 180 | 193 | 285 | 350 |
| 18-32 | 32#20 | 0 | 85 | 138 | 222 | 265 |
| 20-16 | 16#16 | 0 | 238 | 318 | 333 | 347 |
| 20-39 | 37#20, 2#16 | 0 | 63 | 144 | 252 | 333 |
| 20-41 | 41#20 | 0 | 45 | 126 | 225 | |
| 22-12 | 12#12 | 0 | 17 | 41 | 64 | |
| 22-21 | 21#16 | 0 | 16 | 135 | 175 | 349 |
| 22-41 | 27#20, 14#16 | 0 | 39 | 135 | 264 | |
| 22-55 | 55#20 | 0 | 30 | 142 | 226 | 314 |
| 24-19 | 19#12 | 0 | 30 | 165 | 315 | |
| 24-31 | 31#16 | 0 | 90 | 225 | 255 | |
| 24-61 | 61#20 | 0 | 90 | 180 | 270 | 324 |
| 24-100 | 10 COAX SZ8 | 0 | 45 | 90 | 135 | |

### 3.9.5 MSFC SPECIFICATION 40M38298 CONNECTOR, ELECTRICAL, SPECIAL, MINIATURE CIRCULAR, ENVIRONMENT RESISTING, 200°C (SPECIAL FOR PYRO CONNECTIONS)

| Part No. Breakdown | NBS6 | E | 8 | - | 2 | P | N |
|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | | 4 | 5 | 6 |

NOTE:

When writing part numbers, omit spaces between letters and numbers.

Code 1.

| Basic Part No. | Type | Appendix* |
|---|---|---|
| NBS0 | Receptacle, flange hermetic | G |
| NBS3 | Receptacle, solder mount, hermetic | H |
| NBS6 | Plug, straight, without backshell, environmental | B |
| NBS6G | Plug, straight, RFI ground, without backshell, environmental | J |
| NBS7 | Receptacle, jam nut, without backshell, environmental | C |
| NBS8 | Plug, with 90° backshell, environmental | I |
| NBS8G | Plug, RFI ground, with 90° RFI backshell, environmental | K |
| NBS9 | Plug, with straight RFI backshell, environmental | F |
| NBS9G | Plug, RFI ground, with straight RFI backshell, environmental | M |

NOTES:

1. Shell sizes 6, 6G, and 7 are for the Space Shuttle program. Only polarization positions N, A, B, C, and D shall be used.

*2. See referenced appendix in MSFC Specification 40M38298.

Code 2. CLASS.
E - Environmental
H - Hermetic

Code 3. SHELL SIZE.
8 only

Code 4. INSERT ARRANGEMENTS.

8-2, 2#20HD 8-3, 3#20HD 8-4, 4#20HD

Code 5. STYLE.

P - Pins
S - Sockets

Code 6. INSERT POSITION.

N - Normal
A, B, C, D, E, F, G, & H are alternates

## 3.10 MIL-C-38999 CONNECTOR, ELECTRIC, CIRCULAR, MINIATURE, HIGH DENSITY, QUICK DISCONNECT, ENVIRONMENT RESISTANT, REMOVABLE CRIMP CONTACTS

| Part No. Breakdown | MS27472 | T | 10 | B | 8 | P | A |
|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

NOTE:

When writing part numbers, omit spaces between letters and numbers.

Code 1.

| Basic Part No. | Type |
|---|---|
| MS27472 | Receptacle, wall mount, crimp contact |
| MS27475 | Receptacle, wall mount, solder contact, hermetic |
| MS27474 | Receptacle, jam nut, crimp contact |
| MS27477 | Receptacle, jam nut, solder contact, hermetic |
| MS27478 | Receptacle, solder mount, solder contact, hermetic |
| MS27497 | Receptacle, back panel, wall mount, crimp contact |
| MS27664 | Receptacle, back panel, wall mount, crimp contact |
| MS27508 | Receptacle, back panel, box mount, crimp contact |
| MS27476 | Receptacle, box mount, solder contact, hermetic |
| MS27499 | Receptacle, box mount, crimp contact |
| MS27513 | Receptacle, box mount, crimp contact |
| MS27667 | Receptacle, through-bulkhead |
| MS27473 | Plug, straight cable, crimp contact |
| MS27484 | Plug, straight cable, crimp contact |

NOTES:

1. Only Series I listed to be used in Shuttle program.

2. NLS connectors shown in MSFC Specification 40M38277 are special Shuttle flight connectors. Mating connectors for non flight use may be per MIL-C-38999, Series II.

Code 2. CLASS.

E - Environmental resistant with rear hardware
P - For embedment
*T - Environmental resistant, without rear hardware
Y - Hermetic

Code 3. SHELL SIZE.

8, 10, 12, 14, 16, 18, 20, 22, & 24

*Preferred

Code 4. MATERIAL FINISH. (All Conductive Except for "C")

A - Bright cadmium
*B - Olive drab cadmium over nickel
C - Hard, anodic
D - Fused tin plate, carbon steel
E - SST, passivated
F - Nickel, dull
N - Hermetic seal, SST

Code 5. INSERT ARRANGEMENTS FOR MIL-C-38999 SERIES 2

Table 3-16. MIL-C-38999 Series 2 Insert Arrangements

| INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE | INSERT ARR. | NO. | WIRE SIZE |
|---|---|---|---|---|---|---|---|---|
| *8-2 | 2 | 20 | 14-37 | 37 | 22M | 20-16 | 16 | 16 |
| -3 | 3 | 20 | -68 | 8 | 16 | *-35 | 79 | 22D |
| -6 | 6 | 23M | -97 | 8 | 20 | 20-39 | 37 | 20 |
| -35 | 6 | 22D | | 4 | 16 | | 2 | 16 |
| -44 | 4 | 22 | *16-6 | 6 | 12 | -41 | 41 | 20 |
| -97 | 2 | 22M | -8 | 8 | 16 | 22-1 | 100 | 22M |
| | 2 | 20 | -13 | 13 | 16 | -2 | 85 | 22 |
| -98 | 3 | 20 | -26 | 26 | 20 | -14 | 14 | 12 |
| 10-4 | 4 | 20 | *-35 | 55 | 22D | -21 | 21 | 16 |
| -5 | 5 | 20 | -42 | 42 | 22 | -32 | 32 | 20 |
| -13 | 13 | 22M | -55 | 55 | 22M | *-35 | 100 | 22D |
| -35 | 13 | 22D | -99 | 21 | 20 | -53 | 53 | 20 |
| -98 | 6 | 20 | | 2 | 16 | -55 | 53 | 20 |
| -99 | 7 | 20 | 18-11 | 11 | 16 | 24-1 | 128 | 22M |
| 12-3 | 3 | 16 | -28 | 26 | 20 | -2 | 100 | 22 |
| -4 | 4 | 16 | | 2 | 16 | -4 | 48 | 20 |
| -8 | 8 | 20 | -30 | 29 | 20 | | 8 | 20 |
| -22 | 22 | 22M | | 1 | 16 | -19 | 19 | 12 |
| -35 | 22 | 22D | -32 | 32 | 20 | -24 | 12 | 16 |
| -98 | 10 | 20 | *-35 | 66 | 22D | | 12 | 12 |
| 14-4 | 4 | 12 | -53 | 53 | 22 | -29 | 29 | 16 |
| -5 | 5 | 16 | -66 | 66 | 22M | *-35 | 128 | 22D |
| -15 | 14 | 20 | -68 | 18 | 16 | -37 | 37 | 16 |
| | 1 | 16 | -96 | 9 | 12 | -43 | 23 | 20 |
| -18 | 18 | 20 | 20-1 | 79 | 22M | | 20 | 16 |
| -19 | 19 | 20 | -2 | 65 | 22 | -61 | 61 | 20 |
| *-35 | 37 | 22D | -11 | 11 | 12 | | | |

*Preferred Arrangements

Code 6. STYLE.

*P - Pins
*S - Sockets
C - Feedthrough contact
X - Pin with eyelet
Z - Socket with eyelet

Code 7. INSERT POSITION.

Blank is normal. A, B, C, D are alternates

NOTE:

DO NOT SPECIFY alternate insert positions unless the interface connector dictates.

### 3.10.1 MSFC SPECIFICATION 40M38277 CONNECTOR, CIRCULAR, MINIATURE, HIGH DENSITY, ENVIRONMENT RESISTING

| Part No. Breakdown | NLS 6 | E | 18 | 35 | P | A |
|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 |

NOTE:

When writing part numbers, omit spaces between letters and numbers.

Code 1.

| Part No. | Type | Class | Appendix* | Equivalent MIL-C-38999 |
|---|---|---|---|---|
| NLS0 | Receptacle, flange mount | E | E | MS27497 |
| NLS3 | Receptacle, solder mount | H | J | MS27478 |
| NLS5 | Receptacle, through-bulkhead | H | D | -- |
| NLS6 | Plug, straight | E | F | MS27473 |
| NLS6G | Plug, straight, grounded | E | G | MS27484 |
| NLS6W | Plug, straight, without coupling ring and backshell | E | I | [1] |
| NLS7 | Receptacle, jam nut | E&H | H&K | MS27474 |

Code 2. CLASS.

E - Environmental resisting, with backshell less cable clamp
H - Hermetically sealed
T - Environmental resisting without backshell

Code 3. SHELL SIZE.

8, 10, 12, 14, 16, 18, 20, 22, and 24.

Code 4. INSERT ARRANGEMENT (No. and Wire Size).

| | | | | | |
|---|---|---|---|---|---|
| 8-35, | (6#22D) | 14-35, | (37#22D) | 20-35, | (79#22D) |
| 10-35, | (13#22D) | 16-35, | (55#22D) | 22-35, | (100#22D) |
| 12-35, | (22#22D) | 18-35, | (66#22D) | 24-35, | (128#22D) |

Code 5. STYLE.

P - Pins
S - Sockets

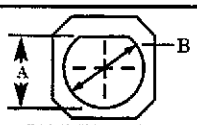
Code 6. INSERT POSITION. No letter required for normal. A, B, C, D are alternate positions.

NOTES:

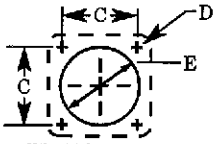
*1. See referenced appendix in MSFC Specification 40M38277.

1 2. Use MS27473 and discard coupling nut and backshell.

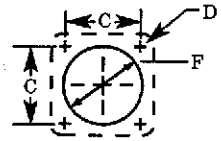
3. Do not specify for GSE design unless the flight article interfacing dictates.




JAMNUT MOUNT



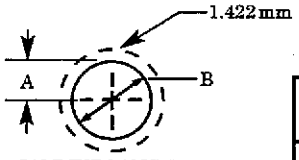

FLANGE MOUNT
(EXCEPT TR BF)



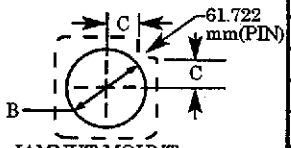

THRU BLKD FLANGE MOUNT

Table 3-17a. MIL-C-26482 Miniature Connector Cutouts – (Metric units/mm)

| SHELL SIZE | A +.127 -.000 | B +.254 -.000 | C ±.127 | D ±.127 | E +.254 -.000 | F +.254 -.000 |
|---|---|---|---|---|---|---|
| 8 | 13.767 | 14.529 | 15.088 | 3.175 | 15.469 | 14.275 |
| 10 | 16.993 | 17.704 | 18.263 | 3.175 | 17.856 | 17.450 |
| 12 | 21.082 | 22.454 | 20.625 | 3.175 | 21.819 | 21.819 |
| 14 | 24.257 | 25.578 | 23.012 | 3.175 | 24.613 | 24.994 |
| 16 | 27.534 | 28.804 | 24.613 | 3.175 | 27.762 | 28.169 |
| 18 | 30.683 | 31.979 | 26.975 | 3.175 | 31.344 | 31.344 |
| 20 | 33.858 | 35.154 | 29.362 | 3.175 | 34.519 | 34.519 |
| 22 | 37.059 | 38.278 | 31.750 | 3.175 | 37.287 | 37.694 |
| 24 | 40.234 | 41.504 | 34.925 | 3.962 | 40.462 | 40.869 |

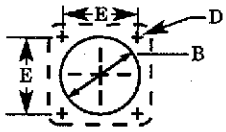



JAMNUT MOUNT
(WITH LOCATING PIN) WHERE LOCATING PIN IS NOT USED IF DIMN REMAINING THE SAME




JAMNUT MOUNT
(WITH FLANGE CUTOUT FOR LOCATING PIN)

