NAVAIR 01–1A–505–1
TO 1–1A–14
TM 1–1500–323–24–1
1 September 2004

TECHNICAL MANUAL

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

It is incomplete without NAVAIR 01-1A-505.6, NAVAIR 01-1A-505.7, NAVAIR 01-1A-505.8, NAVAIR 01-1A-505.9, NAVAIR 01-1A-505.10, NAVAIR 01-1A-505.11, NAVAIR 01-1A-505.12, NAVAIR 01-1A-505.13, NAVAIR 01-1A-505.14, NAVAIR 01-1A-505.15, NAVAIR 01-1A-505.16, NAVAIR 01-1A-505.17, NAVAIR 01-1A-505.18, NAVAIR 01-1A-505.19, NAVAIR 01-1A-505.20, NAVAIR 01-1A-505.22, NAVAIR 01-1A-505.23, NAVAIR 01-1A-505.24, NAVAIR 01-1A-505.25, and NAVAIR 01-1A-505.29.

For U.S. Air Force and Army Users Only – It is incomplete without TO 1–1A–14–1 (Air Force and Army Only Supplement).

This manual supersedes NAVAIR 01-1A-505 dated 15 June 1988 with RAC 2 dated 10 August 1994, NAVAIR 01-1A-505.1 dated 15 October 1988, NAVAIR 01-1A-505.2 dated 15 October 1988, NAVAIR 01-1A-505.3 dated 15 October 1988, NAVAIR 01-1A-505.4 dated 15 October 1988, NAVAIR 01-1A-505.5 dated 15 October 1988, NAVAIR 01-1A-505.26 dated 15 October 1988, NAVAIR 01-1A-505.27 dated 15 October 1988, NAVAIR 01-1A-505.28 dated 15 October 1988, TO 1–1A–14 dated 30 April 2003 with Change 2 dated 2 September 2003, TO 8–1–1 of 30 April 1997, and TM 55–1500–323–24 dated 15 February 1982 with Change 44 dated 31 August 1999.

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NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES

List of Current Changes

Original . . . . 1 September 2004

Only those work packages/pages assigned to the manual are listed in this index. Insert Change _____ , dated _____________. Dispose of superseded and deleted work packages/pages. Superseded and deleted classified work packages/pages shall be destroyed in accordance with applicable regulations. If changed pages are issued to a work package, insert the changed pages in the applicable work package. The portion of text affected in a changed or revised work package is indicated by change bars or the change symbol “R” in the outer margin of each column of text. Changes to illustrations are indicated by pointing hands or change bars, as applicable. Changes to wiring diagrams and schematics are indicated by shading.

Total number of pages in this manual is 1340 consisting of the following:

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LIST OF TECHNICAL PUBLICATIONS DEFICIENCY REPORTS INCORPORATED

INSTALLATION AND REPAIR PRACTICES
AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

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None	

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ALPHABETICAL INDEX

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

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INTRODUCTION

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

1 . **PURPOSE AND SCOPE.**

2 . This manual was prepared for the following reasons:

a. To gather under one cover the recommended practices and techniques to be used for installing, repairing, and maintaining aircraft electrical wiring.

b. To standardize these techniques and methods so that electrical installations will be done in a uniform manner.

c. To indoctrinate all personnel with the importance of good workmanship.

d. To point out the failures which may result from poor workmanship.

e. To promote safety by pointing out and prohibiting unsafe practices.

3 . This manual covers all general purpose wiring and wiring devices used for the interconnection of equipment in aircraft. It also includes thermocouple systems and coaxial cabling installed in aircraft.

4 . **ARRANGEMENT AND USE.**

5 . This manual is divided into work packages (WPs) which are self–contained procedures that may be used to support specific tasks.

6 . Each WP is maintained separately. The WPs are identified by five–digit numbers in the upper right corner of each page. This number aids in rapid assembly of a complete manual and is used for referencing within a manual.

7 . **REQUISITIONING AND AUTOMATIC DISTRIBUTION.**

8 . Procedures to be used by Naval activities and other Department of Defense activities requiring NAVAIR technical manuals are defined in NAVAIR 00-25-100.

9 . **QUALITY ASSURANCE.**

10 . Maintenance procedure steps, essential to equipment performance or to the safety of personnel, are highlighted by the addition of the abbreviation (QA) following the procedure. Quality Assurance action shall be taken on all steps designated (QA) prior to proceeding to the next step.

11 . **SUPPORT EQUIPMENT REQUIRED.**

12 . Table 1 provides a cumulative list of the support equipment required to maintain the components covered in this manual. The equipment required for each maintenance task is listed in the corresponding WP. When alternate repair procedures exist, different tools may be required. Where possible, the alternate tools are identified.

13 . **CONSUMABLE MATERIALS REQUIRED.**

14 . Table 2 provides a cumulative list of materials required to maintain the components covered in this manual. The materials required for each maintenance task are listed in the corresponding WP. When alternate repair procedures exist, different materials may be required. Where possible, the alternate materials are identified.

15 . **REFERENCE MATERIAL.**

16 . Table 3 provides a list-of the reference material required to install aircraft wiring and wiring devices.

17 . **TECHNICAL DIRECTIVES.**

18 . A record of applicable technical directives will also appear in each WP in this manual, but will list

only technical directives that affect the text and illustrations of that particular WP.

19 . **WARNINGS, CAUTIONS, AND NOTES.**

20 . Warnings, Cautions, and Notes are used throughout this manual. They are defined as follows:

WARNING

An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to or death of personnel.

CAUTION

An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE

An essential operating or maintenance procedure, condition, or statement, which must be highlighted.

TABLE 1. SUPPORT EQUIPMENT REQUIRED

Nomenclature	Part No./Type Designation
Fixture, Holding	AD-1319
Crimping Tool	AD-1377
Clamp Assembly Tool	ADEL560
Crimping Tool	AMP 49935
Connector, Thermocouple	AN 5537
Ohmmeter	AN/USM-21A
Adapter, Fixture	AT-1319-11
Adapter, Fixture	AT-1319-14
Adapter, Fixture	AT-1319-17
Adapter, Fixture	AT-1319-18
Adapter, Fixture	AT-1319-19
Tool, Thermogun Heating	CV-5000
Heat Gun, Mini	CV-5300
Tool, Mini-Gun Hot Air	CV-5302
Heat Gun	CV-5700
Coaxial Cable Splice Kit	D-150-02
Coaxial Cable Splice Kit	D-150-12
Coaxial Cable Splice Kit	D-150-15
Coaxial Cable Splice Kit	D-150-16
Coaxial Cable Splice Kit	D-150-28
Coaxial Cable Splice Kit	D-150-29
Tool, Banding	DBS-1100
Wire Twister Plier with Side Cutter	GGG-W-3408

TABLE 1. SUPPORT EQUIPMENT REQUIRED (Cont)

Nomenclature	Part No./Type Designation
Heat Gun	HT-900B
Heat Gun	HT-920B
Infrared Heating Tool	IR-500
Infrared Heating Tool	IR-550
Two-Station Solder Tacts Heater	IR-1044
Infrared Heating Tool	IR-1079
Die, Crimp	MS23002
Crimp Tool, Hydraulic	MS25441
Die, Crimp	MS90485
Crimp Tool Frame	M22520/1-01
Turret	M22520/1-12
Turret	M22520/1-13
Turret	M22520/1-14
Positioner	M22520/1-15
Inspection Gage	M22520/3-12
Inspection Gage	M22520/3-13
Inspection Gage	M22520/3-14
Crimp Tool	M22520/5
Crimp Tool	M22520/5-01
Crimp Tool Frame	M22520/5-03
Die	M22520/5-05
Die	M22520/5-07
Die	M22520/5-09
Die	M22520/5-11
Die	M22520/5-13
Die	M22520/5-19
Die	M22520/5-25
Die	M22520/5-33
Die	M22520/5-35
Die	M22520/5-41
Die	M22520/5-55
Die	M22520/5-57
Die	M22520/5-59
Die	M22520/5-61
Die Set	M22520/5-100
Die Set	M22520/5-102
Die Set	M22520/5-103
Crimping Tool	M22520/10-01
Die Set	M22520/10-103
Die Set	M22520/10-104
Crimp Tool	M22520/24
Crimp Tool Frame	M22520/36-01
Positioner	M22520/36-02
Positioner	M22520/36-03

TABLE 1. SUPPORT EQUIPMENT REQUIRED (Cont)

Nomenclature	Part No./Type Designation
Locator	M22520/36-04
Locator	M22520/36-05
Locator	M22520/36-15
Positioner	M22520/36-16
Positioner	M22520/36-17
Locator	M22520/36-18
Crimping Tool	M22520/37-01
Inspection Gage	M22520/39-01
TJS Block Removal Tool	M81714/39-01
TJS Block Removal Tool	M81714/69-02
Reflector	MG-2
Pliers, Connector	Model 11-6147-1
Knife, Thermal	Model 2A
Crimping Tool	OMNI SPECTRA T-200
Reflector	TG-12
Reflector	TG-13
Reflector	TG-13A
Reflector	TG-21
Reflector	TG-22
Reflector	TG-23
Reflector	TG-24
Cable Stripper	45-162
Cable Stripper	45-163
Cable Stripper	45-164
Cable Stripper	45-165
Wire Strippers	45-1610
Ideal 45-123 Cutters, Wire	45-1611
Wire Strippers	45-4987
Syringe 3 cc, 23 Gage Needle	5585
Multimeter	77/BN
Crimping Tool	901-2500
Stripper No-Nik (.010)	980-0005-548
Stripper No-Nik (.016)	980-0005-549
Diamond Scribe	980-0006-755
Jewel Tweezers	980-0006-757
Kevlar Shears	980-9500-000
Tip, Boot and Tubing Gun, Sealing	979648
Brush, Bristle	—
Crimping Tool, Modified	—
Diagonal Cutters	—
Knife	—
Knife, Exacto	—
Magnification 100X	—
Magnification 200X	—

TABLE 1. SUPPORT EQUIPMENT REQUIRED (Cont)

Nomenclature	Part No./Type Designation
Micrometer Metric	—
Nitrogen Bottle	—
Paddle, Wooden	—
Pliers, Diagonal	—
Pliers, Padded Conduit	—
Pliers, Resistance Heating	—
Pliers, Slip Joint	—
Pliers, Wire Twister with Side Cutter	—
Ruler, 12 In.	—
Safety Glasses	—
Scissors	—
Scissors, Small Line Splicing	—
Screwdriver, Flat	—
Screwdriver, Torque Limiting	—
Scribe	—
Sealing Gun	—
Shield, Notched Copper Sheet	—
Socket, 3/8 Inch	—
Soft Bristled Brush	—
Solder Pot	—
Soldering Iron, 140 Watt	—
Soldering Iron, 200-250 Watt	—
Spacer, 3/8 Dowel	—
Spatula	—
Strap Wrench	—
T-Handle, 1/4 inch Drive	—
Torque Wrench, 0-100 in/lbs	—
Wrench, Torque 0-150 in. lbs.	—
Wrench, Torque 150-250 in. lbs.	—
Wrench, Torque Limiting Socket	—

TABLE 2. MATERIALS REQUIRED

Nomenclature	Specification No./Part No.
Abrasive Mat	A–A–58054
Adhesive	RTV-108
Adhesive	S-1009
Adhesive	S-1030
Adhesive	S-1125
Alcohol, Denatured	O–M–232
Alcohol, Isopropyl 150	TT-I-735
Alcohol, Isopropyl (Isopropanol)	TT-I-735
Alcohol, Isopropyl, Grade A, Technical	TT–I–735 Grade A
Aliphatic Naphtha	MIL–PRF–680 Type II
Bag, Plastic	—
Bands, 3 In.	4-1380
Bolt	AN-3
Bonding Paste	—
Boot, Bulbous	202A100 Series
Boot, Bulbous	202D100 Series
Boot, Low Profile	200D200 Series
Borax	—
Braid, Metallic	A–A–59569
Brush	A–A–3077
Brush, Acid Swabbing	—
Brushing Compound, Zinc Chromate	—
Cable, Safety, Self-Looping	AS3621 Series
Cap, End	MS25274-1
Cap, End	MS25274-2
Cap, End	MS25274-3
Cap, End	MS25274-4
Carbon Dioxide, Solid	—
Casting Compound, Epoxy (Stycast 2651 B Emerson and Cuming)	MIL-I-16923
Chemical Conversion Material	MIL-C-5541, Class 3
Clamp, Bonding	AN735
Clamp, Cushioned Metal	MS21919
Clamp, Plastic	MS25281
Cleaning Cloth	CCC-C-46, Class 4
Cleaning Compound	MIL-PRF-29608, Type I, Class C
Cloth	MIL-C-85043
Cloth, Abrasive Coated	ANSI B74.18
Component Rack Assembly	M81714/67
Component Rack Assembly	M81714/67
Component Rack Assembly	M81714/67
Component Rack Assembly	M81714/67

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Compound, Molding	—
Compound, Sealing	MIL-PRF-8516
Compound, Thread Coating	—
Conductor, Copper	ASTM-B172
Contact	M39029/74–400
Contact	M39029/74–400
Contact	M39029/73–397
Contact	M39029/73–397
Contact	M39029/74–401
Contact	M39029/74–401
Contact	M39029/73–398
Contact	M39029/73–398
Contact	M39029/74–399
Contact	M39029/74–399
Contact	M39029/73–396
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Contact	D-602-16
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Contact	D-602-57
Contact	D-602-57
Contact	D-602-72
Contact	D-602-72
Contact	D-602-73
Contact	D-602-73
Contact Fiber Optic Pin	031-9582-000
Contact Fiber Optic Pin	031-9593-000

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Contact Fiber Optic Pin	031-9595-000
Contact Fiber Optic Pin	031-9597-000
Contact Fiber Optic Pin	031-9602-000
Contact Fiber Optic Pin	031-9606-000
Contact Fiber Optic Socket	031-9579-000
Contact Fiber Optic Socket	031-9592-000
Contact Fiber Optic Socket	031-9594-000
Contact Fiber Optic Socket	031-9596-000
Contact Fiber Optic Socket	031-9603-000
Contact Fiber Optic Socket	031-9605-000
Cord, Lacing	—
Corrosion Preventive Compound	MIL-C-81309, Type II and Type III
Crimp Splice, Red	M81824/1-1
Crimp Splice, Yellow	M81824/1-3
Diamond Wheel 6 Micron	995-0001-990
Dichloromethane (Methylene Chloride)	ASTM D4701 or other approved solvent
Emery Cloth #320	—
End caps, Heat shrinkable (also known as SSC end caps)	SAE AS81765/1
Environmental Test Methods for Aerospace and Ground Equipment	MIL–Std–810
Ferrule, Elongated	AS3619 Series
Fluorocarbon Etchant (WL Gore, etc.) (or Equivalent Such as Bondaid or S16943)	Tetra Etch
Flux, Hard Solder	O-F-499
Flux, Lactic Acid	—
Flux, Liquid	J–STD–004, J–STD–005 and J–STD–006
Flux, or Equivalent	A–A–51145
Flux, Silver Brazing	AMS3411–S
Glue, Epoxy	—
Grommet, Caterpillar	NASM22529
Grommet, Donut	MS35489
Gross Shield	—
Insulator	MS3373
Jewel Contact	980-0007-605
Jewel Contact	980-0007-606
Jewel Contact	980-0007-607
Jewel Contact	980-0007-608
Jewel Contact	980-0007-645
Jewel Contact	980-0007-646
Jewel Contact	980-0007-647
Jewel Contact	980-0007-648
Jewel Contact	980-0007-649

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Jewel Contact	980-0007-650
Kim Wipes	—
Kit, Safety Cable	AS3617 Series
Lapping Film 30 Micron	970-0008-095
Lens Cleaning Fluid	970-0006-984
Locknut	MS21042
Locknut	MS21043
Lockwasher	AN-935
Lockwasher	AN-936B
Lockwasher	MS35338
Lockwasher	MS35340
Lockwasher	MS-35388
Lockwire, Aluminum Alloy, Anodized, Blue, 0.020 Diameter	MS20995-AB20
Lockwire, Aluminum Alloy, Anodized, Blue, 0.032 Diameter	MS20995-AB32
Lockwire, Nickel-Chomium-Iron Alloy, 0.032 Diameter	MS20995-N32
Lockwire, Nickel-Chromium-Iron Alloy, 0.020 Diameter	MS20995-N20
Lockwire, Nickel-Copper Alloy, 0.020 Diameter	MS20995-NC20
Lockwire, Nickel-Copper Alloy, 0.032 Diameter	MS20995-NC32
Loop, Strap Fastener	GE21E1
Magnesium Alloy, Pretreatment	SAE AMS–M–3171 TYPE VI
Marker, Harness I.D.	HT-TMS-WM9
Methanol	O-M-232
Methyl Ethyl Ketone (MEK)	ASTM D740 or other approved solvent
Methyl Isobutyl Ketone	ASTM D1153 or other approved solvent
Mineral Spirits, Dry Cleaning	MIL–PRF–680 TYPE II
Mold Release	—
Nut	AN-345
Nut	MS-25682
Nut, Plain	AN-340
Nut, Self locking	MS-21042
Nut, Self locking	MS-21044
Nut, Steel	MS-35649
Nut, Steel	MS-35650
Petrolatum,-Zinc Dust Compound	—
Pin Contact	MIL-C-39029
Pipe Cleaner	840507
Polishing Compound Linde B .05 Micron	980-0005-545

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Polishing Compound Linde C 1.0 Micron	970-0005-544
Polyethlene Sheeting	—
Polyethylene Bags	—
Polyethylene Wax	—
Polyurethane Coating	PR-1532
Primer, Coating, Epoxy	MIL–PRF–23377
Primer for Specific Sealing Compound	Primer
Primer for Silicone Substrates	MIL–P–47215
Protective Sleeve	RNF-100
Push-On End Caps	—
Q-Tips	—
Remover, Paint, Epoxy	TT–R–2918
Rosin	A–A–59142
Sandpaper	—
Screw	MS51957
Screw	NAS1801
Screw	NAS1802
Sealing Compound, Polysulfide	AMS 3276 Class B–1/4
Sealing Compound, Polysulfide	MIL-PRF-8516
Sealing Compound, Polyurethane	MIL-M-24041
Sealing Compound, Silicone	MIL-PRF-23586
Sealing Compound, Silicone (DC3140, DC3145 - Dow Corning)	MIL-A-46146
Sealing Compound, Silicone, Oil Resistant (Dow Corning)	RTV 735
Shearwire, Copper, Cadmium Plated, Yellow, 0.020 Diameter	MS20995-CU20
Shield Terminations	SAE AS83519 Series
Shielding Jumper Wire	M22795/11-22-5
Shielding Termination Ferrule	1 3280XX
Shielding Termination Ferrule	1 5M608-XX
Shipping Cap, Plastic	MS90376
Sleeve, Filling	CTA-0006
Sleeve, Filling	CTA-0042
Sleeve, Protective	RNF-100
Sleeving, Heat Shrink	CRN-T
Sleeving, Heat Shrink	SAE AMS–DTL–23053
Sleeving, Heat-Shrinkable	—
Sleeving, Insulation	1 M23053/12-XX-0
Sleeving, Insulation, Heat Shrinkable	SAE AMS–DTL–23053/5, Class I
Solder	Sn60WRMAP3
Solder Sleeve Shield Termination	SAE AS83519

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Solder, Hard	—
Solder, Soft	—
Solder, Soft	J–STD–004, J–STD–005, AND J–STD–006
Solvent, Dry Cleaning	MIL–PRF–680 Type II
Solvent, Stoddards	MIL–PRF–680 Type II
Splice Set, Quick Disconnect	M6852-3
Spot Tie	—
Strap, Self-Clinching	AS33671
Tape	—
Tape, Adhesive Copper Foil	Flexishield 8015
Tape, Black Non-Adhesive Self-Bonding	A–A–59163 Type II, NSN 5970-00-955-9976
Tape, Cellophane	CHR, M-60
Tape, Finish C, Glass Tying, Size 2	—
Tape, Finish C, Glass Tying, Size 3	—
Tape, Finish C, Polyester Tying, Size 2	—
Tape, Finish C, Polyester Tying, Size 3	—
Tape, High-Temperature Pressure-Sensitive	A–A–59474
Tape, Lacing and Tying	A–A–52080 thru A–A–52084
Tape, Non-Adhesive Silicone	—
Tape, Non-Adhesive, Self-Bonding, Black	A–A–59163 TYPE II, NSN 5970-00-955-9976
Tape, Non-Adhesive, Self-Bonding, Red	A–A–59163 TYPE II, NSN 5970-00-949-4846
Tape, Pressure Sensitive	—
Tape, Red Non-Adhesive Self-Bonding	A–A–59163 TYPE II, NSN 5970-00-949-4846
Tape, Self-Adhesive, Color	—
Tape, Self–Bonding Silicone	A–A–59163, TYPE II
Tape, Self–Bonding Silicone Rubber	A–A–59474
Tape, Silicone	—
Tape, Teflon	A–A–59474 Type I, Class 4, NSN 5970–01–012–4280
Tape, Teflon	299-947-110, Type III, Class I
Terminal Board	MS27212
Terminal Board Cover	MS18029
Terminal Lug, Aluminum	SAE AS70991
Terminal Lug, Aluminum	MS25435
Terminal Lug, Copper	SAE AS7928
Terminal Lug, Copper	MS20659
Terminal Lug, Copper	MS36036

TABLE 2. MATERIALS REQUIRED (Cont)

Nomenclature	Specification No./Part No.
Terminal Lug, Crimp Copper Insulated	MS25036 (Series)
Terminal Lug, Crimp Copper Uninsulated	MS20659 (Series)
Texmet Polishing Cloth	980-0005-546
Thinner, Dope and Lacquer	TT–R–2918
Tubing	RP-4800
Tubing	VPB-RT
Tubing or Vinyl Sheet	—
Tubing, Heat Shrink	SAE AMS–DTL–23053
Tubing, Plastic	—
Tubing, Wire Braid	2194
Uni-Boot	202C600 Series
Washer	NAS1149
Washer, Flat Plated	MS25440
Washer, Plain	AN-960
Water-Displacing Corrosion Preventive Compound	MIL-DTL-85054, Type IA
Wire	M22759/41, /42
Wire	MIL-W-22759
Wire, 30 AWG Bare	—
Wire, Filterline	M85485/9, /10
Wire, Heavy Wall	MIL-W-22759
NOTES: 1 Required size to be determined by technician.	

TABLE 3. REFERENCE MATERIAL

Nomenclature	Publication
ORGANIZATIONAL MAINTENANCE SYSTEM MAINTENANCE WITH IPB ELECTRICAL SYSTEM NAVY MODEL F/A–18A/B/C/D 161353 AND UP	A1-F18AC-420-300
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A750001 THRU 74A750999 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-100
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A752001 THRU 74A753220 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-200

TABLE 3. REFERENCE MATERIAL (Cont)

Nomenclature	Publication
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A753221 THRU 74A753999 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-300
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A754001 THRU 74A756999 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-400
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A760001 THRU 74A760219 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-500
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A760220 THRU 74A761999 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-600
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A770001 THRU 74A770156 NAVY MODEL F/A–18C AND F/A–18D	A1-F18AE-WRM-700
ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE WIRING REPAIR WITH PARTS DATA CABLE ASSEMBLIES 74A770159 THRU 74A999999, 74R794300 THRU 74R799999 AND MISCELLANEOUS CABLE ASSEMBLIES	A1-F18AE-WRM-800
Wiring, Aerospace Vehicle	SAE AS50881 (previously MIL-W-5088K or MIL–W–5088L)
Splices, Electric, Permanent, Crimp Style, Copper Insulated Heat Shrinkable, Environment Resistant, General Specification for	SAE AS81824 or MIL-S-81824
Cables, Radio Frequency, Flexible and Semi-Rigid	MIL-C-17
Connectors, Plug and Receptacle, Electrical, Triaxial, Radio Frequency, General Specifications for	MIL-C-3655
Crimping Tools, Hand or Power Actuated, Wire Termination and Tool Kits, General Specification for	MIL-DTL-22520
Cables, Radio Frequency, Semi-Rigid Coaxial Semi-Air-Dielectric	MIL-C-22931
Cables, Radio Frequency, Coaxial, Semi-Rigid, Foam Dielectric	MIL-DTL-23806

TABLE 3. REFERENCE MATERIAL (Cont)

Nomenclature	Publication
Connectors, Electrical, (Circular, Miniature, Quick Disconnect, Environment Resisting), Receptacles and Plugs	MIL-C-26482
Connectors, General Purpose, Electrical, Miniature, Circular, Environment Resisting	MIL-DTL-26500
Cable, Electric, Shielded and Unshielded Aerospace	NEMA WC 27500
Connectors, Electrical, Rectangular, Rack and Panel, Solder Type and Crimp Type Contacts	MIL-DTL-28748
Connectors, Coaxial, Radio Frequency, General Specification for	MIL-DTL-39012
Electrical Contacts	MIL-C-39029
Electrical Contacts – Series I or crimp type external socket contacts	MIL-C-39029/1
Electrical Contacts – Series II or crimp type external socket contacts	MIL-C-39029/22
Cables, Power, Electrical (Flexible, Flat, Unshielded), (Round Conductor) General Specification for	MIL-DTL-49055
Transmission Line, Transverse Electromagnetic Mode	MIL-C-81490
Connectors and Assemblies, Electrical, Aircraft Grounding: Type IV Jumper Cable Assembly, Lead Electrical	MIL-C-83413/8
Connectors, Electrical, Circular, (Environment Resisting), Receptacles and Plugs	MIL-DTL-83723
Connectors, Electrical Miniature, Rectangular Type, Rack to Panel, Environment Resisting, 200°degree symbol °C Total Continuous Operating Temperature	MIL-DTL-83733
Connector Accessories, Electrical, General Specification for	MIL-DTL-85049
Cable, Electric, Filter Line, Radio Frequency Absorptive	MIL-C-85485
Line, Radio Frequency, Transmission	MIL-DTL-3890
Connectors, Plugs and Receptacles, Electrical, Triaxial, Radio Frequency, General Specification for	MIL-PRF-49142
Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured	MIL-PRF-8516
Standard General Requirements for Electronic Equipment	MIL-HDBK-454
Electromagnetic Environmental Effects Requirements for Systems	MIL-STD-464
Terminal Junction System	AS81714

TABLE 3. REFERENCE MATERIAL (Cont)

Nomenclature	Publication
Terminals: Lug and Splice, Crimp Style, Aluminum for Aluminum Aircraft Wire, General Specification for,	SAE AS70991
Transmission Lines, Transverse Electromagnetic Mode	MIL-T-81490
Composite Termination System Socket Connectors	MIL-T-81714
Wire, Electric, Polyvinyl Chloride Insulated	MIL-W-5086
Wire, Electrical, Iron and Constantan Thermocouple	MIL-W-5845
Wire, Electrical, Chromel and Alumel Thermocouple	MIL-W-5846
Wire, Electrical, Copper and Constantan Thermocouple	MIL-W-5908
Wire, Electric, 600 Volt Aluminum Aircraft	MIL-W-7072
Wire, Electrical, Insulated	MIL–DTL–16878
Wire, Electric, Fluoropolymer, Insulated Copper or Copper Alloy	MIL-W-22759
Wire, Electric, High Temperature, and Fire Resistant	MIL-W-25038
Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or Polyarylene Insulated Copper or Copper Alloy	MIL-W-81044
Wire, Electric, Polyimide Insulated Copper or Copper Alloy	MIL-DTL-81381
Terminal Board Assembly, Molded-In Stud, Electric	MS27212
Sealing Plugs	MS27488
Grommet, Cushion, Composition, Edging	NASM22529/2
MS27488	NASM22529/3
Installation Practices, Aircraft Electric and Electronic Wiring	NAVAIR 01-1A-505.Series
Toxicity, Flash Point, and Flammability of Chemicals	NAVAIR 07-1-505
Avionic Cleaning and Corrosion Prevention Control	NAVAIR 16-1-540
Consolidated Hazardous Item List	NAVSUP Publication 4500
Brazing Alloys, Silver	QQ-B-654
Surface Clearing and Preparating	SAE AIR 4069
Safety Cable Kit Procurement Specification and Requirements for Use	SAE AS4536

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DEFINITIONS AND SYMBOLS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRICAL AND ELECTRONIC WIRING

Reference Material

Cable, Electric, Filter Line, Radio Frequency–Absorptive MIL–C–85485
Graphic Symbols for Electrical and Electronic Diagrams ANSI-Y32.2-1975
Sealing Compound, Polysulfide MIL–PRF–8516
Wire, Electric, Polyimide Insulated Copper or Copper Alloy MIL–DTL–81381

Alphabetical Index

1 . INTRODUCTION.

2 . This work package (WP) lists definitions of terms used in aircraft wiring. The electrical and electronic symbols and their meanings are in accordance with ANSI-Y32.2-1975.

3 . SYMBOLS.

4 . Refer to Table 1 for listing of common symbols utilized in the electrical/electronic field.

NOTE

Only those symbols associated with aircraft electronic/electrical wiring are listed here. These symbols have been categorized in general. Refer to ANSI-Y32.2-1975 for specific details on each symbol.

5 . DEFINITIONS.

6 . Table 2 defines terminology utilized in the electrical/electronic field.

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS

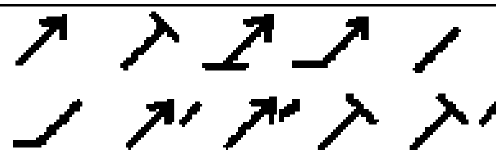
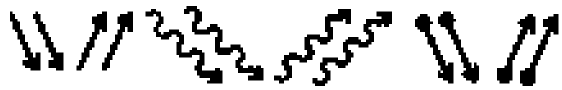
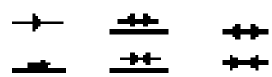
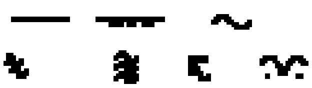
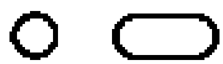
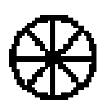
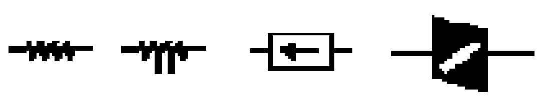
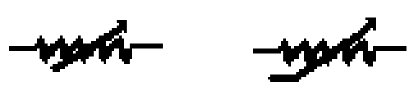
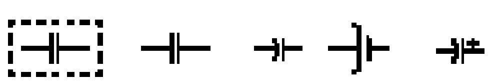
Meaning	Symbol
Adjustability Variability	
Radiation Indicators	
Physical State Recognition	
Test-Point Recognition	
Polarity Markings	
Direction of Flow of Power, Signal, or Information	
Kind of Current	
Envelope Enclosure	
Shield Shielding	
Special Connector or Cable Indicator	
Resistor	
Potentiometer	
Variable Resistor	
Capacitor	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

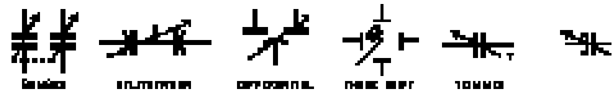
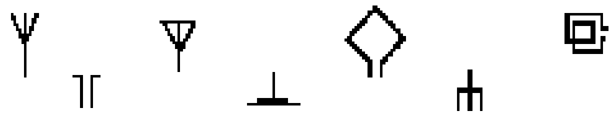
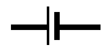
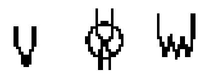
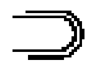
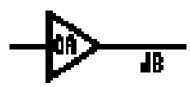
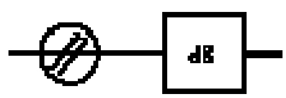
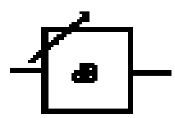
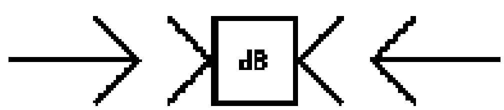
Meaning	Symbol
Variable Capacitor	
Antenna	
Battery	
Thermal Element, Thermomechanical Transducer	
Thermocouple	
Spark Gap/Igniter Gap	
Continuous Loop Fire Detector (temperature sensor)	
Ignitor Plug	
Amplifier, optical NOTE: Indicates the specific change in dB.	
Attenuator, optical NOTE: Indicates the specific change in dB.	
Attenuator, variable, optical NOTE: Indicates the specific change in dB.	
Attenuator, within a connector assembly, optical NOTE: Indicates the specific change in dB.	
Optical Fiber /Optical Component	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

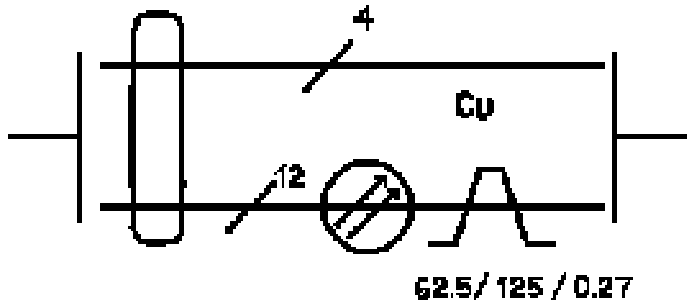
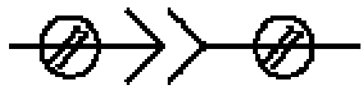
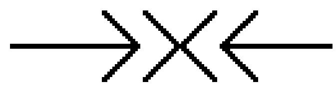
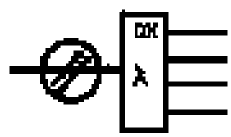
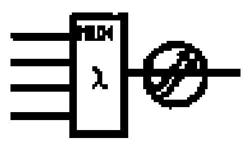
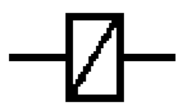
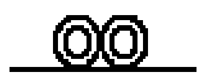
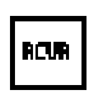
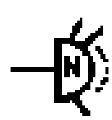
Meaning	Symbol
Cable, composite NOTE: Composite cable shown contains following supplementary information: 4 copper conductors 12 optical fibers with core diameter = 62.5 microns clad diameter = 125 microns NA = 0.27 (optional)	
Connector, plug–to–receptacle type, optical	
Connector, male–to–male with mating adapter type, optical NOTE:”NC” or ”PC” can be added. NC = non–contact. PC = physical contact.	
Demultiplexer, wavelength (WDM) NOTE: Four channel configuration shown.	
Multiplexer, wavelength NOTE: Four channel configuration shown.	
Polarizer	
Polarization controller	
Receiver	
Splice	
Splitter, optical	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

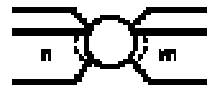
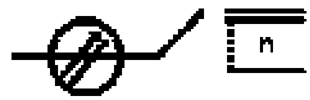
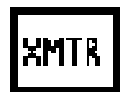
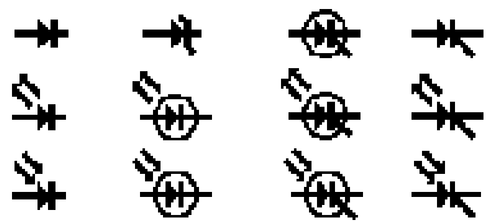
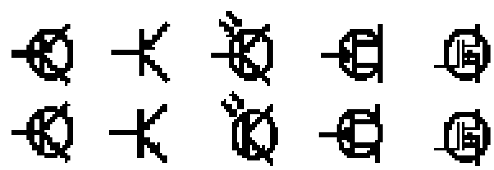
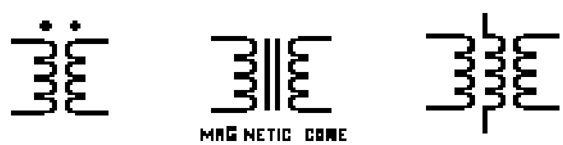
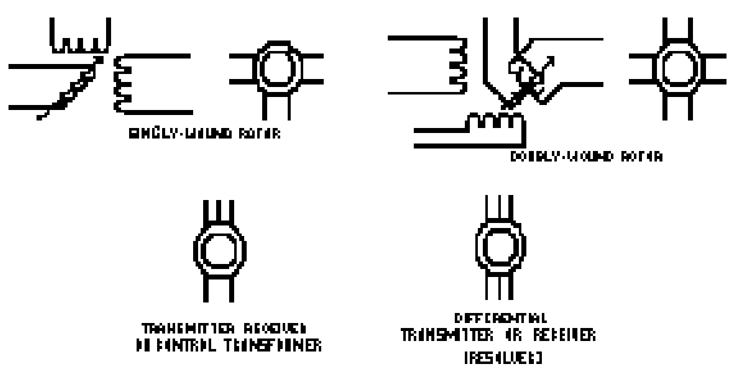
Meaning	Symbol
Star coupler NOTE: n by m star coupler shown. Change in dB may be placed in circle.	
Switch, optical NOTE: 1 by n switch shown.	
Transmitter	
Diodes, SCRs	
Transistors	
Transformers	
Inductive Paths	
Synchros	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

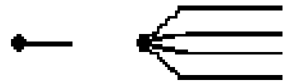
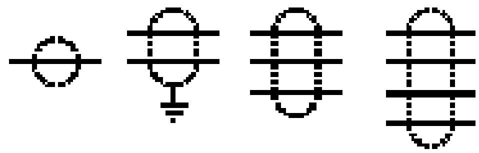
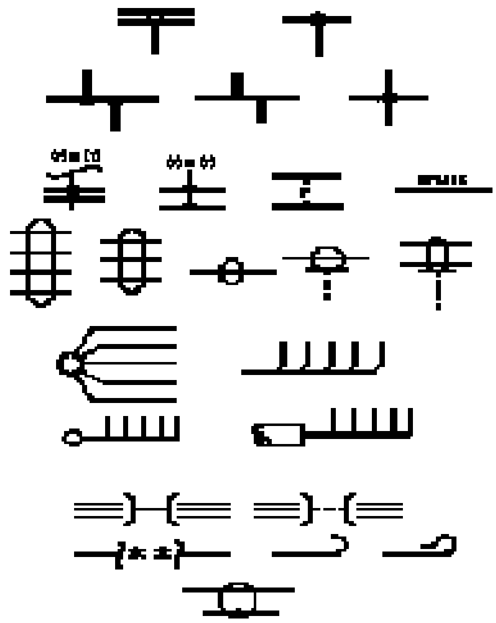
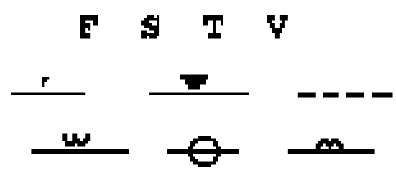
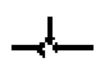
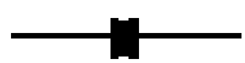
Meaning	Symbol
Terminations	
Shielded Transmission Path Conductor Cable Wiring	
Transmission Path Conductor Cable Wiring	
Distribution Lines/Transmission Lines	
Alternative or Conditioned Wiring	
Intentional Isolation of Direct-Current Path in Coaxial or Waveguide Applications	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

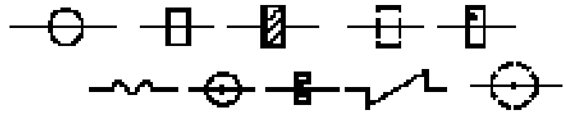
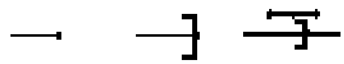
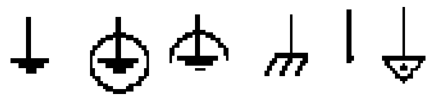
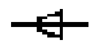
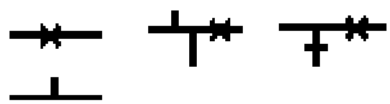
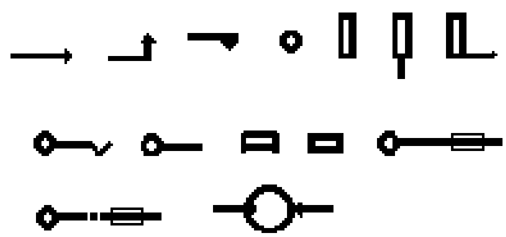
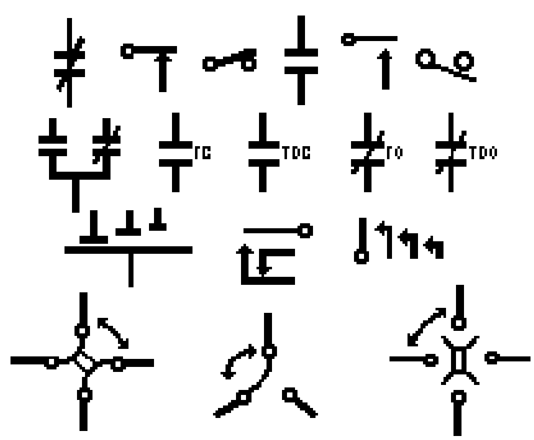
Meaning	Symbol
Waveguide	
Strip-Type Transmission Line/Stripline	
Termination	
Circuit Return/Ground	
Pressure-Tight Bulkhead Cable Gland Cable Sealing End	
Switching Function	
Electrical Contact	
Basic Contact Assemblies	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

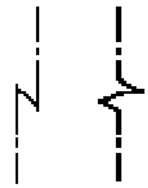
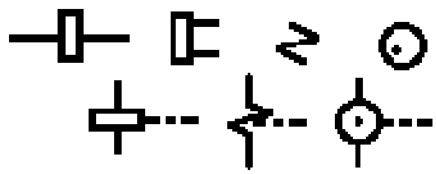
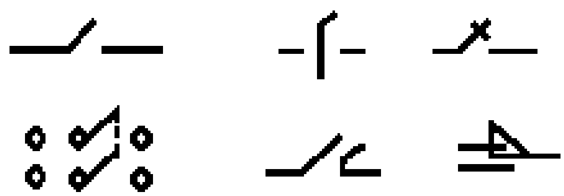
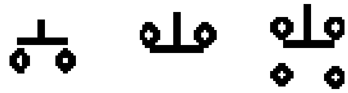
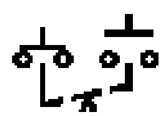
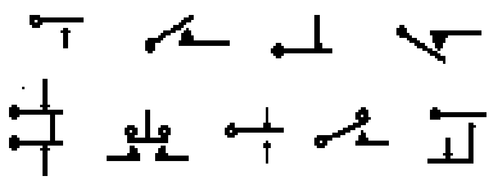
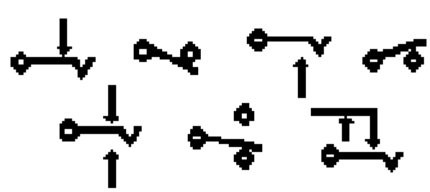
Meaning	Symbol
Magnetic Blowout Coil	
Operating Coil Relay Coil	
Switch	
Pushbutton, Momentary or Spring-Return	
Two-Circuit, Maintained or Not Spring-Return	
Nonlocking Switching, Momentary or Spring-Return	
Locking Switch	
Combination Locking and Nonlocking Switch	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

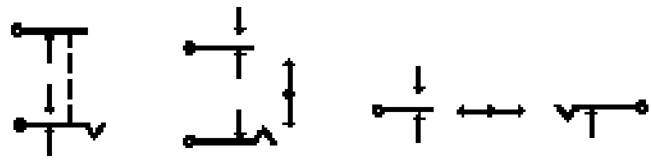
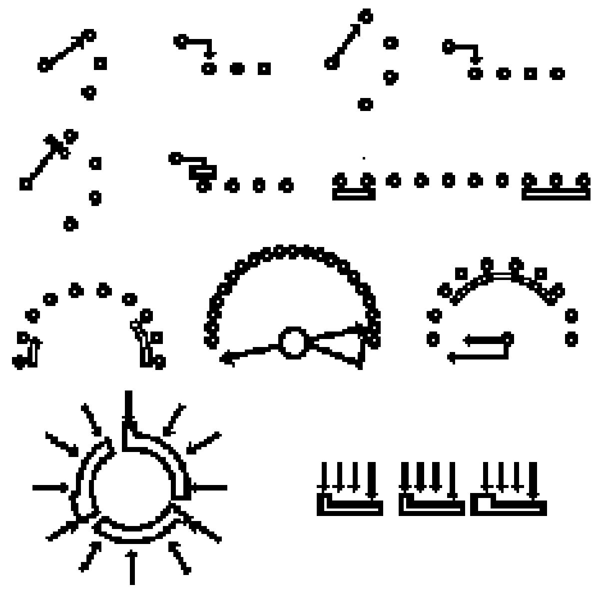
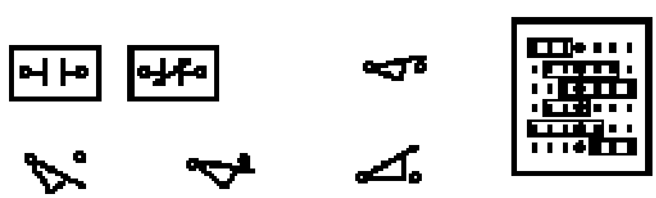
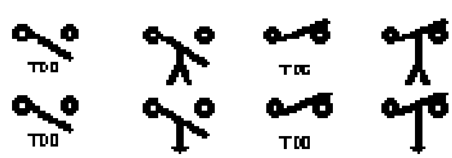
Meaning	Symbol
Key-Type Switch/Lever Switch	
Selector or Multiposition Switch	
Safety Interlock	
Limit Switch/Sensitive Switch	
Switches with Time-Delay Feature	
Flow-Actuated Switch	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

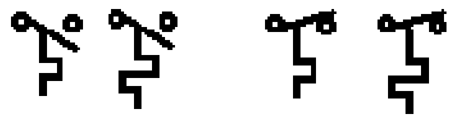
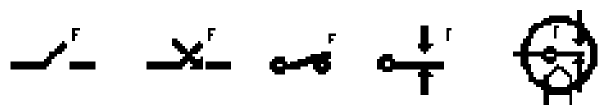
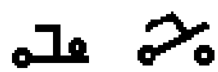
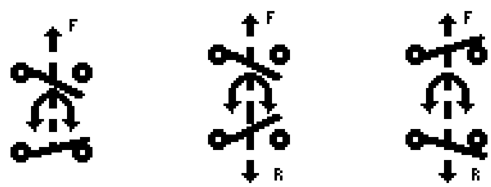
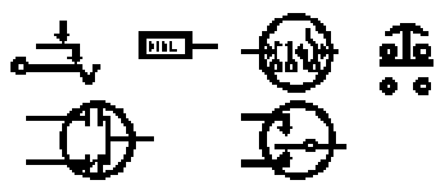
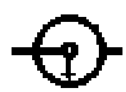
Meaning	Symbol
Liquid-Level Actuated Switch	
Pressure- or Vacuum-Actuated Switch	
Temperature-Actuated Switch	
Thermostat	
Flasher Self-interrupting Switch	
Foot-Operated Switch Foot Switch	
Switch Operated by Shaft Rotation and Responsive to Speed or Direction	
Switches with Specific Features	
Governor Speed Regulator	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

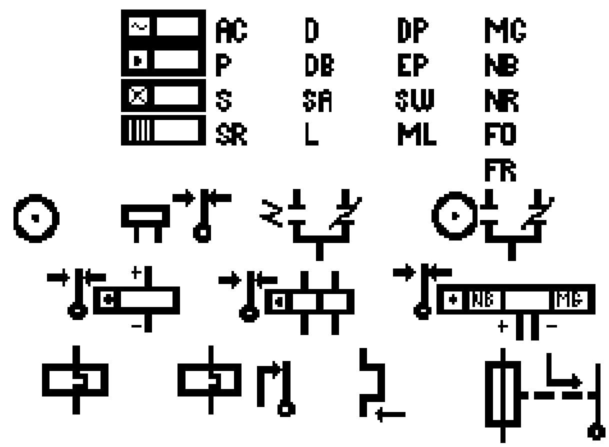
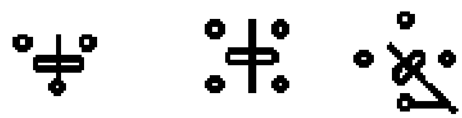
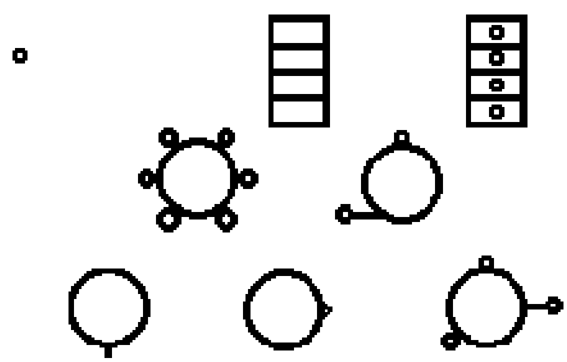
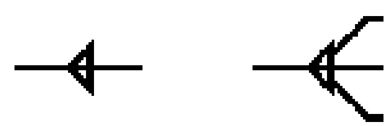
Meaning	Symbol
Relay	
Inertia Switch	
Mercury Switch	
Terminals	
Cable Termination	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

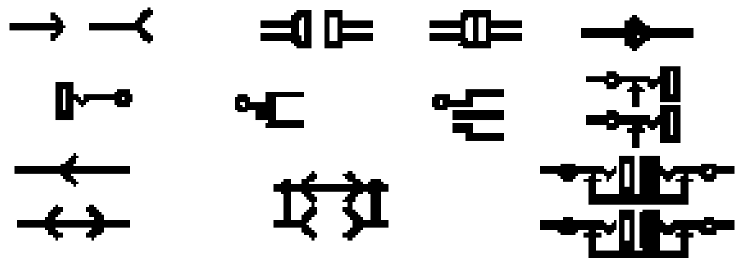
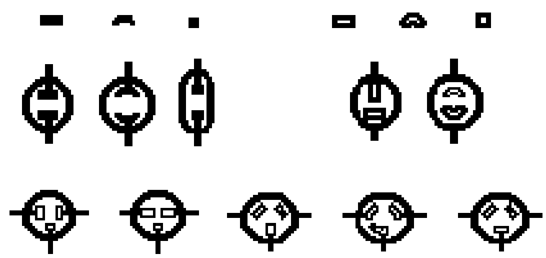
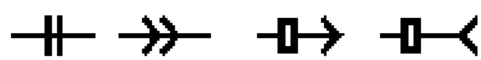
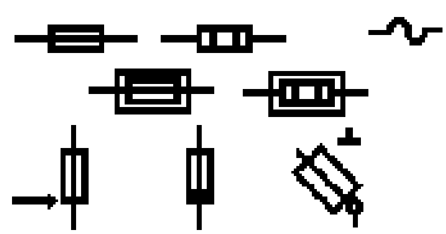
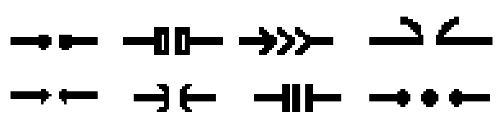
Meaning	Symbol
Connection / Disconnection Device	
Connectors of the Type Commonly Used for Power-Supply Purposes	
Test Blocks	
Coaxial Connector	
Waveguide Flanges Waveguide Junction	
Fuse	
Lightning Arrester Arrester Gap	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

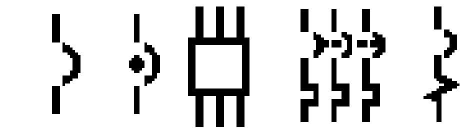
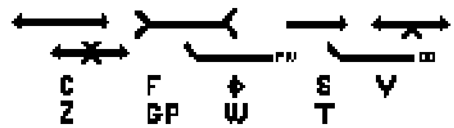
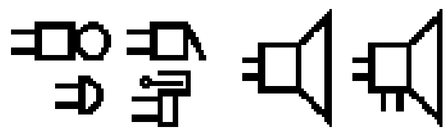
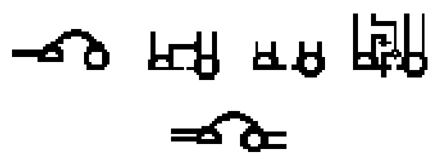
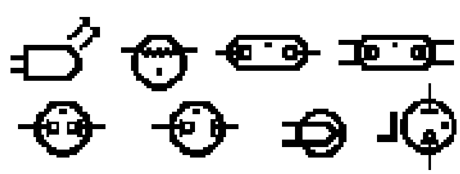
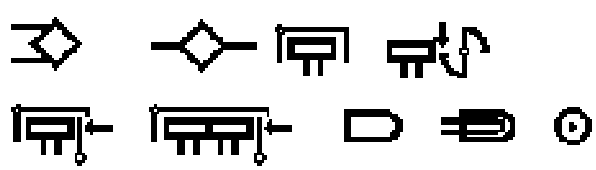
Meaning	Symbol
Circuit Breaker	
Protective Relay	
Audible-Signaling Device	
Microphone	
Handset/Operator’s Set	
Lamp /Indicator	
Visual-Signaling Device	
Mechanical Connection Mechanical Interlock	

TABLE 1. ELECTRONIC/ELECTRICAL SYMBOLS (Cont.)

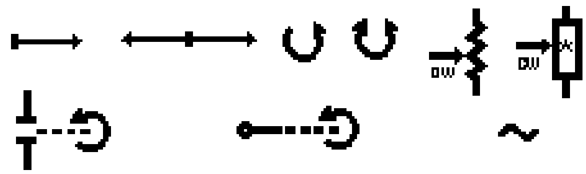
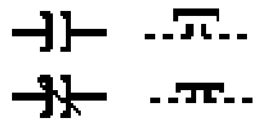
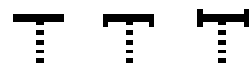
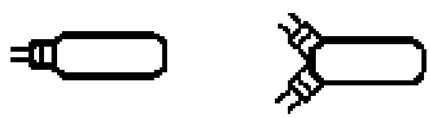
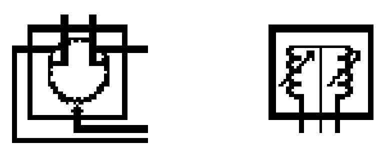
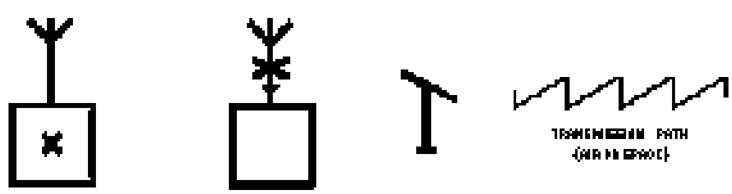
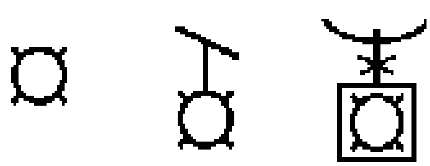
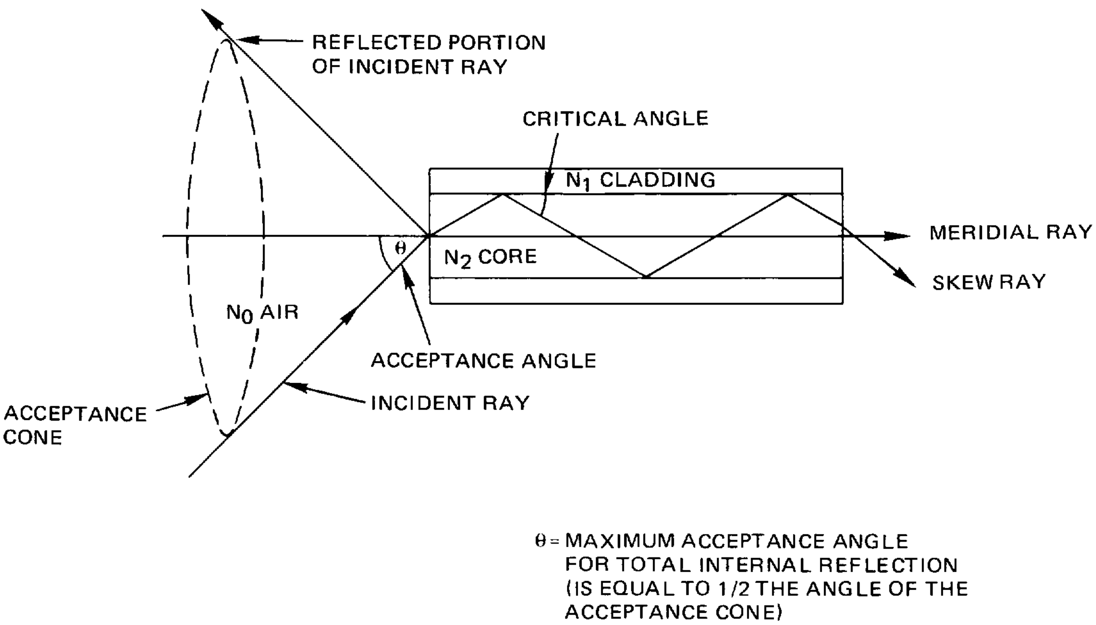
Meaning	Symbol
Mechanical Motion	
Clutch Brake	
Manual Control	
Gyro/Gyroscope/Gyrocompass	
Position Indicator	
Fire Extinguisher Actuator Head	
Position Transmitter	
Radio Station – Air / Space Transmission Path	
Space Station	

TABLE 2. TERMS AND DEFINITIONS

Term	Definition
A	(1) Designation for asbestos insulated, no braid type of wire. Dry locations only. Only for leads within apparatus or within raceways connected to apparatus. Limited to 300 V, 392°F (200°C). (2) (See Ampere.)
AA	(1) Designation for asbestos insulated type of wire, asbestos or glass braid. Dry locations only. Only for leads within apparatus or within raceways connected to apparatus or as open wiring. Limited to 300 V, 392°F (200°C). (2) Abbreviation for the Aluminum Association.
AAAC	All Aluminum Alloy Conductor, usually used to refer to 6201 aluminum alloy.
AAC	All Aluminum Conductor.
AASC	Aluminum Alloy Stranded Conductors.
AB	Designation for high voltage butyl cable.
ABP	Designation for butyl-polyethylene high voltage cable, 167°F (75°C).
Abrasion machine	Laboratory device for determining the abrasive resistance of wire or cable. Testing devices include the squirrel cage with square steel bars and the abrasive grit types.
Abrasion resistance	Ability of a wire, cable, or material to resist surface wear.
ABS	(See Acrylonitrile-Butadiene-Styrene.)
Absolute zero	Theoretical temperature at which all thermal motion of heat action ceases, approximately -459.69°F (-273.16°C, 0°K).
Absorption	Amount of material, such as water, that a given substance will assimilate and retain. It is an important property consideration in the selection of insulating materials.
AC	(1) Designation for branch circuit and feeder cables with flexible metal tape armor. (2) (See Alternating Current.)
ACAR	Aluminum Conductor Alloy Reinforced.
Accelerated aging	Test in which certain parameters, such as voltage and temperature, are increased above normal operating values to obtain observable deterioration in a relatively short period of time. The plotted results give expected service life under normal conditions. Also called accelerated life test.
Accelerator	Chemical used to speed up a reaction or the curing of a plastic. Often used with a catalyst, hardener, or curing agent. Sometimes used to describe the curing agent.

TABLE 2. TERMS AND DEFINITIONS (Cont)

Term	Definition
Acceptance angle (fiber optic)	Angle, measured from the core centerline, above which light will not enter the fiber. It is equal to one half the angle of the acceptance cone.



Term	Definition
Acceptance pattern (fiber optic)	Curve of total transmitted power plotted against the launch angle (fiber bundle or fiber).
Acceptance test	Test that determines conformance of a product to design specifications as a basis for acceptance.
Access holes	Series of holes in successive layers, each set having a common center or axis. These holes of a multilayer printed board provide access to the surface of the land in one of the layers of the board.

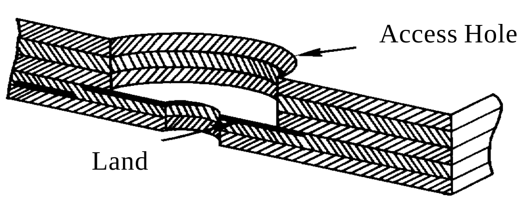


TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Accessories	Mechanical devices, such as cable clamps, added to connector shells and other such hardware which are attachable to connectors to make up the total connector configuration.

Typical Accessory Applications

Application of Function	Cable Type	Cable Clamp or Grommet Nut	Sealing Glands	Transition	Ground Rings	Backshell
Strain Relief Directly to Connector	Wire Bundle	X				
Strain Relief to Accessory	Wire Bundle	X				X
Strain Relief Cable Sealing to Accessory (Note 1)	Jacketed Wire Bundle	X	X			X
Strain Relief Shield Grounding to Accessory	Shielded Wire Bundle		X		X	X
Strain Relief Cable Sealing, Shield Grounding to Accessory (Note 2)	Jacketed, Shielded Wire Bundle	X	X	X	X	X

NOTES

1. Sealing glands not required for MS3057-B or MS3057-C cable clamps.

2. Sealing glands and transition are not required for MS3057-B or MS3057-C cable clamps.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

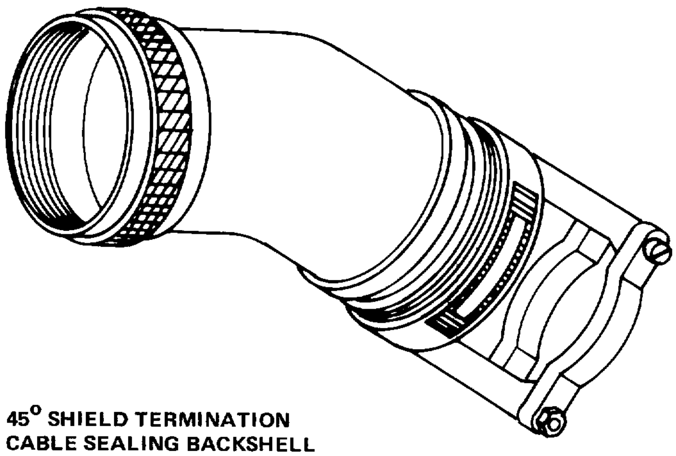
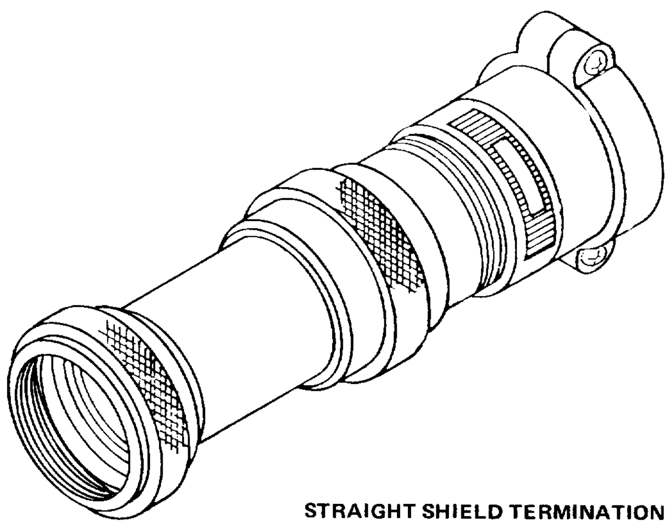
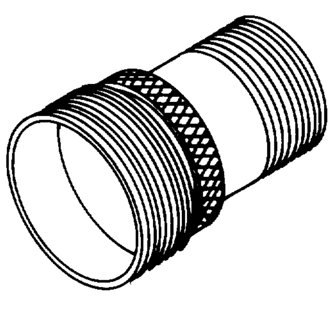
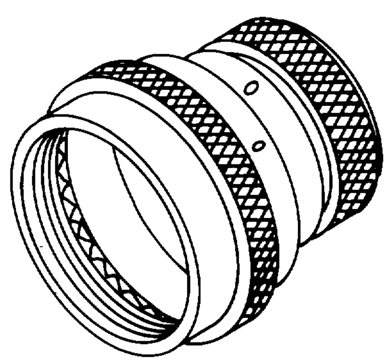
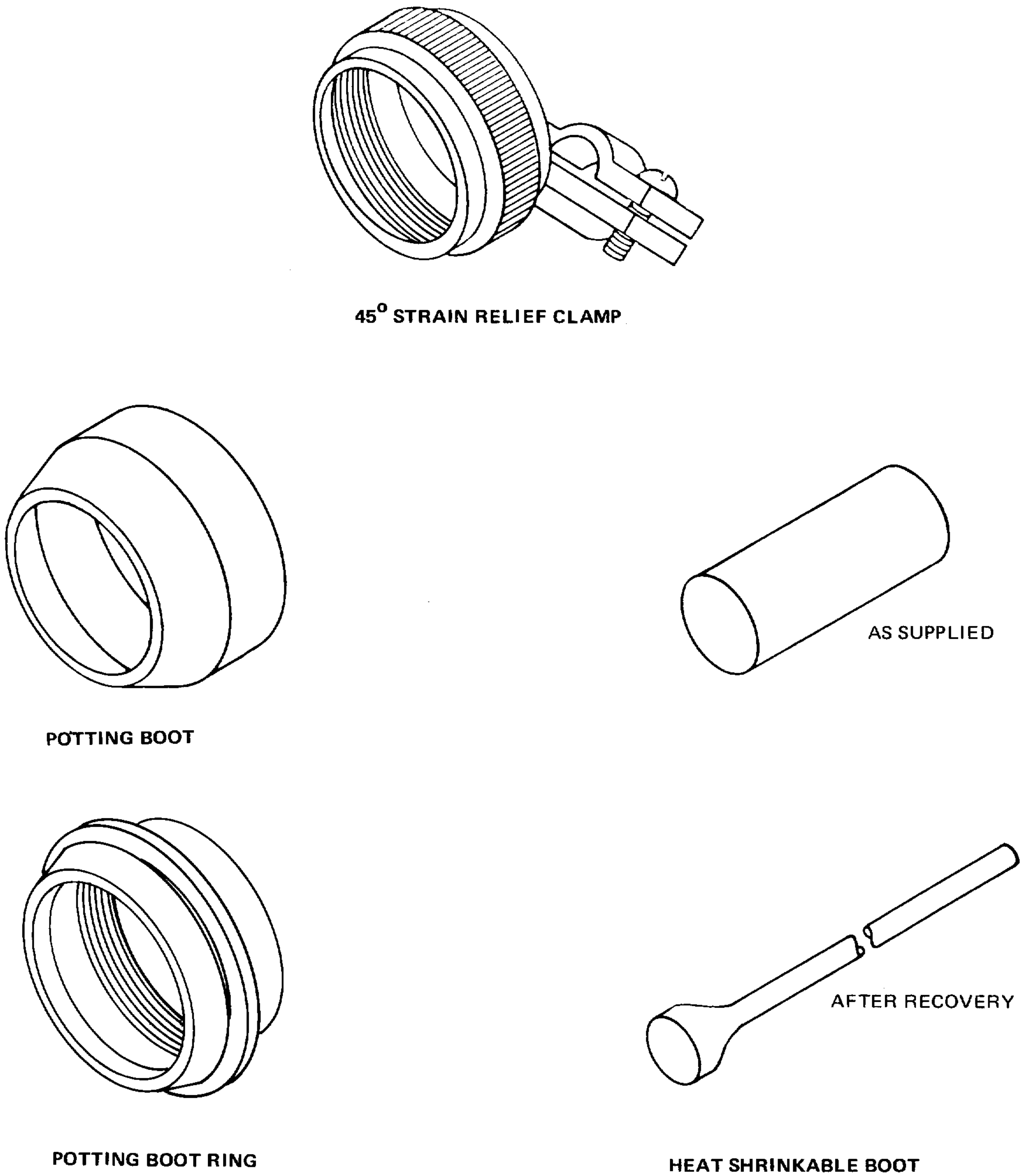
Term	Definition
Accessories (Cont.)	 45° SHIELD TERMINATION CABLE SEALING BACKSHELL  STRAIGHT SHIELD TERMINATION CABLE SEALING BACKSHELL  THREADED ADAPTER  SHRINK BOOT ADAPTER

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition



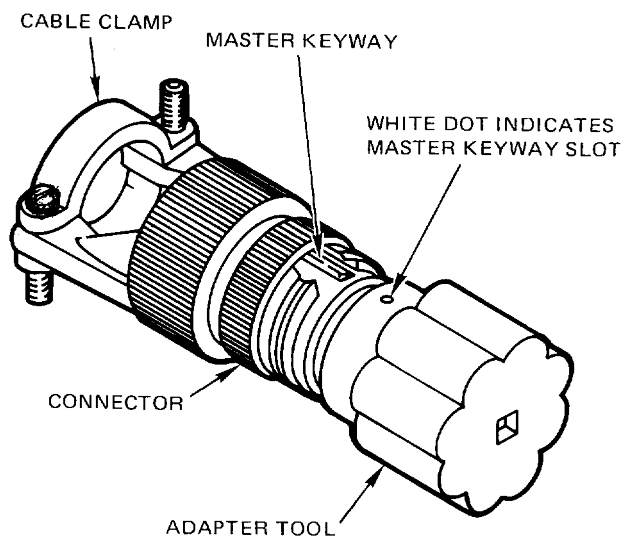
TYPICAL CONNECTOR ACCESSORIES

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Accordion	(1) Retractable cable with a series of equally-spaced transverse folds. (2) Type of connector contact where a flat spring is given a Z shape to permit high deflection without overstress.
Acetal resins	Rigid thermoplastics with properties similar to zinc, aluminum, and other metals. The molecular structure of the polymer is that of a linear acetal, consisting of unbranched polyoxymethylene chains. Can be molded or extruded to provide high tensile and flex strengths, resilience, and solvent resistance. Good electrical properties that survive humid conditions. Used commonly in tape and yarn.
Acetate fibers	Acetate fibers are cellulose based fibers in filament form characterized by high dielectric strength and a dielectric constant of about 5.0 at 60 Hz and 50% RH. The primary electrical application appears to be in the form of woven cloth for pressure sensitive electrical tapes because of noncorrosiveness. (See tape-acetate cloth.)
Acid	Hydrogen-containing substance which breaks down in water to produce hydrogen ions which are released in solution. The higher the concentration of hydrogen, the stronger the acid. (See pH.) The hydrogen ion carries one positive electrical charge.
Acid core solders	Wire solders with self-contained acid flux.
Acid gas generation	Amount of acid-forming gases liberated by a compound when exposed to elevated temperatures.
Acid number	Quantitative value that can be assigned to measure the degree of acidity of any acid. However, there is not necessarily a relationship between a high acid number and the corrosiveness of an acid; corrosive acid action is a function of free or ionic acidity.
ACR	Designation for cable with corona resisting insulation.
Acrylic	Synthetic resin made from acrylic acid or from an acrylic acid derivative. For enamel film coated magnet wire, the basic resin is copolymer of acrylonitrile plus acrylate and phenolic resin. The enamel film is applied for an aqueous dispersion. The film is resistant to refrigerants and many solvents. Suggested for use in hermetic motors.
Acrylic resins	Synthetic resins made from acrylic acid or from an acrylic acid derivative. Flame resistance and clarity offer applications in lighting fixtures.
Acrylonitrile	Monomer (CH_2 CHCN) useful in copolymers.
Acrylonitrile-Butadiene-Styrene (ABS)	Family of three-polymer engineering thermoplastics. Acrylonitrile, styrene liquids, and butadiene gas are polymerized together in a variety of ratios to produce required properties such as suitable electrical properties, chemical resistance, and dimensional stability.
ACSR	Designation for Aluminum Conductor Steel Reinforced. Aluminum wires stranded around a steel core. Used for high voltage transmission lines.
ACT	Designation for armored cable with plastic insulated conductors.
Activated	Condition of a compound or mixture of compounds having higher chemical activity than that normally found with the compound or mixture. An example is the addition of an activator to rosin to increase its fluxing activity.
Activation	Changing of the passive state of the surface of metal to a chemically active state. Contrast with passivation.
Activator	Chemical additive used to initiate the chemical reaction in a specific chemical mixture.
Active port diameter	On a light source or detector the diameter of the area in which light can be coupled to or from an optical fiber.
Active wire	(1) The wire in an armature winding which produces useful voltage. (2) That portion of the winding in which induction takes place.
ACU	Designation for armored cable with latex rubber insulated conductors.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
ACV	Designation for varnished cambric insulation and polyvinyl chloride, with overall interlocked armor, rated at 5000 V.
Adapter	Intermediate device to provide for attaching special accessories or to provide special mounting means.
Adapter tool	A device used to hold the connector while installing or removing adapters, cable clamps, etc. from the rear of the connector.



Term	Definition
Additive process	Process for obtaining conductive patterns by the selective deposition of conductive material on unclad base material.
Adhesion	Force of attraction between the molecules (or atoms) of two different phases, such as liquid brazing filler metal and solid copper or plated metal and basic metal. Contrast with cohesion.
Adhesive-bonded	Cables where bonding is accomplished by adding an adhesive coating to the surface of the cable components (wire insulation, cable jacket or spacer), and joining and curing the adhesive to form a cable. (See bonded cables.)
Admittance	Measure of the ease with which an alternating current flows in a circuit. The reciprocal of impedance.
AD 123	Aluminum alloy used for making electric wire.
AF	Designation for asbestos insulated, single or stranded conductor fixture wire impregnated with moisture-resisting, flame retarding compound with or without braid, 300 V, 302°F (150°C).
AFC	Designation for two or three individually braided (cotton or rayon) AF conductors, twisted together without overall covering, 300 V, 302°F (150°C).
AFPD	Designation for two or three AF conductors twisted together with cotton or asbestos braid overall, 300 V, 302°F (150°C).
AFPO	Designation for two AF conductors without individual braid, laid parallel and braided overall, 300 V, 302°F (150°C).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
AFS	Designation for two or three conductor heat resistant cord with impregnated asbestos insulation and rubber jacket. For use in damp locations, 300 V.
AFSJ	Designation for cord same as AFS, but for lighter (junior) service, 300 V.
Aging	Change in properties of a material with time under specific conditions.
AGS	Designation for solid or stranded flexible nickel conductor with silicone impregnated, asbestos insulation and with glass braid overall. For appliance wiring, 300 V, 392°F (200°C).
AI	Designation for impregnated asbestos insulated appliance wire similar to type A, but moisture, heat, and flame resistant. Dry locations only. Without braid, 300 V, 257°F (125°C).
AIA	(1) Designation for felted asbestos fibers with outer asbestos or glass braid, impregnated with heat, flame, and moisture resistant compound. Dry locations only. 600 V, 257°F (125°C). (2) Aircraft Industries Association.
AIEE	Former American Institute of Electrical Engineers. Now known as Institute of Electrical and Electronics Engineers (IEEE).
Air core cable	Telephone cable in which the interstices in the cable core are not filled with a moisture barrier.
Aircraft ignition cable	High tension cable for ignition systems of internal combustion aircraft engines.
Aircraft wire	Wire for airborne equipment. It often must meet severe environmental conditions such as heat, cold, altitude, solvents, fuels, etc.
Air dielectric coaxial cable	Coaxial cable in which air is the dielectric material. A spiral filament or spacer may be used to center the conductor.
Air spaced coaxial cable	Coaxial cable in which air is the dielectric material. A spirally wound, synthetic filament, beads, or braided filaments may be used to center the conductor.
AL or ALS	Designation used as a suffix to denote a wire or cable having an aluminum sheath.
Alkali	Chemical that gives a base reaction.
Alkaline cleaner	Material blended from alkali hydroxides and such alkaline salts as borates, carbonates, phosphates, or silicates. The cleaning action may be enhanced by the addition of surface-active agents and special solvents.
Alkyd resin	Polyester resins made with a fatty acid modifier. Thermosetting, molding compounds are used in electrical motor control, automotive ignition, and electronic components.
Alkylated chlorodiphenyl oxide	Used primarily as an impregnant for large power capacitors, it has a maximum operating temperature range of -76°F (-60°C) to 257°F (125°C). It offers superior corona behavior and good stress handling. Impregnated capacitors reportedly have achieved an exceptionally low-failure field record.
Alligator clip	Mechanical device, similar to the jaws of an alligator, generally used as a temporary connection on the end of a test lead or interconnections wire.
Alloy	Combination of two or more metal elements. The combination may be in the form of a solid solution of one or more metals in another metal, or in distinct phases, or components, of the alloy. Generally, alloys will have different properties from those exhibited by their constituent elements. An example is 63% tin plus 37% lead, a solder alloy. This alloy melts at 361°F, (182.8°C), whereas pure tin melts at 449°F (231.7°C), and pure lead at 621°F (326.7°C).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

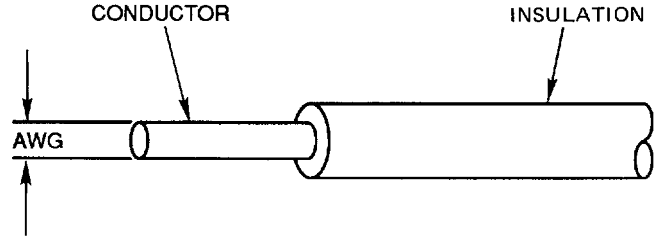
Term	Definition
All-rubber cable	Cable in which all interstices between conductors are filled with rubber compound. This provides greater resistance to impact, adds strength, reduces the tendency to kink, and reduces flexibility.
Allyl plastics	Plastics based on resins made by additional polymerization of monomers containing allyl groups, such as diallyl phthalate. Often compression molded, offering good high temperature performance and chemical resistance.
Alpha-cellulose	Very pure form of cellulose.
Alphanumerical coding	Wire identification by letters and/or numbers. (See surface printing.)
Alternating Current (AC)	Current in which the charge-flow periodically and regularly reverses in cyclic manner. A graph to a base of time shows the waveform, which comprises a succession of instantaneous values, the greatest of which is the amplitude or peak value. The time taken by one complete cyclic repetition is the period or Pulse Repetition Time (PRT), and the number of periods in one second is the frequency. (See frequency, formulas-electrical.)
Alumina	Alumina ceramics have very good mechanical characteristics at room and elevated temperatures. They also have good dielectric loss properties which persist at low and high frequencies. High-alumina ceramic is one of the best all-around insulations available.
Aluminum and its alloys	Metal characterized by high resistance to corrosion, good electrical and thermal conductivity, and a density of one third or less than that of steel, copper, or nickel. It can be fabricated, joined, and treated by most methods used for other metals. Because of its relatively high conductivity in relation to its light weight and low cost, aluminum is used as a conductor in large AWG sizes. Since its conductivity is 61% that of copper, aluminum restricts miniaturization. Aluminum is used extensively in wire form for power lines. Other major applications include magnet strip or foil, and shielding for wire, cable, and other products. It is available in wire, extrusion, sheet foil, powder, and cast forms.
Aluminum-steel conductor	Composite conductor made up of a combination of aluminum and steel wires. In the usual construction, the aluminum wires surround the steel.
Amalgam	Alloy of mercury with one or more other metals.
Ambient temperature	Temperature of the environment, usually air, surrounding a connector, conductor, cable or other device.
American National Standards Institute (ANSI)	Federation of trade, technical, and professional organizations, government agencies, and consumer groups. Coordinates the development of, and publishes standards. Operates a voluntary certification program.
American Society for Testing and Materials (ASTM)	A non-profit, industry-wide organization which publishes standards, methods of tests, recommended practices, definitions, and other related material.
American Wire Gauge (AWG)	Standard system used for designating wire diameter. Also referred to as the Brown and Sharpe (B&S) Wire Gauge. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Amorphous	Condition of a material whose atoms and molecules are not arranged in any definite pattern or form. The material is not crystalline. A characteristic of amorphous materials is the lack of certain well defined physical properties. For example, the material is homogeneous, but does not show a sharp melting or freezing point. Generally, amorphous materials are poor conductors of heat and electricity. Glass, carbon, and rosin are examples of amorphous materials.
Ampacity	Maximum current a conductor can carry without exceeding insulation and jacket temperature limitations.
Ampere (A)	Unit of current. One ampere equals the current (I) flowing through one ohm of resistance (R) at one volt (E) potential. I = E/R (See Current).
Ampere’s rule	Current in a certain direction is the flow of an electrical current. One ampere is the current flowing through one ohm of resistance at one volt potential.
Ampere turn	Unit of magnetomotive force obtained by multiplying the current in amperes by the number of turns in a coil.
Amplifier	Device used to boost the strength (db level) of an electronic signal.
Amplitude	Distance between high or low points of a waveform or signal. Also referred to as wave “height”.
Amplitude modulation	Method of adding information to an electronic signal where the height (amplitude) of the wave is changed to the added information.
Analog signal	Electrical signal that varies continuously over an infinite range of voltage or current signal, which varies discreetly between two values, usually one and zero.
Analytical chemistry	Branch of chemistry which deals with the detection or identification of the atoms, ions, or radicals (groups of atoms which react as a unit) of which a substance is composed, the compounds which they form, and the proportions of these compounds which are present in a given substance.
AND	Air Force-Navy Design.
Angle of incidence	Angle between an incident ray and the normal to a reflecting or refracting surface.
Angular misalignment loss	Optical power loss caused by angular deviation from the optimum alignment of source to optical fiber, fiber-to-fiber, or fiber-to-detector.
Anion	Negatively charged atom or radical.
Anneal	Relief of mechanical stress in brittle materials through heat and gradual cooling, to make it less brittle.
Annealed-in-process wire	Wire annealed at an intermediate stage between rod size and finished size in order to produce a softer wire of fairly uniform temper.
Annealed wire	Wire which has been softened by heating. Sometimes referred to as soft drawn wire.
Annular conductor	Round, stranded conductor whose strands are laid around a suitable core. The core is usually made wholly or mostly of non-conducting material. This construction has the advantage of lower total AC resistance for a given cross-sectional area of conducting material by eliminating the greater skin effect at the center.
Annular ring	Portion of conductive material completely surrounding a hole.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Anode	(1) Positive pole of a plating cell. It is the physical entity of the plating setup at which negatively charged ions leave the plating solution. The ions are converted back to the parent atom (or group of atoms) and are discharged as gas, redissolve in the solution, or precipitated as sludge in combination with other components of the solution. The electrical charge which had been carried by the ion then enters the external electrical circuit. In plating solder, as in many plating baths, the anode is consumed by giving up its metal content to the bath in the form of positive metal ions. These are then deposited on the cathode. (2) The P-type or more positively doped material of a diode, symbolized by the arrow section of the schematic symbol.
Anodic films	Anodic film insulation (aluminum oxide coating on aluminum conductor) can be used on magnetic wire but other wire applications have been suggested. The coating is thin, space-saving, inorganic, and resistant to extreme temperatures with a 3600°F (1982.2°C) melting point. Although anodic film insulated conductors can be bent and processed without rupturing the film, flexibility is limited relative to other insulations.
Anodizing	Electrolytic process for producing a protective or decorative film on certain metals, chiefly aluminum and magnesium.
ANSI	(See American National Standards Institute.)
Antenna wire	Wire generally with high tensile strength used as an antenna. It may be insulated or uninsulated.
Anti-fray lacquer	Lacquer used to coat textile or glass braid to prevent ends from fraying when cutting.
Anti-oxidant	Substance which prevents or slows down oxidation of material exposed to air.
Apparatus wire and cable	Overall term used to describe a number of specific wire types including nonautomotive battery cables, defroster wire, electric furnace cables, and gas tube sign ignition cables. Also included under this heading in AWG sizes 14 and heavier are appliance wire, fixture wire, machine tool wire, motor and transformer lead wire, pump or well cable, and switchboard and control wire.
Aramid fiber	Excellent heat resistance, durability and good dimensional stability. Does not melt and is flame retardant. At 482°F (250°C), it retains 60% of its room temperature breaking strength.
Arc	Luminous discharge of electricity through a gas. Characterized by a change (approximately equal to ionization potential of the gas) in the space potential in the immediate vicinity of the negatively charged electrode.
Arc Fault Circuit Breaker	Circuit breaker with internal electronic circuitry, capable of detecting arcing events of much shorter duration than required for traditional thermal activated bi–metal circuit breakers.
Arc resistance	Time required for an arc to establish a conductive path in a material. Breakdown between two electrodes usually occurs as a conducting paths burned on the surface of the dielectric material.
Arc Tracing/Tracking	An event that occurs when electrical wire insulation material is carbonized as the result of an arcing incident. This carbonizing of the insulator material is capable of propagating the length of the wire and often results in wire and proximity damage due to fire.
Armature wire	Stranded annealed copper wire, straight lay, with soft, loose, white cotton braid. It is used for low voltage, high current, rotor winding motors and generators. Straight lay permits forming in armature slots and increases compressibility.
Armor	Braid or wrapping of metal, usually steel, used for mechanical protection of a wire or cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Arrhenius curve	Method whereby accelerated aging data is plotted graphically to produce curves that may be used to predict end of life conditions.
ASA	American Standards Association.
Asbestos	Silicate mineral that readily separates into flexible fibers suitable for use as an incombustible, non-conducting, chemical resistant material, but is physically weak. Fibrous asbestos insulation is used in the form of yarn servings, felts, lap, roving, braid, and paper.
ASC	Aluminum Stranded Conductors.
ASE	Designation for service entrance cable, above ground use. Some constructions are suitable for underground use. Covering is flame retardant, moisture resistant, and abuse resistant.
ASESA	Armed Services Electro Standards Agency.
ASG	Aeronautical Standards Group.
ASME	American Society of Mechanical Engineers.
ASP	Filled direct burial telephone cable used in areas subject to rodent attack. Consists of a filled cable core, corrugated aluminum shield, corrugated steel tape, flooding compound, and polyethylene jacket.
Aspect ratio	Length divided by width or diameter.
Assembly	Article consisting of detailed parts and sub-assemblies performing functions necessary to the operation of the device.
ASTM	(See American Society for Testing and Materials.)
Asynchronous	Method of transmitting data. Low-cost alternative to synchronous communications.
Atom	Smallest particle of an element which can enter into a chemical combination. All chemical molecules are composed of atoms. The differences between molecules result from the differences in type and number of atoms involved.
Atomic percentage	Number of atoms of an element in a total of 100 representative atoms of a substance; often written A/O.
Attenuation	Power loss in an electrical system. Applied to coaxial cables, the power drop or signal loss in a circuit. Expressed in decibels (dB). It is also the decrease in amplitude of a wave with distance of wave propagation when the amplitude at any given place is constant in time, or the decrease in amplitude with time at a given place.
Attenuation allowance	(See Flux budget.)
Attenuation coefficient	Factor expressing optical power loss per unit of length, expressed in d b/km.
Attenuation-limited operation	Condition prevailing when the received signal amplitude (rather than distortion) limits performance.
Audio frequency	Range of frequencies audible to the human ear. Usually 20 Hz to 20 KHz.
Auto-ignition point	Temperature at which vapor from a material in air will spontaneously burst into flame. This is opposed to the flash point where the material vapors will ignite only under the influence of an external energy source such as a flame or spark.
AV or AVC	Designation for asbestos and varnished cambric insulated power and control cables.
AVA	Designation for impregnated asbestos and varnished cambric insulated wire with asbestos or glass braid, 600 V, 230°F (110°C).
Avalanche Photodiode (APD)	Photodiode that show gain in its output power that it receives through avalanche multiplication of photo current.
AVB	Same as AVA except with cotton braid, 194°F (90°C).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

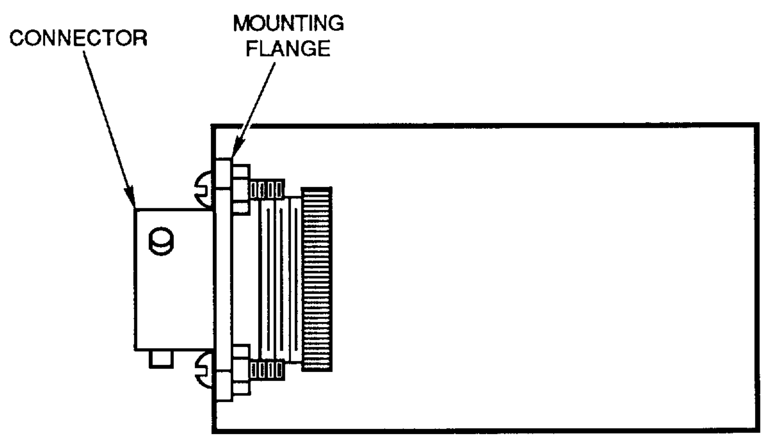
Term	Definition
AVL	(1) Same as AVA except lead sheath in place of braid, 600 V, 230°F (110°C); 500 V, 212°F (100°C). (2) Approved Vendors List.
AVPD	Designation for asbestos and varnished cambric insulated cord with asbestos braid, two or three conductors. Heat and moisture resistant, and flame retardant. For damp locations, 600 V, 212°F (100°C). Round construction.
AVPO	Same as AVPD except two-conductor flat construction.
AWG	(See American Wire Gauge.)
AWM	Designation for Appliance Wiring Material.
Axial lead	Wire coming out from the end along the axis of a component. (See radial lead.)
Axial ray	Light ray that travels along the optical fiber's axis.
Azeotropic system	System of two or more liquid compounds which has a constant boiling point at a particular composition.
B	(See Braid.)
Back-mounted	When a connector is mounted from the inside of a panel or box with its mounting flange inside the equipment. 
Backplane panels	Interconnection panel into which Printed Circuit (PC) cards or other panels can be plugged. These panels come in a variety of designs ranging from a PC mother-board to individual connectors mounted in a metal frame. Panels lend themselves to automated wiring.
Backplane wiring	Connections between levels to each other and to other sub-circuits.
Backscattering	That portion of scattered light which returns in a direction generally reverse to the direction of propagation.
Backshell mold	Form used to mold a rubber or neoprene covering over the backshell of a connector or plug after it is connected to a cable. The compound is usually chemically cured. (See potting mold.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

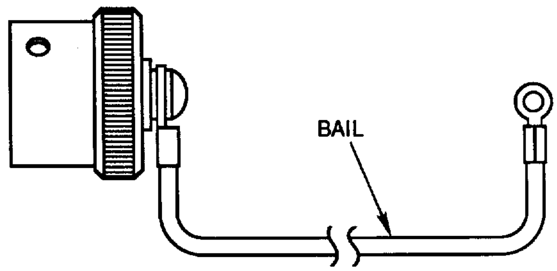
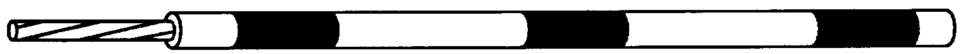
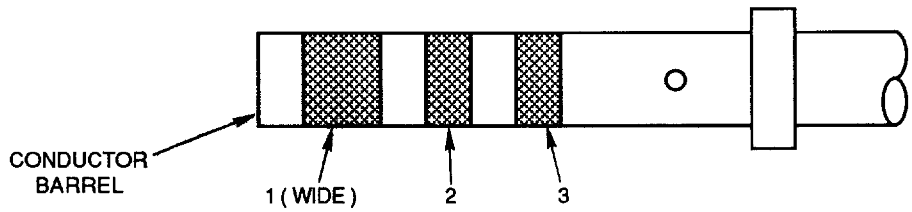
Term	Definition
Bail	Loop of wire used to prevent permanent separation of two or more parts assembled together. One example is the bail holding the dust cap on cylindrical connectors. 
Balun	Device for matching an unbalanced coaxial transmission line to a balanced two-wire system. Normally, also gives impedance transformation, such as 300 ohm balanced to 75 ohm unbalanced.
Banded cable	Two or more cables banded together by stainless steel strapping.
Band marking	Continuous circumferential band applied to a conductor at regular intervals for identification.
BAIZAL	Designation for Bare Aluminum conductor.
Baron nitride	Less brittle than most ceramics. It has high thermal shock resistance, high thermal conductivity, and is lightweight. It is relatively weak and affected by humidity.
Bandwidth (BW)	Frequency range of electrical signals transmitted. Coaxial cable has a broad bandwidth and will transmit signals from 0 to 5 MHz. (See formulas-electrical.)
Barrel	(1) Conductor barrel. Section of the terminal, splice, or contact that accommodates the stripped conductor. (2) Insulation barrel. Section of the terminal, splice, or contact that accommodates the conductor insulation.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

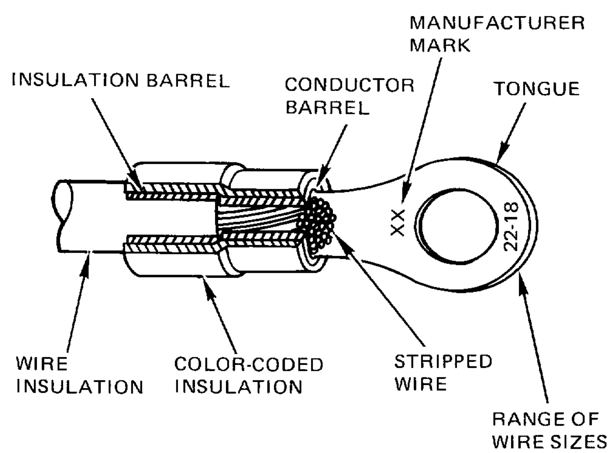


WIRE IDENTIFICATION



BLACK	0	GREEN	5
BROWN	1	BLUE	6
RED	2	VIOLET	7
ORANGE	3	GRAY	8
YELLOW	4	WHITE	9

CONTACT IDENTIFICATION



Term	Definition
Barrel chamfer	Bevel at the end of the conductor barrel for easier entry of the conductor.
Barrel-packed	Method of coiling into a fiber drum for shipment. It has wide application where large volumes of wire are used with automatic feed systems. Sometimes termed, drummed packing.
Base	(1) Material (such as paper, cotton, glass, fabric, fiber, felted asbestos, and nylon fabric) in the form of sheets which are impregnated with resin to form laminated plastics. (2) Substance which upon solution in water produces one or more hydroxyl ions. A hydroxyl ion is composed of one atom of oxygen and one atom of hydrogen. The hydroxyl ion carries one negative electrical charge. The strength of a base is determined by the number of hydroxyl ions that are released into solution. (See pH.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

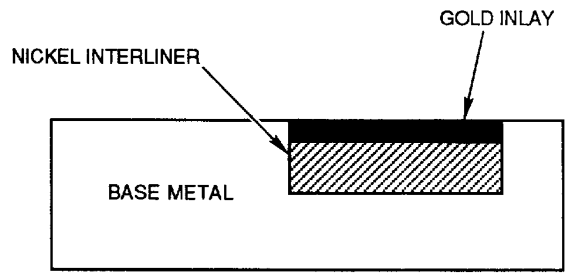
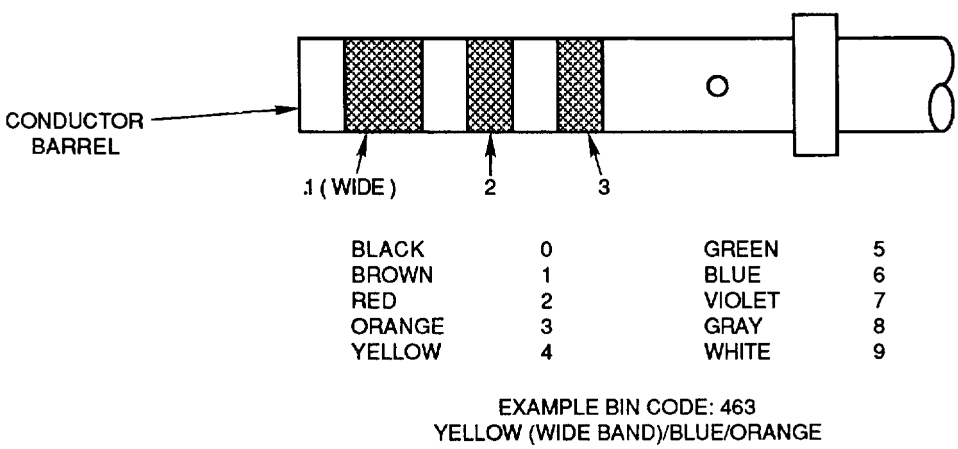
Term	Definition
Base band	Signaling technique in which the signal is transmitted in its original form and not changed by modulation.
Base element	Easily oxidized element as opposed to a noble element.
Base film	Original form in which a film, such as polyester, exists prior to coating.
Base material	Insulating material upon which the conductive pattern may be formed. The base material may be rigid or flexible.
Base metal	Metal from which the connector, contact, or other metal accessory is made and on which one or more metals or coatings may be deposited. 
Basic Identification Number (BIN)	Contact numbering system which utilizes color coding for contact identification. 
Battery cable	Single conductor cable, insulated or uninsulated, used for carrying current from batteries to the point where power is needed. Also used for grounding.
Baud	Measurement of the signaling speed of a data transmission device.
Bayonet coupling	Quick coupling device for plug and receptacle connectors. Accomplished by rotation of a cam operating device designed to bring the connector halves together.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

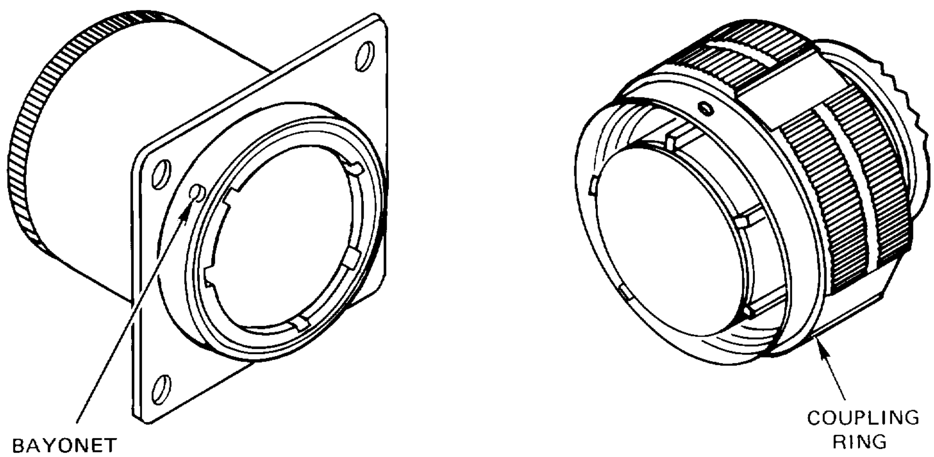
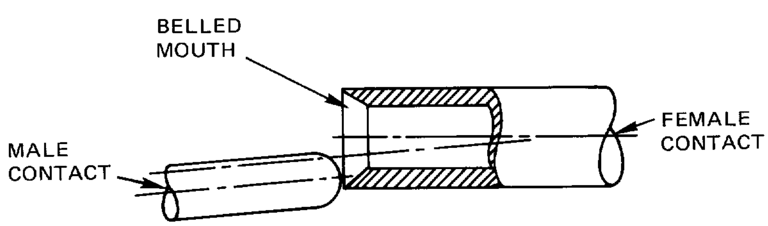
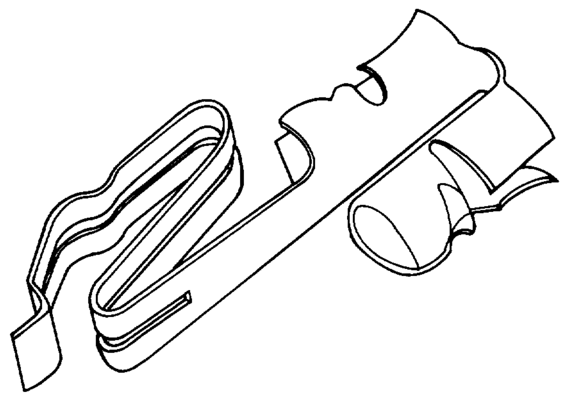
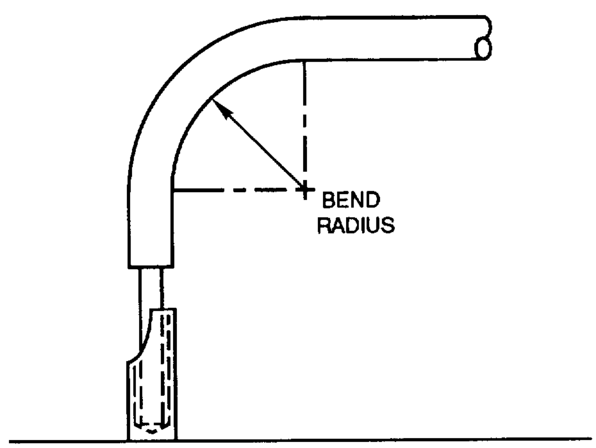
Term	Definition
	
BC	Bare Copper or Bell Cord.
BCF	(See Billion Conductor Feet.)
BDC	Designation for Busdrop Cable, plastic.
Beaded coax	Coaxial cable with a dielectric consisting of beads made of various materials.
Beam diameter	Distance between two diametrically opposed points at which the irradiance is a specified fraction of the beam's peak irradiance.
Beam divergence	Increase in beam diameter with increase of distance from the source.
Beamsplitter	Device for dividing an optical beam into two or more separate beams.
Beamwidth	(See beam diameter.)
Belled mouth (bellmouth)	Flared or wide entrance of a terminal, splice, or contact barrel to permit easier insertion of the conductor.
	