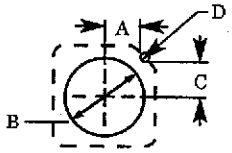
WITHOUT LOCATING PIN



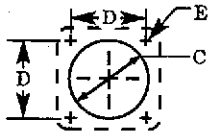

FLANGE MOUNT

Table 3-18a. MIL-C-5015 General Purpose Connector Cutouts – (Metric units/mm)

| SHELL SIZE | A ±.127 | B +.381 -.000 | C ±.127 | D | E +.127 | REDUCED FLANGE |
|---|---|---|---|---|---|---|
| 8 | 8.204 | 12.700 | 9.423 | 3.251 | 15.088 | - |
| 10 | 9.779 | 15.875 | 10.566 | 3.251 | 18.263 | 15.875 |
| 12 | 11.379 | 19.050 | 11.659 | 3.251 | 20.625 | 16.866 |
| 14 | 12.954 | 22.225 | 12.802 | 3.251 | 23.012 | 18.542 |
| 16 | 14.554 | 25.400 | 13.919 | 3.251 | 24.587 | 21.438 |
| 18 | 16.129 | 28.575 | 16.180 | 3.251 | 26.975 | - |
| 20 | 17.729 | 31.750 | 17.297 | 3.251 | 29.362 | - |
| 22 | 19.304 | 34.925 | 18.415 | 3.251 | 31.750 | - |
| 24 | 20.904 | 38.100 | 19.533 | 3.962 | 34.925 | - |
| 28 | 24.079 | 44.450 | 21.768 | 3.962 | 39.675 | - |
| 32 | 27.254 | 50.800 | 24.028 | 4.623 | 44.450 | - |
| 36 | 30.429 | 57.150 | 26.264 | 4.623 | 49.225 | - |
| 40 | - | 63.500 | 28.499 | 4.623 | 55.550 | - |




JAMNUT MOUNT

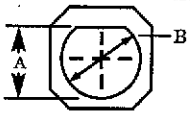



FLANGE MOUNT

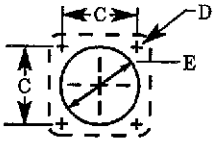
Table 3-19a. MIL-C-22992 Heavy Duty Connector Cutouts – (Metric units/mm)

| SHELL SIZE | A ±.127 | B | C +.381 -.000 | D ±.127 | E | |
|---|---|---|---|---|---|---|
| 12 | 13.945 | 3.175 | 22.225 | 23.012 | 3.988 | |
| 14 | 15.062 | 3.175 | 25.400 | 24.613 | 3.988 | |
| 16 | 17.424 | 3.175 | 28.575 | 26.975 | 3.988 | |
| 18 | 18.440 | 3.175 | 31.750 | 29.362 | 4.699 | |
| 20 | 19.558 | 3.175 | 34.925 | 31.750 | 4.699 | |
| 22 | 20.676 | 3.175 | 38.100 | 34.925 | 4.699 | |
| 24 | 22.936 | 3.175 | 44.450 | 39.675 | 4.699 | |
| 28 | 24.917 | 3.175 | 50.800 | 44.450 | 4.699 | |
| 32 | 27.432 | 3.175 | 57.150 | 49.225 | 5.537 | |
| 36 | 29.642 | 3.175 | 63.500 | 55.575 | 5.537 | |
| 40 | 32.410 | 3.175 | 69.850 | 60.325 | 5.537 | |

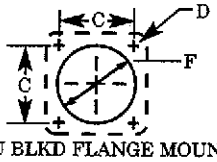
Figure 3-7a. Mounting Hole Cutouts (Metric units/mm)




JAMNUT MOUNT



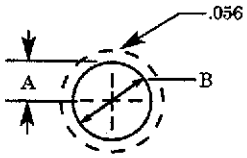

FLANGE MOUNT
(EXCEPT TR BF)



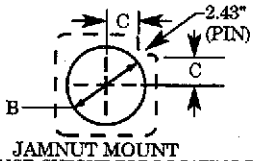

THRU BLKD FLANGE MOUNT

Table 3-17b. MIL-C-26482 Miniature Connector Cutouts – (English units/inches)

| SHELL SIZE | A +.005 -.000 | B +.010 -.000 | C ±.005 | D ±.005 | E +.010 -.000 | F +.010 -.000 |
|---|---|---|---|---|---|---|
| 8 | .542 | .572 | .594 | .125 | .609 | .562 |
| 10 | .669 | .697 | .719 | .125 | .703 | .687 |
| 12 | .830 | .884 | .812 | .125 | .859 | .859 |
| 14 | .955 | 1.007 | .906 | .125 | .969 | .984 |
| 16 | 1.084 | 1.134 | .969 | .125 | 1.093 | 1.109 |
| 18 | 1.208 | 1.259 | 1.062 | .125 | 1.234 | 1.234 |
| 20 | 1.333 | 1.384 | 1.156 | .125 | 1.359 | 1.359 |
| 22 | 1.459 | 1.507 | 1.250 | .125 | 1.468 | 1.484 |
| 24 | 1.584 | 1.634 | 1.375 | .156 | 1.593 | 1.609 |

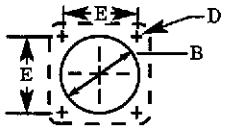



JAMNUT MOUNT
(WITH LOCATING PIN) WHERE LOCATING PIN IS NOT USED IF DIMN REMAINING THE SAME




JAMNUT MOUNT
(WITH FLANGE CUTOUT FOR LOCATING PIN)

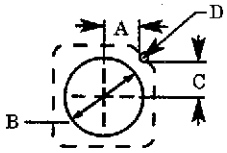
WITHOUT LOCATING PIN



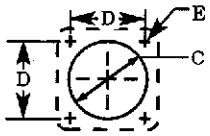

FLANGE MOUNT

Table 3-18b. MIL-C-5015 General Purpose Connector Cutouts – (English units/inches)

| SHELL SIZE | A ±.005 | B +.015 -.000 | C ±.005 | D | E ±.005 | REDUCED FLANGE |
|---|---|---|---|---|---|---|
| 8 | .323 | .500 | .371 | .128 | .594 | - |
| 10 | .385 | .625 | .416 | .128 | .719 | .625 |
| 12 | .448 | .750 | .459 | .128 | .812 | .664 |
| 14 | .510 | .875 | .504 | .128 | .906 | .730 |
| 16 | .573 | 1.000 | .548 | .128 | .968 | .844 |
| 18 | .635 | 1.125 | .637 | .128 | 1.062 | - |
| 20 | .698 | 1.250 | .681 | .128 | 1.156 | - |
| 22 | .760 | 1.375 | .725 | .128 | 1.250 | - |
| 24 | .823 | 1.500 | .769 | .156 | 1.375 | - |
| 28 | .948 | 1.750 | .857 | .156 | 1.562 | - |
| 32 | 1.073 | 2.000 | .946 | .182 | 1.750 | - |
| 36 | 1.198 | 2.250 | 1.034 | .182 | 1.938 | - |
| 40 | - | 2.500 | 1.122 | .182 | 2.187 | - |




JAMNUT MOUNT




FLANGE MOUNT

Table 3-19b. MIL-C-22992 Heavy Duty Connector Cutouts – (English units/inches)

| SHELL SIZE | A ±.005 | B | C +.015 -.000 | D ±.005 | E | |
|---|---|---|---|---|---|---|
| 12 | .549 | .125 | .875 | .906 | .157 | |
| 14 | .593 | .125 | 1.000 | .969 | .157 | |
| 16 | .686 | .125 | 1.125 | 1.062 | .157 | |
| 18 | .726 | .125 | 1.250 | 1.156 | .185 | |
| 20 | .770 | .125 | 1.375 | 1.250 | .185 | |
| 22 | .814 | .125 | 1.500 | 1.375 | .185 | |
| 24 | .903 | .125 | 1.750 | 1.562 | .185 | |
| 28 | .981 | .125 | 2.000 | 1.750 | .185 | |
| 32 | 1.080 | .125 | 2.250 | 1.938 | .218 | |
| 36 | 1.167 | .125 | 2.500 | 2.188 | .218 | |
| 40 | 1.276 | .125 | 2.750 | 2.375 | .218 | |

Figure 3-7b. Mounting Hole Cutouts - (English units/inches)

# SECTION IV

# ACCESSORIES

## 4.1 ACCESSORIES FOR MIL-C-5015 CONNECTORS

The accessories that are supplied as part of the connector are normally discarded and the accessories listed below are installed to provide for special fabrication at KSC.

Table 4-1. Connector Backshell Molding Adapters and Boots for commonly used shell sizes

| SHELL SIZES | | | | | | | MS3109 BOOTS | | |
|---|---|---|---|---|---|---|---|---|---|
| SOLDER MS3106 | CRIMP MS3456 | THREAD SIZE | BACKSHELL ADAPTERS 75M13303 | MS3158 * | M85049/31 & /60 * | MS3419 * | FOR MS PARTS | FOR 75M13303 | NOTES |
| | 8S | .500-20 | | -8C | -8GC | -8C | -11AC | | |
| 10SL | | .562-24 | -1 | -3C | -3GC | -3C | -11AC | -14AC | 1 |
| 12S | 10SL | .625-24 | -3 | -10C | -10GC | -10C | -12AC | -14AC | 2 |
| 14, 14S | 12S | .750-20 | -5 | -12C | -12GC | -12C | -12AC | -14AC | |
| 16, 16S | 14, 14S | .875-20 | -7 | -14C | -14GC | -14C | -13AC | -15AC | |
| 18 | 16, 16S | 1.000-20 | -8 | -16C | -16GC | -16C | -14AC | -15AC | |
| | 18 | 1.062-18 | | -18C | -18GC | -18C | -14AC | | |
| 20 | | 1.125-18 | -9 | | | | | -16AC | |
| | 20 | 1.188-18 | | -20C | -20GC | -20C | -15AC | | |
| 22 | | 1.250-18 | -10 | | | | | -16AC | |
| | 22 | 1.312-18 | | -22C | -22GC | -22C | -15AC | | |
| 24 | | 1.375-18 | -11 | | | | | -16AC | |
| | 24 | 1.438-18 | | -24C | -24GC | -24C | -16AC | | |
| 28 | | 1.625-18 | -12 | | | | | -17AC | |
| | 28 | 1.750-18 | | -28C | -28GC | -28C | -16AC | | |
| 32 | | 1.875-16 | -13 | | | | | -17AC | |
| | 32 | 2.000-18 | | -32C | -32GC | -32C | -17AC | | |
| 36 | | 2.062-16 | -14 | | | | | -18AC | 3 |
| 36 | | 2.125-16 | -15 | | | | | -18AC | 5 |
| | 36 | 2.250-16 | | -36C | -36GC | -36C | -17AC | | |
| 40 | | 2.312-16 | -16 | | | | | -18AC | 4 |
| 40 | | 2.375-16 | -17 | | | | | -18AC | 6 |
| | 40 | 2.500-16 | | -40C | -40GC | -40C | -18AC | | |
| | 44 | 2.750-16 | | -44C | -44GC | -44C | -18AC | | |

NOTES:

1. For MS3106R10SL Cannon Connectors
2. For MS3106R10SL Bendix Connectors
3. For MS3106R36 Bendix Connectors
4. For MS3106R40 Bendix Connectors
5. For MS3106R36 Cannon Connectors
6. For MS3106R40 Cannon Connectors

* Not recommended for molding adapters but acceptable for potting boots.

Other acceptable adapters are: 75M13304, 80K51161, 80K51302, 80K56934, 80K51393, 80K52525, 10-262441 (Bendix), M85049/52 (MS3417) strain relief.

MS3MS3419 backshells are used with MS3161 shield rings to terminate the overall shield to the connector shell.

Do not specify -2, -4, or -6 molding adapters per 75M13303 since they are identical to -3, -5, and -7 respectively.

MS3100 and MS3101 receptacles use same hardware as MS3106.

MS3400, MS3401, MS3450, and MS3451 receptacles use same hardware as MS3456.

Adapters per 80K56934 may also be used for shield-to-shell termination.

## 4.2 ELECTRO ADAPTER BACKSHELL FOR MIL-C-22992 CONNECTOR

| Part No. Breakdown | 13632 | - | 40 | 16 | - | 10 | 03 |
|---|---|---|---|---|---|---|---|
| Code | 1 | | 2 | 3 | | 4 | 5 |

Electro Adapter Co. P/N — 1
Connector Shell Size — 2
Cable Entry Code — 3
Length (in quarter inches) — 4
Finish Code — 5

Table 4-2. Electro Adapter Backshells for MIL-C-22992 Connectors

| ELECTRO ADAPTER 13632 (CODE 1) | | | | CABLE ENTRY DATA (CODE 3) | | |
|---|---|---|---|---|---|---|
| CODE 2 SHELL SIZE | THREAD, LH CLASS 2B | OD MAX mm (in.) | CODE 3 RANGE | NUMBER | CABLE DIA mm (in.) | THREAD, RH CLASS 2A |
| 12 | .750-20 | 23.012 (.906) | 03 TO 06 | 03 | 6.350 (.250) | .500-28 |
| 14 | .875-20 | 26.187 (1.031) | 03 TO 08 | 04 | 7.925 (.312) | .625-24 |
| 16 | 1.000-20 | 29.362 (1.156) | 04 TO 10 | 06 | 11.125 (.438) | .750-20 |
| 18 | 1.125-18 | 32.537 (1.281) | 04 TO 12 | 08 | 14.275 (.562) | .875-20 |
| 20 | 1.250-18 | 35.712 (1.406) | 06 TO 12 | 10 | 15.875 (.625) | 1.000-20 |
| 22 | 1.375-18 | 38.887 (1.531) | 06 TO 16 | 12 | 19.050 (.750) | 1.188-18 |
| 24 | 1.625-18 | 46.838 (1.844) | 08 TO 16 | 16 | 23.825 (.938) | 1.433-18 |
| 28 | 1.875-16 | 53.188 (2.094) | 08 TO 20 | 20 | 31.750 (1.250) | 1.750-18 |
| 32 | 2.062-16 | 57.937 (2.281) | 10 TO 24 | 24 | 34.925 (1.375) | 2.000-18 |
| 36 | 2.312-16 | 64.287 (2.531) | 12 TO 40 | 28 | 41.275 (1.625) | 2.250-16 |
| 40 | 2.625-16 | 72.238 (2.844) | 12 TO 40 | 32 | 47.625 (1.875) | 2.500-16 |
| | | | | 40 | 60.325 (2.375) | 3.000-16 |

Code 4: 10 (63.500 mm [2-1/2"]) minimum up to any desired length.

Code 5: 03 only: Cadmiun, olive drab, per QQ-P-416, Type II, Class 3.

NOTE:

To determine cable diameter refer to KSC-SPEC-E-0031 cable index.

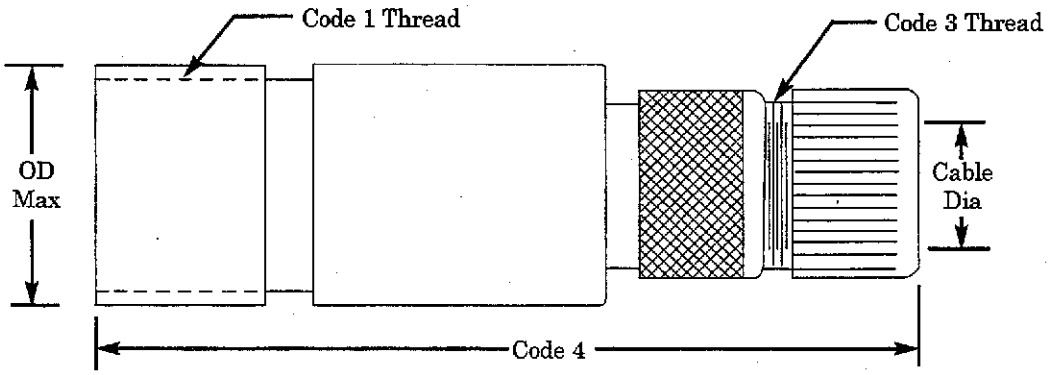



Figure 4-1. Electro Adapter Backshells for MIL-C-22992 Connectors

## 4.3 BACKSHELL ADAPTERS FOR MIL-C-22992 SERVICE CLASS L CONNECTORS-BENDIX 360°

10-560555-221

Basic Bendix No. — Shell Size and Cable Entry Suffix

At present only shell sizes 22, 24, and 40 are in production. Other shell sizes may be procured upon request.

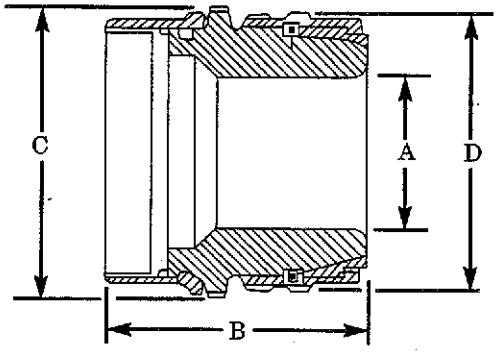



Figure 4-2. Backshell Adapters for MIL-C-22992 Service Class L Connectors

Backshells per 79K24801 are recommended for 360° shield-to-shell termination.

Table 4-3. Backshell Adapters for MIL-C-22992 Service Class L Connectors

| DASH NO. | THREAD, LH CLASS 2B | A DIA mm (in) | B LNG mm (in) | C DIA mm (in) | D APPROX DIA mm (in) | BOOT MS3109 |
|---|---|---|---|---|---|---|
| 221 | 1.375 - 18UNEF | 25.273 (.995) | 70.256 (2.766) | 45.898 (1.807) | 45.898 (1.807) | -17 |
| 222 | 1.375 - 18UNEF | 18.339 (.722) | 70.256 (2.766) | 40.742 (1.604) | 37.795 (1.488) | -16 |
| 223 | 1.375 - 18UNEF | 13.538 (.533) | 70.256 (2.766) | 40.742 (1.604) | 33.757 (1.329) | -16 |
| 224 | 1.375 - 18UNEF | 9.601 (.378) | 70.256 (2.766) | 40.742 (1.604) | 30.531 (1.202) | -15 |
| 241 | 1.625 - 18UNEF | 31.344 (1.234) | 76.098 (2.996) | 50.724 (1.997) | 52.324 (2.060) | -17 |
| 401 | 2.625 - 16UN | 54.102 (2.130) | 76.098 (2.996) | 74.828 (2.946) | 74.955 (2.951) | -18 |
| 402 | 2.625 - 16UN | 47.752 (1.880) | 76.098 (2.996) | 74.828 (2.946) | 68.097 (2.681) | -18 |
| 403 | 2.625 - 16UN | 41.402 (1.630) | 76.098 (2.996) | 74.828 (2.946) | 62.027 (2.442) | -17 |
| 404 | 2.625 - 16UN | 35.052 (1.380 | 76.098 2.996 | 74.828 2.946 | 55.575 2.188 | -17 |
| 405 | 2.625 - 16UN | 31.877 (1.255) | 76.098 (2.996) | 74.828 (2.946) | 52.324 (2.060) | -17 |
| 406 | 2.625 - 16UN | 23.952 (0.943) | 76.098 (2.996) | 74.828 (2.946) | 44.247 (1.742) | -16 |

NOTES:

To determine "A" diameter refer to Table 2-1. Other acceptable adapters are 10-242067 (Bendix) 75M14303.

## 4.4 MOLDING ADAPTER FOR MIL-C-22992 SERVICE CLASS R OR P CONNECTOR

10-242067 - x x x

- Adapter Finish (5 is preferred finish)
- Connector Shell Size

This is used for molding where 360° shielding is unnecessary. This adapter is included as a part of some HK-series connectors. Refer to comparison Table 3-11. Also a 10-130999-xx plastic encapsulation end bell is furnished with above connectors and molding adapter.

10-281666-xx where xx is connector shell size. This is a tapered plastic end bell that can be cut to fit various sizes of cables.

## 4.5 KERN ENGINEERING BACKSHELL ADAPTER CT0594 FOR MIL-C-22992 CONNECTORS

| Part No. Breakdown | CT0594 | 161 | D | 10 | N | 5 | G |
|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Basic No. — 1
Order No. — 2
Function — 3
Cable Code — 4
Clamp Type — 5
Length (12.7 mm [1/2"] increments) — 6
Finish — 7

NOTE:

When writing part number, omit spaces between letters and numbers.

Code 1. BASIC NUMBER. for left hand threaded adapter

Code 2. ORDER NO.

Table 4-4. Backshell Adapter Order No.

| ORDER NO. | SHELL SIZE | THREAD, LH CLASS 2B | OD MAX mm (in.) |
|---|---|---|---|
| 121 | 12 | .750-20 | 23.800 (.937) |
| 141 | 14 | .875-20 | 26.975 (1.062) |
| 161 | 16 | 1.000-20 | 30.150 (1.187) |
| 181 | 18 | 1.185-18 | 33.325 (1.312) |
| 201 | 20 | 1.250-18 | 36.500 (1.437) |
| 221 | 22 | 1.375-18 | 39.675 (1.562) |
| 241 | 24 | 1.625-18 | 46.025 (1.812) |
| 281 | 28 | 1.875-16 | 52.375 (2.062) |
| 321 | 32 | 2.062-16 | 58.725 (2.312) |
| 361 | 36 | 2.312-16 | 65.075 (2.562) |
| 401 | 40 | 2.625-16 | 73.025 (2.875) |

Code 3. FUNCTION. (D is the only function designation used at KSC)

Code 4. CABLE CODE.

Table 4-5. Backshell Adapter Cable Code

| CABLE CODE | CABLE DIA. RANGE mm (in.) | OD OF REAR mm (in.) | CABLE CODE | CABLE DIA. RANGE mm (in.) | OD OF REAR mm (in.) |
|---|---|---|---|---|---|
| 04 | 4.064 - 12.700 (.160 - .500) | 30.150 (1.187) | 15 | 38.989 - 47.625 (1.535 - 1.875) | 65.075 (2.562) |
| 05 | 7.239 - 15.875 (.285 - .625) | 33.325 (1.312) | 16 | 42.164 - 50.800 (1.660 - 2.000) | 68.250 (2.687) |
| 06 | 10.414 - 19.050 (.410 - .750) | 36.500 (1.437) | 17 | 45.339 - 53.975 (1.785 - 2.125) | 71.425 (2.812) |
| 07 | 13.589 - 22.225 (.535 - .875) | 39.675 (1.562) | 18 | 48.514 - 57.150 (1.910 - 2.250) | 74.600 (2.937) |
| 08 | 16.764 - 25.400 (.660 - 1.000) | 42.850 (1.687) | 19 | 51.689 - 60.325 (2.035 - 2.375) | 77.775 (3.062) |
| 09 | 19.939 - 28.575 (.785 - 1.125) | 46.025 (1.812) | 20 | 54.864 - 63.500 (2.160 - 2.500) | 80.950 (3.187) |
| 10 | 23.114 - 31.750 (.910 - 1.250) | 49.200 (1.937) | 21 | 58.039 - 66.675 (2.285 - 2.625) | 84.125 (3.312) |
| 11 | 26.289 - 34.925 (1.035 - 1.375) | 52.375 (2.062) | 22 | 61.214 - 69.850 (2.410 - 2.750) | 87.300 (3.437) |
| 12 | 29.464 - 38.100 (1.160 - 1.500) | 55.550 (2.187) | 23 | 64.389 - 73.025 (2.535 - 2.875) | 90.475 (3.562) |
| 13 | 32.639 - 41.275 (1.285 - 1.625) | 58.725 (2.312) | 24 | 67.564 - 76.200 (2.660 - 3.000) | 93.650 (3.687) |
| 14 | 35.814 - 44.450 (1.410 - 1.750) | 61.900 (2.437) | | | |

NOTE:

To determine cable diameter, refer to Table 2-1.

5. CLAMP TYPE.
   N = Nut
   C = Clamp

6. LENGTH. Given in 12.7 mm (1/2") increments. Shortest length that will provide sufficient space for required termination. For cable without conductor shields, use 50.8 mm (2") length.

7. FINISH.
   *G - Cadmium Plate over electroless nickel. A, B, D, E, F - are accepted

*Preferred

## 4.6 BACKSHELLS FOR MIL-C-26482 SERIES 2 CONNECTORS

Table 4-6. Backshells for MIL-C-26482 Series 2 Connectors

| SHELL SIZE | BENDIX | 75M13303 | MS3416 | MS3419 | MS3158 | THREAD |
|---|---|---|---|---|---|---|
| 8 | 10-262441-105 | 75M13303-21 | -8GC | -8C | -8C | .500 - 20 |
| 10 | 10-262441-125 | 75M13303-3 | -10GC | -10C | -10C | .625 - 24 |
| 12 | 10-262441-145 | 75M13303-5 | -12GC | -12C | -12C | .750 - 20 |
| 14 | 10-262441-165 | 75M13303-7 | -14GC | -14C | -14C | .875 - 20 |
| 16 | 10-262441-185 | 75M13303-8 | -16GC | -16C | -16C | 1.000 - 20 |
| 18 | 10-247908-183 | | -18GC | -18C | -18C | 1.062 - 18 |
| 20 | 10-247908-203 | | -20GC | -20C | -20C | 1.188 - 18 |
| 22 | 10-247908-223 | | -22GC | -22C | -22C | 1.312 - 18 |
| 24 | 10-247908-243 | | -24GC | -24C | -24C | 1.438 - 18 |

NOTES:

1. If Series 1 connectors are used, shell sizes 8 through 16 have different backthreads and other backshells must be specified; e.g., Bendix Part number 10-247908-xx3 where xx is the shell size.

2. 80K52525 molding adapter to be used on shell size 12.

## 4.7 BACKSHELL FOR MIL-C-38999 CONNECTORS

| Part No. Breakdown | MS27666 | B | - | 12 | - | 1 |
|---|---|---|---|---|---|---|
| Code | 1 | 2 | | 3 | | 4 |

Code 1. MS NO.

Finish

Shell size

Configuration

Code 2. FINISH.

*B - Olive Drab Cadmium Plate over Nickel (Conductive)
F - Electroless-Nickel Coating (Conductive)

Code 3. SHELL SIZE.

Table 4-7. MIL-C-38999 Backshell Size

| SHELL SIZE | THREAD SIZE | OD mm (in.) | ENTRY DIA. [mm (in.)] |
|---|---|---|---|
| 8 | 7/16 - 28 | 14.275 (.562) | 7.137 (.281) |
| 10 | 9/16 - 24 | 17.450 (.687) | 8.712 (.343) |
| 12 | 11/16 - 24 | 20.625 (.812) | 11.100 (.437) |
| 14 | 13/16 - 20 | 23.800 (.937) | 14.275 (.562) |
| 16 | 15/16 - 20 | 26.975 (1.062) | 15.875 (.625) |
| 18 | 1-1/16 - 18 | 30.150 (1.187) | 17.450 (.687) |
| 20 | 1-3/16 - 18 | 33.325 (1.312) | 19.050 (.750) |
| 22 | 1-5/16 - 18 | 36.500 (1.437) | 22.225 (.875) |
| 24 | 1-7/16 - 18 | 39.675 (1.562) | 25.400 (1.000) |

Code 4. CONFIGURATION.