Bellows contact	Contact in which a flat spring is folded to provide a more uniform spring rate over the full tolerance range of the mating unit.

TABLE 2. TERMS AND DEFINITIONS (Cont.)



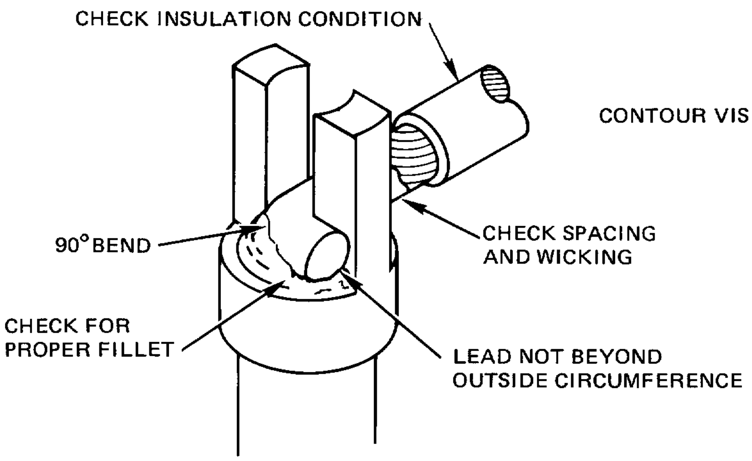
Term	Definition
Belt	Number of layers of insulation on a conductor or number of layers of jacket on a cable.
Belted-type cable	Multiple conductor cable having a layer of insulation over the assembled insulated conductors.
Bend loss	Increased attenuation occurring when the fiber is curved around a restrictive radius.
Bend radius	Maximum amount a wire, cable, fiber, or fiber cable can be bent without causing damage. Usually called minimum safe bending radius.

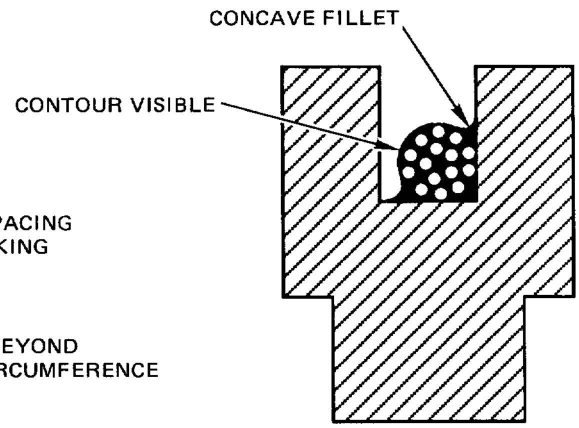


Term	Definition
Beryllia	Beryllium oxide ceramics (BeO) are significant in that they have high thermal conductivity characteristics. Applications include heat sinks, circuit boards, diodes, ceramic to metal seals, and waveguide windows.
Beryllium	Metal lighter than aluminum, non-magnetic, and characterized by good electrical conductivity and high thermal conductivity. Available in sheet, foil, and wire forms. Strong conductor wire can be made from beryllium for use in applications where light weight is critical. The most important use for beryllium is in alloys, especially beryllium-copper alloys.
Bifilar	Winding made non-inductive by winding two wires carrying equal current in opposite directions together, side-by-side, as one wire.

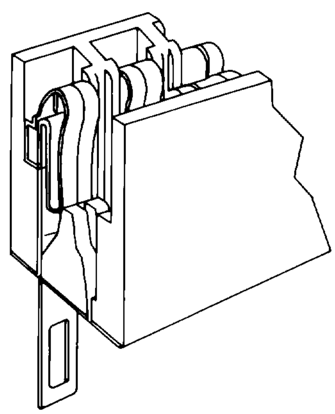
TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Bifurcate	Describes lengthwise slotting of a flat spring contact, as used in a printed circuit connector, to provide additional independently operating points of contact. One application is the bifurcated contact.
Bifurcated contact	Contact (usually flat spring) which is slotted lengthwise to provide additional independently operating points of contact.

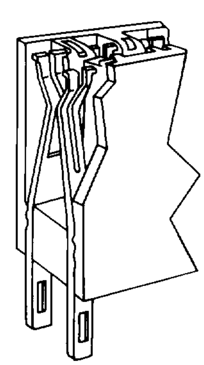




Term	Definition
Bifurcated terminal	Terminal containing a slot or split in which wires or leads are placed and soldered.



BIFURCATED BELLOWS
CONTACT



BIFURCATED CANTILEVER
CONTACT

Term	Definition
Billion Conductor Feet (BCF)	Quantity derived by multiplying the number of conductors in a cable by the amount of cable. Usually used to indicate plant capacity or an annual requirement.
Bimetallic wire	Any wire formed of two different metals joined together (not alloyed). It can include wire with a steel core for high strength, clad wire, or plated or coated wire.
BIN	(See Basic Identification Number.)
Binary alloy	Alloy containing two component elements.
Binder	(1) Spirally served tape or thread used for holding assembled cable components in place until additional manufacturing operations are performed. (2) Substances added to unfired substrates and thick film compounds to hold ingredients together or fill voids.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Bird cage	Defect in stranded wire where the strands in the stripped portion between the covering of an insulated wire and a soldered connection (or an end-tinned lead) have separated from the normal lay of the strands.
Birmingham Wire Gauge (BWG)	Birmingham Wire Gauge was used extensively in Great Britain and the United States for many years, but is now obsolete. Its uses have persisted, however, for certain purposes including sizing galvanized steel wire for cable armor.
Blade contact	Flat male contact designed to mate with a tuning fork or a flat-formed female contact.
Blind joint	Concealed or covered joint.
Blister	Localized swelling and separation between any of the layers of a laminated base material or between the base material and a conductive foil. (A form of delamination.)
Blowhole	Small hole or cavity in the vicinity of the solder joint caused by gas entrapped during solidification.
Blown jacket	Term used for outer cable covering applied by the controlled inflation of the cured jacket tube and the pulling of the cable through it.
BMC	(See Bulk Molding Compound.)
Board thickness	Thickness of the metal-clad base material including conductive layer or layers. (May include additional platings and coatings depending upon when the measurement is made.)
Board to motherboard or backplane	Connection point between printed circuit boards or sub-circuit modules and the motherboard or a backplane board.
Bobbin	(1) Spool used for taking up drawn wire and subsequently used for pay out packages in cabling and stranding equipment. (2) Insulated spool which serves as a support for a coil.
Bobbin lugs	Mounted in plastic or paper bobbins, lugs serve to connect coil wires to external lead wires.
Body, connector	Main portion of a connector to which contacts and other components are attached. This term is not used with connectors incorporating non-integral shells in their construction.
Boiling point	Temperature of a liquid at which its vapor pressure is equal to the pressure of the atmosphere surrounding the fluid. For example, at 212°F (100°C), water has a vapor pressure equal to 14.7 psi, which is the pressure of the atmosphere at sea level.
Bond	Junction of joined parts. Where solder is used, it is the junction of the solder and the heat affected base metal.
Bond strength	Force per unit area required to separate two adjacent bonded surfaces by a force perpendicular to the surface. (See peel strength.)
Bondable wire	Insulated wire whose surface has been treated to facilitate adherence to other materials such as potting compounds. The term also could be applied to magnet wires used in making coils where bonding the turns together is desirable.
Bonded	Joined by atomic attraction or by direct contact with a melted filler material (as a solder joint).
Bonded assembly	Connector assembly in which the components are bonded together using an electrically appropriate adhesive in a sandwich type structure. Provides sealing against moisture and other environmental conditions which weaken electrical insulating properties.
Bonded assembly, electrical	Assembly whose supporting frame and metallic non-circuit elements are connected so as to be electrically shorted together.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

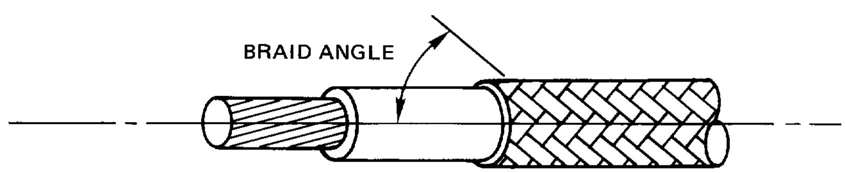
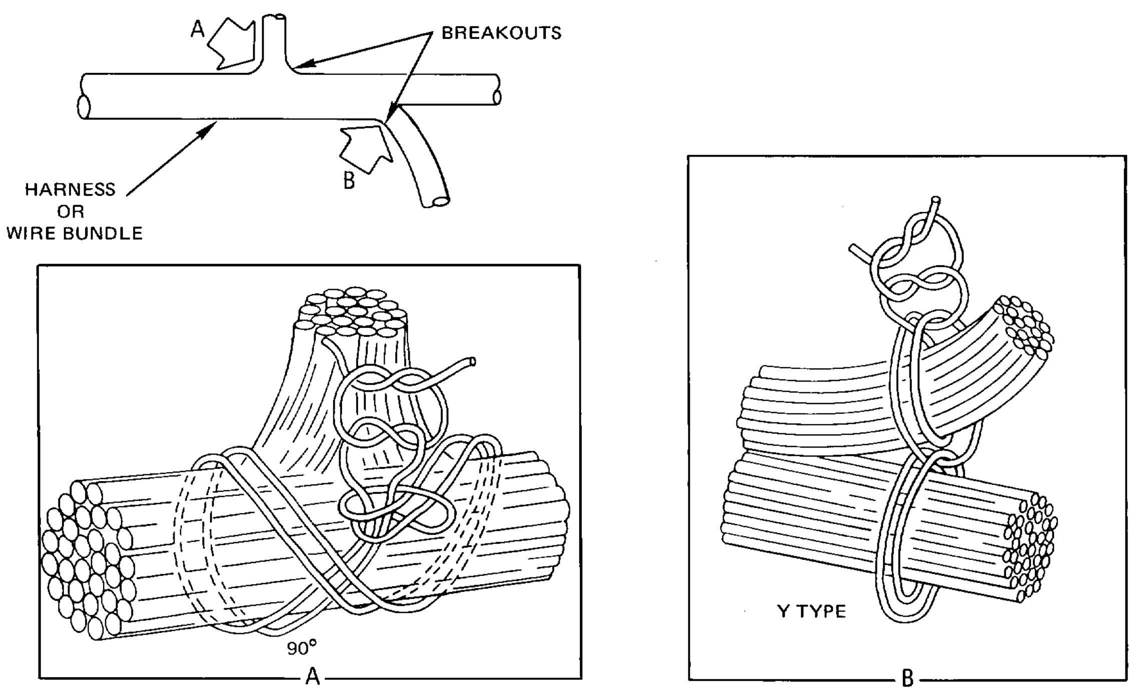
Term	Definition
Bonded cables	Cables consisting of pre-insulated conductors or multiconductor components which are laid in parallel and bonded into a flat cable. (See solvent-bonded, adhesive-bonded, film-bonded, flat cable.)
Bonded construction	Type of insulation construction in which the glass braid and nylon jacket are bonded together.
Bonding pad	Metallized area at the end of a thin metallic strip or on a semiconductor to which a connection is made.
Bonding wire	Fine gold or aluminum wire for making electrical connections in hybrid circuits between various bonding pads on the semiconductor device substrate and device terminals or substrate lands.
Booster	Device inserted into a line (or cable) to increase the voltage. Boosting generators are also used to raise the level of a DC line. Transformers are usually employed to boost AC voltages. The term booster is also applied to antenna preamplifiers.
Boot	(1) Protective covering over any portion of a cable, wire, or connector in addition to the normal jacketing or insulation. (2) A form placed around the wire termination of a connector to contain the liquid potting compound before it hardens. (3) A protective housing usually made from a resilient material to prevent entry of moisture into a connector.
Bow	Deviation from flatness of a board characterized by a roughly cylindrical or spherical curvature such that, if the board is rectangular, its four corners are in the same plane. (See twist.)
Braid angle	Angle between the axis of the cable and the axis of any one member or strand of the braid. It is the smaller of the two angles formed by the carrier and the longitudinal axis of the braid. 
Braid (B)	(1) Flexible conductor made of a woven or braided assembly of fine wires. (See shield.) (2) Covering formed from textile yarn. Braids provide mechanical and thermal protection to plastic insulation, separate cable segments in multiconductor cables, and act as components in flame retardant cables.
Braid carrier	Spool or bobbin on a braiding machine which holds one group of strands or filaments consisting of a specific number of ends. The carrier revolves during the braiding operation.
Braid ends	Number of strands used to make up one carrier. The strands are wound side by side on the carrier spool and lie parallel in the finished braid.
Braider or braiding machines	Machines used to apply braids to wire and cable and to produce braided sleeving and braids for tying or lacing purposes. Braiding machines are identified by the number of carriers such as 16-carrier or 24-carrier. Strands from the individual supply packages are braided as the upper and lower carriers revolve in opposite directions.
Brake wire	Wires used in automotive and truck trailers to supply current to the electrical braking system.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Brazing	Group of joining processes wherein the filler metal is a non-ferrous metal or alloy whose melting point is typically higher than 1000°F (537.8°C), but lower than that of the metals or alloys to be joined. At one extreme, brazing is similar to soldering and is sometimes called hard soldering.
Breakdown (puncture)	Disruptive discharge through insulation.
Breakdown voltage	Voltage at which the insulation between two conductors fails.
Breakout	Point at which a conductor or group of conductors leaves a multiconductor cable or harness to complete circuits at various points along the cable.



Term	Definition
Break-out boxes	Device that you can connect different cables together and see what works with what.
Bright dip	Solution which produces, through chemical action, a bright surface on an immersed metal.
British standard wire gauge	Modification of the Birmingham Wire Gauge and the legal standard of Great Britain for all wires. Variously known as Standard Wire Gauge (SWG), New British Standard (NBS), English Legal Standard, and Imperial Wire Gauge.
Broadband	Signaling technique in which more than one signal can be carried simultaneously.
Brown and Sharp (B&S) wire gauge	Wire diameter standard that is the same as American Wire Gauge (AWG). (See American Wire Gauge.)
B-stage material	(See prepreg, resin - B stage of.)
Buffer	Substance or substances added to an acid or base solution. Its purpose is to reduce the rate at which acidity or alkalinity of the solution is changed during chemical reactions. An example is a buffered acid flux.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

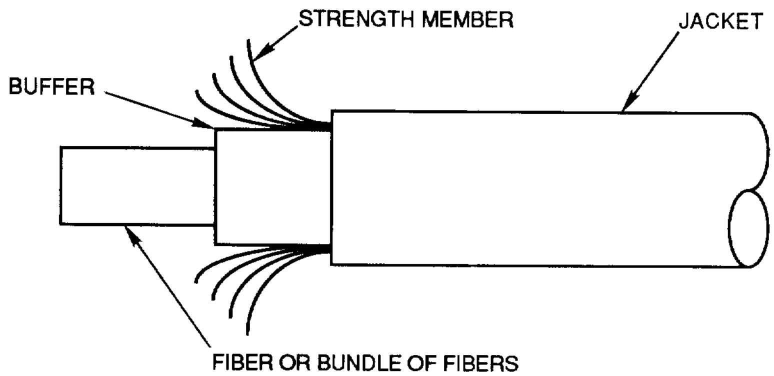
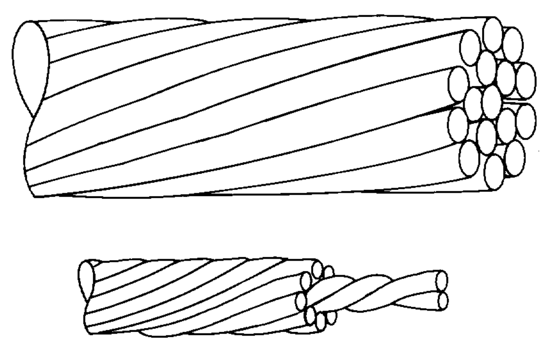
Term	Definition
Buffer (fiber optic)	Protective material which covers and protects a fiber, or fiber bundle, in a fiber cable. The buffer has no optical function. 
Buffing stripper	Motorized device for removing flat cable insulation by means of one or two buffing wheels that melt the insulation and brush it away from the conductors. Also called abrasion stripper.
Building wire	Wire used for light and power distribution in the building trades.
Bulk Molding Compound (BMC)	Thermosetting plastic resins mixed with standard reinforcement, a filters, and other additives into a viscous compound for compression or injection molding.
Buna rubber	(See nitrile-butadiene rubber, styrene-butadiene rubber.)
Buncher	Machine that twists wires together in random arrangement.
Bunch stranding	Group of wires of the same diameter twisted together without a predetermined pattern. 
Bundle	Number of wires and/or cables, groups, or harnesses routed together.
Burnoff	Removal of electroless copper as a result of excessive current. Usually occurs at edges of holes and causes plating failure in the hole.
Burrs	Featherlike cross sections developed along the edge of a piece of metal that has been sawed, filed, or ground.
Bus	Used to connect two terminals inside of an electrical unit. A common point for electrical circuits to return. Can be bare, tinned, or insulated.
Busbar	Heavy copper (or other metal such as aluminum) strip or bar used to carry heavy currents.
Bused	Joining of two or more circuits.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Bushing	Mechanical device used as a lining for an opening to prevent abrasion to wire and cable. Also used as a low cost method of insulating, anchoring, cushioning, and positioning. Usually, a non-metallic material is preferred.
Bus network	Network in which all work stations are connected to a single cable.
Butadiene	Hydrocarbon synthetic rubber used in compounds such as butadiene-styrene and acrylonitrile-butadiene-styrene.
Butt	When two conductors come together end-to-end, with their axes in line, but do not overlap.
Butt contact	Mating contact configuration in which the mating surfaces engage end-to-end without overlap and with their axes in line. This engagement is usually under spring pressure with the ends designed to provide optimum surface contact.
Butting die	Crimping die so designed that the nest and indentor touch at the end of the crimping cycle. Also called bottoming die.
Butt joint	Joint between two members lying approximately in the same plane.
Button-hook contact	Contact with a curved, hooklike termination often located at the rear of hermetic headers to facilitate soldering or de-soldering of leads. (See hook terminal.)
Butt splice	Splice wherein two wires from opposite ends butt against each other, or against a stop, in the center of a splice.
Butt wrap	Tape wrapped around an object or conductor in an edge-to-edge condition.
Butyl rubber	Synthetic rubber copolymer of isobutylene and isoprene. It has excellent moisture, ozone, and aging characteristics. It is usually used as an insulation on power and high voltage cables.
BW	(See Bandwidth.)
BWG	(See Birmingham Wire Gauge.)
BX	Designation for armored building wire, 600 V.
Bypass cabling or relays	Wired connections in a ring network that permits traffic to travel between two nodes that are not normally wired next to each other.
C	(1) Designation for lamp cord, two or more conductors twisted together. Rubber insulation, cotton braid. For pendant or portable use in dry places. No overall covering, 300 V or 600 V, 140°F (60°C). (2) (See Capacitance.) (3) (See Coulomb.)
Cable	Two or more insulated conductors, solid or stranded, contained in a common covering; two or more insulated conductors twisted or molded together without common covering; one insulated conductor with a metallic covering shield or outer conductor.
Cable and wire fault locating equipment and counters	Cable and wire fault locating equipment can be classified into two separate categories - that used in cable and wire manufacturing operations, and that for locating faults in cable after installation. The two categories have little in common. In the case of manufacturing operations, sparkers are used to continuously monitor the integrity of the insulation (as it is being applied to the wire) by a voltage between the wire and the sparker electrode. In the case of installed cable or wire, particularly long power or communication circuits, the problem is somewhat different. Here, a discrete single fault may have occurred during operation of the system. The problem is to locate it within a few feet, in a circuit that may be miles in length. Types of equipment may be: special bridges, a combination of some form of tone generator with a suitable detector, a pulse generator with an oscilloscope for observing the electrical reflection from the fault, a high voltage surge generator with a suitable detector, or an instrument for measuring capacitance.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

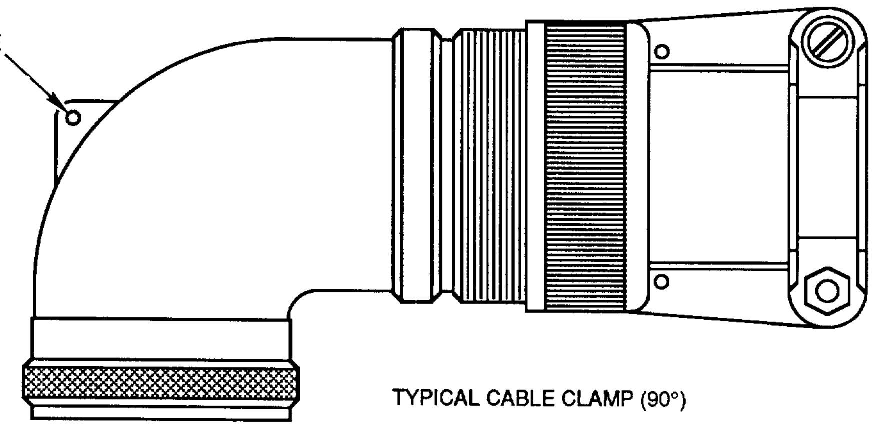
Term	Definition
Cable assembly	Completed cable and its associated hardware.
Cable clamp	Mechanical clamp attached to the cable side of the connector to support the cable or wire bundle, provide strain relief, and absorb vibration and shock otherwise transmitted by the cable to the contact/wire connection.  TYPICAL CABLE CLAMP (90°)
Cable clamp adapter	Mechanical adapter that attaches to the rear of a plug or receptacle to allow the attachment of a cable clamp.
Cable clips	Harnessing system for mounting wire and cables. Some clips are adjustable for tension control.
Cable, coaxial	Cable in which one conductor is concentrically centered inside another. Used primarily for the transmission of radio frequency signals.
Cable core	The portion of an insulated cable lying under the protective covering or coverings.
Cable core binder	Wrapping of tapes or cords around the several conductors of a multiple-conductor cable used to hold them together. Cable core binder is usually supplemented by an outer covering of braid, jacket, or sheath.
Cable covers	“U” channel sections of fiberglass cloth reinforced epoxy tubing rated at 311°F (155°C), used to protect wire and cable.
Cable fiber optic	Jacketed Fiber in a form that can transmit optical signals.
Cable filler	Material used in multiconductor cables to occupy the interstices formed by the assembly of the insulated conductors, thus forming a cable core of the desired shape (usually circular).
Cable guards	Rectangular pieces of fiberglass laminated epoxy, 311°F (155°C), used to protect delicate cable harnesses and connectors.
Cable loss	Amount of RF signal attenuated by coaxial cable transmission.
Cable pullers	A tool for pulling cables through a conduit.
Cable sealing clamp	Device consisting of a gland nut and sealing member. Designed to seal around a single jacket cable.
Cable sheath	Protective covering applied to cables.
Cable, shielded	One or more insulated conductors covered with a metallic outer conductor.
Cable shielding clamp	Device designed to terminate the shield of an electrical cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Cable terminal	Device which seals the end of a cable and provides insulated egress for the conductors. In power work, also known as a pothead or end bell.
Cable ties	Belt-like plastic strip devices which loop around bundles of cables or insulated wires to hold them together or anchor them to an electronic cabinet, a wall, or another assembly.
Cable vulcanizers	Simple compression molding machines used to repair cable jacketing that has had a part removed for splicing, for adding connectors or other devices, or for replacing damaged sections. Both portable and stationary models are available.
Cabling	(1) Mechanically twisting together two or more insulated conductors to form a cable. (2) Bundling of wires together as in forming wire harnesses. (3) (Fiber optic) A method by which a group of fibers or bundle of fibers is mechanically assembled.
Cabling factor	Used in the formula for calculating the diameter of an unshielded, unjacketed cable. D = Kd, where D is the cable diameter, K is the factor, and d is the diameter of one insulated conductor.
CAC	Designation for flexible copper, synthetic tape, felted asbestos, and lacquered braid, 1000 V, 257°F (125°C).
Cadmium	White, ductile metallic element generally used in plating steel hardware for electronic equipment. It provides improved solderability, surface conductivity, and helps to prevent corrosion.
Cadmium-chromium-copper	Alloy with a small loss in conductivity to provide high strength. Used in high temperature applications. Flex life is good.
Cadmium-copper	High strength alloy. Easy to work with and relatively inexpensive, but it has a softening temperature of 347°F (175°C) to 392°F (200°C).
Caged armor	Armor wires within a polyethylene jacket. Often used in submarine cables.
Caliper	Overall flat cable thickness.
Cambric	Fine weave linen or cotton fabric used for insulation.
Canvas	Cotton fabric weighing more than four ounces per square yard.
Capacitance and dissipation factor, equipment	AC high voltage capacitance ridges are used for the measurement of capacitance and dissipation factors in the testing of insulators, cables, and dielectrics.
Capacitance (C)	That property of a system of conductors and dielectrics which permit the storage of electricity when potential difference exists between the conductors. The value is expressed as the ratio of a quantity of electricity to a potential difference. A capacitance value is always positive. (See formulas-electrical.)
Capacitance coupling	Desirable or undesirable electrical interaction between two conductors which is caused by the capacitance between them. (See crosstalk.)
Capacitor	Device consisting of two conducting surfaces separated by an insulating material such as air, paper, mica, ceramic, glass, metal, or plastic film. A capacitor stores electric energy, blocks the flow of direct current, and permits the flow of alternating current to a degree dependent on the frequency and capacitance of the device.
Capillary action	Interaction between a liquid and a small diameter channel, or opening in a solid. Because of the physics involved, if the liquid wets the sides of the solid channel, surface tension will draw the liquid up into the capillary channel. This travel is sometimes for a considerable distance. The term capillary, alone, refers to the channel itself. An example of this action in soldering is demonstrated by dipping a stranded wire into a liquid flux which wets the conductor. The small spacings between the individual strands of the wire act as capillary channels. The liquid flux will travel for a considerable distance up the stranded wire.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Capillary attraction	Combination of force, adhesion, and cohesion which causes liquids, including molten metals, to flow against gravity between very closely spaced solid surfaces.
Capillary force	Phenomenon of surface tension which causes a liquid to be drawn into the space created by two closely mated parallel surfaces.
Carrier	(1) Basic woven element of a braid consisting of one or more ends (strands) which create the interfaced effect. (2) A spindle, spool, tube, or bobbin (on a braiding machine) containing yarn or wire, employed as a braid. It is normal to have an 8-carrier, 12-carrier, 16-carrier, 24-carrier, 32-carrier, or 48-carrier machine. Larger cable diameters require a greater number of carriers to apply the braid. (3) Holders for electronic parts and devices which protect parts during transport, and facilitate handling during processing, production, imprinting, or testing operations. (4) The basic signal used for transmission prior to modulation.
Carrier signal	Continuous waveform whose properties are capable of being modulated or impressed with a second information-carrying signal.
Castor oil	Can be used in such applications as plasticizers for vinyl electrical resins, and as a dielectric for energy storage capacitors, since it exhibits corona resistance. A highly refined grade is recommended for DC applications where high voltages may be imposed.
Catalyst	Substance which initiates and/or accelerates a chemical reaction, but normally does not enter into the reaction.
Cathode	(1) Negative pole of a plating cell. It is the physical entity of the plating set up at which positively charged ions leave the plating solution. The cathode is normally the object of the plating; i.e., a metal is deposited on the cathode. In solder plating, for example, metal from the anode is plated on the cathode. The anode metal enters the bath as positive ions which are attracted to the negative cathode, where they give up their electrical charge to the external circuit. The ion is then converted to an atom which remains adhering to the cathode. (2) The N-type, or more negatively doped material of a diode. Represented by the straight line in the schematic symbol.
CCITT	Comite Consulatit International de Telegraphic et Telephonic.
Cellular insulation	Material in foamed or sponge form with cells closed or interconnected.
Cellular plastics	Materials with cell structure throughout their mass. Also called foamed plastics.
Celluloid	Thermoplastic material made by the direct blending of cellulose nitrate with camphor. Alcohol is normally employed as a volatile solvent to assist plasticization and is subsequently removed.
Cellulose	Carbohydrate found in plants, used to form thermoplastic materials.
Cellulose acetate	An acetic acid ester of cellulose that is a tough thermoplastic material. Cellulose acetate film offers low moisture absorption, good heat resistance to 220°F (104.4°C), and a glossy transparent finish.
Cellulose acetate butyrate	Acetic and butyric ester of cellulose and a thermoplastic material.
Cellulose ester	Cellulose in which the free hydroxyl groups have been replaced, wholly or in part, by acidic groups. Used in the manufacture of thermoplastic molding compositions.
Cellulose lacquer	Coating for magnet wire based on cellulose acetate.
Cellulose nitrate (nitrocellulose)	Nitric acid of cellulose.
Cellulose propionate	Ester of cellulose and propionic acid. Used as the basis of a thermoplastic molding material.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

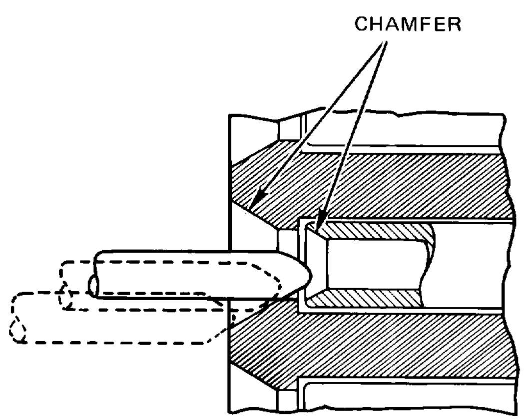
Term	Definition
Cellulosic resins	Thermoplastic compounds used for good electrical properties. Suitable insulators against usual industrial and domestic currents.
Center-to-center distance	(See pitch.)
Ceramic fiber	Inorganic, non-metallic substance used as insulation for extremely high temperature applications. Usually applied to as a braid or tape. Excellent radiation resistance, but poor mechanical and moisture characteristics. May operate at 1000°F (537°C) or more.
Ceramics	Ceramics are basically a combination of three main materials: clay, feldspar, and sand. A wide variety of ceramics are shaped and used for numerous applications; including, spark plug insulation, sockets, fuse blocks, circuit substrates, etc. They are used primarily because of their low loss qualities, long life characteristics, and ability to withstand high operating temperatures and heat shock. Applications are being developed in the area of superconductors, conductors with very low resistance.
Cermet	Combination of ceramic and metal powders used for thin- and thick-film resistors.
Certification	Act of verifying that required training has been completed, and specified proficiency has been required.
CF	Designation for fixture wire, heat resistant with flame retardant, moisture resistant, impregnated cotton insulation with or without cotton braid, 300 V, 194°F (90°C).
CFC	Designation for two or three CF type wires twisted together without overall covering. Color coded, 300 V, 194°F (90°C).
CF Glass	Continuous Filament glass yarn which is used in braiding and in making glass fabric and thread.
CFPD	Designation for two or three CF type wires twisted together with overall braid. Color coded, 300 V, 194°F (90°C).
CFPO	Designation for two CF type wires laid parallel with overall braid. Color coded, 300 V, 194°F (90°C).
CFT	Abbreviation for 100 feet.
Chafing	Repeated relative motion between wiring system components, or between a wiring system component and the structure or equipment, which results in a rubbing action that causes harmful wear.
Chamfer	Funnel type angle, on the inside edge of the barrel entrance of a connecter insert and/or socket contact, which permits easier insertion of a pin contact into the barrel. (See belled mouth.) 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Characteristic impedance	Characteristic impedance of a uniform line is the ratio of an applied potential difference to the resultant current, at the point where the potential difference is applied when the line is of infinite length. The term is applied only to a uniform line. Coaxial cable is such a uniform line. There are three main impedance groups in coaxial cable; 50, 70, and 93 ohms.
Charge	In electrostatics, the amount of electricity present on any substance which has accumulated electric energy.
Chemical analysis - wet	This method, quantitative or qualitative, is performed by manipulating the unknown through a series of predetermined chemical reactions. The term “wet” means that most of the chemical manipulations are carried out in a solution.
Chemical cleaning	Removal, by chemical means, of foreign material or oxide film which would interfere with soldering.
Chemical hole cleaning	Chemical process for cleaning conductive surfaces exposed within a hole. (See etchback.)
Chemical stability	Characteristic of a compound which describes its ability to retain, without modification, its chemical properties over a long period of time. The term, “shelf life” is normally used to describe the extent of this characteristic of a compound.
Chemical stripping	Processing of removing enamel insulation from wire using compounds specifically formulated for dissolving and removing enamel coating.
Chemical Vapor Deposition (CVD) Chip	Process by which a heated gas produces an oxide deposit to fabricate a glass fiber preform. The deposited glass becomes the core. Single substrate on which all the active and passive circuit elements have been fabricated, by using one or all of the semiconductor techniques of diffusion, passivation, masking, photoresist, and epitaxial growth. The term is also applied to discrete capacitors and resistors, which are small enough to be bonded to substrates by hybrid techniques.
Chip capacitors	Discrete devices which introduce capacitance into an electronic circuit. Made in tiny wedge or rectangular shapes.
Chip carrier	Multiple contact device with connections from chips to external circuit. Leadless: surfaces to be connected are soldered to carrier surfaces. Leaded: surfaces to be connected are soldered to leads from carrier.
Chip component	Unpackaged circuit element (active or passive) for use in electronics. Besides integrated circuits, the term includes diodes, transistors, resistors, and capacitors.
Chlorinated hydrocarbon	Organic compound having hydrogen atoms and, more importantly, chlorine atoms in its chemical structure. Trichloroethylene, methyl chloroform, and methylene chloride (dichloromethane) are chlorinated hydrocarbons.
Chlorinated polyether	Crystalline thermoplastic polymer with excellent resistance to heat and various chemicals.
Chloropentafluoroethane	Gas used as a dielectric. (See gaseous dielectrics.)
Chlorosulphonated Polyethylene (CSPE)	Synthetic rubber most often used as a jacket material. It has good resistance to ozone, heat, solvents, and moisture. Widely used as a substitute for neoprene because of its superior thermal characteristics.
Circuit	Interconnection of a number of devices, in one or more closed paths, needed to perform a desired electrical or electronic function.
Circuit density	Amount of circuitry on a given area of board. Usually expressed as a ratio of total surface area to circuitry and component coverage.
Circuit sizes	Popular term for building wire sizes 14 thru 10 AWG.
Circular Mil (CM)	Area of a circle one mil (0.001 in.) in diameter, 7.854×10^{-7} sq. in. Used in expressing wire cross-sectional area.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

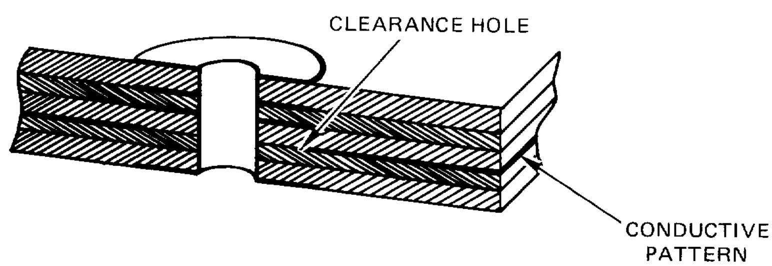
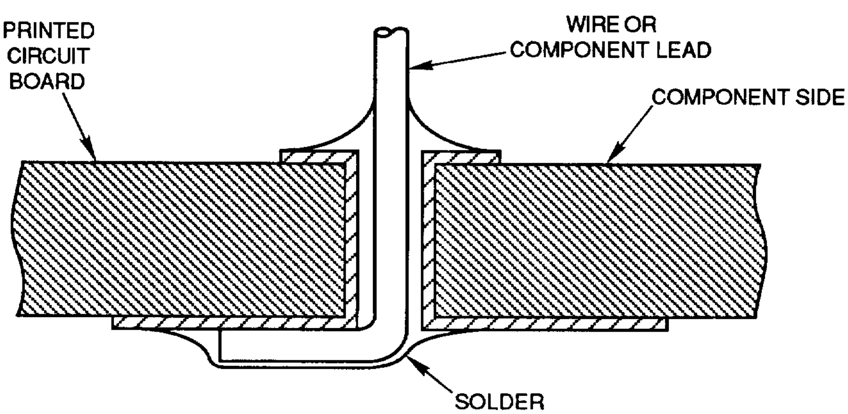
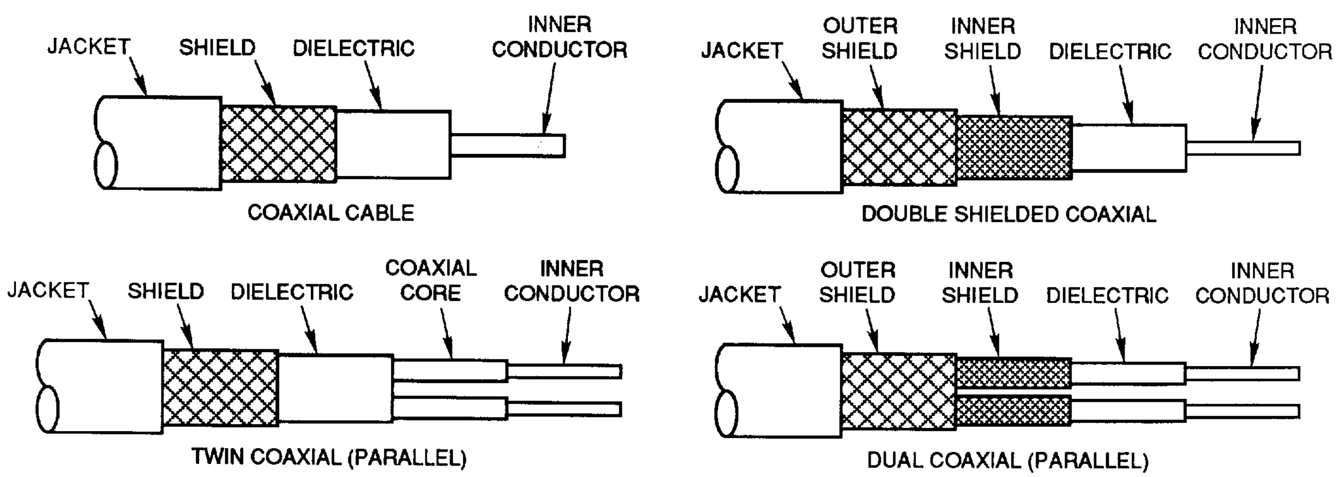
Term	Definition
Circumferential crimp	Type of crimp where the crimping dies completely surround a barrel and result in symmetrical indentations in the barrel. (See crimp termination.)
Cladding (fiber optic)	Sheathing or cover of a lower refractive index material directly in contact with the core of a higher refractive index material. Provides optical insulation and protection to the total reflection interface. (See fiber.)
Clad metals	Composite of two or more metals to effectively combine the best qualities of each metal. Possible applications include contacts, thermostats, blades, springs, lead frames, connectors, etc.
Clad or cladding	(1) Relatively thin layer or sheet of metal foil bonded to a laminate core to form the base material for printed circuits. (2) Method of applying a layer of metal over another metal; whereby, the junction of the two metals is continuously welded.
Cladding mode	Mode that is confined by virtue of a lower index medium surrounding the cladding (See Mode.)
Cladding mode stripper	Device that encourages the conversion of cladding modes to radiations modes.
Clearance	(1) Gap or space between two mating parts. (2) Space provided between the relief of a cutting tool and the surface cut.
Clearance hole	Hole in the conductive pattern larger than, but coaxial with, a hole in the printed board base material. 
Clinched-wire through connection	Connection made by a wire which is passed through a hole in a printed circuit board, then subsequently formed or clinched, in contact with the conductive pattern, and soldered. 
Closed entry	Contact or contact cavity design in the insert or body of the connector, which limits the size or position of the mating contact or printed circuit board to a predetermined dimension.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Closed entry contact	Socket contact designed to prevent the entry of a pin or probing device, having a cross-sectional dimension (diameter) greater than the mating pin.
CM	(See Circular Mil.)
CMIP	Common Management Information Protocol.
Coatings	Usually applied in a liquid state for thin coatings. Printed circuit coatings are thin, very conformable coatings that follow the shape of the printed circuit board and its components. May be applied by spraying, dipping, or brushing. Coatings protect printed circuit boards from moisture, dirt, and other contaminants. (See Varnishes.)
Coaxial cable	Cable consisting of two cylindrical conductors with a common axis. The two conductors are separated by a dielectric. The outer conductor or shield, normally at ground potential, acts as a return path for current flowing through the center conductor and prevents energy radiation from the cable. The outer conductor is commonly used to prevent external radiation from affecting the current flowing in the inner conductor The outer conductor consists of woven strands of wire, or is a metal sheath.



Term	Definition
Coaxial connector	Connector that has a coaxial construction and is suitable for use with coaxial cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

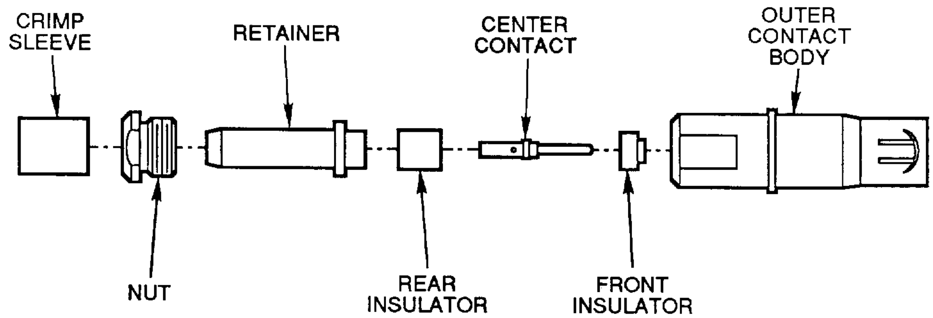
Term	Definition
Coaxial contact	Contact having two conducting surfaces, a center contact, and a coaxially placed sleeve. Pin contacts have a pin outer contact with a socket center contact. Socket contacts have a socket outer contact with a pin center contact.  TYPICAL SOCKET COAXIAL CONTACT
Coefficient of expansion and contraction	Degree to which a material will expand or contract when heated or cooled.
Coherent light (fiber optic)	Light of essentially one wavelength, in phase, traveling in the same direction. Used as the means of transmitting information in a fiber optic system. (See fiber optics.)
Cohesion	Force of attraction between the molecules (or atoms) within a single phase. Contrast with adhesion.
Coil form terminals	Used on small transformer coils to connect coil wires. Terminals are attached to the coil base or collar.
Coin silver	Alloy containing 90% silver, with copper being the usual alloying element.
Cold flow	Permanent deformation of a compound due to mechanical force or pressure; not heat induced.
Cold short	Metallurgical term to denote a brittle condition in a metal at temperatures below the recrystallization temperature.
Cold solder joints	This type of solder joint is characterized by non-wetting one or both of the surfaces being joined. Usual causes are: surfaces which are not clean, soldering iron with too low a tip temperature, or heating of the solder rather than the metals to be joined.
Cold weld	Joining together of two metals (without an intermediate material) by the application of pressure only, without an electrical current or elevated temperature.
Collimation	Process by which a divergent or convergent beam of radiation is converted into a beam with the minimum divergence possible for the System. (See Beam Divergence.)
Color code	System for circuit, terminal, and related device identification through use of solid colors, tracers, stripes, and surface printing, etc.
Combustible liquids	Any liquid having a flash point at or above 140° F (60°C), and below 200°F (98.2°C).
Combustion	Rapid oxidation. The oxidation process of rusting iron is not combustion. It proceeds at a very slow rate. The burning of a candle is an oxidation process which proceeds at great speed and is an example of combustion.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

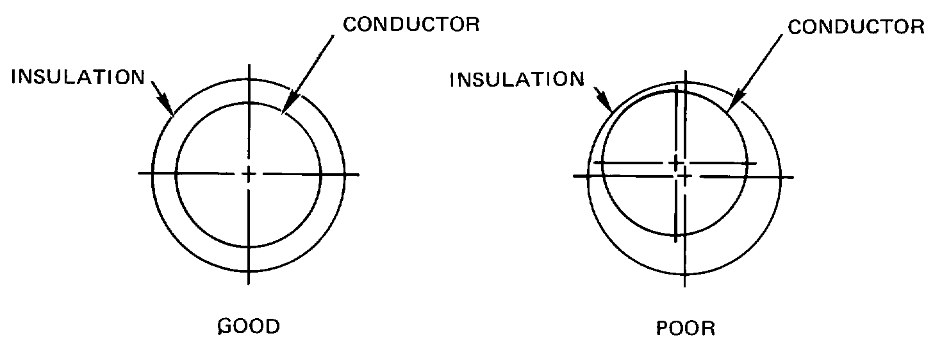
Term	Definition
Component	Article which is normally a part or combination of detailed parts, subassemblies, or assemblies, and is a self-contained element which performs a function necessary to the operation of the device. A component may be any of various electrical devices such as a resistor or capacitor. It may also be a mechanical device.
Component density	Quantity of components on a printed board per unit area.
Component hole	Hole used for the attachment and electrical connection of component terminations, including pins and wires, to the printed board.
Component lead	Solid or stranded wire which extends from and serves as a connection to a component.
Component side	Side of the printed board on which most of the components will be mounted.
Composite cable	(See hybrid cable.)
Composite (clad) wire	Wire having a core of one metal, to which an outer shell of one or more different metals is fused.
Composite conductor	Two or more strands of different metals, such as aluminum and steel or copper and steel, assembled and operated in parallel.
Composite laminates	Laminated plastic joined to a non-plastic material such as a metal or rubber.
Compound	Insulating or jacketing material made by mixing two or more ingredients.
Compression cable	Pipe type cable in which the pressure medium (oil or gas) is separated from the insulation by a membrane or sheath.
Compression set	Amount of compression an elastomer retains. Expressed as a percentage of original dimensions.
Computer cable	Used for interconnecting computers, electronic equipment, and the conveyance of information.
Concentric	Central core surrounded by one or more layers of helically wound strands in a fixed, round, geometric arrangement. It is optional for the direction of lay for successive layers to be alternately reversed or in the same direction. The standard direction of lay of the outer layer is left hand.
Concentricity	In a wire or cable, the measurement of the location of the center of the conductor with respect to the geometric center of insulation. 
Concentric-lay cable	Multiple-conductor cable composed of a central core surrounded by one or more layers of helically laid insulated conductors.
Concentric-lay conductor	Conductor composed of a central core surrounded by one or more layers of helically laid wires. In the most common concentric-lay conductor, all wires are the same size, and the central core is a single wire.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

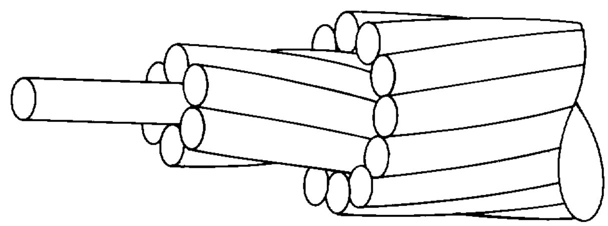
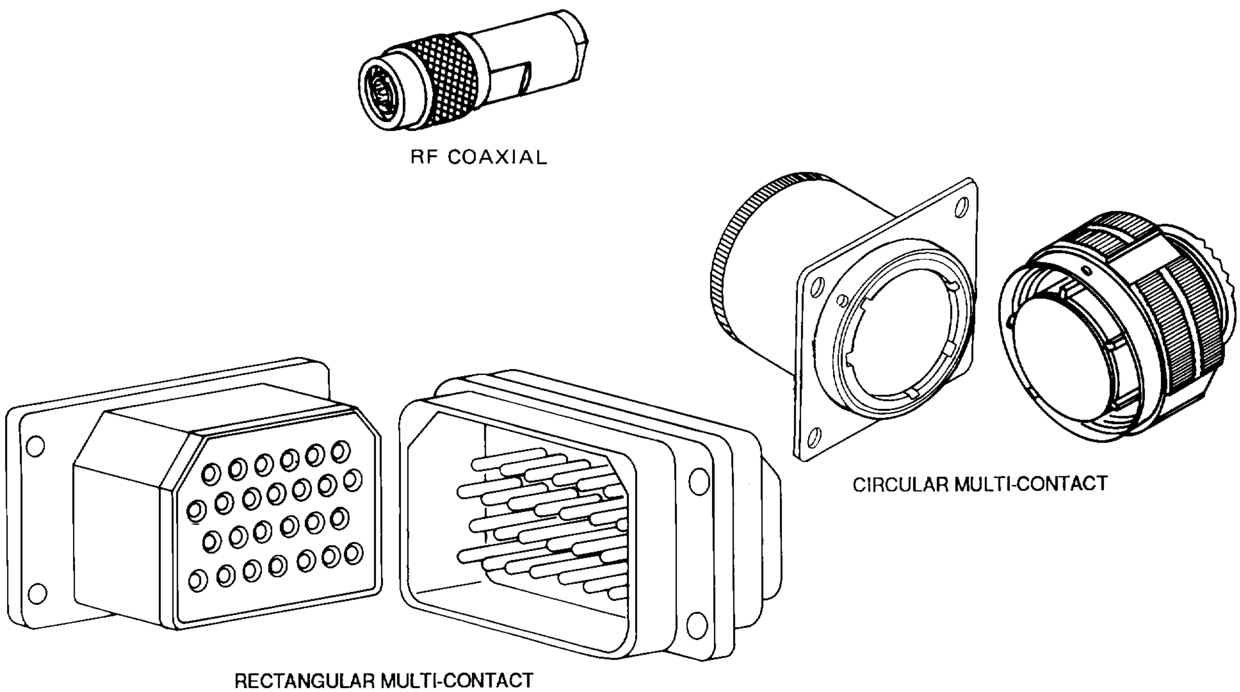
Term	Definition
Concentric stranding	Central wire surrounded by one or more layers of helically wound strands in a fixed round geometric arrangement. Each layer after the first has six more strands than the preceding layer and is applied in a direction opposite to that of the layer under it. (See true concentric, unidirectional concentric.) 
Condensation soldering	(See vapor phase soldering.)
Conductance (G)	Reciprocal of resistance. The ratio of current passing through a material, to the potential difference at its ends.
Conducted susceptibility	Tendency of a piece of equipment to have the performance degraded in response to noise on the connecting wires.
Conductive compounds	Coatings, materials, inks, and paints used for: chip bonding, electrostatic shielding, corona shielding, making connections, repairing printed circuits, attaching leads, adhesive work, ignition cable sheath coating, making electrodes, contacts, terminations, surfaces receptive to plating, hybrid circuit paths, land areas, and solderable surfaces.
Conductive ink	In hybrid technology, the conductive paste used on thick-film materials to form the printed conductor pattern. Usually contains metals, metal oxide, glass frit, and solvent.
Conductive pattern	Configuration or design of the conductive material on the base material. Includes conductors, lands, and through connections, when these connections are an integral part of the manufacturing process.
Conductivity	Measure of the capability of a material to carry electrical current. Usually expressed as a percentage of copper conductivity (copper being 100%).
Conductor	Material suitable for carrying electrical current.
Conductor barrel	Section of the terminal, splice, or contact which accommodates the stripped conductor.
Conductor spacer	Distance between adjacent edges (not centerline to centerline) of isolated conductive patterns in a conductor layer.
Conductor stop	Device on a terminal, splice, contact, or tool used to prevent excessive extension of the conductor beyond the conductor barrel.
Conductor thickness	Thickness of the conductor including all metallic coatings.
Conductor to hole spacing	Distance between the edge of a conductor and the edge of a supported or unsupported hole.
Conductor width	Observable width of the pertinent conductor at any randomly chosen point on the printed board, normally viewed from above, unless otherwise specified. (Imperfections, such as: nicks, pin-holes, or scratches allowable by the relevant specification, shall be ignored.)
Conduit	Tube or trough in which insulated wires and cables are run.
Configuration control	Discipline providing for uniformity in a manufactured items material, processes, geometry, and performance.
Conformal coating	Insulating protective coating, which conforms to the configuration of the object coated, applied to the completed board assembly.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Connector	Describes all devices, either plug or receptacle, used to provide rapid connect/disconnect service for electrical cable and/or wire interconnections. A fixed connector is used for attachment to a rigid surface, while a free connector mates with the wire or cable. Connectors used in military applications generally fall into three broad categories; single contact coaxial connectors, circular multi-contact connectors, and rectangular multi-contact connectors.



Term	Definition
Connector area	That portion of printed wiring used to provide for external electrical connections.
Connector classes	Categories based on shape, function, and smallest size contact in the series. Shapes are: cylindrical, rectangular, and keystone, etc. Functions are: hermetic, rack-and-panel, pendant, bulkhead, firewall, and feed-thru, etc. Sizes include: standard (size 16 contacts), miniature (size 20 contacts), subminiature or high-density (size 22 contacts), and microminiature (size 24 contacts).
Connector induced optical conductor loss (fiber optic)	Connector insertion loss, expressed in decibels, due to impurities or structural changes to the optical conductors caused by termination or handling within the connector. (See coupling loss.)
Connector insertion loss	Power loss, expressed in decibels, due to insertion of a mated connector onto a cable.
Connector set, electrical	Two or more separate connectors, plug connector and receptacle connector, designed to be mated together. The set may include mixed connectors mated together, such as one connector plug and one dummy connector receptacle, or one connector receptacle and one dummy electrical plug.
Constantan	An alloy of 55% copper and 45% nickel used in thermocouples with copper in the temperature range of 336.2°F (169°C) to 730.4°F (388°C). Temperature coefficient of electrical resistivity, 0.0002°C. Usually the copper is the positive wire and the constantan is the negative wire.
Contact	Conducting members of a connecting device which are designed to provide a separable electrical connection. (See socket contact, pin contact, nude contact, dressed contact.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

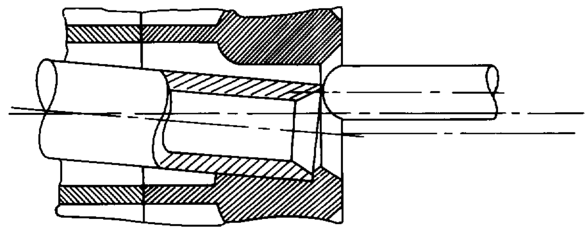
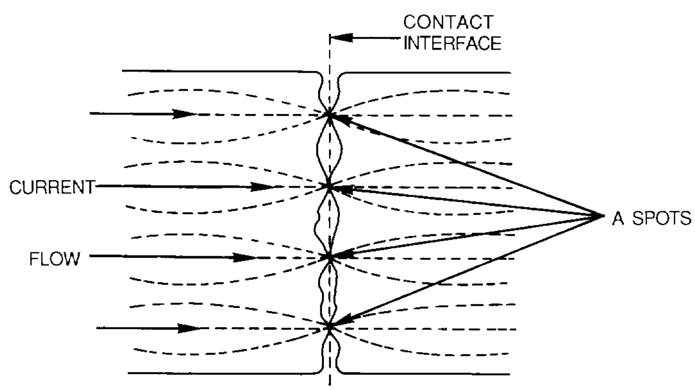
Term	Definition
Contact alignment	Defines the overall side play which contacts have within the insert cavity to permit self alignment of contacts. Sometimes referred to as the amount of contact float. 
Contact area	When two contacts are joined, true areas of contact occur only at minute points of asperity spread over the two interface surfaces. These are shown as A spots. Their number and location depend on the shape and finish quality of the two contact members. 
Contact cavity	Defined hole in the connector insert into which the contacts must fit.
Contact engaging and separating force	Force needed to either engage or separate pin and socket contacts when they are in and out of connector inserts. Values are generally established for maximum and minimum forces. Performance acceptance levels vary by specification and/or customer requirements. Contact engaging and separating force is not only measured initially, but after a specified number of engagements and separations. (See contact pressure.)
Contact, insertable/ removable	Contact that can be mechanically joined to, or removed from an insert. Usually special tools lock the contact in place or remove it for repair or replacement. (See front release contact, rear release contact.)
Contact inspection hole	Hole in the cylindrical rear portion of a contact used to check the depth to which a conductor has been inserted. Crimp-type contacts usually have inspection holes, solder-types seldom do. Larger solder-type sizes have contact inspection holes in which the hole’s function is to allow solder and air to bleed out during soldering.
Contact length	Length of travel made by one contact in contact with another during assembly or disassembly of a connector. (See contact wipe, wiping action.)
Contact plating	Metal plated over basic contact metal to provide required contact resistance, wear resistance, and electrical conductivity. Contact platings may be classified as noble: gold, rhodium, palladium, and platinum; or non-noble: tin, tin-lead, silver, and nickel.
Contact pressure	Force which mating surfaces exert against one another.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

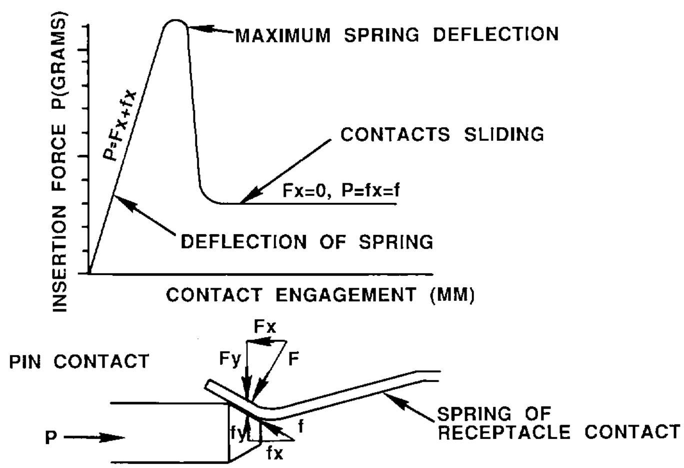
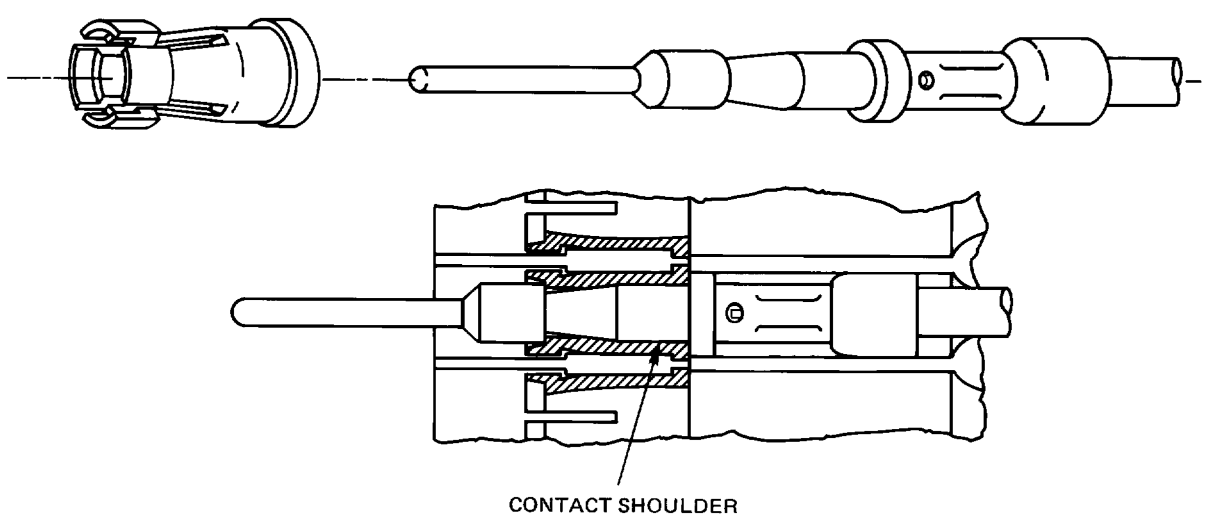
Term	Definition
Contact resistance	Maximum permitted electrical resistance of pin and socket contacts when assembled in a connector. Carrying a specific test current, electrical resistance of each pair of mated pin and socket connections is determined by measuring from the pin to the extreme terminal end of the socket (excluding both crimps). Overall contact resistance includes wire to wire measurement.
Contact retaining member	Device, on the contact or in the insert, to retain the contact in an insert or body.
Contact retention	Axial load, in either direction, which a contact can withstand without being dislodged from its normal position within an insert or body. 
Contact shoulder	Flanged portion of the contact which limits its travel into the insert. 
Contact size	Defines the largest size wire which can be used with the specific contact. By specification dimensioning, it also defines the diameter of the engagement end of the contact. For example, size 16 AWG contacts will accept a wire up to 16 AWG.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

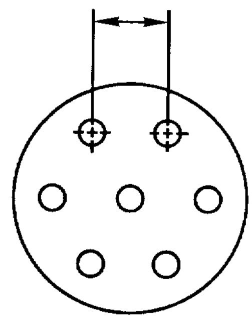
Term	Definition
Contact spacing	Distance between centers of contacts within an insert. 
Contact spring	Spring placed within the socket type contact to force the pin into a position of positive direct contact. Depending upon the application, various types are used including leaf, cantilever, napkin ring, squirrel cage, hyperbolic, and Chinese finger springs. All types perform the function of wiping and establish good contact. Several metal alloys are used. For example, beryllium copper is used where high conductivity and long life are required. Stainless steel, while its conductivity is only about 2%, is used in high temperature applications.
Contact wipe	Distance of travel (electrical engagement) made by one contact with another during its engagement or separation, or during mating or unmating of the connector halves. (See wiping action.)
Contaminant	Impurity or foreign substance present in a material or on a surface which affects performance of the material or circuit.
Continuity	When a conductor path is complete from one point to another and will allow electrical current to flow between the two points.
Continuity check	Test performed on a length of finished wire or cable to determine if the electrical current flows continuously throughout the length. Separate conductors may also be checked against each other to ensure there are no shorts.
Continuous duty	In some portable cords there are two standard number of strands of a given wire size. The one with the greater number (most flexible) is called continuous duty, and the other is called stationary duty.
Continuous Vulcanization (CV)	Simultaneous extrusion and vulcanization of rubber type materials usually by application of steam and pressure.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

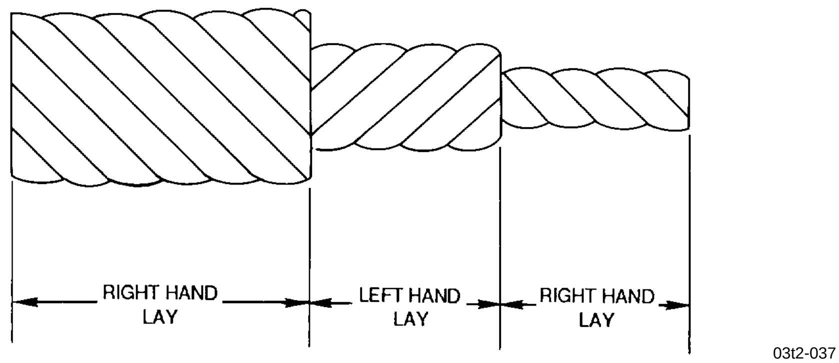
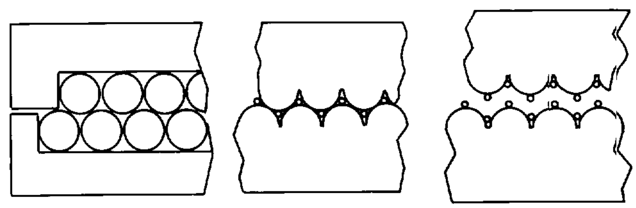
Term	Definition
Contrahelical lay	Term meaning the application of two or more layers of spirally applied materials where each successive layer is wrapped in the opposite direction to the preceding layer. (See true concentric.) 
Controlled impedance cable	Package of two or more insulated conductors where impedance measurements between respective conductors is kept essentially constant throughout the entire length.
Control wire and cable	Any wire which carries current to control a valve, to control a relay, or to cause any event without actually carrying the energy controlled in the event.
Copolymer	Compound formed from the chemical reaction of two different monomers with each other.
Copper and copper alloys	Available in rod, sheet, foil, tube, and wire forms. On a volume basis, copper has the best conductivity of the common (non-precious) metals. Copper and copper alloys offer excellent corrosion resistance, high thermal conductivity, and ease of fabricating, joining, and forming. However, copper and copper alloys are readily attacked by alkalies. The strength to weight ratio of copper is relatively low and it loses strength at elevated temperatures. Copper is the most widely used electrical conductor in wires and cables.
Copper clad invar	Strip material consisting of outer layers of copper metallurgically bonded to a core of invar, a nickel-iron alloy with low thermal expansion characteristics. The composite is used as a substrate, thermal plane, and/or heat sink for ceramic and/or silicon package interconnection.
Copper clad stainless steel	Strip material consisting of outer layers of copper metallurgically bonded to a core of stainless steel. Used in lead frame applications to achieve the optimum combination of thermal conductivity, mechanical strength, and fracture resistance.
Copper-covered steel wire	Wire having a steel core to which an outer shell of copper is fused.
Copperweld	Trade name for copper-clad steel conductors.
Cord	Small flexible insulated cable constructed to withstand mechanical abuse. There is no sharp dividing line in respect to size between a cord and a cable, but generally a cord is considered to be 10 AWG or smaller.
Cordierite	Cordierite ceramics exhibit a very low thermal coefficient of expansion. This aids in their ability to withstand extreme thermal shocks. They have poor mechanical strength and relatively poor dielectric properties at high frequencies.
Cordwood construction	Method of mounting components perpendicular between two printed wiring boards.
Cord sets	Portable cords fitted with any type of wiring device at one or both ends.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

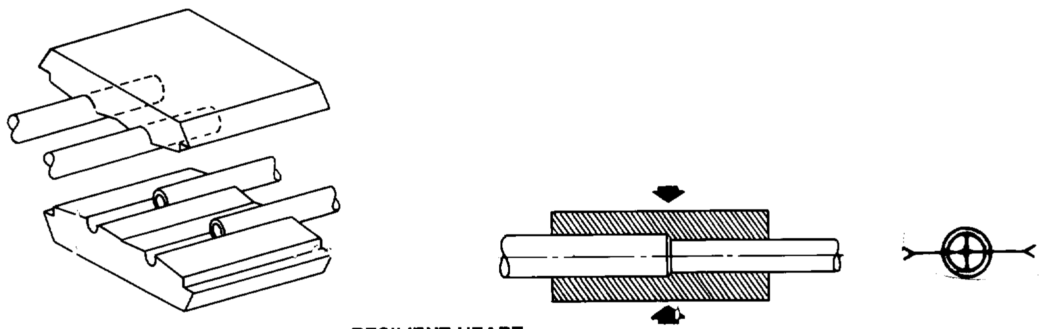
Term	Definition
Core	(1) In cables, a component or assembly of components over which additional components are applied, such as a shield, a sheath, or armor. (2) In fiber optic, high refractive index central material of an optical fiber through which light is propagated. (See fiber.)
Core-to-cladding ratio (fiber optic)	Ratio of the cross-sectional area of the core to the total cross-sectional area of the fiber.
Corona	Luminous discharge due to ionization of the gas surrounding a conductor around which exists a voltage gradient exceeding a certain critical value.
Corona initiation point	Value in the application of an increasing electrical potential where corona is first noticed by a detection device.
Corona resistance	Time that the insulation will withstand a specified level of ionization that does not result in the immediate complete breakdown of the insulation.
Corrosion	The most common kind of corrosion is that of rusting. This is a special case of a general classification known as atmospheric corrosion, or oxidation, wherein the oxygen of the atmosphere reacts with the material in question. Most metals, with the exception of the noble metals such as gold, can be oxidized by atmospheric oxygen. Usually water vapor must be present before any appreciable oxidation takes place. Corrosion is considered to consist of the slow chemical and electrochemical reactions between a metal and its environment.
Cosmetic defect	Variation from the conventional appearance of a product, such as a slight change in color or surface finish not necessarily detrimental to service performance.
Cotton	Used for servings and braids. Flexibility and strength are good. Treatments are required to provide chemical and fungus resistance. Heat resistance is limited.
Coulomb (C)	Unit quantity of electricity; the quantity transferred by one ampere in one second.
Coupler (fiber optic)	Optical device used to interconnect three or more optical conductors.
Coupling efficiency	Fraction of available output from a radiant source which is coupled and transmitted by an optical fiber.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

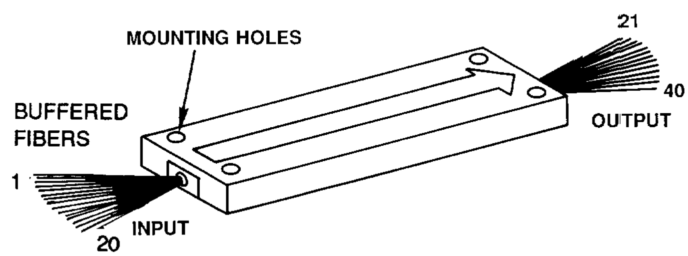
<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Coupling loss (fiber optic)</td><td>Total optical power loss within a junction, expressed in decibels, due to small differences in numerical aperture, core diameter, core concentricity, and tolerances in splicing connectors when two fibers are aligned. Also known as splicing loss and transfer loss.



OVERLAPPING V GROOVE CONNECTORS



RESILIENT HEART



UNI-DIRECTIONAL COUPLER</td></tr>
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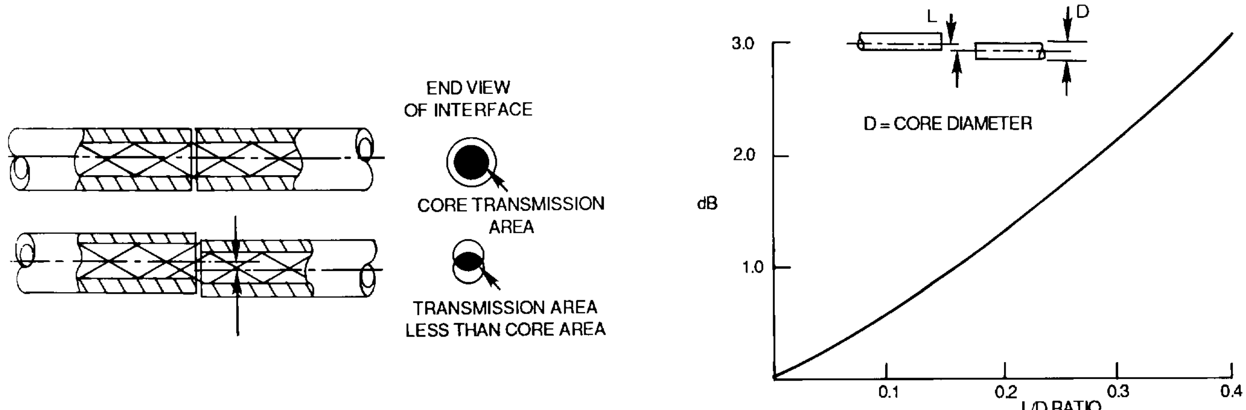
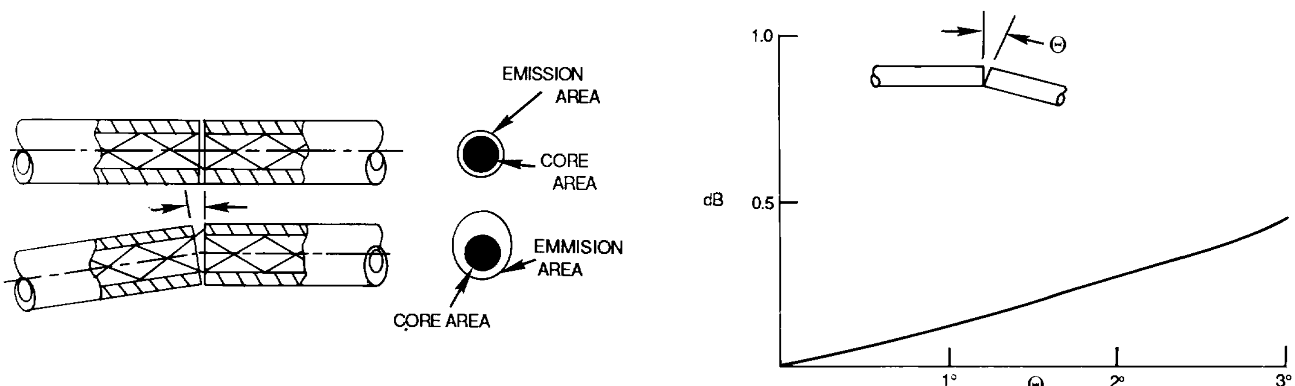
TABLE 2. TERMS AND DEFINITIONS (Cont.)

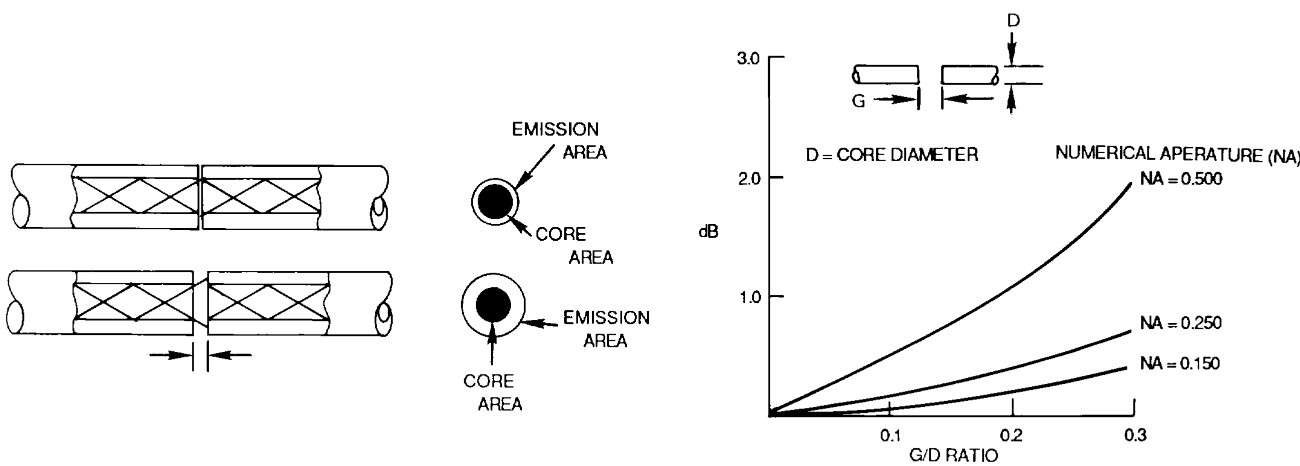
Term	Definition



LATERAL MISALIGNMENT LOSS



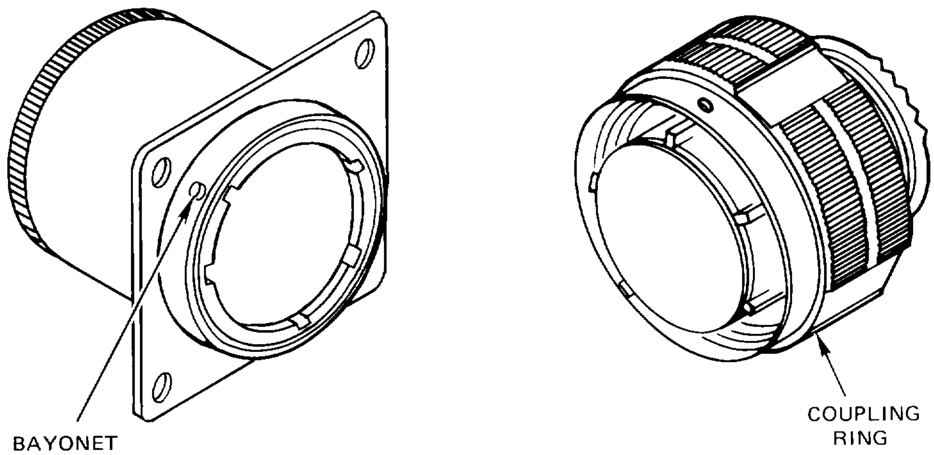
ANGULAR LOSS



GAP LOSS

TABLE 2. TERMS AND DEFINITIONS (Cont.)