*-1 Straight
-2 90° Elbow Long Backshell
-3 90° Elbow Short Backshell without Encapsulating Holes
-4 90° Elbow Short Backshell with Encapsulating Holes
-5 90° Elbow with Strain Relief
-6 Straight Backshell with Strain Relief

NOTE:

For shell sizes 18 through 24, the MS3158 backshell may be used.

*Preferred

## 4.8 END BELL, POTTING, ELECTRICAL CONNECTOR, SHORT

Table 4-8. MS310X (Short)

| PART NUMBER | A DIA [mm (in.)] | | | B mm (in.) | C | D DIA mm (in.) |
|---|---|---|---|---|---|---|
| | +.000 (.000) -.010 (.254) | +.000 (.000) -.015 (.381) | +.000 (.000) -.020 (.508) | | | |
| 10-130999-8 | 13.106 (.516) | | | 27.559 (1.085) | 22° | 7.315 (.288) |
| 10-130999-10 | 15.469 (.609) | | | 27.559 (1.085) | 22° | 9.119 (.359) |
| 10-130999-12 | 19.456 (.766) | | | 27.559 (1.085) | 22° | 12.294 (.484) |
| 10-130999-13 | 19.456 (.766) | | | 32.334 (1.273) | 22° | 12.294 (.484) |
| 10-130999-14 | 21.438 (.844) | | | 27.559 (1.085) | 22° | 15.469 (.609) |
| 10-130999-15 | 21.438 (.844) | | | 32.334 (1.273) | 22° | 15.469 (.609) |
| 10-130999-16 | 24.613 (.969) | | | 27.559 (1.085) | 22° | 18.644 (.734) |
| 10-130999-17 | 24.613 (.969) | | | 32.334 (1.273) | 22° | 18.644 (.734) |
| 10-130999-18 | 27.788 (1.094) | | | 31.547 (1.242) | 22° | 21.819 (.859) |
| 10-130999-20 | | 30.963 (1.219) | | 31.547 (1.242) | 22° | 24.994 (.984) |
| 10-130999-22 | | 34.138 (1.344) | | 31.547 (1.242) | 22° | 28.169 (1.109) |
| 10-130999-24 | | 37.313 (1.469) | | 29.947 (1.179) | 22° | 31.334 (1.234) |
| 10-130999-28 | | 43.663 (1.719) | | 29.947 (1.179) | 22° | 36.246 (1.427) |
| 10-130999-32 | | | 50.800 (2.000) | 27.965 (1.101) | 34° | 43.383 (1.708) |
| 10-130999-36 | | | 56.363 (2.219) | 27.965 (1.101) | 34° | 48.133 (1.895) |
| 10-130999-40 | | | 62.713 (2.469) | 27.965 (1.101) | 34° | 54.102 (2.130) |
| 10-130999-44 | | | 70.663 (2.782) | 27.965 (1.101) | 34° | 62.052 (2.443) |
| 10-130999-48 | | | 77.368 (3.046) | 27.965 (1.101) | 34° | 68.758 (2.707) |

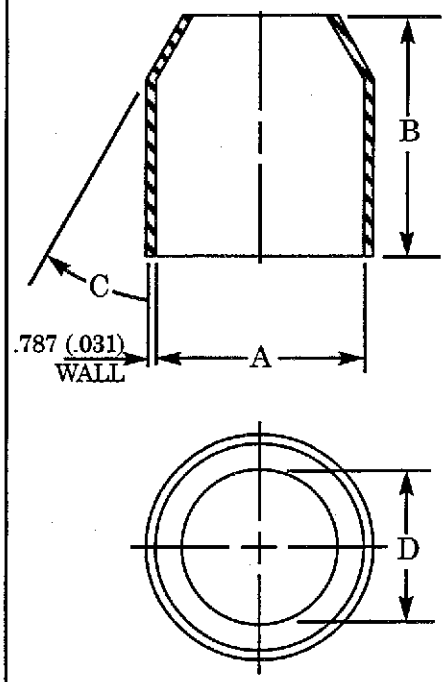



Figure 4-3. MS310X (Short)

## 4.9 END BELL, POTTING, ELECTRICAL CONNECTOR, LONG

Table 4-9. MS310X (Long)

| PART NUMBER | A DIA [mm (in.)] | | | B mm (in.) | C mm (in.) | D mm (in.) | E mm (in.) | |
|---|---|---|---|---|---|---|---|---|
| | +.000 (.000) -.254 (.010) | +.000 (.000) -.381 (.015) | +.000 (.000) -.508 (.020) | +.000 (.000) -.254 (.010) | | | +.254 (.010) -.000 (.000) | +.381 (.015) -.000 (.000) |
| 10-281666-8 | 13.106 (.516) | | | 76.098 (2.996) | 12.598 (.496) | 6.350 (.250) | .787 (.031) | |
| 10-281666-10 | 15.469 (.609) | | | 80.569 (3.172) | 17.069 (.672) | 6.350 (.250) | .787 (.031) | |
| 10-281666-12 | 19.456 (.766) | | | 87.960 (3.463) | 24.460 (.963) | 6.350 (.250) | .787 (.031) | |
| 10-281666-14 | 21.438 (.844) | | | 91.643 (3.608) | 28.143 (1.108) | 6.350 (.250) | .787 (.031) | |
| 10-281666-16 | 24.613 (.969) | | | 97.536 (3.840) | 34.036 (1.340) | 6.350 (.250) | .787 (.031) | |
| 10-281666-18 | 27.788 (1.094) | | | 103.372 (4.075) | 40.005 (1.575) | 6.350 (.250) | .787 (.031) | |
| 10-281666-20 | | 30.963 (1.219) | | 109.372 (4.306) | 45.872 (1.806) | 6.350 (.250) | .787 (.031) | |
| 10-281666-22 | | 34.138 (1.344) | | 115.341 (4.541) | 51.841 (2.041) | 6.350 (.250) | .787 (.031) | |
| 10-281666-24 | | 37.313 (1.469) | | 121.234 (4.773) | 57.734 (2.273) | 6.350 (.250) | .787 (.031) | |
| 10-281666-28 | | 43.663 (1.719) | | 127.203 (5.008) | 63.703 (2.508) | 9.525 (.375) | .787 (.031) | |
| 10-281666-32 | | | 50.800 (2.000) | 153.213 (6.032) | 77.013 (3.032) | 9.525 (.375) | | .787 (.031) |
| 10-281666-36 | | | 56.363 (2.219) | 157.683 (6.208) | 81.483 (3.208) | 12.700 (.500) | | .787 (.031) |
| 10-281666-40 | | | 62.713 (2.469) | 157.683 (6.208) | 81.483 (3.208) | 12.700 (.500) | | .787 (.031) |

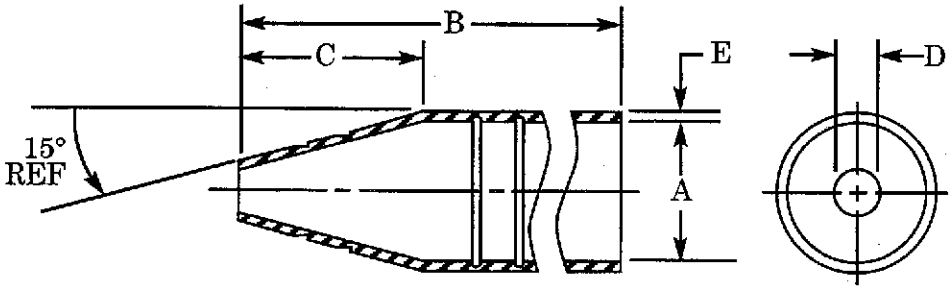



Figure 4-4. MS310X (Long)

## 4.10 END BELL, POTTING, ELECTRICAL CONNECTOR, PYGMY SHORT

Table 4-10. MS310X (Pygmy Short)

| PART NUMBER | DIMENSIONS [mm(in.)] | | | | IDENT NO |
|---|---|---|---|---|---|
| | A +.000 (.000) -.254 (.010) | B +.000 (.020) -.254 (.010) | C | D DIA | |
| 10-314998-4 | 9.957 (.392) | 25.400 (1.000) | 5.994 (.234) | 5.131 (.202) | 65 |
| 10-314998-8 | 13.106 (.516) | 25.400 (1.000) | 5.994 (.234) | 8.306 (.327) | 85 |
| 10-314998-10 | 16.307 (.642) | 31.750 (1.250) | 5.994 (.234) | 11.278 (.444) | 105 |
| 10-314998-12 | 19.456 (.766) | 31.750 (1.250) | 5.994 (.234) | 14.173 (.558) | 125 |
| 10-314998-14 | 22.657 (.892) | 38.100 (1.500) | 5.994 (.234) | 17.348 (.683) | 145 |
| 10-314998-16 | 25.857 (1.018) | 38.100 (1.500) | 5.994 (.234) | 20.523 (.808) | 165 |
| 10-314998-18 | 29.007 (1.142) | 38.100 (1.500) | 5.994 (.234) | 23.089 (.909) | 185 |
| 10-314998-20 | 32.207 (1.268) | 38.100 (1.500) | 5.994 (.234) | 26.772 (1.054) | 205 |
| 10-314998-22 | 35.357 (1.392) | 38.100 (1.500) | 5.994 (.234) | 29.439 (1.159) | 225 |
| 10-314998-24 | 38.557 (1.518) | 38.100 (1.500) | 5.994 (.234) | 32.614 (1.284) | 245 |

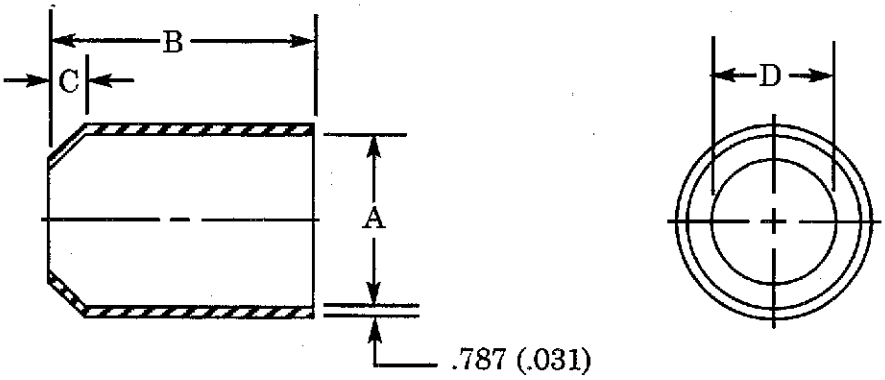



Figure 4-5. MS310X (Pygmy Short)

## 4.11 END BELL, POTTING, ELECTRICAL CONNECTOR, PYGMY LONG

Table 4-11. MS310X (Pygmy Long)

| PART NUMBER | DIMENSIONS [mm(in.)] | | | | | NO. OF GROOVES | IDENT NO |
|---|---|---|---|---|---|---|---|
| | A +.000 (.000) -.254 (.010) | B +.000 (.020) -.254 (.010) | C | D +.254 (.010) -.000 (.000) | E | | |
| 10-261999-6 | NOT AVAILABLE | | | | | | |
| 10-261999-8 | 13.106 (.516) | 75.870 (2.987) | 12.370 (.487) | .787 (.031) | .127 – .254 (.005 – .010) | 2 | 87 |
| 10-261999-10 | 16.307 (.642) | 81.839 (3.222) | 18.339 (.722) | .787 (.031) | .127 – .254 (.005 – .010) | 3 | 107 |
| 10-261999-12 | 19.456 (.766) | 87.732 (3.454) | 24.232 (.954) | .787 (.031) | .127 – .254 (.005 – .010) | 5 | 127 |
| 10-261999-14 | 22.657 (.892) | 93.701 (3.689) | 30.201 (1.189) | .787 (.031) | .127 – .254 (.005 – .010) | 7 | 147 |
| 10-261999-16 | 25.857 (1.018) | 99.670 (3.924) | 36.170 (1.424) | .787 (.031) | .127 – .254 (.005 – .010) | 9 | 167 |
| 10-261999-18 | 29.007 (1.142) | 105.537 (4.155) | 42.037 (1.655) | .787 (.031) | .127 – .254 (.005 – .010) | 11 | 187 |
| 10-261999-20 | 32.207 (1.268) | 111.506 (4.390) | 48.006 (1.890) | .787 (.031) | .127 – .254 (.005 – .010) | 13 | 207 |
| 10-261999-22 | 35.357 (1.392) | 117.399 (4.622) | 53.899 (2.122) | .787 (.031) | .127 – .254 (.005 – .010) | 15 | 227 |
| 10-261999-24 | 38.557 (1.518) | 123.596 (4.866) | 60.096 (2.366) | .787 (.031) | .127 – .254 (.005 – .010) | 17 | 247 |

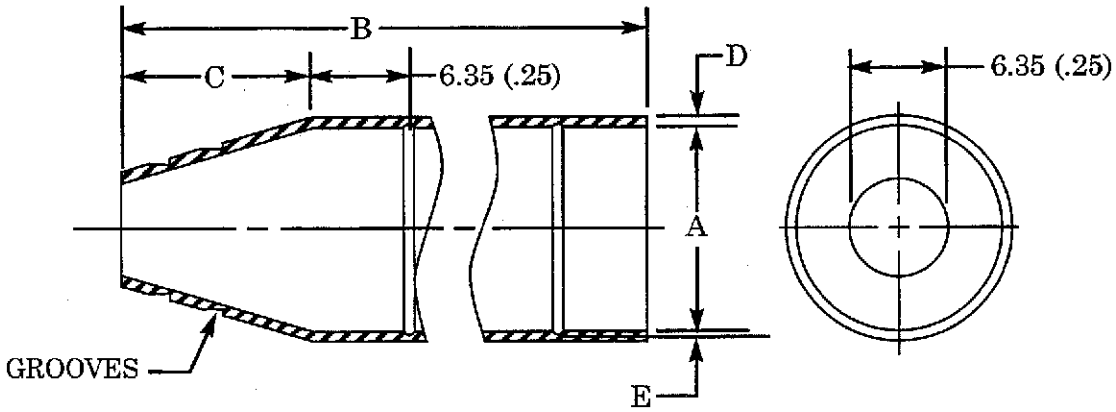



Figure 4-6. MS310X (Pygmy Long)

## 4.12 PROTECTION COVERS (CAPS) FOR MIL-C-5015

Table 4-12. Protection Covers (Caps) for MIL-C-5015

| PLUGS | | | | | RECEPTACLES | | | | |
|---|---|---|---|---|---|---|---|---|---|
| METAL MS25042 | THREAD SIZE | CHAIN LENGTH mm (in.) | MTG HOLE mm (in.) | PLASTIC MS90376 | METAL MS25043 | THREAD SIZE | CHAIN LENGTH mm (in.) | MTG HOLE mm (in.) | PLASTIC MS90376 |
| -8D | .500 - 28 | 101.600 (4.00) | 3.962 (.156) | -8Y | -8D | .500 - 28 | 101.600 (4.00) | 3.556 (.140) | -8R |
| -10D | .625 - 24 | 101.600 (4.00) | 3.962 (.156) | -10Y | -10D | .625 - 24 | 101.600 (4.00) | 3.556 (.140) | -10R |
| -12D | .750 - 20 | 101.600 (4.00) | 3.962 (.156) | -12Y | -12D | .750 - 20 | 114.300 (4.50) | 3.556 (.140) | -12R |
| -14D | .875 - 20 | 101.600 (4.00) | 3.962 (.156) | -14Y | -14D | .875 - 20 | 114.300 (4.50) | 3.556 (.140) | -14R |
| -16D | 1.000 - 20 | 101.600 (4.00) | 3.962 (.156) | -16Y | -16D | 1.000 - 20 | 114.300 (4.50) | 3.556 (.140) | -16R |
| -18D | 1.125 - 18 | 101.600 (4.00) | 3.962 (.156) | -18Y | -18D | 1.125 - 18 | 114.300 (4.50) | 3.556 (.140) | -18R |
| -20D | 1.250 - 18 | 127.000 (5.00) | 4.750 (.187) | -20Y | -20D | 1.250 - 18 | 127.000 (5.00) | 3.556 (.140) | -20R |
| -22D | 1.375 - 18 | 127.000 (5.00) | 4.750 (.187) | -22Y | -22D | 1.375 - 18 | 127.000 (5.00) | 3.556 (.140) | -22R |
| -24D | 1.500 - 18 | 139.700 (5.50) | 4.750 (.187) | -24Y | -24D | 1.500 - 18 | 139.700 (5.50) | 4.343 (.171) | -24R |
| -28D | 1.750 - 18 | 196.850 (7.75) | 4.750 (.187) | -28Y | -28D | 1.750 - 18 | 196.850 (7.75) | 4.343 (.171) | -28R |
| -32D | 2.000 - 18 | 196.850 (7.75) | 5.537 (.218) | -32Y | -32D | 2.000 - 18 | 196.850 (7.75) | 4.750 (.187) | -32R |
| -36D | 2.250 - 16 | 196.850 (7.75) | 5.537 (.218) | -36Y | -36D | 2.250 - 16 | 196.850 (7.75) | 4.750 (.187) | -36R |
| -40D | 2.500 - 16 | 196.850 (7.75) | 5.537 (.218) | -40Y | -40D | 2.500 - 16 | 196.850 (7.75) | 4.750 (.187) | -40R |
| -44D | 2.750 - 16 | 196.850 (7.75) | 5.537 (.218) | -44Y | -44D | 2.750 - 16 | 196.850 (7.75) | 4.750 (.187) | -44R |

Drawing callouts will be selected from the table above, but 75M13306, 75M13307, MS25177, MS25178, or vendor part number caps may be used as direct substitutes. Metal caps are preferred but plastic caps may be used when metal caps are not available. All caps stocked at KSC are equipped with a stainless steel sash chain with eyelet but other configurations are acceptable unless specific configuration is required. The "C" suffix on the dash number may also be used, when available. Chain lengths are different that those shown, however.

## 4.13 PROTECTION COVERS (CAPS) FOR MIL-C-26482.

Table 4-13. Protection Covers (Caps) for MIL-C-26482

| PLUGS | | | | RECEPTACLES | | | |
|---|---|---|---|---|---|---|---|
| METAL MS3180 | CHAIN LENGTH mm (in.) | MTG HOLE mm (in.) | PLASTIC MS90376 | METAL MS3181 | CHAIN LENGTH mm (in.) | MTG HOLE mm (in.) | PLASTIC MS90376 |
| -8C | 76.200 (3.00) | 4.115 (.162) | -8Y | -8C | 76.200 (3.00) | 4.115 (.162) | -8Y |
| -10C | 76.200 (3.00) | 4.115 (.162) | -8R | -8R | 76.200 (3.00) | 4.115 (.162) | -10R |
| -12C | 88.900 (3.50) | 4.115 (.162) | -12Y | -12C | 88.900 (3.50) | 4.115 (.162) | -14Y |
| -14C | 88.900 (3.50) | 4.115 (.162) | -12R | -14C | 88.900 (3.50) | 4.115 (.162) | -16Y |
| -16C | 88.900 (3.50) | 4.115 (.162)) | -16Y | -16C | 88.900 (3.50) | 4.115 (.162) | -18Y |
| -18C | 88.900 (3.50) | 4.115 (.162) | -16R | -18C | 88.900 (3.50) | 4.115 (.162) | -20Y |
| -20C | 101.600 (4.00) | 4.115 (.162) | -18R | -20C | 101.600 (4.00) | 4.115 (.162) | -22Y |
| -22C | 101.600 (4.00) | 4.115 (.162) | -20R | -22C | 101.600 (4.00) | 4.115 (.162) | -24Y |
| -24C | 101.600 (4.00) | 4.115 (.162) | -22R | -24C | 101.600 (4.00) | 4.115 (.162) | -24R |

Drawing callouts will be selected from the above table, but 75M13706, 76M13707, or vendor part number caps may be used as direct substitutes. Metal caps are preferred but plastic caps may be used when metal caps are unavailable. All caps stocked at KSC have stainless steel sash chain with eyelet but caps without chains or other configurations may be substituted unless specific configuration is required

## 4.14 METAL PROTECTION COVERS (CAPS) FOR MIL-C-22992 CONNECTORS

| Part No. Breakdown | MS17349 | N | 40 | B |
|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 |

NOTE:

When writing part numbers, omit spaces between letters and numbers.

Code 1. MS NUMBER.

a. *MS17349 Receptacle protection covers.
b. *MS17350 Plug protection covers.

Code 2. COVER FINISH.

C - for conductive
*N - for nonconductive (better corrosion resistance conductivity is not necessary)

Code 3. COVER SIZE. Shell size of connector used

Code 4. COVER TYPE. (MS17349 only)

A - has washer for use with HK01 and HK04 connectors
*B - has eyelet for use with HK00 and HK02 connectors
(either chain type may be used unless specific configuration is required)

*Preferred

## 4.15 EQUIVALENT BENDIX PROTECTION COVERS FOR MIL-C-22992

| Part No. Breakdown | 10-524917 | - | 40 | 5 |
|---|---|---|---|---|
| Code | 1 | | 2 | 3 |

Code 1. BASIC NUMBER.

10-524915 plug cover with chain with eyelet
10-524916 receptacle cover with chain with eyelet
10-524917 receptacle cover with chain and ring

Code 2. COVER SIZE. Shell size of connector used

Code 3. FINISH.

5 - nonconductive alumilite finish
9 - conductive olive drab cadmium plate over nickel

NOTE:

Older style Bendix protection covers, Part Number 10-350693 (plug) and 10-350694 (receptacle) may be used until supply is exhausted.

## 4.16 PROTECTION COVERS (CAPS) FOR MIL-C-38999

| Part No. Breakdown | MS27510 | B | 10 | C | L |
|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 |

NOTE:

When writing part numbers, omit spaces between letters and numbers.

Code 1. MS NUMBER.

MS27501 (Series I) - Plug Protection Cover
MS27510 (Series II) - Plug Protection Cover

MS27502 (Series I) - Receptacle Protection Cover
MS27511 (Series II) - Receptacle Protection Cover

Code 2. FINISH. (all are conductive except C)

A - Bright
*B - Olive Drab Cadmium Over Nickel
C - Hard, Anodic
D - Fused Tin Plate, Carbon Steel
E - SST, Passivated
F - Nickel, Dull
N - Hermetic Seal, SST

Code 3. COVER SIZE. Shell Size of Connector Used

Code 4. STYLE.

C - Chain
A - Without Chain
N - Chain and Ring (MS27511 Only)
R - Rope (MS27511 Only)

Code 5. CHAIN LENGTH.

*(Leave blank for standard length)
Standard Length: shell sizes 8 and 10, 76.2 mm (3"); 12 through 18, 88.9 mm (3.5"); 20, 22, and 24, 101.6 mm (4")

L - 27 mm (5")
M - 152.4 mm (6") - Only MS27510
N - 177.8 mm (7") - Only MS27510

*Preferred

## 4.17 ADAPTER - CONNECTOR TO CONDUIT (75M04097)

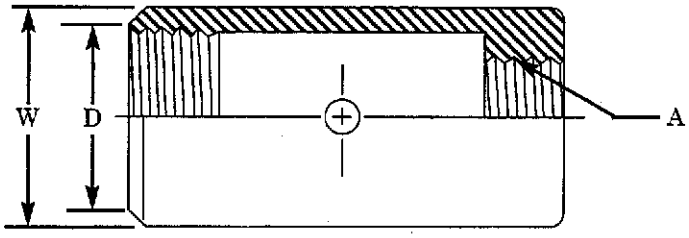



Figure 4-7. Adapter - Connector to Conduit

Table 4-14. Adapter, Connector to Conduit

| 75M04097 DASH NO. | CONNECTOR SPEC | SHELL SIZE | THREAD FOR (V) CONNECTOR | (W) OD mm (in.) | (D) ID CONN END mm (in.) | PIPE (A) THREAD |
|---|---|---|---|---|---|---|
| -1 | MIL-C-22992 | 12 | .750 -20UNEF-2B-LH | 23.800 (.937) | 16.129 (.635) | 1/2 X 14NPT |
| -2 | MIL-C-22992 | 14 | .875 -20UNEF-2B-LH | 26.975 (1.062) | 19.304 (.760) | 1/2 X 14NPT |
| -3 | MIL-C-22992 | 16 | 1.000 -20UNEF-2B-LH | 30.150 (1.187) | 22.479 (.885) | 1/2 X 14NPT |
| -4 | MIL-C-22992 | 18 | 1.125 -18NEF-2B-LH | 33.325 (1.312) | 25.502 (1.004) | 1/2 X 14NPT |
| -5 | MIL-C-22992 | 20 | 1.250 -18NEF-2B-LH | 36.500 (1.437) | 28.677 (1.129) | 1/2 X 14NPT |
| -6 | MIL-C-22992 | 22 | 1.375 -18NEF-2B-LH | 39.675 (1.562) | 31.852 (1.254) | 1/2 X 14NPT |
| -7 | MIL-C-5015 | 10* & 12 | .625 -24NEF-2B-RH | 25.400 (1.000) | 14.681 (.578) | 1/2 X 14NPT |
| -8 | MIL-C-5015 | 14 | .750 -20UNEF-2B-RH | 25.400 (1.000) | 17.856 (.703) | 1/2 X 14NPT |
| -9 | MIL-C-5015 | 16 | 1.000 -20UNEF-2B-RH | 28.575 (1.125) | 21.031 (.828) | 1/2 X 14NPT |
| -10 | MIL-C-5015 | 18 | 1.125 -20UNEF-2B-RH | 31.750 (1.250) | 24.206 (.953) | 1/2 X 14NPT |
| -11 | MIL-C-5015 | 20 | 28.575 -18NEF-2B-RH | 36.500 (1.437) | 28.575 (1.125) | 1/2 X 14NPT |
| -12 | MIL-C-5015 | 22 | 1.250 -18NEF-2B-RH | 38.100 (1.500) | 30.150 (1.187) | 1/2 X 14NPT |
| -13 | MIL-C-22992 | 18 | 1.125 -18NEF-2B-LH | 33.325 (1.312) | 25.502 (1.004) | 3/4 X 14NPT |
| -14 | MIL-C-5015 | 10** | .562 2-24NEF-2B-RH | 25.400 (1.000) | 13.208 (.520) | 1/2 X 14NPT |