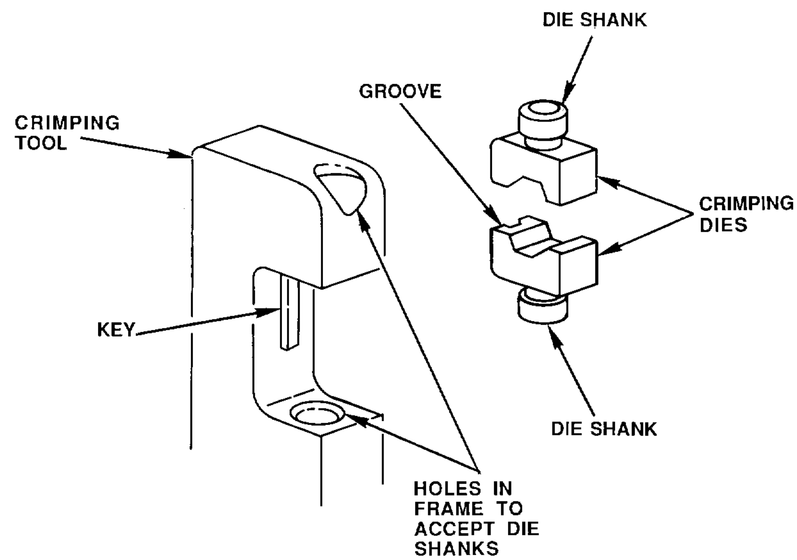
Term	Definition
Coupling ring	Device used on cylindrical connectors to lock plug and receptacle together. It may or may not give mechanical advantage to the operator during the mating operation.



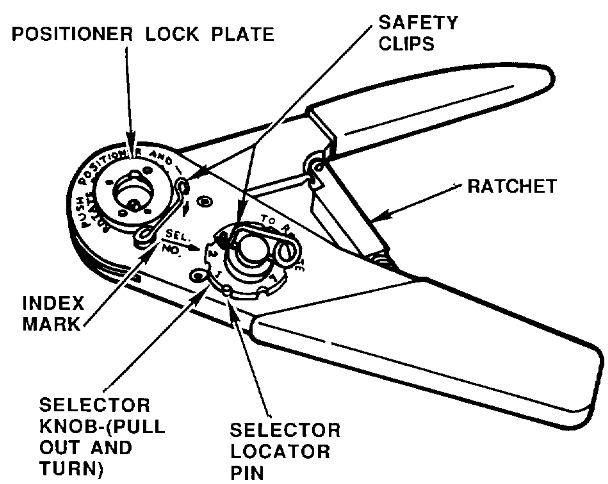
Term	Definition
Coverage	Calculated percentage which defines the completeness in which a metal braid covers the underlying surface. The higher percentage of coverage, the greater the protection against external interference.
Cover, electrical connector	Item which is specifically designed to cover the mating end of a connector for mechanical and/or environmental protection.
Coverings	Textile braids or jackets of rubber, plastics, or other materials applied over wire and cables to provide mechanical protection and possible identification.
Crazing	Minute cracks on the surface of materials such as plastics.
CRCS	Continuous Rigid Cable Support, synonymous with tray.
Creep	Time-dependent strain occurring under stress. The creep strain occurring at a diminishing rate is called primary creep; that occurring at a minimum and almost constant rate is secondary creep; that occurring at an accelerating rate is tertiary creep.
Creepage	Conduction of electricity across the surface of a dielectric.
Creepage path	Path across the surface of a dielectric between two conductors. Lengthening the creepage path reduces the possibility of arc damage or tracking.
Creep distance	Shortest distance on the surface of an insulator separating two electrically conductive surfaces.
Creeping surface	Insulating surface which provides physical separation as a form of insulation between two electrical conductors of different potential.
Creep strength	Characteristic of a material which describes strength and resistance to elongation, i.e. stretching, at low loads. This characteristic can be measured either as the load to fracture the sample at a given temperature, or the load that will produce a given percent of stretch, or elongation, at a given temperature.
CRES	Designation for Corrosion Resistant Steel.
Crimp	Physical compression (deformation) of a contact barrel around a conductor in order to make an electrical connection.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Crimp contact	Contact whose conductor barrel is a hollow cylinder accepting the conductor. After a bared conductor is inserted, a crimping tool is applied to swage or form the contact metal firmly against the conductor. Excellent mechanical and electrical contact results. Often referred to as a solderless contact.
Crimping die	Portion of the crimping tool that shapes the crimp.



Term	Definition
Crimping tool	Mechanism used for crimping. (See crimp termination.)



M22520/2-01 CRIMP TOOL FRAME

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Crimp termination	Connection in which a metal sleeve is secured to a conductor by mechanically crimping the sleeve with pliers, presses, or automated crimping machines. Splices, terminals, and multicontact connectors are typical terminating devices attached by crimping.

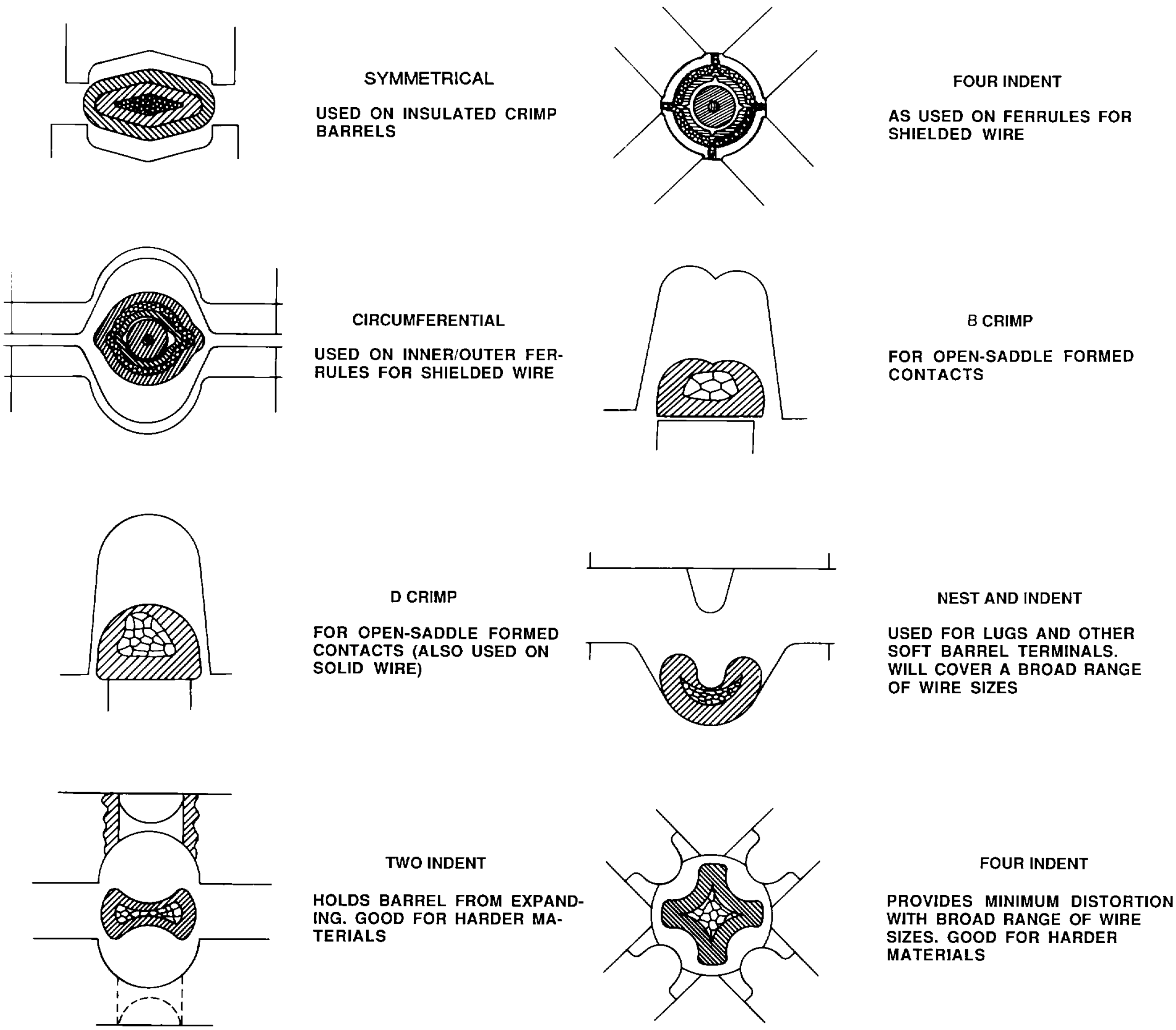


TABLE 2. TERMS AND DEFINITIONS (Cont.)

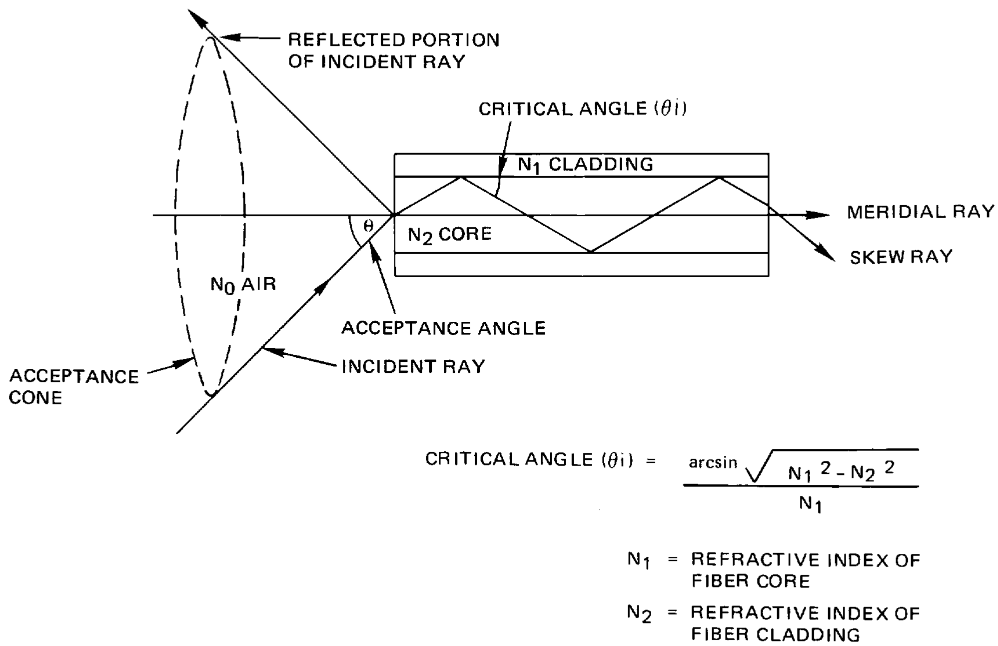
Term	Definition
Critical angle (fiber optic)	Maximum angle at which light can be propagated within a fiber. 
Crossed wire	Technique of measuring contact resistance that eliminates all resistances but the resistance of the contact point.
Cross-linked	Intermolecular bonds produced between long chain molecules in a material to increase molecular size by chemical or electron bombardment, resulting in an improved change in physical properties in the material.
Cross-Linked Polyethylene (XLPE)	Polyethylene material that has been modified by chemical or irradiation processing to change it from a thermoplastic to a thermoset material. It has good resistance to cut-through, solvents, and abrasion. Most often used in 600 to 2000 V control cable applications. Normally rated 194°F (90°C).
Cross-sectional area of a conductor	Sum of the cross-sectional areas of its component wires. Each wire is measured perpendicular to its individual axis.
Crosstalk	(1) Undesired electrical currents in conductors caused by electromagnetic or electrostatic coupling from other conductors or from external sources. Also called spurious signal. (See inductive coupling, capacitive coupling.) (2) In fiber optic, leakage of optical power from one optical conductor to another.
Cryogenics	Study of the behavior of matter at super-cold temperatures.
Crystal	Solid composed of atoms, ions, or molecules arranged in a pattern which is repetitive in three dimensions.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Crystalline	Describes material which has atoms or molecules arranged in geometric repeating patterns. Salts and metals are the most common examples of crystalline materials. With a crystalline material, the dividing line between atoms and molecules is usually obliterated. The number of repeating patterns of atoms that form the crystal are generally not fixed, but are dependent upon the conditions under which the crystal was formed. No definite number of atoms go into an individual crystal. Since these atoms are not grouped in any way other than the regular geometry of the crystal, there is no real meaning to the subdivision of the material called a molecule. Crystalline materials have definite and sharp melting points, which in most metals, are relatively good conductors of heat and electricity.
Crystallization	Separation, usually from a liquid cooling phase, of a solid crystalline phase.
CSA	Canadian Standards Association, a non-profit, independent organization which operates a listing service for electrical and electronic materials and equipment. The Canadian counterpart of the Underwriters' Laboratories.
CSPE	(See Chlorosulfonated Polyethylene.)
Cure	Change in the physical properties of a material by chemical reaction, by the action of heat and catalysts, alone or in combination, with or without pressure.
Cure time	Time at which ultimate physical properties of the curing thermoset plastic composition are reached. For many materials, this time may be a week or more.
Curing	Chemical energy (heat) being liberated by the reaction of an epoxy resin and a hardening agent. This heat raises the temperature of the hardening resin and increases the rate of cure.
Curing agents	Agents added to accelerate the reaction or curing of thermosetting plastics. They act as catalysts; i.e. they do not react directly with the polymer in the polymerization. Crosslinking agents are distinguished from catalysts because they react with molecules and are coupled directly into the cured system as a structural member of the polymer.
Curing cycle	Time, temperature, and pressure required for cure.
Curl	Degree to which a wire tends to form a circle after removal from a spool. An indication of the ability of the wire to be wrapped around posts in long runs.
Current-carrying capacity	Current a conductor of given size and length is capable of carrying safely without exceeding its temperature limitations.
Current density	Plating term referring to the amount of electrical current (amperes) passing through an anode (or cathode) divided by the surface area (square feet) of the anode. For example, if an anode 1 foot by 2 feet by 1 foot thick was totally immersed in the plating solution, its surface area would be 10 square feet. If 16 amperes of current are passing through the anode, then the current density of that anode would be 1.6 amperes per square foot.
Current (I)	Rate of transfer of electricity, measured in amps, which represents the transfer on one coulomb per second. (See ampere, formulas-electrical.)
Current rating	Maximum continuous electrical flow of current recommended for a given wire in a given situation. Expressed in amperes.
Cut-through resistance	Ability of a material to withstand mechanical pressure, usually from a sharp edge or small radius, without penetration.
Cutout, connector	Hole, usually round or rectangular, cut in a panel for mounting a connector. May include holes for mounting screws or bolts.
CV	(See Continuous Vulcanization.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
CVD	(See Chemical Vapor Disposition.)
Cyanoethyl sucrose	A liquid used as a dielectric. (See liquid dielectrics.)
Cycle	Complete sequence, including reversal, of the flow of an alternating electric current. (See wavelength.)
D	Used as a suffix to indicate a twin wire with two insulated conductors laid parallel under an outer nonmetallic covering.
Daisy chain	Cable assembly with three or more connectors. The term is also used as a verb.
DAP	(See Diallyl Phthalate.)
Dark current	External current that, under specified biasing conditions, flows in a photodetector when there is no incident radiation.
Data link service	Service which guarantees transmission between two stations sharing the same physical medium.
Data set	Device containing the electrical circuitry necessary to connect data processing equipment to a communication channel, usually through modulation and demodulation of the signal.
Datum reference	Defined point, line, or plane used to locate the pattern or layer for manufacturing, inspection, or both.
dB	(See decibel.)
dBm	Decibels above or below one milliwatt.
dBmV	Abbreviation for decibel millivolt.
DBWP	Double Braided Weatherproof cable.
DC	(See Direct Current.)
D cable	Two-conductor cable, each conductor having the shape of the capital letter D, with insulation between the conductors and between conductors and sheath.
DCC wire	Double Cotton Covered magnet wire.
DCR	(See Direct Current Resistance.)
Dead face	Term which describes the various methods used to protect contacts when not engaged. The most common method uses a cover on the mating ends of connectors which automatically cover the contacts when the connectors are separated. Typical is a spring powered cover which automatically flips over the faces of the plug and/or receptacle when the two are separated.
Dead front	Mating surface of a connector designed so that the contacts are recessed below the surface of the connector insulator body to prevent accidental short-circuiting of the contacts.
Decibel (dB)	Unit to express differences of power level. Used to express power gain in amplifiers, or power loss in passive circuits or cables. Ten times the logarithm (to the base 10) of the ratio of two intensities.
Decomposition	Process whereby a chemical compound is broken down into simpler constituents. An example is the breaking down of activators in rosin fluxes when soldering temperatures are reached.
Defect	Condition that impairs the usefulness of an object or a part of that object.
Definition	Sharpness of circuit patterns as reproduced in the master film, in the resist film, or in the circuit after etching.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Degree of cure	Arbitrary term approximating the percentage of ultimate performance properties; such as, flexural strength, deflection temperature, and volume resistivity, reached by a curing thermoset plastic composition at any given time.
Degree rise	Amount of increase in temperature caused by the introduction of electricity into a unit.
Deionized and demineralized water	Water which has been treated to remove the small quantity of minerals normally dissolved in hard water. In addition, any ions present are also removed in the process. Pure water is required for certain applications in the electronic and semiconductor industries where extreme precautions must be taken to remove or reduce contamination on parts rinsed in the water.
Delamination	Separation between any of the layers of a base material, or between the laminate and the conductive foil, or both.
Delay line	Cable made to provide a very low velocity of propagation with long electrical delay for transmitted signals.
Demodulation	Process of separating a data (digital) signal from an analog carrier signal.
Denier	Term that describes the weight of a yarn (not cotton or spun rayon) which in turn determines its physical size.
Density	Ratio of the weight or mass of a substance to its volume. For example, the density of water is 62.4 lbs./cu.ft. Units of measurement can also be grams per cubic centimeter, in place of pounds and cubic feet.
Depth of crimp	Thickness of the crimped portion of a connection measured between two opposite points on the crimped surface. (See T dimension.)
Derating factor	Factor used to reduce the ampacity of a wire when in environments other than that for which the value was established.
Detector (fiber optic)	Device which converts optical energy to electrical energy, such as a PIN photodiode. The optical receiver in a fiber optic system. (See fiber optics.)
Detent	Bump or raised section projecting from the surface of a spring or other part.
Dewetting	Condition which results when molten solder has coated a surface and then receded, leaving irregularly shaped mounds of solder separated by areas covered with a thin solder film. Base metal is not exposed.
D-glass	Fibers of glass with high boron content used in laminates for controlling dielectric constant.
Diallyl Phthalate (DAP)	Thermosetting molding materials used in electrical/electronic applications where high arc resistance and dielectric strength, low dielectric loss, and good mechanical properties must be maintained under high humidity and temperature conditions. They can be produced to withstand 350°F (176.7°C).
Dichlorofluoromethane	Gas used as a dielectric. (See gaseous dielectrics.)
Die	(1) Device used in the drawing of wire which reduces it to achieve a predetermined diameter. (2) That part of a plastic extrusion machine that forms the plastic compound around the wire or cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

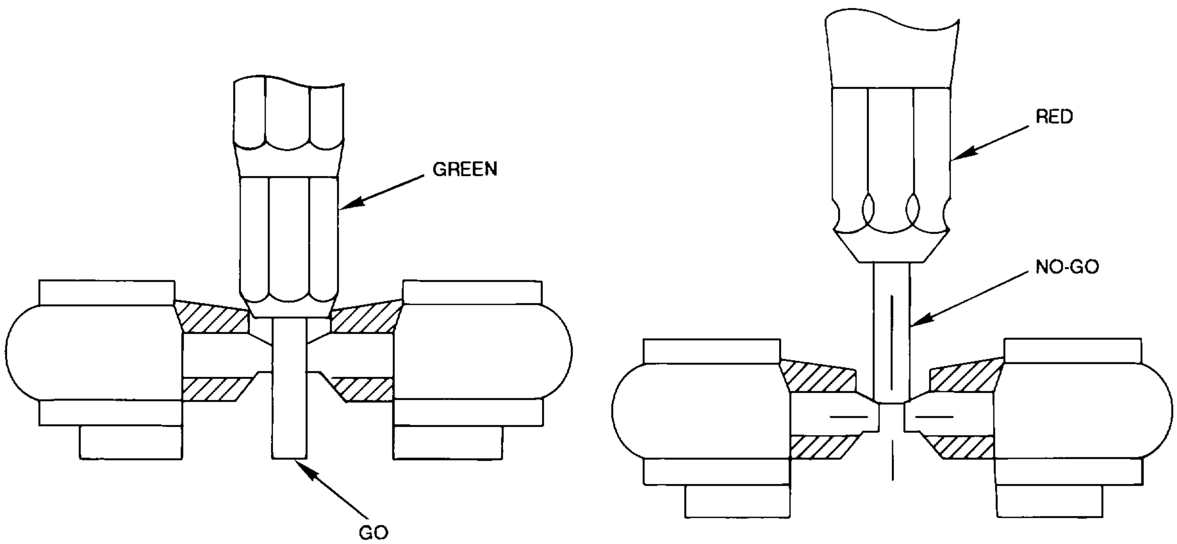
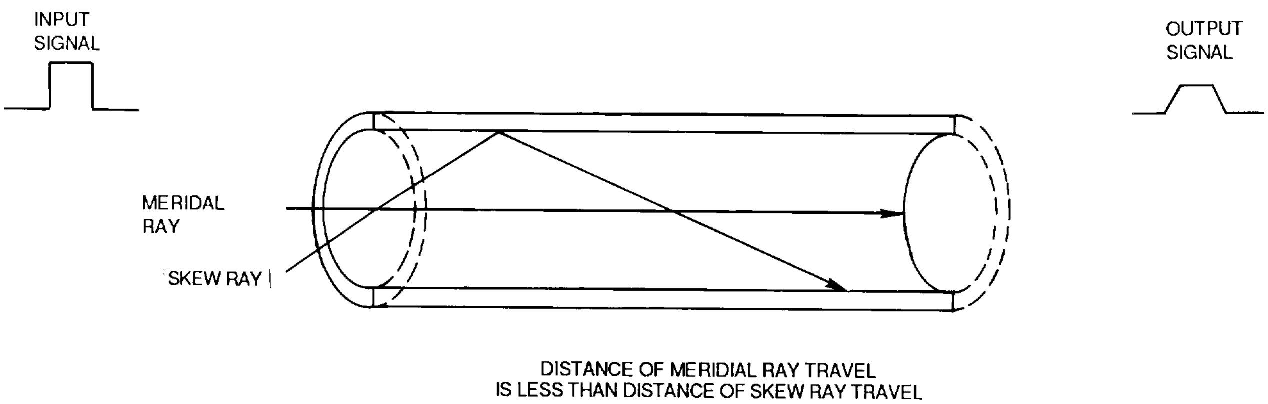
Term	Definition
Die closure	Gap between indenter dies at full handle closure. Usually defined by Go/No-Go dimensions.  TYPICAL DIE CLOSURE CHECK
Dielectric	(1) Any insulating medium which intervenes between two conductors and permits electrostatic attraction and repulsion to take place across it. (2) Material having the property that energy required to establish an electric field is recoverable in whole or in part, as electric energy.
Dielectric absorption	Property of an imperfect dielectric where there is an accumulation of electric charges within the body of the material when placed in an electric field.
Dielectric breakdown	Voltage required to cause an electrical failure or breakthrough of the insulation.
Dielectric constant (K)	Property of a dielectric which determines the electrostatic energy stored per unit volume for unit potential gradient. The ratio of the capacitance between two electrodes separated by the dielectric, as compared to the same electrodes separated by a vacuum. Also called permittivity and specific inductive capacity.
Dielectric loss	Time rate at which electric energy is transformed into heat in a dielectric when subjected to a changing electric field.
Dielectric loss angle	Difference between ninety degrees and the dielectric phase angle. Also called dielectric phase difference.
Dielectric loss factor	Product of dielectric constant and the tangent of the dielectric loss angle. Also called dielectric loss index.
Dielectric phase angle	Angular difference in phase between the sinusoidal alternating potential difference applied to a dielectric, and the component of the resulting alternating current having the same period as the potential difference.
Dielectric power factor	Cosine of the dielectric phase angle, or sine of the dielectric loss angle.
Dielectric strength	Maximum voltage that a dielectric material can withstand, under specified conditions, without rupturing. Usually expressed as a voltage gradient (volts/unit thickness). Also called electric strength and disruptive gradient.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Dielectric strength and breakdown test equipment	High potential test equipment is produced in both alternating current and direct current types. Equipment for measuring dielectric breakdown of electrical insulation: a 60 Hz step-up transformer, a variable primary voltage, a circuit breaker, and a means of indicating the voltage applied.
Dielectric test	Test in which a voltage, higher than the rated voltage, is applied for a specified time to determine the adequacy of the insulation under normal conditions.
Diffusion	Physical process whereby one material passes, i.e., diffuses, through another. The diffusion of gases through solid materials, or the diffusion of one metal with another are examples. In soldering, the gold of a gold-plated object migrates or diffuses into solder.
Digital signal	Signal that is either zero (off) or one (on), rather than as a continuum of voltages.
Diode	Semiconductor device with two electrodes, cathode and anode, having a much greater resistance in one direction. In the forward biased condition, anode voltage more positive than cathode, current flows through the device with little resistance. In the reversed biased condition, cathode voltage more positive than anode, current flow is effectively blocked. Zener diodes are designed to operate in the reverse biased condition until a certain breakdown or avalanche voltage is reached. This quality is useful in voltage regulation.
DIP	(See Dual In-line Package.)
Dip brazing	Brazing by immersion in a molten salt or metal bath. Where a metal bath is employed, it may provide the filler metal.
Dip coating	Method of coating an article by dipping it into tank or resin, and chilling the coating which adheres to the surface.
Dip soldering	Process whereby printed boards are brought in contact with the surface of a static pool of molten solder for the purpose of soldering the entire exposed conductive pattern in one operation.
Dip solder terminal	Terminals on a connector which are inserted into holes in the printed circuit board and then soldered in place.
Direct capacitance	Capacitance measured directly from conductor to conductor through a single insulating layer.
Direct Current (DC)	Electric current which flows in only one direction.
Direct Current Resistance (DCR)	Resistance offered by any circuit to the low of direct current.
Directional coupler	Passive device used in a cable system to divide or combine unidirectional RF power sources.
Discrete component	Circuit component having an individual identity, such as a transistor, capacitor, or resistor.
Discrete wiring	Wire or wires having distinct identity and individuality of purpose.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Dispersion (fiber optic)	(1) Spread out or broadening of a light pulse as it propagates through the optical conductor. Dispersion increases with length of conductor and is caused by the difference in ray path lengths within the fiber core. (2) Variation of the refractive index of a material with wave-length. This variation causes light of different wave-lengths to travel at different velocities in the material. They are also bent differently as they pass from one material to another. This creates the familiar spectrum when white light passes through a prism.



Displacement current	Current which exists in addition to ordinary conduction current in AC circuits. Proportional to the rate of change of the electric field.
Disruptive discharge	Sudden and large increase in current through an insulation medium, due to the complete failure of the medium under electrostatic stress.
Disruptive gradient	(See dielectric strength.)
Dissipation factor	Measure of the AC loss. Dissipation factor is proportional to the power loss per cycle (f) per potential gradient (E squared) per unit volume as follows: $\text{Diss Fac} = \dfrac{\text{power loss}}{E^2 \times f \times \text{volume} \times \text{constant}}$
Distillation	Boiling or evaporation process generally used to separate one liquid component from a mixture of other liquids. In soldering, for example, the cleaning solution used to remove flux residues after soldering can be distilled. By maintaining the proper temperature, the basic solvent is boiled off, leaving behind a residue of soil that has been removed from the work. The solvent vapors are then collected and condensed back into the liquid form and reused.
Distortion	Any deviation from the desired shape or contour.
Distortion-limited operation	Condition prevailing when distortion of a received signal, rather than its amplitude (or power), limits performance.
Disturbed conductor	Conductor that receives energy generated by the field of another conductor or an external source such as a transformer.
Disturbing conductor	Conductor carrying energy that creates spurious signals in another conductor.
Dopant	Material, usually germanium or boron oxide, added to silica to change its index of refraction.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

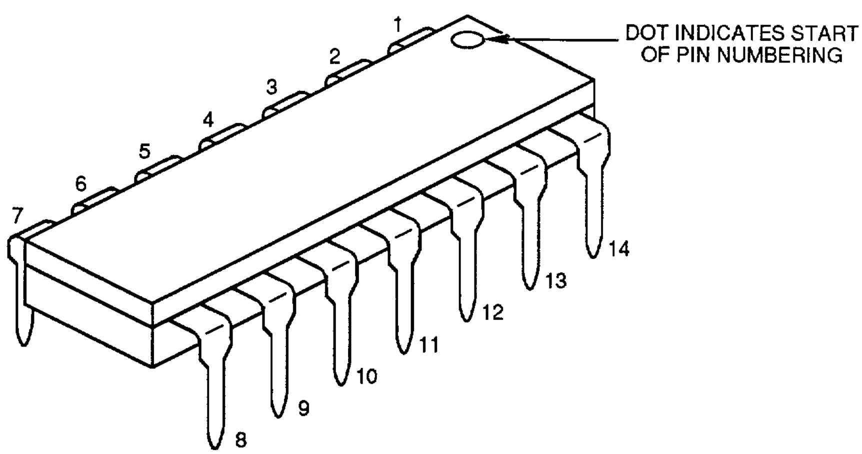
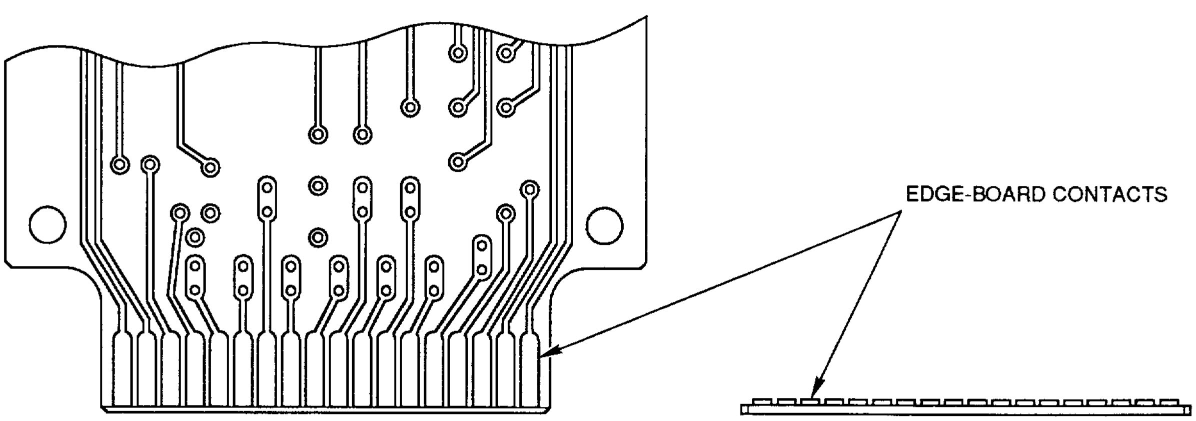
Term	Definition
Double-faced tape	Tape finished on both sides with a rubber or synthetic compound.
Double shield	Two shields, one over the other. Maximum coverage 98%. (See shield.)
Double-sided board	Printed board with a conductive pattern on both sides.
Drag in	Water or solution carried into another solution by the work and the associated handling equipment.
Drag-out	Solution carried out of a bath by the work and the associated handling equipment.
Drain wire	In a cable, an uninsulated wire laid over the component or components and used as a ground connection and method of termination for a shield.
Draw feed stock	Rod or wire that is subsequently drawn to a smaller size.
Drawing	In wire manufacture, pulling the metal through a die or series of dies to reduce the diameter to a specified size.
Dressed contact	Contact with a permanently attached contact retaining member.
Dross	Metal oxides and other entrapped impurities which float in or on the surface of a molten metal bath. In the case of solder, it would include the oxides of lead and tin. In addition to non-metallic impurities such as flux residues that were dragged into the solder bath and oxides of any metal impurities found in the solder.
Drummed packing	(See barrel-packed.)
Dual coaxial cable	Two individually insulated conductors laid parallel or twisted, and placed within an overall shield and sheath.
Dual In-Line Package (DIP)	Carrier in which a semiconductor integrated circuit is assembled and sealed. Package consists of a plastic or ceramic body with two rows of vertical leads which are inserted into a circuit board and secured by soldering. 
Duct	Underground or overhead tube for carrying electrical conductors or cable.
Ductility	Ability of a material to deform plastically without fracturing. Measured by elongation or reduction of area in a tensile test, by height of cupping in an Erichsen test, or by other means.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Dummy connector	Connector which does not have provisions for attaching conductors. Generally used for storage of a cable assembly connector.
Dumping period	Length of time a material, such as a liquid flux or the solder in a solder pot, can be used before it is necessary to replace with new material.
Duplex	Characteristic of data transmission either full or half duplex.
Duplex cable	Cable composed of two insulated single conductor cables twisted together. The assembled conductors may or may not have a common covering of binding or protecting material. (See parallel pair.)
Durometer	Measurement device used to determine the hardness of a substance.
Dust cover	(See cover, electrical connector.)
Dyne	The unit of force in the centimeter-gram-second system equal to the force that would give a free mass of one gram an acceleration of one centimeter per second per second.
E	(1) (See voltage.) (2) (See Enamel.)
E-glass	Electrical glass; fibers of glass with low alkali borosilicate, used to reinforce plastics and provide high resistivity.
Eccentricity	Like concentricity, a measure of the center of a conductors location with respect to the circular cross section of the insulation. Expressed as a percentage of displacement of one circle within the other.
ECMA	European Computer Manufacturers Association.
ECTFE	(See Ethylene-Chlorotrifluoroethylene.)
Eddy currents	Circulating currents induced in conducting materials by varying magnetic fields. Usually undesirable because they represent loss of energy and cause heating.
Edge-board contacts	Series of contacts printed on or near any edge of a printed circuit board and intended for mating with an edge connector.



Term	Definition
Edge connectors, printed circuit boards	One-piece. Connector mates directly with Printed Circuit (PC) board by slipping over and gripping board edge. Connection is made between spring contacts in connector and edge-board contacts on PC board. The PC board acts as one-half of the connector.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Edge margin	(See margin.)
EEI	Edison Electric Institute.
Egg crating	Insulation walls between each cavity within the contact wire entry face of the connector housing normally allows the rear portion of the contact to be fully protected by housing material, thereby preventing shorts between adjacent contacts, and minimizing the danger of shock. Sometimes used to improve crosstalk characteristics or to minimize the flexing of wires and/or contacts.
EIA	Electronic Industries Association.
EIA Interface	Standardized set of signal characteristics (time duration, voltage, and current) specified by the EIA.
Elastic deformation	Change of dimensions accompanying stress in the elastic range. Returning to original dimensions upon release of stress.
Elasticity	That property of a material which tends to recover its original size and shape after deformation.
Elastic limit	Maximum stress to which a material may be subjected without any permanent strain remaining upon the complete release of stress.
Elastic modulus	(See modulus of elasticity.)
Elastomer	(See rubber.)
Electric connector	Provides fiber optic transceiver access to AC power, then transmits this power source to the unit's power converter.
Electrical insulation	This property is the inverse of electrical conductivity and is proportional or related to electrical resistance. The insulating properties of a material describe its ability to restrict or block the flow of electricity. (See resistance.)
Electrical Moisture Absorption (EMA)	Water tank test during which submerged cables are subjected to voltage and the water is maintained at rated temperature. The immersion time is long, with the object being to accelerate failure due to moisture in the insulations. Simulates buried cable.
Electric field strength	At a given point, the vector limit E of the quotient of the force that a small stationary charge will experience by virtue of its charge, to the charge as the charge approaches zero in a macroscopic sense.
Electric resistance soldering	Soldering by connecting work between a ground and an electrode, or between two movable electrodes, to complete an electrical circuit. Coalescence is produced by means of resistance of work or tips connecting the work to the electric current.
Electric strength	Maximum potential gradient that the material can withstand without rupture. Value obtained for the electric strength will depend on the thickness of the material, and on the method and conditions of test. Also called dielectric strength or disruptive gradient.
Electrode	Conductor, not necessarily metal, through which a current enters or leaves an electrolytic cell, arc, furnace, vacuum tube, gaseous discharge tube, or any conductor of the nonmetallic class.
Electrode potential	Potential of a half cell, as measured against a standard reference half cell.
Electrolyte	This term is commonly applied to substances which, either in the molten state or in solution, conduct electricity by transfer to ions. The more important electrolytes are solutions of salts, acids, or bases, in water.
Electrolytic corrosion (soldered joint)	Deterioration of a joint produced by contact of dissimilar metals in an electrolyte.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

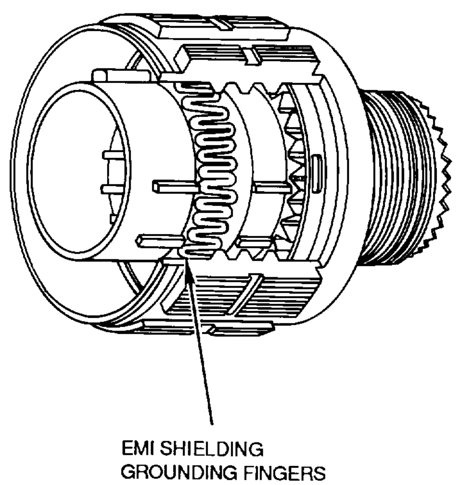
Term	Definition
Electrolytic Tough Pitch Copper (ETPC)	Widely used for wire and bus bars. Has a minimum conductivity of 99.99%.
Electromagnet	Coil of wire, which produces a strong magnetic field when current is sent through the coil. The field is strengthened by the addition of an iron core.
Electromagnetic field	Rapidly moving electric field and its associated moving magnetic field. Located at right angles to the electric lines of force and to their direction of motion.
Electromagnetic induction	Production of a voltage in a coil, due to a change in the number of magnetic lines of force (flux linkages) passing through the coil.
Electromagnetic Interference (EMI)	Frequency spectrum of electromagnetic radiation extending from subsonic frequency to X-rays. This term should not be used in place of the term Radio Frequency Interference (RFI). (See radio frequency interference.) Shielding materials for the entire EMI spectrum are not readily available. 
Electromotive Force (EMF)	Pressure or voltage. The force which causes current to flow in a circuit.
Electromotive series	List of elements arranged according to their standard electrode potentials. In corrosion studies, the more practical galvanic series of metals is generally used. The relative position of a given metal is not necessarily the same in the two series.
Electron	That portion of an atom which circles around the center, or nucleus, and flows as current in a circuit. An electron possesses a negative electric charge, and is the smallest charge of negative electricity known.
Electronic	Pertaining to the application of that branch of science which deals with the motion, emission, and behavior of currents of free electrons, especially in vacuum, gas or phototubes, and special conductors or semi-conductors. Contrasted with electric which pertains to the flow of large currents in wires or conventional conductors.
Electronic hook-up wires	Wires used to make the internal connections between the various electrical parts of electronic assemblies.
Electronic wire and cable	Length of conductive or semiconductive material, with or without insulation and other refinements, which is used in an electronic application. It could be a length of cord when used as a speaker extension cable, or a piece of braided wire cable used as a chassis ground strap.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Electroplate	Electrodeposition of an adherent metal coating on a conductive object for protection, decoration, or other purposes. The object to be plated is placed in an electrolyte and connected to one terminal of a DC voltage source. The metal to be deposited is similarly immersed and connected to the other terminal. Ions of the metal transfer to the object as they make up the current flow between the electrodes.
Electrostatic powder coating	Directing resin powders with high voltage charge onto metal, to be subsequently fused.
Electro-tinned	Electrolytic process of tinning wire using pure tin.
Electrotinning	Electroplating tin on an object.
Elongation	Fractional increase in length of a material stressed in tension.
EMA	(See Electrical Moisture Absorption.)
Embossing	Marker identification by means of thermal indentation leaving raised lettering on the sheath material of cable.
Embrittlement	Reduction in the normal ductility of a metal due to physical or chemical change.
Emergency overloads	Loads which occur when larger than normal currents are carried through a cable or wire over a certain period of time.
EMF	(See Electromotive Force.)
EMI	(See Electromagnetic Interference.)
Emitter or source	Source of optical power. (See fiber optics.)
EMP	Electromagnetic Pulse.
EMV	Electromagnetic Vulnerability.
Enamel	Varnish-like finish that is applied by repeated dipping and baking cycles, producing a very thin insulation. Enamel insulation is most often used on magnet wire for motors, coil windings, and thermocouple type wire, etc.
Enameled wire	Conductor with a baked-on enamel film insulation. In addition to magnet wire, enameled insulation is used on thermocouple type wires.
Encapsulate	To coat a component or assembly in a conformal or thixotropic coating by dipping, brushing, or spraying. Generally used to protect components from environmental and/or handling stresses. (See potting.)
Encapsulating shells and molds	Containers into which components and assemblies are inserted. After which, potting compounds are poured in the shells in order to completely surround and protect the components or assemblies. When the potting compound is cured, the unit is completely sealed. (See potting mold.)
End bell	Accessory similar to a cable clamp which attaches to the back of a plug, receptacle, or junction. Serves as an adapter for the rear of termination assemblies. Some angular end bells have built-in cable clamps. Angular end bells are available up to 90°. (See accessories.)
End cap	Short pieces of tubing having one end sealed. Cap is placed over the wire splice and heated to shrink and permanently seal.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

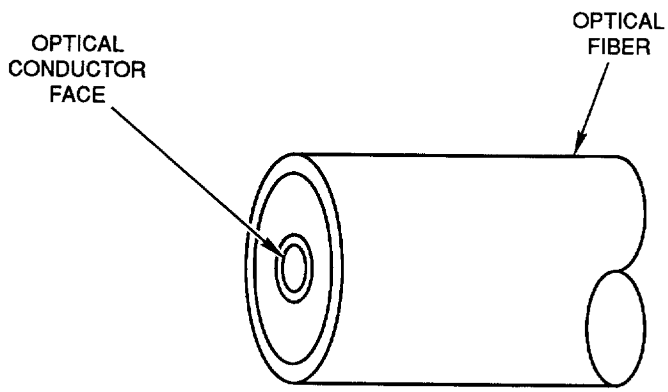
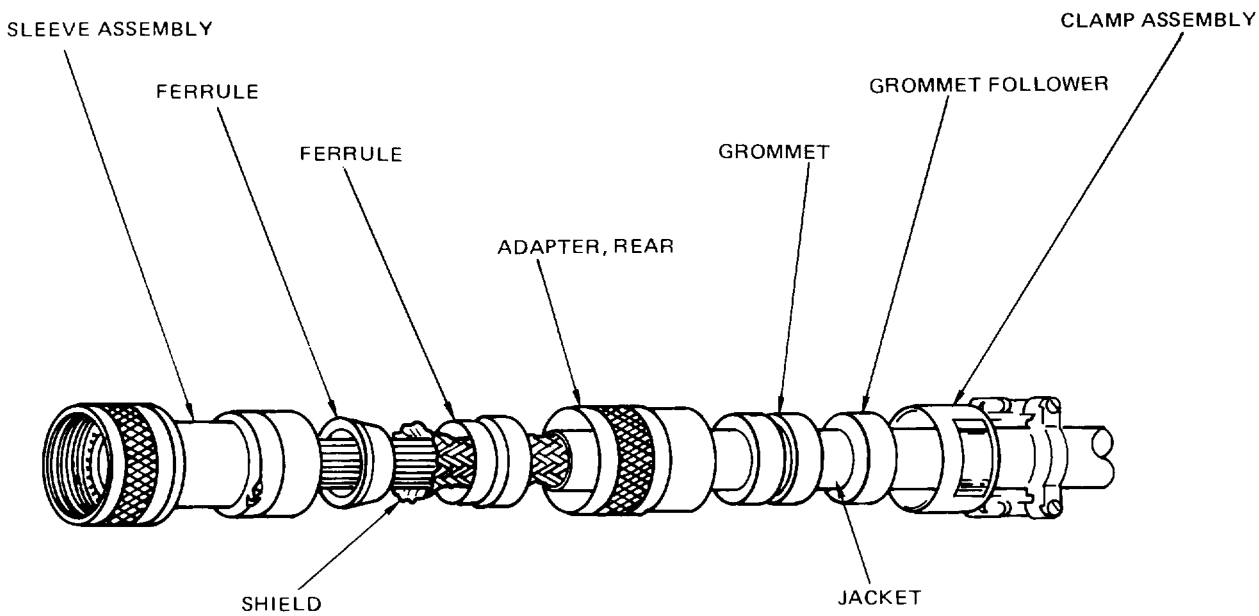
Term	Definition
End finish (fiber optic)	Surface condition at the optical conductor face. 
End separation loss	Optical power loss caused by distance between the end of a fiber and source, detector, or another fiber.
End-to-end check	Tests conducted on a completed wire and/or cable run to ensure electrical continuity.
Ends	In braiding, the number of essentially parallel wires or threads on a carrier.
Energize	To apply rated voltage to a circuit or device in order to activate it.
Energy of a charge	Given in ergs when the charge, Q, and the potential, V, are in electrostatic units, E = 1/2QV.
Energy of the electric field	Represented by E = KH/8, where H is the electric field intensity in electrostatic units, K the specific inductive capacity, and the energy of the field E is in ergs per cm.
Engaging and separating force	Amount of force needed to engage and/or separate contact elements in mating connectors. Force levels vary. Measurements are taken during initial insertion and removal, and/or after a specified number of insertion-removal cycles. (See contact engaging and separating force.)
Engineering plastics	Plastics with properties suitable for high performance use.
English Legal Standard	(See British Standard Wire Gauge.)
Environment	Surroundings into which wire or cable is to be placed.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Environmentally sealed	Device that is provided with gaskets, seals, grommets, potting, or other means to keep out moisture, dirt, air, or dust which might reduce performance. Does not include non-physical environments such as RF and radiation.



TYPICAL ENVIRONMENTAL SHIELDED BACKSHELL

Term	Definition
Environment resistant	(See environmentally sealed.)
EPDM	Ethylene-Propylenediene Monomer rubber.
Epoxy Potting Compound	Nonconductive, organic plastic used for encapsulation of components and wires.
Epoxy resins	Straight-chain resins based on ethylene oxide, its derivatives, or homo-logs. Used for bonding, potting connectors, and for splicing in some infield splicing kits. For magnet wire enamels, the basic resin is an epoxy of high epoxide equivalent with urea-formaldehyde modifying resins. Other resins may be present as modifiers in some enamels. (See potting compound-epoxy.)
EPR	(See Ethylene Propylene Rubber.)
EPT	Ethylene-Propyleneterpolymer rubber.
Equalization	Means of modifying the frequency response of an amplifier or network, thereby resulting in a flat overall response.
Equilay	More than one layer of helically laid wires with the direction of lay reversed for successive layers, but with the length of lay the same for each layer.
Equilibrium	Dynamic condition of balance between atomic movements, where the resultant is zero and the condition appears to be one of rest, rather than change.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

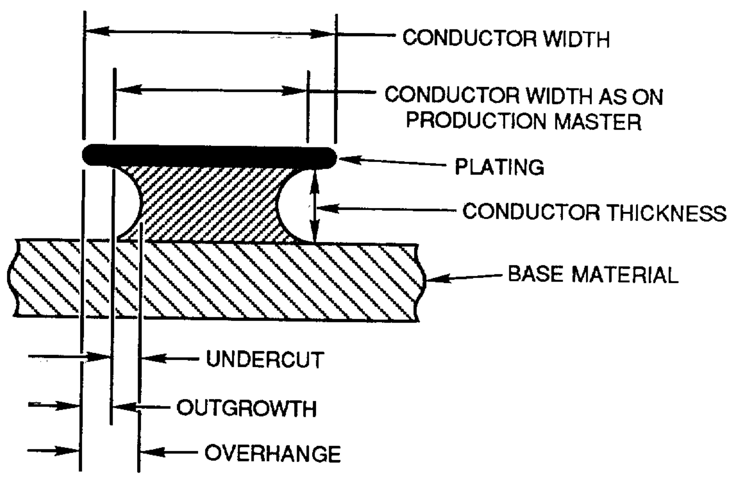
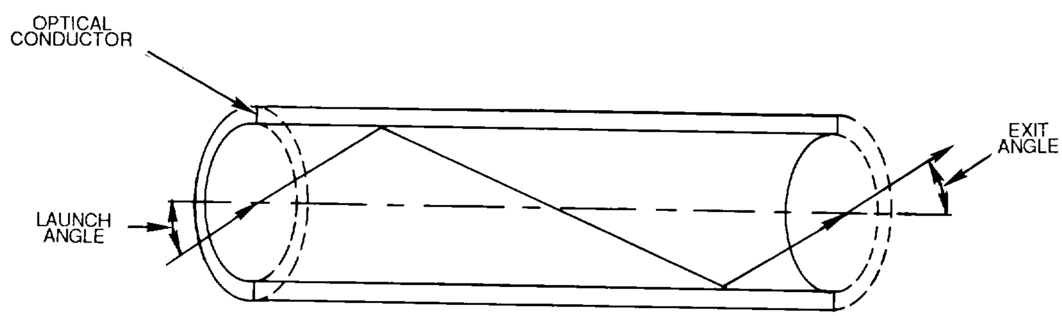
Term	Definition
Equilibrium diagram	Graphical representation of the temperature, pressure, and composition limits of phase fields in an alloy system as they exist under conditions of complete equilibrium. In metal systems, pressure is usually considered constant.
Equilibrium length	For a specific excitation condition, the length of multimode optical wave-guide necessary to attain stable distribution of power among propagating modes.
Equilibrium Mode Distribution (EMD)	Condition in a multimode optical fiber in which the relative power distribution among the propagating modes is independent of length.
Erg	A centimeter-gram-second unit of work equal to the work done by a force of one dyne acting through a distance of one centimeter.
Error detection	Checking for errors in data transmission. A calculation is made on the data being sent and the results are sent along with it.
Error detection code	Code in which each data signal conforms to specific rules of constructions so that departures from the norm errors are automatically detected.
Ester	Reaction product of an alcohol and an acid.
Etchant	Solution used, by chemical reaction, to remove the unwanted portion of a conductive material bonded to a base.
Etchback	Controlled removal of all components of base material by a chemical process on the side wall of holes in order to expose additional internal conductor areas.
Etched wire	Process applied to fluoroplastic wire in which the wire is passed through a sodium bath to create a rough surface and allow epoxy resin to bond the fluoroplastic.
Etch factor	Ratio of the depth of etch (conductor thickness) to the amount of lateral etch (undercut). 
ETFE	(See Ethylene Trifluoroethylene.)
Ethyl cellulose	Of the cellulosic resins, the one with the lowest density. Chemically an ether, it has toughness and dimensional stability. Can be extruded, injection molded, cast as film, or used in coating.
Ethylene-Chlorotrifluoroethylene (ECTFE)	Fluorocarbon copolymer, made from ethylene and chlorotrifluoroethylene, with outstanding strength and wear characteristics. Has outstanding resistance to solvents, cleaners, or chemicals, and is flame retardant. Disadvantages include, cost and stiffness. It is rated 302°F (150°C).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

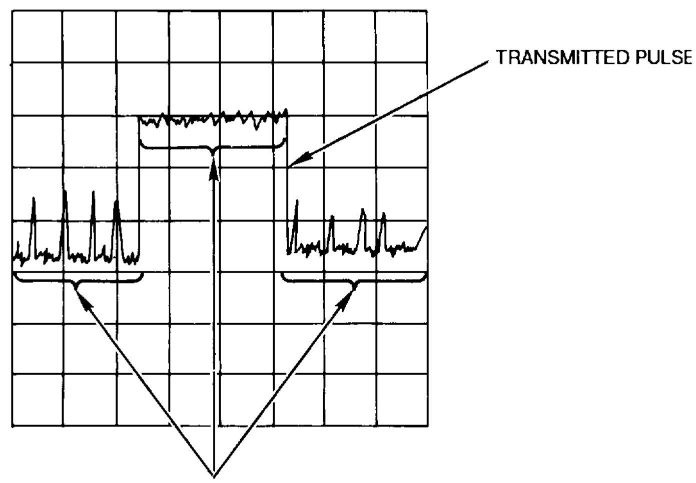
Term	Definition
Ethylene glycol	Liquid used in antifreeze and as a liquid dielectric.(See liquid dielectrics.)
Ethylene-Propylene Rubber (EPR)	Low cost synthetic rubber copolymer, made from ethylene and propylene, these materials offer excellent resistance to corona, ozone, and weathering. They also have excellent electrical properties and good to excellent heat resistance and high temperature properties, but poor mechanical and flame characteristics. Widely used as an insulation for 600 V and high voltage cables, and normally rated 194°F (90°C). Often combined with hypalon as a conductor jacket to overcome its deficiencies.
Ethylene-Trifluoroethylene (EFTE)	Fluoropolymer that is thermoplastic with very good electrical, mechanical, and chemical resistance characteristics, 302°F (150°C).
ETPC	(See Electrolytic Tough Pitch Copper.)
Eutectic	(1) Isothermal reversible reaction in which a liquid solution is converted into two or more directly mixed solids on cooling, the number of solids formed being the same as the number of components in the system. (2) Alloy having the composition indicated by the eutectic point on an equilibrium diagram. (3) Alloy structure of intermixed solid constituents formed by a eutectic reaction.
Evaporation	Physical process by which a liquid loses material to the atmosphere surrounding it. Evaporation is caused by the motion of the molecules of a liquid. These molecules are moving randomly in all directions. Molecules which head in the direction of the surface of liquid can escape completely if they have sufficient velocity. Vapor pressure is an indication of the rate of evaporation which a material will undergo. The evaporation process generally increases with increasing temperature.
Exane	Trade name of ITT Surprenant for its family of irradiated cross-linked polyolefin insulation. This material combines electrical, mechanical, and heat aging characteristics to give an excellent balance of properties. Most often used for control and power cables at 600 V to 2000 V. Rated 194°F (90°C) to 257°F (125°C).
Excess solder	This condition completely obscures the configuration of the joint, and may be characterized by globules of solder hanging from the joint. Because of the mass of solder present, the condition may disguise other defects which compound the unacceptability of the joint.
Exit angle (fiber optic)	Angle between the output radiation vector and the axis of the fiber or fiber bundle.



Exotherm	Characteristic curve of a resin during its cure, which shows the heat of reaction (temperature) versus time. Peak exotherm is the maximum temperature on the curve.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Extender	Substance added to a plastic composition to reduce the amount of resin required per unit volume. Generally has adhesive action.
External interference	Effects of electrical waves, fields, or physical external circuit conditions, which cause variations other than the desired signal. Static. (See crosstalk.)



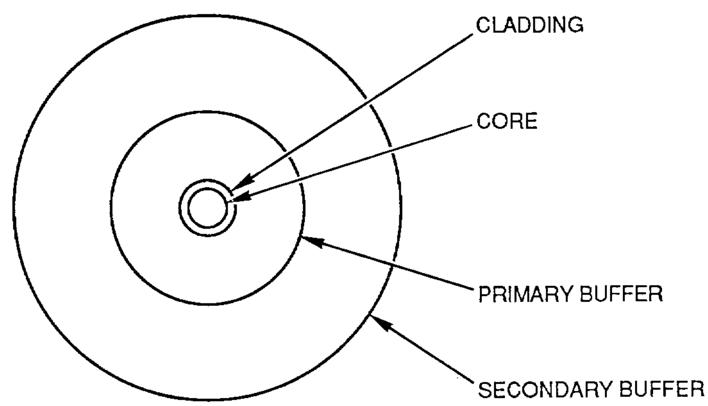
Term	Definition
External wiring	Category of electronic wiring which interconnects various subsystems within the weapons system. It is frequently subjected to severe environments. (See internal wiring.)
Extruded cables	Cables with conductors which are insulated and formed in a uniform configuration by the application of a homogeneous insulation material in a continuous extrusion process.
Extrusion	Method of forcing plastic, rubber, or elastomer material through an orifice in continuous fashion to apply insulation or jacketing to a conductor or cable.
Eyelet	Metallic, donut-shaped device used to terminate conductors. Eyelet is attached to a conductor or to a Printed Circuit (PC) board with pliers or an eyelet setting machine. On PC boards, wire or component lead is inserted through eyelet and soldered in place.
f	(See Frequency.)
F	(1) Designation for flat band metallic armor. (2) (See Farad.)
Factor of assurance of wire or cable insulation	Ratio of the voltage at which completed lengths are tested to that at which they are used.
Farad (F)	Unit of capacitance. The capacitance of a capacitor which, when charged with one coulomb, gives a difference of potential of one volt. (See capacitance.)
Faraday shield	Network of parallel wires heated to a common conductor at one end to provide electrostatic shielding without affecting electromagnetic waves. The common conductor is usually grounded.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

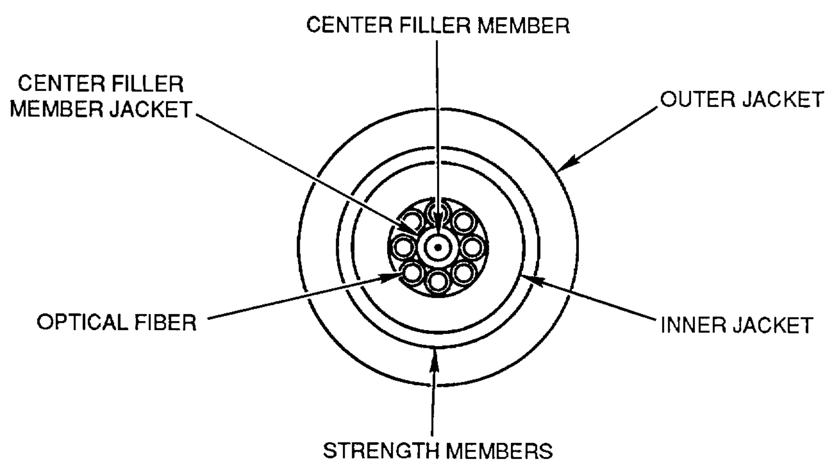
Term	Definition
Fatigue	Phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material. Fatigue fractures are progressive, beginning as minute cracks that grow under the action of the fluctuating stress.
Fatigue life	Number of cycles of stress that can be sustained prior to failure for a stated test condition.
Fatigue limit	Maximum stress below which a material can presumably endure an infinite number of stress cycles. If the stress is not completely reversed, the value of the mean stress, the minimum stress, or the stress ratio should be stated.
Fatigue resistance	Resistance to metal crystallization which leads to conductors or wires breaking from flexing.
Fatigue strength	Maximum stress that can be sustained for a specified number of cycles without failure, the stress being completely reversed within each cycle unless otherwise stated.
Fatigue strength reduction factor (Kf)	Ratio of the fatigue strength of a member or specimen with no stress concentration to the fatigue strength with stress concentration. Kf has no meaning unless the geometry, size, and material of the member or specimen, and its stress range, are stated.
FCC	(1) Designation for Flexible Control Cable. (2) Federal Communications Commission.
FDDI	An emerging standard for a 100 Mbit/sec local area network, based upon fiber optic media configured as dual control rotating token rings.
Feed-thru insulators	Fabricated from dielectric materials, feed-thru insulators are used to carry a metal conductor through the chassis while preventing the hot lead from shorting to the ground chassis.
Feed-thru or feed-through	Use of special connectors or junctions to pass conductors thru bulkheads or panels. Contacts can be pin on one side, socket on the other, or can be pin on either side, or socket on either side. Feed-thru connectors differ from rack and panel types in that connection can be made on both sides of the panel to which they are attached.
Feedback module	Module having one face containing contact cavities. It is used for general purpose interconnection and busing. (See terminal junction module.)
Female contact	(See socket contact.)
FEP	(See Fluorinated Ethylene Propylene.)
FEPB	Designation for FEP insulated wire with glass or asbestos braid.
FEPCC	Designation for high temperature control cable.
Ferrites	Ferrites are powdered, compressed, and sintered magnetic materials having high resistivity and consisting chiefly of ferric oxide combined with one or more metals. These oxides have a crystal structure into which a divalent metal, i.e., iron, zinc, nickel, barium, and manganese can be fitted. Ferrites are lightweight, flexible, resistant to chemicals, and offer relatively good magnetic properties.
Ferrous metals	Alloys containing iron.
Ferrule	Short tube used to make connections to shielded or coaxial cables. Also used in connectors to reduce transmission of torque to grommet.
FF-1	Designation for fixture wire, flexible, rubber insulated, single conductor, 300 V, 140°F (60°C).
FF-2	Same as FF-1, but with 600 V rating.
FFC	Flexible Flat Cable. (See flat cable.)
FFH-1	Same as FF-1, except heat resistant.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
FFH-2	Same as FFH-1, but with 600 V rating.
Fiber	(1) (fiber optic) Single discrete element used to transmit optical (light wave) information. Analogous to a single wire used to transmit electrical information. Usually consists of a core that transmits the information and a cladding around the core. (2) Thread or threadlike structure such as cellulose, asbestos, or glass yarn.



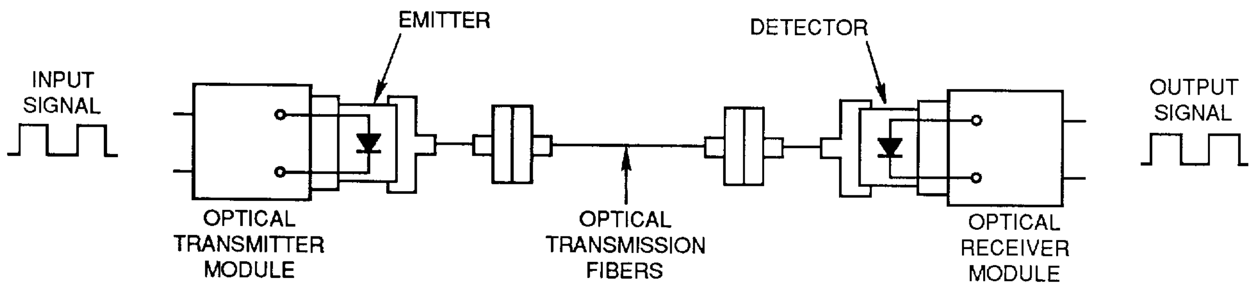
Term	Definition
Fiber bandwidth	Range of frequencies over which light intensity exiting a waveguide can be varied before attenuation varies 3dB from the mean expressed in megahertz.
Fiber buffer	Materials used to protect an optical fiber or cable from physical damage, providing mechanical isolation or protection.
Fiber bundle (fiber optic)	Consolidated group of single fibers used to transmit a single optical signal.



Term	Definition
Fiber cable (fiber optic)	Cable composed of a fiber bundle or single fiber, strength members, and a cable jacket used to transmit optical signals.
Fiber glass	Yarn used for braiding when high heat and moisture resistance are necessary. While not as abrasion resistant as cotton, it is satisfactory for most applications and can, if necessary, be protected with an extruded nylon jacket.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Fiberguide (fiber optic)	Optical fiber. (See fiber.)
Fiber Optics (FO)	General term describing a lightwave or optical communications system. In such a system, electrical information is converted to light energy, transmitted to another location through optical fibers, and is there converted back into electrical information.



Term	Definition
Fiber optic link	Any optical transmission channel designed to connect two end terminals or to be connected in series with other channels.
Fiber Optic Medium Attachment Unit (FOMAU)	Fiber optic device that provides for the connection to all Ethernet and IEEE 802-3 compatible DTE's via baseband transceivers with full compliance to Ethernet and IEEE 802-3 standards.
Fiber optic transceiver	Device that converts electronic signals to optic signals then drives them on to the fiber optic.
Fiber tubing (fiber optic)	Loose crush-resistant cylinder applied over individual fibers to provide mechanical protection.
Field	Area of influence around a magnet or electric charge.
Field coil	Suitable insulated winding to be mounted on a field pole to magnetize it.
Field strength	Strength of an electromagnetic field. The measurement may be either the electric or the magnetic component of the field, and may be expressed as V/m or A/m. Either of these may be converted to solve for the others.
Figure 8 cable	Aerial cable configuration in which the conductors and the steel strand which supports the cable are integrally jacketed. A cross section of the finished cable approximates the figure eight.
Filament	Fiber characterized by extreme length.
Filled cable	Cable construction in which the cable core is filled with a material that will prevent moisture from entering or passing through the cable.
Filled-core annular conductor	Conductor composed of a plurality of conducting elements disposed around a non-conducting supporting material which substantially fills the space enclosed by the conducting elements.
Filled tape	Fabric tape which has been thoroughly filled with a rubber or synthetic compound, but not necessarily finished on either side with this compound.
Filler	(1) Material used in multiconductor cable to occupy interstices formed by the assembled conductors. (2) An inert substance added to a compound to improve properties or decrease cost.
Filler metal	Metal added in making a brazed, soldered, or welded joint.
Fillet	(1) Radius (curvature) imparted to inside meeting surfaces. (2) Concave cornerpiece used on foundry patterns.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

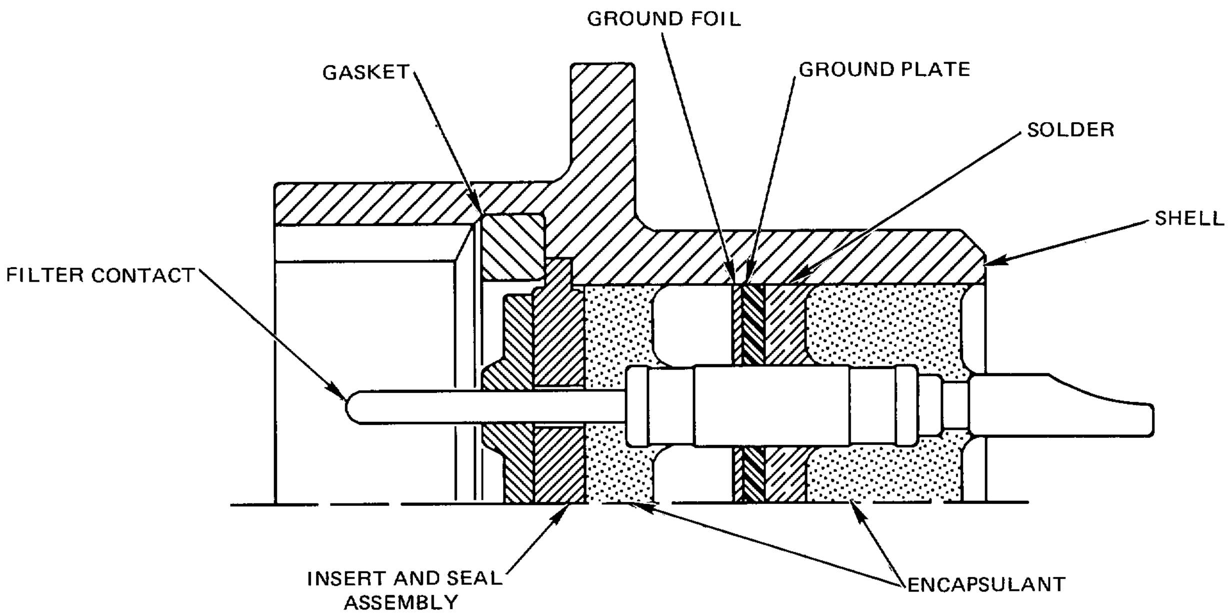
Term	Definition
Film	Sheeting having a nominal thickness not greater than 0.010 inch. Plastic films are used for pressure sensitive tapes, flexible circuit substrates, and a wide variety of insulating and protective applications in electrical/electronic products either alone or in combination with other materials.
Film bonded	Cables where bonding is accomplished by solvent-bonding or adhesive-bonding wire, cable, or spacer to a film to form a cable. (See bonded cables.)
Film resistor	Device whose resistive material is a film on an insulator substrate; resistance value is adjusted by trimming.
Filter contact	Filters are assembled onto a common contact shaft and the active electrodes are soldered to the pin. In a connector, the ground electrode is connected to a ground plate which in turn is connected to the connector shell. Consequently the filter works between the pin and the connector shell. There is the conventional Pi, and unbalanced Pi, a cascaded Pi and a capacitor filter. All are designed to meet a specific EMI environment. 
Filter line cable	Filter line cable provides protection from conducted and radiated high frequency Electromagnetic Interference (EMI). It acts as a low-pass filter, which strongly attenuates conducted signals or noise above 100 MHz while lower frequency signals pass with little loss. Filter line cable configurations are typically defined in MIL-C-85485, or AS85485.
Fine silver	Silver (Ag) with a fineness of 999; equivalent to a minimum content of 99.9% Ag with the remaining content not restricted.
Fingers	(See edge-board contacts.)
Firewall	Point of interconnection between two portions of a network, usually implemented by an intelligent router, where information propagating into one network from the other can be restricted for reasons of fault isolations and routing control.
Fixed contact	Contact permanently included in the insert material. It is mechanically locked, cemented, or embedded in the insert.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Fixture wire	Fixture wires, according to the National Electrical Code, are designed for installation in lighting fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use. They also are used for connecting lighting fixtures to the conductors of the circuit that supplies the fixtures. Fixture wires shall not be smaller than 18 AWG. Flexible stranding is used for most fixture wire, but solid conductors may be used in some applications.
Flag terminal	Type of terminal where the tongue projects out from the side of the terminal barrel rather than the end of the barrel.
Flame resistance	Relative ability of a material not to propagate flame.
Flame retardant	Either reactive compounds or additive compounds added to formulation to increase resistance to combustion. Reactive fire-retardant compounds become an integral part of the polymer structure, while additive fire-retardant chemicals are physically dispersed in the polymer.
Flammability	Measure of the material's ability to support combustion.
Flammable	Capable of bursting into flame when a spark or open flame is passed sufficiently near, as with fumes and vapors from hot oils or volatile combustible liquids, and with finely powdered, combustible solids.
Flammable liquids	Liquid having a flash point below 140°F (60°C) and having a vapor pressure not exceeding 40 pounds per sq in.(absolute) at 100°F (37.8°C).
Flange, connector	Projection extending around a connector with provisions to permit mounting the connector to a panel.
Flange spade terminal	Terminal whose tongue edges are turned at an angle to the plane of the tongue.
Flash	Thin film of material formed at the sides of a forging, casting or molded part where some of the material is forced between the faces of the forging dies or the mold halves. (2) The excess metal extruded between both halves of crimping dies when making certain circumferential or symmetrical crimps. (3) Thin deposit of plastic material usually at the base of molded-in pins.
Flashover	Disruptive discharge around or over the surface of a solid or liquid insulator.
Flash point	Temperature at which a volatile liquid mixes with air in such proportions as to produce a flammable gaseous mixture. This mixture will flash when exposed to a flame or spark but will not necessarily continue to support combustion.
Flash welding	Resistance butt welding process in which the weld is produced over the entire abutting surface by pressure and heat, the heat being produced by electric arcs between the members being welded.
Flat braid	Woven braid, composed of tinned copper strands, which is rolled flat at time of manufacture to a specific width depending upon construction. It is generally used as a high current conductor at low voltages.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

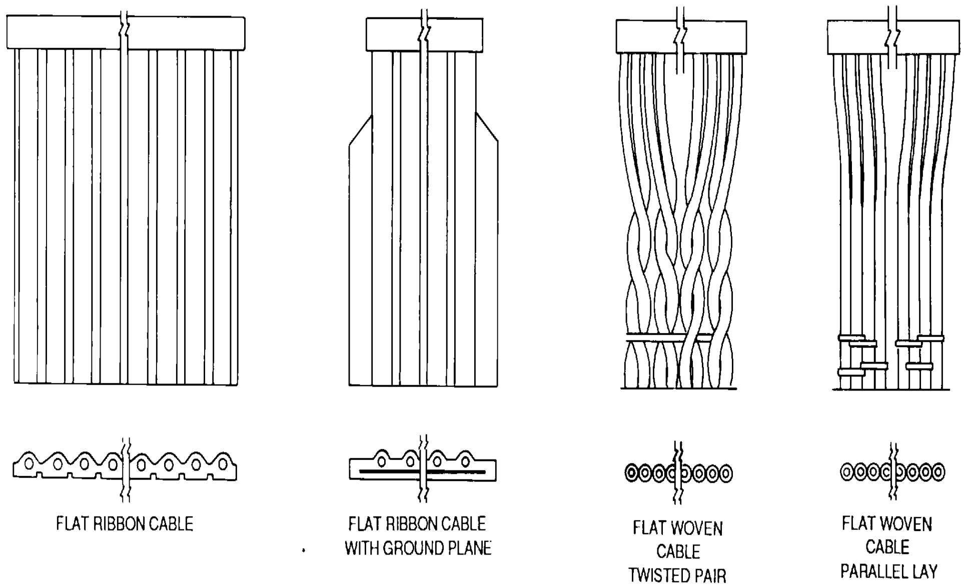
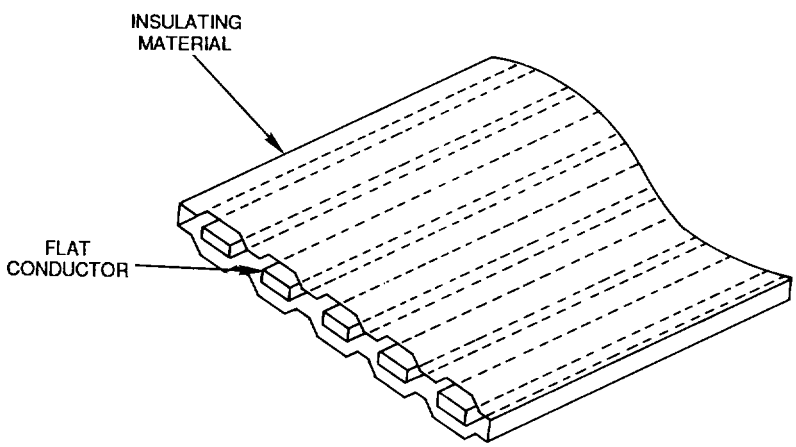
Term	Definition
Flat cable	Cable with two or more parallel, round, or flat conductors in the same plane encapsulated by an insulating material. Also called flexible flat cable. 
Flat conductor	Conductor with a width-to-thickness ratio of 5 to 1 or greater, having a rectangular shape rather than round, cross sections.
Flat conductor cable	Flexible flat cable with a plurality of flat conductors that have rectangular, rather than round, cross sections. 
Flat jacketed	Parallel conductor configuration which is usually restricted to vinyl insulated wires and vinyl jackets. The outer jacket does not fuse with the primary insulation, a condition which would make impossible the stripping of the jacket without damage to the individual wire coverings. While opaque jackets are generally specified, transparent materials are available which allow the color-coded wires to be seen throughout the cable length.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Flatpack	Subassembly composed of two or more stages made up of integrated circuits and thin-film components mounted on a ceramic substrate. This semiconductor network is enclosed in a shallow rectangular or square package with the connecting leads projecting from the edges of the package. Normally designed for surface mounting.
Flat transmission cable	(See transmission cable.)
Flexibility	Ease with which a cable may be bent.
Flexibilizer	Additive that makes a resin or rubber more flexible. More often called plasticizer.
Flexible	That quality of a cable or cable component which allows for bending under the influence of outside force, as opposed to limpness which is bending due to the cable’s own weight.
Flexible Flat Cable (FFC)	(See flat cable.)
Flexible printed wiring	Random arrangement of printed wiring utilizing flexible base material with/without flexible cover layers.
Flex life	(1) Time of heat aging that an insulating material can withstand before failure when bent around a specific radius (used to evaluate thermal endurance). (2) The ability of a conductor, wire, or cable to withstand repeated bending.
Flexural strength	Material’s ability to flex without sustaining permanent distortion or fracture.
Floating	Referring to a circuit which has no connection to a ground.
Floating bushing	Design feature which aids in the alignment of plug and receptacle shells during engagement. The floating bushing generally is an eyelet-type bushing which is fitted into the plug mounting holes so that there is freedom of motion in all directions between the plug and receptacle.
Flow	Movement of molten solder in and around a joint.
Flow brazing	Pouring molten filler metal over a joint.
Flow point	Point at which an alloy is completely liquid.
Flow soldering	(See wave soldering.)
Fluidity	Relative ease with which a liquid material will flow.
Fluorinated Ethylene Propylene (FEP)	Melt-extrudable fluorocarbon copolymer made from perfluorethylene and perfluoropropylene. It has outstanding chemical inertness and heat resistance. Most often used as an insulation in thin wall constructions. Disadvantages include cost, cold flow, and stiffness. Rated 392°F (200°C).
Fluorocarbon	Compound of fluorine and carbon. Large numbers of such compounds are known in many of their properties they resemble the hydrocarbons, differing in their greater stability. The chemical inertness of the fluorocarbons makes them useful as solvents.
Fluorocarbon resins	Resins which include fluorine in their molecular structure; the greater the fluorine content, the better are the polymers electrical, mechanical, thermal, and chemical properties. Polyvinylidene fluoride, polytetrafluoroethylene,fluorinated ethylene propylene, and Perfluoralkoxy are wire insulations from the fluorocarbon family.
Fluoroplastics	Polymers with monomers containing one or more atoms of fluorine or copolymers of such monomers. The family includes fluorocarbons, which are composed of carbon and fluorine. Typical examples of fluoroplastics are polytetrafluoroethylene,fluorinated ethylene propylene, polyvinylidene fluoride, polychlorotrifluoroethylene, ethylene chlorotrifluoroethylene, etc.
Fluorosilicones	Liquid used as a dielectric. (See liquid dielectrics.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Flush conductor	Conductor whose outer surface is in the same plane as the surface of the insulating material adjacent to the conductor.
Flux	(1) Lines of force which make up an electrostatic field. (2) Rate of flow of energy across or through a surface. (3) Substance used to promote or facilitate fusion, such as a material that removes oxides from surfaces to be joined by soldering or welding.
Flux budget	Optical power attenuation permitted between any two transceivers. Attenuation allowance plus Loss budget plus Optical Power budget equals the Flux budget.
Flux consistency	Degree to which the flux is liquid.
Flux residue	Residue left on the joint after soldering is completed.
FO	(See Fiber Optics.)
Foamed plastics	Resins in flexible or rigid sponge form with the cells closed or interconnected. Foamed insulations provide low dielectric constants and weight savings.
Foaming agents	Chemicals added to plastics and rubbers that cause them to assume a cellular structure.
Foil	Thin, continuous sheet of metal, usually copper or aluminum. Foil is used for electrical coils as a replacement for copper magnet wire, static shielding, contacts, and many other electrical applications. Aluminum foil is available in a wide variety of thicknesses as thin as 0.00015 in. It is used to a large extent in many types of capacitors. Copper foil is best known for its use in printed-circuits. Copper is used because of its low resistance, high heat conductivity, high softening and melting temperatures, strength, ductility, workability, and ability to be coated or plated readily with other metals, or to be soldered or brazed. Steel foil in thicknesses as low as 0.001 in. and up to 42 in. wide is suggested for the resistive element in radiant heating panels, electromagnetic shielding in color TV, and other applications. Steel foil is adaptable to soldering, welding, adhesives, mechanical fastening, and laminating to a variety of materials.
Follower	Sleeve used to compress the grommet, thus tightening the seal around the conductors entering the connector.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Formulas, electrical</td><td>Mathematical formulas are used for determining values in electrical circuits. Normally, two or more circuit parameters (values) must be known. The following generalized listing can be used for the most common circuit parameters. To define letter designations not identified here, refer to the designation definition or the general heading it falls under. The subscript t denotes total or true (as in power) and the subscript a denotes applied (as in voltage) or apparent (as in power). The subscript n denotes up to and including the last item in a set. The designation N denotes the number of items in a set. When dealing with transformers, N denotes the number of turns in a coil, subscript p denotes the primary winding, and subscript s denotes the secondary winding. When performing trigonometric functions, θ is an angle of a right triangle which is not 90°, the Opposite (O) side is the length of the side opposite angle 0, the Adjacent (A) side is the length of the side adjacent to angle 0, and the Hypotenuse (H) is the length of the side opposite the 90° angle (right angle). The trigonometric function conversion table can be used to determine the trigonometric functions Sine (Sin), Tangent (Tan), Cotangent (Cot), and Cosine (Cos) when the angular measurement is known. When the value of a specific trignometric function is known, the table may also be used to determine the angular measurement. The value of a trigonometric function can be determined by locating the angular measurement and crossing it to the specific function heading and value. To determine the angular measurement when the value of a specific function is known, locate the value under its respective function and cross it to the angular measurement. The angular measurements from 0° to 45° are located on the left side of the chart and correspond to the headings at the top of the chart. The angular measurements from 45.1° to 90° are located on the right side of the chart and correspond to the headings at the bottom of the chart. (See Ohm's law, Kirchoff's law.)

Voltage (E)
$E = IR$
$E = P/I$
$E = \sqrt{PR}$

Resistance (R)
$R = E/I$
$R = E^2/P$
$R = P/I^2$

Current (I)
$I = E/R$
$I = P/E$
$I = \sqrt{P/R}$

Series Circuits
$E_t = E_1 + E_2 + E_3 + E_n$
$I_t = I_1 = I_2 = I_3 = I_n$
$R_t = R_1 + R_2 + R_3 + R_n$
$P_t = P_1 + P_2 + P_3 + P_n$
$L_t = L_1 + L_2 + L_3 + L_n$
$C_t = \frac{C_1 \text{ x } C_2}{C_1 + C_2}$ (2 capacitors)
$C_t = \frac{1}{\frac{1}{C_1} \quad \frac{1}{C_2} \quad \frac{1}{C_3} \quad \frac{1}{C_n}}$ (2 or more capacitors)
$C_t = \frac{C}{N}$ (2 or more capacitors of equal value)</td></tr>
</table>

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Formulas, electrical (Cont.)	
	<u>VSWR</u>
	VSWR = $\frac{E_{max}}{E_{min}} = \frac{E_i + E_r}{E_i - E_r}$
	<u>Impedence (Z)</u>
	$Z_t = \sqrt{X_t^2 + R_t^2}$
	$Z_t = \frac{E_a}{I_t}$
	<u>Reactance (X)</u>
	$X_L = 2\pi fL$
	$X_C = \frac{1}{2\pi fC} = \frac{0.159}{fC}$
	$X_t = X_L - X_C$ (resultant is inductive)
	or
	$X_t = X_C - X_L$ (resultant is capacitive)
	(The smaller is always subtracted from the larger)
	<u>Frequency (f)</u>
	$f = \frac{1}{PRT}$
	$f_{co} = \frac{1}{2\pi RC} = \frac{0.159}{RC}$
	$f_{co} = \frac{R}{2\pi L}$
	$f_o = \frac{1}{2\pi\sqrt{LC}} = \frac{0.159}{\sqrt{LC}}$
	<u>Inductor quality (Q)</u>
	$Q = \frac{X_L}{R}$
	<u>Bandwidth (BW)</u>
	$BW = \frac{f_o}{Q}$
	$BW = f_2 - f_1$
	<u>Alternating Current</u>
	$E_{RMS} = E_{peak} \times 0.707$
	$E_{peak} = E_{RMS} \times 1.414$
	$WVDC = E_{RMS} \times 1.5$

TABLE 2. TERMS AND DEFINITIONS (Cont.)

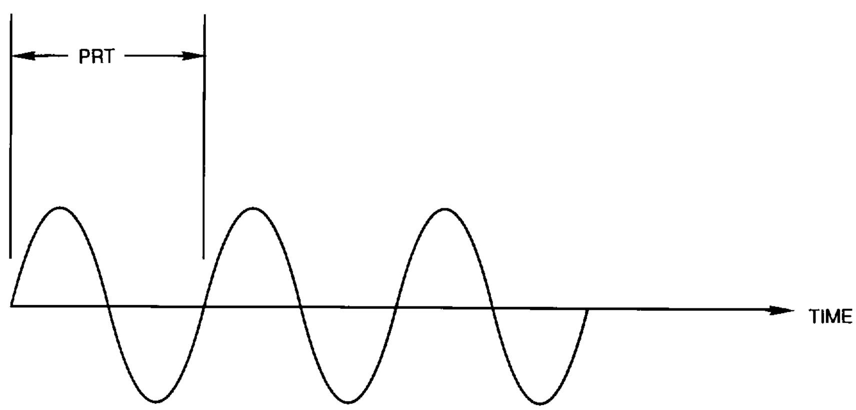
Term	Definition
	Trigonometric Functions Sine $\angle\Theta = \frac{O}{H}$ Cosine $\angle\Theta = \frac{A}{H}$ Tangent $\angle\Theta = \frac{O}{A}$
Form wound	Coil or winding prewound on a form of a predetermined shape.
Forsterite	Forsterite ceramics have the desired vacuum tightness, thermal expansion characteristics, and high operating temperature ability for ceramic-to-metal sealing in vacuum tubes. They also can be used in the high frequency range.
Fracture	Irregular surface produced when a metal is ruptured or broken.
Fractured joints	Fractured or disturbed joints are usually caused by movement, relative to each other, of one or both of the surfaces being joined before the solder has completely solidified. This defect may be characterized by strain marks on the surface, by small cracks in the solder, or by a rough, gritty appearance. A lack of electrical continuity may result from this defect, as well as decreased structural strength or loss of a hermetic seal in non-electrical applications.
Frame	In the case of a multiple contact connector having a removable body or insert, the frame is the surrounding portion (usually metal) which supports the insert and permits a method for mounting the connector to a panel or a mating connector half.
Free connector	Connector for attachment to the free end of a wire or cable.
Freezing point	Temperature at which a previously molten material solidifies, or becomes completely solid.
Frequency (f)	Number of times an alternating current repeats its cycle in one second. Expressed in Hertz (Hz). The designation f_{co} is the cut-off frequency, and designation f_o is the frequency of oscillation or resonant frequency. (See formulas-electrical.) Frequency (f) = Number of cycles per second expressed as Hertz (Hz) f = 1/PRT Pulse Repetition Time (PRT) = Time to complete one cycle in seconds (1/f) 
Frequency division multiplex (FDM)	Method by which the available transmission frequency range is divided into narrower bands, each used for a separate channel.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

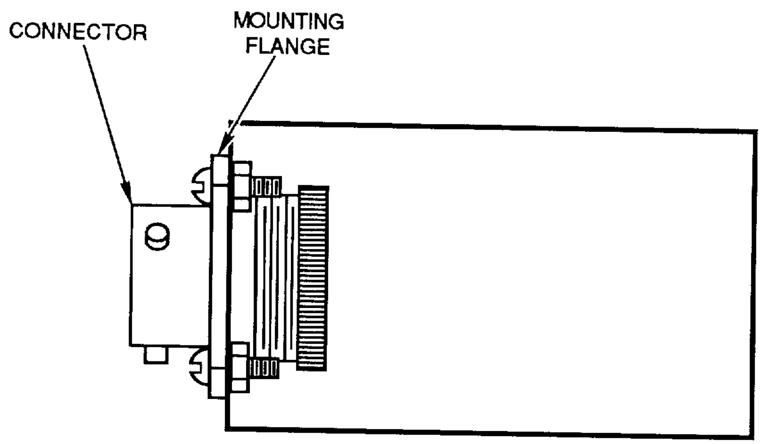
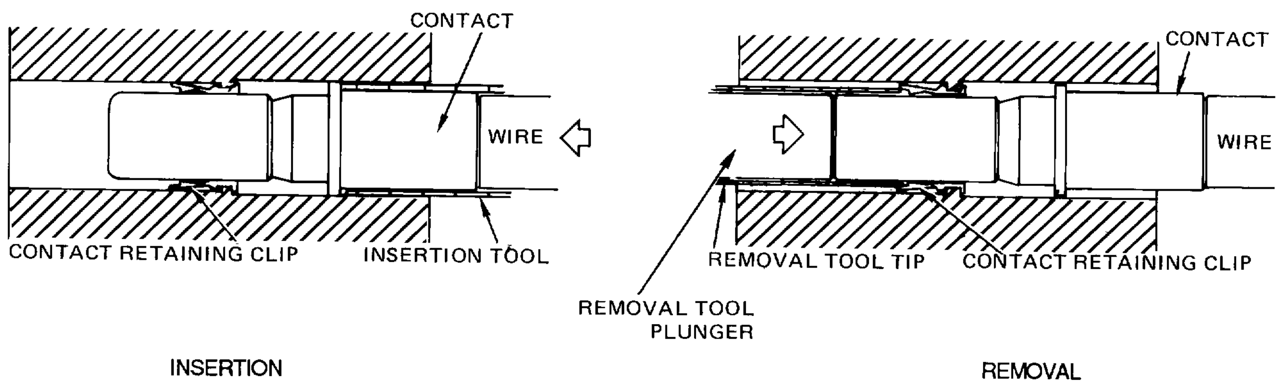
Term	Definition
Frequency division multiplexing	Splitting of a communication line into separate frequency bands each capable of carrying information signals.
Frequency modulation	Process of using a medium to carry information.
Frequency plan	Specification of how the various frequencies of a broadband cable system are allocated for use.
Frequency response	Change of gain with frequency.
Fresnel reflection	Reflection of a portion of the light incident on a plantar interface between two homogeneous media having a different refractive indices.
Fresnel reflection loss (fiber optic)	Loss that is incurred at the optical conductor interface due to refractive index differences.
Fretting	Condition where slight movement between mated surfaces occurs which continually exposes fresh metal. As the metal oxidizes it builds-up until electrical continuity is broken.
Frit	Finely ground glass used to join glass to metal or other glasses. Also called solder glass, it may or may not lose its transparency during temperature cycles.
FRMR	Flame Retarding Moisture Resisting finish.
Front mounted	Connector mounted on the outside of a panel or box with its mounting flange outside the equipment. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Front release contact	Connector contact released from the front side of the connector and then removed from the back wire side of the connector. The removal tool engages the front portion of the contact and pushes it out the back where it is removed by hand.