* Bendix 10 Shell Size
** Cannon 10 Shell Size

## 4.18 CRIMP CONTACT ADAPTER

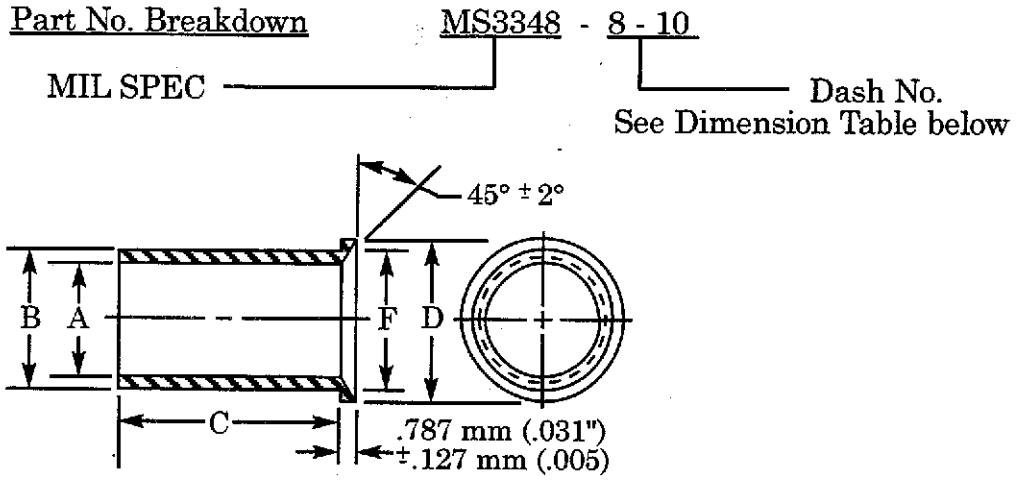



Figure 4-8. Crimp Contact Adapter

Table 4-15. Contact Adapter Dimension Table

| DASH NUMBER | CONTACT WIRE BARREL SIZE (REF) | WIRE SIZE (.076) (REF) | A +1.295 (.051) -1.930 (.076) mm (in.) | B +1.295 (.051) -1.930 (.406) mm (in.) | C +10.973 (.432) -10.312 mm (in.) | D ±10.312 (.406) (.127) mm (in.) | F +.3.861 (.152) -3.226 mm (in.) |
|---|---|---|---|---|---|---|---|
| -8 -10 | 8 | 10 | 3.454 (.136) | 4.394 (.173) | 9.652 (.380) | 6.350 (.250) | 4.775 (.188) |
| -4 -6 | 4 | 6 | 5.715 (.225) | 6.909 (.272) | 9.652 (.380) | 8.738 (.344) | 7.417 (.292) |
| -0 -2 | 1/0 | 2 | 9.119 (.359) | 11.278 (.444) | 13.614 (.536) | 13.106 (.516) | 11.735 (.462) |
| -4 -6L | 4 | 6 | 5.715 (.225) | 6.909 (.272) | 17.780 (.700) | 8.738 (.344) | 7.417 (.292) |
| -1 -2L | 1 | 2 | 9.119 (.359) | 10.058 (.396) | 17.780 (.700) | 13.081 (.515) | 10.719 (.422) |
| -4 -5L | 4 | 5 | 6.350 (.250) | 6.909 (.272) | 17.780 (.700) | 8.738 (.344) | 7.417 (.292) |
| -6 -8L | 6 | 8 | 4.699 (.185) | 5.715 (.225) | 17.780 (.700) | 7.544 (.297) | 6.350 (.250) |
| -6 -9L | 6 | 9 | 3.937 (.155) | 5.715 (.225) | 17.780 (.700) | 7.544 (.297) | 5.563 (.219) |
| -1 -6L | 1 | 6 | 5.715 (.225) | 10.058 (.396) | 17.780 (.700) | 13.106 (.516) | 10.719 (.422) |
| -4/0 -2/0L | 4/0 | 2/0 | 12.700 (.500) | 15.977 (.629) | 17.780 (.700) | 18.263 (.719) | 14.275 (.562) |
| -4 -8L | 4 | 8 | 4.699 (.185) | 6.909 (.272) | 17.780 (.700) | 8.738 (.344) | 6.350 (.250) |
| -6 -10L | 6 | 10 | 3.454 (.136) | 5.715 (.225) | 17.780 (.700) | 7.544 (.297) | 4.775 (.188) |

NOTE:

Material: Copper alloy contact bushings -8 -10, -4 -6 and -0 -2 are for use with wire barrels conforming to MS3190, Types B and C. Contact bushing -( ) -( )L is for use with contacts MS90559 and MS90560.

## 4.19 WIRE TO CONTACT REDUCING ADAPTERS

Reducing adapters are used to accommodate wires larger or smaller than the wire size of the contact being used.

ESC Technologies, Inc. Part Number Designation

229441 SS 20 - 16

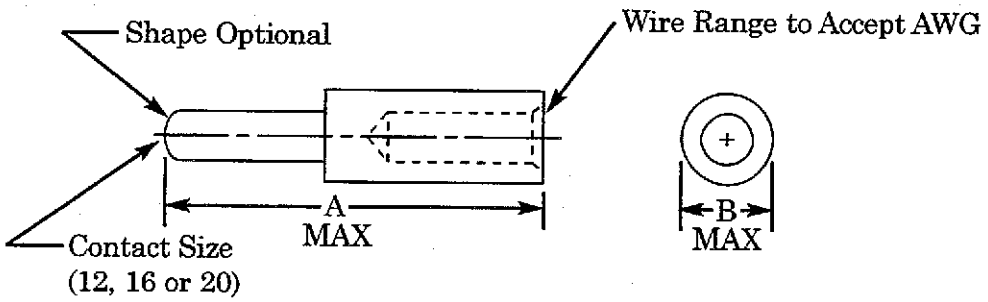
ESC Part No. — 229441
Finish — SS
Contact Size — 20
Wire Range — 16

GS - Gold over nickel
SS - Silver flash
TT - Tin plate

Table 4-16. Reducing Adapter Table

| ESC, INC. PART NO. | SOURIAU PART NO. | CONTACT SIZE | WIRE RANGE | A MAX mm (in.) | B MAX mm (in.) |
|---|---|---|---|---|---|
| 229441*12-10 | - | 12 | 8-10 | 25.654 (1.010) | 6.985 (.275) |
| 229441*16-12 | - | 16 | 12-14 | 16.256 (.640) | 4.064 (.160) |
| - | 8500-1985 | 16 | 20 | | |
| 229441*20-12 | - | 20 | 12-14 | 13.716 (.540) | 4.064 (.160) |
| 229441*20-16 | - | 20 | 16-18 | 15.875 (.625) | 2.794 (.110) |
| 229441*22-20 | | 20 | 20-22 | 13.487 (.531) | 1.397 (.055) |
| - | 8500-781 | 20 | 30-24 | | |

* Finish



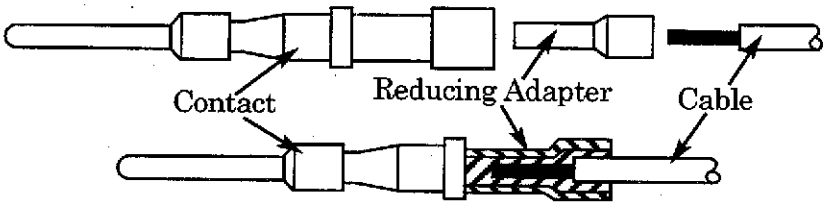




Figure 4-9. Reducing Adapters

## 4.20 WIRE END CAP - CRIMP STYLE

Table 4-17. Wire End Cap - Crimp Style

| MS NUMBER | WIRE SIZE | WIRE BARREL DIA (MAX) mm (in.) | OUTSIDE DIA mm (in.) | COLOR CODE |
|---|---|---|---|---|
| MS25274-1 | 26-24 | .889 (.035) | 5.461 (.215) | YELLOW |
| MS25274-2 | 22-18 | 1.626 (.064) | 5.461 (.215) | RED |
| MS25274-3 | 16-14 | 2.286 (.090) | 6.223 (.245) | BLUE |
| MS25274-4 | 12-10 | 3.556 (.140) | 8.001 (.315) | YELLOW |

Crimping tools: MS90413 for sizes 26 through 14, MS3316 for sizes 12 through 10.

## 4.21 FLANGE GASKETS (BENDIX)

10-36675-xx (xx is connector shell size -55°C to 135°C temperature range [-67° to +275°F]).

*10-40450-xx (xx is connector shell size -17.778°C to 125°C temperature range [-0° to 257°F]).

## 4.22 SOLDER

All solder used for tinning and solder connections shall conform to NASA-STD-8739.3.

## 4.23 WIRE WELL DATA FOR MIL-C-22992 CONNECTORS

For test cables the smallest wire size required may be soldered into any wire well size, e.g., a #24 wire may be soldered into a size 0 wire well.

Table 4-18. Wire Well Data for MIL-C-22992 Connectors

| WIRE WELL SIZE | 0 | 4 | 8 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|
| WIRE SIZES | 0, 1, 2 | 4, 6 | 8, 10 | 12, 14 | 14, 16, 18, 20 | 16, 18, 20, 22 |

## 4.24 INSULATION SLEEVING, HEAT SHRINKABLE (MIL-I-23053)

| Part No. Breakdown | M23053/5 | 3 | 11 | 0 |
|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 |

Code 1. SPECIFICATION SHEET IDENTIFIER.

| | |
|---|---|
| *M23053/1 | Polychloroprene, Flexible |
| M23053/2 | Polyvinyl Chloride, Flexible |
| M23053/3 | Polyvinyl Chloride, Semi-Rigid |
| M23053/4 | Polyolefin, Dual-wall, Rigid Outer Wall, Crosslinked |
| *M23053/5 | Polyolefin, Flexible Crosslinked |
| M23053/6 | Polyolefin, Semi-Rigid, Crosslinked |
| M23053/7 | Polyethelene, Terephthalate |
| M23053/8 | Polyvinylidene Fluoride, Semi-Rigid, Crosslinked |
| M23053/9 | Fluorosilicone Rubber, Flexible (canceled) |
| M23053/10 | Silicone Rubber, Flexible |
| M23053/11 | Fluorinated Ethylene Propylene |
| M23053/12 | Polytetrafluoroethtlene |
| M23053/13 | Fluoroelastomer, Flexible |
| M23053/14 | Ethylene-Tetrafluorethylene, Semi-Rigid |
| *M23053/15 | Polyolefin, Heavy wall, Coated, Flexible |
| M23053/16 | Elastomeric Polyolefin, Flexible |

Code 2. CLASS. (See applicable specification sheet for other slash numbers)

| | | |
|---|---|---|
| M23053/1 | 1xx-x | -55°C to +90°C |
| *M23053/1 | 2xx-x | -70°C to +121°C |
| M23053/5 | 1xx-x | -55°C to +135°C (flame resistant) |
| M23053/5 | 2xx-x | -55°C to +135°C (flammable, clear) |
| *M23053/5 | 3xx-x | -40°C to +135°C (highly flame resistant) |
| *M23053/15 | 1xx-x | -55°C to +110°C |
| M23053/15 | 21xx-x | -55°C to +110°C |

Code 3. SIZE. (See applicable specification sheets for other than /1, /5, and /15 slash numbers. Values shown are: Minimum ID as supplied, maximum ID after unrestricted shrinkage, and nominal wall thickness after unrestricted shrinkage (wall thickness will be less when shrinkage is restricted). Sizes 15 through 23 are high shrinkage.

Table 4-19. Insulation Sleeving, Heat Shrinkable (MIL-I-23053)

| *M23053/5-1xx-x<br>M23053/5-2xx-C (Clear only)<br>*M23053/5-3xx-x | | | | |
|---|---|---|---|---|
| xx | ID [mm (in)] | ID [mm (in)] | WALL [mm (in)] | CLASS |
| 01 | 1.168 (.046) | .584 (.023) | .406 (.016) | ALL |
| 02 | 1.600 (.063) | .787 (.031) | .432 (.017) | ALL |
| 03 | 2.362 (.093) | 1.143 (.045) | .508 (.020) | ALL |
| 04 | 3.175 (.125) | 1.575 (.062) | .508 (.020) | ALL |
| 05 | 4.750 (.187) | 2.362 (.093) | .508 (.020) | ALL |
| 06 | 6.350 (.250) | 3.175 (.125) | .635 (.025) | ALL |
| 07 | 9.525 (.375) | 4.750 (.187) | .635 (.025) | ALL |
| 08 | 12.700 (.500) | 6.350 (.250) | .635 (.025) | ALL |
| 09 | 19.050 (.750) | 9.525 (.375) | .762 (.030) | ALL |
| 10 | 25.400 (1.000) | 12.700 (.500) | .889 (.035) | ALL |
| 11 | 38.100 (1.500) | 19.050 (.750) | 1.016 (.040) | ALL |
| 12 | 50.800 (2.000) | 25.400 (1.000) | 1.143 (.045) | 1 & 2 |
| 13 | 76.200 (3.000) | 38.100 (1.500) | 1.270 (.050) | 1 & 2 |
| 14 | 101.600 (4.000) | 50.800 (2.000) | 1.397 (.055) | 1 & 2 |
| 15 | 25.400 (1.000) | 6.985 (.275) | 1.143 (.045) | 1 |
| 16 | 50.800 (2.000) | 13.970 (.550) | 1.143 (.045) | 1 |
| 17 | 76.200 (3.000) | 20.574 (.810) | 1.143 (.045) | 1 |
| 18 | 101.600 (4.000) | 26.670 (1.050) | 1.143 (.045) | 1 |
| 19 | 25.400 (1.000) | 11.735 (.462) | 1.143 (.045) | 1 |
| 20 | 60.325 (2.375) | 17.272 (.680) | 1.143 (.045) | 1 |
| 21 | 76.200 (3.000) | 21.336 (.840) | 1.143 (.045) | 1 |
| 22 | 95.250 (3.750) | 23.622 (.930) | 1.143 (.045) | 1 |
| 23 | 114.300 (4.500) | 36.830 (1.450) | 1.143 (.045) | 1 |

Table 4-19. (Cont.) Insulation Sleeving, Heat Shrinkable (MIL-I-23053)

| M23053/15-1xx-x<br>M23053/15-2xx-x | | | | |
|---|---|---|---|---|
| xx | ID [mm (in)] | ID [mm (in)] | WALL [mm (in)] | CLASS |
| 01 | 19.050 (.750) | 5.588 (.220) | 2.667 (.105) | 1 |
| 01 | 10.160 (.400) | 3.810 (.150) | 1.524 (.060) | 2 |
| 02 | 27.940 (1.100) | 9.525 (.375) | 3.048 (.120) | 1 |
| 02 | 19.050 (.750) | 5.588 (.220) | 1.524 (.060) | 2 |
| 03 | 38.100 (1.500) | 12.700 (.500) | 3.556 (.140) | 1 |
| 03 | 27.940 (1.100) | 9.525 (.375) | 2.667 (.105) | 2 |
| 04 | 50.800 (2.00) | 19.050 (.750) | 3.937 (.155) | 1 |
| 04 | 33.020 (1.300) | 9.525 (.375) | 2.667 (.105) | 2 |
| 05 | 76.200 (3.00) | 31.750 (1.250) | 3.937 (.155) | 1 |
| 05 | 38.100 (1.500) | 12.700 (.500) | 3.048 (.120) | 2 |
| 06 | 101.600 (4.00) | 44.450 (1.750) | 3.937 (.155) | 1 |
| 06 | 43.180 (1.700) | 12.700 (.500) | 3.556 (.140) | 2 |
| 07 | 68.580 (2.700) | 22.860 (.900) | 3.937 (.155) | 2 |

| M23053/1-1xx-0<br>*M23053/1-2xx-0 | | | |
|---|---|---|---|
| xx | ID [mm (in)] | ID [mm (in)] | WALL [mm (in)] |
| 01 | 6.350 (.250) | 3.632 (.143) | .889 (.035) |
| 02 | 9.525 (.375) | 5.359 (.211) | 1.016 (.040) |
| 03 | 12.700 (.500) | 7.264 (.286) | 1.219 (.048) |
| 04 | 15.875 (.625) | 9.068 (.357) | 1.321 (.052) |
| 05 | 19.050 (.750) | 10.871 (.428) | 1.448 (.057) |
| 06 | 22.225 (.875) | 12.700 (.500) | 1.651 (.065) |
| 07 | 25.400 (1.000) | 14.478 (.570) | 1.778 (.070) |
| 08 | 31.750 (1.250) | 18.136 (.714) | 2.210 (.087) |
| 09 | 38.100 (1.500) | 21.768 (.857) | 2.413 (.095) |
| 10 | 44.450 (1.750) | 25.400 (1.000) | 2.718 (.107) |
| 11 | 50.800 (2.000) | 28.956 (1.140) | 2.794 (.110) |
| 12 | 76.200 (3.000) | 43.434 (1.710) | 3.175 (.125) |
| 13 | 101.600 (4.000) | 57.912 (2.280) | 3.556 (.140) |

NOTE:

Sizes 15 through 23 are high shrinkage.

Code 4. COLOR DESIGNATOR. Specify Black only (0), if other colors required, see specification.

## 4.25 MS TERMINAL LUGS

Table 4-20. MS Terminal Lugs

| WIRE SIZE | STUD SIZE | MS20659 UNINSULATED | MS25036 INSULATE |
|---|---|---|---|
| 18-22 | No. 4 | -138 | -148 |
| | No. 6 | -101 | -101, -102 |
| | No. 8 | - | -149 |
| | No.10 | -102 | -103 |
| | 1/4 | - | -150 |
| | 5/16 | -161 | -104 |
| | 3/8 | -125 | -105 |
| | 1/2 | -162 | -151 |
| 14-16 | No. 4 | -139 | -152 |
| | No. 6 | -126, -103 | -106, -107 |
| | No. 8 | - | -153 |
| | No. 10 | -104 | -108 |
| | 1/4 | - | -154 |
| | 5/16 | -163 | -109 |
| | 3/8 | -127 | -110 |
| | 1/2 | -164 | -155 |
| 10-12 | No. 6 | -165 | -111 |
| | No. 8 | - | -156 |
| | No. 10 | -105 | -112 |
| | 1/4 | - | -157 |
| | 5/16 | -106 | -113 |
| | 3/8 | -128 | -114 |
| | 1/2 | -166 | -158 |
| 8 | No. 8 | -140 | - |
| | No. 10 | -107 | -115 |
| | 1/4 | -141 | -116 |
| | 5/16 | -108 | -117 |
| | 3/8 | -129 | -118 |
| | 1/2 | -142 | - |
| 6 | No.10 | -130 | -119 |
| | 1/4 | -109 | -120 |
| | 5/16 | -131 | -121 |
| | 3/8 | -110 | -122 |
| | 1/2 | -143 | - |
| 4 | No.10 | -144 | - |
| | 1/4 | -111 | -123 |
| | 5/16 | -132 | -124 |
| | 3/8 | -112 | -125 |
| | 1/2 | -145 | - |
| 2 | No.10 | -146 | - |
| | 1/4 | -113 | -126 |
| | 5/16 | -147 | - |
| | 3/8 | -114 | -127 |
| | 7/16 | -148 | - |
| | 1/2 | -133 | -128 |
| 0 | 1/4 | -117 | -132 |
| | 5/16 | -151 | - |
| | 3/8 | -118 | -133 |
| | 7/16 | -152 | - |
| | 1/2 | -135 | -134 |
| 0000 | 5/16 | -157 | - |
| | 3/8 | -123 | -140 |
| | 7/16 | -158 | - |
| | 1/2 | -124 | -141 |
| | 5/8 | -159 | - |
| | 3/4 | -160 | - |
| | 7/8 | -137 | - |

## 4.26 TAPE, PRESSURE SENSITIVE, POLYESTER FILM

Table 4-21. Tape, Pressure Sensitive, Polyester Film

| SPECIFICATION | TYPE AND DESCRIPTION | GENERAL NOTES |
|---|---|---|
| L-T-100 | Type I | Prevents unwrapping of barrier tape and provides a snug fit over the inner shield ring. |
| | Transparent, Polyester, Solvent, Resistant | 19.050 mm (3/4") wide is KSC stocked width and size used on cables. |

## 4.27 COMPOUND, POTTING/MOLDING, ELASTOMERIC, URETHANE

Table 4-22. Compound, Potting/Molding, Elastomeric, Urethane

| MSFC SPECIFICATION | TYPE | SHORE A HARDNESS SCALE | TENSILE STRENGTH N/m (lb/in) | MANUFACTURER DESIGNATION | MANUFACTURER AND FSCM CODE |
|---|---|---|---|---|---|
| MSFC-SPEC 515 | I | 60-90 | 350252.76 (2000) | PR-1535 | PRC DeSoto Kennesaw, GA 30122 FSCM Code: 83574 |
| (Where KSC-E-0029 Type III compound is specified, MSFC-SPEC-515, Type I is authorized.) | II | 60-90 | 262689.57 (1500) | PR-1590 | PRC DeSoto Kennesaw, GA 30122 FSCM Code: 83574 |

## 4.28 COMPOUND, POTTING, MOLDING, RESIN

Table 4-23. Compound, Potting/Molding, Resin

| MSFC SPECIFICATION | TYPE | HARDNESS SCALE | MANUFACTURER DESIGNATION | MANUFACTURER AND FSCM CODE |
|---|---|---|---|---|
| MSFC-SPEC-222 General Purpose For connector potting | II | 89+5 | Stycast 2651 | Emerson-Cuming Div. Canton, Mass FSCM: 04552 |

# APPENDIX A

# CABLE VENDORS

Table A-1. Cable Vendors

| Section Table | Product Description | Brand Name/Type | Company | Address | Cage No. | Phone |
|---|---|---|---|---|---|---|
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Alpha Wire Corp. | 711 Lidgerwood Ave. Elizabeth, NJ | 92194 | 908-925-8000 800-522-5742 |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Belden Wire & Cable Co. | 10355 Sanden Dr, P.O.Box 38413 Dallas, TX 75238 | | 800-553-3154 972-463-9473 |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Columbia | | | |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Consolidated Electronic Wire & Cable | 11044 King Street Franklin Park, IL 901301 | 73612 | 847-455-8830 800-621-4278 |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Daburn Electronics & Cable Co. | 224 Pegaus Ave. Northvale, NJ | 25706 | 201-768-5400 |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | Dearborn Wire & Cable, L.P. | 250 West Carperter Ave. Wheeling, IL | 28105 | 800-323-0198 847-459-1000 |
| 2.1 to 2.3 Tables | Conductor & Conductor Sets | Various | SJO | | ODZH3 | |
| 3.2 Table | Circular Connectors | Various | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 3.2 Table | Circular Connectors | Various | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 3.2 Table | Circular Connectors | Various | Bumcly-Framatone Connectors | 2700 WoodlandParkDr, Suite1218 Houston, TX 77082 | | 281-293-0411 800-678-6681x3O17 |
| 3.2 Table | Circular Connectors | Various | Cinch Connector, UK (rep. By South Atlantic) | | U1718 | 407-857-3650 |
| 3.2 Table | Circular Connectors | Various | Deutsch Connectors | 3850 Industrial Ave. Hemet, CA 92545 | 11139 | 909-849-7844 |
| 3.2 Table | Circular Connectors | Various | G & H Technology | 750 W Ventura Blvd. Camarillo, CA 93010 | ODOV6 | 805-484-0543 |
| 3.2 Table | Circular Connectors | Various | ITT Cannon RIF Products | 585 East Main St. New Britain, CT 06015 | 98291 | 860-223-2700 |
| 3.2 Table & 3.5 Section | Circular Connectors | MIL-C-38999, Series I | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix77820 Pyle 49367 Matrix 14283 | 607-563-5011 |

Table A-1. (Cont.) Cable Vendors

| Section Table | Product Description | Brand Name/Type | Company | Address | Cage No. | Phone |
|---|---|---|---|---|---|---|
| 3.2 Table & 3.5 Section | Circular Connectors | MIL-C-38999, Series 11 | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 | 607-563-5011 Matrix 14283 |
| 3.4 Section | Circular Connectors | 40M38298 (NBS Type) | ITT Cannon RF Products | 585 East Main St. New Britain, CT 06015 | 98291 | 860-223-2700 |
| 3.9 Section | Circular Bulkhead Connector | 10-874xx-xS | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 3.9 Section | Circular Bulkhead Connector | BFR-xx-xS | ITT Cannon RF Products | 585 East Main St. New Britain, CT 06015 | 98291 1 | 860-223-2700 |
| 3.9 Section | Circular Jam Nut Connector | 10-873-xS | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 3.9 Section | Circular Jam Nut Connector | RTFxx-xS | ITT Cannon RF Products | 585 East Main St. New Britain, CT 06015 | 98291 | 860-223-2700 |
| 4.1 Section | Boots | MS3109 | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 4.1 Section | Boots | MS3109 | ITT Cannon RF Products | 585 East Main St. New Britain, CT 06015 | 98291 | 860-223-2700 |
| 4.2 Section | Backshell Adapter | MIL-C-22992 | Electro- Adapter Inc. | 20640 Nordhoff St. Chatsworth, CA 91311 | 31461 | 818-998-1198 |
| 4.5 Section | Backshell Adapter | MIL-C-22992 (CT0594) | Kern Engineering & Manufacturing | 1146 East Ash Ave. Fullerton, CA 92831 | 50619 | 714-992-9630 |
| 4.9 Section | Protection Covers | MIL-C-22992 | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 4.12 Section | Adapter - Connector to Conduits | 75MO4097 | Amphenol Aerospace (also was Bendix, Pyle, Matrix) | 40-60 Delaware Ave. Sidney, NY 13838 | Bendix 77820 Pyle 49367 Matrix 14283 | 607-563-5011 |
| 4.12 Section | Adapter - Connector to Conduits | 75MO4097 | ITT Cannon RF Products | 585 East Main St. New Britain, CT | 98291 | 860-223-2700 |