Term	Definition
FR-1	Flammability rating established by Underwriter's Laboratories for wires and cables that pass a specially designed vertical flame test FR-1. Replaced by VW-1. (See VW-1.)
Full cycling control	Controls placed on the crimping cycle of crimping tools forcing the tool to be closed to its fullest extent completing the crimping cycle before the tool can be opened.
Full duplex	Connection on the network that allows transmission in both directions at the same time.
Funnel entry	Flared or widened entrance to a terminal or connector wire barrel. Permits easier insertion of the conductor, and helps assure that all wire strands will be directed into the wire barrel. (See belled mouth.)
Furnace soldering	Joining together by heating in a furnace.
Fused coating	Metallic coating (usually tin or solder alloy) which has been melted and solidified forming a metallurgical bond to the base material.
Fused conductors	Individual strands of heavy tinned copper wire stranded together and then bonded together by induction heating.
Fused spiral tape	Refers to a type of PTFE insulated hookup wire. The spiral wrapped conductor is passed through an oven where the overlaps are fused together.
Fuse wire	Wire made from an alloy that melts at a relatively low temperature.
Fusing	Fusing, or wire fusing, describes the termination of magnet wire to a terminal without prior removal of its film insulation. The insulation is then removed during the fusing process.
G	(1) Designation for rubber insulated, neoprene jacketed, power cable with two to five 8 AWG or larger conductors with ground wires, 203°F (95°C). (2) (See conductance.) (3) (See Gauss.) (4) (See Giga.)
Gage	Term used to denote the physical size of a wire. Also called gauge. (See American Wire Gauge.)
Gain	Increased signal power, usually the result of amplification.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

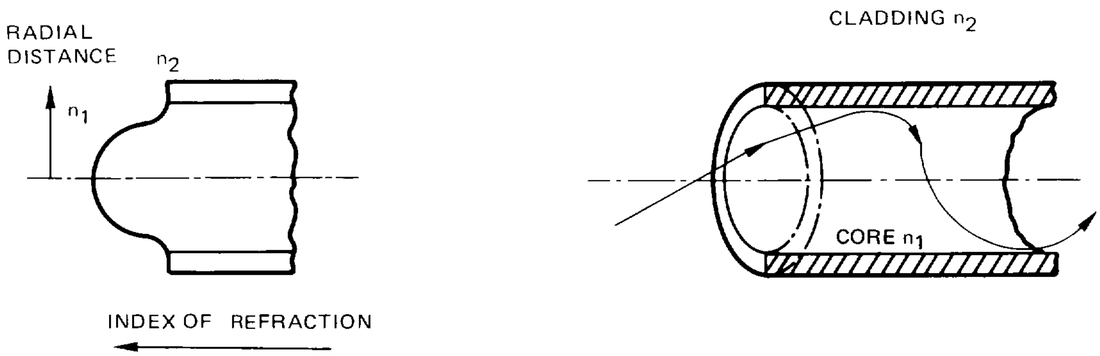
Term	Definition
Galvanic corrosion	Corrosion associated with the current of a galvanic cell consisting of two dissimilar conductors in an electrolyte or two similar conductors in dissimilar electrolytes. Where the two dissimilar metals are in contact, the resulting reaction is referred to as couple action.
Galvanic series	Series of metals and alloys arranged according to their relative electrode potentials in a specified environment. (See electromotive series.)
Galvanizing	To coat a metal part with zinc by dipping or electroplating.
Galvanometer	Instrument for detecting or measuring a small electric current by movements of a magnetic needle or of a coil in a magnetic field.
Gang disconnect	Connector that permits the rapid and simultaneous disconnection of two or more electrical circuits.
Ganged Contact Release (GCR)	System whereby all contacts in an assembly are locked/unlocked simultaneously.
Gang strip	Simultaneously stripping all conductors in a flat or ribbon cable.
Gap loss (fiber optic)	Power loss, expressed in decibels, due to the deviation from optimum spacing between the ends of separable optical conductors. (See coupling loss.)
Gaseous dielectrics	Gaseous dielectrics are used for insulating and cooling purposes in a variety of applications. Chemical and thermal stability, inertness, compatibility with other materials, price, nonflammability, toxicity, high heat transfer rates, low boiling and melting points, and resistance to decomposition under arcing conditions (with no toxic by-products) are the factors which must be considered when evaluating specific gases.
Gas filled cable	Self-contained pressure cable in which the pressure medium is an inert gas having access to the insulation.
Gas filled pipe cable	Pipe cable in which the pressure medium is an inert gas having access to the insulation.
Gas pressure compensated	Saturated paper insulated cable containing tubes for the transmission of gas pressure along a cable, and with external gas feed to the tubes.
Gas tight	Contact system that utilizes soft metals at low contact pressure or hard metals at high contact pressure so that upon mating, metal is upset and the resultant joint prevents contaminant gases from entering the contact area.
Gauge	Term used to denote the physical size of a wire. Also called gage. (See American Wire Gauge.)
Gauss (G)	The centimeter-gram-second unit of magnetic induction equal to the magnetic flux density that will induce an electromotive force of one one-hundred millionth of a volt in each linear centimeter of a wire moving laterally with a speed of one centimeter per second at right angles to a magnetic flux.
Gb	(See Gilbert.)
GCR	(See Ganged Contact Release.)
Gel	Semi-solid system consisting of a solid held in liquid.
Gel time	Time required for a curing thermoset plastic composition to undergo the change in state from a fluid to a solid or semi-solid under the conditions of use (film, thin casting, laminate, thick casting, etc.).
General purpose	Expression used to describe a low-cost, heavy-duty connector.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
GG	Ground to Ground.
Giga (G)	Numerical prefix denoting one billion (10^9).
Gigahertz (GHZ)	Unit of frequency equal to one billion hertz.
Gilbert (Gb)	The centimeter-gram-second electromagnetic unit of magnetomotive force, equal to 10/4 ampere-turns.
Gimmick	Short length of wire which is soldered onto a circuit component and used as a small adjustable capacitor. A gimmick is often two short insulated wires that are twisted together to form a capacitor.
Glass	Amorphous transparent or translucent brittle material usually made by fusion of silica, soda ash, lime, salt cake, or similar materials. Glass fibers are used in yarn servings and braids and as strength members. High tensile strength, nonflammability, flexibility, and resistance to moisture and high temperatures are characteristics of glass fibers. Glass is also used in fibers and fiber cables.
Glass bonded mica	By using a low-melting electrical grade of glass as a binder for mica, inorganic plastic insulating materials can be made that offer the combined properties of high dielectric strength, low loss at high frequencies, high heat resistance, arc resistance, mechanical strength, and no moisture absorption.
Glassivation	Deposited layer of glass on top of a metallized wafer or chip. Primarily a protective layer.
Glazed substrate	Glass coating on a ceramic substrate to effect a smooth and nonporous surface.
Gold	This metal is a very soft, yellow, and ductile material, which is noted for its resistance to corrosion. Next to silver, gold has the highest electrical conductivity and is specified for critical communication and electronic products. Electroless gold can be used to deposit coatings on small parts, such as eyelets, screws, and terminals. It is also used to improve contact resistance of selected areas that are not electrically joined, thus avoiding electroplating and the use of electrical contacts.
Gold dot	Interconnection system for flat cable. Gold buttons are plated directly onto the flat flexible circuitry; when compressed with proper force, the gold button flows producing a gas-tight joint.
GOR	Designation for Gasoline and Oil-Resistant wire.
Government Rubber Synthetic (GRS)	Government standard for Buna-S Rubber for jacketing and insulating compounds for military wires and cables.
GPU	Ground Power Unit.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Graded index fiber (fiber optic)	Fiber whose refractive index decreases with increasing radial distance from the center of the core.



Term	Definition
Graded insulation	Combination insulations with the portions thereof arranged in such a manner as to improve the distribution of the electric field to which the insulation combination is subjected.
Grain	Individual crystal in a polycrystalline metal or alloy.
Grid	Orthogonal network of two sets of parallel equidistant lines used for locating points on a printed board. Connections should be located on the crosspoints of the gridlines. The position of conductors may be independent of the grid, i.e., not necessarily following the gridlines.
Grid spaced	When contacts in a multiple-contact connector or on the edge of a printed circuit board are spaced equally in a rectangular pattern.
Grommet	Rubber seals that are placed in the cable side of a connector with hole patterns that correspond to the insert configuration. The wires entering the rear of the connector go through the grommet and are affixed to the contacts. Inside the rubber grommet are one or more seals which hold themselves against the wire and prevent moisture and dirt from entering the contact cavity.
Groove	(1) Slot or cavity in a connector which bears directly on the cable. (2) The depression in a crimping die which holds the connector during crimping.
Grope free	(1) Connector coupling system which can be easily mated and locked, usually with one hand. (2) A coupling ring held in the proper position to start the mating cycle while uncoupled. (See scoop-proof.)
Ground conductor	Conductor in a transmission cable or line that is grounded.
Grounded neutral	Neutral wire is metallically connected to ground.
Ground (GRD)	(1) Connection to the earth or other large conducting body to serve as an earth thus making a complete electrical circuit. (2) A point of common potential in an electric circuit used for common connections and reference voltage.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

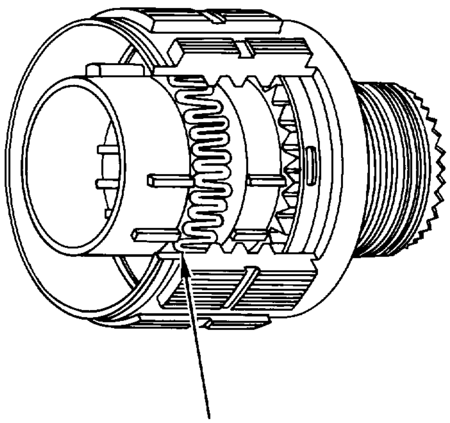
Term	Definition
Grounding fingers	Set of spring fingers provided in the connector to allow shell to shell grounding, before contacts mate and after they separate. 
Ground insulation	Major insulation used between a winding and the magnetic core or other structural parts usually at ground potential.
Ground loop	Generation of undesirable current flow within a ground conductor, from the circulation currents which originate from a second source of voltage (frequently as a result of connecting two separate grounds to a single circuit).
Ground plane	Conductor layer, or portion of a conductor layer, used as a common reference point for circuit returns, shielding, or heat sinking.
Ground power cable	Cable assembly fitted with appropriate terminations to supply power to an aircraft from ground power unit.
Ground support cable	Cable construction, usually rugged and heavy duty for use as interconnection for ground support control or power systems for missiles.
Ground wire	Conductor leading from radio equipment to an electrical connection with the ground.
Group	Number of wires and/or cables secured together and routed to a single item or set-up of equipment.
GR-S	(See styrene-butadiene rubber.)
GRD	(See Ground)
GRS	(See Government Rubber Synthetic.)
Guide pin	Pin or rod extending beyond the mating faces of a connector designed to guide the closing or mating of the connector to ensure proper engagement of contacts.
h	(See Henry.)
H	Designation for shielded power cable. Multi-conductor cables have paper varnished cambric insulation applied directly over individual conductors, spiralled metallic shielding tape over insulation, with overall protective covering.
Halar	Allied Chemical trade name for their brand of ethylene chlorotrifluoroethylene.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

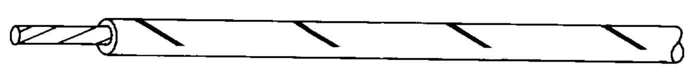
Term	Definition
Half duplex	Connection on the network that allows transmission in two directions, one direction at a time.
Half duplex	Connection on the network that allows transmission in two directions, one direction at a time.
Halogenated hydrocarbon	Organic compound in which some, or all, of the hydrogen atoms linked to the carbon atoms are replaced by atoms of the halogen family. One of the largest uses for these compounds is as solvents.
Halogens	Group of elements similar in their properties and chemical activities. These elements, in order of decreasing activity, are fluorine, chlorine, bromine, and iodine.
Haloing	Mechanically-induced fracturing/delamination on or below the surface of the base material. Usually exhibited by a light area around holes, other machined areas, or both.
Handshaking	An exchange of predetermined signals for purposes of control when a connection is established between two data sets.
Hardboard	(See paper.)
Hard drawn copper wire	Copper wire that has not been annealed after drawing.
Hardener	Chemical added to a thermosetting resin for the purpose of causing curing or hardening, and which becomes a part of the chemical reaction and chemical composition after curing.
Hardness	(1) Resistance of metal to plastic deformation, usually by indentation. However, the term may also refer to stiffness or temper, or to resistance to scratching, abrasion, or cutting. Indentation hardness may be measured by various hardness tests, such as Brinell, Rockwell, and Vickers. (2) For grinding wheels, the same as grade.
Hardware	Hardware usually refers to shells, guide pins, polarizing pins, strain relief clamps, mounting screws, etc.
Harness	Assembly of wires and/or cables arranged so it may be installed or removed as a unit.
Hash mark stripe	Non-continuous stripe applied to an insulated conductor for circuit identification.
	
HC	Designation for two or more conductor Heater Cord, asbestos and rubber insulation with cotton braid over each conductor. Twisted, no overall covering.
HDPE	(See High Density Polyethylene.)
Head assembly	(See positioner.)
Header	Feedthrough device which introduces a conductive path through an insulating plate.
Head set cord	Very flexible cord used for communication equipment usually 24 to 22 AWG multi-conductor. Usually made with Buna insulation, rubber, or neoprene jacket; sometimes the outer jacket is a cotton braid. The conductor may be bare copper or cadmium bronze.
Heat-affected zone	That portion of the base metal which was not melted during brazing, cutting, or welding, but whose microstructure and physical properties were altered by the heat.
Heat aging	Exposing a cable or material to specific time and temperature conditions to determine degree of thermal stability.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

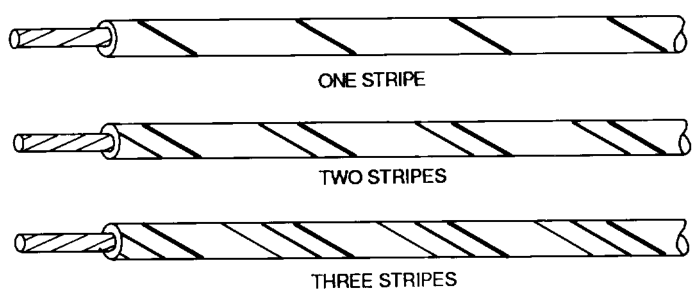
Term	Definition
Heat distortion	Deformation of a material caused by the application of heat. Heat distortion temperature is the maximum temperature that a material will withstand without deformation.
Heat endurance	Time of heat aging that a material can withstand before failing a specific physical test.
Heat resistant	Copper or brass terminal, nickel plated to withstand 650°F (343.3°C).
Heat seal	Method for sealing a tape-wrap jacket by heat fusion.
Heat shock	Test to determine stability of a material by sudden exposure to high temperatures for a short period of time.
Heat shrinkable	Term describing tubes, sleeves, caps, boots, films, or other forms of plastic which shrink to encapsulate, protect, or insulate connections, splices, terminations, and other configurations with the application of heat. Heat shrinkable sleeves are typically defined in MIL-S-23053.
Heat sink	Device used to absorb or transfer heat away from heat sensitive parts.
Helical	Spiral
Helical stripe	Continuous, colored, spiral stripe applied to an insulated conductor for circuit identification. 
Helix	Spiral winding.
Henry (h)	Unit of inductance when the induced electromotive force of one volt is produced when the induced current changes at a rate of one ampere per second. (See inductance.)
Hermaphroditic connector	Connector design which utilizes pin and socket contacts in a balanced arrangement such that both mating connectors are identical. The contacts may also be hermaphroditic.
Hermaphroditic contact	Contact design which is neither pin nor socket and mates with another contact of the same design. The contacts may be arranged as male and female contacts as for pins and sockets. Hermaphroditic contacts may also be used in a manner that one half of each contact mating surface protrudes beyond the connector interface and both mating connectors are identical.
Hermetic	Permanently sealed by fusion, soldering, or other means to prevent the transmission of air, moisture vapor, and all other gases.
Hermetic connector	Hermetically sealed connectors are usually multiple contact connectors where the contacts are bonded to the connector by glass or other materials and permit a maximum leakage rate of gas through the connector of 1.0 micron ft/hr at one atmosphere pressure (14.7 psig). For special applications, maximum leakage rates below 1.0 can be specified.
Hertz (Hz)	Unit of frequency equal to one cycle per second. (See frequency.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

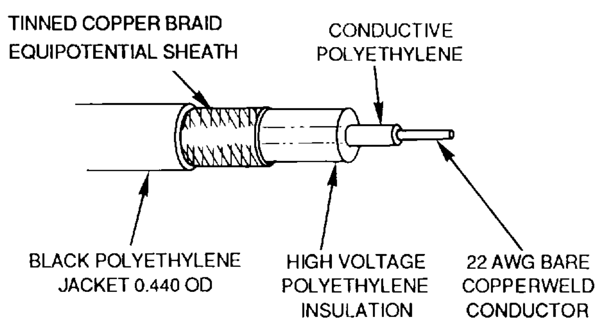
Term	Definition
Heterogeneous insulation	Cable insulating system composed of two or more layers of different insulating materials. (See homogeneous insulation.)
Hexafluoroethane	A gas used as a dielectric. (See gaseous dielectrics.)
Hi-pot	Test designed to determine the highest potential that can be applied to a conductor without breaking through the insulation.
High density harness	A harness designed to save weight and space which requires an outer covering for mechanical protection. High density harnesses have proven to have maintenance accessibility problems and a high rate of failure due to shorting caused by abrasion.
High Density Polyethylene (HDPE)	Those polyethylenes whose density ranges from 0.94 to 0.96 and above. They are linked to longer chains, forming a more rigid resin material.
High frequencies	Frequencies from 160 MHZ to 400 MHZ allocated for the forward direction in a mid-split system.
High-pressure laminates	Laminates molded and cured at pressures not lower than 1000 psi.
High-split	Broadband cable system in which the bandwidth utilized to send toward the head-end (reverse direction) is approximately 6 MHZ to 180 MHZ, and the bandwidth utilized to send away from the head end (forward direction) is approximately 220 MHZ to 400 MHZ. The guard band between the forward and reverse directions (180 MHZ to 220 MHZ) provides isolation interference.
High strength alloy conductor	Conductor which shows a maximum 20% increase in resistance and a minimum of a 70% increase in breaking strength over the equivalent construction in pure copper while exhibiting a minimum elongation of 5% in 10 inches. As required, the alloy should be capable of sustaining continuous exposure to temperatures as high as 572°F (300°C) without suffering an appreciable permanent change in properties.
High tension	(See high voltage cable.)
High voltage cable	Generally considered to be a wire or cable with an operating voltage of over 600 V. Also called high tension.  TYPICAL HIGH VOLTAGE CABLE CONSTRUCTION
High voltage time test	Accelerated life test on a cable sample in which the voltage is the factor increased.
HMWPE	High Molecular Weight Polyethylene.
Holding strength	Ability of a connector to remain assembled to a cable when under tension.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

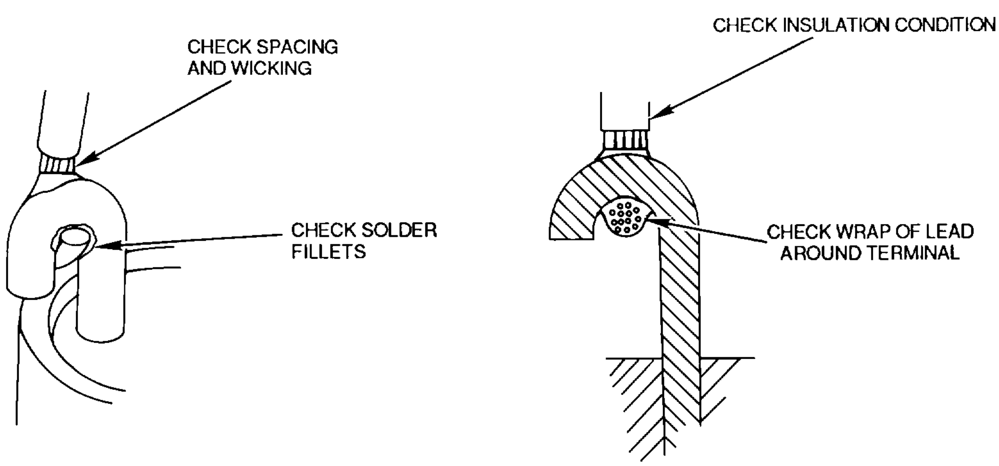
Term	Definition
Hollow copper conductors	An electrical conductor that integrally provides a means of heat exchange. A cooling fluid is passed through the interior of the conductor and carries away the heat generated by the flow of the electrical current.
Hollow-core annular conductor	(1) Conductor composed of a plurality of conducting elements disposed around a supporting member which does not fill the space enclosed by the elements. (2) Plurality of such conducting elements disposed around a center channel and interlocked one with the so shaped that they are self-supporting. Also called hollow-core conductor.
Homogeneous insulation	Complete cable insulation structure whose components cannot be identified as layers of different materials. (See heterogeneous insulation.)
Hook terminal	Terminal with a hook-shaped tongue. 
Hook-up wire	Insulated wire used for low current, low voltage (under 1000 V) applications within enclosed electronic equipment.
Hot	Wire, terminal, or any ungrounded conductor connected to a voltage source and energized.
Hotcracking	Cracking of a metal or alloy upon freezing. In relation to solder, this can occur as a result of stress developed in the solder joint by uneven cooling. For example, if a very massive part is soldered to a very light part, the heat of a soldering will tend to flow more rapidly toward the massive part which acts as a heat sink. The stresses developed by this unequal cooling can crack or fracture the joint. This phenomenon may or may not be associated with hotshortness.
Hot dip	Term denoting the covering of a surface by means of dipping the surface into a molten bath of the coating material.
Hot melt	(See wax.)
Hot plate soldering	Joining wires together using a hot plate as a heat source.
Hotshortness	Brittleness which develops at elevated temperatures in certain metals and alloys.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Hot stamping	Method of alphanumerical coding. Identification markings are made by pressing heated type and marking foil into softened insulation surfaces. Hot stamping inherently reduces insulation thickness, this can easily damage thin wall insulations typically used in aircraft applications. (See surface printing.)
Hot tin dip	Process of passing bare wire through a bath of molten tin to provide a coating.
Housing, connector, electrical	Connector less insert, but with insert-retaining and positioning hardware required by standard construction.
HPD	Designation for rubber and asbestos-insulated heater cord. No braid on individual conductors; but braid overall. Also made with neoprene insulation.
HPN	Designation for two-conductor, neoprene-insulated heater cord. Parallel construction. For damp locations.
HS	Designation for rubber and asbestos insulated heater cord. Cotton serving and rubber jacketed overall for damp locations has 14 AWG or 12 AWG conductors. Also made with neoprene insulated inners and asbestos.
HSJ	Same as type HS but with 18 AWG or 16 AWG conductors and differing jacket thickness.
HSJO	Same as HSJ but with neoprene jacket.
HSO	Neoprene jacketed heater cord.
Humidity test	Test involving exposure of specimens at controlled levels of humidity and temperature.
HW	Designation for radio hook-up wire with polyvinyl insulation, with or without nylon jacket, braid, or shield, 2500V.
Hybrid cable	Multiconductor cable containing two or more types of components.
Hybrid integrated	The physical realization of electronic circuits or subsystems from a number of extremely small circuit elements electrically and mechanically interconnected on a substrate.
Hydrin	(See epichlorohydrin.)
Hydrocarbon	Organic compound having hydrogen atoms in its chemical structure. Most organic compounds are hydrocarbons. Aliphatic hydrocarbons are straight chained hydrocarbons, and aromatic are ringed structures based on the benzene ring. Methyl alcohol, trichloroethylene, etc. are aliphatic; benzene, xylene, toluene, etc. are aromatic.
Hydrogen	Gas used as a dielectric. (See gaseous dielectrics.)
Hydrogen brazing	Brazing in a hydrogen atmosphere, usually in a furnace.
Hygroscopic	This characteristic of a material describes its ability to absorb water, usually from the air. Examples of hygroscopic materials are quite common in ordinary life. Most salts are hygroscopic. This is manifested by their clumping or lumping together when exposed to humid conditions. The salts absorb water and form solutions which then causes the particles to be bound together. The resin used in soldering fluxes is an example of a non-hygroscopic material. That is, after soldering and hardening, the resin residues do not absorb water from the atmosphere.
Hypalon	Dupont trade name for chlorosulfonated polyethylene, an ozone resistant synthetic rubber.
Hypereutectic alloy	Any binary alloy which has a composition that lies to the right of the eutectic on an equilibrium diagram, and which contains some eutectic structure.
Hz	(See Hertz.)
I	(1) Designation for interlocked armor of aluminum, bronze, or steel. (2) (See current.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
IACS	International Annealed Copper Standard.
ICEA	(See Insulated Cable Engineers Association.)
Icicling	Formation of solder spikes resulting from poor drain-off of liquid solder following wave or dip-soldering of printed circuit boards and assemblies. Poor solderability of the surfaces to be soldered and contaminated solder are frequent causes of icicling.
ICR	(See Individual Contact Release.)
IDC	(See Insulation Displacement Connector.)
IEC	International Electrotechnical Commission.
IEEE	Institute of Electrical and Electronic Engineers.
IEEE 802/802.3	Standards for the interconnection of local area network computer equipment.
IEEE 802.5	Standard for using token passing as an access method.
IEE 802.6	Standard (under development) for a Metropolitan Area Network spanning many kilometers using a distributed queuing access control method and a dual bus architecture.
IIR	(See Isobutylene - Isoprene Rubber.)
Impact energy	The amount of energy required to fracture a material, usually measured (impact value) by means of an Izod of Charpy test. The type of specimen and the testing conditions affect the values and therefore should be specified.
Impact strength	A test for determining mechanical abuse a cable can withstand without breakdown by impacting with a given weight, dropped a given distance, in a controlled environment.
Impedance matching	Very generally, connecting cables and devices together which have the same impedance value in ohms.
Impedance (Z)	Total opposition that a circuit offers to the flow of alternating current or any other varying current at a particular frequency. It is a combination of resistance, R, and reactance X, measured in ohms, and designated by Z. (See formulas - electrical.)
Imperial Wire Gauge	(See British Standard Wire Gauge.)
Impregnation	Application of a resin to tightly built devices (for example, coil windings). The resin penetrates internal voids and a solid assembly results. Impregnation may be used together with embedment or encapsulation.
Impulse	Surge of unidirectional polarity.
Impulse ratio	Ratio of the flashover, sparkover, or breakdown voltage of an impulse to the crest value of the power frequency flashover, sparkover, or breakdown voltage.
Impulse strength	Voltage breakdown of insulation under voltage surges on the order of microseconds in duration.
Impulse test	Voltage test for finished wire in which the wire passes through an ionized air space created by a continuous voltage wave for a specific duration, rise time, frequency, and damping. Used to detect manufacturing flaws.
Impurities	Elements or compounds whose presence in a material is undesired.
IMSA	International Municipal Signal Association.
In-line	Term used to describe a termination that has no structural mounting provisions and joins conductors end to end. (See pendant.)
Inclusions	Non-metallic materials, such as slag and dirt, entrapped during solidification of a molten metal.
Incoherent source	Light source which emits wide, diffuse beams of light of many wave (fiber optic) lengths. Light waves emitted from an incoherent source are out of phase. (See coherent light.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

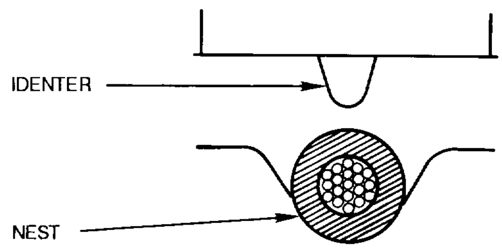
Term	Definition
Indenter	That part of a crimping die, usually the moving part, which indents or compresses the conductor barrel. 
Index edge	(See reference edge)
Index matching fluid (fiber optic)	Fluid with refractive index same as fiber core; used to fill air gap between fiber ends at connectors.
Index matching materials (fiber optic)	Materials used for intimate contact between the ends of optical conductors to reduce coupling losses by reducing Fresnel reflection loss. (See Fresnel reflection loss.)
Index of refraction (fiber optic)	Ratio of the speed of light in a vacuum to the speed of light in a material. (See refractive index.)
Index profile	In a graded-index optical fiber, the refractive index as a function of radius.
Indium	Indium is a semi-precious, non-ferrous metal. It is soft and ductile and exhibits high adhesion to other metals. In spite of its softness however, indium will harden copper, tin, or lead alloys to increase their strength. Approximately 1% in lead will double the hardness of lead. In solders it improves wetting and lowers the melting point.
Individual Contact Release (ICR)	System whereby each contact in an assembly can be individually locked or unlocked and removed without unlocking the other contacts.
Inductance (L)	Property of a circuit or circuit element that opposes a change in current flow. Inductance thus causes current changes to lag behind voltage changes. Inductance is measured in Henrys (H). (See formulas - electrical.)
Induction	Influence exerted by a charged body or by a magnetic field on neighboring bodies without apparent communication. Electrifying, magnetizing, or inducing voltage by exposure to a field.
Induction coil	Device for changing direct current into high-voltage alternating current. Its primary coil contains relatively few turns of heavy wire, and its secondary coil, wound over the primary, contains many turns of fine wire. Interruption of the direct current in the primary by a vibrating contact arrangement induces a high voltage in the secondary.
Induction heating	Heating process which utilizes a phenomenon associated with metallic or crystalline materials. A high frequency electrical current is generated in a solid material by placing that material within an externally applied high frequency magnetic field. The external current is matched within the material by the material absorbing electrical energy from the field. Individual atoms or molecules of the material will then vibrate in step with the frequency, and small local currents are generated in groups of atoms or molecules. The heat is generated by the electrical resistance of the material to the small local currents. The term high frequency refers to any alternating current above approximately 1KHz. This method of heating is extremely efficient and usually very fast. Since the heating is accomplished by local currents which are generated in the body of the material (see eddy currents), the higher the resistivity of the material, the faster it will heat up under the influence of an induction heating unit.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

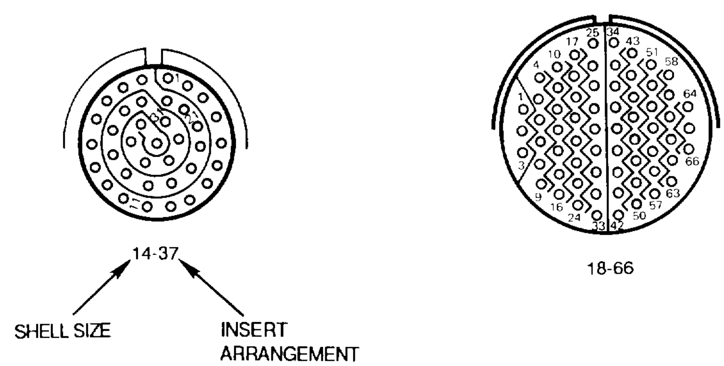
Term	Definition
Inductive coupling	Electrical interaction resulting from the action of the electromagnetic field of one conductor on the other. (See crosstalk.)
Inductive Soldering	Joining produced by the heat obtained from resistance of the work to the flow of induced electric current.
Inductor Quality	(Q-factor) Ratio of coil reactance to effective coil resistance which is the measure of electrical loss in a coil. (See formulas - electrical.)
Infrared radiation	Band of electromagnetic wavelengths extending from 770 nanometers (the extreme of the visible) to the shortest microwaves. The strong absorption of infrared by many substances renders it a useful means of applying heat energy.
Inhibitor	(1) Material which prevents or delays oxidation and galvanic action on a connector surface, or the interface of different conductors. (2) A chemical compound added to a mixture to restrain its chemical reaction until a desired condition exists.
Injection Laser Diode (ILD)	Semiconductor device consisting of at least one P-N junction capable of emitting coherent stimulated radiations under specified conditions.
Inorganic	Chemistry of those compounds found in nature or synthesized by man which do not depend essentially upon the chemistry of carbon for their properties (see organic). Examples of inorganic compounds are minerals, metals, and gases such as those found in the air.
Inorganic chemicals	Chemicals whose chemical structure is based on atoms other than the carbon atom.
Input/Output (I/O)	Connections for power and signals into and out of a system. Connections may be between subassemblies within the same enclosure or between individual units.
Insert	That part which holds the contacts in their proper arrangement and electrically insulates them from each other and from the shell.
Insert arrangement	Number, spacing, and arrangement of contacts in a connector. Also called insert configuration.
	 TYPICAL INSERT ARRANGEMENTS
Insert, closed entry	One having openings that restrict the entry of devices larger than the specified contact.
Insertion loss	Loss in load power resulting from the insertion of a cable, component, or device. It is expressed in decibels as the ratio of power received at the load before insertion, to the power received at the load after insertion.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

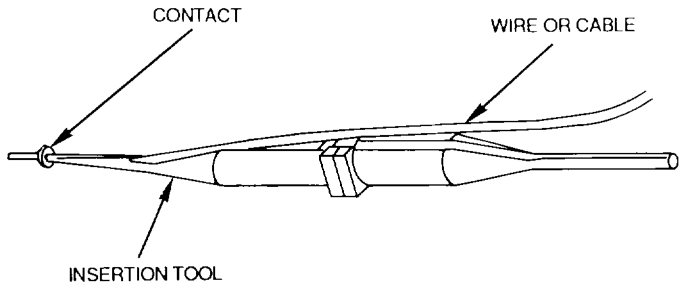
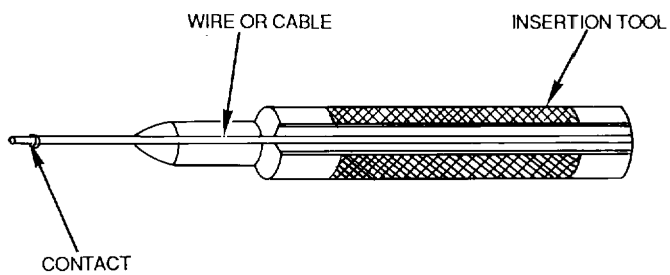
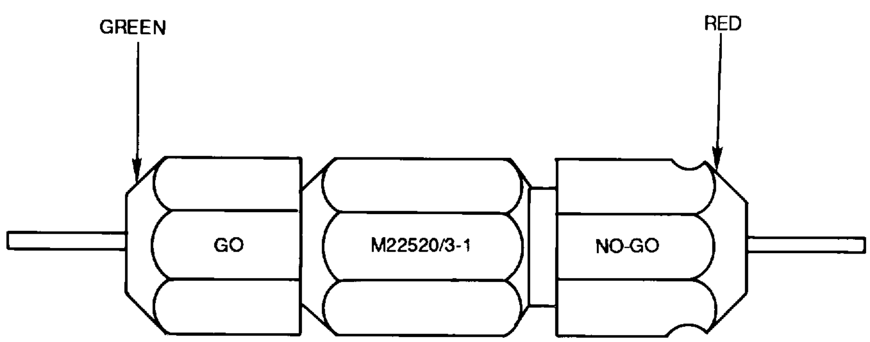
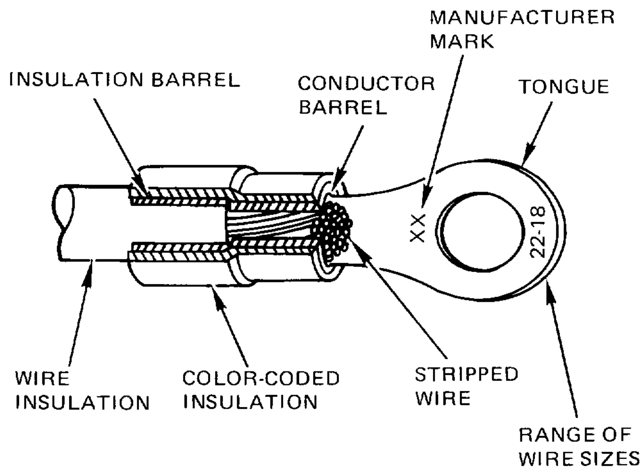
Term	Definition
Insertion tool	Hand tool used to insert contacts into the connector insert or retainer.  TYPICAL PLASTIC INSERTION TOOL  TYPICAL METAL INSERTION TOOL
Insert retention	Axial load in either direction which an insert must withstand without being dislocated from its normal position in the connector shell.
Inspection gage	A device which conforms to the gaging limits specified on the applicable tool specification sheet, used to ensure correct die closure. 
Inspection hole	Hole placed at the bottom end of a contact conductor barrel to permit visual inspection in seeing that the conductor has been inserted to the proper depth in the barrel prior to crimping.
Insufficient solder	Defect readily identified by the lack of enough solder to properly wet and bond the surfaces being joined. The resulting joints are very weak and highly susceptible to vibration failures.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Insulated Cable Engineers Association (ICEA)	Association of power cable engineers from many different companies. Their object is to establish standards in the insulated power cable industry.
Insulated terminal	Terminal having its barrel and insulation support or grip, if used, covered with a dielectric material.

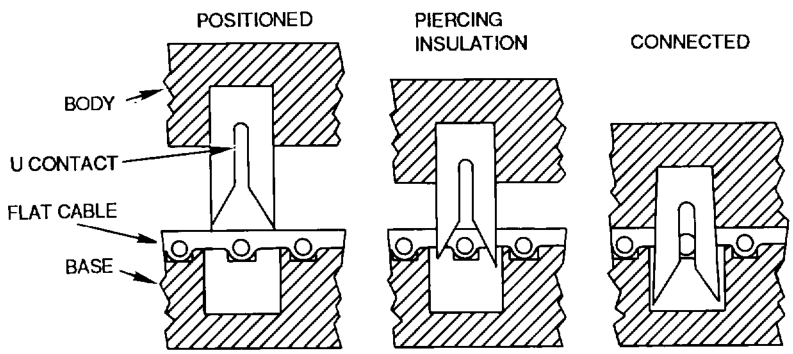


TYPICAL INSULATED TERMINAL

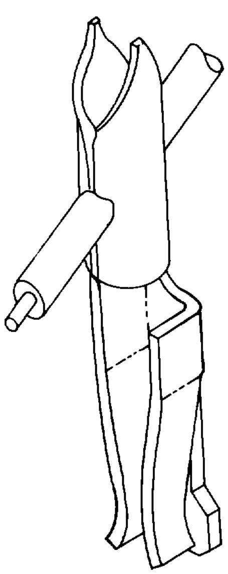
Term	Definition
Insulated wire	Conductor of electricity covered with a nonconducting material (insulation).
Insulating joint	Device which mechanically couples and electrically insulates the sheath and armor of continuous lengths of cable.
Insulation	Material which offers high electric resistance making it suitable for covering components, terminals, and wires to prevent the possible future contact of the adjacent conductors resulting in a short circuit.
Insulation adhesion	Degree of looseness or tightness of the insulation over the base conductor measured in terms of force required to remove a specified length of insulation from the wire.
Insulation barrel	Section of the terminal, splice or contact that accommodates the conductor insulation. (See barrel.)
Insulation crimp	Area of a terminal, splice, or contact that has been formed around the insulation of the wire.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

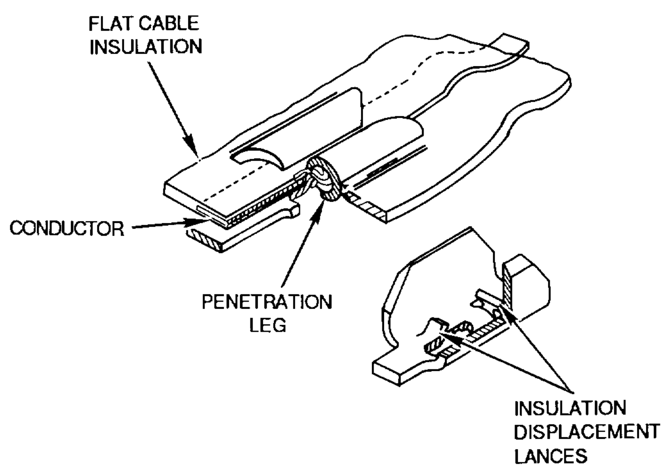
Term	Definition
Insulation Displacement Connector (IDC)	Assembly process wherein an insulation piercing edge of the contact is pushed through the insulation and into contact with the conductor. Most commonly used in mass termination applications.



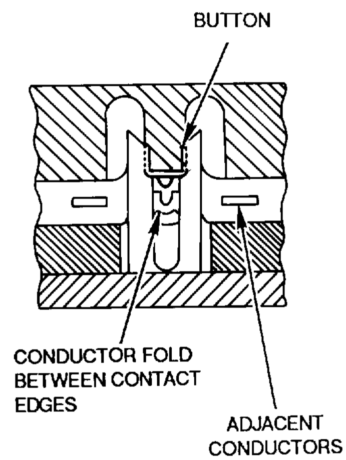
U-CONTACT



MODIFIED-U CONTACT



FLAT CONDUCTOR CRIMP



FLAT - CONDUCTOR ADAPTER

Insulation grip	Certain crimp type contacts have extended cylinders at the rear designed to accept the bare wire and a small length of its insulation. When crimped, both the wire and insulation are held firmly in place. This prevents the wire from being exposed by the insulation receding.
Insulation level	Impulse voltage breakdown of cable and accessory equipment.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Insulation piercing	Method of crimping, whereby lances cut thru the insulation of the wires and into the strands making electrical contact thus eliminating stripping of the wire. (See insulation displacement connector.)
Insulation resistance (IR)	Ratio of the applied voltage to the total leakage current between two electrodes in contact with a specific insulation.
Insulation stress	Molecule separation pressure caused by a potential difference across an insulator. The practical stress on insulation is expressed in volts per mil.
Insulation support	Portion of a barrel similar to an insulation grip except that it is not compressed around the conductor insulation.
Insulation system	All of the insulation materials used to insulate a particular electrical or electronic product.
Insulator	Material of such low electrical conductivity that the flow of current through it can usually be neglected.
Integral belt	In a cable, a layer of insulation or semiconductive material applied usually by extrusion over two or more insulated, twisted or parallel conductors, to form a round, smooth diameter.
Integrated circuit	Small, complete circuit built up by vacuum deposition and other techniques, usually on a silicon chip, and mounted in a suitable package. Makes possible extremely high circuit board densities.
Integrated detector/ preamplifier	Single chip which contains a detector and an amplifier which converts optical signals to usable electrical output.
Intercalated tapes	Two or more tapes, generally of different composition, applied simultaneously in such a manner that a portion of each tape overlies a portion the other tape.
Intercom wire	Wire used to connect communication instruments, telephones, telegraph, etc.
Interconnecting cable	Wiring between modules, units, or the larger portions of a system.
Interconnecting wire	Physical wiring between components (outside of a module), between modules, units, or larger portions of a system or systems.
Interconnection	Mechanically joining assemblies together to complete electrical circuits.
Interface	(1) Common boundary shared by individual components where they are joined electrically, e.g., conductor to contact, pin to socket, contact to bus. (2) Device, cable, or process used to electrically join together different assemblies.
Interfacial compression	Compression of the resilient material faces of mating inserts that provides positive sealing and insulation when plug and receptacle are locked together.
Interfacial gap	Any gap between the faces of mated inserts.
Interfacial junction	Junction that is formed by the faces of the two mating halves of a connector. This junction can be tightly compressed or loose, depending upon the requirements of the application of the connector.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
	Stranding Lay Lengths

AWG	No. of Wires	Strand Diameter Each Strand (In.)	Stranded Diameter (In.) Min	Stranded Diameter (In.) Max	Length of Lay (In.) Min	Length of Lay (In.) Max
0000	2109	0.0100	0.580	0.605	*5.24	8.47
000	1665	0.0100	0.515	0.540	*4.32	7.56
00	1330	0.0100	0.455	0.480	*3.84	6.72
0	1045	0.0100	0.405	0.425	*3.40	5.95
1	817	0.0100	0.360	0.380	*3.04	5.32
2	665	0.0100	0.320	0.340	*2.72	4.76
4	133	0.0179	0.250	0.274	*2.19	3.84
6	133	0.0142	0.192	0.217	*1.74	3.04
8	133	0.0113	0.157	0.173	*1.38	2.42
10	37	0.0159	0.103	0.114	0.91	1.82
	49	0.0142	0.118	0.128	1.02	1.79
12	37	0.0142	0.090	0.100	0.80	1.60
	19	0.0179	0.083	0.092	0.74	1.47
	37	0.0126	0.082	0.090	0.72	1.44
14	19	0.0142	0.066	0.073	0.58	1.17
16	19	0.0113	0.052	0.058	0.46	0.93
18	19	0.0100	0.046	0.051	0.41	0.82
	16	0.0100	0.045	0.048	0.38	0.77
20	19	0.0080	0.037	0.041	0.33	0.66
	7	0.0126	0.037	0.039	0.31	0.62
22	19	0.0063	0.029	0.033	0.26	0.54
	7	0.0100	0.029	0.031	0.25	0.50
24	19	0.0050	0.023	0.026	0.21	0.42
	7	0.0080	0.023	0.025	0.20	0.40
26	19	0.0040	0.019	0.021	0.17	0.34
	7	0.0063	0.018	0.020	0.16	0.32
28	7	0.0050	0.0147	0.016	0.13	0.26
30	7	0.0040	0.0117	0.013	0.10	0.23

* Rope Strandings - Lay lengths area minimum of 8 times, and a maximum of 14 times, the maximum stranded diameter. All other stranding lay lengths are 8 times minimum and 16 times maximum stranded diameter.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Interfacial seal	Depending upon connector design there can be either one or two interfacial seals. These are pieces of rubber which have been bonded to the face of the insert and have hole patterns that correspond to the insert configuration. When the receptacle and plug are fully mated, the plug and receptacle interfacial seals are compressed together. This provides an environmental seal between the faces of the plug and receptacle and also increases the dielectric between contacts which can increase the service rating of the connector.
Interference	Any undesirable electromagnetic emission or any electrical or electromagnetic disturbance, phenomenon, signal or emission, man-made or natural which causes (or can cause) an undesired response, malfunctioning, or degree radiation of the electrical performance of electrical and electronic equipment.
Intergranular penetration	Process by which solder, by diffusion, penetrates into grain boundaries of parent metal.
Interlayer connection	Electrical connection between conductive patterns indifferent layers of a multilayer printed board. (See through connection.)
Intermetallic compound	Intermediate phase in an alloy system, having a narrow range of uniform composition and relatively simple component quantity proportions, in which the nature of the atomic binding can vary from metallic to ionic.
Intermittent weld	Weld in which the continuity is broken by recurring unwelded spaces.
Internal layer	Conductive pattern which is contained entirely within a multilayer-printed board.
Internal wiring	Electronic wiring which interconnects components, usually within a sealed subsystem. (See external wiring.)
Interstice	In cable construction, the space, valley, or void left between or around cabled components.
Intrinsic joint loss	Loss by fiber-parameter mismatches when two non-identical fibers are joined.
I/O	(See Input/Output.)
Ion	Particle, usually in solution, composed of a single atom or groups of atoms, bearing an electrical charge. These atoms or groups of atoms breakdown from compounds when the compound is dissolved. An ion carrying a positive charge is called a cation, while an ion carrying a negative charge is called an anion. Ions formed outside of a solution usually are very short-lived unless they are in high vacuum. Corrosion is a process usually resulting from ionic reaction.
Ion-exchange column	Apparatus containing specially treated resin particles of two types, an-ionic and cationic resins, which attract and remove both positively and negatively charged ions from a solution. Also known as demineralizers and deionizers.
Ionizable	Characteristic of a material which has the capability of breaking down into ions when in a solution. (See ion.)
Ionization	(1) Dissociation of an atom or molecule into positive or negative ions or electrons. (2) State of an insulator whereby it facilitates the passage of current due to the presence of charged particles usually induced artificially.
Ionization factor	Difference between percent power factors of a dielectric at two specified values of electrical stress. The lower of the two stresses is usually selected so that the effect of ionization on power factor at this stress is negligible.
Ionization voltage (corona level)	Minimum value of falling RMS voltage which sustains electrical discharge within the vacuous or gas-filled spaces in the cable construction or insulation.
IPCEA	Insulated Power Cable Engineers Association. (See ICEA.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
IPE	Designation for Irradiated Polyethylene tape.
IR	(See Insulation Resistance.)
IRE	Former Institute of Radio Engineers.
Iron-constantan	Combination of metals used in thermocouples, thermocouple wires, and thermocouple lead wires. The iron wire is positive, the constantan negative.
Irradiation	In insulations, the exposure of the material to high energy emissions for the purpose of favorably altering the molecular structure.
ISDN	Integrated Service Data Network.
ISHM	International Society for Hybrid Microelectronics.
ISO	International Organization for Standardization.
Isobutylene-Isoprene Rubber (IIR)	Polymer of isobutylene with small amounts of isoprene. This insulation and jacketing material is characterized by excellent resistance to oxidation and aging, exceptional ozone resistance, and very good electrical properties. Resistance to moisture, physical abuse, and chemicals is also good. Applications include power cables, apparatus and equipment leads, control cables, and various other cables. It is alkali-sensitive and may revert under hot, wet conditions.
Isocyanate resins	This resin is generally reacted with polyols such as polyester, polyethers, etc. The reactants are joined through the formation of the urethane linkage.
ISO OSI	ISO’s architecture for Open Systems Interconnection, a scheme for universal standard architecture and protocol suite.
ISO reference model for OSI	Standard approach to network design which introduce modularity by dividing the complex set of functions into more manageable, self contained, functional slives. These layers, from innermost layer, are as follows: (1) Physical, (2) Link, (3) Network, (4) Transport, (5) Session, (6) Presentation, and (7) Application Layers.
j	(See Joule.)
J	Designation for asphalted Jute, nonmetallic armor.
Jack	Plug-in type terminal widely used in electronic apparatus for temporary connections. A connection is made to a jack simply by plugging a probe or plug attached to a flexible insulated wire or cable into the jack.
Jacket	(1) Rubber or synthetic covering applied over the primary insulation, braids, shields, cable components, or over the cable itself. (2) (fiber optic) A covering, frequently plastic, over a fiber, bundle of fibers, or cable which protects against the environment.
Jackscrew (screwlock)	Screw attached to one-half of a two piece multiple contact connector used to draw and hold both halves together and to separate them. (See mechanically engaged connector.)
JAN specification	Joint Army-Navy specification.
Joint	Location where two or more members are to be or have been fastened together mechanically or by brazing, welding, or soldering.
Joint clearance	Dimensions between interfaces of the soldered joint.
Joule (j)	Unit of energy or work. The absolute joule is equal to 10 million ergs or 0.7375 foot pounds. The internal joule is equal to the work required to maintain a current of one ampere for one second in a resistance of one ohm.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

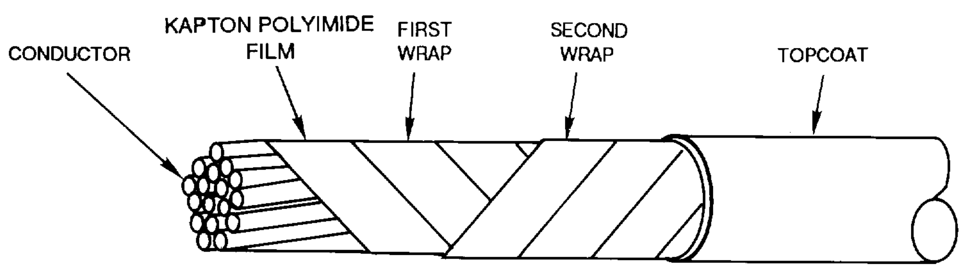
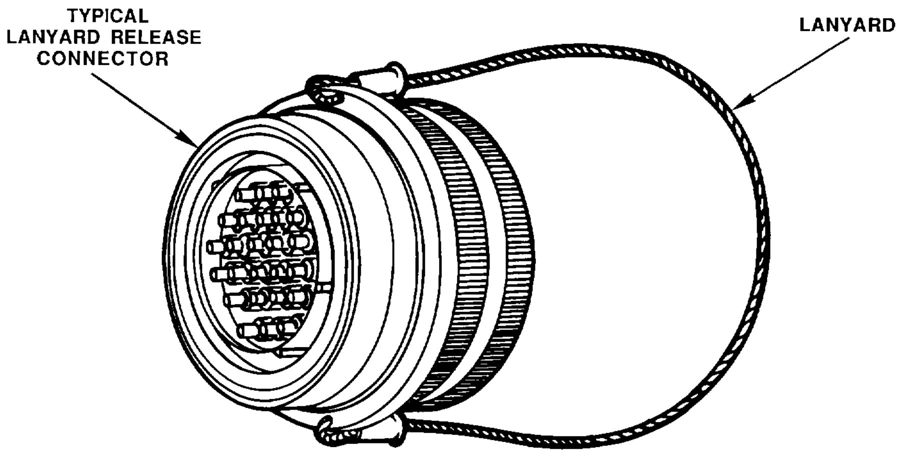
Term	Definition
Jumper	Electrical connection between two points on a printed board added after the intended conductive pattern is formed.
Junction	Joining of two different semiconductors or of semiconductor and a metal. Alloy, diffused, electrochemical, and grown are the four junction types.
Jute	Natural fiber of plant base formed into rope-like strands. Used in cables for filling the interstices to give a round cross-section.
K	(1) (See dielectric constant.) (2) (See Kilo.)
Kapton	A trademark of the DuPont Company for their polyimide resin film used as wire insulation. Kapton polyimide film is transparent and is amber in color. The film is wrapped in one direction on the wire or cable at an angle with approximately a 50% overlap, then wrapped in the opposite direction with a 50% overlap. After wrapping, the film is heated to seal the wrapped layers. An opaque top coat is applied to provide different colors of wire and a surface for wire printing. Kapton wire configurations are defined in MIL-DTL–81381. Kapton wire has poor life characteristics and is no longer recommended for Navy aircraft.  TYPICAL KAPTON INSULATED WIRE
Kari butanol value	Measure of the strength of a solvent, such as its ability to dissolve soils. The higher the value, the more effective the solvent, and the greater the tendency to attack delicate plastic.
Key	A short pin or other projection which slides in a mating slot, hole, groove, or keyway to guide two parts being assembled and hold the parts in position. Generally used in shell-enclosed connectors to obtain polarization.
Keyway	Slot in which a key slides; to ensure the correct location in a mating connector.
Kf	(See fatigue strength reduction factor.)
Kilo (K)	Numerical prefix denoting 1000 (10^3).
Kilovolt ampere (KVA)	1000 volts x amperes.
Kirchoffs laws	(1) The algebraic sum of the currents which meet at any point is zero. (2) In any closed circuit the algebraic sum of the products of the current and the resistance (voltage drops) in each conductor in the circuit is equal to the electromotive force (voltage applied) in the circuit.
Kraft paper	(See Paper.)
KVA	(See Kilovolt Ampere.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Kynar	The trade name of Pennwalt Company for their brand of polyvinylidene fluoride.
L	(1) Designation for Lead Sheath. (2) (See inductance.)
Lacing and harnessing	Lacing, harnessing, or bundling is a method of grouping wires by securing them in bundles or designated patterns. (See breakout.)
Lacing cord or twine	Used for lacing and tying cable forms, hook-up wires, cable ends, cable bundles, and wire harness assemblies. Available in various materials and impregnants.
Lacing tape	Flexible, flat fabric tape for tying harnesses and wire bundles, securing of sleeves and other items, and general lacing and tying applications. Available in various materials and impregnants.
Lacquer	Solution of natural or synthetic resins in readily evaporating solvents. Lacquers can be applied by dipping, spraying, die wiping, screening, or other suitable means. The film or coating is formed by the evaporation or the volatile components. The use of lacquer as an insulating material has found the greatest acceptance in the manufacture of insulated wire and printed circuits.
Lacquer finish	Finish applied over braided wire or cable for appearance and protection against fraying, wicking, moisture absorption, abrasion, etc.
Lambertian radiator (fiber optic)	Radiance distribution that is uniform in all directions of observation.
Laminate	Raw material for printed circuits. Consists of a sheet of plastic with copper foil adhered to one or both sides.
Laminated cable, heterogeneous	This class of cable is fabricated using a film of insulating material which has been pretreated by the addition of an adhesive coating that reacts to heat and/or pressure. When two films are pressed together, the adhesive flows around the conductors, which helps to provide good insulation between them.
Laminated cable homogeneous	This class of cable is fabricated using insulating materials which can be softened, melted, or cured by the use of heat and/or pressure. The insulating material is fusion bonded and does not use any other adhesive.
Laminated plastics	Class of standard structural shapes, plates, sheets, angles, channels, rods, tubes, and zees that are produced by combining layers of resin-impregnated materials in a press under heat and pressure. Base materials may be paper, asbestos paper and mat, cotton cloth and mat, glass cloth and mat, nylon cloth, silica cloth, and wood veneer. Resins include phenolics, melamines, epoxies, silicones, polyesters, polyimides, and others.
Laminated tape	Tape consisting of two or more layers of different materials bonded together.
Land	Portion of a conductive pattern usually, but not exclusively, used for the connection and/or attachment of components.
Lanyard	Device attached to certain connectors which permits uncoupling and separation of connector halves by a pull on a wire or cable.

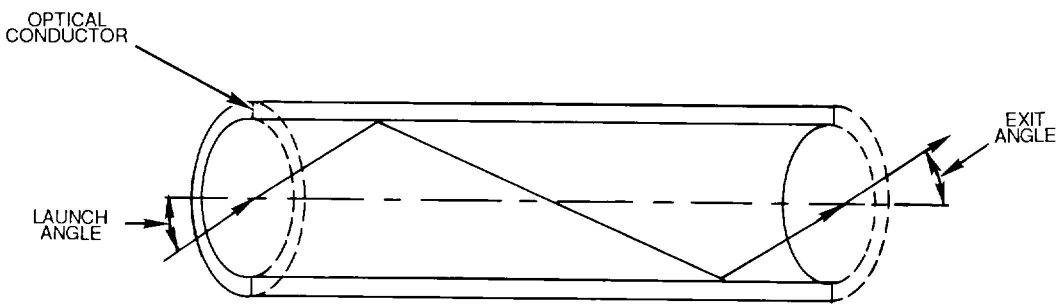
TABLE 2. TERMS AND DEFINITIONS (Cont.)



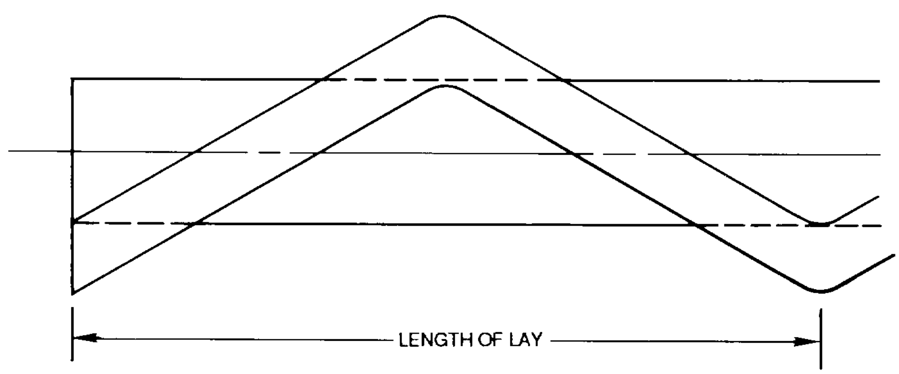
Term	Definition
Lap joint	Two conductors joined by placing them side by side so that they overlap. (See parallel splice.)
Lap winding	An armature winding in which opposite ends of each coil are connected to adjoining segments of the commutator. The windings thus overlap.
Lap wound	(See taped insulation.)
Lap wrap	Tape wrapped around an object in an overlapping condition.
Large-Scale Integration (LSI)	Usually denotes arrays of integrated circuits on a single substrate that comprise 100 or more individual active circuit functions or gates.
Laser	Acronym for Light Amplification by Stimulated Emission of Radiation, a device which transmits an extremely narrow and coherent beam of electronmagnetic energy in the visible light spectrum.
Laser diode (fiber optic)	Semiconductor diode that when pulsed, emits coherent light, light of essentially one wavelength, in phase, traveling in the same direction.
Lasing threshold	Lowest excitation level at which a laser's output is dominated by stimulated emission rather than spontaneous emission.
Lateral loss (fiber optic)	Power loss, expressed in decibels, due to the deviation from optimum coaxial alignment of the ends of separable optical conductors. (See coupling loss.)
Lateral misalignment loss (fiber optic)	That portion of the loss, expressed in decibels, due to the lateral or angular misalignment of the optical junction centerline. (See coupling loss.)
Lateral offset loss	An optical power loss caused by transverse or lateral deviation from optimum alignment of source to optical fiber, fiber-to-fiber, or fiber-to-detector.
Latex	Rubber material used for insulation of wire.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

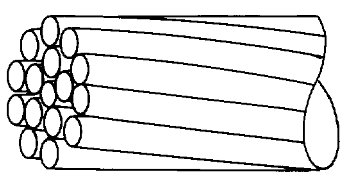
Term	Definition
Launch angle (fiber optic)	Angle between the input radiation vector and the axis of the fiber or fiber bundle.



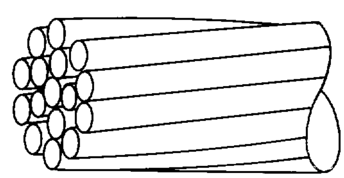
Term	Definition
Lay	Lay of any helical element of a cable is the axial length of a turn of the helix of that element. Among the helical elements of a cable may be each strand in a concentric-lay cable, or each insulated conductor in a multi-conductor cable. Lay is often referred to as pitch.



Term	Definition
Lay, direction of	Direction in which the strands or a conductor or components in a cable pass over the top of the bundle as they recede from an observer looking along the axis of the conductor or cable. Termed right hand or left hand. (See lay.)



RIGHT - HAND LAY



LEFT - HAND LAY

Term	Definition
Layer	Consecutive turns of a coil lying in a single plane.
Layer insulation (for transformers)	Dielectric used between the layers of magnet wire in a coil.
Layer-to-layer spacing	Thickness of dielectric material between adjacent layers of conductive circuitry in a multilayer printed board.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Layout	Original design of a circuit board. Includes not only circuitry but locating marks, pilot holes, identification marks, and number of units per board.
LC	Designation for Lead Covered.
LDPE	(See Low Density Polyethylene.)
Leaching and non-leaching	In a leaching wire the plasticizer will migrate or leave the vinyl compound when exposed to the heat of baking. The wires treated become brittle and hard. A non-leaching wire will retain its plasticizer under extreme temperature conditions remain flexible after baking. A non-leaching wire is desirable for use as motor lead wire.
Lead	Wire, with or without terminals, that connects two points in a circuit.
Lead aluminosilicate	Lead aluminosilicate ceramics show low shrinkage and self-glazing properties. Dense ceramic bodies in the compositional range of lead oxide (47.5% to 83.9%), alumina (2.5% to 27.2%), and silica (10.8% to 35.0%), when fabricated from commercial raw materials and by conventional fabricating techniques, exhibit low fired shrinkage characteristics. When fabricated at optimum pressures, bodies of zero fired shrinkage are obtained.
Lead covered cable	Cable provided with a sheath of lead for the purpose of excluding moisture and affording mechanical protection. Also called lead sheathed cable.
Lead cured	Vulcanizing process whereby a lead sheath is used as a mold to contain a rubber compound during curing.
Lead dress	Placement or routing of wire and component leads in an electrical circuit.
Lead frames	Large scale integrated circuits are connected to lead frames to facilitate making connections to and from the various solid-state devices of the package. The leads are generally flat ribbons, down to mils wide and from 2 to 10 mils thick. Lead frames are made of kovar, nickel, copper, and other metals.
Lead-in	Conductor or conductors that connect the antenna to electronic equipment.
Leakage	Loss of insulation between conductors on a board. May be due to improper cleaning procedures that leave conductive residues.
Leakage current	Undesirable flow of current through or over the surface of an insulation.
Lecher wires	Two parallel wires with a movable shunt that are connected to the output of a radio frequency source and are used mainly to measure wave lengths shorter than about 10 meters.
Lenz’s law	When an electromotive force is induced in a conductor by any change in the relation between the conductor and the magnetic field, the direction of the electromotive force is such as to produce a current whose magnetic field will oppose the change.
LESCW	Designation for Low Energy Safety Circuit Wire.
Levels of interconnection	Device to board or chassis. Connection point between components (tubes, transistors, integrated circuits, etc.) and the Printed Circuit (PC) board or chassis. Board to mother board or backplane. Connection point between PC boards or sub-circuit modules and the mother board or a back-plane board. Backplane wiring. Connections between levels to each other and to other subcircuits. Input/output. Connections for power and signals into and out of a system. Connections may be between subassemblies within the same enclosure or between individual units.
LID	Leadless Inverted Device.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Life cycle	A test performed on a material to determine the length of time before failure in a controlled and accelerated environment.
Light	In a strict sense, the visible spectrum nominally covering the wave-length range of 400nm to 750nm.
Light Emitting Diode(LED)	Semiconductor device which emits incoherent light from a P-N junction (when biased with an electrical current).
Light-intensity ratio	Ratio of input light intensity to the output light intensity.
Light source (fiber optic)	Any object capable of emitting coherent light. The light source is normally either a light emitting diode or a laser. (See fiber optics, coherent light.)
Lightwave communications (fiber optic)	Communications using light, instead of an electric current, to carry the information. (See fiber optics.)
Limpness	Ability of a cable to lay flat or conform to a surface.
Line balance	Degree to which the conductors of a cable are alike in their electrical characteristics with respect to each other, to other conductors, and to ground. Similar to balanced line.
Line cord	Cord, terminating in a plug at one end, used to connect equipment or appliances to a power outlet.
Line drop	Voltage loss occurring between any two points in a power or transmission line. Such loss, or drop, is due to the resistance, reactance, or leakage of the line.
Line equalizer	Reactance (inductance and/or capacitance) connected in series with a transmission line to alter the frequency-response characteristics of the line.
Line level	Level of a signal at a certain point on a transmission line. Usually expressed in decibels.
Line of force	Used in the description of an electric or magnetic field to represent the force starting from a positive charge and ending on a negative charge.
Line voltage	Voltage existing in a cable or circuit such as at a wall outlet or other terminals of a power line system. The line voltage is usually between 115 and 120 volts, with 117 as an average, but may vary at times as much as five volts above or below the 115 and 120 volt limits.
Liquation	Tendency of the more fusible components of an alloy to separate from the less fusible components during melting.
Liquid coatings	Liquid or semi-liquid resinous compounds which, when dried or cured, provide a protective barrier between the coated product and the environment. (See conformal coating, potting.)
Liquid dielectrics	Liquids serve as dielectric filling agents or impregnants in transformers, capacitors, switch gear, high voltage cables, terminals, circuit breakers, and electronic devices. In addition to their dielectric function, they also may be used for coating and arc quenching functions.
Liquidus	In a constitution or equilibrium diagram, the locations of a set of points representing the temperatures at which the various compositions in the system begin to freeze on cooling or to finish melting on heating. (See solidus.)
Lithium aluminosilicates	Lithium aluminosilicates have low or negative thermal expansion characteristics, allowing for excellent thermal shock resistant bodies. They have slightly below average strength properties.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Litz wire	Wire made from a number of fine, separately-insulated strands specially braided or woven together for reduced skin effect and hence, lower resistance to high frequency currents for lower radio frequency losses. The full name is Litzendraht wire.
Loaded line	Transmission line that has lumped elements (inductance or capacitance) added at uniformly spaced intervals. Loading is used to provide a given set of characteristics to a transmission line.
Locator	Device for positioning terminals, splices, or contacts into crimping dies, positioners, or turret heads. (See positioner.)
Locking spring	(See contact retaining member.)
Long-haul network	Network most frequently used to transfer data over distances of from several thousand feet to several thousand miles.
Longitudinal indent	Crimp indent shape where the longest dimension is in line with the connector barrel. (See crimp termination.)
Longitudinal shield	Tape shield, flat or corrugated, applied longitudinally with the axis of the core being shielded. (See shield.)
Longitudinal wrap	Tape applied longitudinally along the axis of the core being covered, as opposed to a spiral wrap.
Loopback	Diagnostic test in which the transmitted signal is returned to the sending device after passing through a data communications link or network.
Looping-in	Wiring method which avoids tee joints by carrying the conductor or cable to and from the point to be supplied.
Loop resistance	Total resistance of two conductors, measured round trip from one end (twisted pair, shield and conductor, etc.).
Loss	Energy dissipated without accomplishing useful work.
Loss budget	(See Flux budget.)
Loss factor	For an insulating material, the product of dissipation and dielectric constant,
Loss Index	Product of the power factor and the dielectric constant.
Lossy line	Cable having large attenuation per unit of length.
Low Density Polyethylene (LDPE)	Polyethylene whose density ranges from about 0.915 to 0.925. Relatively soft but tough material.
Low frequencies	Frequencies from 5 MHZ to 116 MHZ allocated for the return direction in a mid-split system.
Low loss	Term applied to a dielectric material or cable that has a small amount of power loss over long lengths making it suitable for transmission of radio frequency energy.
Low noise cable	Cable specially constructed to eliminate spurious electrical disturbances caused by capacitance changes, or self-generated noise, induced by either physical abuse or adjacent circuitry.
Low pressure laminates	Laminates molded and cured in the range of pressures under 400 psi.
Low tension	Low voltage, as applied to ignition cable.
LSI	(See Large-Scale Integration.)
Lug	Termination, usually crimped or soldered to the conductor, with provision for screwing on to terminal.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
LW	Designation for radio hook-up wire with polyvinyl insulation with or without nylon jacket, braid, or shielding braid, 300 V.
m	(See Milli.)
M	(1) Suffix indicating two or more insulated, twisted conductors under an outer, nonmetallic covering. (2) (See Mega.)
Machineable glass	Machineable glass ceramics are distinguishable from other ceramics and glasses by their micro-structure. This structure consists of a highly interlocked array of plate-like mica crystals dispersed throughout a glassy matrix. Some of these materials can be fabricated on conventional metalworking equipment, allowing parts to be made with the ease of machining.
Macrobending	In a a optical fiber, all macroscopic deviations of the axis from a straight line, distinguished from microbending.
Macrostructure	Structure of metals as revealed by examination of a polished specimen at a magnification not exceeding ten diameters.
Magnesium	Magnesium has a high melting point 5072°F (2800°C) and excellent thermal and dielectric properties. However, it is difficult to fabricate and sinter high purity bodies.
Magnetic	Generally speaking, magnetic metals contain iron, whereas non-magnetic metals do not contain iron. However, this varies in the case of certain types of stainless steel which contain iron but are non-magnetic, and monel which does not contain iron but is mildly magnetic. In view of this fact, should mild steel, stainless steel or monel pieces become mixed up, they can be readily identified by exposing them to a magnet.
Magnetic core	In an armature, magnet transformer, etc., the iron stampings or laminates which, when assembled, form a metallic path for the magnetic circuit.
Magnetic density	Number of lines of magnetic force passing through a magnet or magnetic field per unit area of cross section.
Magnetic field	Region surrounding a magnet, through which magnetic forces act. Composed of lines of force.
Magnetic flux	Rate of flow of magnetic energy across or through a surface (real or imaginary).
Magnet strip	Sheet or foil aluminum (either bare or insulated) used as the conductor in electric windings. Copper is also used. Usually in the form of a bare aluminum strip with shaped, rounded, or contoured edges. This is wound with paper, plastic film, mica paper, or other sheet insulation between layers. A coated strip (of both aluminum and copper) has also been developed.
Magnet wire	Insulated wire intended for use in windings on motor, transformer, and other coils for electromagnetic devices.
Magnetostriction	Characteristic of a material that is manifested by strain when it is subjected to a magnetic field; or the inverse. Some iron-nickel alloys expand; pure nickel contracts.
Male contact	(See pin contact.)
Malleability	Ability of a material to accept deformation under pressure, i.e., coining.
Manufacturer’s identification	Colored threads under insulation or jacket, or surface printing or marking, intended to identify a wire or cable construction as the product of a particular manufacturer. Often required by Underwriter’s Laboratories or Government specifications.
Margin	Distance between reference edge of cable and nearest edge of first conductor.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

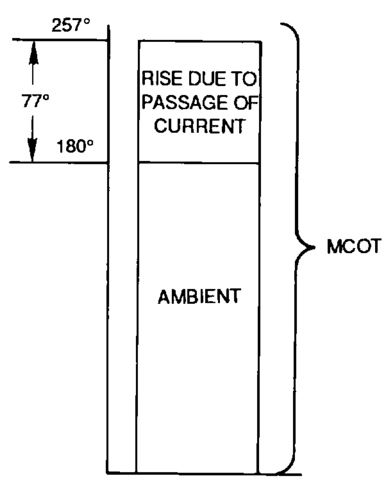
Term	Definition
Marker tape	Tape laid parallel to the conductors under the sheath in a cable, imprinted with the manufacturer's name and the specification to which the cable is made.
Marker thread	Colored thread laid parallel and adjacent to the strand in an insulated conductor which usually identifies the manufacturer and specification of the wire.
Mask	Material applied to enable selective etching, plating, or the application of solder to a printed board.
Mass termination	Simultaneous termination of several or all conductors of a cable. This process generally uses terminals that pierce the insulation without stripping to cold flow mate with the conductors and form a gas-tight, metal-to-metal joint. (See insulation displacement connector.)
Master drawing	Document that shows the dimensional limits or grid locations applicable to any or all parts of a printed board (rigid or flexible), including the arrangement of conductive and nonconductive patterns or elements; size, type, and location of holes; and any other external characteristics.
Mat	Randomly distributed felt of fibers used in reinforced plastics and flexible composites and coated materials.
Mate	To join two connector halves in a normal engaging mode.
Material dispersion	Light empulse broadening caused by various wavelengths of light traveling at differing velocities through a fiber.
Material scattering loss (fiber optic)	Loss due to fluctuations in the refractive index and to non-uniform material composition and temperature.
Matteucci effect	Voltage generating property of a twisted ferromagnetic wire upon change of magnetization.
Maximum Conductor Operating Temperature (MCOT)	Ambient temperature plus temperature rise due to passage of electric current. 
Maxwell (Mx)	The centimeter-gram-second electromagnetic unit of magnetic flux through a square centimeter normal to a magnetic induction of one gauss.
Maxwell's rule	Every part of an electric circuit is acted upon by a force tending to move it in such a direction as to enclose the maximum amount of magnetic flux.
MBit/Sec	Megabits per second, a measure of network bandwidth.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

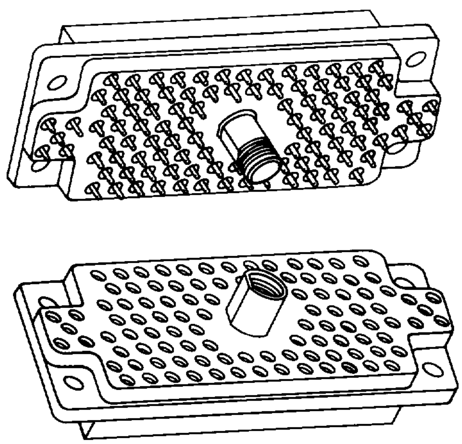
Term	Definition
MC	Designation for cable with interlocking metal tape or corrugated tube enclosure.
MCM	One thousand circular mils. 200 MCM = 200,000 circular mils. (See circular mil.)
MCOT	(See Maximum Conductor Operating Temperature.)
Measling	Condition existing in the base material in the form of discrete white spots or crosses below the surface of the base material, reflecting a separation of fibers in the glass cloth at the wave intersection.
Mechanically engaged connector	A connector in which engagement is made mechanically, normally through the use of a bayonet coupling, a threaded coupling, or a jack-screw. 
Mechanical Properties	Properties of a material that reveal elastic and inelastic behavior where force is applied, thereby indicating suitability for mechanical applications; for example, modulus of elasticity, tensile strength, elongation, hardness, and fatigue limit.
Mechanical wrap	Securing of a wire or the lead of a component around a terminal prior to the soldering operation.
Medium	Copper wire or microwave transmission signal.
Medium-Scale Integration	Physical realization of a microelectronic circuit fabricated from a single semiconductor integrated circuit having circuitry equivalent to more than 10 individual gates or active circuit functions.
Megabyte	Basic unit of mass storage (1,048,576 bytes) and data-transfer rates.
Megahertz (MHZ)	Unit of frequency equal to one million hertz.
Meg or Mega (M)	Numerical prefix denoting 1,000,000 (10^6).
Megarad	Unit for measuring radiation dosage, lx (10^6) rads.
Megohmmeter	High range ohmmeter, often with hand cranked generator, used to measure insulation resistance. Readings are in megohms.
Melamine-formaldehyde resins	Family of amino resin thermosetting materials. Low molecular weigh types are used for laminating, impregnating paper, etc.
Melt index	Extrusion rate of a thermoplastic material through an orifice of specified diameter and length under specified conditions of time, temperature, and pressure.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

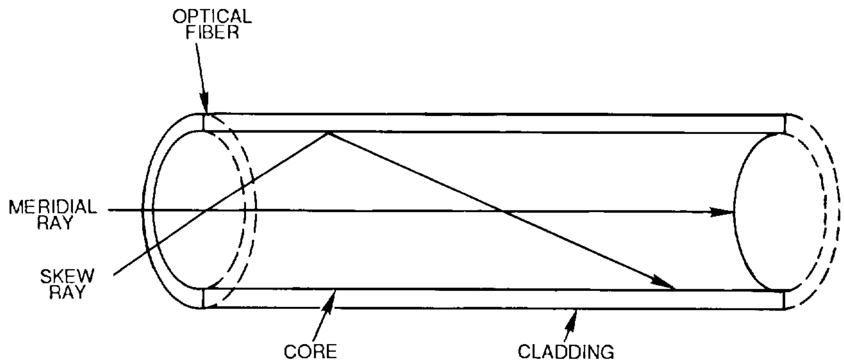
Term	Definition
Melting point	Temperature at which a pure metal, a compound, or a eutectic changes from solid to liquid; the temperature at which the liquid and the solid are in equilibrium.
Melting range	Difference in temperature between the melting point of an alloy and its flow point.
Meridial rays (fiber optic)	Rays of light which propagate by passing through the axis of the fiber and travel in one plane. 
Mesh (powdered metal)	Screen number of the finest screen of a standard screen scale through-which almost all the particles of a powder sample will pass. Also called mesh size.
Metal	Most substances that are chemically classified as metals have certain characteristics and almost unique physical properties. Among these are high electrical and thermal conductivity, attributed to free electrons; non-transparent and high reflectivity of light, due to the same cause; malleability, a sort of plasticity by virtue of which a metal may be cold-worked and rolled into thin sheets; ductility, a combination of malleability and toughness which permits a metal to be drawn into wire. Metals in their normal state are crystalline.
Metal clad	Refers to construction in which the cable core is enclosed in a metal covering.
Metallizing (spray metallizing)	Forming a metallic coating by atomized spraying with molten metal or by vacuum deposition.
Metallography	Study of the structure and properties of metals and alloys, principally by microscopic and X-ray diffraction methods.
Metallurgy	Term comprises both the science and technology of metals. That area concerned with the extraction of metals for their ores and the refiring of these metals is known as process metallurgy. Physical metallurgy, on the other hand, is primarily concerned with the uses of metals and deals with their physical and mechanical properties as they are affected by heat treating, mechanical working, and alloying.
Metal Oxide Semiconductor (MOS)	A technology for producing transistors that incorporates metal over oxide over silicon layers. Used commonly with Field Effect Transistors (FET), designated MOSFET.
Metered solder cup	Term used when the cylindrical portion of the contact (in which the conductor is inserted) is partially filled with a specific amount of solder before assembly of the connector. Thus the conductor can be soldered into the contact by the simple addition of heat and without additional solder.
MHD	Medium Hard Drawn copper wire.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Mho	Unit of conductance. Reciprocal of an ohm. One ampere of current passing through a material under a potential difference of one volt provides one Mho of conductance. (See Mineral Insulated.)
MI	(See Mineral Insulated).
Mica	Silicate which separates into layers and has high insulation resistance, dielectric strength, and heat resistance. It is used as an insulation wrap in wires and cables, to a limited degree, where radiation resistance requirements are severe, and for high temperature work demanding good heat resistance.
Micro (μ)	Numerical prefix denoting one-millionth (10^{-6}).
Microbending loss (fiber optic)	Loss due to small geometrical irregularities along the core/cladding interface of the fiber.
Microcircuit	Physical realization of a (hybrid or monolithic) interconnected array of very small active and passive electronic elements.
Microelectronics	Electronic circuits or systems from a number of extremely small circuit elements inseparably on or within a continuous body. Microelectronics had developed along two basic technologies - monolithic integrated circuits and hybrid integrated circuits.
Micrograph	Graphic reproduction of the surface of a prepared specimen, usually etched, at a magnification greater than 10 diameters. If produced by photographic means, it is called a photomicrograph.
Micron	Measure of length equal to (10^{-6}) meters. Used to describe wavelength, it is equal to 100 nanometers, the preferred term.
Microphone cable	Special shielded cable used to connect a microphone to an amplifier.
Microphonics	Noise in a system caused by mechanical vibration of components within the system. In a microphone cable, for example, microphonic noise can be generated by the shield rubbing against the dielectric as the cable is moved or flexed.
Microprocessor	Integrated circuit package incorporating logic, memory, control, and/or interface circuits, the whole of which is designed to handle certain central processing functions during computer operation.
Microstrip	Type of transmission line configuration which consists of a conductor over a parallel ground plane, and separated by a dielectric.
Microstructure	Structure of polished and etched metals as revealed by a microscope at a magnification greater than 10 diameters.
Microwave	Short electrical wave with a wavelength less than 30 cm and a frequency above 1000 MHz.
Mid-Split	Broadband cable system in which the cable bandwidth is divided between transmit and receive frequencies.
Migration	Movement of some metals, notably silver, from one location to another. It is felt that this results from a plating action in the presence of moisture and an electrical potential.
Migration of plasticizer	Loss of plasticizer from an elastomeric plastic compound with subsequent absorption by an adjacent medium of lower plasticizer concentration.
MIL	Abbreviation for Military as in Military Standard (MIL-STD).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Mil	A unit used in measuring diameter of wire and thickness of an insulation over a conductor, 0.001 in.
Milli (m)	Prefix denoting one thousandth.
Millivolt drop test	Test designed to determine the voltage loss due to resistance of a crimped joint.
Mineral Insulated (MI)	Designation for cable and thermocouple wire consisting of one or more conductors surrounded by magnesium oxide insulation and enclosed in a liquid and gas-tight metallic sheathing. Because the construction is completely inorganic, the cable is very heat resistant and inert to most conditions.
Mineral oil	Liquid used as a dielectric. (See liquid dielectrics.)
Miniature wire	Insulated conductors of 24 AWG to 34 AWG.
Mismatch, connector impedance	Terminal or connector having a different impedance than that for which the circuit or cable is designed or mated to.
ML	Designation for two wire types. Type A is AVC mine locomotive cable, 600 V and Underwriter’s Laboratories approved. AVC cables will not carry flame or support combustion. Type B is a motor lead type wire used as wire to electric motors with stranded copper conductor polyvinylchloride, rubber, or rubber and braid insulation.
Mode (fiber optic)	One of the components of a general configuration of a propagating wave front. Mode is characterized by a particular geometrical pattern and propagation constant.
Mode coupling	In an optical fiber, the exchange of power among modes.
Modular	Connector in which similar or identical sections can be assembled together to provide the best connector type or size for the application.
Modulation	(1) Manner in which a carrier radio frequency is coded with audio or other signals for transmission purposes. May be either Amplitude Modulation (AM) or Frequency Modulation (FM). (2) (Fiber optic) Manner in which in-is coded into light for transmission through a fiber. May be either pulse modulation (digital) or intensity modulation (analog).
Module (electronic)	Group of electronic parts joined by welding, soldering, or other methods to form a separable part of an assembly.
Modulus of elasticity	Measure of the rigidity of metal. Ratio of stress, within proportional limit, to corresponding strain. Specifically, the modulus obtained in tension or compression in Young’s modulus, stretch modulus, or modulus of extensibility; the modulus obtained in torsion or shear is modulus of rigidity, shear modulus or modulus of torsion; the modulus covering the ratio of the mean normal stress to the change in volume per unit volume is the bulk modulus. The tangent modulus and secant modulus are not restricted within the proportional limit; the former is the slope of the stress-strain curve at a specified point; the latter is the slope of a line from the origin to a specified point on the stress-strain curve. Also called elastic modulus and coefficient of elasticity.
Moisture absorption	Amount of moisture in percentage that an insulation will absorb under specified conditions.
Moisture resistance	Ability of a material to resist absorbing moisture from the air or when immersed in water.
Molded plug	Connector molded on the end of a cord or cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Mold release	Material applied to the surfaces of a mold cavity to ease removal of the material(s).
Molecular weight	Weight of any molecule which is the sum of the weights of its constituent atoms.
Molecule	Smallest quantity of matter which can exist by itself and be recognizable as a particle of the original material. A molecule retains all the properties of the bulk substance from which it came.
Molybdenum	Metallic element like iron, copper, aluminum, and nickel that is found world-wide. An alloying ingredient for iron and nickel base alloys, it is also used in its pure form and as a lubricant base. It displays high temperature strength, good fabricability, and good electrical conductivity.
Monofilament	Single strand filament as opposed to a braided or twisted filament.
Monomer	Chemical (usually a liquid or gas) of low molecular weight used as a starting material for polymerization to produce solid or heavy liquid materials of larger molecular weight, called polymers.
Monotectic	Isothermal reversible reaction in a binary system, in which a liquid, on cooling, decomposes into a second liquid of a different composition and a solid. It differs from a eutectic in that only one of the two products of the reaction is below its freezing range.
MOS	(See Metal-Oxide-Semiconductor.)
Mother-board	Printed board used for interconnecting arrays of plug-in electronic modules.
Motor lead wire	Wire which connects to the usually fragile and easily damaged magnet wire found in coils, transformers, and stator or field windings. General requirements are abrasion resistance, toughness, flexibility, dielectric strength, thermal resistance, and low percent of extratables (where applicable; such as in hermetic wires).
Mounting hole	Hole used for the mechanical mounting of a printed board or for the mechanical attachment of components to the printed board.
Mouth	Cable entrance of a connector barrel. (See belled mouth.)
MRFR	Designation for Moisture Resistant Flame Retardant finish.
MS	Military Standard (sheet).
MSI	(See Medium-Scale Integration.)
MT	Machine Tool wire used for internal wiring of appliances or tools. Solid or stranded conductor, thermoplastic insulation.
MTW	Designation for thermoplastic insulated Machine Tool Wire, 194°F (90°C) to 221°F (105°C), 600 V.
Mullite	Mullite has a good thermal shock resistance and high refractoriness. Mullite ceramic tubes are used to make thermocouple insulating beads and tubes.
Multi-channel cable	Optical cable having more than one fiber.
Multiconductor cable	Combination of two or more conductors cabled together and insulated from one another and from sheath or armor where used. Special cables are referred to as 3-conductor cable, 7-conductor cable, 50-conductor cable, etc.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

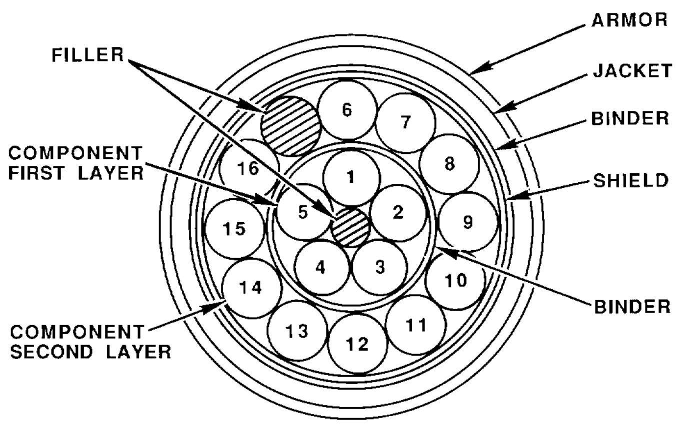
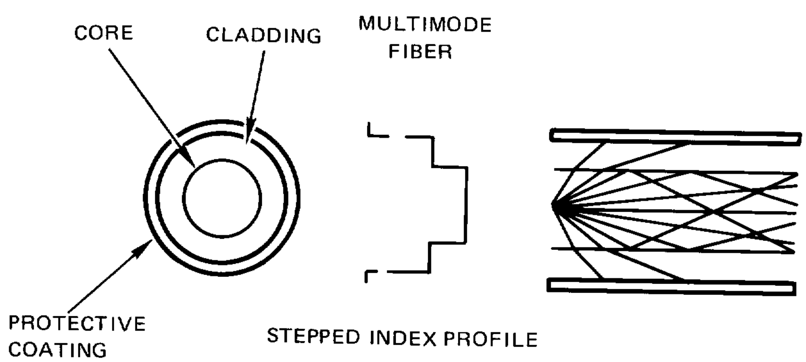
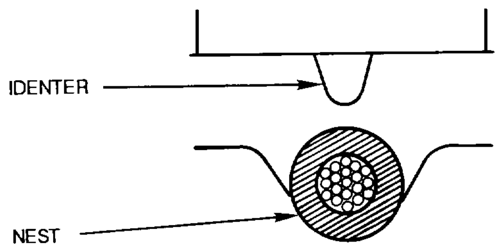
Term	Definition
	 TYPICAL MULTICONDUCTOR CABLE
Multiconductor concentric cable	Cable composed of an insulated central conductor with one or more tubular stranded conductors laid over it concentrically and insulated from one another.
Multilayer printed circuit board	Printed board consisting of alternate layers of conductive patterns and insulating materials bonded together, with conductive patterns in more than two layers, and with the conductive patterns interconnected as required.
Multimode fiber (fiber optic)	Fiber which transmits many modes.
	
Multiplexing	Sending several signals over a single line and separating them at the other end.
Mutual capacitance	Capacitance between two conductors when all other conductors including ground are connected together and then regarded as an ignored ground.
MW	Designation for radio hook-up wire, with polyvinyl insulation and plain or nylon jacket, or braid or shield, 1,000 V.
Mx	(See Maxwell.)
Mylar	Trade name of the DuPont Company. A polyester film used widely as a binder tape or separator in cables.
n	(1) (See Nano.) (2) (fiber optic) (See refractive index.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
NA (fiber optic)	(See Numerical Aperture.)
Nano (n)	Numerical prefix denoting one-billionth (10^{-9}).
Nanometer	One billionth of a meter.
Nanosecond	One billionth of a second.
National Electrical Manufacturers Association (NEMA)	It is known in industry for its standardization of wire and cable specifications.
National Electric Code (NEC)	Consensus electrical construction standard published by the National Protection Association (NFPA), incorporated in OSHA regulations, and used nationally.
Natural Rubber (NR) (isoprene)	Rubber by itself is lacking in many properties required of wire and cable insulating and jacketing materials. However, by proper compounding and mixing with other products, it can be converted to a material with excellent physical properties, good electrical properties, and fair to moderate ozone resistance and chemical resistance. (See rubber.)
NBC	(See NBR/PVC.)
NBR	(See Nitrile-Butadiene Rubber.)
NBR/PVC	Blend of Nitrile-Butadiene Rubber and Polyvinyl Chloride, recommended for oil and ozone resistant jacketing of flexible cord and fixture wires, cables, and ignition wires. NBR/PVC is said to offer toughness, smoothness, flame resistance, flexibility, and resistance to abrasion and heat deformation, and to give outstanding service when exposed to weather, light, fuel, oil, or ozone.
NBS	(1) National Bureau of Standards. (2) New British Standard (See British Standard Wire Gauge.)
NEC	(See National Electric Code).
Negative lap wound	(See taped insulation.)
Negative (noun)	Artwork, artwork master, or production master in which the intended conductive pattern is transparent to light, and the areas to be free from conductive material are opaque.
NEMA	(See National Electrical Manufacturers Association.)
NM	Designation for Nonmetallic sheathed cable, braid or plastic covered. For dry use, 140°F (60°C).
NMC	(1) Designation for Nonmetallic Sheathed Cable, plastic or neoprene covered. Wet or dry use, 140°F (60°C). (2) Abbreviation for Naval Material Command.
Neoprene	Trade name of the DuPont Company. Chemically this synthetic rubber is known as polychloroprene. Although the electrical properties of neoprene are inferior to many other insulations, they are adequate for low voltage work. The physical properties of neoprene are similar in some respects to natural rubber but it is considerably better from the standpoint of resistance to oil, ozone, heat, weather, sunlight, and aging. It does not support combustion and resists abrasion and cutting. It is used for a wide variety of wire and cable jacketing applications. (See polychloropene.)
Nest	Portion of a crimping die which supports the barrel during crimping.

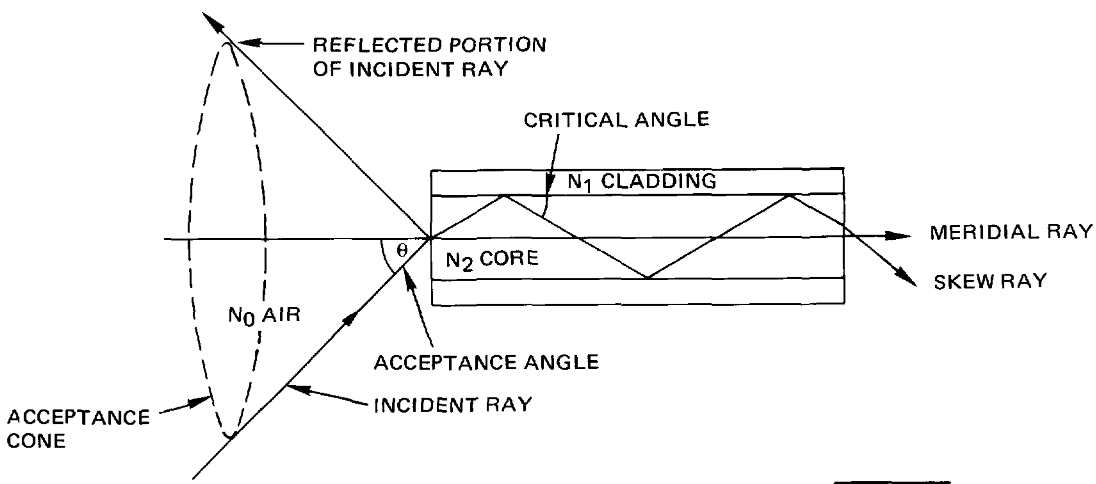
TABLE 2. TERMS AND DEFINITIONS (Cont.)



Term	Definition
Neutral Flame	Gas flame in which there is no excess of either fuel or oxygen.
New British Standard (NBS)	(See British Standard Wire Gauge.)
Nickel	This metal offers combination of moderate corrosion resistance, formability, and tough physical properties. For these reasons, nickel is used for alloying purposes and in nickel clad copper wire.
Nickel clad copper wire	Wire with a layer of nickel on a copper core where the area of the nickel is approximately 30% of the conductor area. The nickel has been rolled and fused to the copper before drawing.
Nick (notch)	Cut or notch in conductor strands or insulation.
Nitrile-Butadiene Rubber (NBR)	Specific properties depend on the actual composition but generally, this rubber offers excellent resistance to oils and solvents. Low temperature flexibility is good. Nitrite rubber has a very low resistivity value. Tensile strength, hardness, toughness, oil and solvent resistance, and resilience vary with the acrylonitrile content (the rubber is the result of the copolymerization of acrylonitrile and butadiene). Also known as nitrite rubber.
Nitrite-Polyvinyl	A thermosetting jacket compound which combines the resistance of Chloride rubber to oils, greases, and solvents with the ozone and sunlight resistance of polyvinyl chloride.
Nitrogen	A gas used as a dielectric. (See gaseous dielectrics.)
Noble metal	(1) Metal whose potential is highly positive relative to the hydrogen electrode. (2) Metal with marked resistance to chemical reaction particularly to oxidation and to solution by inorganic acids. The term as often used is synonymous with precious metals.
Noise	Refers to random spurts of electrical energy or interference. Random electrical signals, generated by circuit components or by natural disturbances, that make up transmitted data inaccurate by introducing errors.
Noise Equivalent Power (NEP)	Root-mean-square (rms) value of optical power which is required to produce an rms signal-to-noise ratio of 1.
Noise weighting	Method of assigning a specific value, in numerical readings, to the transmission impairment due to the noise encountered to an average user operating a particular class of subset.
Non-conductor	(See insulation.)
Noncontaminating	(1) Material that will not migrate into and contaminate or degrade adjacent materials. (See migrate.) (2) Type of PVC jacketing material whose plasticizer will not migrate into the dielectric of a coaxial cable and thus avoids contaminating and destroying the dielectric. (See migrate.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Non-ferrous metals	Alloys not containing iron.
Non-migrating	Synonymous with non-contaminating. (See migrate.)
Non-polar compound	This type of compound has electrical charges symmetrically distributed over the surface of the molecule and, therefore, shows no electrical, effects in solution or otherwise. (See polar compound.)
Notch sensitivity	Measure of the reduction in strength of a metal caused by the presence of stress concentration. Values can be obtained from static, impact, or fatigue tests.
Notch strength (notch tensile strength)	Ratio of maximum load to the original minimum cross-sectional area in notch tensile testing.
NP	Nickel Plate.
NR	(See Natural Rubber.)
NRHW	Designation for moisture and heat resistant rubber insulation with neoprene jacket for use in ducts. Dry and wet locations, 600 V, 167°F (75°C).
Nude contact	Contact with a contact retaining member that remains in the insert at all times.
Numerical Aperture (NA) (fiber optic)	Characteristic of an optical conductor in terms of its acceptance of impinging light. Equal to the refractive index of the coupling medium multiplied by the sine of the acceptance angle, and equals the square root of the difference of the square of the refractive index of the fiber core minus the square of the refractive index of the fiber cladding.



NUMERICAL APERTURE (NA) $= N_0 \sin\theta = \sqrt{N_2^2 - N_1^2}$

$\theta =$ MAXIMUM ACCEPTANCE ANGLE FOR TOTAL INTERNAL REFLECTION

$N_0 =$ REFRACTIVE INDEX OF AIR = 1.00

$N_1 =$ REFRACTIVE INDEX OF FIBER CLADDING

$N_2 =$ REFRACTIVE INDEX OF FIBER CORE

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Nylon	Generic name for synthetic fiberforming polyamides. Available in three forms for wires and cables: as a yarn for wire serving and braid; as an extrusion material (primarily for jackets); and a coating. For conductors of any but a small size, the electrical and hygroscopic properties of nylon limit its use to jacketing rather than primary insulation. Nylon extrusions are characterized by toughness and excellent oil resistance. Nylon magnet wire has excellent windability due in part to the smooth coating that resists rubbing abrasion. It can be soldered through by using rosin alcohol flux and tin-lead solders.
OD	(See Outside Diameter.)
Oe	(See Oersted)
OEM	(See Original Equipment Manufacturer.)
Oersted (Oe)	Centimeter-gram-second electromagnetic unit of magnetic intensity equal to the intensity of a magnetic field in a vacuum in which a unit magnetic pole experiences a mechanical force of one dyne in the direction of the field.
Off center	Conductor displaced within the cross-section of its insulation; not perfectly centered within the insulation. (See concentricity.)
Offgassing	Percentage of a specified gas released during the combustion of insulation or jacketing material.
Offset terminal	Terminal whose tongue is forward of, and whose stud hole is offset from, the centerline of a terminal barrel.
OFHC	(See Oxygen-Free High Conductivity Copper)
Ohm (Ω)	Unit of electrical resistance. The resistance of a circuit in which a potential difference of one volt produces a current of one ampere.
Ohm’s law	Current, I, electromotive force, E and resistance, R, expressed by the equations I = E/R, R=E/I, and E=IR. (SEE formulas-electrical.)
Oil aging	Cable aged in an accelerated manner (to simulate field conditions) by placement in an oil bath, heated to a pre-set temperature, for a stated time. At the end of such an oil bath test, the cable is subjected to physical and electrical tests in order to evaluate any decline in properties.
Oil feeding reservoirs	Oil storage tanks situated at intervals along the route of an oil filled cable or at oil filled joints of solid cable for the purpose of keeping the cable constantly filled with oil under pressure.
Oil-filled cable	Cable, into which high grade mineral oil is forced underpressure, saturating the insulation to prevent moisture and gases from entering.
Oil-filled pipe cable	Pipe cable in which the pressure medium is oil having access to the insulation.
Oil-modified phenolic	(See phenolic varnish, oil modified.)
Olefin	Types of unsaturated aliphatic hydrocarbons, having the formula CnHn, including ethylene, propylene, and butene. They are the bases for such plastics as polypropylene and polyethylene.
Oleoresin	(1) Mixture of resin with the oil of the resin’s source plant. (2) Similar mixtures of drying oils and natural or synthetic resins.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Oleoresinous (plain enamel)	This magnet wire film is basically a cured varnish made with a natural resin and a drying oil. Plain enamel is still being used in applications where the winding hazards are not severe. In some applications, it is chosen due to its low cost, ease of winding, and performance ability.
Opaque (fiber optic)	Not permitting the passage of light.
Open butt	(See taped insulation.)
Open cell	Foamed or cellular material with cells which are generally interconnected. Closed cells refer to cells which are not interconnected.
Open entry contact	Socket whose engaging end is split and vulnerable to distortion or damage from test probes or other wedging devices.
Operating temperature	Maximum internal temperature resistant capabilities of a connector in continuous service.
Optical cable assemblies	Cable complete with connectors.
Optical communication cable (fiber optic)	Fiber with a protective jacket around it. A cable may have one or more fibers within it. (See fiber cable.)
Optical communication fiber (fiber optic)	Term analogous to a single strand of electrical fiber wire in that it wire in that it carries information from point to point. (See fiber.)
Optical communications (fiber optic)	Communications using light, instead of an electric current, to carry information. Also called lightwave communications. (See fiber optics.)
Optical conductors (fiber optic)	Materials which offer a low optical attenuation to transmission of light energy. Types of optical conductors include: (1) Single Fiber - a discrete optical conductor; (2) Bundle - a number of optical conductors in a random arrangement, grouped together and used as a single transmission medium (channel); (3) Single Channel, Single Bundle Cable - a bundle with a protective covering; (4) Multi-Channel, Single Fiber Cable - more than one single fiber cable jacketed; (5) Single Channel, Single Fiber Cable - a discrete optical conductor with a protective covering; (6) Multi - Channel, Bundle Cable - more than one single bundle cable jacketed; (7) Multi-Channel Cables - a combination of cables.
Optical connectors	Used to attach the transmit and receive optical fibers in the fiber optic cable to the fiber optic transceiver.
Optical filter	Device that selectively transmits certain optical wavelengths and blocks a range of wavelengths.
Optical power (LED)	Radiant power expressed in watts.
Optical power budget	(See Flux budget.)
Optical receiver	Device that receives optical signals from an optical transmitter via the receiver fiber of the fiber optic cable.
Optical Time Domain Reflectometry (OTDR)	Method for characterizing a fiber wherein an optical pulse is transmitted through the fiber and the resulting backscatter and reflections are measured as a function of time.
Optical transmitter	Receives electrical signals from the Ethernet controller via the fiber optic transceiver’s interface cable and converts electrical signals to optical signals.
Optical waveguide (fiber optic)	Fiber used for optical communications. Analogous to a waveguide used for microwave communications. (See fiber.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Organic	When used in reference to chemistry, relates to the chemistry of carbon compounds. Some carbon compounds, such as carbon dioxide gas, do not fall into this category but the vast bulk of carbon-containing compounds do fall into the organic chemistry class. The reason for the use of the word organic in describing these compounds is that until fairly recently, all of the carbon-containing compounds were found only in nature as part of growing organisms.
Organic ester	A liquid used as a dielectric. (See Liquid Dielectrics.)
Organic halides	Organic compounds containing halogens. (See halogens, organic.)
Orifice	Opening or hole.
Original Equipment Manufacturer (OEM)	Organization that assembles a complete functioning device, e.g., plane, missile, satellite, truck, automobile, etc.
Oscillator	(1) Device used to create waveforms. (2) Device used mainly in cabling telephone paired components. By oscillating the pairs, alternately rotating the cable forming plate left and right, a false cable lay is obtained.
Oscillatory surge	Surge which includes both positive and negative polarity values.
OSHA	Occupational Safety and Health Act. The Williams-Steiger law passed in 1970 covering all factors relating to safety in places of employment.
OSI	Open Systems Interconnection, a logical structure for network operations standardized with the ISO.
Outgassing	Dissipation of gas from a dielectric evidencing decomposition.
Outside Diameter (OD)	Distance between external surfaces measured perpendicular to the axis of a circular cross section.
Overall diameter	Finished outside diameter of wire or cable.
Overcoat	Stranded conductor made from individual strands of tin coated wire stranded together, and then given a coat of tin overall.
Overcurrent	Current which causes an excessive temperature rise in a conductor.
Overheating	Heating a metal or alloy to such a high temperature that its properties are impaired. When the original properties cannot be restored by further heat treating, by mechanical working, or by a combination of working and heat treating, the overheating is known as burning.
Overlap	Amount the trailing edge laps over the leading edge of a spiral tape wrap.
Oxidation	Simple addition of oxygen to a metal, the addition of atmospheric oxygen to iron to form rust, or any process where a metal loses electrons and is converted from the metal form, zero electrical charge, to a metallic ion with a positive charge. (See corrosion).
Oxide	Substance resulting from the combination of metal and oxygen, which though most prevalent on the surface of the metal, is also capable of penetrating the sub-surface of the metal. This substance forms at room temperature and its development is greatly accelerated at elevated temperatures.
Oxygen bomb test	Method of determining aging effect on wire under heat, tensile strength, and elongation conditions. Wire is placed in a bomb at 158°F (70°C), under 300 psi using pure oxygen gas for a period of 48 to 96 hours.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Oxygen-Free High Conductivity Copper (OFHC)	Copper with no residual deoxidant, 99.95% minimum copper content and an average annealed conductivity of 101%.
Oxygen index	Percentage of oxygen necessary for a compound to support combustion under a given test configuration.
Ozone test	Exposing materials to a high concentration of ozone to give an accelerated indication of degradation in normal environments and in proximity to ozone-producing apparatus.
p	(See Pico.)
P	(1) Designation for two or more rubber-insulated stranded conductors with cotton braid over each. Reinforced with overall covering of cotton braid over rubber filler. For pendant or portable use in damp locations 300 V to 600 V. (2) (See Power.)
PAC	Preassembled Aerial cable.
Package	(1) Complete assembly of board and components; may be encapsulated. (2) The case used to contain semi-conductors or integrated circuits.
Packing fraction loss (fiber optic)	That part of the loss, expressed in decibels, due to packing fraction.
Packing fraction (PF) (fiber optic)	Ratio of active cross-sectional area of fiber core, or cores, to the total end surface area of the fiber or fiber bundle.
Pad	Area of copper surrounding a hole in a board to be used for insertion of lead of component or inter-connecting wire. Provides area for solder bonding. (See land.)
Pair	Term used for two insulated conductors usually twisted together and considered as a unit. (See twisted pair.)
Palladium	This metal is used in the fabrication of contact parts and strips. It is used as a contact material when low and consistent surface resistances are required. Various amounts of iridium, ruthenium, and other elements are added to palladium to create alloys with higher mechanical wear resistance.
Pan cured	Method of vulcanizing. Coils of unvulcanized insulated wire are coiled in pans and vulcanized under pressure with steam.
P & R	Pendant and Reel cable.
Panel	Side or front of a piece of equipment, usually metal, on which connectors are mounted.
PAP	Commonly used term for air core (unfilled) direct burial telephone cable with a corrugated aluminum shield.
Paper (and board)	Paper is a term applied to all kinds of matted or felted sheets of fiber formed on a fine wire screen from a water suspension. Paperboard is basically the same, but is generally thicker, more dense, and less flexible. Paper and paperboard are used as insulation for telephone cable, high voltage cable, magnet wire, and with a lead sheath for underground service conductors. They are relatively economical, efficient, and versatile. Their chief problem is in nonuniformity, variation in dielectric constant, dielectric loss factor, strength, and conductivity. Oil impregnated paper has improved electrical and moisture resistance properties. Paper is also used as a cable filler.
Paper, aramid	Aramid paper is non-matting and has a long useful life at temperatures to 428°F (220°C). It is tough with extremely stable electrical and chemical properties over wide ranges of temperatures and humidity.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

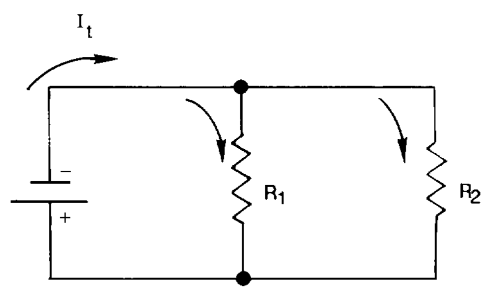
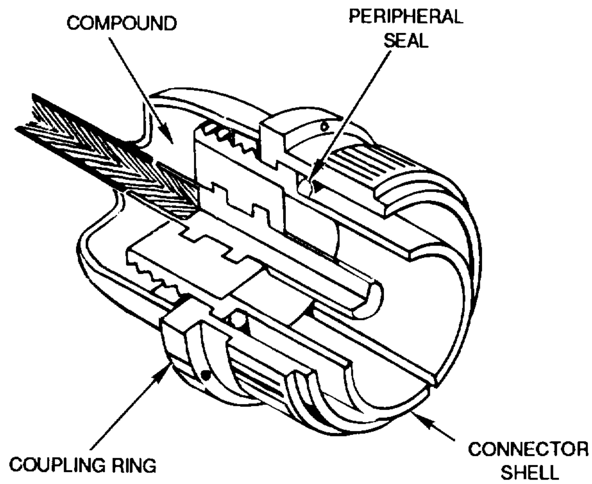
Term	Definition
Paper, cellulose fiber	Cellulose fiber papers exhibit excellent dielectric strength and low dielectric loss for DC and power frequency use. Its chief advantage lies in its economy compared to most solid insulating materials.
Paper, ceramic	An alumina-silica paper composed of approximately 51% alumina and 47% silica. It is resilient, uniform product that is not affected by thermal shock and can be used continuously at temperature to 2192°F (1200°C).
Parallel circuit	Circuit which has more than one possible path for current to flow. The current flow in each parallel branch is independent of the other parallel branches of the circuit. The sum of the currents in all parallel branches is equal to the total current supplied to the circuit. (See formulas-electrical.)  $I_t = I_{R_1} + I_{R_2}$
Parallel pair	Duplex construction where the two insulated conductors are laid parallel and then covered overall with a braid or jacket. Often referred to as duplex cable.
Parallel splice	A device for joining two or more conductors in which the conductors lie parallel and adjacent. (See lap joint.)
Parallel stripe	Stripe applied longitudinally on a wire or cable parallel to the axis of the conductor.
Paraxylylene	Generic name of a polymer series that provides continuous conformal coatings as thin as 250 angstroms. These coatings are claimed to offer unequaled thin layer protection for precision parts, including electronic components and assemblies. They are applied by a vacuum deposition system and reportedly provide an even coating on all surfaces, sharp edges, complex shapes, and in deep, narrow holes.
Parity	Method of ensuring each data byte transmitted or received.
PASP	Air core (unfilled) direct burial telephone cable used in areas subject to rodent attack. It consists of an unfilled cable core, corrugated aluminum shield, corrugated steel tape, flooding compound, and polyethylene jacket.
Passivation	Form of surface oxidation that acts as a barrier to further oxidation or corrosion.
Pasty range	Region between the solidus and liquidus temperatures.
Patch cable	Cable with plugs or terminals on each end of the conductor or conductors used to temporarily connect circuits of equipment together.
Patch cord	Usually braid covered with plugs or terminals on each end. Used to connect jacks or blocks in switchboards or programming systems.
Pattern	The configuration of conductive and non-conductive materials on a panel or printed board.
Pay-off	(1) Process of feeding a cable or wire from a bobbin, reel, or other packages. (2) A device used for paying out wire or cable into a piece of equipment or machinery.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
PC board	(See Printed Circuit.)
PCG	Commonly used term for air core (unfilled) direct burial cable with a corrugated copper shield.
PCS (fiber optic)	(See Plastic Clad Silica fiber.)
PCTFE	Polychlorotrifluoroethylene.
PD	Designation for rubber insulated stranded conductors with cotton braid over each. Conductors twisted with braid overall. Light duty, dry locations, or appliances, 300 V.
PE	(See Polyethylene.)
Peak exothermic temperature	Maximum temperature, in degrees C, reached by a curing thermoset plastic, measured during determination of the gel time.
Peak time	Time from the start of mixing the components of a thermoset plastic composition, until the peak exothermic temperature is reached.
Peak voltage	Maximum instantaneous voltage.
Peak wavelength	Wavelength at which the optical power of a source is at maximum.
Pendant	Type of plug and/or receptacle that is not mounted in a fixed position or attached to a panel or side of equipment. (See in-line.)
Percent conductivity	Conductivity of a material expressed as a percentage of that of copper.
Percent plating	Quantity of plating on a conductor expressed as a percentage by weight; thus, for the same percentage, as the conductor diameter increases, so does the thickness of the plating.
Perfluoralkoxy (PFA)	Fluoropolymer similar to PTFE and FEP teflon. It may be extruded as an insulation using conventional high temperature extrusion equipment. It has superior mechanical properties over FEP at high temperatures and possesses excellent electrical characteristics.
Perfluorobutane	A gas used as a dielectric. (See gaseous dielectrics.)
Perfluoropropane	A gas used as a dielectric. (See gaseous dielectrics.)
Perforated or pierced terminal	Terminal containing a hole through which leads or wires are placed before soldering.
Periodicity	Uniformly spaced variations in the insulation diameter of a transmission cable that result in reflections of a signal, when its wavelength or a multiple there of is equal to the distance between two diameter variations.
Peripheral seal	Either a flat gasket, O-ring seal, or preformed packing used to keep moisture from entering the connector from the outside via the connector shell. Flat gaskets are commonly used on receptacles and O-rings on plugs. When the metal shells of the plug and receptacles come together or bottom out, the seal prevents any moisture from entering the connector shell.

TABLE 2. TERMS AND DEFINITIONS (Cont.)



Term	Definition
Peritectic	An isothermal reversible reaction in which a liquid phase reacts with a solid phase to produce another solid phase on cooling.
Permittivity	Preferred term for dielectric constant. (See dielectric.)
Petroleum oils	A liquid used as a dielectrics. (See liquid dielectrics.)
PF	(1) (fiber optic) (See Packing Fraction.) (2) (See Power Factor.)
PFA	(See Perfluoralkoxy.)
PG	Designation for portable mine cable having power and ground conductors, 600 V.
pH	Measure of the acidity or alkalinity of a solution. A pH of 7 is considered neutral (neither acid nor base). Solutions having pH below 7 are acid, and those greater than 7 are basic. The further the pH measurement of the solution is away from seven, the stronger the acid or base. (See acid, base.)
Phase	Physically homogeneous and distinct portion of a material system.
Phase diagram	Graphical representation defining the phase fields of a multiphase system, such as an alloy, in a coordinate system using the temperature and the compositions of the phases as coordinates. The tin/lead phase diagram, for example, shows the solidus and liquidus temperatures for a variety of tin/lead solder compositions.
Phase modulation	Modulation is the process of using a medium to carry information.
Phenolic resin	A synthetic resin produced by the condensation of phenol with formaldehyde. Thermosetting material is compatible with many filters and modifiers to achieve high temperature and shock resistance, and other properties. Many electrical applications in molded parts, impregnation, coating, encapsulation, etc. (See varnish.)
Phenoxy resins	Linear thermoplastics with high molecular weights, good processing properties, low mold shrinkage, and good creep resistance.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Phenylene oxide based resin	Engineering thermoplastic with very low specific gravity. It is a tough, rigid material which maintains its excellent mechanical properties, relatively unchanged, up to about 300°F 148.9°C. It also exhibits excellent dimensional stability with low creep and low moisture absorption. Dielectric strength is high and dissipation factor is low and constant up to 1 MHz.
Phosphor bronze	This strong and relatively hard material is used to fabricate metal parts and springs. It is formulated by reducing tin bronze with phosphorus and is available in several grades. Phosphor bronze is resistant to corrosion.
Photoconductivity	Conductivity increase exhibited by some nonmetallic materials, resulting from the free carriers generated when photon energy is absorbed in electronic transitions.
Photocurrent	Current that flows through a photosensitive device as the result of exposure to radiant power.
Photomask	Square, flat glass substrate, coated with a photographic emulsion of a very thin layer of metal on which appear several hundred circuit patterns (each containing thousands of images). The patterns are exposed onto semiconductor wafers.
Photon	Quantum of electromagnetic energy.
Photovoltaic effect	Production of a voltage difference across a P-N junction resulting from the absorption of photon energy.
Physical properties	Properties, other than mechanical, that pertain to the physics of a material; for example, density, electrical conductivity, heat conductivity, and thermal expansion.
PIC	General term for any type of Plastic Insulated Telephone cable.
Pick	Distance between two adjacent crossover points of braid filaments.
Pickling	Chemical treatment of parts to remove oxide, generally a combination of certain types of acid and water.
Picks per inch	Number of times the carriers in a braid cross over each other in the same direction along the longitudinal axis for each inch of length.
Pico (p)	Numerical prefix denoting one-millionth of one-millionth (10^{-12}).
Pigtail	A short piece of wire attached to a shield for terminating purposes, the conductor extending from a small component, or a short wire extending from an electric or electronic device to serve as a jumper or ground connection.
Pigtail wire	Fine stranded, extra flexible, rope lay lead wire.
PILC	Paper Insulated, Lead Covered.
Pilot hole	Hole used to position board for other operations so registration will be accurate.
Pin contact	Contact type designed to slip inside and be surrounded by, the mating socket contact. Normally connected to the dead side of the circuit.
Pin-diode	Device used to convert optical signals to electric signals in a receiver.
Pinholes	Small holes visible on the surface of soldered joints which generally indicate the presence of a larger void within the joint. Typically caused by the generation of gas during solidification due to presence of salts and water. Sometimes called blowholes.
Pin photodiode	Diode with a large intrinsic region sandwiched between P and N doped semiconducting regions.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

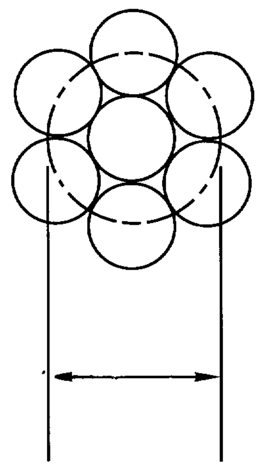
Term	Definition
Pipe cable	Pressure cable in which the container for the pressure medium is a loose fitting rigid metal pipe.
Pitch	Nominal distance from center-to-center of adjacent conductors. Where conductors are of equal size, and spacing is uniform, the pitch is usually measured from the reference edge of a conductor to the referenced edge of the adjacent conductor.
Pitch diameter	Diameter of a circle passing through the center of the conductors in any layer of a multiconductor cable. 
PL	Two rubber insulated, parallel laid, lamp cords with overall cotton or rayon braid. For light duty on small appliances in dry locations 300 V.
Plain conductor	Conductor consisting of one metal only.
Plain enamel	Magnet wire film coating. (See oleoresinous.)
Plain weave	Weave used on woven cables. Threads between the wire act as binders and give the cable a lateral stiffness while maintaining a linear flexibility. Plain weave is used when the cable is to be programmed with leads exposed at fixed lengths. Also called standard weave and square weave.
Planck’s constant	Number h that relates the energy E of a photon with the frequency g of the associated wave through the relation E = hg; h = 6.626 x 10^{-34} joule second.
Planetary cabler	Versatile cabler capable of laying down any number of shielded, over-braided, or jacketed singles, pairs, called groups, or any combination of them in a prearranged sequence. These cablers can be operated in tandem.
Planetary twister	Twisting machine whose payoff spools are mounted in rotating cradles that hold the axis of the spool in a fixed direction as the spools are revolved about one another so the wire will not kink as it is twisted.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Plastic	(1) High polymeric substances, including both natural and synthetic products that are capable of flowing under heat and pressure at one time or another. Does not include rubbers. (2) Used in soldering, that condition of a material which allows it to deform and/or flow continuously without rupturing. The term applies only to solids. The creep properties (see creep strength) of a material are due to its plastic properties. At elevated temperatures, under relatively low loads, tin/lead solders will deform to extreme lengths without rupture. This is a plastic characteristic of the solder.
Plastic clad silica (PCS) fiber	Fiber composed of a silica glass core with a transparent plastic cladding.
Plastic deformation	Change in dimensions under load that is not recovered when the load is removed.
Plasticizer	Chemical agent added to plastics to make them more pliable.
Plastic range	Refers to a range of temperature in which a metal or alloy can be mechanically worked without danger of cracking the material. The term is sometimes used in reference to the range of temperatures between the liquidus and solidus, where the material is a combination of liquid and solid.
Plastic silver brazing	Alloy that develops a plastic or mushy condition at some point within its melt range.
Plated soldering iron tip	Solid copper tip that has been plated or coated or clad with iron, nickel, chromium, or similar metal that will extend the service life of the tip.
Plated-through hole	Hole in which electrical connection is made between internal or external conductive patterns, or both, by the deposition of metal on the wall of the hole.
Plating	Overlaying of a thin coating of metal on metallic components to improve conductivity, provide for easy soldering, or prevent rusting or corrosion.
Platinum	Platinum is a contact material which provides low and consistent surface resistances. It is used in the moving contacts of ultrasensitive relays, thermostats, and potentiometers. Other elements are added to this previous metal to create alloys with higher mechanical wear resistance. Platinum sometimes can be used to replace gold in the plating of metal parts. It is resistant to corrosion and film formation.
PLSJ	All rubber, parallel jacketed, two conductor, light duty cord for pendant or portable use in damp locations, 300 V.
PLT	Same as PLSJ except thermoplastic insulation.
Plug	Part of the two mating halves of a connector which is free to move when not fastened to the other mating half. The plug is usually thought of as the male portion of the connector. This is not always the case. The plug may have female contacts if it is the free to move member.
Plug, end seal	(See sealing plug.)
Ply	Number of individual strands or filaments twisted together to form a single thread. In two-ply yarns, two strands are thus twisted; in three-ply, three strands, etc.
PNA, PNR, PNW	Designations for polyethylene-insulated control cables with nylon sheath on individual conductors. Cabled tape and polyvinylchloride jacket. Dry or wet locations, 600 V,167°F (75°C).
PO	Designation for two stranded copper conductors with separator and rubber insulation and cotton braid over each. Laid parallel with cotton or rayon braid overall. For use in dry locations on small appliances, 300 V to 600 V.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Point-to-point wiring	Interconnecting technique wherein the connections between components are made by wires routed between connecting points.
Poise	Unit of coefficient of viscosity, equal to 1 dyne sec cm.
Polar compound	Compound in which the electrical charges are not distributed symmetrically over the surface of the molecule. Ionizable compounds, such as flux activators, are usually polar compounds. (See non-polar compound.)
Polarity	(1)Electrical condition determining the direction in which current tends to flow. (2) The quality of having two opposite charges.
Polarization	Mechanical arrangement of inserts and/or shell configuration (referred to as clocking in some instances) which prohibits the mating of improper plugs and receptacles. This is to allow connectors of the same size to be lined up, side by side with no danger of making the wrong connection. Coded arrangements of contacts, keys, keyways, and insert positions are used. In rectangular connectors, the shells are so designed that mating usually is possible only in one way.
Polarizing pin, key or keyway	Pin or key located on one half of a two-piece connector in such a position that by mating with an appropriate hole or keyway on the other half during assembly of the connector it will ensure that only related connector halves can be assembled.
Polishing (fiber optic)	Act of smoothing ends of fibers to an optically smooth finish, generally using abrasives. Optically smooth surfaces allow maximum transmission of light between fibers at connections and minimum coupling loss.
Polyamide	A nylon-like polymer in which the structural units are linked by amide or thioamide groupings. Generally thermo plastic with high mechanical strength.
Polyamide-imide	High temperature plastic with an aromatic structure which cures with heat to a linear amide-imide homopolymer. Because of its outstanding thermal stability and very good electrical properties, it was introduced initially in magnet wire enamels and insulating varnishes. Sheet, bar-stock, and other shapes are available. (See varnish polyamide-imide.)
Polyamide-imide enamel	Magnet wire insulating film based on an aromatic polyamide-imide resin. It is based on trimellitic anhydride (TMA). The film is tough, smooth, and abrasion resistant. It has high dielectric strength which is maintained under humid conditions and after long-time aging. It resists deformation under heat and pressure. It can be used in applications as high as 428°F (220°C). This enamel has found its greatest use as an overcoating for other enamels.
Polyarylate	Family of engineering polymers exhibiting good electrical properties, flex recovery, resistance to deformation, ultraviolet stability, and heat resistance.
Polyarylsulfone	Thermoplastic resin composed mainly of phenyl and biphenyl groups linked by thermally stable ether and sulfone groups. Wide temperature range and good resistance to chemicals, impacts, and solvents leads to use in electrical insulation.
Polybutadiene	Family of thermosetting molding compounds formulated from essentially all-hydrocarbon polymeric resins containing high loadings of filler (such as ground silica) reportedly offer good physical properties, excellent electrical properties, and outstanding resistance to water and aqueous liquids. Heat aging results show the moldings to possess excellent high temperature stability at temperatures as high as 500°F (260°C) for as long as 1000 hours.
Polybutenes	A liquid used as a dielectric (See liquid dielectrics.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Polycarbonate resins	Polymers derived from the direct reaction between aromatic and aliphatic dihydroxy compounds with phosgene or by the ester exchange reaction with appropriate phosgene derived precursors. Strength, dimensional stability, flexibility, and predictable injection molding results are reasons why polycarbonates are suggested for structural parts in electrical products. Has outstanding heat stability, impact strength, and dimensional stability over a wide range of temperature and humidity environments, and stable electrical properties. Transparency, creep resistance, a high gloss surface, and low, predictable mold shrinkage are also important attributes.
Polychloroprene	Synthetic rubber polymer most often used as a jacket material. Although available in a variety of types and grades, it has generally good mechanical strength, abrasion, and cut through characteristics, and resistance to solvents and oils. It is thermoset, has good aging properties, and is quite flexible. Generally rated 167°F (75°C) to 194°F (90°C).
Polycrystalline	Polycrystalline ceramics have high dielectric strength, high melting point, 3704°F (2040°C), and are essentially gas-tight.
Polyester	Synthetic polymer most often used as a film or tape separator in wire or cables. Polyesters are generally good dielectric materials, are transparent, have high strength, and good resistance to heat and chemicals. Polyester tape wraps are often applied to isolate braided shields and to protect insulated conductors from damage. Rated 221°F (105°C) to 257°F (125°C).
Polyester magnet wire enamels	These films are composed of synthetic resin based on polyesters of terephthalic acid and polyhydric alcohols with or without a superimposed polyester film. The polyesters may be modified with other resins. The enamels can be used alone or two may be employed where one serves as an overcoat for the other. In addition, they may be overcoated with other polymers including nylon, amide-imide, epoxy, etc. There also are polyester-amide-imide and polyester-imide enamels. The many different types available provide a variety of desirable properties.
Polyesters, saturated	Family of polyesters whose molecular backbones are vinyl-saturated and unreactive. Some are low molecular weight liquids used as plasticizers or as reactants to form urethane polymers. Some are high molecular weight linear thermoplastics.
Polyesters, unsaturated	Family of polyesters characterized by vinyl unsaturation in the polyester backbone. These can cure and harden by copolymerizing with some reactive monomers. They are thermosetting and are used for potting electrical components and in reinforced plastics.
Polyethersulfone	A high temperature thermoplastic composed of repeating phenyl groups linked by thermally stable ether and sulfone groups. Good flame and tear resistance, transparency, and dimensional stability. Extruded and injection molded.
Polyethylene (PE)	Thermoplastic material composed of polymers of ethylene. A variety of types of polyethylene are used in wires and cables in very large amounts. Polyethylene has excellent electrical properties for wire and cable insulation plus superior abrasion and solvent resistance, moisture resistance, light weight, low brittle point, and durability. Polyethylene is used as an insulation or jacketing material for hook-up wire, coaxial cable, communication cable, line wire, lead wire, high voltage cable, etc. Flame retardant types of polyethylene are available. Chlorinated Polyethylenes (CPE) can be produced in a wide range of elastomeric to rigid polymers. They impart flame retardance and flexibility to blends with polyethylene. Other features reported for chlorinated polyethylene include resistance to low temperature cracking as well as ozone and oil resistance. CPE/PE blends have excellent heat and abrasion resistance.
Polyhalocarbon	General name for polymers containing halogen atoms. The halogens are fluorine, chlorine, bromine, and iodine.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Polyimide	High temperature thermoplastic resins available as molded parts, injection molding compounds, glass reinforced compression molding compounds, potting and encapsulating compounds, and plastic film and coatings for fabrics and wire. Have a wide range of physical and mechanical properties including high resistance to oxidative degradation, weathering, radiation, and all chemicals except strong bases; excellent resistance to abrasive and frictional wear; and excellent mechanical and electrical properties which can be retained during continuous use at 480°F (248.9°C) in air. (See tape - polyimide film.)
Polyisobutylene	Polymerization product of isobutylene. (See butyl rubber.)
Polymer	Compound formed by polymerization which results in the chemical union of monomers or the continued reaction between lower molecular weight polymers.
Polymerize	A process whereby compounds link together to form long chains. The compounds involved may be the same or may be a mixture of several compounds, in which case the result is a copolymer, terpolymer, etc. When polymerization of the same compound results in long chains, the end result is called a polymer. Plastics are the most common example of this. The properties of the polymer are usually radically different from that of the compounds which make it up. Polymerization usually results in the formation of a resin from simpler compounds. The hardening of resin residues after soldering is an example of polymerization.
Polyolefin	Family of plastics including cross linked polyethylene and various ethylene copolymers. Polyolefins are used as high speed laminated flat cable insulation. (See rubber - polyolefin based.)
Polyparbonic acid	(See tape - polyparbonic acid film.)
Polyphenylene sulfide	Crystalline aromatic polymer which features a service temperature of 450°F (232.1°C), excellent chemical resistance, and is non-burning. Has a melting temperature of 550°F (287.8°C) and can be used as an injection and compression molding compound and as a coating resin. Molded parts are rigid and tough. Available also in glass-reinforced compounds, with excellent electrical properties.
Polypropylene	Plastic made by the polymerization of high-purity propylene gas in the presence of an organometallic catalyst at relatively low pressures and temperatures. It is similar to polyethylene but is lighter and offers even better heat resistance, tensile strength, abrasion resistance, and lower dielectric constant. For high frequency work, a specially purified grade is required. The material is used in solid extruded and foam forms. In addition, polypropylene film is being used, either alone or in combination with other material, as a cable or core wrap to act as a thermal (during extrusion) or moisture barrier in cable constructions.
Polystyrene	Thermoplastic produced by the polymerization of styrene (vinyl benzene). The homopolymer is clear in color, has good electrical properties and good dimensional stability. Often copolymerized to overcome brittleness or increase chemical resistance. Used when stable dielectric loss is required.
Polysulfones	Strong heat-resistant thermoplastic, available, in both clear and opaque forms. The material is flame resistant and stable over a temperature range of -150°F (-118.9°C) to over 300°F (148.9°C) for extended periods of time. It can be electroplated. Chemically, the polymer is composed of phenylene units, linked by three different chemical groups - isopropylidene, ether, and sulfone. The presence of a diphenylene sulfone group in the linkage is responsible for the polymer’s thermal stability, resistance to oxidation, and rigidity at elevated temperatures.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Polytetrafluoroethylene (PTFE)	This is the most thermally stable and chemically resistant of all carbonaceous insulating compounds. It is unaffected by sunlight, moisture, and practically all chemicals. Temperature range is -130°F (-90°C) to 482°F (250°C) and electrical properties are very constant over the temperature range and a wide range of frequencies. Insulation may be applied by extrusion, taping, dipcoating, and in cases where another material is used, by dispersion coating. Both conventional and ribbon type wires are made as well as magnet wire. PTFE is used for both primary insulation and extruded jackets. Also as TFE.
Polytrifluorochlor-ethylene	This material approaches PTFE in many properties but is characterized by somewhat lower heat resistance.
Polyurethane	This material is primarily of interest as a magnet wire enamel for wires which can be soldered without prior removal of the film. The mechanical, chemical, and electrical characteristics of the wires are such as to render them suitable for withstanding winding hazards. Extruded polyurethane is being used for jacketing coaxial and hook-up cables. In tape form, it is suggested as a cable jacketing wrap. Polyurethane resins Family of resins used to form thermosetting materials by reacting with water, glycols, or other urethanes, under the action of heat or catalysts.
Polyvinyl Chloride (PVC)	Thermoplastic material composed of polymers of vinyl chloride. PVC is widely used for primary wire insulation or jacketing on communication wires, control cables, bell wire, building wire, hook-up wire, fixture wire, appliance cords, power cables, lighting cables, motor leads, and other low voltage work (to 600 V). Many different formulations are available including grades for high temperatures, low temperatures, flame resistance, deformation resistance, etc. Dielectric strength is excellent and flexibility is very good. Some formulations may have limitations when considering toughness, moisture resistance, and resistance to chemicals. PVC is probably the most versatile of the lower cost, conventional temperature wire insulations in round and ribbon forms. A conductive vinyl can be used to obtain shielding and mechanical protection at the same time.
Polyvinyl formal	This magnet wire film is formed in place from a solution of two principal resins. In some cases one or more other resins may be added. The resin present in the larger proportion is polyvinyl formal. The resin present in smaller proportion is an alkyl phenol-formaldehyde condensation reaction product. This wire has been used in very large quantities. The characteristics are such that it is suitable for use in most electrical apparatus designed for operation as class A devices. It has excellent windability. It is compatible with most insulations, varnishes, and compounds.
Polyvinylidene fluoride	This thermoplastic resin, a fluorocarbon, is characterized by good (PVF) mechanical, electrical, and chemical properties. In primary insulation and in jackets for multi-conductor cables, it has performed successfully at temperatures from -80°F (-62.2°C) to 300°F (148.8°C). This material can be extruded, or applied as a film, or solution or dispersion coating. PVF offers excellent resistance to abrasion and cut-through. Radiation cross-linking provides improved heat resistance. Applications include hook-up, control, aircraft, lead, and computer wires and cables.
Porcelain	Porcelain exhibits satisfactory electrical properties for low frequency insulation, but poor performance for high frequency insulation.
Porcelainize	To coat and fire a metal with glass material, as in forming a hybrid circuit substrate.
Porosity	Fine holes or pores within a substance.
Portable power cable	Flexible, all rubber insulated for hard usage. Some cables have shielded conductors (metallic or nonmetallic and can have neoprene sheath overall).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

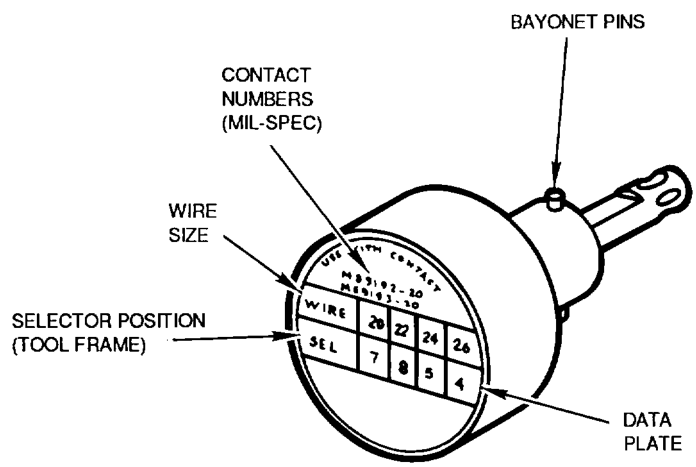
Term	Definition
Positioner	Device that is attached to a crimping tool and locates the contact in the correct location. 
Positive lap wound	(See taped insulation.)
Positive lock	(1) Type of latch or locking mechanism used to hold a die set in an installation tool, or an insert in a connector shell, in such a way that the parts cannot be unlocked accidentally. (2) Describes retention of certain wire terminating contacts (tabs) used with edge or printed circuit connectors.
Positive (noun)	Artwork, artwork master, or production master in which the intended conductive pattern is opaque to light, and the areas intended to be free from conductive material are transparent.
Post insulate	To insulate a connection after assembly.
Post-type terminals	Fixed posts around which wire is wrapped and secured with a threaded nut, or over which a terminal, such as blade, tongue, etc., is placed and secured.
POT	Designation for thermoplastic, parallel, light duty ripcord, 300 V, 140°F (60°C).
Pot	(1) Vessel for holding molten metal. (2) To embed a component or assembly in a liquid resin using a case, shell, or other container which remains as an integral part of the product after the resin is cured.
Potential voltage	Work per unit charge required to bring any charge to the point at which the potential exists.
Pot Life (working life)	Time required for a curing thermoset plastic composition to become unusable in the mass ordinarily mixed at one time (usually either 100 g or 415 ml).
Potting	Process of completely enclosing an article in an envelope of liquid dielectric material which then changes to a solid. Potting is performed to improve and protect the electrical functions of the unit. The compound acts as a dielectric and provides strain relief and protection to the unit from the environment.
Potting compound, addition cure silicone rubber	Addition cure silicone rubbers are distinguished by their reversion resistance to combustion, even without additives (which enables their use in hazardous locations). Dissipation factor dielectric strength, and volume resistivity values are equal to those of the best RTV silicone rubbers, dielectric constants are generally lower.
Potting compound, chemically cured polyurethane, polyether based	Compound used in potting connectors when resistance to oil and fuel is required at temperatures not exceeding 275°F (125°C). Conforms to MIL-M-24041. (See potting.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

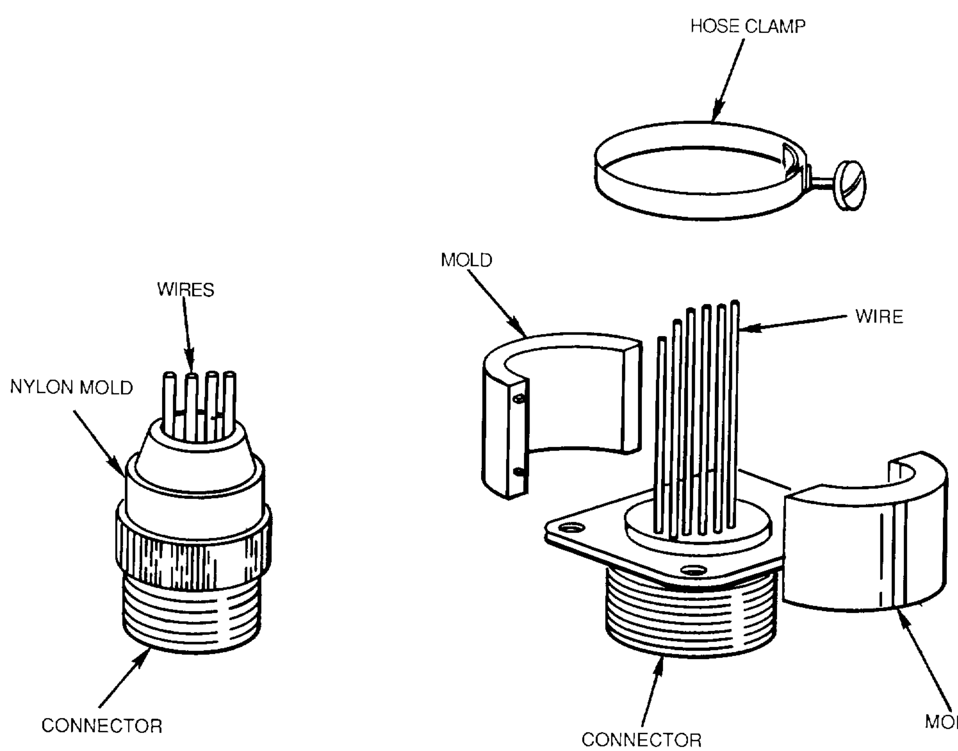
Term	Definition
Potting compound, depolymerized rubber	A room temperature curing polymer which will not stress delicate components during cure nor during temperature cycling. They exhibit good resistance to vapor transmission, ozone, corona, and fungus. (See potting.)
Potting compound, epoxy	Epoxy compounds have become the most widely used materials for potting and encapsulation and have established the performance standards against which other materials often are evaluated. They are especially desirable since they provide excellent adhesion, absence of weight gain and low shrinkage when cured, good electrical properties, resistance to moisture and chemicals, and good compatibility and adaption with other materials. (See potting.)
Potting compound, ethyl cellulose base	A thermoplastic potting compound which is a blend of waxes and plasticizers in an ethyl cellulose base. It can be melted at about 350°F (176.7°C) for sealing and insulating connectors, rectifiers, capacitors, etc. It sets into a hard, tough material. (See potting.)
Potting compound, plastasols	Dispersions of polyvinyl chloride paste resin in a plasticizer. They are supplied as liquids, but with a temperature of 325°F, (162.8°C) to 375°F (190.6°C), they convert irreversibly into a solid. They possess excellent electrical properties.
Potting compound, RTV	(See Room Temperature Vulcanizing silicone rubber.)
Potting mold	Item, solid or split, designed to be used as a hollow form into which potting compound is injected and allowed to cure or set to seal the back of an electrical termination. The potting may eliminate the need for a back shell on the connector. The form may or may not be removable after potting. (See potting.)  TYPICAL ONE-PIECE PLASTIC MOLD TYPICAL SPLIT TYPE CIRCULAR MOLD
Pour point	Lowest temperature at which a viscous substance will pour.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

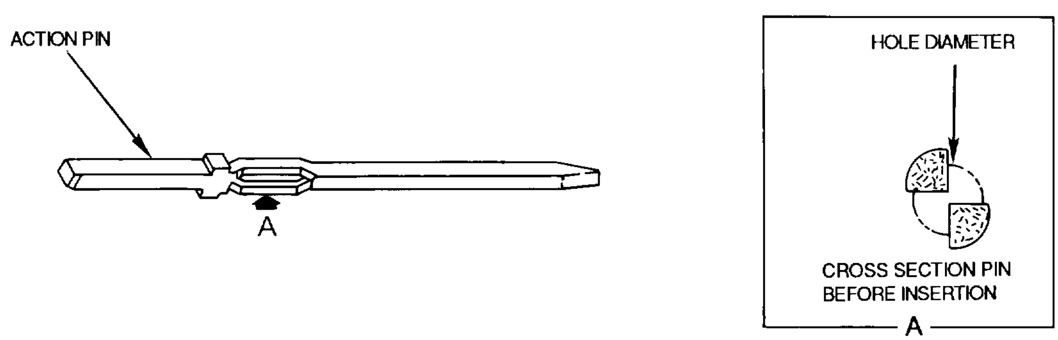
Term	Definition
Power (P)	Rate of doing work, equivalent to the work divided by time, or, in a DC circuit, the product of voltage and current. Expressed in watts (W). (See formulas-electrical.)
Power cable	Various cable sizes and constructions that are used to supply electrical power to many types of equipment.
Power contact	Type of contact used in multi-contact connectors to support the flow of rated current.
Power converter	An “AC-to-DC” converter which converts the +12 to +15 VDC power received from the controller/host to the voltages required by the fiber optic transceiver optoelectronic circuitry.
Power efficiency	Ratio of emitted optical power from a source to the electrical input power.
Power Factor (PF)	Ratio of resistance to impedance. The ratio of the actual power of an alternating current to apparent power. Mathematically, the cosine of the angle between the voltage applied and current resulting. (See formulas - electrical.)
Pre-bond	Term used for stranded wire which has been fused, topcoat tinned, or overcoat tinned.
Precious metal	One of the relatively scarce and valuable metals; gold, silver, and the platinum-group metals. (See noble metals.)
Pre-insulate	Insulation of a connector prior to assembly of the contact or terminal on the conductor.
Prepreg	Sheet material, notably glass cloth, available with semicured resins. These consist of the base material impregnated with a synthetic resin such as epoxy or polyimide partially cured to the B-stage. These materials are molded under heat and pressure for multilayer printed circuitry, and used for bonding together the individual circuit layers of multilayer printed circuit boards. As a general rule, for dielectric purposes, the thickness of the prepreg should be twice that of the copper foil. The bonding sheets or prepregs are available in both general purpose and flame-resistant types.
Press-fit contact	An electrical contact which can be pressed into a hole in an insulator, printed board (with/without plated-through holes), or a metal plate. 
Pressure cable	An oil-impregnated, paper-insulated cable in which positive gauge pressure is maintained on the insulation under all operating conditions.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

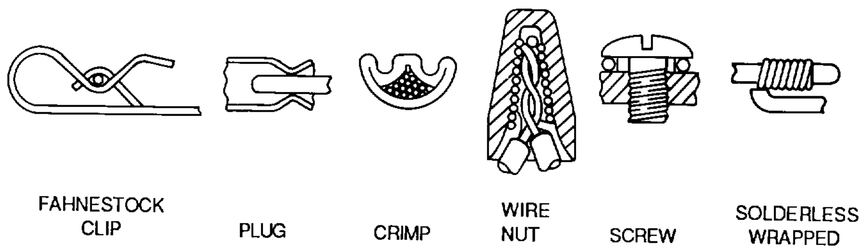
Term	Definition
Pressure connection	An electrical connection which is maintained by a mechanical force holding conductors together.  TYPICAL PRESSURE CONNECTIONS
Pressure differential	Difference in pressure between one side of a connector and the other as in a bulkhead mounting, or the pressure difference between the inside and outside of a sealed connector.
Pre-tinned	Solder applied to either or both the contact and conductor prior to soldering.
Pre-tinned solder cup	Solder cups whose inner surfaces have been precoated with a small amount of tin-lead solder.
Primary insulation	Nonconductive material, usually the first layer, over a current-carrying conductor. Main function is to act as an electrical barrier for the applied potential.
Primary support	Support provided for wiring which carries the weight of the wiring and secures it in the intended position.
Primary winding	Transformer winding which receives the energy from a supply circuit.
Printed Circuit (PC)	(1) A generic term to describe a certain technique. (2) Circuit obtained by printing and comprising printed and/or conventional components, printed wiring, or a combination thereof, all formed in a predetermined design in, or attached to a surface or surfaces of a common base.
Printed Circuit (PC) board	General term for completely processed printed circuit or wiring configurations. It includes single, double, and multilayer boards, both rigid and flexible.
Printed component part	A component part, such as an inductor, resistor, capacitor, or transmission line, which is in printed form.
Printed contact	Portion of a conductive pattern formed by printing, serving as one part of a contact system.
Printed wiring	Printed circuit, or a portion thereof, intended primarily to provide point-to-point electrical connections.
Printed wiring assembly drawing	Document that shows the printed board (rigid or flexible), the separately manufactured components which are to be added to the board, and any other information necessary to describe the joining of these parts to perform a specific function.

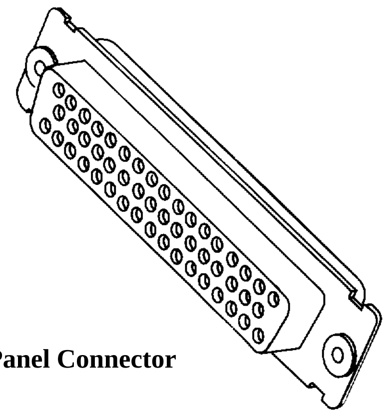
TABLE 2. TERMS AND DEFINITIONS (Cont.)

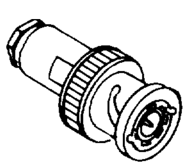
Term	Definition
Printed wiring layout	Sketch that depicts the printed wiring substrate, the physical size and location of electronic and mechanical components, and the routing of conductors that electrically interconnect components, in sufficient detail to allow the preparation of documentation and artwork.
Programmed wiring	Method by which conductors are attached to a multicontact termination panel by a programmable machine. Applicable to highly dense wiring and high production quantities. Wire attachment is by automatically wrapping the wire around a solid, square, or rectangular terminal.
Programming	(1) Ability to select various circuit patterns by interconnecting or jumping appropriate contacts on one side of a connector plug or panel. (2) The setting up of a computer to perform a predetermined task.
Propagation delay	Time delay between input and output of signal usually measured in nanoseconds per foot of cable.
Propagation time	Time required for an electrical signal to travel between two points on a transmission line.
Proportional limit	Maximum stress at which strain remains directly proportional to stress.
Protocol converter	Device for translating the data transmission code and/or protocol of one network or device to the corresponding code or protocol of another network or device, enabling equipment with different conventions to communicate with one another.
Proximity effect	Phenomena or non-uniform current distribution over the cross-section of a conductor caused by the variation of the current in a neighboring conductor.
PRT	(See Pulse Repetition Time.)
PS	Designation for thermostat cable with solid conductors, individual rubber insulation and cotton braid. Twisted, rubber jacket and cotton braid overall.
PSH	Three conductor cable. Each conductor has type PS shielding over the insulation and contains ground wires. The insulation is extra heavy. Recommended for intermediate voltage where extra safety factor is needed.
PTFE	Also as TFE (See Polytetrafluoroethylene.)
Pulling eye	Device fastened to a cable in order to pull the cable into or from a duct.
Pull-out force	Force necessary to separate a conductor from a contact or terminal, or a contact from a connector, by exerting a tensile pull.
Pull strength	Amount of force (in pounds/kilograms) necessary to break a piece of material when loaded or pulled in a straight line at a constant rate. Rate of pull is in inches per minute.
Pulse	Energy which changes abruptly from one intensity to another. May be light energy or electrical energy.
Pulse cable	Type of coaxial cable constructed to efficiently transmit repeated high voltage pulses.
Pulse dispersion	Widening of a pulse as it travels the length of a fiber.
Pulse Repetition Time (PRT)	Time to complete one complete cycle of a waveform in seconds or fractions of a second. (See frequency.)
Pulse spreading	Dispersion of incoming optical signals along the length of an optical fiber.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

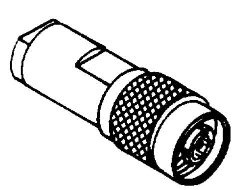
Term	Definition
Purple plague	One of several gold-aluminum compounds formed when bonding gold to aluminum and activated by re–exposure to moisture and high temperature 93.2°F (34°C). Purple plague is purplish in color and is very brittle, potentially leading to time-based failure of the bonds. Its growth is highly enhanced by the pressure of silicon to form ternary compounds.
Put-up	Packaging length for finished wire or cable.
PVC	(See Polyvinyl Chloride.)
PVF	(See Polyvinylidene Fluoride.)
PW	Designation for moisture proof, reinforced, portable cord with two or more rubber insulated conductors with individual cotton braid. Moisture resistant cotton braid finish over rubber jacket, 300V to 600 V. Sometimes referred to as PWP.
Q-factor	(See inductor quality.)
QPL	Qualified Products List issued by the U.S. Government.
Quad	(1) Series of four separately insulated conductors, generally twisted together in pairs. (2) Series-parallel combination of transistors with increased reliability because failure of one transistor will not disable the entire circuit.
Quadders	Three-bay machines which can twist four wires together. They can cable braided and shielded wires with varying lay lengths.
Quad-indent	Indentor configuration of a crimp tool producing four closely grouped indents on the connector barrel. Also called four indent. (See crimp termination.)
Qualitative analysis	Analysis of an unknown that determines what elements or compounds are present in an unknown. This type analysis does not indicate the amounts of the components present.
Quantitative analysis	Analysis that determines what elements and/or compounds are present in an unknown and the quantity of each.
Quartz	Quartz has low loss properties, therefore, its presence with a low loss fluxing or gloss phase results in low loss ceramic insulation.
Quench	Process of shock cooling a thermoplastic from a molten state. Often accomplished by immersion in water just after material is removed from mold.
Quick disconnect	Type of connector or splice which permits relatively rapid locking and unlocking of mating parts.
R	(1) Designation for rubber insulated building wire, 600 V, 140°F (60°C). (2) (See Resistance.)
Rack	Type of structure used to house electronic components which permits convenient removal of portions of the equipment.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

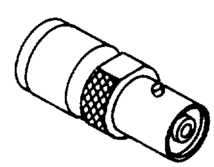
Term	Definition
Rack and panel connector	Connects the inside back end of the cabinet (rack) with the drawer containing the equipment when it is fully inserted. The drawer permits convenient removal of portions of the equipment for repair or examination. Special design and rugged construction of the connector allows for variations in rack to panel alignment.  **Typical Rack and Panel Connector**
Rad	The unit of measure of radiation dose.
Radial lead	Lead extending out the side of a component rather than from the end. (See axial lead.)
Radiance (fiber optic)	Radiant flux per unit solid angle and per unit surface area normal to the direction considered. The surface may be that of a source, detector, or any other surface intersecting the flux.
Radiant power	Time rate of flow of radiant energy, expressed in watts.
Radiation pattern (fiber optic)	For a fiber or bundle, a curve of the output radiation intensity plotted against the exit angle.
Radio Frequency Interference (RFI)	Electromagnetic radiation in the radio frequency spectrum from 15 KHz to 100 GHz. The best shielding materials against RFI are copper and aluminum alloys. The term Electromagnetic Interference (EMI) should not be used in place of RFI since shielding materials for the entire electromagentic frequency spectrum are not available.
Radio Frequency (RF)	Frequency spectrum from 15 KHz to 100 GHz.
Radio Frequency (RF) connector	Connector which terminates or connects coaxial cable.



BNC SERIES
PLUG



N SERIES
PLUG



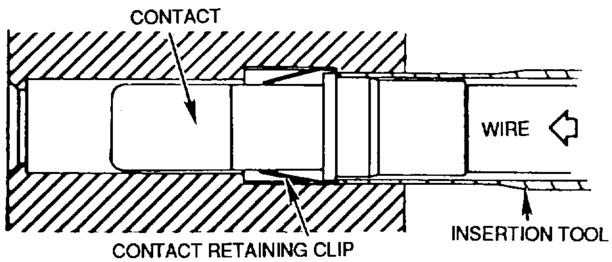
C SERIES
STRAIGHT
RECEPTACLE

TABLE 2. TERMS AND DEFINITIONS (Cont.)

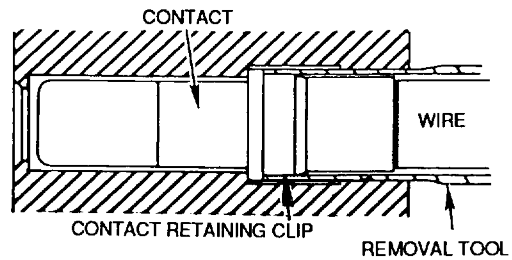
Term	Definition
Radio Frequency (RF) contact	Impedence matched shielded contact.
Rail (track or frame)	Device to contain and retain a number of modules.
Rainbow cable	Two or more insulated conductors of different colors bonded into two flat parallel configurations.
RAM	(See Random Access Memory.)
Ram	The moving portion in the head of a crimping tool.
Ram extruder	Type of wire-making machinery for extruding PTFE teflon insulation over a conductor.
Ramp	Portion of a terminal connector located between the tongue and the barrel. Also called stuff.
Random Access Memory (RAM)	Type of memory which offers access to storage locations within it.
Random winding	Winding in rotating equipment wherein the wires do not lie in an even pattern.
Range	Number of sizes of connectors or cables of a particular type.
Range, wire	(1) Sizes of conductors accommodated by a particular barrel. (2) The diameters of wires accommodated by a sealing grommet.
Ratchet control	Device to ensure the full crimping cycle of a crimping tool.
Rated temperature	Temperature at which one material is deemed to be operable without undue degradation or safety hazard.
Rated voltage	Maximum voltage at which an electric component can operate for extended periods without undue degradation or safety hazard.
Ray angle (fiber optic)	The angle between a light ray and a reference line or plane, usually the optical conductor face.
Ray (fiber optic)	Straight line, representing light, perpendicular to the light wave front and traveling in the same direction. At a boundary surface, or interface such as the surface between a fiber core and cladding, the ray may change direction suddenly, but it remains a straight line.
Rayleigh scattering	Scattering of refractive index fluctuations that are small with respect to wavelength.
Rayon	Synthetic used for yarn serving and braid applications generally in the same applications where cotton can be used.
RD	Designation for rubber insulated twin conductors, fibrous covered.
RDL	Designation for rubber insulated twin conductors, lead covered.
Reactance (X)	Opposition offered to the flow of alternating current by inductance (X) or capacitance (X) of a component or circuit. (See formulas - electrical.)
Read Only Memory (ROM)	A random access storage in which the data pattern is unchangeable after manufacture.
Read out	Term used with printed circuit boards and printed circuit connectors, meaning the ability to make contact with certain circuits. Example: a double readout printed circuit connector will permit two wires to be connected to any one circuit on the printed circuit board.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Rear release contact	Connector contact released and removed from the rear (wire side) of the connector. The removal tool engages the contact from the rear and pulls the contact out of the connector contact retainer, and out the rear of the connector.



INSERTION



REMOVAL

Rear seal	Design feature which provides an environmental seal at the rear of the plug or receptacle. It generally consists of rubber grommets which fit between the wire and sidewall of the insert cavities, or consists of a flat sheet of rubber which fits between the back-up of plate and insert of the plug and receptacle. This flat sheet of rubber is sometimes called family or group seal since it contains the same number of holes as the insert has cavities. It is through these holes that wires are threaded to the connector contacts.
Receiver, optical (fiber optic)	Electro-optical module which converts an optical input signal to an electrical output signal. (See fiber optics.)
Receiving element (fiber optic)	The accepting terminus in an optical junction. (See terminus.)
Receptacle	Electrical connector assembly with contacts constructed to be electrically connected to a cable, coaxial line, cord, or conductor to join with another electrical connector, and designed to be mounted on a bulkhead, wall, chassis, or panel.
Rectangular terminal	Terminal whose tongue is rectangular in shape.
Red	Unit of radiation dose which is absorbed, equal to 0.01 joule/kilogram.
Red plague	A powdery brown-red growth sometimes found on silver coated copper conductors and shield braids. It is fungus-like in appearance and will appear in random spots along the length of a conductor or shield. It most often occurs at the point of crossover in a shield or in the interstices of a standard conductor. Proper design and material selection has largely eliminated this problem.
Redraw	Consecutive drawing of wire through a series of dies to reach a desired wire size.
Reducing joint	Joint between two lengths of cable where the conductors are not the same size.
Reduction	Chemical process opposite to oxidation, In the narrow sense, reduction is the removal of oxygen from a compound, such as the reduction of lead oxide to metallic lead. In the general chemical sense, reduction is a decrease in the positive charge on an element or ion. The process of plating, for example, converts metal ions in solutions to the metallic form of the element by gain of an electron. This reduces the positive charge of the ion thus, a reduction process.
Reel	Revolvable flanged device made of wood and/or metal which is used for winding flexible metal wire or cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

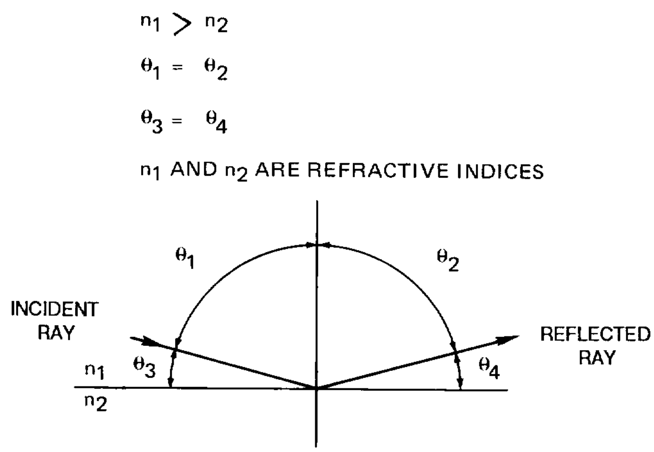
Term	Definition
Reference designation	Unique combination of letters and numbers assigned to each electrical part or item within the aircraft. The reference designations are labeled on identification markers close to or on electrical parts or items, and are divided into three major categories: electrical components, aircraft splices, and ground points.
Reference edge	Edge of cable or conductor from which measurements are made. Sometimes indicated by a thread, identification stripe, or printing. Conductors are usually identified by their sequential position from the reference edge, with number one conductor closest to this edge. Sometimes called index edge.
Reference surface	Surface of an optical fiber which is used to contact transverse alignment elements of a connector or other component.
Reflectance	Ratio of reflected power to incident power.
Reflection (fiber optic)	Change in direction of a light wave, or light ray when it strikes a surface. 
Reflection loss	Part of a signal which is lost due to reflection of power at a discontinuity, or a non-uniformity in the shield or conductor.
Reflow	(See fusing.)
Reflowing	Melting of an electrodeposit followed by solidification. The surface has the appearance and physical characteristics of being hot-dipped (especially tin or tin alloy plates).
Reflow soldering	Method in which a solder joint is made by melting the solder coatings on the mating surfaces.
Refraction (fiber optic)	Bending of lightwaves or rays as they go from one material to another due to the difference in velocity in the materials.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

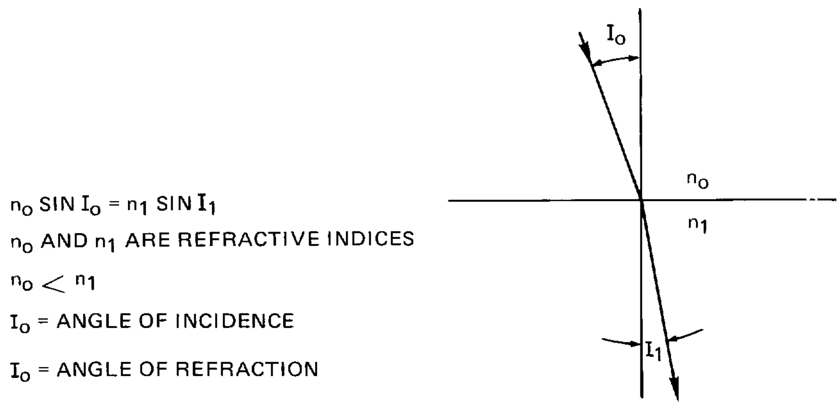
Term	Definition
Refractive index (n) (fiber optic)	Ratio of the velocity of light in a vacuum to its velocity in a material such as a fiber. Also, the ratio of the sine of the angle of incidence of light on the material to the angle of refraction of the light. The refractive index of any material varies with the wavelength of the light. Also called index of refraction. In a fiber, core refractive index must be greater than that of the cladding. 
Refractive index profile	Description of refractive index as a function of radius in a fiber.
Refractory	Difficult to fuse material such as a ceramic which requires extremely high fusion temperatures.
Registration	Degree of conformity of the position of a pattern, or a portion thereof, with its intended position or with that of any other conductor layer of a board.
Reinforced sheath	Outmost covering of a cable that has cable sheath constructed in layers with the addition of a reinforcing material, usually a braided fiber, molded in place between layers.
Reinforcement	Material used to reinforce strengthen, or give dimensional stability to another material such as the braid portion of a sheath constructed in layers.
Relay	Electrically controlled device that opens and closes electrical contacts to effect the operation of other devices in the same or another electrical circuit.
Reluctance	Property of a magnetic circuit which determines the total magnetic flux in the circuit when a given magnetomotive force is applied.
Remanence	Magnetic induction that remains in a magnetic circuit after the removal of an applied magnetomotive force.
Removable contact	A contact that can be mechanically joined to, or removed from an insert. Usually, special tools are required to lock the contact in place, or remove it for repair or replacement.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

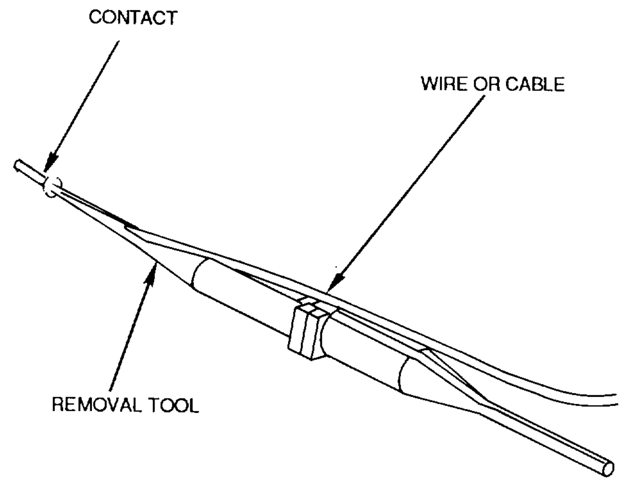
Term	Definition
Removal tool	Hand tool used to remove a contact from a connector, insert, or retainer.  TYPICAL PLASTIC REMOVAL TOOL
Repair	Approved operations performed on a nonconforming article to place the article in a usable condition.
Repeater (fiber optic)	Device which converts a received optical signal to its electrical equivalent, reconstructs the source signal format, and amplifies and reconverts it to an optical output signal; used to overcome previous attenuation.
Residual elements	Elements present in an alloy in small quantities, but not added intentionally.
Resin	Solid or semi-solid organic compound lacking a crystalline structure. Resins are characterized by not having definite and sharp melting points, are usually not conductors of electricity and many are transparent or translucent. Natural resins usually originate in plants, such as pine sap, and are not water-soluble. The rosin used in soldering fluxes is an example of a resin. Synthetic resins may have many of all of the properties of natural resins.
Resin, A stage of	Condition of low molecular weight of a resin polymer during which the resin is readily soluble and fusible.
Resin, B stage of	Condition of a resin polymer when it is more viscous, with higher molecular weight. It is insoluble, but plastic and fusible.
Resin, C stage of	Condition of a resin polymer when it is in the solid state, with high molecular weight, being insoluble and infusible.
Resin-rich	Significant thickness of non-reinforced, surface-layer resin of the same composition as that within the base material. Also called butter-coat.
Resist	Coating material used to mask or protect selected areas of a pattern from the action of an etchant, solder, or plating.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

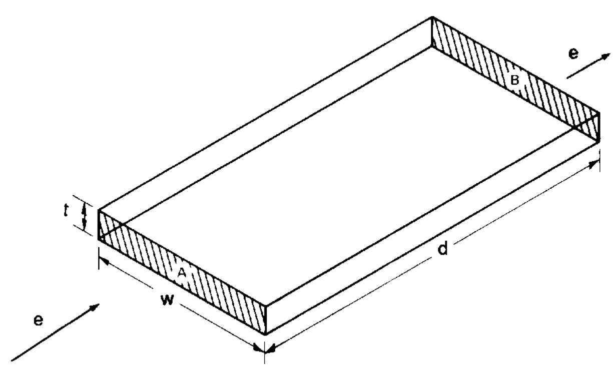
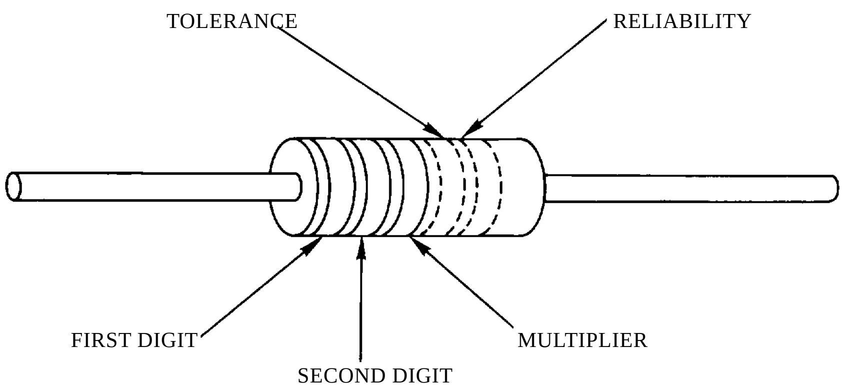
Term	Definition
Resistance alloys	Electrical resistance alloys are used to control or regulate either alternating or direct current. The electrical properties of interest are resistivity, temperature coefficient of resistance, and thermoelectric potential. The first is a measure of the resistance to the flow of current in a metal or alloy, while the second is a measure of the consistency of the resistance over a range of temperatures. The last defines the electromotive force generated when two dissimilar metals are joined and exposed to a variation in temperature.
Resistance brazing	Brazing by resistance heating, the joint being part of the electrical circuit
Resistance heating	Resistance heating is based on the resistance of an air gap, which causes arc and rapid heating until gap is filled by metal.
Resistance (R)	Property of an electrical component or assembly that describes its resistance to the flow of electricity. The unit of measurement of resistance is called an ohm, symbolized by the Greek letter Omega (Ω). The intrinsic property of a material that describes its resistance is called resistivity. The terms resistance and resistivity should not be confused, in as much as an assembly containing a material with a high resistivity may, because of its size, have a lower resistance than one containing a low resistivity material. An analogy to this would be two pipes of differing sizes. Under a given hydraulic pressure, the larger pipe will carry more water, or conversely it has a lower resistance to fluid flow. Solders usually-range from 10 to 20 times the resistivity of copper, which is the normal standard. Despite this, there is usually no problem with the resistance of a solder joint because of its large cross-section as compared to the copper conducting wires. (See formulas-electrical.) Resistance soldering Method of soldering in which a current is passed through and heats the soldering area by contact with two electrodes.
Resistance soldering	Method of soldering in which a current is passed through and heats the soldering area by contact with two electrodes.
Resistance welding	Welding in which the metals to be joined are heated to melting temperatures at their points of contact by a localized electric current while pressure is applied.
Resistive conductor	Conductor used primarily because it possesses the property of high electric resistance.
Resistivity	Ability of a material to resist passage of electrical current either through its bulk, or on a surface. The unit of volume resistivity is the ohm. The resistivity does not change from 1 in. to 1 ft. According to the laws of electron flow, at a given t (thickness of coating), the resistivity between the faces (A and B) varies directly with d, doubling as d doubles. Resistivity also varies inversely with w, halving as w doubles. Thus, as long as d equals w, and t remains the same, for all practical purposes, the resistance remains the same in ohms per square. Varying the thickness of the coating (t), is the primary method of varying the resistivity. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Resistor	A device designed to intentionally limit the flow of current, or to provide a voltage drop.

TOLERANCE



Color of Band	First and Second Digits	Multiplier
Black	0	1
Brown	1	10
Red	2	10^2
Orange	3	10^3
Yellow	4	10^4
Green	5	10^5
Blue	6	10^6
Violet	7	10^7
Gray	8	10^8
White	9	10^9
Gold	—	0.01
Silver	—	0.01

Tolerance	
Gold	± 5%
Silver	± 10%
None	± 20%

Reliability (NOTE)	
Brown	1%
Red	0.1%
Orange	0.01%
Yellow	0.001%

NOTE

% Failures Per 1000 Hours

TABLE 2. TERMS AND DEFINITIONS (Cont.)