# APPENDIX B

# WIRE CHARACTERISTICS

Table B-1. Wire Characteristics

| WIRE SIZE | STRANDS NO. | STRANDS SIZE mm (in.) | OHMS/ 300 m (1000') | CONDUCTOR DIA mm (in.) | CONDUCTOR CM | INS DIA mm (in.) | kg/ 300 m (lb/1000') | AMP | SPEC |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 19 | .201 (.0063) | 16.43 (16.70) | .965 (.030) | 755 | 1.676 (.059) | 1.96 (4.40) | 5 | 16878 |
| 20 | 19 | .201 (.0079) | 10.33 (10.50) | .965 (.038) | 1200 | 1.676 (.066) | 2.81 (6.30) | 7.5 | 16878 |
| 20 | 19 | .201 (.0079) | 10.33 (10.50) | .965 (.038) | 1200 | 1.321 (.052) | | 7.5 | PE |
| 18 | 19 | .254 (.010) | 6.46 (6.57) | 1.219 (.048) | 1909 | 1.930 (.076) | 3.83 (8.60) | 10 | 16878 |
| 18 | 19 | .254 (.010) | 6.46 (6.57) | 1.219 (.048) | 1909 | 2.083 (.082) | | 10 | PE |
| 16 | 19 | .287 (.0113) | 4.77 (4.85) | 1.448 (.057) | 2409 | 1.676 (.066) | 4.77 (10.70) | 13 | 16878 |
| 16 | 19 | .287 (.0113) | 4.77 (4.85) | 1.448 (.057) | 2409 | 2.311 (.091) | | 13 | PE |
| 14 | 19 | .361 (.0142) | 2.94 (2.99) | 1.930 (.076) | 3830 | 2.972 (.117) | 7.32 (16.40) | 17 | 5086 |
| 14 | 19 | .361 (.0142) | 2.94 (2.99) | 1.930 (.076) | 3830 | 3.048 (.120) | | 17 | PE |
| 12 | 19 | .455 (.0179) | 1.85 (1.88) | 2.438 (.096) | 6088 | 3.480 (.137) | 11.02 (24.70) | 23 | 5086 |
| 12 | 19 | .455 (.0179) | 1.85 (1.88) | 2.438 (.096) | 6088 | 3.556 (.140) | | 23 | PE |
| 10 | 49 | .361 (.0142) | 1.14 (1.16) | 3.251 (.128) | 9880 | 4.801 (.189) | 19.64 (44.0) | 33 | 5086 |
| 10 | 104 | .254 (.010) | 1.14 (1.16) | 3.251 (.128) | 9880 | 5.639 (.222) | | 33 | EPR |
| 8 | 133 | .287 (.0113) | .68 (.70) | 4.470 (.176) | 16864 | 6.096 (.240) | 31.25 (70.0) | 46 | 5086 |
| 8 | 133 | .287 (.0113) | .68 (.70) | 4.470 (.176) | 16864 | 7.620 (.240) | | 46 | EPR |
| 6 | 133 | .361 (.0142) | .429 (.436) | 5.537 (.218) | 26813 | 7.442 (.293) | 49.10 (110) | 60 | 5086 |
| 6 | 133 | .361 (.0142) | .429 (.436) | 5.537 (.218) | 26813 | 8.687 (.342) | | 60 | EPR |
| 4 | 133 | .455 (.0179) | .270 (.274) | 6.909 (.272) | 42613 | 9.017 (.355) | 73.66 (165) | 80 | 5086 |
| 4 | 133 | .455 (.0179) | .270 (.274) | 6.909 (.272) | 42613 | 10.058 (.396) | | 80 | EPR |
| 2 | 665 | .254 (.010) | .176 (.179) | 8.763 (.345) | 66832 | 10.795 (.425) | 111.61 (250) | 100 | 5086 |
| 2 | 259 | .511 (.0159) | .176 (.179) | 8.763 (.345) | 66832 | 12.929 (.509) | | 100 | EPR |
| 0 | 1045 | .254 (.010) | .112 (.114) | 10.973 (.432) | 105022 | 13.335 (.525) | 178.57 (400) | 150 | 5086 |
| 0 | 259 | .574 (.0201) | .112 (.114) | 10.973 (.432) | 105022 | 14.935 (.588) | | 150 | EPR |
| 00 | 1330 | .254 (.010) | .107 (.109) | 12.446 (.490) | 133665 | 14.986 (.590) | 223.22 (500) | 175 | 5086 |
| 00 | 259 | .574 (.0226) | .107 .109 | 12.446 (.490) | 133665 | 16.408 (.646) | | 175 | EPR |

Table B-1. (Cont.) Wire Characteristics

| WIRE SIZE | STRANDS NO. | STRANDS SIZE mm (in.) | OHMS/ 300 m (1000') | CONDUCTOR DIA mm (in.) | CONDUCTOR CM | INS DIA mm (in.) | kg/ 300 m (lb/1000') | AMP | SPEC |
|---|---|---|---|---|---|---|---|---|---|
| 000 | 1665 | .254 (.010) | .071 (.072) | 13.919 (.548) | 167332 | 16.510 (.650) | 276.79 (620) | 200 | 5086 |
| 0000 | 2109 | .254 (.010) | .056 (.057) | 15.621 (.615) | 211954 | 18.288 (.720) | 350.46 (785) | 225 | 5086 |
| 0000 | 427 | .574 (.0226) | .0517 (.0525) | 15.291 (.602) | 211954 | 19.253 (.758) | | 225 | EPR |
| 250M | 6384 | .160 (.0063) | .0424 (.0431) | 18.110 (.713) | | 22.098 (.870) | 366.53* (821)* | | NEMA |
| 300M | 7581 | .160 (.0063) | .0534 (.0360) | 19.507 (.768) | | 24.282 (.956) | 435.28* (975)* | | NEMA |
| 350M | 8806 | .160 (.0063) | .0303 (.0308) | 20.955 (.825) | | 25.324 (.997) | 504.48* (1130)* | | NEMA |
| 500M | 12691 | .160 (.0063) | .0213 (.0216) | 25.324 (.997) | | 29.667 (1.168) | 727.71* (1630)* | | NEMA |
| 750M | 18788 | .160 (.0063) | .0142 (.0144) | 30.658 (1.207) | | 37.948 (1.494) | 1078.17* (2415)* | | NEMA |
| 1000M | 25193 | .160 (.0063) | .0106 (.0108) | 36.043 (1.419) | | 41.580 (1.637) | 1446.49* (3240)* | | NEMA |

STRAND TABLE

| SIZE | DIA mm (in.) | CM |
|---|---|---|
| 23 | .574 (.0226) | 510 |
| 24 | .511 (.201) | 404 |
| 25 | .455 (.0179) | 320 |
| 26 | .404 (.0159) | 254 |
| 27 | .361 (.0142) | 201 |
| 28 | .320 (.0126) | 160 |
| 29 | .284 (.0112) | 127 |
| 30 | .254 (.0100) | 100 |
| 31 | .226 (.0089) | 80 |
| 32 | .201 (.0079) | 63 |
| 33 | .180 (.0071) | 50 |
| 34 | .160 (.0063) | 40 |
| 35 | .142 (.0056) | 32 |
| 36 | .127 (.0050) | 25 |

*WT with no insulation

LEGEND

16878 – MIL-W-16878/1, PVC insulation, nylon jacket
5086 – MIL-W-5086 Type 1, nylon jacket
PE – KSC-SPEC-E-0031, polyethylene insulation
EPR – KSC-SPEC-E-0031, ethylene propylene rubber insulation
NEMA – NEMA Publication No. WC3-1959, Table 6 (IPCEA Publication No. S-19-81)

# APPENDIX C

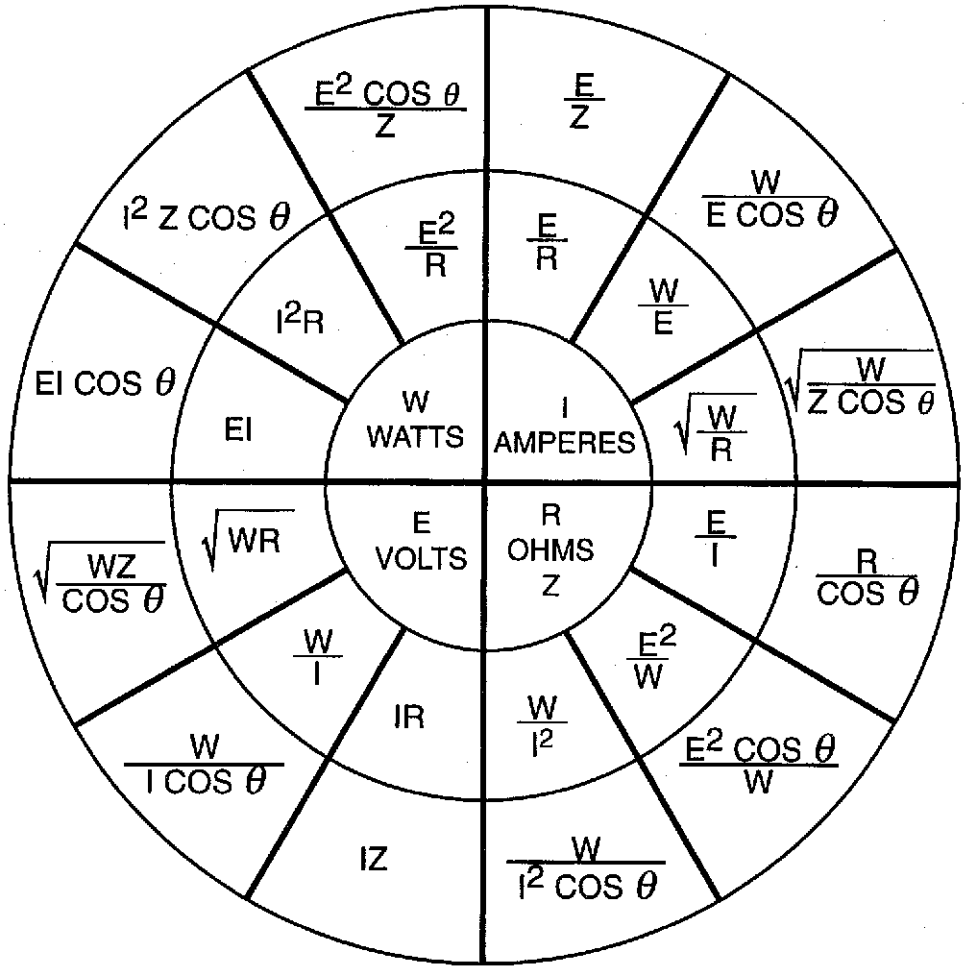
# OHM'S LAW AND CONVERSION TABLES

RETMA
COLOR CODE

0 – Black
1 – Brown
2 – Red
3 – Orange
4 – Yellow
5 – Green
6 – Blue
7 – Violet
8 – Gray
9 – White

MULTIPLIER
PREFIXES

| | |
|---|---|
| Tera | $-10^{12}$ |
| Giga | $-10^{9}$ |
| Mega | $-10^{6}$ |
| Kilo | $-10^{3}$ |
| Hecto | $-10^{2}$ |
| Deka | $-10$ |
| Deci | $-10^{-1}$ |
| Centi | $-10^{-2}$ |
| Milli | $-10^{-3}$ |
| Micro | $-10^{-6}$ |
| Nano | $-10^{-9}$ |
| Pico | $-10^{-12}$ |




$Z = \frac{1}{2\pi FC}$

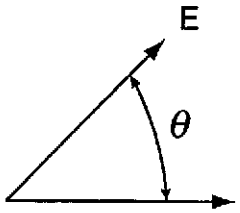
F = CYCLES/SEC (HERTZ)
C = FARADS

$Z = 2\pi FL$

F = CYCLES/SEC (HERTZ)
L = HEN

FOR RESISTIVE LOAD
DC FORMULAS APPLY
TO AC i.e. $\cos\theta = 1$

$\cos\theta$ = POWER FACTOR
(SEE MATH TABLES)




IN. x 2.54 = CM.
FT. x 30.48 = CM.
MI. x 1.6093 = KM.
SQ. IN. x 6.452 = SQ. CM.
SQ. FT. x .0929 = SQ. M.

CU. IN. x 16.387 = CU. GM.
CU. FT. x .028 = CU. M.
CU. FT. x 7.481 = GAL.
CU. FT. x 28.316 = LITER
GAL. x 231 = CU. IN.

GAL. x 3785 = CU. CM.
GAL. x 3.78 = LITER
AVOIR. OZ. x 28.35 = GRAM
FL. OZ. x .029 = LITER
LB. x 453.6 = GRAM

Figure C-1. Ohm's Law and Conversions Tables

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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