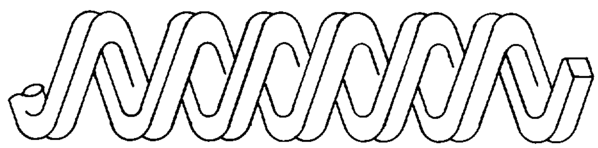
Term	Definition
Resolution	A measure of the thinness of a line a photoresist can successfully reproduce in a circuit.
Responsivity	Ratio of an optical detector's electrical output to its optical input, the precise definition depending on the detector type.
Respool	To rerun material from one package spool to another for various purposes, such as to verify lengths, inspect the defect, etc.
Retractile cable	Cable that returns, by its own stored energy, from an extended condition to its original contracted form. 
Retractile cord	Cord having specially treated insulation or jacket so that it will retract like a spring. Retractibility may be added to all or part of a cord's length.
Return wire	Common wire, a ground wire, or the negative wire in a direct-current circuit.
Rework	Reprocessing of articles or material that will make the articles or material conform to the drawings, specification, or contract.
RF	(1) Designation for fixture wire, code or latex rubber insulation and braid over solid or stranded conductor, 140°F (60°C). (2) (See Radio Frequency.)
RFH	Same as RF, with rubber or latex rubber insulation, heat resistant, 167°F (75°C).
RFI	(See Radio Frequency Interference.)
RG	Military designation for coaxial cable.
RG/U	Radio Guide. Universal. RG is the military designation for coaxial cable.
RH	Designation for rubber insulated, heat resistant, building wire, 167°F (75°C).
RHD	Designation for rubber insulated, twin conductor, heat resistant, fibrous covered wire.
RHDL	Same as RHD, except lead instead of fibrous covered.
RHH	Designation for rubber insulated, heat resistant, building wire, 194°F (90°C.)
RHL	Same as RHH, but with lead sheath overall.
RHM	Designation for rubber insulated, multiple conductors, heat resistant and overall fibrous covered.
RHML	Same as RHM, but with lead cover overall.
Rhodium	Rare metal which is found in platinum ores. It is the hardest of the platinum-group metals, and is one of the most infusible. The plated metal has a high corrosion resistance and a light reflectivity of 80%. Rhodium is valued for use in electrical contacts.
RH/RW	Designation for rubber insulated, heat and moisture resistant, building wire, 167°F (75C) dry; 140°F (60°C) wet.
RHW	Designation for rubber insulated building wire, heat and moisture resistant, 167°F (75°C) dry or wet.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Ribbon cable	Flat cable with conductors that have been individually insulated together. Structure is usually characterized by individual colors of insulation for each conductor, although a single color may be used for all conductors. (See flat cable.)
Ridge marker	One or more ridges running laterally along the outer surface of plastic wire for purposes of identification. Readily perceptible to sight and touch, they are formed by minute notching of the extrusion die.
Jackscrew (screwlock)	Screw attached to one-half of a two piece multiple contact connector used to draw and hold both halves together and to separate them. (See mechanically engaged connector.)
JAN specification	Joint Army-Navy specification.
Joint	Location where two or more members are to be or have been fastened together mechanically or by brazing, welding, or soldering.
Joint clearance	Dimensions between interfaces of the soldered joint.
Joule (j)	Unit of energy or work. The absolute joule is equal to 10 million ergs or 0.7375 foot pounds. The internal joule is equal to the work required to maintain a current of one ampere for one second in a resistance of one ohm.
Jumper	Electrical connection between two points on a printed board added after the intended conductive pattern is formed.
Junction	Joining of two different semiconductors or of semiconductor and a metal. Alloy, diffused, electrochemical, and grown are the four junction types.
Jute	Natural fiber of plant base formed into rope-like strands. Used in cables for filling the interstices to give a round cross-section.
K	(1) (See dielectric constant.) (2) (See Kilo.)
ROM	(See Read Only Memory.)
Room Temperature Vulcanizing (RTV) silicone rubber	RTV silicone rubbers cure at room temperature to produce durable resilient and flexible silicone rubbers. They exhibit good physical and electrical properties, high and low temperature flexibility, solvent and ozone resistance, easy release, and excellent bonding ability.
Root Mean Square	Applied to alternating voltage and current, the effective value, that is, it (RMS) produces the same heating effect as a direct current or voltage of the same magnitude. Means of expressing AC voltage in terms of DC. The RMS is equal to 70.79 of the AC peak voltage.
Rope concentric	Group of standard conductors assembled in a concentric manner. The direction of lay of the outer rope members is left hand.
Rope-lay conductor or cable	Cable composed of a central core surrounded by one or more layers of helically laid groups of wires. This kind of cable differs from a concentric-lay conductor, in that the main strands are themselves stranded. In the most common type of rope-lay conductor or cable, all wires are of the same size, and the central core is a concentric-lay conductor.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

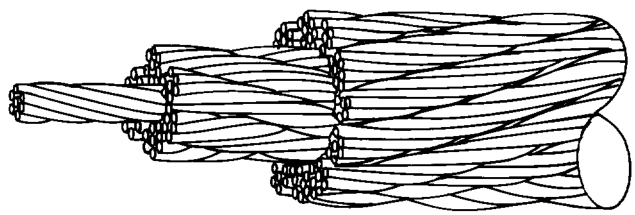
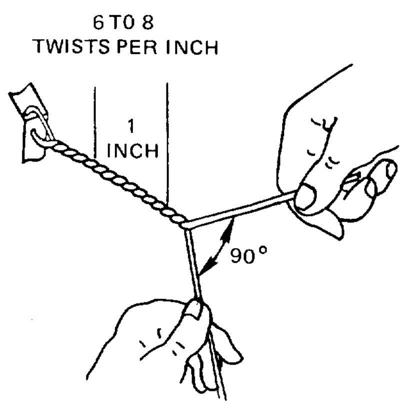
Term	Definition
Rope strand	Conductor or cable composed of a central core surrounded by one or more layers of helically laid groups of wires. 
Rope unilay	Group of stranded conductors assembled in a unilay manner. The direction of lay of the unilay rope is left hand.
Rosin	Naturally occurring resin usually associated as a component of pine sap. It is a mixture of several organic acids, of which abietic acid is the chief component. Rosin, alone, is a mild flux for soldering operations.
Rosin base flux	Flux made from rosin dissolved in an organic solvent.
Rosin core solder	Wire solder containing a rosin flux.
Rosin joints	Flux trapped in the solder joint identifies this defect. The entrapment is usually due to insufficient heat or insufficient time at soldering temperature, or both. The flux, under the conditions noted, cannot boil off the surfaces it is protecting and rise to the surface of the solder. The results of this defect are usually insufficient bonding and high electrical resistance.
Round conductor flat cable	Cable made with parallel, round conductors in the same plane. (See flat cable.)
Round wire shields	Shields constructed from bare, tinned, or silverplated copper wire. Three types of round wire shields include braided, spiral, and reverse spiral.
Router	An electronic device interconnecting two or more networks that operate at a Network Layer of the OSI model.
Routing	Path followed by a cable or conductor.
Roving	A collection of carded fibers rubbed into a single soft and bulky strand without twist, or a sliver which has been drawn out and slightly twisted. In the case of glass, roving is a collection of continuous filament, untwisted strands into a single bulky strand.
RP	Designation for performance grade rubber insulation, 140°F (60°C).
RR	Designation for rubber insulation, neoprene jacket.
RS	Designation for integral Rubber insulation and jacket on Single conductor cables.
RS-232-C	Technical specification published by the EIA that specifies the mechanical and electronic characteristics of the interface for connecting DTE and DCE.
RS-422	Standard operating in conjunction with RS-449 that specifies electrical characteristics for balanced circuits.
RS-423	Standard operating in conjunction with RS-449 that specifies electrical characteristics for unbalanced circuits.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

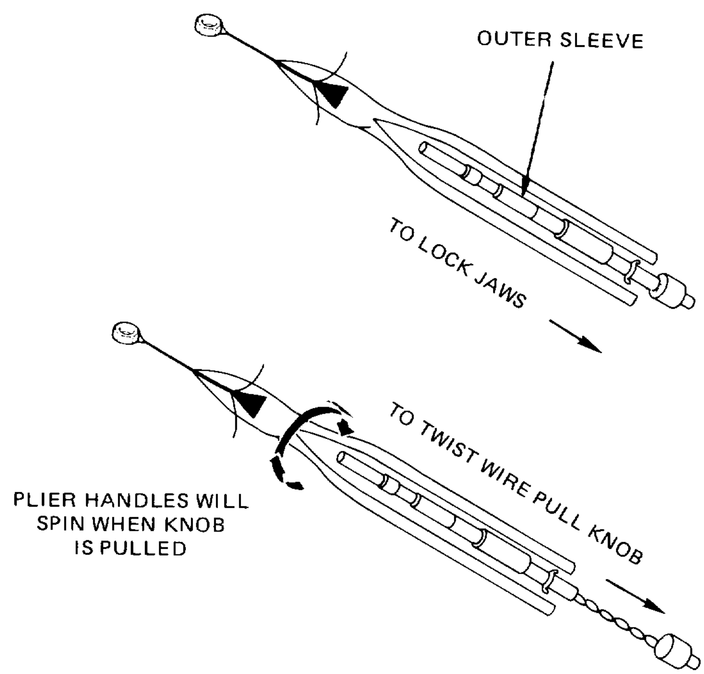
Term	Definition
RS-449	Applies to binary, serial, synchronous, or asynchronous communications.
RTL	Rubber Test Lead.
RTS	Reverse Twist Secondary.
RTV	(See Room Temperature Vulcanizing, silicone rubber.)
RU	Designation for rubber insulated, latex building wire, 140°F (60°C).
Rub coating	Process in which a metal is precoated with molten solder by abrading the surface.
Rubber and elastomer	Rubber is a material which is capable of recovering from large deformations, quickly and forcibly, and can be, or already is, modified to a state in which it is essentially insoluble in boiling solvents. Elastomers have been defined as natural or synthetic materials that can be, or have been, vulcanized to a state in which they have the ability to accept, and recover from extreme deformation (in the order of hundreds of per cent). The term elastomer is used to include natural rubber, and a variety of synthetic materials exhibiting rubber-like properties.
Rubber, epichlorohydrin	Epichlorohydrin exhibits most of the better qualities of nitrile and neoprene. Commonly called hydrin, this elastomer is attacked by ketones, esters, aldehydes, and chlorinated and nitro hydrocarbons, but resists water and ozone weathering. It provides good tear and abrasion resistance. Compression set and resilience are also good.
Rubber, fluoro elastomers	Fluoro elastomers provide heat resistance up to 600°F (315.6°C), and excellent oil and solvent resistance. However, they are not recommended for ketones, low molecular weight esters, and nitro containing compounds. Fluoro elastomers adhere well to metals. They are abrasion and tear resistant, with good compression set and fair resilience. They offer excellent weather aging characteristics.
Rubber, polyisoprene	Synthetic elastomer possessing physical properties which approximate those of natural rubber. It can be used in many of the same applications, and can be handled in existing equipment. However, the raw polymer is softer and can be plasticized at a more rapid rate. No electrical properties are reported, but it can be assumed that they are comparable to natural rubber.
Rubber, polyolefin based	Tough material suitable for primary insulation and jacketing for wire and cable. These applications range from high voltage to low frequency signals. Electrical properties are equal to those of cross-linked polyethylene. It resists the effects of prolonged sunlight and ozone, and it is not attacked by alkalis and acids common to soil burial.
Rubber, polysulfide	Polysulfides exhibit very good resistance to solvents and oils, good aging characteristics, exceptional resistance to ozone, and good electrical resistivity. However, they have an unpleasant odor and some deficiency in mechanical properties. The polysulfide rubbers are used for cable coverings where resistance to solvents and oil is required. MIL-PRF-8516 define typical sealing and potting compounds.
RUH	Same as RU, but heat resistant, 167 5°F (75°C).
Rulan	Trade name of DuPont Company. Material is a polyethylene composition with additives to reduce the rate of burning. Used for insulation.
Rupture	In breaking strength or tensile strength tests, the point at which a material physically comes apart, as opposed to yield strength, elongation, etc.
RUW	Same as RU, but moisture resistant, 140°F (60°C).

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
S	Designation for heavy duty, rubber insulated, portable cord. Stranded copper conductors with separator and individual rubber insulation. Two or more color coded conductors, cabled with filler, wrapped with separator, and rubber jacketed overall, 600 V.
SA	Designation for silicone rubber insulation, asbestos or glass braid, for use in dry locations. Maximum operating temperature for special applications, 257°F (125°C.)
Safetying	Feature of connector design which permits safety wiring of plug and/or receptacle, to prevent the loosening or vibrating free of plug from receptacle.
Safety wire	Securing wire used to prevent the loosening or vibrating free, of the attached part



WIRE TWISTING BY HAND

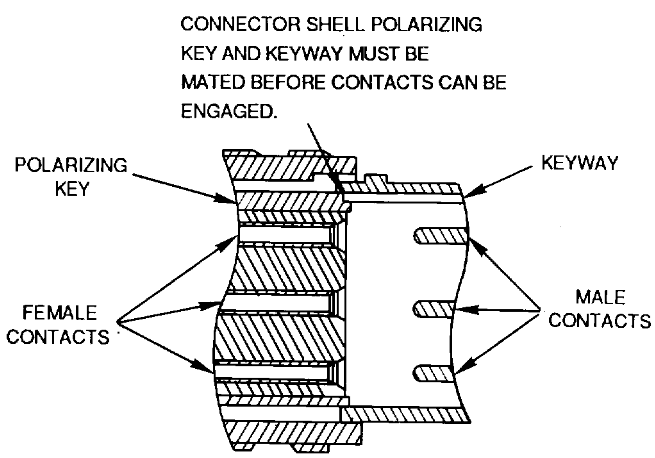


TWISTING WITH WIRE TWISTER PLIERS

Term	Definition
Sag (conductor)	The vertical distance between a suspended conductor and an imaginary straight line connecting the points of suspension. Sag may be measured at the midpoint between the suspensions, the lowest point of the conductor, or at any specified point.
Salt	Sodium chloride compound formed by reaction between an acid and a base. The hydrogen ion of the acid is replaced by the metal associated with the base, and the hydroxyl ion of the base is replaced by the negative ion associated with the acid. The hydrogen and hydroxyl ions combine to form water. For example, a mixture of hydrochloric acid (hydrogen and chlorine) dissociates in solution into a hydrogen ion with a positive charge and a chlorine ion with a negative charge. When combined with sodium hydroxide (a base consisting of sodium, oxygen, and hydrogen which breaks down in a solution into a positive sodium ion and a negative hydroxyl ion), this combination results in common salt, i.e., sodium chloride. Separation of the salt from the solution can be accomplished by evaporating the water.
SAP	(See Sintered Aluminum Powder.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Sapphire	Sapphire provides a uniform dielectric constant, controlled orientation, thermal conductivity, and the single crystal surface desired for hybrid integrated circuit, and other microcircuit systems.
Saturated solution	Solution in which the solvent can accept no more solute (see solvent, solute). The result of adding additional solute to the solution is the formation of the solute as a distinct phase, e.g., solid particles suspended or precipitated to the bottom of the container in which the solution is held.
Saturation	When received optical signal is too strong for the maximum power allowed by the receiver, optical saturation prevents regeneration of the input signal, thus resulting in distortion in the received signal.
SB	Designation for slow burning wire. Three cotton braids, impregnated, 194°F (90°C).
SBR	(See Styrene-Butadiene Rubber.)
Scattering (fiber optic)	Change in direction of light ray due to heterogeneity (imperfections) in material. When a ray hits an imperfection, it is reradiated in a direction different from that of the original ray.
Schematic diagram	Drawing which shows, by means of graphic symbols, the electrical connections, components, and functions of a specific circuit arrangement.
Scoop-proof	Because of the connector’s long shell design and the polarizing keys and keyways, it is impossible for the mating plug connector to inadvertently be cocked into the mating receptacle and damage or electrically short the contacts.



Term	Definition
Screen	Semiconductor or high resistance material used to reduce stress concentrations at the surface of stranded conductors or edges of outer shielding tapes. May be extruded plastic, rubber-filled tapes, carbon black paper, or thin aluminum foil laminated to paper (metallized paper). In the U.S., a screen at the conductor is frequently called a strand shield, although a shielded cable frequently has no strand shield.
Screwlock	(See jackscrew.)
Screw-machine contact	Contact made by screw-machine operations.
Scrim	Light, non-woven fabric with relatively large openings between the yarns. Used as reinforcement for paper, and other products.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

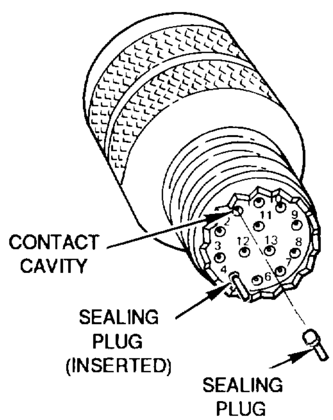
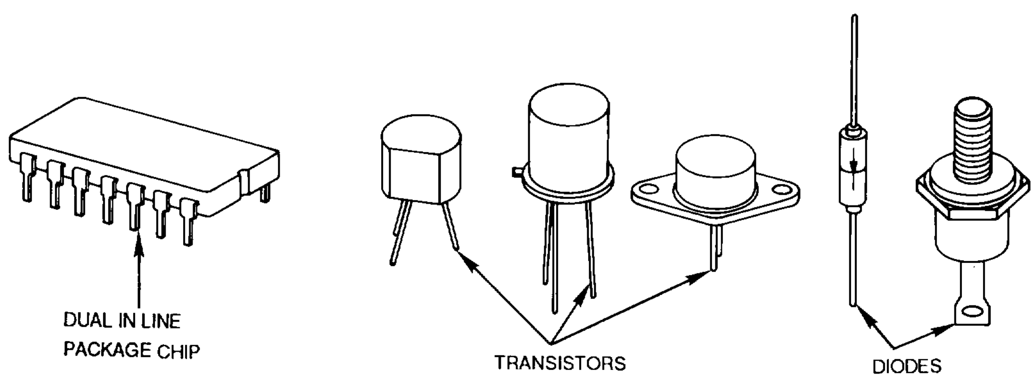
Term	Definition
SD	Designation for service drop cable. Two coded, rubber insulated conductors, taped, laid parallel, with neutral conductor concentric thereover. Tape and braid overall. Also, round construction.
SDC	Self Damping Conductors.
SDN	Designation for small diameter, multiconductor control cable with neoprene jacket and nylon sheath over polyethylene insulation.
SE	Designation for above ground service entrance cable, not protected against mechanical abuse. Flame retardant, moisture resistant covering. Overall neoprene sheath,140°F (60°C) to 167°F (75°C).
SEA	Designation for service entrance cable, steel armored under outer braid, one or two rubber insulated conductors with neutral conductor served concentrically, moisture resistant tape, weatherproof braid finish, 300 V, 167°F (75°C).
Sealing metals and alloys	Various metals and alloys used for sealing purposes, including sealing to glass and ceramics. These include iron-nickel-cobalt sealing alloy, iron-nickel sealing alloy, chromium-iron sealing alloy, dumet (copper coated 42% nickel-iron) wire for sealing to soft glass, and other products. These alloys are selected to match the thermal expansion of different types of glasses and ceramics, and are normally sold on the basis of expansion characteristics.
Sealing plug	Plug which is inserted to fill a contact cavity in a connector insert. Its function is to seal all unoccupied apertures in the insert, especially in environmental connectors. 
Seamless terminal or splice	Terminal or splice conductor barrel made without an open seam.
Secondary insulation	Non-conductive material whose prime functions are to protect the conductor against abrasion, and provide a second electrical barrier. Placed over the primary insulation.
Secondary metal	Metal recovered from scrap by remelting and refining.
Secondary winding	Transformer winding that receives energy by electromagnetic induction from the primary winding.
Sector cable	Multiple-conductor cable in which the cross section of each conductor is approximately the sector of a circle. Sector conductors are used in order to obtain, with a given conductor cross sectional area, a cable of decreased overall diameter; or to obtain, in a cable of given overall diameter, conductors of a larger cross sectional area.
Sector stand	Group of wires laid in triangular shape with rounded corners, for use as one conductor of a three conductor cable; with 120°angle between faces, and with 90°angle for a four conductor cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Segmental conductor	Stranded conductor consisting of three or more stranded conducting elements; each element having approximately the shape of the sector of a circle, assembled to give a circular cross section. The sectors are usually lightly insulated for each other and, in service, are connected in parallel.
Segregation	Non-uniform distribution of alloying elements, impurities, or microphases.
Selective plating	Application of plating material to a limited portion of a connector contact, especially those areas susceptible to wear.
Selenium cure	Process used in curing neoprene and rubber jacketed wires and cables. The process makes a dense, tough, durable jacket.
Self-align	Design of two mating parts so that they will engage in the proper relative position. (See polarization.)
Self-contained pressure cable	Pressure cable in which the container for the pressure medium is an impervious, flexible metal sheath, reinforced if necessary, which is factory assembled with the cable core.
Self extinguishing	Characteristic of a material whose flame is extinguished after the igniting flame is removed.
Semi-conducting jacket	Jacket having a sufficiently low resistance so that its outer surface can be kept at ground potential by a grounded conductor in contact with it at frequent intervals.
Semiconductor	Material whose conductive ability lies between that of a conductor, e.g., copper, and an insulator, e.g., glass. The most common semiconductor materials used in such solid state devices as transistors, rectifiers and diodes are silicon and germanium.
Semiconductor device	Any device based on either preferred conduction through a solid in one direction, as in rectifiers; or on a variation in conduction characteristics through a partially conductive material, as in a transistor.



TYPICAL SEMICONDUCTOR DEVICES

Term	Definition
Semi-rigid	Cable containing a flexible inner core and a relatively inflexible sheathing material, such as a metallic tube; but which can be bent for coiling, spooling, or placing in a duct or cable run.
Semi-solid	Insulation cross section having a partially open space between the conductor and the insulation perimeter.
Separator	Pertaining to wire and cable; a layer of insulating material such as textile, paper, etc., which is placed between a conductor and its dielectric, between a cable jacket and the components it covers, or between various components of a multiconductor cable. It can be utilized to improve stripping qualities, and/or flexibility, or can offer additional mechanical or electrical protection to the components it separates.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

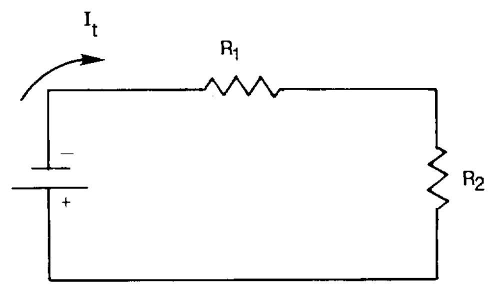
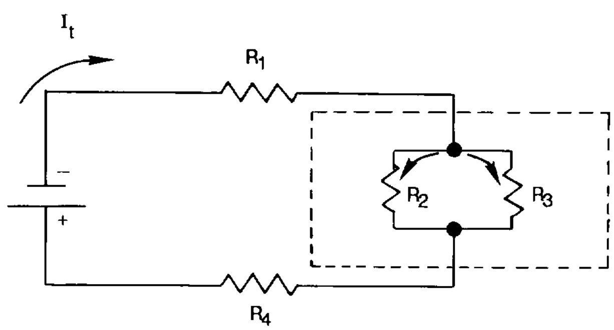
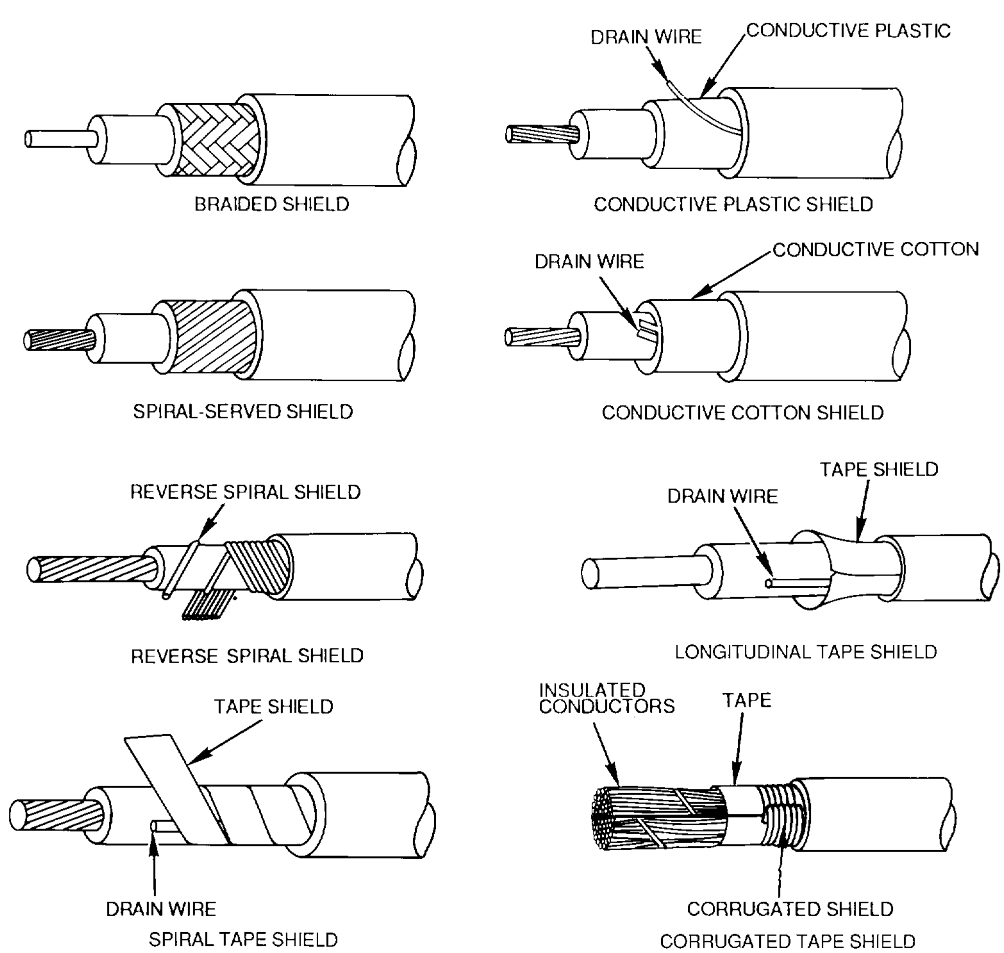
Term	Definition
SER	Round, service entrance cable.
Serial interface	Lowest common denominator of data communications.
Serial interface card	Printed circuit card which drops into one of the expansion slots and changes the parallel internal communications into the one-bit-at-time serial transmission for sending information.
Serial transmission	Transmission where one bit of information is sent at a time on a channel.
Series circuit	Circuit which has only one possible path for current to flow. The total current supplied flows through each series component of the circuit. (See formulas-electrical.)
	 $I_t = I_{R_1} = I_{R_2}$
Series-parallel circuit	Circuit which has a parallel circuit forming a component of a series circuit. The sum of the currents in all parallel branches is equal to the current through each series component, and the total current supplied to the circuit. (See series circuit, parallel circuit, formulas-electrical.)
	 $I_t = I_{R_1} = I_{R_2} + I_{R_3} = I_{R_4}$
Serration	Deformation on the inside surface of a conductor barrel to provide better gripping of the conductor, or on the outside of the connector body to provide better gripping of the connector.
Serve	Filament or group of filaments, such as fibers or wires, wound around a central core.
Service life	Period of time which a device is expected to perform satisfactorily.
Service loop	Small portion of wire cable which is added to the overall length to facilitate maintenance and servicing. Generally, the lead is long enough to provide for one servicing in the field.
Service rating	Maximum voltage or current which a connector is designed to carry continuously.
Serving	Wrapping applied over the core of a cable or over a wire. Servings may be in the form of filaments, fibers, yarn, tape, etc.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Session	Logical network connection between two workstations typically a user station and a server - for the exchange of data.
SEU	Same as SEA, but not armored.
Severe Wind And Moisture Problem (SWAMP) areas	Areas such as wheel wells, wing folds, areas near wing flaps, and areas directly exposed to extended weather conditions are considered SWAMP areas on aerospace vehicles.
SF	Designation for silicone rubber insulated fixture wire, solid or seven strand conductor, 392°F (200°C).
SFF	Same as SF, except flexible stranding, 302°F (150°C).
SH-A	Designation for portable mine power cable, three or four individually shielded conductors, 932°F (500°C).
Shank	Cylindrical or rod-like portion of a connector or contact.
SH-B	Same as SH-A, except shield is overall.
SH-C	Same as SH-B, but with grounding conductors.
SH-D	Same as SH-A, but with grounding conductors.
Shear area or depth of shear	Distance that two parallel surfaces are overlapped.
Shear strength	Stress required to produce fracture in the plane of cross section. The conditions of loading being such that the directions of force and resistance are parallel and opposite, although their paths are offset a specified minimum amount.
Sheath	Outer covering or jacket over the insulated conductors to provide mechanical protection for the conductors. Also known as the external conducting surface of a shielded transmission line.
Sheet	Any material (conducting, insulating, or magnetic) manufactured in sheet form and cut to suit in processing.
Sheet metal contacts	Contacts made by stamping and bending sheet metal, rather than by the machining of metal stock. Available in a wide variety of configurations, and usually less expensive than machined contacts.
Sheet Molding Compound (SMC)	Thermosetting plastic resin, mixed with stranded fiberglass reinforcement, filters, and other additives, into a highly viscous compound which is rolled into sheet form for compression molding.
Shelf life	Length of time, under specified conditions, that a stored material in original, unopened containers retains its usability.
Shell, electrical	Outside case of a connector, into which the dielectric material and contacts are assembled.
SHF	Super High Frequency.
SHFS	Designation for polyvinyl insulated with felted asbestos, flame proof cotton or rayon braid, Navy switchboard wire, 600 V.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

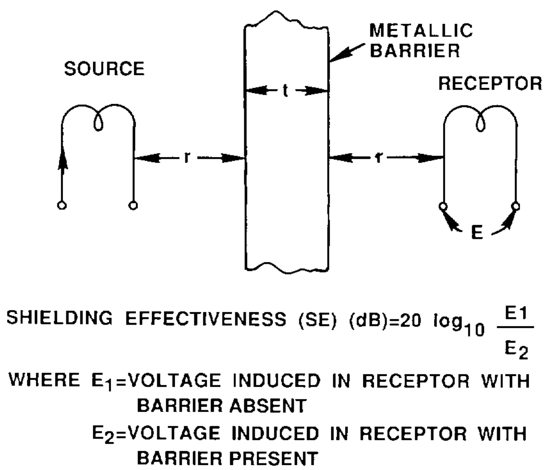
Term	Definition
Shield	Conducting envelope composed of metal strands that encloses a wire, group of wires, or cable. Constructed so that nearly every point on the surface of the underlying insulation is at ground potential, or at some predetermined potential with respect to ground. Shields level out surge impedance along the length of the cable, screen a signal from external excitation, or confine a signal to an intended electrical path. In coaxial cables, they may act as return wires. In telephone cables, they may protect against shorts due to ground surges, provide a barrier against termites and rodents, or filter out low frequency interference from nearby power lines.

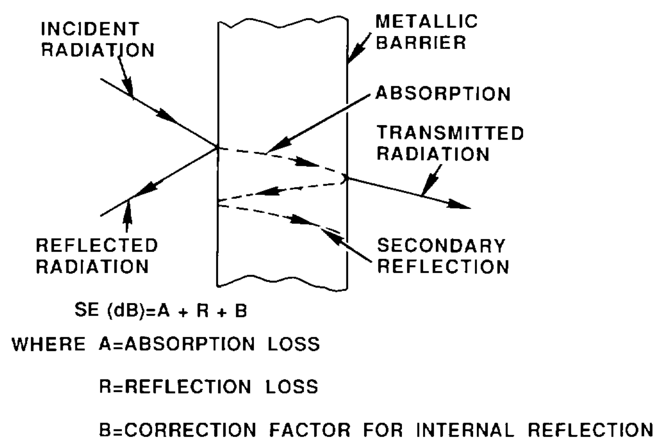


Term	Definition
Shield coverage percent	Percentage of the surface area of cable core insulation covered by the shield. Also called shield percentage.
Shielded cable	Cable surrounded by a separate conductor (the shield), intended to minimize the effects of internal or external electrical circuits.
Shielded contact	(See coaxial contact.)
Shielded line	Transmission line whose elements confine propagated radio waves to an essentially finite space inside a tabular conducting surface called the sheath, thus preventing the line from radiating radio waves.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Shield, electrical connector	Item especially designed to be placed around that portion of a connector which contains the facilities for attaching wires or cables. Used for shielding against electrical interference or mechanical injury, and usually has provisions for passage of the wire or cable.
Shielded-type cable	Cable in which each insulated conductor is enclosed in a conducting envelope constructed so that nearly every point on the surface of the insulation is at ground potential, or at some predetermined potential with respect to ground, under normal operating conditions. (See shield.)
Shielding	Metal sleeving surrounding one or more of the conductors in a circuit to prevent interference, interaction, radio frequency or current leakage. Usually grounded, the shielding is carried through the connector shell or through a special internal shell in the case of individual coaxial contacts. (See shield, coaxial contact.)





Shielding effectiveness	Relative ability of a shield to screen out undesirable signals.
Shore hardness	Instrument measure of the surface hardness of an insulating or jacket material.
Short circuit	Electrical loads which occur during fault conditions, and are usually high current flow.
Shroud, insulation	(See insulation support.)
Shunt wire	Conductor joining two parts of an electric circuit to divert part of the current.
SIC	(See Specific Inductive Capacity.)
Signal	Current used to convey information; either digital, analog, audio, or video.
Signal cable	Cable designed to carry current of less than 1 ampere per conductor.
Signal conditioning	Amplification and/or modification of electrical signals to make them more appropriate for transmission over a certain medium.
Signal conductor	Individual conductor used to transmit an impressed signal.
Signal level	Root-mean square (rms) voltage measured during the peak of the RF signal.
Signal Quality Error Test (SQE/Heartbeat)	At the end of each transmission by a transceiver, it must send a short burst of 10 MHZ waveform on the collision lead to permit the controller to check proper operation of the collision signal path.
Signal-to-Noise (S/N) ratio	Usable information in a signal (optical or electrical), compared to the noise that tends to interfere with the transmission of the information.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Silica fibers	Silica (and quartz) fibers can withstand 1799.6°F (982°C) continuous service without change in physical properties. These fibers also withstand nuclear radiation without damage and without accumulating large residual amounts of radiation. Fused quartz fibers, however, become brittle at temperatures of 1400°F (760°C) to 1600°F (871°C) within hours. Both fiber forms have melting points of about 3099.2°F (1704°C). The extreme heat resistance of silica fibers recommends them for critical applications.
Silicate ester	Liquid used as a dielectric. (See liquid dielectrics.)
Silicon	Brittle, gray, crystalline chemical element which, in its pure state, serves as a semiconductor substrate in microelectronics. Naturally found in compounds such as silicon dioxide.
Silicon dioxide	Structural material important in controlling the fabrication process of integrated circuits. Electrically, it serves to protect the silicon surface from contamination. It also serves as an insulating substrate for metallization, and as a dielectric in certain types of capacitors.
Silicone	Polymeric materials in which the recurring chemical group contains silicon and oxygen atoms as links in the main chain. Silicone rubber extrusions offer retention of good electrical properties, resilience, and flexibility after longtime heat aging. Excellent ozone resistance, low temperature flexibility, long life, low moisture absorption, weather resistance, radiation resistance, and corona resistance are other characteristics. Relatively poor resistance to some oils, solvents, and strong acids.
Silicone rubber	Thermosetting elastomer with excellent low temperature flexibility, ozone and corona resistance. Used in 200°F (93°C) to 450°F (232°C) potting applications, when designed to MIL–PRF–23586. (See potting.)
Silicone treating	Silicone liquid treatment applied to insulated conductors to be jacketed to allow for easy jacket strippability.
Silky fracture	Metal fracture in which the broken metal surface has a fine texture usually dull in appearance. Characteristics of tough and strong metals.
Silver and its alloys	White, precious metal which is very malleable and ductile. Has the highest conductivity of all metals, and is a good material for many contact applications. Silver base alloys containing copper, nickel, palladium, and gold offer better mechanical, electrical, and corrosion resistance than pure or fine silver, with some sacrifice in surface and bulk resistance. Mixtures of silver and tungsten are also used as contact materials. When combined properly, silver-tungsten contacts offer the current carrying capability of silver, and the wear characteristics of tungsten.
Silver brazing	Brazing with silver-base alloys as the filler metal.
Silver chromate paper test	Simple qualitative test to determine presence of ionic halides. Usually used to check that a mildly activated flux, such as Type RMA, contains no ionic halides. The Silver Nitrate Test, also serves the same purpose.
Silver migration	Ionic displacement of metallic silver through an insulating medium. Usually caused by a combination of conditions of extended time, high humidity, temperature variations, and DC potential.
Simplex	Transmission in any one direction.
Single cable	One-cable system in broadband in which a portion of the bandwidth is allocated for send signals, and a portion for receive signals, with a guard band in between to provide isolation from interference.
Single-ended	Unbalanced, such as grounding one side of a circuit or transmission-line.
Single-faced tape	Fabric tape finished on one side with a rubber or synthetic compound.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

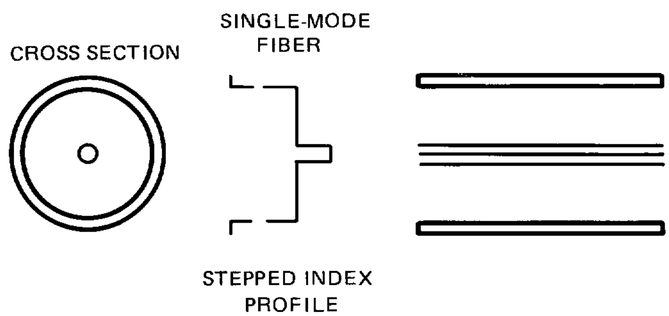
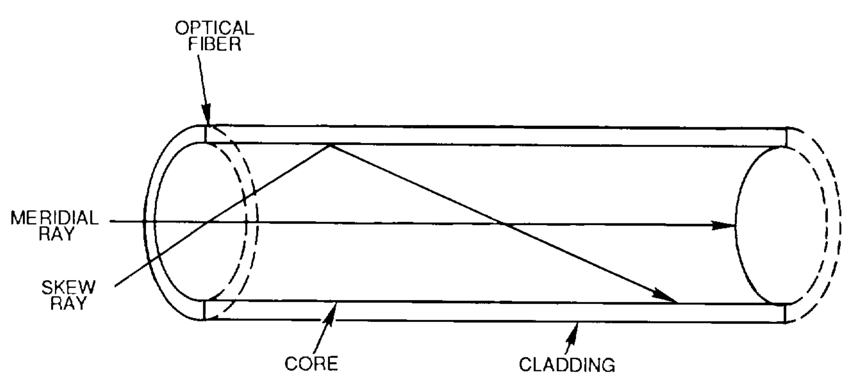
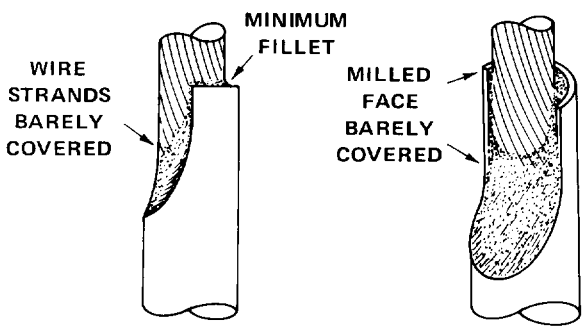
Term	Definition
Single mode fiber (fiber optic)	(1) Fiber that will propagate light only in a single wave form. (2) Fiber having a small core diameter (approximately 3 micrometers),with a cladding having a refractive index very close to that of the core. Will transmit light rays that enter at a narrow angle, and will transmit over very wide bandwidth. 
Single-sided board	Printed board with a conductive pattern on one side only.
Sinter	To thermally treat a powdered material, to cause the particles to fuse together.
Sintered Aluminum Powder (SAP)	Material composed of aluminum or an aluminum alloy in which is dispersed aluminum oxide. The material is used to improve the temperature stability of aluminum products.
Sizing	(1) Applying a material to a surface to fill pores. (2) Surface treatment applied to glass fibers.
SJ	Designation for junior hard service, rubber insulated pendant or portable cord. Same construction as type S, but 300 V.
SJO	Same as SJ, but neoprene, oil resistant compound outer jacket, 300 V, 140°F (60°C).
SJT	Designation for junior hard service thermoplastic or rubber insulated conductors with overall thermoplastic jacket, 300 V, 140°F (60°C).
SJTO	Same as SJT, but oil resistant thermoplastic outer jacket.
Skeining	Technique in which the coil wire ends are reinforced by folding a number of strands together, twisting them into a braid, and then securing them to the coil.
Skeleton braid	Widely separated braid of fiber, copper, or steel. Used to hold core together, for reinforcing jacket, or for shielding.
Skew rays (fiber optic)	Rays of light which do not propagate through the axis of the fiber. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

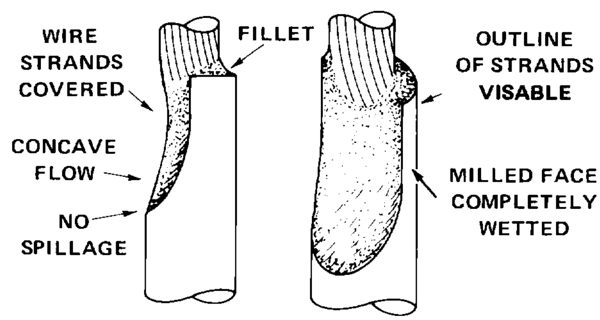
Term	Definition
Skim tape	Filled tape, coated on one or both sides with a thin film of uncured rubber or synthetic compound, to produce a coating suitable for vulcanization.
Skin effect	Phenomenon in which the depth of penetration of electric currents into a conductor decreases as the frequency increases.
Skived tape	Tape shaved in a thin layer from a cylindrical block of material such as skived PTFE tape.
SL	Designation for single conductor paper lead cables twisted together, without overall covering.
Sleeve	Braided, knitted, or woven tube used over wires or components as insulation tubing. Also called sleeving.
Slivers	Icicles, nubs, and spikes which are undesirable protrusions from a soldered connection.
Slotted tongue terminal	Terminal with a slotted tongue for sliding onto the screw or stud so that neither screw nor unit needs removing. Also called spade tongue terminal.
Small Outline (SO) package	Similar to miniature, dual in-line package. Typical lead spacing: 0.050 in.
Small-scale integration	Circuit of under 10 gates, generally involving one metallization level, implementing one circuit function in monolithic silicon.
SMC	(See Sheet Molding Compound.)
Snap-on	Used to describe the easy removal or assembly of one part to another. Certain connectors are provided with snap-on plastic covers to permit quick and convenient installation.
Snippers	Instrument for cutting wire.
SNM	Cable designed for use in hazardous locations. Consists of insulated conductors in an extruded non-metallic jacket, which is then covered with an overlapping spiral metal tape and wire shield, and jacketed with an extruded moisture, flame, oil, corrosion, fungus, and sunlight resistant non-metallic material.
S/N ratio	(See Signal-to-noise ratio.)
SO	(1) Designation for a 600 V senior service, oil resistant neoprene jacket cord. Same construction as type S, except for neoprene jacket. (2) (See Small Outline package.)
Socket connector	Connector containing socket contacts into which a connector, having male contacts, is inserted.
Socket contact	Contact type (usually completely surrounded by insert material), designed to surround the mating pin contact. Normally connected to the live side of the circuit.
Socket contact sleeve	Sleeve that holds the contact spring in the correct position within the socket contact, and provides a smooth exterior surface.
Soft drawn	(1) Relative measure of the tensile strength of a conductor. (2) Wire which has been annealed to remove the effects of cold working.
Soils	In solder processing, foreign matter that might exist on a surface to be soldered. The soils may be organic or inorganic. An example would be the residue left by a finger print on a clean copper surface. This would be a combination of both organic and inorganic soils, which may interfere with soldering.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

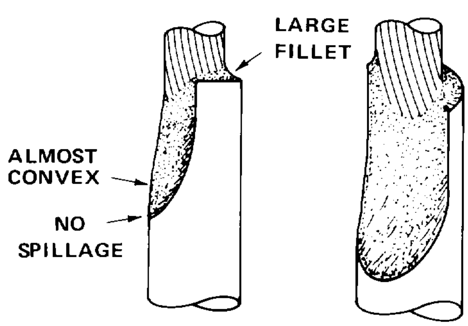
Term	Definition
Solder	Metal or metal alloy, usually having a low melting point, used to join other metals having higher melting points than the solder. The action of the solder is of an adhesive type, that is, wetting of the surfaces and forming the joint by molecular attraction between the solder and the base metals; or involving some diffusion of the solder into the base metals, or vice versa. Solders are generally classified as soft solders and hard solders. Soft solders have melting points up to approximately 700°F (371°C), whereas the melting points of the hard solders are above 700°F (371°C). The most common soft solders are the tin/lead alloys (example; 63% tin/37% eutectic lead).
Solderability	Property of a metal to be wetted by solder.
Solder contact	Contact having a cup, hollow cylinder, eyelet, or hook to accept a wire for a conventional soldered termination.
Solder cream	Homogeneous combinations of solder, flux solvent, and a gelling or suspension agent for automated production of solder joints. Available with rosin or water soluble flux bases.
Solder cup	Hollow cylinder at the tubular end of a terminal or solder contact, in which a conductor is inserted and soldered in place.



INSUFFICIENT SOLDER QUANTITY



MINIMUM ACCEPTABLE SOLDER QUANTITY



MAXIMUM ACCEPTABLE SOLDER QUANTITY

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Solder embrittlement	Reduction, in mechanical properties of a metal, as a result of local penetration of solder along grain boundaries.
Solder eye	Solder type contact provided with a hole at its end, through which a wire can be inserted, prior to being soldered.
Soldering	Similar to brazing, with the filler metal having a melting temperature range below an arbitrary value, generally 800°F (426.7°C). (See solder.)
Solder joints	Connection of similar or dissimilar metals by applying molten solder, with no fusion of the basic metals.
Solderless connection	Joining of two metals by pressure means, without the use of solder, braze or any method requiring heat. (See pressure connection, solderless wrap.)
Solderless wrap	Method of connecting a solid wire to a square, rectangular, or V-shaped terminal, by tightly wrapping the wire around the terminal with a special tool. (See wire wrap, wire wrap tool.)
Solder lug	Device to which wire is secured by soldering.
Solder mask	(See solder resist.)
Solder paste	(See solder cream.)
Solder preforms	Manufactured solder configurations containing a predetermined quantity of alloy, with, or without a flux core or coating. Available as stamped discs and washers, spheres, and formed wire.
Solder resist	(Permanent or temporary) Coatings which mask and surface insulate those areas of a circuit where soldering is not desired or required. Also make possible the minimization of solder bridging between closely spaced conductors or runners.
Solder splatter	Unwanted fragments of solder.
Solder tapes	Solder alloys, in the form of thin tapes, in widths generally from 1/4 in. to 3 in. Also called solder foils or strips.
Solid conductor	Conductor consisting of a single wire (not stranded).
Solidification shrinkage	Decrease in volume of a metal during solidification.
Solids	When referring to rosin fluxes, solids or solids content, the percentage by weight of rosin in that formulation.
Solid state	Technology utilizing semiconductors in place of vacuum tubes.
Solidus	Temperature at which a metal alloy begins to melt. Some components of the alloy melt or begin to melt, whereas the balance of the material is still solid. This mushy characteristic is taken advantage of, especially in solders, for forming wiped joints. For example, the solder composition 30% tin/70% lead has a solidus of 361°F (182.8°C). Its liquidus is approximately 520°F (271°C). In the plastic range between them, the material can be mechanically worked and forced into joints. This wide plastic range is thus an advantage in plumbing and cable work for forming large solder joints. (See liquidus.)
Solubility	Amount of solute present in a given amount of solvent or solution.
Solute	Component of a solution which is dissolved in solvent. Generally the solute is a solid, but can also be a liquid or gas.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Solution	Homogeneous mixture formed by processing, in which a substance that is solid, liquid, or gas, is mixed with a liquid (or by extension with a solid or gas) called a solvent. The term is usually associated with liquids, but may include solids, as in alloys or gaseous mixtures. Generally, a solution will be clear or transparent. A liquid mixture which is cloudy, is not considered a solution. (See suspension).
Solvent	One of the components of a solution. It is that component in which the other components, i.e., the solutes, are dissolved. In the case of a solution composed of several liquids, the liquid present in the greater quantity is usually referred to as the solvent. (See solution.)
Solvent-bonded	Cables where bonding is accomplished by tackifying the surfaces of wire insulation, cable jacket, or spacer; then joining and driving off the solvents to form a cable. (See bonded cables.)
Solventless polyester	(See varnish-solventless polyester.)
Source (fiber optic)	Source of radiant energy, such as a Light Emitting Diode (LED). (See fiber optics.)
Source coupling loss (fiber optic)	Loss of light intensity, as light from source passes into fiber. Depends on numerical aperture of fiber, and is less, for larger numerical apertures. Also, depends on end finish conditions and geometry of alignment.
SP	Silver Plate.
SP-1	Designation for all rubber, parallel jacketed, two-conductor, light duty cord for pendant or portable use in damp locations, 300 V.
SP-2	Same as SP-1, but heavier construction, with, or without third conductor for grounding purposes, 300 V.
SP-3	Same as SP-2, but heavier construction for refrigerators or room air conditioners, 300 V.
Spacer	Metal piece placed between two conductors in a connector. Example: most aluminum to copper connectors use a spacer located between the dissimilar cable to reduce galvanic corrosion.
Spacing	Distance between closest edges of two adjacent conductors.
Spade contact	Contact with fork-shaped female members designed to dovetail with spade-shaped male members. Alignment in this type of connection is very critical if good conductivity is to be achieved.
Spade tongue terminal	Slotted tongue terminal designed to slip around a screw or stud without removing the nut.
Span	(1) Pertaining to flat conductors, distance from reference edge of the first conductor to the reference edge of the last conductor. (2) Pertaining to round conductors, distance between centers of the first and last conductors.
Sparking	Term used for continuous high voltage testing of insulated wire. (See spark test)
Spark test	Test designed to locate pin-holes in the insulation of a wire or cable by application of a voltage for a very short period of time while the wire is being drawn through the electrode field.
SPC	Silver Plated Copper.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

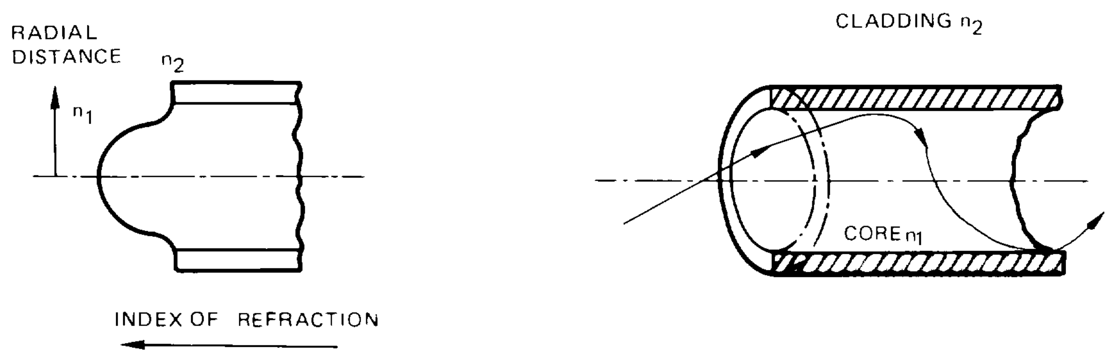
Term	Definition
Specialty wire not insulated	Constructions including those with unusual wire drawing (such as extremely fine diameters), annealing, elongation, tensile strength, stranding, and bunching requirements. This applies to copper, copper alloy, silver or tin- plated, and clad wires. Specific gravity Ratio of the density of a material to the density of water. For example, a cubic foot of water weighs 62.4 lbs. If a cubic foot of another material weighed 124.8 lbs., the specific gravity of the second material would be 2. In the metric system, where the units of weight and measurement are grams and cubic centimeters, specific gravity and density would be identical. The reason for this is that water weighs 1 gram per cubic centimeter. Therefore, if a material has a density of 4 grams per cubic centimeter, its specific gravity would be 4.
Specific Inductive Capacity (SIC)	Dielectric constant of insulating material. (See dielectric constant.)
Spectral response (fiber optic)	Response of a detector (or a system) over different wavelengths.
Spectral width	Measure of the wavelength range of a sources output spectrum.
Spectrographic analysis	Analysis to determine elements present in an unknown. May be quantitative or qualitative. This type of analysis is based on the fact that when an element or group of elements is placed in an electrical arc or spark, each element will radiate wavelengths of light, i.e., colors, peculiar to itself. The light from the arc is then passed through a prism or diffraction grating to break it into its component colors or wavelengths. By noting those wavelengths, the elements that were present in the unknown can then be determined. By suitable standardizing (see standards, spectrographic) of the apparatus, one can determine quantitatively how much of the element is present by noting the intensity of the various colors of light given off by the arc.
Spike	Pulse having great magnitude.
Spinel	Spinel ceramic bodies, having the spinel crystalline phase (MgO:A1 O), are strong and have low loss qualities. Spinel has been used for substrates in microcircuit technology because silicon can be grown on it epitaxially.
Spiral shield	Metallic shield of fine stranded wires applied spirally rather than braided. (See shield.)
Spiral stripe	Color coding stripe applied helically to the surface of an insulated wire or cable. (See helical stripe.)
Spiral wrap	Term given to describe the helical wrap of a tape or thread over a core.
Spirit varnish	(See varnish-spirit.)
Splice	Connection of two or more conductors or cables to provide good mechanical strength as well as good conductivity.
Splicing loss (fiber optic)	(See coupling loss.)
Split conductor cable	Cable in which each conductor is composed of two or more insulated conductors normally connected in parallel.
Splitter	Passive device used in a cable system to divide the power of a single input into two or more outputs of lesser power.
Spodumene	Spodumene does not exhibit shrinking of 8% to 30% like most dense ceramic bodies. During sintering, alpha-spodumene inverts to betaspodumene accompanied by an expansion of 33%. These bodies are formed at optimum pressures, then sintered to obtain zero fired shrinkage characteristics on a dense body. A typical body has 60% spodumene and 40% lead bisilicate.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Spontaneous emission	Radiation emitted when the internal energy of a quantum mechanical system drops from an excited level to a lower level without regard to the simultaneous presence of similar radiation.
Spot ties	Ties other than secondary support ties used to separate a number of wires, cables, groups, or harnesses within a bundle.
Spring-finger action	Design of a contact, as used in a printed circuit connector or a socket contact, permitting easy, stress-free spring action to provide contact pressure and/or retention.
SPT-1	Same as SP-1, except all thermoplastic, 300 V. With or without third conductor for grounding.
SPT-2	Same as SP-2, except all thermoplastic, 300 V. With or without third conductor for grounding.
SPT-3	Same as SP-3, except all thermoplastic, 300 V. With or without third conductor for grounding.
SR	Designation for silicone rubber control cable, 600 V, 257°F (125°C).
SR-AW	Designation for flexible, nickel plated copper conductor, silicone rubber insulation, glass braid, 600 V, 392°F (200°C).
SR-C	Designation for solid copper conductor, silicone rubber insulation, glass braid, 600 V, 257°F (125°C).
SR-H	Designation for silicone rubber insulated, asbestos braid, 500 V, 257°F (125°C).
SRL	(See Structural Return Loss.)
ST	Hard service cord, jacketed, same as type S except all plastic construction, 600 V,140°F (60°C) to 221°F (105°C).
Stabilizer	Ingredient used in some plastics to maintain physical and chemical properties throughout processing and service life.
Standard source (fiber optic)	Reference optical power source to which emitting and detecting devices are compared for calibration purposes.
Standards, spectrographic	Sample of material whose precise chemical composition is known. A standard is used to calibrate the equipment used in quantitative spectrographic analysis.
Standard Wire Gauge (SWG)	(See British Standard Wire Gauge.)
Standing wave ratio	In a transmission line, waveguide, or analogous system, a figure of merit used to express the efficiency of the system in transmitting power, taking into account the mismatch between source, line, and load.
Stand-off	Terminal insulated from and usually mounted on the chassis for the purpose of bringing two or more wires of similar electrical characteristics to a common point.
Staple fibers	Fibers of spinnable length manufactured directly or by cutting continuous filaments to short lengths.
Stay cord	Component of a cable, usually a high tensile textile, used to anchor the cable ends at their points of termination and to keep any pull of the cable from being transferred to the electrical connections.
ST connector	Type of connector used on fiber optic cable utilizing a spring loaded twist and lock coupling similar to the BNC connectors used with coaxial cabling.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Steatite	Steatite can easily be fabricated to close tolerances because its composition contains a large portion of talc. It has good mechanical properties, low loss qualities at MHz, and poor thermal shock characteristics.
Steels, electrical	Steels that are made in an electric furnace. Electrical steels are available in several grades and are used when energy conservation is a major consideration. They are specialty alloys which are classified as non-oriented, oriented, or super-oriented. Non-oriented electrical steels are steels in which the magnetic properties are practically the same in any direction of magnetization in the plane of the material. Oriented electrical steels are steels that possess magnetic properties that are strongly oriented with respect to the direction of rolling. Super-oriented electrical steels provide an outstanding degree of grain orientation.
Stepped index fiber (fiber optic)	Multimode fiber consisting of a core of uniform refractive index, surrounded by cladding of slightly lower refractive index. Accepts light rays over wider angle, but has smaller bandwidth than single mode fiber. (See graded index fiber, single mode fiber.)



Term	Definition
Step soldering	Technique of making a series of soldered joints in sequence. The first joint is made with a solder operation at the highest temperature. Each succeeding joint is made with a solder at such lower temperature as will not impair the first joint.
Steradian	Unit of solid angular measure, being the subtended surface area of a sphere divided by the square of the sphere’s radius.
Sterling silver	Silver alloy containing at least 92.5% silver, the remainder being unspecified but usually copper.
Stimulated emission	Radiation emitted when the internal energy of a quantum mechanical system drops from an excited level to a lower level when induced by the presence of radiant energy at the same frequency.
STO	Same as ST, but with oil resistant thermoplastic outer jacket, 600 V.
Stopping off	(1) Applying a resist. (2) Depositing a metal such as copper in localized areas to prevent carburization, decarburization, or nitrating in those areas during heat treatment. (3) Filling in a portion of a mold cavity to keep out molten metal.
Stop plate	Device attached to a crimping tool to properly locate a terminal, splice, or contact in the tool prior to crimping. (See positioner.)
Strain relief clamp	(See cable clamp.)
Strain relief or stress loop	Forming of component leads in a designated pattern to provide relief from stress between terminations.
Strand	One of the wires, or groups of wires, of any stranded conductor.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

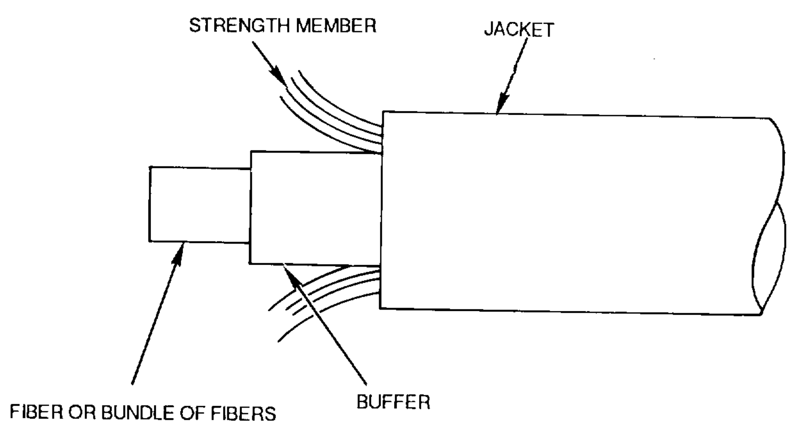
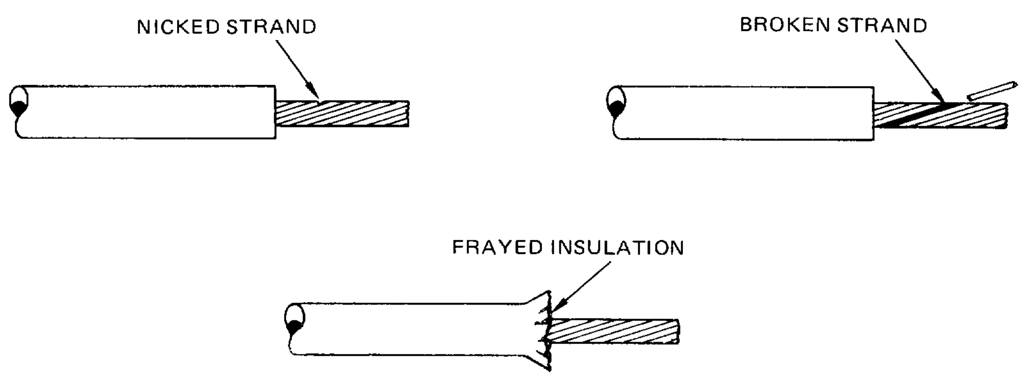
Term	Definition
Stranded conductor	Conductor composed of a group of wires, or of any combination of groups of wires. The wires in a stranded conductor are usually twisted or braided together.
Strand lay	Distance of advance of one strand of a spirally stranded conductor, in one turn, measured axially. (See lay.)
Strand shield	Layer of semiconducting material or tape applied directly over the stranded conductor of cables rated 2000 V and higher. This reduces the possibility of high stress points occurring between the conductor and insulation.
Strap	Square or rectangular section bare conductor manufactured and used in coil form.
Streamlined	Design of high-voltage connectors to eliminate sharp points or corners and to recess all hardware to reduce corona discharge.
Strength member (fiber optic)	Member included in a fiber cable to add tensile strength. Does not carry information. Also called tension member. 
Stress loop	Forming of a slight curve in the leads of components to avoid stress between terminations.
Stress raisers	Changes in contour or discontinuities in structure that cause local increases in stress.
Stress relief	Predetermined amount of slack to relieve tension in components to avoid stress between terminations.
Stress-rupture test	Tension test performed at constant load and constant temperature, the load being held at such level as to cause rupture. Also known as creep rupture test.
Stringular cable	Wire rope used to support electrical or fiber optic cable.
Strip	(1) To remove insulation from a cable. (2) Strip contacts: a continuous length of formed contacts for use in an automatic installation machine.
Strip force	Force required to remove a small section of insulation material from the conductor it covers. Usually measured in pounds.
Stripline	Type of transmission line configuration which consists of a single narrow conductor parallel and equidistant to two parallel ground planes.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Stripping tools and equipment	For wire stripping, a variety of hand-operated, hand-held electrically operated, and bench-mounted electrically or air powered units are available. Stripping actions include cutting (blades and knives), thermal abrasion, lasers, etc. When used for the proper application, all give quick, clean cutting of insulation and are safe-guarded to prevent cutting into the wire. The powered units use various types of strippers to handle various types of insulation. Thermal units will score through thermoplastic insulation up to 1/4 in. thick easily. These units need no adjustments to handle different size wires or cables. Fiberglass and wire brush stripping wheels are used to strip film and bonded insulation. Two wheel stripper heads or one wheel heads in conjunction with a carbide-edged blade are available for handling both round and rectangular conductors. Rotary strippers consist of a tiny, precision-hinged adjustable stripping blade which is actuated entirely by the movement of the wire being stripped. It is suitable for PTFE, nylon, vinyl, and similar insulations. Centrifugal force strippers include one with three counterbalanced knives that close around the wire and strip off the insulation by centrifugal force. Speed is varied according to wire size. Another uses a spinning, gimbal-mounted thermal element which is applied to the wire by its own centrifugal force. Application of the element is delicate yet positive. Automatic wire cutting and stripping machines will cut lengths of insulated wire or cable and strip both ends to the same or different lengths. Production rates vary with type of insulation, size of wire, and lengths cut. For stripping flat cables, high temperature 10,832°F (6000°C)] flame or infrared tools are available. The insulation is vaporized almost instantly. Since infrared light is radiant energy, it heats only those materials which absorb it - this means that transparent or translucent insulations must be painted where they are to be vaporized. Insulation on wire as fine as one mil in diameter can be removed with a high energy electric arc tool. With the tool, wire is fed through a narrow gap between two electrodes. The tool oscillates by means of a cam so that the arc generated by the electrodes sweeps across all the insulation to be removed. The insulation vaporizes almost instantly. Insulation can be removed from a specific segment of wire, or when the wire is fed automatically, on a continuous basis. A shielding stripper for the stripping of braided metal shielding on coaxial and other wires cuts the braid and leaves the strands of the braid fuse-welded together so that they cannot unravel and are easy to insert into connectors.
Stripping wire	Removal of a predetermined portion of insulation without affecting the mechanical or electrical characteristics of the conductor or the remaining insulation. 

STRIPPED WIRE UNACCEPTABLE CONDITION

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Strip process insulation	Insulation consisting of one or more strips of unvulcanized thermosetting material folded around a conductor and vulcanized after application.
Structural Return Loss (SRL)	Not all signals fed into the input end of a cable arrive at the output (load) end. Some of this signal energy is lost in the form of heat due to resistance of the cable, and some of this energy is reflected backward due to irregular dimensions in the cable structure. These backward reflected energies from uneven parts of the cable structure are termed structural return loss.
Stud	Post for connecting wire, similar to a binding post.
Stud hole	Hole or opening in the tongue of a terminal to accommodate a screw or stud.
Stuff	(See ramp.)
Styrene-Butadiene Rubber (SBR)	Copolymers of styrene and butadiene, styrene-butadiene rubbers are not resistant to oils, solvents, and chemicals, being particularly susceptible to strong oxidizing agents, ozone, petroleum, and chlorinated and cyclic hydrocarbons. Resistance to water is one of the chief assets. SBR has good electrical insulating properties and is used in wire and cable insulation for general-purpose applications. Also GR-S or Buna-S.
Sublimation	Physical process in which a solid evaporates directly into a vapor, without passing through a liquid phase. The evaporation of dry ice is an example of this process.
Submarine cable	Cable used underwater from one point to another for power or communication. Lead sheath and/or rubber jacket.
Subsplit	Method of frequency division that allows two-way traffic on a single cable.
Substituted coromatic hydrocarbon	Liquid used as a dielectric. (See liquid dielectrics.)
Substrate	(1) Physical material upon which an electronic circuit is fabricated. Used primarily for mechanical support but may serve a useful thermal or electrical function. (2) Material on whose surface an adhesive substance is spread for bonding or coating, or any material which provides a supporting surface for other materials.
Subtractive process	Process for obtaining conductive patterns by the selective removal of unwanted portions of a conductive foil.
Sudden jerk	Elongation rate of approximately 12 feet to 16 feet (3.6 meters to 4.8 meters) per second. Also called rapid elongation.
Sulphur hexafluoride	Gas used as a dielectric. (See gaseous dielectrics.)
Superconductors	Materials in which the resistance drops to almost zero at a temperature near absolute zero. Superconductivity is exhibited by many of the metallic elements, their alloys, intermetallic compounds, and, most recently, ceramic compounds.
Supported hole	Hole in a printed board that has its inside surface plated or otherwise reinforced.
Surface conditioners	Specially formulated liquid cleaners to restore the solderability of the most commonly used metals and alloys in the soldering process.
Surface conductance	Conductance of electrons along the outer surface of a conductor.
Surface leakage	Passage of current over the boundary surfaces of an insulator as distinguished from passage through its volume.
Surface mounting	Electrical connection of components to the surface of a conductive pattern without utilizing component holes.
Surface printing	Method of wire identification in which engraved wheels turn in a bath of marking ink. Legends are imprinted on the moving insulation material.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Surface resistivity	Resistance of a material between two opposite sides of a unit square of its surface. Usually expressed in ohms. (See resistivity.)
Surface tension	Property of liquids, due to molecular forces existing in the surface film of all liquids, which tends to contract the volume into a form with the least surface area. That is, the molecules on the surface of a liquid are not acted upon by the same forces as those molecules in the interior of the liquid. For example, a given molecule in the body of a liquid will be acted upon by forces of identical molecules completely surrounding it. At the surface, however, in one direction the surface molecules will be acted upon by air or whatever the atmosphere is above the liquid. The particles on the surface film are inwardly attracted, thus resulting in a tension force at the surface of the liquid. This surface tension or force can be broken down by the addition of certain chemical agents to the liquid. The breakdown of the surface tension film results in a flowing out, or wetting action, by the liquid (see wetting). One of the actions which must be accomplished by a soldering flux is a breaking down of the surface tension of the liquid solder. This results in a wetting or complete flowing of the solder over the surface to be coated. An example of a non-wetting situation: raindrops hitting a highly waxed automobile hood. The liquid drops do not wet the wax finish, with the result that the water droplets ball off into spheres. This action is entirely due to the surface tension of the water.
Surface transfer	If a current is caused to flow on the outside of a cable shield, then an impedance induced longitudinal voltage will result along the inside of that shield. The ratio of that induced voltage to the driving current is an impedance, or surface transfer impedance.
Surge	Transient variation in the current and/or potential at a point in the circuit.
Surlyn	Dupont’s trade name for their thermoplastic resin with ionic crosslinks.
Surveillance inspection	Random, unannounced daily inspections monitoring the processes.
Suspension	Mixture of liquid or solid in a liquid. Not considered a true solution because discrete particles or droplets are visible and the mixture is not clear. (See solution.)
SWAMP areas	(See Severe Wind And Moisture Problem areas.)
Swedging	Term for crimping.
Sweep test	Method to determine the frequency response of a cable by generating a radio frequency voltage whose frequency is varied at a rapid constant rate over a given range. Structural return loss values are obtained by this test method.
SWG	Standard Wire Gauge. (See British Standard Wire Gauge.)
Switchboard cable	Cable used within and between the central office main frames and the switchboard
Switchboard wire	Chemically cross-linked polyethylene or asbestos insulated wire used in switchboards and control apparatus. Heat, flame, and corrosive vapor resistant.
Switches	Devices that make or break connections in an electrical or electronic circuit. Switches are usually manually operated, but can also work by mechanical, thermal, electromechanical, barometric, hydraulic, or gravitational means.
TAA	Designation for flexible nickel or nickel–clad copper, PTFE tape, felted asbestos, asbestos braid, 392°F (200°C).
Tab	(See printed contact.)
Take-up	Device to spool wire and cable in a manufacturing operation.
Tandem extrusion	Extruding two materials, the second being applied over the first, with the two extruders being just a short distance apart in the process. (See extrusion.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Tank test	Term used to describe a voltage dielectric test where the specimen to be tested is submerged in a liquid (usually water) and a voltage potential is applied between the conductor and the liquid as ground.
Tantalum	Gray, hard, lustrous metal resembling platinum which is used primarily in capacitors. Forms include powder, bar, rod, wire, foil, sheet, and tubing. Electrical stability, high temperature strength, and corrosion resistance are features.
Tap	Special lead brought out from an intermediate point of a coil or winding.
Tape	Relatively narrow, woven or cutstrip of fabric, paper, or film material.
Tape, acetate cloth	Combines the strength and impregnability of the acetate cloth backing with excellent electrical properties. It is also printable.
Tape, acetate cloth/acetate film	Addition of the acetate film gives improved electric strength properties without impairing the noncorrosive features and with only a slight added overall thickness.
Tape, acetate film	Combines thinness with good electrical properties. Their cost, compared to other film tapes, is low.
Tape, acetate film/rayon filament reinforced	Tape of exceptional tensile strength and tear resistance, it is practically always found in use where heavy conductors must be firmly anchored and where any other backing would not provide the necessary strength. The acetate film carrier produces high electrical strength properties.
Tape, acetate film/glass filament reinforced	Tape is similar to rayon filament reinforced, but is available in a thinner gauge which gives it good conformability. It is a strong tape for tough holding and insulating uses.
Tape cable	Form of multiconductor cable consisting of parallel metal strips imbedded in insulating material. Also called flat flexible cable. (See flat cable.)
Tape, composite (combination)	Pressure sensitive tape made by combining two different types of backing by a laminating process and coating a pressure sensitive adhesive onto one side of the laminate. Generally, combinations are used which produce characteristics and properties not available in either of the individual backings by themselves.
Tape, epoxy bonded mica paper/glass cloth	Designed for use as a high-voltage lead pad in coils and as a form wound coil wrapper for high-voltage rotating equipment.
Tape, fluorohalocarbon film	Film has an electrical grade acrylic adhesive and is designed for use at class F operating temperatures.
Tape, friction (cotton cloth)	Product is never recommended for use internally in an electrical unit. It is commonly used where its function is strictly mechanical and low cost is mandatory.
Tape, friction (cotton cloth/rubber)	Designed specifically to save taping time in making electrical splices. Not recommended for use within an electrical unit.
Tape, glass cloth	Glass cloth backing used can be combined with either a rubber adhesive, an acrylic adhesive, or a high temperature silicone adhesive. These tapes are usable at different temperature ranges.
Tape, glass cloth, epoxy resin treated	Tape is readily conformable with good handling properties. The continuous epoxy film provides electrical properties and the glass cloth provides physical strength.
Tape, glass cloth, polytetrafluoroethylene treated	Polytetrafluoroethylene treatment imparts added electric strength properties to the glass cloth and also antifriction properties.
Tape, glass cloth, silicone rubber coated	Silicone rubber coating gives the glass cloth improved electric strength properties depending upon the total thickness of the rubber coating.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Tape, glass cloth, silicone varnished	The silicone varnish provides greater electric strength than available in the untreated glass cloth and when made with a silicone adhesive, is usable in the 356°F (180°C) temperature range.
Tape, impregnated creped kraft	Use of a creped kraft backing provides elongation features which allow the tape to be used in applications where conformance to an irregular surface is important.
Tape, impregnated flatback rope	This product is widely used. Individually, its properties do not compare to properties found in other pressure sensitive electrical tapes, but its low cost makes it most attractive for use in applications where requirements are not too demanding.
Tape, paper pressure sensitive	Most economical of the pressure sensitive electrical tapes. Used where the physical and electrical requirements are not excessive and/or the cost factor is of major importance. The papers used as the backings must be processed to negate as much as possible the corrosive properties of salts present in the base paper and to eliminate the hygroscopic properties.
Tape, plastic film or rubber pressure sensitive	Has diverse properties when used as backings for electrical tapes. The one common feature, and one of the features that makes tapes produced with these backings so valuable, is thinness.
Tape, polyester film	Tapes feature excellent physical properties (as compared to physical properties of other film backed tapes).
Tape, polyester film, bondable surfaced	A shortcoming in normal polyester film electrical tape is the possible poor bondability between the film backing and the varnishes or potting compounds frequently used in electrical/electronic equipment.
Tape, polyester film, heat shrinkable	Designed for use where a closely conforming, dielectric covering is required on metal can capacitors, solenoid coils, transformer laminations, and other electrical or electronic parts.
Tape, polyester film/rope paper	Laminating an electrical grade rope paper to a polyester film produces physical strength not found in the film itself and the film supplements the electric strength of the rope paper.
Tape, polyester film/ polyester mat	This combination produces excellent electric strength and noncorrosive properties, as well as exceptional physical strength features.
Tape, polyester mat, porous	This tape backing with a thermosetting pressure sensitive adhesive represents a completely permeable holding and insulating tape.
Tape, polyethylene film	Limited high temperature resistance has prevented this tape from being used to any extent internally in electrical units. However, the very satisfactory electrical insulating properties and the high degree of conformability make it potentially usable as a means for splicing conductors where elevated temperatures are not involved.
Tape, polyimide film	Aromatic polyimide polymer is one of the most thermally stable organic polymers yet developed. The film has the thermal capacity to allow higher operating temperatures in electrical components to improve their performance and to reduce size and overall weight of units.
Tape, polyparabonic acid film	Demonstrates good physical, chemical, dielectric, and insulating properties over a broad temperature range. Less expensive than higher temperature films, yet designed for high performance applications.
Tape, polytetrafluoroethylene film	These tapes, coated with a silicone based adhesive, are used in 356°F (180°C) applications. This, combined with the relative thinness, makes these tapes most usable and increasingly popular.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

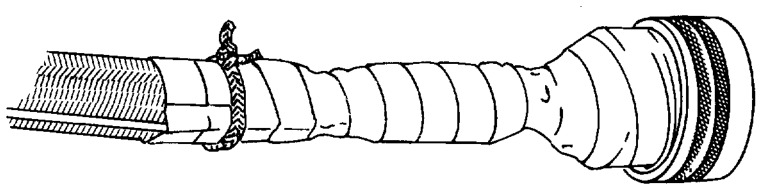
Term	Definition
Tape, polytetrafluoroethylene film, printed surface	While the anti-friction or anti-stick property of polytetrafluoroethylene film is desirable in many instances, this property is a disadvantage if it is necessary or desirable for another material to adhere to it.
Tape, pressure sensitive	Pressure sensitive tapes contain an adhesive coating applied to the backing material which allows the backing to be positioned with application of pressure only. The use of an activator such as heat, solvent, or water is not required. The two primary functions of electrical pressure sensitive tapes are holding and insulating. These tapes are commonly adhered to conductors or other insulating devices, and serve the purpose of holding or anchoring them in a desired manner. Secondary functions of electrical tapes include: (1) protection against abrasion; (2) use as a barrier to the entrance of moisture; (3)identification; (4) spacing factor; (5) reinforcing; (6) bundling. Cloth and mat pressure sensitive tapes are generally used for their physical strength factors. Widely different electrical properties are available depending on the specific chemical construction of the backing used.
Tape shields	Shields constructed from copper and aluminum (either alone or laminated with a dielectric), bimetallic tape (copper/stainless steel/copper), and bronze. Tape shields are supplied in two forms, flat and corrugated. (See shield.)
Tape, silicone rubber	High temperature splicing tape with excellent conformability for wrapping splices or terminations. Excellent arc tracking resistance, electric strength, ozone resistance, and weathering resistance are also claimed.
Tape, vinyl film	These tapes are seldom used internally in an electrical unit, but are commonly used in the insulation of external splices, wrapping leads, and cable harnessing.
Taped insulation	Insulation of helically wound tapes applied over a conductor or over an assembled group of insulated conductors. When successive convolutions of a type overlie each other for a fraction of the tape width, the taped insulation is lap wound. This is also called positive lap wound. When a tape is applied so that there is an open space between successive convolutions, this construction is known as open butt or negative lap wound. When a tape is applied so that the space between successive convolutions is too small to measure with the unaided eye, it is a closed butt taping. Where there are multiple layers of tape, indexing refers to the fact that they are started a certain distance from each other along the axis of the cable to assure full coverage. (See tape wrap.)
Taper pin	Pin-type terminal having a tapered end designed to be impacted into a tapered hole to form a connection.
Taper tab	Flat terminal having tapered side designed to receive a mating tapered female terminal.
Tape wrap	Term denoting a spirally or longitudinally applied tape material wrapped around the wire, either insulated or uninsulated, and used as an insulation or mechanical barrier. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Taping	Process of insulating continuous length, large diameter wires with tape of non-extrudable materials. In most taping operations, two spiral wraps are applied in an opposite direction (cross-wrapped) directly over the conductor. Each tape is overlapped to form a multilayered, void-free covering, and heat sealed to produce an integral and continuous wall.
Tarnish	Surface discoloration of a metal caused by formation of a thin film of corrosion product.
TAS	Thermoplastic appliance shielded wire.
TBS	Designation for switchboard wire, thermoplastic insulation, flame proof cotton braid, 600 V,194°F (90°C).
TBWP	Designation for switchboard wire, weatherproof saturated. No voltage rating.
TC	(1) Tinned Copper. (2) (See Tray Cable.)
T dimension	Dimension of the crimped portion of a connector measured between two opposite points on the crimped surface. (See depth of crimp.)
Tear strength	Force required to tear a material under specified conditions.
Teflon	Trademark of the DuPont Company for fluorocarbons FEP and PTFE.
Tefzel	Trade name of the DuPont Company for ethylene-trifluoroethylene (ETFE) compound.
Telemetry cable	Cable used for the transmission of information from instruments to the peripheral recording equipment.
Telephone wire	General term referring to many different types of communication wire. Refers to a class of wires and cables, rather than a specific type.
Tellurium cure	Curing process similar to selenium cure, except a different element is used.
Temper	(1) Hardness and strength produced by mechanical or thermal treatment or both, and characterized by a certain structure, mechanical properties, or reduction in area during cold working. (2) A measurement of the degree of hardness or lack of ductility in a metal.
Temperature coefficient of resistivity	Change in resistance (electrical) per degree change in temperature. Usually signified by the symbol alpha.
Temperature rating	Maximum temperature at which an insulating material may be used in continuous operation without undue degradation or safety hazard.
Tensile strength	Characteristic of a material which describes its resistance to fracture when the material is being stretched, i.e., under a tensile load. For example, if a wire is attached to a rigid frame at one end and a succession of increasing weights are hung from the other end of the wire, it would be under a tensile load. The point or load at which the wire breaks describes the tensile strength of the wire and the material of its construction.
Tensile test	Controlled pull test on the crimp joint to determine its mechanical strength.
Tension member (fiber optic)	Member included in a fiber cable to add tensile strength. Does not carry information. Also called strength member. (See strength member.)
Tension meter	Meter used to measure and test the tension in all types of wire, yarn, tape, and film during production processing and winding.
Tension set	Condition when a plastic material shows permanent deformation caused by a tension stress, after the stress is removed.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

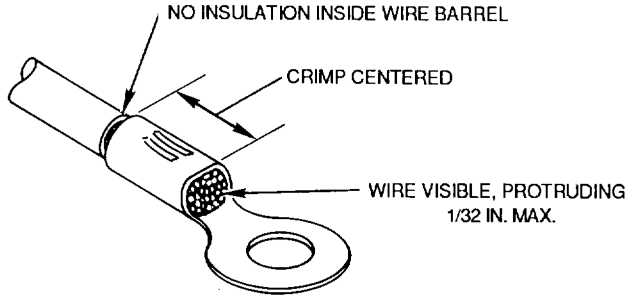
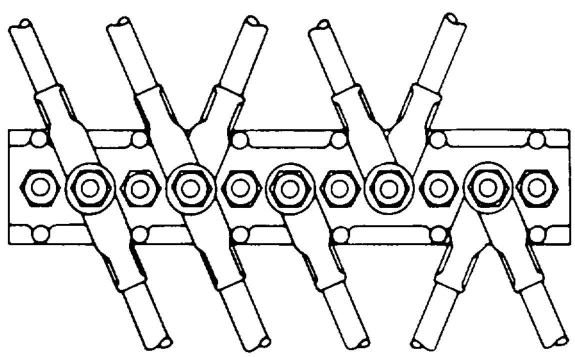
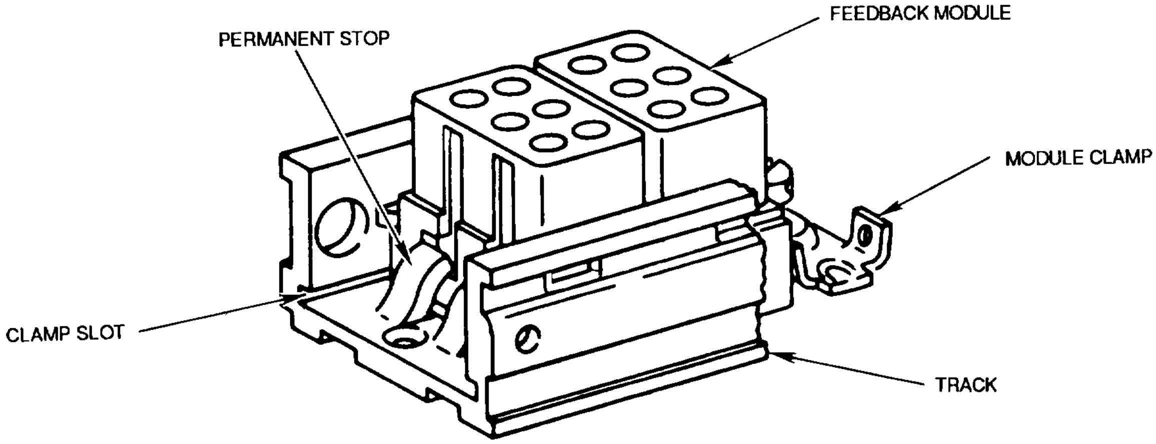
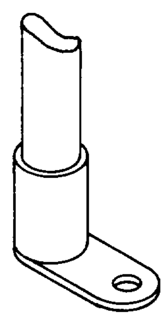
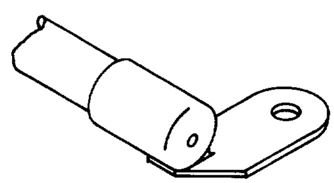
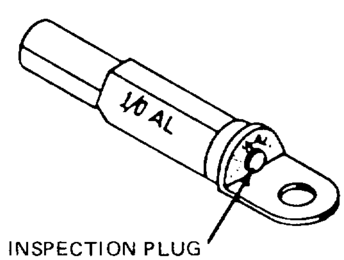
Term	Definition
Terminal	Metal wire termination devices designed to handle one or more conductors, and to be attached to a board, bus, or block with mechanical fasteners, or clipped on. Types are ring, tongue, spade, flag, hook, blade, quick-connect, off-set, flanged, etc. Special types include taper pin, taper tab, and others, either insulated or non-insulated. 
Terminal area	(See land.)
Terminal board	Insulating base equipped with one or more terminal connectors for the purpose of making electrical connections, typical terminal board designs are provided in SAE–AS27212.  NOTE: ALL TERMINALS SHOULD BE PLACED SO THAT MOVEMENT WILL TIGHTEN NUT
Terminal junction module	Termination assembly having multiple contacts interconnected in parallel to form a circuit. May contain one or more circuits. (See terminal junction system.)

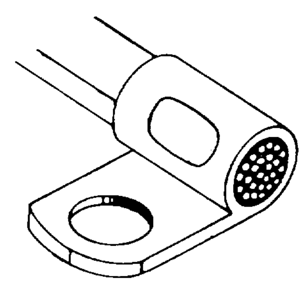
TABLE 2. TERMS AND DEFINITIONS (Cont.)

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Terminal junction system</td><td>System conforming to MIL-T-81714 consisting of modules, tracks, and splices used for interconnecting electrical components and equipment requiring infrequent disconnection.


TERMINAL JUNCTION SYSTEM (TYPICAL)</td></tr>
<tr><td>Terminal lug</td><td>Device designed to be affixed, usually at one end, to a post, stud, chassis, or similar device, and with provision for attachment of an electrical conductor(s) in order to establish an electrical connection.


90º UPRIGHT TYPE ALUMINUM TERMINAL LUG


LEFT ANGLE TYPE ALUMINUM TERMINAL LUG


STRAIGHT TYPE ALUMINUM TERMINAL LUG


FLAG TYPE COPPER TERMINAL LUG</td></tr>
</table>

TABLE 2. TERMS AND DEFINITIONS (Cont.)

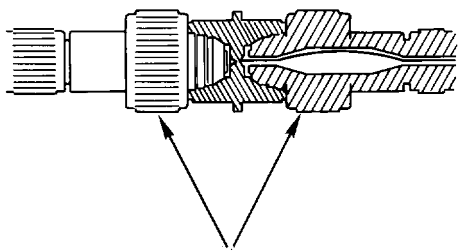
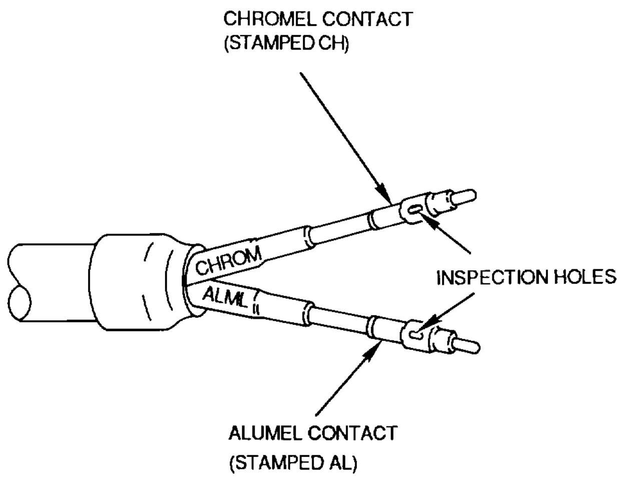
Term	Definition
Terminal nipples	Used to provide overall insulation and protection on terminal lugs and studs. Conforms to A–A–59178.
Terminal style	Tongue design of the terminal (flag, flanged spade, off-set, rectangular, ring, slotted, spade, etc.).
Terminator	A 75-ohm resistive connector used to terminate the end of a cable or an unused tap.
Terminus (fiber optic)	Device used to terminate an optical conductor that provides a means to allocate and contain an optical conductor within a connector. 
Ternary alloy	Alloy that contains three principal elements.
Tertiary winding	Winding added to a transformer in addition to the conventional primary and secondary windings, such as for suppressing third harmonics or connecting to a power-factor correcting device.
Test lead	Flexible, insulated lead wire which usually has a test prod on one end. Ordinarily used for making tests, temporarily connecting instruments to a circuit, or making temporary electrical connections.
Textile braid	Any braid made from threads of cotton, silk, or synthetic fibers.
TF	Designated for solid or seven-strand copper conductor, thermoplastic insulated fixture wire, 140°F (60°C).
TFE	Also as PTFE. (See Polytetrafluoroethylene.)
TFF	Same as TF, but flexible stranding, 140°F (60°C).
TG	Designation for flexible nickel or nickel–clad copper conductor, PTFE tape, overall glass braid, 392°F (200°C).
TGS	Designation for solid or flexible copper, nickel–clad iron or copper, or nickel conductor, PTFE tape, silicone glass braid, 600 V, 482°F (250°C).
Thermal aging	Exposure to a given thermal condition or a programmed series of conditions for prescribed periods of time.
Thermal conductivity	Property of a material or assembly which describes its ability to conduct heat. Metals, in general, are better thermal conductors than nonmetals. Silver and copper are the best conductors of heat. In general, thermal conductivity of a material parallels its electrical conductivity.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Thermal Electromotive Force (EMF)	Measure of a phenomenon which takes place when two dissimilar metals are bonded together. If the temperature of the bonded area is raised, a voltage is generated. An example of this is a thermocouple. Two dissimilar metals are bonded together, and the point of bonding is placed in the medium to be measured. The wires leading from the point of bond are then connected to an instrument that reads the voltage generated at the bond point. For the voltage to appear and be read, the point of measurement and the bonding point must be at two different temperatures. When this temperature difference and the dissimilar metals are present, the thermal electromotive force is generated.
Thermal endurance	Time at a selected temperature for an insulating material or system of materials to deteriorate to some predetermined level of electrical, mechanical, or chemical performance under prescribed conditions of test.
Thermal expansion	Process in which a constant mass of a substance undergoes an increase in volume when heat is applied.
Thermal expansion, coefficient of	Fractional change in length (or volume) of a material for a unit change in temperature.
Thermal insulation	Inverse of thermal conductivity. The ability of a material to thermally insulate, block or resist the flow of heat.
Thermal rating	Temperature at which a given material will perform relative to other materials.
Thermal resistance of a cable	Resistance offered by the insulation and other coverings to the flow of heat from the conductor or conductors to the outer surface. The thermal resistance of the cable is equal to the difference of temperature between the conductor or conductors and the outside surface of the cable divided by rate of flow of heat produced thereby.
Thermal shock	Resulting characteristics when a material is subjected to rapid and wide range changes in temperature in an effort to discover its ability to withstand heat and cold. In connectors, the effect can cause inserts and other insulation materials to pull away from metal parts.
Thermal shunt	Device capable of dissipating heat used to protect heat sensitive components.
Thermal stresses	Stresses in metal, resulting from non-uniform temperature distribution.
Thermal wipe	Slight movement of mated contacts caused by thermal expansion or contraction of parts that can cause poor performance.
Thermocompression bonding	Joining together of two materials without an intermediate material by the application of pressure and heat in the absence of electrical current.
Thermocouple	Device for measuring temperature. Two electrical conductors of dissimilar metals are joined at the point of heat application and a resulting voltage difference, directly proportional to the temperature, is developed across the free ends and is measured potentiometrically.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Thermocouple contact	Contacts of special materials used in connectors employed in thermocouple applications. Materials often used are iron, constantan, copper, chromel, alumel, and others.



TYPICAL THERMOCOUPLE CONTACTS

Thermocouple wire	A two conductor cable, each conductor employing a dissimilar metal, made up specifically for temperature measurements.
Thermoplastic	Term used to describe those plastics which can be repeatedly made to flow under the application of heat to fill a mold, coat non-plastic materials, extrude shapes, etc. Hardening is achieved by a decrease in temperature. The change with temperature is substantially physical rather than chemical.
Thermoplastic Elastomer (TPE)	Jacket material which has many of the characteristics of rubber, as well as excellent electrical, mechanical, and chemical properties. It is less expensive than neoprene or chlorosulfonated polyethylene.
Thermoset	Material which hardens or sets when heat is applied, and which, once set, cannot be resoftened by heating. The application of heat is called curing.
Thermosetting	Term used to describe plastic materials that are capable of being changed into substantially infusible or insoluble products when cured by application of heat or by chemical means. Once cured, the plastic cannot be made to flow. Not all thermosetting materials are cured by heat; some can be cured at room or lower ambient temperatures.
Thermostat metal	Clad metal consisting of at least two materials bonded together: one a high thermal expansion rate alloy, the other a low thermal expansion rate alloy. When heated or cooled, the difference in thermal expansion rate between the materials causes the metal to curve, thereby allowing its usage as a temperature responsive sensor or actuator. Also known as bimetals.
Thermostat wire	Single or multiconductor wire, bare, soft, solid copper conductor, usually PVC insulated. May be twisted and/or jacketed. May have enameled or nylon covered conductors and may have a metal armor covering. May also have asbestos insulation. Used to transmit electrical signals between the thermostat and the heating or cooling unit.
THHN	Nylon jacketed building wire for dry locations, 600 V, 194°F (90°C).
Thickening agents	Chemical additives to fluid solutions (such as coatings) to increase the viscosity or impart thixotropic character. They prevent flow and sag as the fluid sets.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

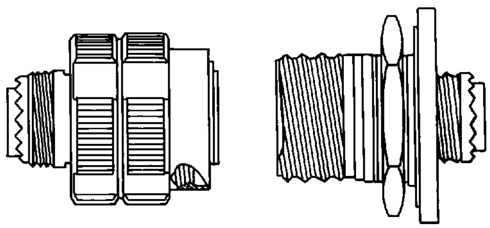
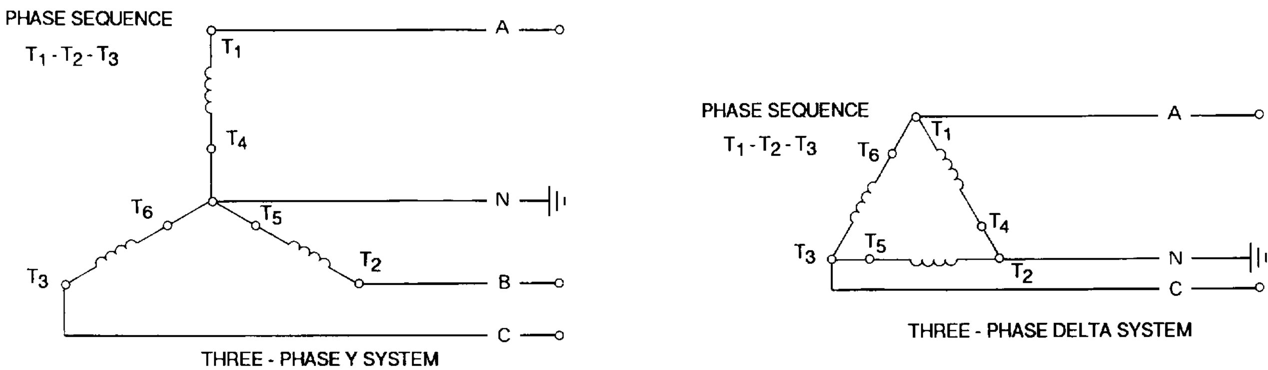
Term	Definition
Thick film	Conductive, resistive, and/or capacitive passive network deposited on a substrate using a metallic or resistive film which is more than 5 microns in thickness.
Thixotropic	Characteristic of a liquid or gel that is viscous when static, yet fluid when physically worked.
Thoria	Thoria is a very good refractory ceramic with a melting point of 5432°F (3000°C). Thoria cathodes are used in magnetrons to provide a stable emission and long life under environmental conditions.
Threaded coupling	Way to couple mating connectors by engaging threads in a coupling ring with threads on a receptacle shell. 
Three-phase current	Current delivered through three wires, with each wire serving as a return for the other two and with three current components differing in phase successively by one third cycle or 120 electrical degrees.
	
Three-phase three-wire sys-tem	Alternating current supply system comprising three conductors over which three-phase power is sent. A four-wire system, which includes a ground, is sometimes used in local installations.
Three-wire system	A dc or single-phase ac system comprising three conductors, one of which (the neutral wire) is maintained at a potential, midway between the potential of the other two.
Through connection	Electrical connection between conductive patterns on opposite sides of an insulating base, e.g., plated-through hole or clinched lead.
THW	Designation for thermoplastic vinyl insulated building wire. Flame retardant and mois-ture and heat resistant, 167°F (75°C). Dry and wet locations.
THWN	Same as THW but nylon jacket overall, 167°F (75°C).
Time Division Multiplexing (TDM)	Method of utilizing channel capacity efficiently in which each mode is allotted a small time interval, in turns, during which it may transmit a message or a portion of a message.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

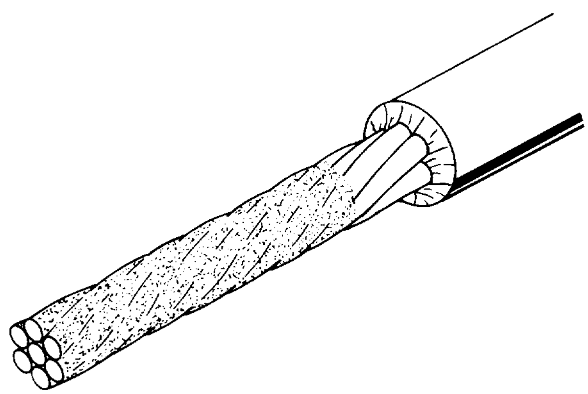
Term	Definition
Tin and tin alloys	Tin, or Stannum (Sn), is used primarily as a coating for other metals. It is resistant to corrosion and tarnish, non-toxic, ductile, and solderable. It is frequently alloyed with other metals to improve mechanical and physical properties. Tin can be plated from both an acid and an alkaline electrolytic although tin fluoborate is most common. Tin coating is slightly more expensive than bare copper wire, but labor savings offset the additional cost, especially when manual twisting and solder dipping of the stripped lead are required. The tin-nickel alloy deposit (65% tin and 35% nickel) can be soldered, has high hardness (650 Vickers), good conductivity, and a low coefficient of friction. These properties are of special interest in printed circuit and allied electronic applications. Tin and tin alloys also are widely used in soldering applications with tin lead being most frequently used in the electrical/electronic industry.
Tin-lead alloys	Tin-lead alloys, or solders, have a low melting temperature range. This makes them ideal for joining most metals, by convenient heating methods, with little or no damage to heat sensitive parts. Tin-lead alloys are also used for plating applications where two different metals are deposited simultaneously to form an alloy on the surface to be plated.
Tinned	Having a thin coating of pure tin or tin alloys.
Tinning	Coating of a terminal, wire, or conductive pattern with tin or solder alloy to improve or maintain solderability or to aid in the soldering operation. 
Tin Overcoat (TOC)	Tinned copper wire, stranded, coated with pure tin.
Tin pest	Polymorphic modification of tin which results in crumbling of the tin into a powder known as gray tin. The reaction can occur below 32°F (0°C) but does not proceed rapidly unless the metal is much colder. Maximum rate is at -54°F (-47.8°C).
Tinsel wire	Very flexible conductor made by serving one or more very small flat conductors over a fibrous core such as a high stength rayon, nylon, or cotton.
TOC	(See Tin Overcoat.)
Topcoat	Bare (untinned) copper wire, stranded then coated with pure tin.
Topology	Description of the physical connections of a network.
Torch soldering	Bonding produced by heat from a torch.
Torsion	Strain created in a material by a twisting action. Correspondingly, the stress within the material resisting the twisting.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Total internal reflection	Total reflection that occurs when light strikes an interface at angles of incidence greater than the critical angle.
Toughness	Ability of a metal to absorb energy and deform plastically before fracturing. Usually measured by the energy absorbed in a notch impact test, but the area under the stress-strain curve in tensile testing is also a measure of toughness.
Toxicity	Relates to all forms of human exposure to substances that can cause distress: inhalation, skin contact, and ingestion. The term TLV is a measure of the inhalation toxicity of a substance, and establishes the maximum average concentration of vapors in air that a typical worker can continuously be exposed to without harm in an 8 hour day.
TP	(1) Tin Plate. (2) Designation for parallel tinsel cord. All rubber insulation and jacket over two extremely flexible conductors. Light duty, attached to appliances of 50 W or less. For use in damp places in lengths of eight feet or less.
TPE	(See Thermoplastic Elastomer.)
TPO	Same construction as type PO, but with extra flexible tinsel conductors, 125 V.
TPT	Same as TP, but all thermoplastic insulation and jacket, 125 V.
Tracer stripe	When more than one color coding stripe is required, the first, or widest, stripe is the base stripe; the other, usually narrower stripes, are termed tracer stripes.
Track	(See rail.)
Tracking	The formation of contaminants on the surface of insulating material due to arcing. Tracking can leave either a conductive or nonconductive path after the arcing stops.
Transceiver	Combined transmitter and receiver.
Transformer	Electrical device which changes voltage in direct proportion to currents and inverse proportion to the ratio of the number of turns of its primary and secondary windings. (See formulas-electrical.)
Transient	Temporary voltage or current existing in a circuit during adjustment to a charged load, different source voltage, or line impulse.
Transistor	A semiconductor device with three or more electrodes commonly used to amplify or switch electric current. (See semiconductor device.)
Transmission	Transfer of electric or optical energy from one location to another through conductors or by radiation or induction fields. The transfer is always accompanied by energy, which is inversely proportional to the efficiency of the medium through which transmission occurs.
Transmission cable	Two or more transmission lines. If the structure is flat, it is called flat transmission cable to differentiate it from a round structure, such as a jacketed group of coaxial cables. (See transmission line.)
Transmission line	Signal-carrying circuit composed of conductors and dielectric material with controlled electrical characteristics used for the transmission of high-frequency or narrow-pulse type signals.
Transmission loss	Term used to denote a decrease or loss in power during the transmission of energy from one point to another. Usually expressed in decibels.
Transmission media	Anything such as wire, coaxial cable, fiber optics, air, or vacuum that is being used to carry an electrical signal which has information.
Transmitter, optical (fiber optic)	Electro-optical module which converts an electrical input signal to an optical output signal. (See fiber optics.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

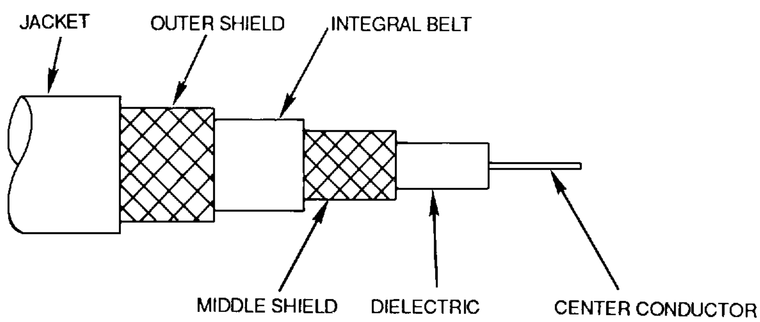
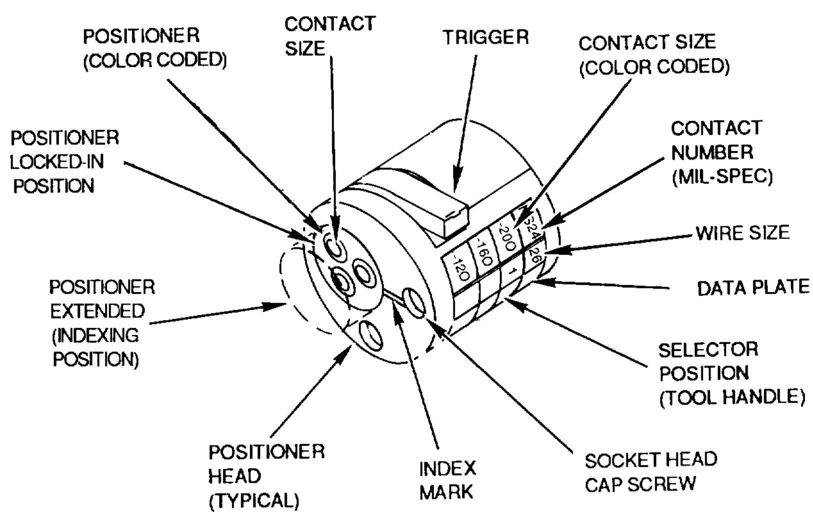
Term	Definition
Transmitting element (fiber optic)	Radiating terminus in an optical junction. (See terminus.)
Transparent (fiber optic)	Transmitting rays of light such that objects can be seen through the material.
Transposition	Interchanging the relative positions of wires to neutralize the effects of induction to or from other circuits or, in two-wire parallel lead-ins for an antenna, to minimize interference pickup by the lead-in during reception.
Transverse conductance	Measure of the flow of electrical current from strand to strand in a multistrand conductor.
Trap wire	Low voltage wire used at hinge points, where severe flexing occurs, usually in burglar alarm systems. Made with tinsel conductor.
Tray	Unit or assembly of sections and associated fittings forming a rigid structural system to support cables.
Tray Cable (TC)	Factory-assembled multiconductor control, signal, and power cable specifically approved by the National Electrical Code for installation in trays.
Triad	Group of three insulated conductors twisted together. Also called a triplex or triplet.
Triaxial cable	A three-conductor cable with one conductor in the center, a second circular conductor shield concentric with the first, and the third circular conductor shield insulated from and concentric with the first and second. Usually with insulation, and a braid or impervious sheath overall. 
Triboelectric noise	Noise generated in a shielded cable due to variations in capacitance between shielding and conductor as the cable is flexed.
Trigonometric functions	(See Formulas - electrical.)
Triple cable	Cable composed of three insulated single conductors and often one bare conductor, all twisted together. The assembled conductors may or may not have a common covering of binding or protecting material. Also called a triad.
Triplex cable	Cable composed of either three insulated single conductor cables twisted together or two insulated single conductor cables twisted together with a bare conductor for ground.
TRPA	Same as TPA except stranded nickel-clad conductor, 650°F (343.2°C).
True concentric	A true concentric stranding or twisted cable is when each successive layer has a reversed direction of lay from the preceding layer.
TS	Designation for two or three conductor rubber insulated and jacketed tinsel cord. Light duty, attached to an appliance of 50 W or less. For use in damp places in lengths of eight feet or less.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
TSO	Same as TS, but with neoprene jacket, 125 V.
TST	Same as TS, but all thermoplastic insulation and jacket.
TT	Designation for polyvinyl chloride insulation and sheath, aerial and duct.
Tubing, flexible	Flexible tubings can be made from materials normally available in sheet form. This type of tubing may be used for specific reasons such as low cost, high dielectric strength in thin thicknesses, high temperature resistance, thin wall, cut-through resistance, or solvent resistance.
Tubing, rigid insulating	These tubes can be made from nearly any type of material by most fabrication methods. The shapes are generally round or rectangular, and they are used for a variety of purposes, i.e., fabricated coil forms, shaft insulators, supports, separators, etc.
Tubing, shrinkable (non-heat)	Encapsulating parts without exposure to heat is accomplished with shrinkable tubing and tape that is automatically activated by chemical evaporation upon exposure to air.
Tubular adapter	Accessory attached to the rear of a connector, usually metallic, used to extend the shell far enough to support a sealing gland or to give mechanical support for a cable or wire harness.
Tungsten	Hard metallic element which is used for low voltage electrical contacts because of its resistance to wear and spark erosion, along with its relatively good electrical conductivity.
Turn	Conductor making one complete loop around a magnetic circuit.
Turret head	Device that contains more than one locator which can be indexed by rotating a circular barrel, and when attached to a crimping tool, positions the contact.



Turret terminal	Round post-type grooved stud around which wires or leads are snugly hooked before soldering.
TW	Designation for thermoplastic vinyl jacketed building wire. Moisture resistant, 140°F (60°C).
Twill weave	A weave, used on woven cables, which does not require threads between the conductors and is used where high flexibility and quick lead exposure are essential.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Twin cable	Pair of insulated conductors twisted and/or sheathed or held together mechanically and not identifiable from each other in a common covering.
Twin coaxial	Configuration containing two separate, complete coaxial cables laid parallel or twisted around each other in one complex.
Twin line	Type of transmission line which has a solid insulating material, in which the two conductors are placed in parallel to each other and whose impedance is determined by the diameter and spacing of the conductors and the insulating material. Also known as twin lead.
Twinner	Device for twisting together two conductors, an operation called twinning or pairing. Tapes, binders, and flat shields can be applied simultaneously during the twisting process.
Twist	Deformation of a rectangular sheet such that one of the corners is not in the plane containing the other three corners. (See bow.)
Twisted pair	Cable composed of two small insulated conductors, twisted together without a common covering. The two conductors of a twisted pair are usually substantially insulated, so that the combination is a special case of a cord.
Two-piece contact	Contact made of two or more separate parts joined by swedging, brazing, or other means of fastening to form a single contact. This type provides the mechanical advantages of two metals but also has the inherent electrical disadvantage of differences in conductivity.
Two-piece edge connector	Connector plug half is soldered to printed circuit board tabs and becomes a permanent part of the board. The plug/board unit is joined to a receptacle half to make connection.
Two-sided board	(See double-sided board.)
U-bend test	Determines corona discharge and ozone resistance. The time to failure is measured.
UG	Universal Government, the two letter designation that precedes the number on connectors for coaxial cable.
UHF	Ultra High Frequency, 300 MHz to 3000 MHz.
UL	(See Underwriters' Laboratories.)
U/L Approved	Mark of approval issued by Underwriters' Laboratories. (See Underwriters' Laboratories.)
Ultimate strength	The maximum conventional tensile, compressive, or shear-stress that a material can withstand.
Ultrasonic	Sound waves that vibrate at frequencies beyond the hearing power of human beings (above 16 KHz). Commercial and military applications include ultrasonic cleaning, gauging, cutting, detection instruments, and welding.
Ultrasonic bond	Bond made by a process in which the wire is pressed against a bonding pad, and the pressing mechanism ultra-sonically vibrated at a frequency above 10 KHz. High-frequency vibrations break down and disperse the oxide films present on the conductor surfaces. As these surface films are removed, diffusion of the conductor materials occurs at the interface. The joints formed are metallurgically sound diffusion bonds.
Ultrasonic cleaning	Immersion cleaning aided by ultrasonic waves which cause microagitation.
Ultrasonic soldering	Fluxless soldering, wherein molten solder is vibrated at ultrasonic frequencies while making the joint.
Umbilical connector	Connector used to connect cables to a rocket or missile prior to launching and which is unmated from the missile at the time of launching.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

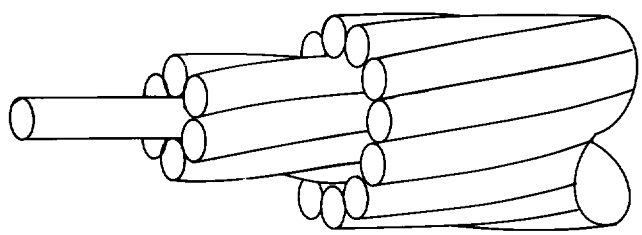
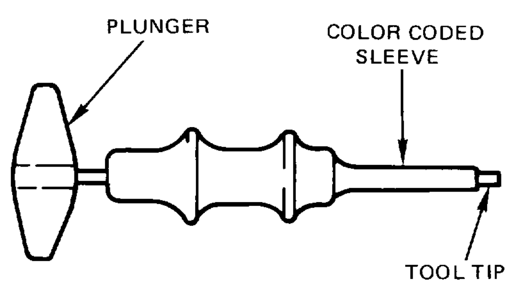
Term	Definition
Unbalanced line	Transmission line in which voltages on the two conductors are unequal with respect to ground; a coaxial cable.
Undercut	The narrowing of a circuit line during etching by the horizontal attack by the etching solution. (See etch factor.)
Underwriters' Laboratories (UL)	A non-profit independent organization which operates a listing service for electrical and electronic materials and equipment.
Unidirectional concentric stranding	Stranding in which each successive layer has a different lay length, thereby retaining a circular form without migration of strands from one layer to another. 
Unidirectional stranding	Term denoting that in a stranded conductor, all layers have the same direction of lay.
Unilay strand	Conductor constructed with a central core surrounded by more than one layer of helically-laid wires, with all layers having a common length and direction of lay.
Unsupported hole	Hole containing no conductive material nor any other type of reinforcement.
Unwired contact removal tool	Hand tool used to remove an unwired contact from a connector insert or retainer. Not to be used for contacts with broken wires (tool tip must slide into the conductor barrel).  TYPICAL UNWIRED CONTACT REMOVAL TOOL
URC	Designation for weatherproof wire.
Urethane	Family of thermosetting plastics produced by reacting isocyanate compounds with polyois (compounds having hydroxyl groups). These polyois are usually glycols, polyesters, and polyethers. Applications include insulation, wire coatings, dipping and impregnating materials for electrical and electronic components, and foam encapsulants. Through choice of materials, varying flexibilities can be achieved. As a class, urethane coatings can be considered to possess toughness, hardness, smooth and glossy film surfaces and resistance to abrasion, moisture, and chemicals.
V	(1) Designation for varnished cambric insulation with fibrous covering. (2) (See Volt.)

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Vacuum encapsulation, potting, and impregnating	Process of enclosing or impregnating electrical components by subjecting the parts to a high vacuum, introducing the impregnant or encapsulant, and then releasing the vacuum. The resin-mix and parts are held under vacuum (in separate chambers) for a period of time to remove moisture, gases, and other contaminants. Then the resin is admitted into the parts chamber and cured at proper temperature.
Vapor Pressure	Pressure exerted by a vapor in equilibrium with a solution, or the material from which the vapor emanated. For example, a quantity of water placed in a closed container will evaporate a certain amount of water vapor. The pressure exerted by this vapor at a given temperature is the vapor pressure of water at that temperature. Vapor pressure, naturally, is dependent upon temperature, i.e., the higher the temperature, the higher the vapor pressure. Vapor pressure is a good indication of the volatility of a material, i.e., the higher the vapor pressure of a material at a given temperature, the higher its evaporation rate will be. This is quite applicable to fluxes or cleaning solvents used in soldering processes. Since these materials are generally mixtures of materials, the components with the highest vapor pressure will evaporate faster than the other components. The result, eventually, is imbalance of the flux or solvent.
Vapor Degreasing	Degreasing work in vapor over boiling liquid solvent, the vapor to be considerably heavier than air. At least one constituent of the soil must be soluble in the solvent.
Vapor density	Relative density of a vapor or gas (with no air present) as compared with air.
Vapor phase soldering	Vapor phase (condensation) soldering uses the high-temperature vapor of a boiling fluorocarbon as the heat-transfer medium.
Varnish	Coatings consisting of natural or synthetic resins which protect coils or windings from dirt, moisture, and other contaminants. They may be water or solvent based.
Varnish, Acrylic	Aqueous dispersions which are non-flammable and eliminate the hazard of fire during application. When cured, they produce tough, flexible films essentially unaffected by most common solvents and oils.
Varnish, Phenolic	Used for outstanding properties of fast cure and excellent chemical resistance. Classed as 221°F (105°C) materials, and perform well with polyvinyl acetal, formetic, nylon, and nylon polyvinyl acetal wire enamels.
Varnish, Phenolic, oil modified	Vary in hardness, speed of cure, and flexibility depending on the amount and kind of oil modification. Most of these varnishes have excellent dielectric properties and good chemical and moisture resistance.
Varnish, alkyd	Made of glycerolphthalate resins combined with drying oils such as linseed, tung, soya, or castor. Noted for heat stability, excellent dielectric properties, and resistance to oils. Usually recommended for 221°F (105°C) operation.
Varnish, alkyd phenolic	Good dielectric properties and good resistance to moisture, hot oil, and weak acids. Slightly better heat resistance than the oil-modified phenolics, and can be used with all magnet wire coatings.
Varnish, alkyd-silicone	Good dielectric properties and better oil resistance than pure silicones, but less moisture resistance. Tend to cure well internally, but some may soften under heat thereby losing their bonding properties at high temperatures.
Varnish, phenolic, polyester modified	Tough oil- and water-proof coatings with good coverage and adhesion. Develops heavy coatings in one application and air dries in two hours. Offers a good dielectric strength, and provides excellent water and oil resistance.
Varnish, polyamideimide	For high temperature applications. Has an aromatic structure which cures with heat to a linear amide-imide homopolymer. The cured polymer is said to have outstanding thermal stability and excellent electrical insulation and mechanical properties.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Varnish, polybutadiene	Exhibit excellent electrical properties, very low drift over a wide range of temperature, moisture, and frequency conditions; good adhesions; good moisture resistance.
Varnish, polyester	High temperature insulating varnishes designed for 266°F (130°C) and 311°F (155°C) operation. Excellent durability and chemical and moisture resistance, and maintain dielectric properties for long periods at temperatures of 356°F (180°C) and above.
Varnish, polyimide	High temperature varnishes for use in conjunction with polyimide enameled wire and coated glass fabrics. Exhibit excellent electrical properties from -392.4°F (-250°C) to 482°F (250°C), thermal stability, radiation, and flame, solvent, and oil resistance. Precautions are necessary to avoid toxic effects.
Varnish, silicone	Silicone varnishes at low temperature curing are designed for use where curing ovens are limited to 275°F (135°C). Used primarily for coating coils of both armatures and stators in electrical motors and generators, and in impregnating coils of transformers intended for high temperature and/or heavy duty service. Also used for the impregnation of assemblies and equipment by dipping or vacuum impregnation.
Varnish, solventless polyester	Semi-rigid varnishes with high thermal stability, good bond strength, excellent electrical properties, moisture resistance, and enough flexibility to withstand thermal shock. Can be applied by dipping or vacuum pressure impregnation, but maximum benefits are realized with the automated treating machines.
Varnish, spirit	Made by dissolving natural or synthetic resins in alcohol. Dry rapidly to a hard glossy surface and are used as a finishing coat. Exhibit good dielectric properties and a fairly good oil and chemical resistance. Have poor through-cure and bonding properties which limit them to protective coating and touch-up rework.
Varnish, urethane	Urethane varnishes have excellent through-curing properties and remain strong and tough at either low or high temperatures.
Varnish, water soluble, electrical insulating	Can be thinned with water or water and solvent combinations to retain their stability in the impregnating tank. Pollution-free, have excellent electrical properties, can be formulated for excellent bond strength, and are rated at 356°F (180°C).
Varnished cloth	Tape wraps of varnished cambric for insulation of wires and cable offer properties that lie between those of rubber and impregnated paper. This applies to dielectric strength, flexibility, resistance to moisture and eat, and handling cable connections and terminations. It provides a greater measure of moisture resistance than paper. In dry locations, it may be used without a lead sheath. It can be used for low and moderate voltage cables.
VCB	Designation for varnished cambric insulation, cotton braid, flame retarding, moisture resisting finish.
VCL	Designation for varnished cambric insulation, lead covered cable. Ends must be hermetically sealed.
VD	Designation for twin wire having two type V conductors laid parallel under an outer fibrous covering.
Velocity of propagation	Applied to coaxial cables, the ratio of the dielectric constant of air to the square root of the dielectric constant of the insulator. Indicates the transmission speed of an electrical signal down a length of cable compared to speed in free space.
VG	Designation for varnished glass over a flexible copper conductor. Varnished glass or nylon braid, 600 V or 3000 V, 266°F (130°C).
VHF	Very High Frequency, 30 MHz to 300 MHz.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Via hole	Plated-through hole used as a through connection, but in which there is no intention to insert a component lead or other reinforcing material.
Video pair cable	Transmission cable containing low-loss pairs with an impedance of 125 ohms. Used for TV pick-ups, closed circuit TV, telephone carrier circuits, etc.
Vinyl	Synthetic resin formed by the polymerization of compounds. As a jacket material, it affords normal mechanical protection, and is usually specified for indoor use and general purpose applications.
Vinyl resins	Synthetic resins formed by the polymerization of compounds. They are strong and tough, having good abrasion resistance. As a class, their electrical properties are excellent. The family includes polyvinyl chloride, polyvinyl acetate, polyvinyl fluoride, polyvinyl butyral, polyvinylidene fluoride, and other polymers.
Virgin metal	Pure metal obtained directly from ore.
Viscosity	Measure of resistance of a fluid to flow either through a specific orifice or in a rotational viscometer. The absolute unit of viscosity measurement is the poise (or centipoise).
Visible light	Electromagnetic wavelengths which can be seen by the human eye ranging from 380 nanometers to 770 nanometers.
Visual examination	Qualitative observation of physical characteristics, utilizing the unaided eye or with stipulated levels of magnification.
VM	Designation for cable having two or more type V conductors twisted together under an outer fibrous covering.
Void	Absence of substance in a localized area.
Voids and inclusions	Bare spaces on the joint surfaces or pockets in the alloy deposit, resulting from failure of the alloy to completely wet the joint surfaces or from flux, gas, or other foreign material becoming entrapped in the alloy deposit.
Volatile	Used to describe materials which have a relatively high evaporation rate or a tendency to evaporate. (See evaporation.)
Volatilization	Evaporation and diffusion of substances at ordinary temperatures.
Volt (V)	Unit of measurement of electromotive force. The difference of potential required to make a current of one ampere flow through a resistance of one ohm.
Voltage (E)	Term most often used in place of electromotive force, potential, potential difference, or voltage drop, to designate electric pressure that exists between two points and is capable of producing a flow of current when a closed circuit is connected between the two points. (See formulas-electrical.)
Voltage Standing Wave Ratio (VSWR)	Ratio of the maximum effective voltage to the minimum effective voltage measured along the length of a mismatched radio frequency transmission line.
Voltage breakdown	Test to determine maximum voltage capability of insulated wire before electrical current leakage occurs through insulation.
Voltage drop	Term expressing the amount of voltage loss from original input in a conductor of given size and length.
Voltage rating	Highest voltage that may be continuously applied to an electric component without undue degradation or safety hazard.
Voltage stress	Stress found within a material when subjected to an electrical charge.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Volume resistivity (specific insulation resistance)	Electrical resistance between opposite faces of a 1 cm cube of insulating material, commonly expressed in ohms/centimeter.
V-ring	Special shaped insulating structure with one or more V-shaped sections used in the construction of commutators.
VSWR	(See Voltage Standing Wave Ratio.)
Vulcanization	Chemical reaction in which the physical properties of an elastomer are changed by reacting it with sulfur or other cross-linking agents.
Vulcanized fiber	Partially regenerated cellulose plastic material, made from rag-base paper or woodpulp. One of the strongest known materials per unit weight. Can be fabricated in complicated shapes and is an excellent electrical insulating material for many applications.
VW-1	A flammability rating established by Underwriters' Laboratories for wires and cables that pass a specific vertical flame test. Formally FR-1.
W	(1) Designation for heavy duty portable power cable, one to six conductor, 600 V,140°F (60°C). (2) (See Watt.)
Wall thickness	Term used that expresses the thickness of a layer of applied insulation or jacket.
Warp	(See bow.)
Water absorption	Ratio of the weight of water absorbed by a material to the weight of the dry material.
Water based	Description of a liquid system, where the primary solvent is water.
Waterblocked cable	Cable specially constructed with no internal voids in order to allow no longitudinal water passage under a given pressure when not subjected to differential pressure.
Water displacement	Characteristic of certain materials, such as lacquers and protective coatings, which replace water.
Water extract resistivity	Value in ohms per centimeter, principally for liquid rosin fluxes, obtained by carrying out a standard test that measures the amount of ionizable material present. The higher the value, the higher the resistivity, hence the less ionizables present.
Water soluble	Description of a liquid system, where the prime solvent is not necessarily water. However, the system is soluble in water, i.e., can be dissolved in or by water.
Watt (W)	Unit of power or work done at a rate of one joule per second or rate of work represented by current of one ampere under a pressure of one volt (volt-ampere). (See power.)
Waveguide	Guide capable of conducting electromagnetic radiation at single or multiple modes.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

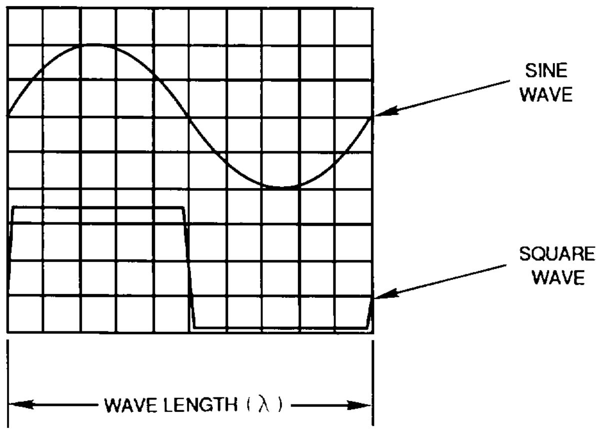
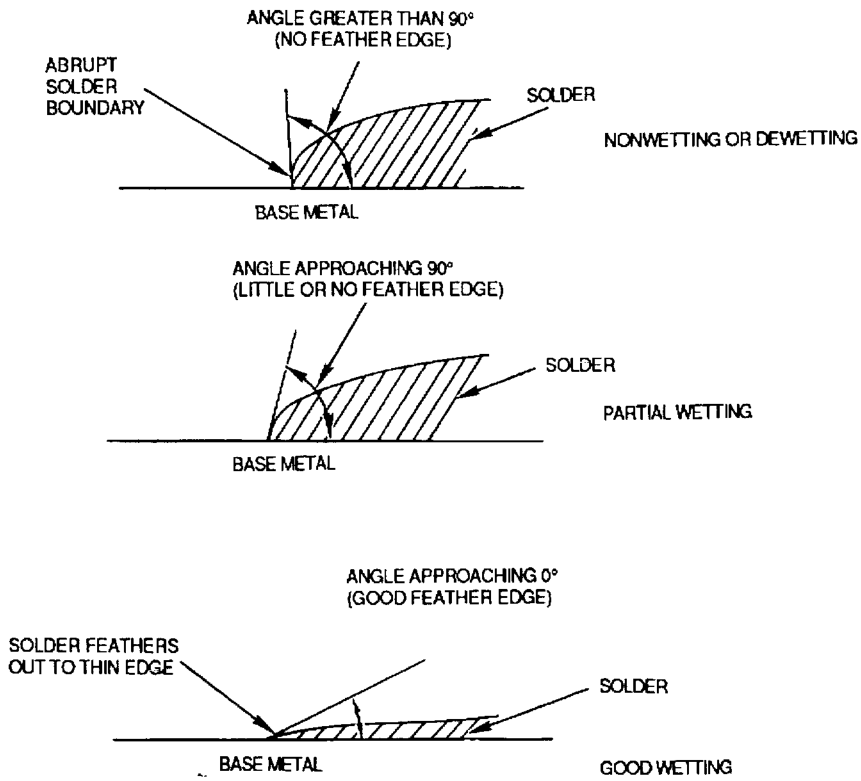
Term	Definition
Wavelength	Distance, measured in the direction of propagation, of a repetitive electrical pulse or waveform between two successive points that are characterized by the same phase of vibration. 
Wave soldering	(1) Removal of a predetermined portion of insulation without affecting the mechanical or electrical characteristics of the conductor or the remaining insulation. (2) Process wherein printed boards are brought in contact with the surface of continuously flowing and circulating solder.
Wave winding	Variation of the layer winding technique in which the pitch angle is much greater than one wire diameter resulting in a honeycombed coil with good cooling properties.
Waxes (hot melt)	Used for electrical components such as coils, transformers, capacitors, etc., as a sealing medium in potting, end sealing, and overdipping. Waxes offer ease of application, excellent moisture protection, low cost, and good electrical properties.
Weave exposure	Surface condition of base material in which the unbroken fibers of woven glass cloth are not completely covered by resin.
Webbing	As applied to soldering, refers to a condition wherein the plastic basic material of the printed circuit board is softened as it passes over the solder wave, with a resultant pick-up of fine particles of solder onto the tacky surface of the plastic. This condition generally is a result of inadequate curing of the plastic materials going into the printed circuit board and can create difficulties on boards where conductor paths are closely spaced or a high voltage is present on the board. Also called spidering.
Wet process	One in which a fluid is used, e.g., adhesives, inks, solder, potting materials, etc. Strict process controls are required, making it difficult to perform wet process when installing or maintaining electrical assemblies.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Wetting	Physical phenomenon of liquids, usually in contact with solids, wherein the surface tension of the liquid has been reduced so that the liquid flows and makes intimate contact in a very thin layer over the entire substrate surface. An example of this is the wetting of a metal surface by a solder. Flux reduces the surface tension of the metal surface and the solder, with the result that the droplets of solder collapse into a very thin film, spreading and making intimate contact over the entire substrate surface.



Term	Definition
Wetting action	The forming of a new alloy by intermolecular attraction between the solder and the base metal and plating.
Wetting agent	Chemical material added to a liquid solution to reduce surface tension. The effect of this reduction of surface tension is to increase the power of the liquid mixture or solution to wet an object on which it is placed. (See wetting.)
W/G	With Ground.
Whisker	Slender acicular (needle-shaped) metallic growth on a printed board.
White metal	General term covering a group of white-colored metals of relatively low melting points (lead, antimony, bismuth, tin, cadmium, and zinc) and of the alloys based on these metals.
Wicking	Capillary absorption of liquid (including water) along the fibers of the base material. The flow of solder along the strands and under the insulation of stranded lead wire.
Wideband	Communications channel offering a transmission bandwidth greater than a voice-grade channel.
Width	Pertaining to flat cable, distance between edges of the cable.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Winding	(1) One or more turns of wire forming a continuous coil. (2) The coil itself, as in transformer primary and secondary windings.
Wipe soldering	Forming a joint by applying semi-fluid solder and shaping the joint by rubbing with a greased cloth pad.
Wiping action	Action of two electrical contacts which come in contact by sliding against each other. (See contact wipe.)
Wire	Technically, a slender rod or filament of drawn metal. Common usage: A solid or stranded group of solid cylindrical conductors, together with any associated insulation. NOTE: For the purpose of these definitions the term wire is used according to its technical definition. For the purposes of discussion in the text of this manual, the term wire is used according to its common usage.
Wire and cable identification	Identification marking of wire and cable can be accomplished in many ways, such as silk screen letters and/or numerals, helical stripes, colored insulation, laser, printed adhesive tape, sleeving, or heat shrinkable tubing, clip-on or crimp-on bands (metallic or non-metallic), ink jet printing, and wrap-arounds.
Wire and cable tying, clamping, and harnessing devices	In addition to tying tapes, lacing cords, and flexible sleevings which are used for wire and cable bundling, harnessing, and holding, a number of other products are also available for this purpose. Most of these devices are in the form of plastic ties or clamps which offer both time savings and weight savings. Spiral-cut plastic tubing, plastic U-shaped trays or ducts in long lengths with removable covers, and other products also are used for harnessing and cabling purposes.
Wire and lead cutters	These tools and machines can vary from plier type cutters to semiautomatic or fully automatic machines integrated with other wire processing operations such as stripping, forming, terminating, etc.
Wire damage curves	Electric current plotted against time required at each current to cause the conductor to be damaged. Such curves are used to establish the circuit protection device: fuse, circuit breaker, limiter, etc., that will prevent conductor damage.
Wire dress	Arrangement of wires and laced harnesses in an orderly manner.
Wire gauge	A system of numerical designation of wire sizes. (See American Wire Gauge.)
Wire guides and parts	Guides and parts involved in wire processing and usage. Frequently must be made of materials which not only are very wear resistant but also which will withstand heat and chemicals. Ceramics are one of the materials used for these reasons. These parts include eyelet guides, bushings, rollers, pulleys, extruder tips, counter inserts, closing dies, and wire depressors.
Wire lead machines	Devices for processing wire leads vary from simple hand or benchstyle tools for bending and forming of leads to high speed equipment which can perform a number of operations. Machines are available which will measure, cut, form, bend, strip, and straighten wire leads.
Wire nut	Form of closed end splice, that is screwed on instead of being crimped. (See pressure connections.)
Wire segment	Wire segment is a conductor between two terminals or connections.
Wire solder	Commercially available form of solder, produced in the shape of a wire.
Wire splice, removable	Splice with a main body accommodating a removable contact at each end.
Wire stop	Stop at the end of a terminal wire barrel to prevent wire from passing completely through the barrel in such a way as to interfere with the function of contact.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

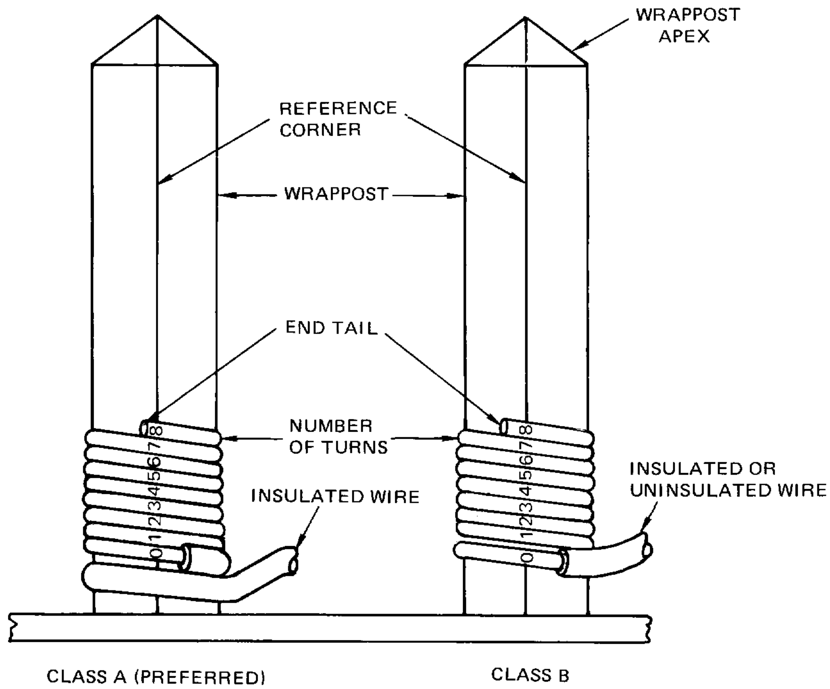
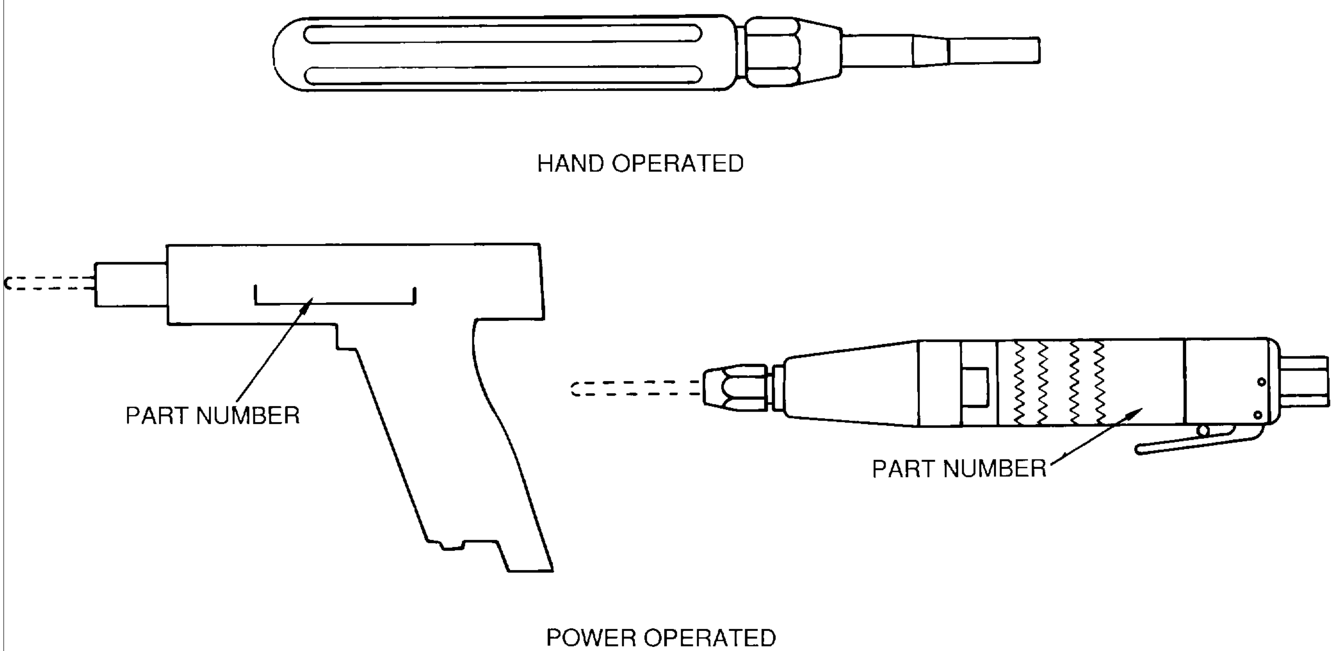
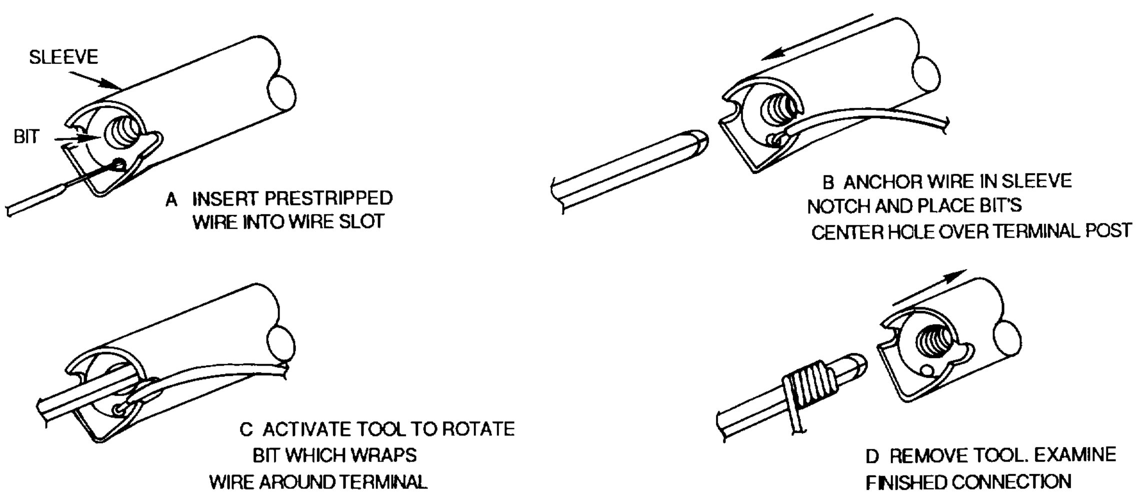
Term	Definition
Wire wrapped connection	Solderless connection made by wrapped bare wire around a square or rectangular terminal with a power or hand tool. Also called solderless wrapped connection, wrapped connection, or wrap post connection. 
Wire wrap tool	Device which mechanically turns a wire around a termination of a contact, forming a gas tight electrical connection equal to a solder termination or a crimp termination.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition



TYPICAL WIRE WRAP TOOLS



TYPICAL WIRE WRAP TOOL SEQUENCE OF OPERATION

TABLE 2. TERMS AND DEFINITIONS (Cont.)

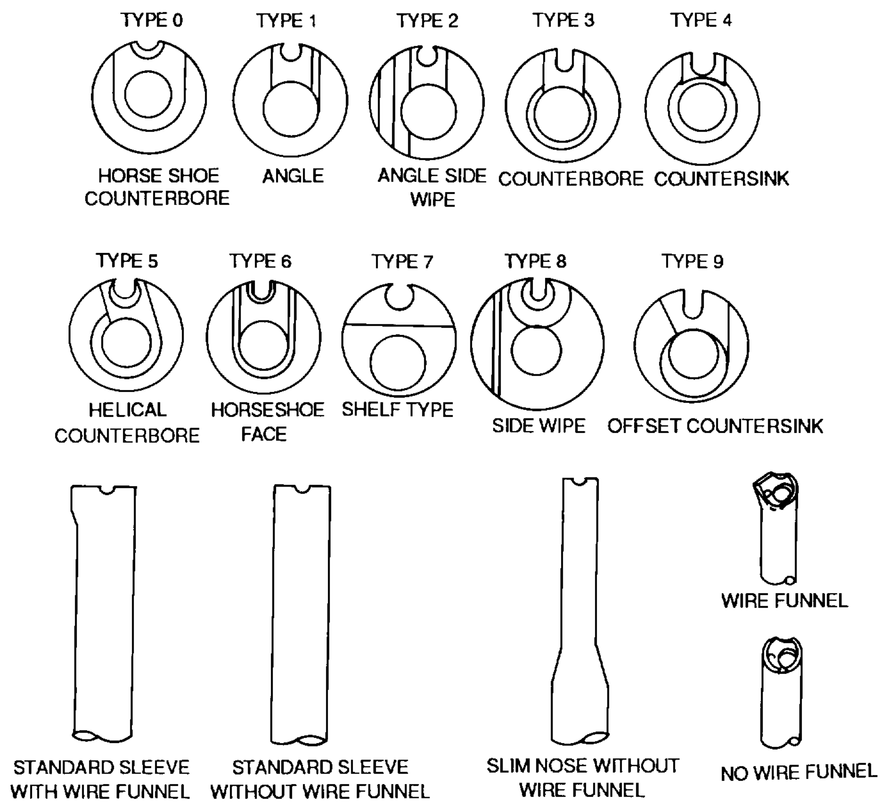
Term	Definition
Wire wrap tool tip	Removable portion of wire wrap tool used for making different types and sizes of wire wrapped connections. 
Wiring	Wires, cables, groups, harnesses and bundles, and their terminations, associated hardware, and support, installed in the vehicle. When used as a verb it is the act of fabricating and installing these items in the vehicle.
Wiring devices	Accessory parts and materials used in the installation of wiring, such as terminals, connectors, junction boxes, conduit, clamps, insulation, and supports.
Wiring ducts	Hollow conduit or raceway through which wires are passed. A duct is used as a protective shield for the wires it contains. Unlike a cable or harness assembly, it permits the addition or removal of individual wires.
Wiring kit	Packet of tools that cut and strip wire and crimp terminals to wire. Wiring kits also contain an assortment of solderless terminals.
Wiring testers	Continuity test instruments for checking wired assemblies. These instruments detect opens, shorts, and miswires in a given assembly. Some are designed to check a small number of wires while others can accommodate thousands of wires. Speed of testing usually is a direct function of the total number of wires to be tested.
W/O/G	Without Ground
Wollastonite	Wollastonite compares to the best steatite bodies with regard to low loss properties. Some wollastonite-talc combinations offer a compromise on loss quality and die wear characteristics.

TABLE 2. TERMS AND DEFINITIONS (Cont.)

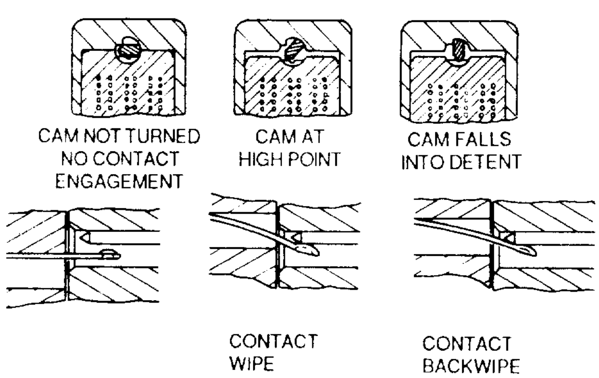
Term	Definition
Work curve	Graph which plots the pull out force, indent force and relative conductivity of a crimp joint as a function of various depths of crimping.
Working voltage	Maximum voltage at which a connector is rated to operate. (See service rating.)
Workmanship samples	Samples of workmanship that will be delivered during the term of the contract.
Workmanship standards	Photographs, models, actual hardware, or other similar items to demonstrate acceptable characteristics to inspectors and operators during fabrication and assembly.
Woven cables	Cables with conductors that are held together in a flat, ribbon cable by thread as a result of a weaving process. (See twill weave, plain weave, flat cable.)
WP	Designation for Weatherproof construction, two or three impregnated cotton braids, 176°F (80°C).
Wrapping	Method of insulating wire by serving insulating tapes around a conductor.
X	(1) Designation for two FX wires twisted together, color coded, 125 V, 140°F (60°C). (2) (See reactance.)
XHHW	Cross-linked polyethylene insulated, 194°F (90°C), dry location; 167°F (75°C), wet location.
XLPE	(See Cross-Linked Polyethylene.)
Xmit	Transmit.
XT	Designation for two FXT wires twisted together, color coded, 125 V, 140°F (60°C).
XON/XOFF	Abbreviation for transmitter on/transmitter off.
Yarns, fibers, and/or threads	There are two forms of fibers: staple fibers which are the short fibers such as those of cotton, and filament fibers which are long strands such as those of many man-made fibers and silk. Yarn construction can be varied according to actual fiber or fibers used, whether the fiber is staple or filament, staple length, size, weight, amount of twist, number of plies, etc. Spun yarns are produced by cleaning, paralleling, attenuating, and twisting staple fibers into yarn by spinning.
Yield point	First stress in a material, usually less than the maximum attainable stress, at which an increase in strain occurs without an increase in stress. Only certain metals exhibit a yield point. If there is a decrease in stress after yielding, a distinction may be made between upper and lower yield points.
Yield strength	Minimum stress at which a material will start to physically deform without further increase in load.
Z	(See impedance.)
Zero Insertion Force Connector	Connector in which the contact surfaces do not mechanically touch until it is completely mated thus requiring no insertion force. After mating the contacts are actuated in some fashion to make intimate electrical contact. 

TABLE 2. TERMS AND DEFINITIONS (Cont.)

Term	Definition
Zinc oxide	Zinc oxide has been grown hydrothermally as single crystals and is used for transducers.
Zircon	Zircon porcelains have improved properties over the feldspathic porcelains in that the properties of strength, electrical characteristics, and thermal shock resistance are all improved.
Zirconia	Zirconia has high chemical inertness and low vapor pressure at high temperature. Therefore, it is useful in high vacuum. Often used as an insulator in swaged thermocouples.
Zytel	Trade name of the DuPont Company for nylon resins.

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WIRE CHARACTERISTICS, REPLACEMENT AND INSPECTION TECHNIQUES

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Low Frequency, Multiconductor Round Cable Description and Replacements . . . 005 00
Wire and Cable Splicing and Repair . . . 014 00
Cable, Electric, Filter Line, Radio Frequency Absorptive . . . MIL-C-85485
Standard Maintenance Practices, Miniature/Microminiature (2M)
Electronic Assembly Repair, Organizational Intermediate Depot . . . NA 01–1A–23
Power Characteristics, Aircraft Electric . . . MIL–STD–704
Wiring, Aerospace Vehicle (previously MIL–W–5088) . . . SAE AS50881
Wire, Electrical, Insulation . . . MIL-DTL-16878
Wire, Electric, Fluropolymer, Insulated Copper or Copper Alloy . . . MIL-W-22759
Wire, Electric, High Temperature, and Fire Resistant . . . MIL-DTL-25038
Wire, Electric, Polyvinyl Chloride Insulated . . . MIL-W-5086
Wire, Electric, 600 Volt Aluminum Aircraft . . . MIL-W-7072
Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or
Polyarylene insulated Copper or Copper Alloy . . . MIL-W-81044
Wire, Electric, polyimide Insulated Copper or Copper Alloy . . . MIL-DTL-81381
Wire, Electrical, Iron and Constantan Thermocouple . . . MIL-W-5845
Wire, Electrical, Nickel–Chromium (also known as Chromel) and Nickel–Aluminum/Silicon
(also known as Alumel) . . . MIL-W-5846
Wire, Electrical, Copper and Constantan Thermocouple . . . MIL-W-5908

Alphabetical Index

Alphabetical Index (Cont.)

Alphabetical Index (Cont)

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

None

1. **INTRODUCTION.**

2. This Work Package (WP) describes the characteristics of wires typically used in aircraft wiring. The information is for edification and insufficient to determine specific selections for wire applications. However there is sufficient information to determine wire substitutions. Part number cross–references for wire substitutions for replacement are provided. The selection and installation of wires should be in accordance with SAE AS50881.

3. The term wire when used throughout this WP shall be interpreted as a single metallic conductor of solid, stranded, or tinsel construction, designed to carry current in an electrical circuit. It shall not have a metal covering, sheath, or shield. For the purpose of this WP, wire refers to insulated electric wire.

4. The term wiring when used throughout this WP shall be interpreted as wires, cables, groups, harnesses and bundles, associated hardware, terminations, and support installed. When used as a verb it is the act of fabricating, and installing these items.

5. **ENVIRONMENT EFFECTS.** There are numerous environmental conditions which must be taken into account when a particular wire is selected for an application. some of the more significant factors used to determine the wire selections are discussed here-in.

6. **TEMPERATURE EFFECTS.** All wire types age (degrade) with time and temperature. The rate of degradation depends upon the temperature level and the time of exposure at that temperature. As the longevity of aircraft is extended, increased degradation of the wire and related maintenance should be expected. The prime concerns of temperature are ambient and elevated temperature rise. Both of these temperature characteristics affect not only the insulation properties but conductor properties as well.

a. **Ambient Temperature.** The temperature in which wire operates as determined by the surroundings through which the wire passes is the ambient temperature.

b. **Elevated Temperature or Temperature Rise.** The increase of temperature of the conductor due to operation and current flow is elevated temperature or temperature rise. The higher the ambient temperature, the less heat required to reach maximum temperature, which results in a lower current carrying capacity. Temperature degradation is a function of time so that maximum permissible temperature is higher for a short time than permissible for continuous service. Temperature affects the internal conductor and the current carrying capacity, but also the insulation and jacketing materials as to their function.

(1) **Tin Plated Conductors.** Tin–copper intermetallics will form with time resulting in an increase in conductor resistance and embrittlement. This increase in resistance is inverse to size, being up to 4 percent for the smallest gage. Also the surface of the tin plating becomes oxidized with time which inhibits solder ability. These potential problems should be considered in the application of tin plated copper wire.

(2) **Silver Plated Conductors.** Degradation in the form of inter–strand bonding, silver migration, and oxidation of the copper strands can occur with continuous operation near rated temperature, resulting in loss of flexibility. Due to potential fire hazard, silver plated conductors shall not be used in areas where they are subject to contamination by ethylene glycol solutions. These potential problems should be considered in the application of silver plated copper wire.

(3) **Nickel Plated Conductors.** The crimp joint of nickel plated conductors may deteriorate with temperatures which will cause high voltage drops in low signal applications and hot spots in power applications.

(4) **Solderability.** Solderability of tin plated copper wire degrades significantly within 6 months to a year after production. When significant oxidation occurs, mildly activated rosin (RMA) flux is required for proper soldering and depending upon temperature exposure, as well as storage time, an activated rosin (RA) flux may be required. Soldering of tin plated copper conductors should be avoided; but when required, compensating steps such as retinning shall be included in maintenance procedures for retermination in accordance with NA01–1A–23.

(5) **Insulation.** Wire insulation is extremely susceptible to degradation as heat may cause the insulation to soften, melt, or vaporize, and this will cause loss of insulating properties necessary to operation. In cases where an external jacket is used insulation degradation may not be noticed until the total system fails, and troubleshooting is extremely difficult as the system failure may only be noticed at altitude and not detectable on the ground.

7. **CURRENT CARRYING CAPABILITIES.** (Ampacity). This is the amount of current a wire can carry before the temperature rise exceeds the permissible value. There are numerous factors by which ampacity is influenced.

CAUTION

The use of parallel wires for load sharing is not a desirable practice and should be avoided.

a. **Conductor Materials.** These affect ampacity as some material is more conductive than others. Copper is widely used and the most common due to a combination of properties as high electrical and thermal conductivity and the ability to be coated or alloyed. Aluminum conductors are lighter in weight, but only about 60% the conductivity of copper.

b. **Conductor Diameter.** It is an important characteristic in that the larger the wire, the lower the resistance per unit length. This means that the larger the wire diameter the greater the current that can be carried without overheating.

c. **Ambient Temperature.** The higher the ambient temperature, less heat is required to reach maximum temperature, which results in a lower current carrying capacity.

d. **Insulation.** Insulation not only acts as an electrical insulator but also a thermal insulator.

e. **Installation.** Bundling, stacking, ventilation, and environment. all affect heat dissipation which will cause conductor heating to change resulting in changes of ampacity.

f. **Number of Conductors.** Single conductors have a higher ampacity than equivalent size multistrand conductors. Each conductor in multistrand is not exposed and heat dissipation is therefore limited resulting in changed ampacity.

g. **Amperage.** Heat rise varies as the square of the applied current, therefore, the more current, the greater the generated heat resulting in changed ampacity.

8. **VOLTAGE DROP.** For power distribution circuits, the total impedance of the wire supply and return paths shall be such that the voltage at the load equipment terminals is within MIL–STD–704 limits.

a. **Environmental Exposure.** The selection of a wire type is significantly affected by the various environmental exposures, such as fluids, humidity, vibration, available protection, sunlight, lightening, etc. Applications in Severe Wind and Moisture Problem (SWAMP) areas such as wheel wells, wing folds, flaps and other weather exposed areas can rapidly age a wire unless properly protected or specifically chosen for the environment.

9. **CORONA PHENOMENON.** Corona is also referred to as ionization, or partial discharges between the outside of an unshielded wire covering and structural elements over which the wire passes, or between the insulation and a braided shield. Corona is a voltage breakdown due to failure of the dielectric under electric field stress and occurs more readily in a gas than a solid.

a. **Influence.** Corona affects the operation of electrical circuitry in that corona generates spurious high-frequency voltages causing false logic switching, and even semiconductor damage. Corona consumes power and is the prime cause of radio frequency interference.

b. **Result.** Corona discharges some gasses or by products which will destroy the insulation to the extent that a hard short and circuit failure will eventually occur, and may corrode adjacent metallic components.

c. **Occurrence.** Corona may occur under certain conditions, notably high ambient temperature and/or high altitude (low pressure) or whenever there is a dielectric failure.

d. **Extinction Level.** Once the inception voltage (starting voltage) is reached and ionization begins in many cases corona will not extinguish until the applied voltage is lowered. This may be as much as 20% below the inception voltage.

10. **BEND RADIUS.** The maximum amount a wire can be bent without causing damage to the conductor or insulation is referred to as minimum bend radius (Figure 1).

a. **Wires Individually Routed and Supported.** The minimum bend radius shall be ten times the outside diameter of the wire. At the point an individual wire breaks out from a group, harness, or bundle the minimum bend radius shall be ten times the outside diameter of the wire provided the wire is suitably supported.

b. **Wires Used as Shield Terminators.** Wires used as shield terminators or jumpers when required to reverse direction, shall have a minimum bend radius three times the wire diameter at the reversal point provided the wire is suitably supported.

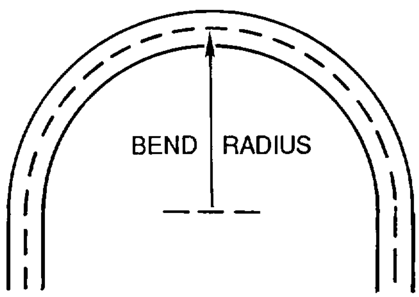

Figure 1. Bend Radius

11 . **WIRE CONSTRUCTION.**

NOTE

This specification permits the general use of size 22 wire as the minimum wire size for airplanes, helicopters and lighter–than–air vehicles. Use of size 24 and smaller gage wire requires approval of procuring activity. Use of size 24 and smaller gage wires in harnesses shall be limited to wires which have break strength of 20lbs. Size 24 and smaller gage wires shall not be installed as a single wire.

12 . There is no simple or easy way to classify wires. Some are described by form, general application, specific application, conductor type, insulation type, property, and voltage. Therefore fundamental discussion of wires is difficult, and this section has been prepared to set forth only basic knowledge to aid in understanding how a wire is constructed. The detail characteristics of a wire are defined in the military specification used to procure the wire.

13 . **WIRE SPECIFICATION / NON–GOVERNMENT STANDARDS.** Insulated wire for aircraft, missiles, and support equipment are of the many different types designed to meet the wide variety of uses and functions as set forth by military and non–government standards. Wire of this type must meet high performance standards, temperature extremes, resistance to radiation, nonflammability, physical toughness, permanence, and top electrical characteristics. The materials used are wide and varied and include nickel clad or plated copper, tin coated copper, silver plated copper stranded conductor, stranded aluminum conductor; coated with Ethylene-tetrafluoroethylene copolymer (ETFE), Fluorinated Ethylene Propylene (FEP), Fluoropolymer Resin, Polytetrafluoroethylene (TFE), Polyvinylidene Fluoride (PVF_2) mica, and a combination of other insulating materials. Many of these insulating and jacketing materials are used in various combinations depending on the particular properties and protective characteristics required.

14 . **CONDUCTOR MATERIALS.** Copper is widely used as an electrical conductor, but when greater strength is desired copper coated steel wire can be used. Copper conductors can also be coated with silver or tin; these coatings minimize oxidation and improve solderability. Silver coated copper wire is a very good high frequency conductor. The use of tin coated copper wire is limited to low frequencies as these conductors have a higher attenuation than bare copper wire, also they are limited to an ambient temperature of 302°F (150°C). Copper conductors coated with nickel plating has a poor solderability, therefore is used mostly in crimp applications. Nickel has an operating temperature of 260°C. The selection of a conductor is sometimes dictated by the required current carrying capacity, as some conductor material is more conducive to current flow than others.

15 . **CONDUCTOR CONSTRUCTION.** Conductors used are solid, stranded, and braided which is dictated by application.

a. **Solid Conductor.** Solid wires have a higher ampacity than equivalent size multi-strand conductors because heat dissipation is increased. In areas where little vibration and no flexing are required, solid conductors are used. Though the cost is lower when compared to stranded wire there remains disadvantages. The solid conductor when flexed or bent, stress and elongation, result at the outer portion of the bend, and the bend area becomes work hardened (brittle). Once the conductor begins to fail (develop cracks), continued flexing will cut through the conductor.

b. **Stranded Conductors.** Strands are utilized in most electronic wires to give them better limpness and longer flex life, thus service life is increased. Surface damage to stranded conductors, such as scratching or nicking during stripping will generally be less serious than damage to a solid conductor. A solid conductor if nicked or damaged will break after only a few bends, whereas the remaining undamaged strands would continue to provide reasonable service life. For a given size (gage) conductor, increasing the number of strands while reducing the size of the individual strands will increase conductor flexibility. Since type and thickness of insulation also affect flexibility all factors should be considered. Physical properties and flexibility are determined by the lay and stranding.

(1) Lay is the axial length of one complete turn of one strand in the conductor, either right hand or left hand twist (Figure 2).

(2) Bunch Stranding is composed of any number of wires of the same diameter twisted together in the same direction without regard to geometric arrangement of the individual strands. Used where low cost is an important factor (Figure 3).

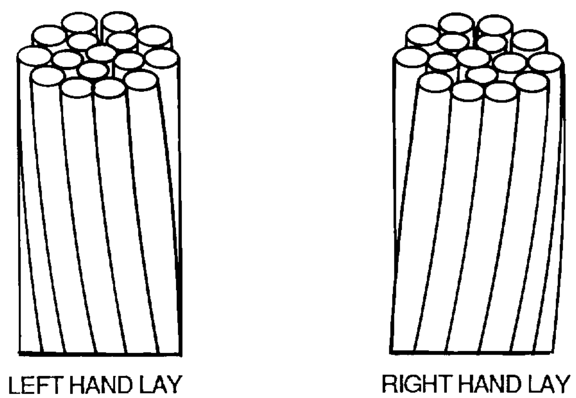

Figure 2. Lay

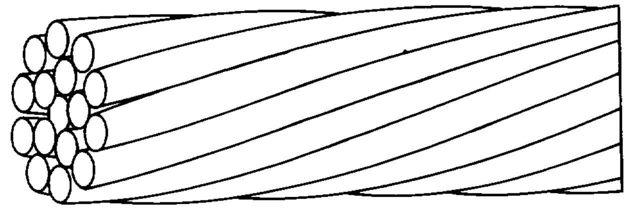

Figure 3. Bunch Stranding

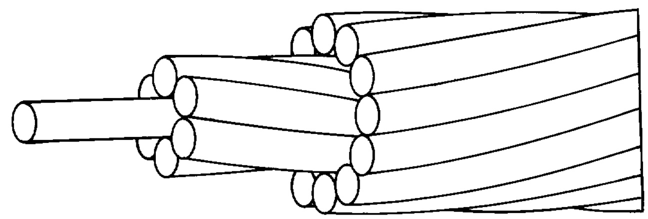

Figure 4. True Concentric and Equilay Stranding

(3) True Concentric Stranding is composed of a central wire surrounded by one or more layers of helically laid wires, with a reversed direction of lay, and an increased length of lay, for each successive layer (Figure 4).

(4) Equilay Stranding is composed of one or more helically laid wires, with a reversed direction of lay of the same length, for each successive layer.

(5) Unidirectional Concentric Stranding is composed of a central wire surrounded by one or more layers of helically laid wires, with the same direction, and an increased length of lay for each successive layer (Figure 5).

(6) Unilay Stranding is composed of more than one layer of helically laid wires, with the same direction of lay of the same length, for each successive layer.

(7) Rope Stranding is composed of groups of any of the above strandings combined in concentric configurations (Figure 6).

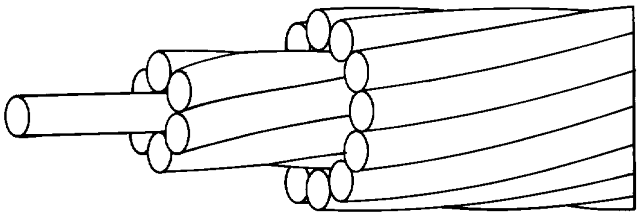

Figure 5. Unidirectional Concentric and Unilay Stranding

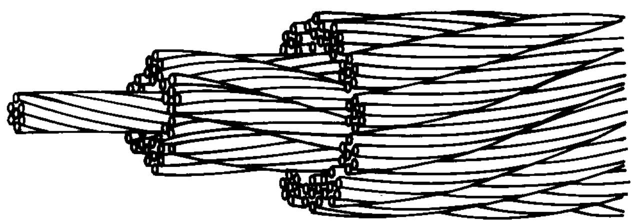

Figure 6. Rope Stranding

(8) Length of Lay. The shorter the lay the greater the flexibility since each single strand is approaching the shape of a coil spring. Shorter lays increase the cost since more conductor material is used in a given length and more time is required to strand the conductor. Physical properties are changed due to the twisting as well as the weight and resistance.

c. **Braided Conductors.** Flat or tubular braided conductors are occasionally used in certain applications for which they are better suited than round, solid or stranded wires. These are seldom insulated since the insulation would hinder the extra flexibility and the ability of the conductor to extend or retract slightly in length. Flat braids are usually used for grounding or bonding. Tubular braids are occasionally used for bonding but are more commonly desired as shields to slip over a wire or group of wires in an installation.

16. **INSULATION MATERIALS.** Numerous insulation and jacketing materials are used for wire applications. The properties considered are temperature, dielectric strength, dielectric constant, toughness, resistance to chemicals, resistance to moisture, processability and price. Wire and cable insulations may be classified in two very broad and basic categories, Thermosetting and Thermoplastic, the types, compounds, and mixtures within these groups are so varied as to make the available number of insulations almost unlimited. Most of the insulation materials used today are composed of compounds made from synthetic rubber polymers and synthetic plastics. These synthetic materials are compounded to provide specific physical and electrical properties.

17. **THERMOSETTING INSULATIONS.** These are characterized by their ability to be stretched, compressed or otherwise deformed, within reasonable limits, and then snap back to their original form and shape when the mechanical stress is removed. Thermosetting Insulations are not subject to heat softening and will not drip, flow, or deform appreciably during the application of external heat, or electrical overloads. In addition a wide range of physical and electrical properties can be compounded from the same basic polymers. Specific applications are covered by military specifications.

18. **THERMOPLASTIC INSULATION.** These materials are best known for their excellent electrical characteristics and relatively low cost. Thermoplastics are popular as insulation since much thinner insulation thicknesses may be used to obtain good electrical properties especially for higher voltage cables, as well as a much thinner cable of equivalent electrical size when thermosetting is used. By nature these materials are thermoforming in that they heat soften and flow under mechanical pressure and retain their deformed shape or form after cooling and/or removal of the mechanical strain. Specific applications are covered by military specifications.

19. **INSULATION COLOR-CODES.** Wire is available in numerous colors and stripes. The Navy prefers only white wire (-9) without stripes. In some older applications, which still exist, and in very unusual high density avionics wiring, color/stripes are still used to assist in the manufacturing. For the military wires discussed herein, the color/stripe is coded by the last three digits of the wire part number (M22759/34-20-9xxx). Table 1 lists the color codes used for wiring coding the insulation. See WP 005 00 for color coding cable primary wires.

Table 1. Preferred Color Code for Single Wires

Base Color	First Stripe or Band	Second Stripe or Band	Third Stripe or Band	Identification No.
Black				0
Brown				1
Red				2
Orange				3
Yellow				4
Green				5
Blue				6
Violet				7
Gray				8
White				9
White	Black			90
White	Brown			91
White	Red			92
White	Orange			93
White	Yellow			94
White	Green			95
White	Blue			96
White	Violet			97
White	Gray			98
White	Black	Brown		901
White	Black	Red		902
White	Black	Orange		903
White	Black	Yellow		904
White	Black	Green		905
White	Black	Blue		906
White	Black	Violet		907
White	Black	Gray		908
White	Brown	Red		912
White	Brown	Orange		913
White	Brown	Yellow		914
White	Brown	Green		915
White	Brown	Blue		916
White	Brown	Violet		917
White	Brown	Gray		918
White	Red	Orange		923
White	Red	Yellow		924
White	Red	Green		925
White	Red	Blue		926
White	Red	Violet		927
White	Red	Gray		928
White	Orange	Yellow		934
White	Orange	Green		935
White	Orange	Blue		936
White	Orange	Violet		937
White	Orange	Gray		938

Table 1. Preferred Color Code for Single Wires (Cont)

Base Color	First Stripe or Band	Second Stripe or Band	Third Stripe or Band	Identification No.
White	Yellow	Green		945
White	Yellow	Blue		946
White	Yellow	Violet		947
White	Yellow	Gray		948
White	Yellow	Blue		956
White	Green	Violet		957
White	Green	Gray		958
White	Blue	Violet		967
White	Blue	Gray		968
White	Violet	Gray		978
White	Black	Brown	Red	9012
White	Black	Brown	Orange	9013
White	Black	Brown	Yellow	9014
White	Black	Brown	Green	9015
White	Black	Brown	Blue	9016
White	Black	Brown	Violet	9017
White	Black	Brown	Gray	9018
White	Black	Red	Orange	9023
White	Black	Red	Yellow	9024
White	Black	Red	Green	9025
White	Black	Red	Blue	9026
White	Black	Red	Violet	9027
White	Black	Red	Gray	9028
White	Black	Orange	Yellow	9034
White	Black	Orange	Green	9035
White	Black	Orange	Blue	9036
White	Black	Orange	Violet	9037
White	Black	Orange	Gray	9038
White	Black	Yellow	Green	9045
White	Black	Yellow	Blue	9046
White	Black	Yellow	Violet	9047
White	Black	Yellow	Gray	9048
White	Black	Green	Blue	9056
White	Black	Green	Violet	9057
White	Black	Green	Gray	9058
White	Black	Blue	Violet	9067
White	Black	Blue	Gray	9068
White	Black	Violet	Gray	9078
White	Brown	Red	Orange	9123
White	Brown	Red	Yellow	9124
White	Brown	Red	Green	9125
White	Brown	Red	Blue	9126
White	Brown	Red	Violet	9127
White	Brown	Red	Gray	9128
White	Brown	Orange	Yellow	9134

Table 1. Preferred Color Code for Single Wires (Cont)

Base Color	First Stripe or Band	Second Stripe or Band	Third Stripe or Band	Identification No.
White	Brown	Orange	Green	9135
White	Brown	Orange	Blue	9136
White	Brown	Orange	Violet	9137
White	Brown	Orange	Gray	9138
White	Brown	Yellow	Green	9145
White	Brown	Yellow	Blue	9146
White	Brown	Yellow	Violet	9147
White	Brown	Yellow	Gray	9148
White	Brown	Green	Blue	9156
White	Brown	Green	Violet	9157
White	Brown	Green	Gray	9158
White	Brown	Blue	Violet	9167
White	Brown	Blue	Gray	9168
White	Brown	Violet	Gray	9178
White	Red	Orange	Yellow	9234
White	Red	Orange	Green	9235
White	Red	Orange	Blue	9236
White	Red	Orange	Violet	9237
White	Red	Orange	Gray	9238
White	Red	Yellow	Green	9245
White	Red	Yellow	Blue	9246
White	Red	Yellow	Violet	9247
White	Red	Yellow	Gray	9248
White	Red	Green	Blue	9256
White	Red	Green	Violet	9257
White	Red	Green	Gray	9258
White	Red	Blue	Violet	9267
White	Red	Blue	Gray	9268
White	Red	Violet	Gray	9278
White	Orange	Yellow	Green	9345
White	Orange	Yellow	Blue	9346
White	Orange	Yellow	Violet	9347
White	Orange	Yellow	Gray	9348
White	Orange	Green	Blue	9356
White	Orange	Green	Violet	9357
White	Orange	Green	Gray	9358
White	Orange	Blue	Violet	9367
White	Orange	Blue	Gray	9368
White	Orange	Violet	Gray	9378
White	Yellow	Green	Blue	9456
White	Yellow	Green	Violet	9457
White	Yellow	Green	Gray	9458
White	Yellow	Blue	Violet	9467
White	Yellow	Blue	Gray	9468
White	Yellow	Violet	Gray	9478

Table 1. Preferred Color Code for Single Wires (Cont)

Base Color	First Stripe or Band	Second Stripe or Band	Third Stripe or Band	Identification No.
White	Green	Blue	Violet	9567
White	Green	Blue	Gray	9568
White	Green	Violet	Gray	9578
White	Blue	Violet	Gray	9678

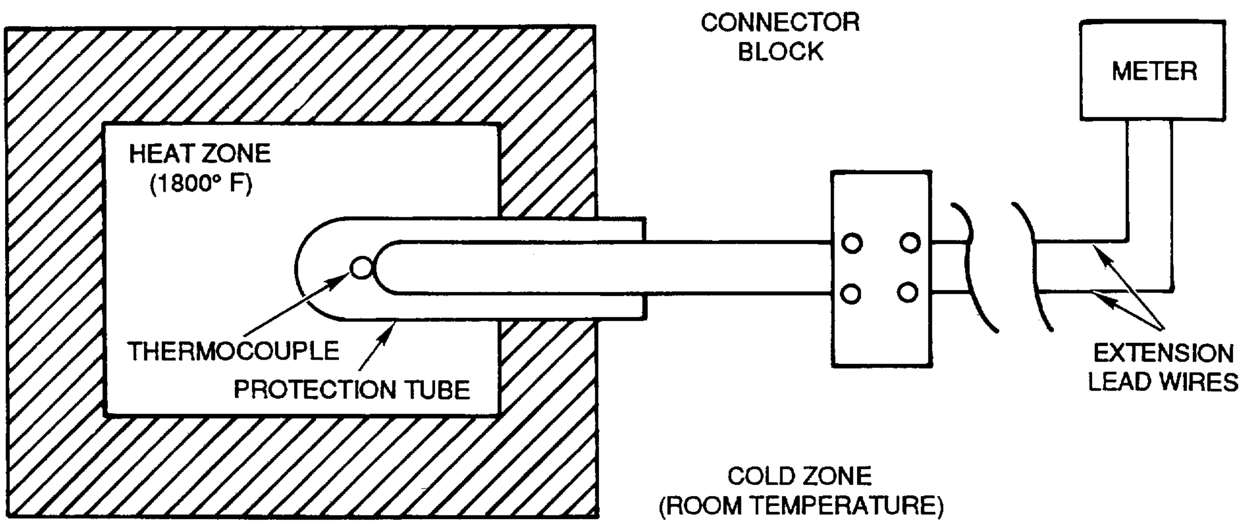

Figure 7. Typical Thermocouple Application

20 . **ALUMINUM WIRE.**

21 . Aluminum conductors are typically used in size 8 and larger, because of their light weight. Aluminum conductors have less flexibility, and conductivity than other conductors. There are numerous application restrictions for aluminum conductors. Aluminum conductors are not interchangeable with copper conductors, nor in general, compatible with copper wire termination devices. Use of aluminum wires require procuring activity approval.

22 . **THERMOCOUPLE WIRE.**

a. **USE.** Thermocouples are used as Thermoelectric Thermometers. The basic factors producing thermoelectric output can be controlled by alloying and heat treating. As a result the degree of this control Thermocouple wires have become one of the most reliable and widely used means of accurate temperature measurement (Figure 7).

b. **BASIC OPERATION.** Thermocouples essentially consist of a pair of dissimilar metallic conductors joined together to form an electrical circuit. When one junction is maintained at a higher temperature than the other an electromotive force (EMF) will be generated. This EMF is due to the temperature differential between the junctions, and as long as there remains temperature differential, current will continue to flow.

23 . **MILITARY WIRE SPECIFICATIONS.**

24 . The military wire specifications discussed herein are to provide a general description of the wire characteristics most commonly found in Navy aircraft. Many of the wire specifications have been canceled, made inactive for new design, superceded with other wire specifications or converted to non–government standards.

25. **MIL–W–5846 WIRE, ELECTRICAL, NICKEL–CHROMIUM (PREVIOUSLY KNOWN AS CHROMEL) AND NICKEL–ALUMINUM/SILICON (PREVIOUSLY KNOWN AS ALUMEL), THERMOCOUPLE.** This specification covers Nickel–Chromium (also known as Chromel) and Nickel–Aluminum/Silicon (also known as Alumel) Thermocouple wires.

26. **Classification.** Thermocouple wires are classified by type and class.

a. Type 1. These are solid and stranded conductors in five classes as follow:

(1) Class A, bare solid conductor.

(2) Class B, insulated solid conductor.

(3) Class C, insulated duplex solid conductor.

(4) Class D, insulated stranded conductor.

(5) Class E, insulated duplex stranded conductor.

b. Type 2. Insulated duplex stranded conductor 7 ohms per 25 feet. Class A, standard insulation.

c. Type 3. Insulated duplex stranded conductor 7 ohms per 50 feet. Class A, standard insulation.

d. Type 4. Insulated duplex stranded conductor 7 ohms per 100 feet. Class A, standard insulation.

27. **Part Number.** The MIL-W-5846 thermocouple cable part number example is shown as follows.

a. Example: M5846-1-A-1/14-A

b. M5684: Defines specification describing the wire performance requirements.

c. -1: Defines the type of wires.

d. -A: Defines the class of conductors.

e. -1: Defines the number of conductors.

f. /14: Defines the size of the conductors.

g. -A: Defines the conductor material.

28. **Conductor Material.** The conductors consist Nickel–Chromium (also known as Chromel)/Nickel–Aluminum/Silicon (also known as Alumel).

29. **Stranding.** Stranding shall be bunched, concentric, or rope. The wire size of all strand are the same for any one conductor except for Types 2, 3, and 4 where strand size may vary to facilitate resistance adjustments.

30. **Insulation.** The wire insulation consists of a concentric layer or layers of suitable material as called for in the specification.

31. **Temperature.** The wire is intended for applications where temperatures of 597.2°F (315°C) are to be encountered.

32. **Repair.** Specific information on repair and installation of Thermocouples is found in WP 015 00.

33. **Intended Use.** Type 1, Class A, B, C, D, and E are intended for fabricating Thermocouples. Type 2, 3, and 4, Class A are intended for fabricating Thermocouple extension leads for aircraft use.

34. **MIL-W-5845 WIRE, ELECTRICAL, IRON AND CONSTANTAN THERMOCOUPLE.** This specification covers Iron and Constantan Thermocouple wires.

35. **Classification.** Thermocouple wire are classified by type and class as follow:

a. Type 1. These are solid and stranded conductor in ten classes:

(1) Class A, bare solid high accuracy.

(2) Class B, insulated solid high accuracy.

(3) Class C, insulated duplex solid high accuracy.

(4) Class D, insulated stranded high accuracy.

(5) Class E, insulated duplex stranded high accuracy.

(6) Class F, bare solid nominal accuracy.

(7) Class G, insulated solid nominal accuracy.

(8) Class H, insulated duplex solid nominal accuracy.

(9) Class I, insulated stranded nominal accuracy.

(10) Class J, insulated duplex stranded nominal accuracy.

(11) Type 2. These are stranded conductor 8 ohms per 100 feet.

(12) Class A, insulated duplex tinned iron wire 248°F (120°C) rating.

(13) Class B, insulated duplex tinned iron wire 446°F (230°C) rating.

(14) Class C, insulated duplex not tinned iron wire.

b. Type 3. These are stranded conductor 8 ohms per 200 feet.

(1) Class A, insulated duplex tinned iron wire 248°F (120°C) rating.

(2) Class B, insulated duplex tinned iron wire 446°F (230°C) rating.

(3) Class C, insulated duplex not tinned iron wire.

36 . **Part Number.** The MIL-W-5845 thermocouple cable part number example is shown as follows.

a. Example: M5845-1-A-1/14-A

b. M5845: Basic specification defining performance characteristics.

c. -1: Defines the type of wires.

d. -A: Defines the class of conductors.

e. -1: Defines the number of conductors.

f. /14: Defines the size of the conductors.

g. -A: Defines the conductor materials.

37 . **Conductor Material.** The conductor consists of Iron or Constantan.

38 . **Stranding.** The stranding may be bunched, concentric, or rope lay. The wire size of all strands are the same for any one conductor, except for Types 2 and 3, Class A, B, and C where the strand size may vary to facilitate resistance adjustments.

39 . **Insulation.** The insulation consists of a concentric layer or layers of suitable material as specified in the specification.

40 . **Repair.** Specific information on repair and installation of thermocouples is found in WP 015 00.

41 . **Intended Use.**

a. Type 1, Class A, B, C, D, and E are intended for fabricating Thermocouples where high accuracy is required.

b. Type 1, Class F, G, H, I, and J are intended for fabricating Thermocouples where nominal accuracy is required.

c. Types 2 and 3, Class A is intended for fabricating Thermocouple extension leads for applications where temperatures of 248°F (120°C) are encountered.

d. Types 2 and 3, Class B is intended for fabricating Thermocouple extension leads for applications where temperatures of 446°F (230°C) are encountered.

e. Types 2 and 3, Class C is intended for use where conditions do not require the iron wire be protected against corrosion.

42 . **MIL-W-5908 WIRE, ELECTRICAL, COPPER AND CONSTANTAN THERMOCOUPLE.** This specification covers Copper and Constantan Thermocouple wire.

43 . **Classification.** Thermocouple wire are classified by type and class as follow:

a. Type 1. Solid and stranded conductors in seven classes:

(1) Class A, bare solid conductor.

(2) Class B, insulated solid conductor.

(3) Class C, insulated duplex solid conductor.

(4) Class D, insulated stranded conductor.

(5) Class E, insulated duplex stranded conductor.

(6) Class F, insulated duplex stranded conductor 248°F (120°C) range.

(7) Class G, insulated stranded conductor 446°F (230°C) range.

b. Type 2. These are stranded conductor 7 ohms per 200 feet:

(1) Class A, insulated duplex 248°F (120°C) range.

(2) Class B, insulated duplex 446°F (230°C) range.

c. Type 3. These are stranded conductor, 20 gage copper, 18 gage constantan:

(1) Class A, insulated duplex 248°F (120°C) range.

(2) Class B, insulated duplex 446°F (230°C) range.

d. Type 4. These are stranded conductor, 20 gage copper, 16 gage constantan:

(1) Class A, insulated duplex 248°F (120°C) range.

(2) Class B, insulated duplex 446°F (230°C) range.

e. Type 5. These are stranded conductor, 18 gage copper, 14 gage constantan:

(1) Class A, insulated duplex 248°F (120°C) range.

(2) Class B, insulated duplex 446°F (230°C) range.

44. **Part Number.** The MIL-W-5908 thermocouple cable part number example is as follows:

a. Example: M5908-1-A-1/14-A.

b. M5908: Basic specification defining performance characteristics.

c. -1: Defines the type of wires.

d. -A: Defines the class of conductors.

e. -1: Defines the number of conductors.

f. /14: Defines the size of the conductors.

g. -A: Defines the conductor material.

45. **Conductor Materials.** The conductor consists of copper or constantan.

46. **Stranding.** Stranding may be bunched, concentric, or rope. The wire size of all strands shall be the same for any one conductor except for Type 2, Class A and B where the strand size may vary to facilitate resistance adjustments.

47. **Insulation.** The insulation consists of a concentric layer or layers of suitable material.

48. **Repair.** Specific information on repair and installation of thermocouples is found in NAVAIR 01-1A-505, WP 015 00.

49. **Intended Use.**

a. Type 1, Class A, B, C, D, and E are intended for use in fabricating Thermocouples.

b. Type 1, Class F and G are intended for fabricating Thermocouple extension leads. Class F is for applications where 248°F (120°C) are encountered. Class G is for applications where 446°F (230°C) are encountered.

c. Types 2, 3, 4, and 5, Class A are intended for fabricating Thermocouple extension leads for applications where 248°F (120°C) are encountered.

d. Types 2, 3, 4, and 5, Class B are intended for fabricating Thermocouple extension leads for applications where 446°F (230°C) are encountered.

50. **MIL-DTK-81381 WIRE, ELECTRIC, POLYIMIDE-INSULATED COPPER OR COPPER ALLOY (ALSO KNOWN AS KAPTON).** This type of wire is insulated with Aromatic Polyimide.

WARNING

Extensive testing on this type shows that it exhibits properties that are not acceptable for continued use in military aircraft.

51. **Part Number.** The MIL-DTL-81381 wire part numbers is as follows:

a. Example: M81381/11-22-93.

b. M81381: Basic specification describing the performance characteristics.

c. /11: Detail specification defining the configuration, materials, and unique characteristics.

d. -22: Defines wire size.

e. -93: Three digit code defining the color. The first digit defines the background color and the last two digits define the stripe color when required. The last two digits are only present when required.

52 . **Conductor Materials.** All conductors are stranded tin, silver, or nickel-coated soft annealed copper, or silver or nickel-coated high strength copper alloy.

53 . **Stranding.** Conductors, sizes 10 through 22 are concentric lay with the outer layer being left-hand lay. Conductors, sizes 8 through 4/0, are rope lay with the outer layer either left or right-hand lay.

54 . **Insulation.** The insulation is a fluorocarbon polyimide tape wrap with a modified aromatic polyimide resin topcoat. For size 8 or larger the outer layer is a polyimide braid.

55 . **Repair or Replacement.** Wherever maintenance instructions, diagrams, drawings, etc. specify MIL-DTL-81381 wire to be used for direct repair or replacement, the wire shall be repaired or replaced with the MIL-W-22759 wire designated in Table 5. Repair or replacement shall be in accordance with WP 015 00. Slight flaking of the topcoat does not require repair or replacement. Any flaking, or other damage (cuts, chafing, etc..) of the Kapton polyimide film requires repair or replacement in accordance with WP 015 00 and WP 004 02. If harness or cable is removed from aircraft for repair, all wire should be replaced when time and funding permits, regardless of the condition of the wire. If the MIL-DTL-81381 wire being replaced with a MIL-W-22759 wire that has a slightly larger diameter, and causes installation interference, contact the Cognizant Field Activity for guidance.

56 . **MIL-W-7072 WIRE, ELECTRIC, 600 VOLT, ALUMINUM AIRCRAFT.** This specification covers single aluminum conductor electric wires capable of continued operation at a maximum conductor temperature of 221°F (105°C), and is suitable for use in aircraft. This specification has been cancelled without replacement. Contact CFA for replacement guidance.

a. **Conductor Material.** All strand conductors are electrical conductor grade, hard drawn, aluminum wire.

b. **Stranding.** The direction of lay is unidirectional concentric with a left-hand lay or wire size 8. Wires, size 6 through 0000, are a rope lay. Individual members may be either concentric or bunch strand, then stranded unidirectional concentric with a left-hand lay.

c. **Insulation.** The primary insulation is extruded polyvinyl chloride, covered by finish treated glass braid, covered by braided nylon impregnated with nylon finishers. Polyvinyl Chloride (PVC) insulated wire shall not be used on any aerospace vehicle for new installation and repair.

WARNING

Do not terminate aluminum wire with SAE AS7928 copper terminals. Use only SAE AS70991 aluminum terminals. Do not splice to copper wire unless specific aircraft instructions are provided. Only point-to point repair (replacement) should be performed unless specific aircraft instructions provide otherwise.

d. **Repair or Replacement.** Aluminum wire has no alternative wire replacement.

e. **Intended Use.** The electric wire covered by this specification is intended for installation in aircraft electrical systems where the potential does not exceed 600 VOLTS RMS. This wire was primarily intended for use where a significant weight savings was realized.

57 . **MIL-DTL-25038 WIRE, ELECTRICAL, HIGH TEMPERATURE AND FIRE RESISTANT.** This specification covers single conductor wires, for use under short-term emergency conditions, involving exposure to flames. This wire is predominantly used in engine compartments in circuits where it is necessary to maintain electrical integrity for 5 minutes in a flame at 2000°F (1093°C), with the operating potential not exceeding 125 volts RMS.

58 . **Part Number.** The MIL-DTL-25038 wire part number is as follows:

a. Example: M25038/1-22-93.

b. M25038: Basic specification describing the performance characteristics.

c. /1: Detail specification defining the configuration materials, and unique characteristics.

d. -22: Defines wire size.

e. -93: Three digit code which defines the color of wire. The first digit describes the background color and the second two are the stripe colors and is present only when required.

59 . **Conductor Materials.** All conductors are stranded of nickel-coated soft or annealed copper.

60 . **Stranding.** Conductors, sizes 12 through 22, are concentric lay with the outer layer being left-hand lay. Conductors, sizes 10 through 4/0, are rope lay with the outer layer either right or left-hand lay.

61 . **Insulation.** The insulation typically contains a layer of inorganic material combined with layers of silicone or tetrafluoroethylene. A glass braid jacket may also be present.

62 . **Repair or Replacement.** There are no alternative wires for repair or replacement.

63 . **Intended Use.** This wire is predominantly used in engine compartments, in circuits where it is necessary to maintain electrical integrity for 5 minutes in a flame at 2000°F (1093°C) with the operating potential not exceeding 125 VOLTS RMS.

64 . **MIL-W-22759 WIRE, ELECTRIC, FLUROPOLYMER INSULATED, COPPER OR COPPER ALLOY.** This specification covers single conductor wire used for the interconnection of electronic and electrical equipment.

65 . **Part Number.** The MIL-W-22759 wire part number example is as follows:

a. Example: M22759/46-22-93.

b. M22759: Basic specification describing the performance characteristics.

c. /46: Detail specification defining the configuration, materials, and unique requirements.

d. -22: Defines the wire size.

e. -93: Three digit code which defines the color of the wire. The first digit define the background color and the last two digits define the color of the stripes and is only present when required.

66 . **Conductor Materials.** All conductors are stranded tin, silver, or nickel-coated copper, or silver or nickel-coated high-strength copper alloy.

67 . **Stranding.** Conductors, sizes 10 through 22, are concentric lay with the outer layer being left-hand lay. Conductors, sizes 8 through 4/0, are rope lay with the outer layer either right or left-hand lay.

68 . **Insulation.** The insulation may be used alone or in combination with any of the following materials:

a. Polytetrafluoroethylene (PTFE)

b. Fluorinated Ethylene Propylene (FEP)

c. Ethylene-tetrafluoroethylene (ETFE) copolymer

d. Fluoropolymer Resin

e. Polyvinylidene Fluoride (PVF2)

CAUTION

Replacement of MIL-W-22759 wire types with other wire types is not mandatory. Repair and replacement shall be in accordance with WP 015 00.

69 . **Repair or Replacement.** Whenever maintenance instructions, diagrams, drawings, etc. specify certain types of MIL-W-22759 wires to be used for repair or replacement, the wire may be replaced with the MIL-W-22759 wire types specified in Table 3.

70 . **Intended Use.** The electric wires covered by this specification are intended for use in any application where their performance characteristics are required. The

wires are suitable for installation on aerospace electrical systems within the limitations of applicable performance requirements.

71. **MIL-W-81044 WIRE, ELECTRIC, CROSSLINKED POLYALKENE, CROSSLINKED ALKANE-IMIDE POLYMER, OR POLYARLENE INSULATED COPPER OR COPPER ALLOY.** This specification covers single conductor electric wires used in the interconnection of electronic and electrical equipment.

72. **Part Number.** The MIL-W-81044 wire part numbers is as follows:

a. Example: M81044/6-22-93.

b. M81044: Basic specification describing the performance characteristics.

c. /6: Detail specification defining the configuration, materials, and unique characteristics.

d. -22: Defines wire size.

e. -93: Three digit code defining the color. The first digit defines the background color and the last two digits define the stripe color when required. The last two digits are only present when required.

73. **Conductor Materials.** All conductors are stranded tin, silver, or nickel-coated soft annealed copper, or silver or nickel-coated high strength copper alloy.

74. **Stranding.** Conductors, sizes 10 through 22 are concentric lay with the outer layer being left-hand lay. Conductors, sizes 8 through 4/0, are rope lay with the outer layer either left or right-hand lay.

75. **Insulation.** The insulation is a cross link polyalkene with a polyvinylidene fluoride jacket.

76. **Compatibility.** Wires with polyvinylidene fluoride jackets may be degraded by contact with hydraulic fluids of phosphate ester type at high temperatures, and are not to be used where they will come in contact with this type of fluid at temperatures above 122°F (50°C).

CAUTION

Replacement of MIL-W-81044 wire with MIL-W-22759 wire is not mandatory. Repair or replacement shall be in accordance with WP 015 00.

Although MIL–DTL–16878 replacement is not mandatory, the higher quality MIL-W-22759 substitutions are recommended to be used.

77. **Repair and Replacement.** Whenever maintenance instructions, diagrams, drawings, etc. specify MIL-W-81044 wire to be used for repair or replacement, the wire may be replaced with the MIL-W-22759 wire specified in Table 4.

78. **Intended Use.** The electric wires covered by this specification are intended for use in any application where their performance characteristics are required. The wires are suitable for installation on aerospace electrical systems within the limitations of applicable performance requirements.

79. **MIL-W-5086 WIRE, ELECTRIC, POLYVINYL CHLORIDE INSULATED.** MIL-W-5086 includes wires rated for 105°C, 600 volt applications.

80. **Part Number.** The MIL-W-5086 part number example is as follows:

a. Example: M5086/5-20-9

b. M5086: Basic Specification which describe the performance characteristics.

c. /5: Detail Specification which defines the configuration, materials, and unique characteristics.

d. -20: Define the Wire Size.

e. -9: Defines a 3 digit Wire Color Code. The first digit is the background color and the remaining two digits is color stripes and is present only when required.

81. **Conductor Material.** The conductors are tin coated soft annealed copper or silver coated high-strength alloy copper.

82. **Insulation.** The primary insulation is a polyvinyl chloride. The Primary is usually covered with a nylon

jacket. Polyvinyl Chloride (PVC) insulated wire shall not be used on any aerospace vehicle for new installation and repair.

83. **Repair and Replacement.** Whenever maintenance instructions, diagrams, drawings etc. specify MIL-W-5086 to be used for repair or replacement, the wire shall be replaced with the MIL-W-22759 wire specified in Table 2.

84. **MIL-W-22759 WIRE REPLACEMENTS.** The various military wires mentioned herein may be replaced with the MIL-W-22759 wire types shown in Tables 2 through Table 6. Conductor size and color shall remain unchanged. For example a M81381/22-20-9 designation represents a size 20 wire colored white (-9) and may be replaced with a wire having a M22759/34-20-9 designation. In some cases the wire replacement outside diameter is slightly larger than the wire being replaced. If the increase in size causes physical interference during installation, contact the Cognizant Field Activity for guidance.

Table 2. MIL-W-5086 Wire Replacements

Present Designator	Replacement Designator	Present Designator	Replacement Designator
M5086/1	M22759/34	M5086/5	M22759/34
/2	/34	/6	/35 (Note 2)
/3	/34 (Note 1)	/7	/34
/4	None	/8	/32 (Note 3)

NOTES:
1 No replacement for Wire Sizes 03 and 04
2 No Replacement for Wire Size 28
3 No Replacement for Wire Size 32

Table 3. MIL-W-22759 Wire Replacements

Present Designator	Replacement Designator	Present Designator	Replacement Designator
M22759/5	M22759/43	M22759/25	M22759/35
/7	/43	/26	/32 (Note 2)
/11	/43 (Note 1)	/27	/33
/13	/34	/28	/43 (Note 1)
/14	/32	/29	/12
/15	/33	/30	/35
/16	/34	/31	/23 (Note 3)
/17	/35	/36	/32
/18	/32 (Note 2)	/37	/34
/19	/33	/38	/33
/22	/33	/39	/34 (Note 4)
/24	/34	/40	/35

NOTES:
1 No replacement for Wire Size 28
2 No Replacement for Wire Size 10
3 No Replacement for Wire Size 30
4 No Replacement for Wire Size 26

Table 4. MIL-W-81044 Wire Replacements

Present Designator	Replacement Designator	Present Designator	Replacement Designator
M81044/1	M22759/43	M81044/16	M22759/34
/2	/34	/17	/35
/3	/44	/18	/32
/4	/32	/19	/33
/5	/43	/20	/34 (Note 2)
/6	/34	/21	/43
/7	/35	/22	/35 (Note 1)
/8	/43	/23	/12
/9	/34	/24	/23
/10	/35	/25	/32
/11	/44 (Note 1)	/26	/44 (Note 1)
/12	/32	/27	/33
/13	/33	/28	/12 (Notes 1 and 3)
/14	/34	/29	/23 (Notes 1 and 3)
/15	/35		

NOTES:
1 No replacement for Wire Size 30
2 No Replacement for Wire Size 26
3 Replacement Wire Diameter is Slightly Larger

Table 5. MIL-DTL-81381 Wire Replacements

Present Designator	Replacement Designator	Present Designator	Replacement Designator
M81381/1	M22759/44 (Note 1)	M81381/12	M22759/41 (Note 4)
/2	/45 (Note 1)	/13	/35 (Notes 3 and 4)
/3	/43	/14	/42 (Notes 3 and 4)
/4	/41	/17	/44 (Note 4)
/5	/33	/18	/45 (Note 4)
/6	/46	/19	/33 (Note 4)
/7	/44 (Notes 1 and 4)	/20	/46 (Notes 2 and 4)
/8	/45 (Notes 1 and 4)	/21	/32 (Notes 1 and 4)
/9	/33 (Note 4)	/22	/34 (Note 4)
/11	/43 (Note 4)		

Notes:
1 No replacement for Wire Size 10
2 No Replacement for Wire Size 30
3 No Replacement for Wire Size 28
4 Replacement Wire Diameter is Slightly Larger

Table 6. MIL-DTL-16878 Wire Replacements

Present Designator	Replacement Designator	Present Designator	Replacement Designator
M16878/4BCB	M22759/11-28	M16878/5BCB	M22759/9-28
/4DCB	/22-28	/5DCB	/20-28
/4BDB	/43-26	/5BDB	/9-26
/4BDE	/43-26	/5BDE	/9-26
/4DDB	/33-26	/5DDB	/20-26
/4DDE	/33-26	/5DDE	/20-26
/4BEB	/43-24	/5BEB	/9-24
/4BEE	/43-24	/5BEE	/9-24
/4DEB	/33-24	/5DEB	/20-24
/4DEE	/33-24	/5DEE	/20-24
/4BFB	/43-22	/5BFB	/9-22
/4BFE	/43-22	/5BFE	/9-22
/4DFB	/33-22	/5DFB	/20-22
/4DFE	/33-22	/5DFE	/20-22
/4BGB	/43-20	/5BGB	/9-20
/4BGE	/43-20	/5BGE	/9-20
/4DGB	/33-20	/5DGB	/20-20
/4DGE	/33-20	/5DGE	/20-20
/4BHB	/43-18	/5BHB	/9-18
M16878/4BKE	M22759/43-14	M16878/5BKE	M22759/9-14
/4BLE	/43-12	/5BLE	/9-12
/4BLG	/43-12	/5BLG	/9-12
/4BMG	/43-10	/5BMG	/9-10

85 . **Original Equipment Manufacturer Replacements.** In earlier aircraft versions the aircraft manufacturer controlled component part numbers by in-house control drawings. In many cases these components were mere duplicates of the existing military specification components. These components shall be substituted with MIL W-22759 wire.

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AIRCRAFT WIRING SYSTEM INSPECTION

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Military Specification, Wiring, Aerospace Vehicle (previously MIL–W–5088) . . . . SAE AS50881
Wire, Electric, Polyimide Insulated Copper or Copper Alloy MIL-W-81381

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Flashlight and Inspection Mirror

Materials Required

None

1 . **INTRODUCTION.**

2 . This work package (WP) is to provide general examination criteria and define wiring discrepancies in aircraft undergoing all levels of maintenance.

3 . **BACKGROUND.** In today's military aircraft electrical wiring systems can no longer be considered a subsystem of another major component. normal operational environments, maintenance, modifications, and conversions can and do contribute to wiring systems stress, deterioration and deficiencies. these wiring systems which are comprised of individual wires, cables, groups, bundles, and harnesses located through out the entire airframe, have necessitated the establishment of this inspection criteria.

4 . Documented fleet problems and inspections, collaborated with testing conducted by the Naval Research Laboratory, Washington DC, have determined MIL–W–81381 (polyimide insulated wire) and/or original equipment manufacturer's equivalents which use polyimide insulation, have exhibited characteristics undesirable for continued use. These characteristics which include but are not limited to, wet and/or dry arc tracking, topcoat cracking, flaking and peeling, have been specifically addressed in this specification.

5 . **APPLICATION.** All military aircraft undergoing any level of maintenance.

6 . **DEFINITIONS.**

a. **Bundle.** Any number of harnesses or branches routed and supported together along some distance within the aircraft.

b. **Cable.** Two or more insulated conductors, solid or stranded, contained in a common covering, or two or more insulated conductors twisted or molded together without common covering, or one insulated conductor with a metallic covering shield or outer conductor.

c. **Chafing.** Abrasion due to repeated relative motion between wiring system components, or between a wiring system component and structure or equipment, which results in a rubbing action that causes visually detectable wear.

d. **Cracks.** Voids or splits that appear in wire insulation as a result of long term exposure to environmental extremes, aging and installation practices.

e. **Dry Areas.** Include locations that are NON–SWAMP areas for the aircraft.

f. **Group.** A number of wires and/or cables and their terminations secured together within the structure of a bundle or harness. Groups normally contain wire and/or cable pertaining to a single circuit or routed to a single item of equipment.

g. **Harness.** An assembly of any number of wires, cables and/or groups and their terminations which is designed and fabricated so as to allow for installation and removal as a unit. A harness may be an open harness or a protected harness.

h. **High Temperature Areas.** They include all locations on the engine, the engine auxiliary power unit (APU), in the engine APU bay, nacelle or in the wake of the engine and APU exhaust. Also includes ECS bays, heat exchanger and exhaust areas.

i. **Severe Wind and Moisture Problem (SWAMP) Areas.** Areas such as wheel wells, wing folds and areas near any flight control surfaces and actuator panels, and areas directly exposed to extended weather conditions are considered SWAMP areas on aerospace vehicles.

j. **Top Coat MIL–W–81381 and/or OEM Equivalent (polyimide insulated) Wire/Cable Only.** A thin coating (1 mil or less, 0.5 mil nominal), applied to the outer surface of polyimide insulated wire. It provides a smoother outer surface, a better marking medium, a means for coloring the wire insulation surface, and eliminates the tendency for manufacturing and maintenance personnel to mistake the copper colored polyimide tape for exposed conductor.

k. **Top Coat Flaking. MIL–W–81381 and OEM Equivalent (polyimide insulated) Wire/Cable only.** Peeling, flaking, falling off of the top coat material.

l. **Wire.** A single metallic conductor of solid, stranded, or tinsel construction, designed to carry current in an electric circuit, but not having a metallic covering sheath or shield. For purpose of this manual "wire" refers to "insulated electrical wire".

m. **Wiring.** Wires, cables, groups, harnesses and bundles, and their terminations, associated hardware, and support, individually or collectively in any combination installed in the aircraft. When used as a verb, wiring is the act of fabricating and/or installing these items in an aircraft.

7. **INSTRUCTIONS.** Examine aircraft wiring in accordance with the following guidelines.

NOTE

In case of conflict between contractor installation drawings, reference (a) or this manual, the precedence is:

a. Contractor Installation Drawings

b. SAE AS50881

c. NAVAIR 01–1A–505

8. **EXAMINATION.**

WARNING

Ensure wire and cable is properly clamped and routed to prevent chafing of any wire, cable, or bundle. Installation practices of wiring using polyimide fluorocarbon insulating materials per MIL–W–81381 (or OEM equivalent) require greater attention to detail due to its undesirable characteristics. Ensure lacing or tied bundles are secure, but not so tightly tied that the cord cuts into the insulation.

9. **Wiring Support.** Examine wiring for proper support and security to prevent chafing IAW NA–01–1A–505 WP 010 00 or SAE AS50881. Examine plastic tie wraps for brittleness or improper cut–off and replace with new tie wraps or approved lacing tape. Wiring not properly supported or secured is a discrepancy.

10. **Wiring Clearances.**

a. Examine wiring for a minimum 1/2 inch clearance from structure, surfaces, and equipment. Where a minimum of 1/2 inch clearance cannot be maintained, a minimum 3/8–inch clearance is acceptable where anti–chafing material is used.

b. A minimum of 2 inches clearance between wiring and fluid carrying lines, tubes and equipment shall be maintained. When there is less than 2 inches clearance between wiring and fluid carrying lines, there must be a positive means (clamp) to maintain a minimum of 1/2 inch clearance. Improper clearance between wiring, fluid carrying lines, tubes and equipment or lack of or improperly installed anti–chafing material is a discrepancy. This separation is not required when a conduit, bulkhead or other continuous structure separates wiring from fluid lines.

c. Examine for proper wiring clearance from linkages, throttle controls, boxes, covers, structures, control cables and component mounting hardware. Improper wiring clearance from any of these areas is considered a discrepancy.

d. Examine for proper clearance of terminal lugs between other lugs, adjacent components and nearby structures at contactors, circuit breakers, relays power control relays and terminal boards. Examine for loose/frayed wire strands bridging clearance gaps between contacts or structure. Lack of proper clearance between terminal lugs and nearby components or evidence of loose/frayed wire strands is a discrepancy.

e. Examine wiring for proper support independent of and with the maximum practicable separation from all fluid–carrying lines, tubes and equipment. Wiring shall not be attached to fluid carrying lines, tubes and equipment unless they require electrical connections. (Unless specifically authorized)

11. **Wire Chafing**. Examine for wire chafing where wiring is routed near structural members, crosses over/under other wiring, passes through lightening holes. Examine wire in areas where it moves/flexes when door(s) are opened/closed, passes over or near hinged areas, turns or bends near components and at connector backshells flexed during the removal and installation of components. Examine around generator power wiring routing areas. Any chafing found is a discrepancy. Using a bright light and mirror, follow all wire runs and examine the backside that is hidden from view. Look for wire chafing structure, components, or hard lines and plumbing, and correct. Partially close all hinged access doors. With doors open as little as possible,

examine with a flashlight to detect and wiring that may be coming in contact with the door hinges, latches, structures, or other mechanical components. Also look for possible door chafing with door open.

12 . **Wire Bend Radius.** Examine wire(s), wire bundles and cables for proper bend radius IAW WP (004 00). Improper bend radius of any wire, wire bundle or cable is a discrepancy.

13 . **Drip Loop.** Examine wiring for proper drip loop installation. Wiring dressed down to a connector should have a drip loop/trap to prevent fluids or condensation from running down the wiring into the connector. Where a drip loop has tape or tubing installed there should be a drainage hole in the tape or tubing at the lowest point , ensure hole is open and no fluids are present. Potted or fiber optic connectors do not require a drip loop. Refer to WP 010 00 for additional information on drip loops.

14 . **INSULATION EXAMINATION.**

a. Cracking or peeling of the insulation of any wire or cable (excluding polyimide topcoat, see paragraph 16) is a discrepancy.

b. Circular cracking (circumferential to axis of wire or cable) is a discrepancy. Some insulation may be more susceptible to cracking within ½ inch of clamps.

c. Heat damage: Melting, scorching, charring and blistering is a discrepancy.

d. Fluid/moisture effects: Swelling, blistering or cracking is a discrepancy.

e. Mechanical damage that is caused by the installation or removal of equipment, crew movements, shifting cargo etc. is a discrepancy.

f. Wiring that bears evidence of having been crushed is a discrepancy.

15 . **Polyimide Insulated Wiring In/Through Swamp Areas.** Missing, flaking or peeling top coat from insulated wire or cable is a discrepancy. In addition, inspect wire harnesses for oil, fuel and hydraulic fluid saturation, and if present determine the source and correct.

16 . **Polyimide Insulated Wiring In/Through Dry Areas.** Missing, flaking or peeling top coat with no evidence of damaged or deteriorated insulation is acceptable.

17 . **Examination of Cushion Clamps.** Cushion clamps must have “W” to be wedge type, non–wedge are not authorized. Examine area located at base or wedge of clamp cushion material to ensure wires are not pinched in metal band of clamp. Examine clamp size for too small or too large for wire bundle and use in between clamp size filler material if necessary. Ensure that Plastic clamps are not located in zones where ambient temperature may exceed 185˚F. Examine for loose, broken or deteriorated cushion clamps, lacing tape ties, strap ties, loose or damaged bundle clamp standoffs and distorted bundle clamp support brackets. Particular attention is required where wire bundles normally flex or move when doors or panels are opened and closed. Inspect for improper usage of clamps and clamp cushions with types not compatible with the installation environment. Any evidence of loose, broken or deteriorated cushion clamps, loose or damaged bundle clamp standoffs or distorted bundle clamp support brackets or improper usage of clamps or clamp cushions is a discrepancy.

CAUTION

Cushion compounds are manufactured to meet specific environmental requirements and deteriorate with age. Missing or deteriorating cushion material in clamps may result in chafing between the clamp band and wire bundle.

18 . Look for deformed clamps and ensure no cracks are evident in the metal portion, particularly at the bolt location. If found cracked, replace clamp.

19 . **Clamp, Hardware and Bracket Security.** Follow all wire/harness runs and lightly shake at all clamp or support devices. Inspect clamps for proper torque by attempting to rotate clamp around bolt/screw axis. If screw/bolt is not tight, improper length may be installed, and bolt may be bottomed out. Install proper length bolt to ensure clamp does not rotate. Check for proper thread protrusion on backside, 3–5 threads optimum.

Flush, or less than 1 1/2 threads is unacceptable. While shaking all clamp locations, ensure airframe clips and brackets do not have loose rivets or fasteners. If found, repair in accordance with the applicable technical publication.

20 . **Wire Routing.** Routing of wires with dissimilar insulation, within the same bundle, is not recommended, particularly when relative motion and abrasion between wires having dissimilar insulation can occur. Any polyimide insulated wiring that crosses over or under dissimilar wire insulation should be string tied to prevent chafing. Insure that wire bundles routed near junctions do not contact saddle clamp screws at connectors. Examine wire bundle routing for proper support hardware and security of installation and droop support. Generally, wiring should be routed above fluid carrying lines. However, when routing beneath fluid carrying lines is unavoidable, routing should be at an angle rather than parallel to the lines. Use of improper support hardware, lack of security and droop support or misrouted wires adjacent to fluid carrying lines is a discrepancy.

21 . **Wire Fraying.** Examine for loose or frayed wiring, cable shields and braided metal jackets. Evidence of loose or frayed wiring, cable shields or braided metal jackets is a discrepancy.

22 . **General Wire System Inspection.** Whenever aircraft panels are removed or remote areas are accessed, the exposed areas should be examined for debris such as dust, lint, metal shavings, or any foreign materials or liquids that could impact the performance of the aircraft wiring system or create safety problems such as increased risk of fire, electrical short circuits or arcing possibilities.

23 . **Connector Examination.**

a. Examine connectors and terminal junctions for bent or recessed contacts and corrosion. Examine electrical connections for security, and proper hardware installation. Evidence of bent, recessed, or corroded contacts, loose connections or improperly installed hardware is a discrepancy.

b. Examine potting of connectors or feed through bushings for proper sealing, cracking or deterioration. Look for contamination tracks, burn marks across potting material to metals. Pay close attention to vertically oriented connector parts for evidence of moisture. Evidence of improper sealing, cracking, deterioration, moisture or burn marks of potting is a discrepancy.

c. Examine all wiring for secure and legible connector identifications in accordance with NA–01–1A–505 WP 008 00 or SAE AS50881. Illegible or missing identification is a discrepancy.

d. Examine for paint overspray on wires or connectors (unless specifically authorized) check for paint over the coupling ring, paint on threaded surfaces or insert of plug or receptacle and clean as necessary.

e. Examine all receptacles with mounting holes; all mounting holes shall be installed with mounting screws installed.

f. Examine connector accessories, accessories shall not be used to terminate ground wires or shields unless the accessory was designed to terminate ground wires or shields. Ground wires shall not be terminated to saddle clamp screws.

g. Examine connectors and terminal junction blocks for sealing plugs. All unwired cavities shall have sealing plugs installed.

h. Examine connectors and terminal junction blocks to verify the strain relief clamp or the wire routing has not opened the rear grommet seals.

i. Connector plugs and receptacles should be examined for gold flaking on their interfaces. This condition indicates excessive wear between the pin and socket contacts and can cause short circuits or open circuit conditions. The connectors should also be examined for damaged threads (mating or accessory threads), bayonet pins, and keyways. The plating and base material in these areas are more susceptible to wear and can lead to catastrophic corrosion conditions and mechanical malfunctions.

24 . **RECOGNIZING CORROSION.** Recognizing corrosion in metals is an important part of corrosion cleaning and prevention program (refer to NAVAIR 161–540). modern avionics systems make use of many metals not normally considered for airframe structures. In addition to recognizing corrosion in metals, the inspection process must include the recognition of corrosion caused by solder fluxes and the deterioration of metals and non–metals caused by microbial, insects, and animal attack.

25 . **Common Types of Corrosion.** There are many forms of corrosion that may occur depending upon the

types of metal, configuration of the metal, and environment in which the components are placed. The following types of corrosion are common to avionics equipment on military aircraft:

a. Uniform Surface Attack

b. Galvanic (dissimilar metals)

c. Pitting

d. Crevice (concentration cell)

e. Inter–granular

f. Stress

g. Erosion

26 . Left untreated, corrosion on electrical connectors will continue to spread to adjacent surfaces and to mating connectors.

27 . External corrosion on cable connectors will, if left untreated, continue to corrode into the electrical contacts causing system degradation and eventual failure.

28 . The characteristics of corrosion on metals used in avionics systems are summarized in Table 1**.**

29 . **Wire Grounding.** No more than four ground wires shall be connected to a common ground stud as per SAE AS50881 paragraph 3.12.2. Examine grounds for corrosion, proper securing hardware, coating and installation. Insure that no more than four ground wires are terminated in a single lug and that no more than four lugs are attached to one stud. Evidence of corroded, improperly secured or improperly coated grounds is a discrepancy.

30 . **Previous Wiring Repairs.** Examine wiring repairs previously performed for proper repair/installation practices for compliance with WP 015 00.

31 . **TERMINAL LUGS AND SPLICES.**

a. Examine terminals crimped condition for any defective connections. Ensure lug barrel is not cracked, and ensure lug insulation is not cracked. Ensure all wire strands are in terminal barrel and no bare wire extends past the terminal barrel. Inspect lug for correct barrel size, ensure color is appropriate for wire gauges.

b. Examine terminal mounting for no more than four terminal lugs or three terminal lugs and a bus bar connected to any one stud (total number of terminal lugs per stud includes a common bus bar joining adjacent studs. Four terminal lugs plus a common bus bar thus are not permitted on one stud).

c. Ensure that when the terminal lugs attached to a stud vary in diameter, the greatest diameter shall be placed on the bottom and smallest diameter on top. Terminal connections shall not deform the terminal lugs or the studs when tightened.

d. Examine splice–crimped connection to ensure indent is centered on splice barrel. Ensure barrel is not cracked, and ensure wire cannot be pulled from splice. Ensure environmental shrink sealing sleeve has been installed correctly. Ensure all wire strands are in splice barrel and no bare wire extends past the splice barrel.

e. Examine terminal lugs/splices for disconnected wires, burn marks, or physical damage.

32 . **CIRCUIT BREAKER INSPECTION.** Perform the following visual inspections to check a circuit breaker for serviceability:

a. Verify amperage indicator on end of actuator is legible and correct for circuit used in.

b. Verify orientation of amperage indicator is correct relative to panel of installation.

c. Check that mounting nut is present and/or secure to panel

d. Inspect for corrosion of mounting hardware.

e. Inspect for corrosion on white trip indicator of push–button.

f. Inspect push–button for cracks or deterioration.

g. Inspect case for cracks, deterioration, discoloration and burn marks.

h. Check for foreign objects that could cause physical damage or electrical shorts.

i. Check leads of disconnected wires for burn marks and physical damage.

j. Check that terminal screws are present and tight.

k. Check for burn marks on the insulating barrier material of three phase circuit breakers.

l. Check for corrosion, discoloration and hot spots on all metal parts, including buss bars.

m. Check for broken wire strands at the wire terminations. If the number of broken strands exceed that allowable by WP 009 00, cut and re–strip the wire.

n. Check the boot for splits or deterioration. The boot should not be removed except for inspection.

33 . Perform the following mechanical inspections to check circuit breakers for serviceability:

a. Pull the button out and push it in.

(1) Check for abnormally high pullout forces.

TABLE 1. CORROSION OF METALS – NATURE AND APPEARANCE OF CORROSION PRODUCTS

Alloy	Type of Attack to Which Alloy Is Susceptible	Appearance of Corrosion Product
Magnesium alloy	Extended or repeated contact with chlorinated solvents may result in embrittlement. Cadmium plated tools can cause embrittle of titanium. Highly susceptible to pitting.	White powder snow–like mounds, and white spots on surface.
Carbon and low alloy steel (1000–800 series)	Surface oxidation and pitting, surface and intergranular.	Reddish–brown oxide (rust).
Stainless steel (300–400 series)	Intergranular corrosion. Some tendency to pitting in marine environment (300 series more corrosion resistant than 400 series).	Corrosion evidenced by rough surface; sometimes by red, brown or black stain.
Nickel–Base alloy (Inconel)	Generally has good corrosion–resistant qualities. Sometimes susceptible to pitting.	Green powdery deposit.
Copper–Base alloy (Inconel)	Surface and intergranular corrosion.	Blue or blue–green powder deposit.
Cadmium (used as a protective plating for steel)	Good corrosion resistance. Will cause embrittlement if not properly applied.	White to brown to black mottling of the surface.
Chromium (used as a wear–resistant plating for steels)	Subject to pitting in chloride environments.	Chromium being cathodic to steel, does not corrode itself, but promotes rusting of steel where pits occur in the coating.
Silver	Will tarnish in presence of sulfur.	Brown to black film.
Gold	Highly corrosion resistant.	Deposits cause darkening of reflective surfaces.
Tin	Subject to whisker growth.	Whisker–like deposits.

(2) Check for abnormally high reset forces.

b. All force measurements should be judged based on a normal feel of the circuit breaker when its pulled and reset (paragraph 62).

34 . **Periodic Cycling.** All circuit breakers should be mechanically cycled two or three times yearly. Pull the button out and push the button in with no electrical power applied. This helps clean possible corrosion from the contacts. Opening circuit breakers a few times a year does not lower their service life; however, the

manual operation of the circuit breaker should be limited to two or three times yearly in order to avoid excessive dynamic wear of the trip mechanism.

35 . **Trip History.** Circuit breaker should not be allowed to develop a history of tripping. A tripped breaker may be faulty, may be in a faulty circuit, or may be improperly applied. A tripped circuit merits post flight analysis. The subject breakers should be sent to a higher maintenance level for failure analysis.

36 . **Replacement.** If any circuit breaker does not meet the inspection criteria, the circuit breaker should be replaced.

LOW FREQUENCY, MULTICONDUCTOR ROUND CABLE DESCRIPTION AND REPLACEMENTS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Ribbonized, Organized, Integrated (ROI) Harness Repair 011 02
Shield Terminations 015 00
Wire and Cable Splicing and Repair 014 00
Wire Characteristics and Substitutions 004 00
Cable, Electric, Filter Line, Radio Frequency Absorptive MIL–C–85485
Cable, Electric, Shielded and Unshielded Aerospace NEMA–WC27500
Wire, Electric, Fluoropolymer, Insulated Copper Or Copper Alloy MIL–W–22759
Wiring Aerospace Vehicle (previously MIL–W–5088) . . . . . . SAE AS50881
Wire, Electric, Polyimide Insulated Copper or Copper Alloy MIL–DTL–81381

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

None

1. **INTRODUCTION.**

2. This work package (WP) describes the types of cables authorized for use in aircraft wiring. This Work Package describes the characteristics of multiconductor Round Cables typically used in aircraft wiring. The information is only for edification and is insufficient to determine specific cable applications. However, there is sufficient information to determine cable substitution. Part numbers cross-reference for cable substitution or replacement are provided. The selection and installation of cables should be in accordance with SAE AS50881.

3. The term cable whenever used throughout this WP shall be interpreted as two or more insulated conductors, solid or stranded, contained in a common covering, or two or more insulated conductors twisted or molded together without a common covering, or one insulated conductor with a metallic covering, shield, or outer conductor.

4. The term wiring whenever used throughout this WP shall be interpreted as wires, cables, groups, harnesses and bundles, associated hardware, terminations, and

installed support. When used as a verb it is the act of fabricating, and installing these items.

5. Multi-Conductor Round Cables vary widely in design configuration, many of which will be discussed in this WP. But all cables serve one or more of the following three principle functions:

a. To provide for a group of wires to be bundled for ease of routing an electrical/optical service to one central location.

b. To provide mechanical protection typically by an insulated jacket.

c. To prevent an electromagnetic signal from interfering with the conductor's electrical signal. This is typically provided by a metal braid, although cross talk effects can be reduced by wire positioning without braids (see WP 011 02).

6. **ENVIRONMENT EFFECTS.**

7. There are numerous environmental conditions, which must be considered when a particular cable is used in an application. These factors are discussed in WP 004 00.

8. **ELECTROMAGNETIC INTERFERENCE (EMI) AND ELECTROMAGNETIC VULNERABILITY (EMV) EFFECTS.** In addition to the typical environmental effects discussed above, stray magnetic fields and electrostatic fields can critically affect signal transmission in electronic and electrical circuits by inducing, radiating, or transmitting voltages (EMI), and by induced, radiated, or transmitted voltages (EMV) that alter transmission signals.

9. **EMI AND EMV PROTECTION.** By using or by employing a shield EMI and EMV can be controlled. A shield is a conducting envelope enclosing a wire, a group of wires, or cable so constructed that substantially every point on the surface of the underlying insulation is at ground potential or some predetermined potential with respect to ground. Shields may be multifunctional in that they may level out surge impedance along the length of the cable, screen a signal from external excitation, confine a signal to its intended path, or in some circuits act as a return as in a coaxial cable. The type of shielding required depends upon the identity of the potential fields in which the circuit will operate either magnetic or electrostatic.

10. **Magnetic Shielding.** Magnetic shielding is employed under three conditions:

a. D.C. and Low Frequency Magnetic fields. The shield will tend to short-circuit the flux lines as these fields attempt to extend through the shield. Shield effectiveness is directly proportional to its thickness.

b. Radio Frequency Magnetic fields. The shield is low resistance and the shield produces eddy currents which tend to oppose the magnetic field.

c. 1 KHz to 1 MHz Magnetic field. Though not as critical as the previous, still need to be cancelled and employ copper and steel tapes, copper braid 50% to 95% coverage or aluminum tape or paper.

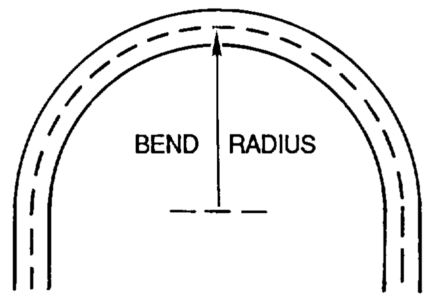

Figure 1. Bend Radius

11. **Electrostatic Shielding.** Does not present as severe a problem as magnetic shielding since neither the shield thickness nor degree of conductivity is critical. The most important factor is that shield effectiveness is proportional to percent coverage with 100% being desirable.

12. **BEND RADIUS.** The maximum amount a cable can be bent without causing damage to the conductor or insulation is referred to as minimum bend radius (Figure 1).

13. **Cables.** The minimum bend radius shall be ten times the outside diameter of the cable when individually routed and supported. At the point where an individual cable breaks out from a group, harness, or bundle the minimum bend radius shall be ten times the outside diameter provided the cable is suitably supported.

14. **Coaxial Cable.** The minimum bend radius shall not adversely affect the characteristics of the cable.

a. When using flexible type coaxial cables, the radius of bend shall not be less than six times the outside diameter.

b. When using semi-rigid type cables, the radius shall not be less than ten times the outside diameter.

15 . **CABLE CONSTRUCTION**.

16 . There is no simple or easy way to classify cables. Some are described by form, general application, specific application, conductor type, insulation type, property, and voltage. A fundamental discussion of cables is difficult because of the variety of cable types. The cables discussed herein are those most commonly found on military aircraft.

17 . **UNSHIELDED CABLES.** Unshielded cables are typically twisted multi-conductors, insulated wires with or without an insulated jacket. Single conductor wires in large diameter (greater than size 4) are also called cables. A twisted unjacketed cable is often used to perform a point-to-point electrical function. The twisted unjacketed wires will have insulations thick enough to provide mechanical protection. When thinner wire insulations are used the cable must be jacketed. A jacket may also be used to provide a better form cable for tight installations. The various types of cable choices are almost unlimited. For applications the cable applications the cable types are restricted by SAE AS50881.

18 . **SHIELDED CABLES.** Shielded cables are typically twisted, multi-conductor, insulated wires with a braided metal shield. The shield will typically be the same material and plating as the conductors in the cable. For aircraft application all shields are supposed to be jacketed. The jacket material will typically be the same as the wire insulation material. In some applications a single conductor insulated wire, shielded and jacketed will also be used. The various combinations of insulation, wire types, number of wires, shield types and jacket types is limited only by the available materials to perform the intended application. For Aircraft the cables type are limited by SAE AS50881.

19 . **SHIELD CHARACTERISTICS.**

20 . FUNCTION. A shield is a conducting envelope enclosing a wire, group of wires or cable, so constructed that substantially every point on the surface of the underlying insulation is at ground potential or at some predetermined potential with respect to ground. Shields perform many and varied functions, both electrical and mechanical. In electronic or electrical systems shields may:

a. Level out surge impedance along the length of the cable.

b. Screen the signal from external excitation.

c. Confine a signal to its intended path.

d. Act as a return.

e. Act as a safety measure in high voltage circuits.

f. Mechanically aid in protection of conductors and insulation.

21 . **SHIELD EFFECTIVENESS.** Stray magnetic and electrostatic fields can critically affect signal transmissions, in electric and electronic circuits, by inducing voltages that alter transmitted signals. Shield effectiveness is the measure of the success of a shield in reducing induced voltages and signal radiations.

22 . **SHIELD CONSTRUCTION.** Braided shields are formed in the same manner as textile braid with copper being substituted for yarn. Braid shield is widely used as it retains its structural integrity (Figure 2).

23 . **SHIELD COVERAGE.** The effectiveness of a braided shield is generally proportional to the amount of coverage expressed as a percentage with 100% being optimum. From an electrical stand point this percentage is unattainable as areas where leakage can occur, however minute, will always exist at points where the shield strands cross. For the majority of audio frequency applications 75% to 85% coverage will prove effective, at higher frequencies 85% to 95% coverage will be necessary for proper effectiveness

24 . **PERCENTAGE COVERAGE.** The percentage of coverage can be calculated and is influenced by four factors:

25 . **Number of Ends Per Carrier.** Generally four to seven are used per carrier. The number of ends effect attenuation and push back characteristics (Figure 3, Item N).

26 . **Picks Per Inch.** These alter the braid angle (a) and are defined as the smaller of two angles formed

by the shield strands and the axis of the cable (Figure 3, Item P).

27 . **Braid Angle.** This angle will always be between 0° and 90° when the number of picks is small and 90° when the number of picks is large. A high braid angle increases attenuation and also increases flexibility and flex life. Therefore shield design will be a compromise. Braid angle is shown (Figure 4).

28 . **Diameter of Individual Shield Strands.** This can be located in individual specifications. Generally size 36 or 34 AWG is used but can be as small as 40 AWG or as large as 28 AWG depending upon intended use (Figure 3, Item d).

29 . **Number of Carriers.** There are usually 16 to 24 carriers used but others may be added or deleted as necessary depending upon intended use (Figure 3, Item C).

a. Carrier refers to the individual braider.

b. 16 to 24 refers to the number of braiders used.

30 . **SHIELD TERMINATION.** There are several methods for terminating braided shields and individual repair and replacement specifications shall be followed in accordance with WP 016 00.

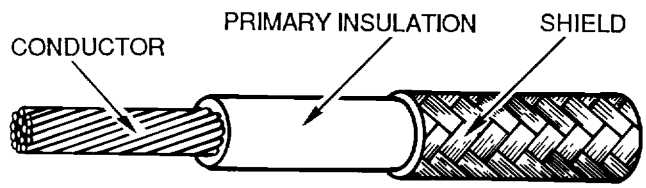

Figure 2. Braided Shield

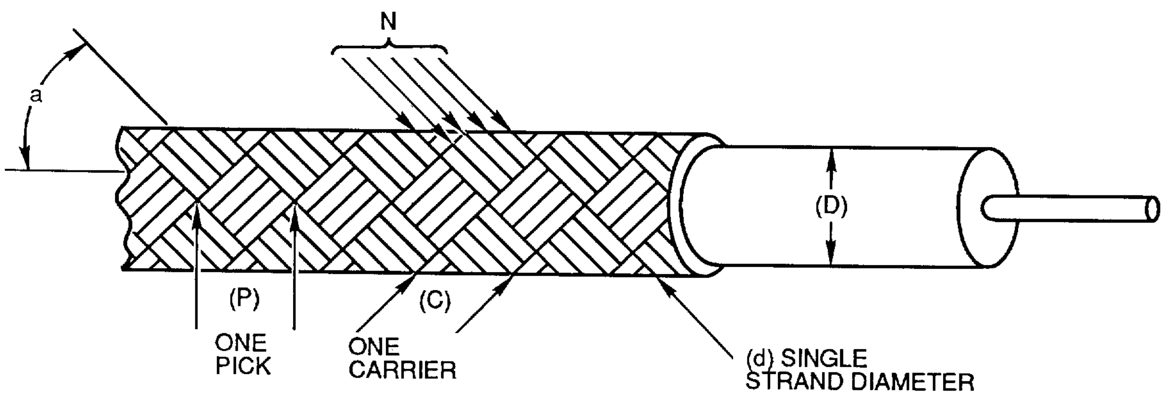

Figure 3. Shield-Constructional Details

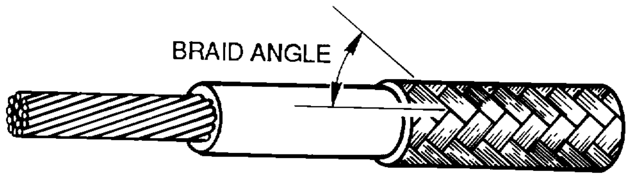

Figure 4. Braid Angle

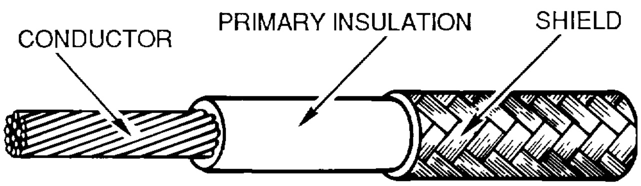

Figure 5. Single Conductor Cable Construction

31 . **SINGLE CONDUCTOR CABLE.**

32 . **DEFINITION.** These cables have one single insulated conductor with a metallic covering, shield, outer conductor, and a jacket or outer covering. These single conductor cables have varied uses and applications. Applicable specifications must be adhered to during repair and replacement, for individual applications and repair (WP 015 00). Each WP will refer to applicable military specifications. The basic construction of a single conductor cable is shown (Figure 5).

33 . **ELEMENTS.** There are three basic elements in the single conductor cable that when combined together during manufacture constitute a single conductor cable (Figure 5).

34 . **Basic Wire.** This basic wire constitutes the single conductor, and shall conform to the military specification for wire (WP 004 00).

35 . **Shield.** A shield or outer conductor will be present and is discussed in detail within this WP.

36 . **Jacket.** The single conductor shield cable will typically have a jacket similar to that shown in Figure 5. The jacket will be an insulating material, probably the same as the primary insulation shown in Figure 5.

37 . **MULTICONDUCTOR CABLES.**

38 . **DEFINITION.** A multiconductor cable may be described as two or more conductors along with those other components as used in single conductor cable. These may be in any combination of conductors and shield. Multiconductor Cables usually have a large number of identical components and when cabled together must be as round, lightweight, and small as possible in overall diameter, without an abundance of large air spaces or voids. These conditions plus, flexing, physical abuse, and electrical parameters must be taken into consideration in the design and manufacture. The basic construction of a multiconductor cable is shown (Figure 6).

39 . **ELEMENTS.** There maybe as few as four elements or as many as are conducive to good design and construction. All the elements listed are not required in cable construction but may be found. A basic multiconductor cable design is shown (Figure 7).

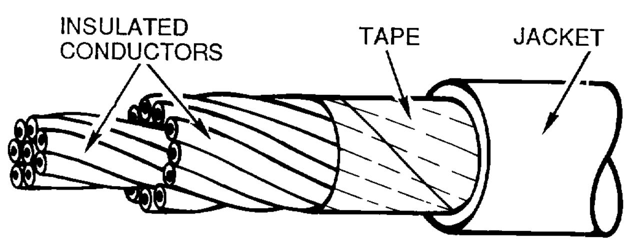

Figure 6. Multiconductor Cable-Twisted Components

40 . **Insulated Conductor Components.** A component is not necessarily one insulated conductor. A component could be a group of insulated conductors. These insulated conductors are termed basic wires and shall conform to the basic wire specifications (WP 004 00).

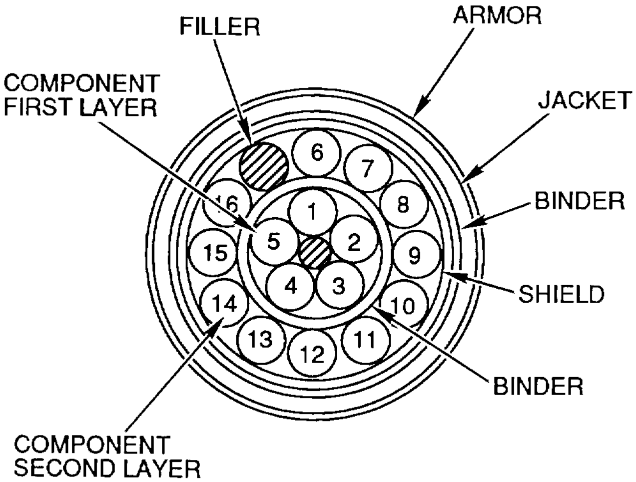

Figure 7. Typical Multiconductor Cable Design

41 . **Shielding.** A shield may be present in the construction and is discussed in detail within this work package (Paragraph 23).

42 . **Fillers.** These are non-conductive materials used to evenly space the insulated conductors, thus avoiding large air spaces and voids.

43 . **Binders.** These are non-conductive materials used to join individual components in concentric patterns.

44 . **Jacket.** The multiconductor cable jacket will be an electrical insulating material, which may or may not be the same as the conductor material compounds. The choice of jacket insulation will depend upon the application environment. The MIL-C-85485 jacket maybe semi-conductive.

45 . **Armor.** This may be used to protect the cable.

46 . **MILITARY SPECIFICATION CABLES.**

47 . **NEMA–WC27500 CABLE, ELECTRICAL SHIELDED AND UNSHIELDED, AEROSPACE.** In aircraft applications unjacketed shielded cables are seldom used. The more typical types of cables are shown herein.

48 . **Description.** MIL-C-27500 cables typically found in aircraft are unjacketed, jacketed, or shielded and jacketed.

CAUTION

Shielded/unjacketed cable shall not be used on aircraft.

a. Unjacketed cables are twisted (Spirally Laid) wires with no jacket for mechanical protection. The wires will have insulation thick enough to provide the mechanical protection. These types of cables are used to improve the time required to build and install a harness or help to define a point-to-point group of electrical signals. An example of an unjacketed, twisted pair is shown in Figure 8.

b. Jacketed cables are twisted wires with a jacket to provide additional mechanical protection or to help form the cable for ease of installation. Typically, the wires will have thinner insulations than the unjacketed cable. The cable may also be used to define a point-to-point group of electrical signals. An example of a jacketed, twisted form conductor cable is shown in Figure 9.

c. Shielded and jacketed cables are twisted wires with a shield braided over the outside then jacketed. The jacket provides mechanical protection to the shield and wires. The shield provides electromagnetic interference protection for wires. The wires provide a point-to-point group of electrical signals. An example of a shielded/jacketed twisted four conductor cable is shown in Figure 10.

Figure 8. Unshielded/Unjacketed/Twisted

Figure 9. Jacketed/Twisted

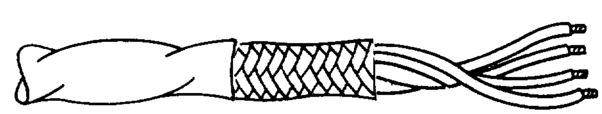

Figure 10. Shielded/Jacketed/Twisted

49 . **Part Number.** The NEMA–WC27500 cable part number is as follows:

a. Example: NEMA–WC27500 A22 CB 3T10

(1) NEMA–WC27500: Defines the military specification, which specifies the cable requirements.

(2) A: Defines the identification method required to clearly distinguish each wire in the cable from all other wires in the cable. The methods may be color code stripe or band code, or print code or a combination of both color and print codes.

(3) 22: Defines the conductor size of each wire in the cable. There are no mixed conductor sizes.

(4) CB: Defines the basic wire types specified by the wire specification. The codes may be one or two digits characters (or letters). For example “CB” refers to a MIL-W-22759/14 wire type. There are no mixed wire types in a cable.

(5) 3: Defines the number of wires in the cable. The code may be one or two digits.

(6) T: Defines the present or absence of a shield, type of shield, and number of shields (one or two).

(7) 10: Defines the jacket type and the number of jackets (one or two). The code is always two digits. The codes 01 through 24 are single jacket insulations and codes 51 through 74 are double jacket insulations. The code 00 means an unjacketed cable.

50 . **Cable Replacement and Repair.** In some cases cable types are nearly functionally interchangeable. Replaceable cables are provided here-in. Repair procedures of low frequency, multi-conductor round cables are provided in WP 015 02.

51 . **Optional Cable Replacements.** Whenever maintenance instructions, diagrams. drawings, etc., specifies a NEMA–WC27500 cable with the basic wire codes shown in Table 1, the cable may be replaced with a different cable as indicated. A cable without a jacket is always code 00. Examples are as follows:

a. M27500A20NL2T12. Replaced by M27500A20SD2T23.

b. M27500A20NL2T. Replaced by M27500A20SD2T73.

c. M27500A20NL2T00. Replaced by M27500A20SD2T00.

CAUTION

Replacement is not mandatory.

Unless otherwise noted in Table 1, only the basic wire code and the jacket code changes for each cable replacement. Single jacket codes 01 through 24 are replaced with 23 and double jacket codes 51 through 74 are replaced with 73.

CAUTION

In rare cases installation maybe difficult due to slight cable diameter increases. Guidance should be requested from the aircraft CFA.

52 . **Recommended Cable Replacements.** Unless otherwise specified by the CFA; whenever maintenance instructions, diagrams, drawings, etc. specify a NEMA–WC27500 cable with MIL-DTL-81381 basic wires, the cable is recommended to be totally replaced, if removed from the aircraft when funding and time permits. If a cable section is only being replaced, it is also recommended that the full cable be substituted. The replacement cables for the MIL-DTL-81381 basic wire codes are provided in Table 1.

CAUTION

In rare cases, installation may be difficult due to slight cable diameter increases. See CFA for guidance.

53 . **Aircraft Manufacturer Cable Replacements.** In some older aircraft the manufacturers used cable drawing control numbers rather than military part numbers to define the cable types. CFA guidance is recommended before performing any substitution of these cables.

54 . **MIL-C-85485 CABLE, ELECTRIC, FILTER-LINE, RADIO FREQUENCY ABSORPTIVE.** This specification covers the requirements for radio frequency absorptive component wires and finished cables which function electrically as distributed low pass filters.

55 . **Description.** MIL-C-85485 filter line cable consists of unshielded or shielded, single or twisted basic wires

with or without a single jacket. The cable has basically the same appearance and characteristics as NEMA–WC27500 cable (paragraph 46), except it also acts as a low frequency band filter for extraneous signals which may be traveling down the conductor (see WP 004 00). To perform properly as a low pass filter, a single conductor cable must be shielded, and Multi-conductor cables must be shielded as well as covered with a semi-conductive jacket. For this reason all filter line cable basic wires are colored light violet to denote special handling.

CAUTION

Filter line cable may require special handling. See aircraft Maintenance Manual for guidance.

56 . **Part Number.** The MIL-C-85485 cable part number is as follows:

a. Example: M85485/7-22U-3A

(1) M85485: Defines the military specification which specifies the cable requirements.

(2) /7: Defines the detail military specification which specifies the detail characteristics of the cable.

(3) -22: Defines the wire conductor size.

(4) U: Defines the various combinations of conductor types, shield types, (jacket and unjacketed).

(5) -3: Defines the numbers of twisted wires in the cable.

(6) A: Defines the color code scheme for wire identification.

57 . **Repair and Replacement.** There are no cables which can be substituted for MIL-C85485 cables. The cable must be repaired in accordance with aircraft maintenance manual or as shown in WP 015 00.

TABLE 1. NEMA–WC27500 OPTIONAL REPLACEMENTS

Present Wire Code	Replacement Wire Code	Present Wire Code	Replacement Wire Code
A	SD	MD	SP
B	SD	ME	SD
C	SD (Note 1)	MF	SE
M	SP	MG	SP
Y	SR (Note 2)	MH	SD
AA	SD	MJ	SE
AB	SE	MK	SR (Note 4)
AD	SD	ML	SB
BA	SD	MM	SC
BB	SE	MN	SD
BC	SB	MP	SE
BE	SC	RC	SP (Note 3)
BF	SD (Note 3)	SA	SP
BG	SP	SF	SB
BH	SE (Note 4)	SG	SD
BJ	RE (Note 6)	SJ	SC
BK	TN (Notes 4 and 6)	SK	SD (Note 5)

TABLE 1. NEMA–WC27500 OPTIONAL REPLACEMENTS (CONT)

Present Wire Code	Replacement Wire Code	Present Wire Code	Replacement Wire Code
BL	SB	SL	SE
BM	SR (Note 4)	TE	SD
BN	SC	TF	SE
BP	RE (Notes 4 and 6)	TG	SB (Note 2)
BR	TN (Notes 4 and 6)	TH	SC
CA	SD	TM	SC
CB	SB	TP	SE
CC	SC	TR	SB (Note 2)
JB	SP (Note 3)	TS	SC
JC	RE (Note 6)	TT	SD
JD	SE (Note 3)	VA	SP
JE	TN (Note 4 and 6)	YA	SS (Note 2)
MA	SD	YB	SP
MB	SR	YC	SM
MC	SB		

NOTES:
1 Not replaceable for basic wire sizes 03 or 04 (see WP 004 00).
2 Not replaceable for basic wire size 10 (see WP 004 00).
3 Not replaceable for basic wire size 28 (see WP 004 00).
4 Not replaceable for basic wire size 30 (see WP 004 00).
5 Not replaceable for basic wire size 26 (see WP 004 00).
6 Use single jacket code 06 for codes 01 through 24 and double jacket code 56 for codes 51 through 74.

Present Wire Code	Replacement Wire Code	Present Wire Code	Replacement Wire Code
MR	SR (Note 1)	NB	SN (Note 3)
MS	SS (Note 1)	NE	SR
MT	SC	NF	SS
MV	ST (Note 2)	NG	SC
MW	SP	NH	ST (Note 2)
MY	SM	NK	SB (Note 1)
NA	SE (Note 3)	NL	SD

NOTES:
1 Not replaceable for basic wire size 10. See CFA for support.
2 Not replaceable for basic wire size 30, See CFA for support.
3 Not replaceable for basic wire size 28. See CFA for support.

RADIO FREQUENCY (RF) CABLE CHARACTERISTICS AND REPLACEMENTS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRICAL AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

None

1 . **INTRODUCTION.**

2 . The term RF cable usually implies that the cable is used to transmit radio frequency energy of 500 KHz upwards. Coaxial cables are often used in frequencies below 500 KHz and have many applications in the audio frequency range. All RF cables are commonly called coaxial cables, although they may include multiple conductors separated by multiple insulators. Coaxial cables used at lower frequency are commonly called

audio cables. By definition (WP 003 00) audio cables are coaxial cables, because the shield is used as a second conductor. A single conductor shielded and jacketed cable (WP 005 00) looks like a coaxial cable, but the shield is used for EMI/RFI protection, not as a conductor. A coaxial cable is a Radio Frequency (RF) transmission line used for the propagation of Electro-magnetic energy in the transverse mode (TEM). Coaxial cables are commonly known as high frequency cables. The purpose of the Work package is to provide some of the more common characteristics of coaxial cables and replacement information when available.

3. **RF CABLE DESCRIPTIONS.** The cables described herein are the typical types. There are numerous variations depending on the electronic system requirements (Figure 1). When standard cables are not available, designers use MIL-T-81490 Transmission Lines, Transverse electromagnetic mode for guidance. Refer to the specific aircraft manual for repair and installation of these type of cables.

a. **COAXIAL.** A coaxial cable may be defined as two concentric wires, cylindrical in shape, separated by a dielectric of some type. One wire is the center conductor and the other wire is the outer conductor. These conductors are covered by a protective jacket, and this jacket may, in cases, be covered by a protective armor (Figure 2).

b. **TWIN COAXIAL.** A twin coaxial cable consists of two individually insulated conductors within a common shield. These insulated conductors are either laid parallel or twisted and placed concentrically within an additional dielectric cable core. The shield is placed over the cable core protected by a jacket and may be covered by an armor jacket (Figure 3).

c. **DUAL COAXIAL.** A dual coaxial cable is two individual coaxial cables, either laid parallel or twisted around one another and placed concentrically within a common jacket or a common shield and jacket (Figure 4).

d. **DOUBLE SHIELDED.** A double shield is often used when improvements over single shielding are required. This cable has a second shield braided over the first with no insulating barrier between them (Figure 5).

e. **TRIAXIAL.** A triaxial cable is very similar to a coaxial cable and is used when further shielding is required. This cable is cylindrical in shape having a center conductor located concentrically within a dielectric core, but having two shields separated by a dielectric material (Figure 6).

4. **AIR–SPACED CABLES.** Air–spaced cables are semi-solid air–spaced coaxial cables, which incorporate a variety of dielectric designs and outer conductor materials. The exact construction is specified on the cable specification and is selected on the basis of electrical performance and the required physical properties.

a. **Air–spaced–Cable Characteristics.** Air–spaced cable is used where one of the following characteristics is desired:

(1) When low capacitance or low attenuation is desired.

(2) When an overall smaller diameter than other dielectric electrically equivalent cables is desired.

(3) When lesser weight is desired than other dialectically equivalent cables, but with some sacrifice in dielectric strength.

5. **INNER CONDUCTORS.** The inner conductor, or center conductor, is either solid, stranded, braided or helical, and the conductor may be either bare or coated. Copper is widely used, because it has high electrical and thermal conductivity, malleability, reasonable strength and the ability to be coated with other metals. In cables where increased strength and flexibility are required, copper clad steel conductors are used.

a. **Inner Solid Conductors.** Solid conductors are constructed of multiple conducting metals and different coatings depending on the electrical and physical characteristics required. Examples are as follows:

(1) Bare Copper Wire.

(2) Tin Coated Copper Wire.

(3) Silver Coated Copper Wire.

(4) Copper Clad Steel Wire.

(5) Annealed Copper Clad Steel Wire

(6) Silver Coated Copper Clad Steel Wire.

(7) Annealed Copper Clad Aluminum Wire.

(8) Copper Beryllium Alloy Wire.

(9) Annealed Copper Beryllium Wire.

(10) Silver Coated Wire.

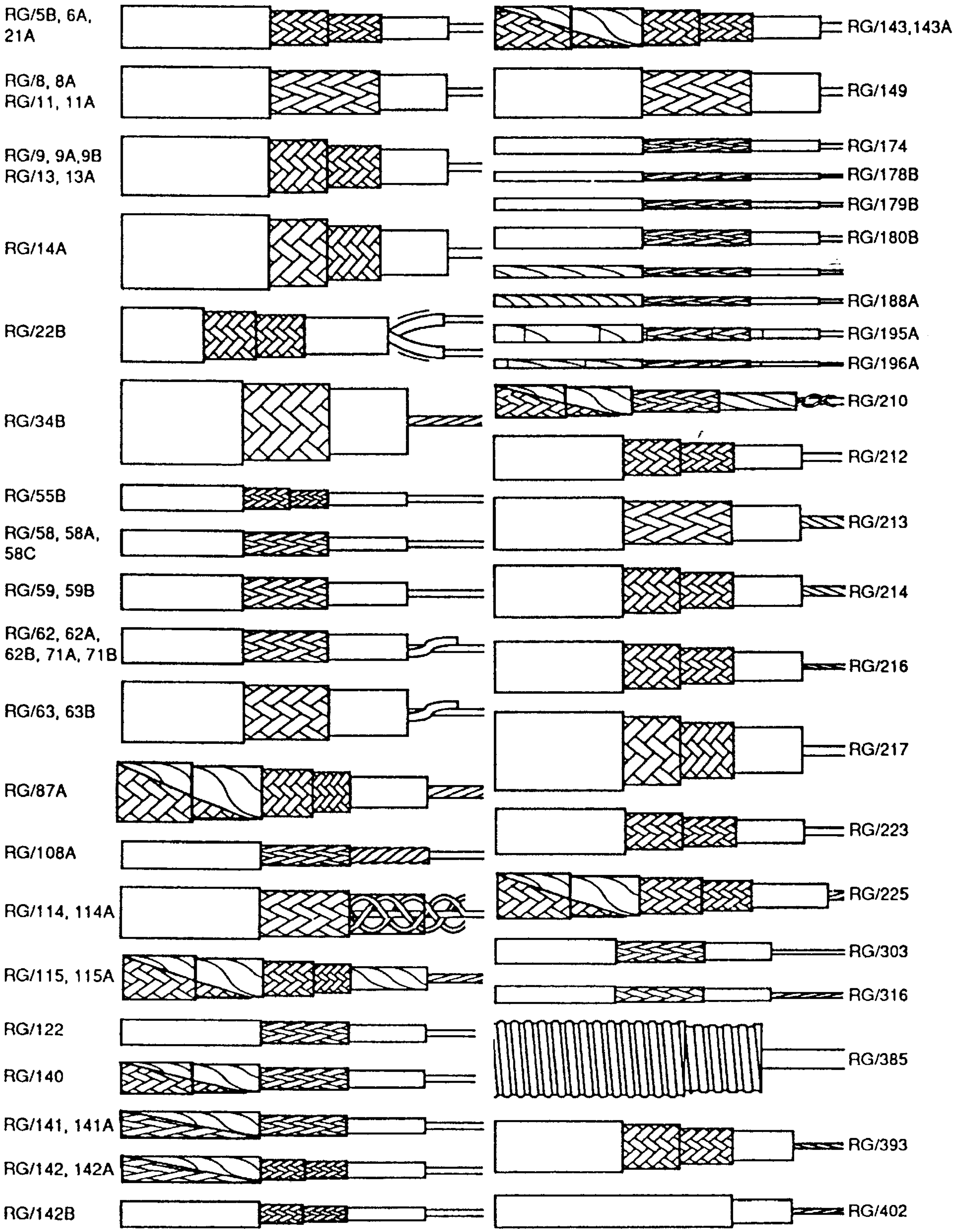

Figure 1. Typical MIL-C-17 Cables.

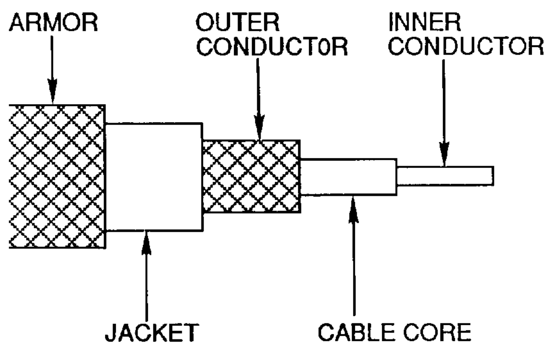

Figure 2. Coaxial Cable

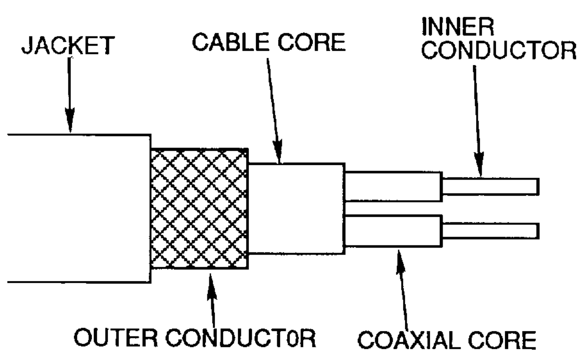

Figure 3. Twin Coaxial (Parallel)

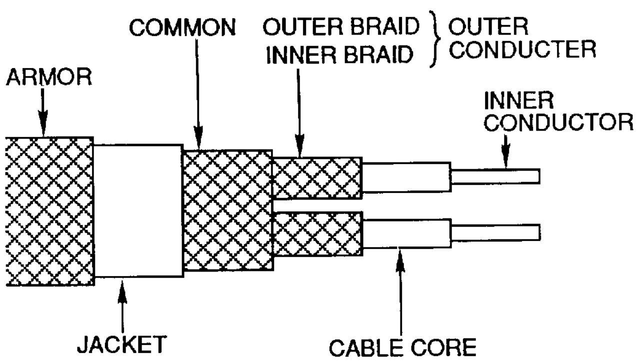

Figure 4. Dual Coaxial (Parallel)

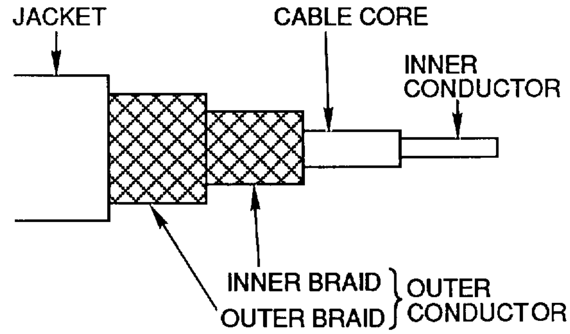

Figure 5. Double Shielded Coaxial

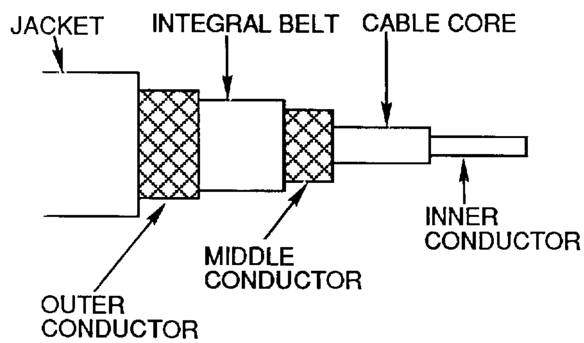

Figure 6. Triaxial Cable

b. **Inner Stranded Conductors.** Stranded conductors are concentrically stranded and are constructed of the same conducting metals as solid conductors. The stranded conductors are coated prior to stranding and are not overcoated.

c. **Conductor Coatings.** Coating the conductor is performed to increase conductivity, prevent oxidation, and increase solderability. Copper by nature, though a good conductor, oxidizes rapidly when heat is applied. This oxidation will appear as a black coating that must be removed, and preferably prevented, before use. Tin and silver are used in varying degrees to achieve the desired electrical and physical characteristics.

(1) Tin Coating. Tin coated conductors act as an aid to soldering. Tin coated conductors will degrade when exposed to elevated temperatures, in that the formation of tin and copper intermetallics causes increased resistance and attenuation.

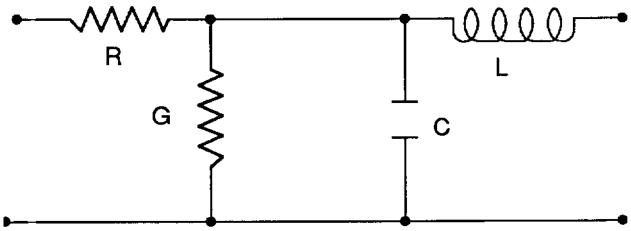

Figure 7. Basic Parameters of a Transmission Line

(2) Silver Coating. Silver coating is employed for cables operating above 302°F (150°C) to about 392°F (200°C), and in higher frequencies where higher conductivity is desired. When exposed to elevated temperatures, interstrand bonding will occur, resulting in a loss of flexibility. Silver migration will also occur, resulting in increased oxidation.

6. **DIELECTRIC CORE CHARACTERISTICS.** A dielectric is by definition any insulating material which intervenes between two conductors and permits electrostatic attraction and repulsion to take place across it. The dielectric core is also a material having the property that energy required to establish the electric field is recoverable in whole or in part as electrical energy when discharged. The material used in dielectric cores is uniform in thickness throughout the cable and consistent to ensure the electrical, environmental, physical, mechanical, and dimensional requirements. The dielectric constant and dissipation factors are constant throughout the cable, but each varies significantly depending on the core material. Changes in core material make for a wide variety of cable designs.

a. **Solid Dielectric Cores.** The dielectric core is either extruded over the conductor or a dielectric tape is wrapped over the conductor then sealed or heat cured.

b. **Air Spaced Dielectric Cores.** Semi-solid air spaced dielectric cores are constructed in such a manner that the air spaces become a basic element of construction. In air spaced cores the conductor is either suspended in foam, or a braid or filament is spiraled around the conductor and placed within spiraled fins of solid dielectric, or placed between tubes of dielectric.

7. **OUTER CONDUCTOR.**

a. **Braided Conductors or Shields.** When braids are used as outer conductors or shields, they are applied with the maximum amount of tension possible to prevent loosening or creeping, but not to cause broken ends. The individual wires used in construction are typically the same conductor metals, and meet the same requirements of the conductor material. Galvanized steel wire may also be used. Tin plate may be used as an alternate to galvanize.

b. **Solid Outer Conductors.** Typically, when solid outer conductors are used they are constructed of seamless, metallic tubing of either copper or aluminum and are 99% pure.

8. **JACKET.** Jackets are designed to be flexible, tough and are applied to the cable tightly and evenly. The jacket may be extruded, single or multiple barrier tape wrap materials. There could be a barrier tape then an extruded jacket. The jacket provides physical, electrical, and environmental protection for the underlying cable. The jacket color is typically black, but may be other colors depending on material used or applications.

9. **ARMOR.** Armor is typically an aluminum alloy constructed to be rugged, tough, and flexible.

10. **ELECTRICAL CHARACTERISTICS OF RF CABLES.**

11. **THEORETICAL ELECTRICAL CHARACTERISTICS.** Theoretically, a transmission line has four basic parameters which consist of shunt capacitance (C), shunt conductance (G) series resistance (R), and series inductance (L) (Figure 7). Shunt capacitance and conductance are measured between the conductors and series resistance and inductance are measured along the cable length. Any transmission line regardless of length has these basic parameters uniformly and evenly distributed along its entire length. A transmission line may be considered as an infinite number of infinitesimally small sections connected end to end the entire cable length. These parameters are always present and are dependent upon the materials and their physical configurations which regulate the electrical performance of the cable.

a. **Shunt Capacitance.** Capacitance by definition is that property of a system of conductors and dielectrics which permit the storage of electricity when potential difference exists between the conductors. Shunt capacitance is directly proportional to a property of the dielectric called dielectric constant.

b. **Series Resistance.** The series resistance is the loop resistance of the center conductor and the outer conductor and is inversely proportional to the area through which the current flows.

c. **Series Inductance.** The series inductance is inductance due to the magnetic flux linkage which is set up by current flow in the conductors. Inductance is the property that opposes change in current flow which causes current changes to lag behind voltage changes.

d. **Shunt Conductance.** The shunt conductance is the amount of conductance between the center conductor and the outer conductor.

12 . **ELECTRICAL INFLUENCES.** There are various other electrical properties which influence the operation of coaxial cables and must be realized as their effect will regulate transmission line usage.

a. **Velocity of Propagation.** The velocity of propagation indicates the speed an electrical signal travels down the length of a cable as compared to the speed of that signal in free space. The velocity may be measured or calculated.

b. **Characteristic Impedance.** The characteristic impedance is when the termination to a transmission line yields the same value of the input impedance. When a cable is terminated in its characteristic impedance all energy transmitted down the line is absorbed in the termination. Any other termination will cause energy to be reflected. A line terminated in its characteristic impedance is then said to be matched.

c. **Attenuation.** All transmission lines and coaxial cables experience losses. These losses termed attenuation decrease the efficiency of the line which in turn limit the power capabilities. This power loss, power drop, or signal loss is expressed in decibels (db).

d. **Voltage Standing Wave Ratio (VSWR).** Whenever a transmission line is terminated in its own characteristic impedance, all energy sent down the line will be absorbed. If the line is terminated in any other impedance energy will be reflected. VSWR is the ratio of the transmitted energy and the reflected energy.

e. **Power Rating.** The maximum RF power a coaxial cable may safely transmit is the power rating, and is influenced by the voltage introduced to the peak power or the thermal heating due to average power.

f. **Power Handling.** The average power handling capacity is determined by the attenuation of the line and the minimum temperature the dielectric and conductor can withstand continuously. Excessive temperatures can result in conductor migration into the dielectric and mechanical damage due to different expansion rates.

13 . **ELECTRICAL REFLECTION.** Reflection is energy that does not reach its intended load which causes increased attenuation, and it is desirable to minimize reflection for several reasons:

a. The reflection can cause echoes that will transmit false information.

b. A high VSWR can exceed the voltage rating of the cable.

c. Conductor maximum temperature can be exceeded.

14 . **REFLECTION CAUSES.** Even though a cable is terminated in its own characteristic impedance, reflection can occur for various reasons.

a. The cable itself can be less than perfect and be nonconforming due to variations in the diameter of the cable core, poor concentricity of the conductor, or variation in the braid.

b. Improper installation can cause reflection as the cable could be damaged by exceeding the bend radius, improper connector assembly, or even improper connection.

15 . **CORONA.** Corona is the ionization of the air that may exist within a coaxial cable and is a continuing problem of transmission lines. The Corona effect increases with altitude, but can be a factor at sea level, if the cable voltage is significantly high. Corona is produced by self-sustained electrical discharges within the cable’s limited air spaces. These limited spaces are normally caused by improper manufacturing techniques and will cause corona to initiate at a much lower voltage than in a properly manufactured cable. Corona simply stated is caused by a difference of potential between the conductors.

a. **Corona Effect.** Corona has three effects on the performance of a coaxial cable in that it will cause premature electrical failure of the dielectric, cause interference with electrical, communication, and measurement systems, and reduce efficiency due to energy loss while power consumption is increased.

b. **Corona Initiation.** Corona initiation is the voltage level necessary to start corona which is a slightly higher voltage than the voltage necessary to sustain corona.

c. **Corona Extinction.** The extinction is the voltage level necessary to stop corona and may be as much as 20% below the initiation voltage. The extinction voltage determines the maximum voltage at which a coaxial cable may operate.

16. **ENVIRONMENTAL EFFECTS.** There are numerous environmental conditions that affect the performance of a RF cable. The typical ones are discussed herein only for information. Determining which cables to use from this information is not recommended (see SAE AS50881).

a. **Temperature.** The effects of temperature, as with any wire or cable, fall into two basic and broad categories; performance degradation and physical deterioration. The degrading effects of temperature can occur at high temperatures as well as low temperatures. The most noticeable change will be in attenuation as this will increase and decrease proportionally with conductor temperature. The permanence and dissipation factor of the dielectric material are comparatively constant over its useful temperature range, and the electrical parameters are virtually independent, other than attenuation, over short periods of temperature fluctuations. Most degrading is attributable to the effects of repeated flexure over wide temperature extremes due to the wide difference in the expansion rates of metal and dielectric material. This can lead to kinking of the cable which causes conductor and dielectric material damage.

(1) Maximum temperature is the ambient temperature plus rise due to power transmission or conductivity. The maximum temperature determines the rate of aging and thermal endurance. Temperature degradation is a function of time in that maximum permissible temperature is higher for a short period of time than that permissible for continuous service.

(2) When cables are operated at high temperatures, then reduced, mechanical fittings can loosen, the corona limit will be reversed, and changes in impedance may be noticed. Cables operated above the upper temperature limits may cause plastic flow and softening which could dislodge mechanical connectors.

(3) Low temperatures, aside from changes in electrical characteristics, tend to make the insulations and dielectrics brittle. When moved, cracks will develop. These cracks, however minute, will continue to degrade even in the normal operating range of temperatures.

b. **Pressure and Humidity.** Variations in pressure and humidity will affect voltage and power ratings of transmission lines and must be considered. To overcome these differentiations and to minimize corrosion some nominal pressurization is employed in almost all rigid and semi rigid air spaced coaxial cables. Without this pressurization corona is more likely to occur as the cables try to obtain pressure equalization. The density of the air also affects the ability of the line to dissipate heat. At sea level virtually all heat is dissipated by convection. This convection is decreased at altitude in rarified atmosphere which will severely change the electrical characteristics. Humidity is of little concern for the cable, as the cable is normally sealed and non–hydroscopic. The connectors however, may collect water and other contaminants. At certain combinations of temperature, humidity, and pressure, condensation will form in and around these connectors causing possible arc-over. In all cases these connectors should be designed to be located to properly drain off water or be protectively sealed.

17. **RADIUS OF BENDS.** The bend radius should be kept as large as possible during storage, handling, and installation so as not to damage the cable. The minimum bend radius shall be such as not to adversely affect the characteristics of the cable.

a. **Flexible Cable.** The bend radius for flexible type cable shall not be less than six times the outside diameter of the cable.

b. **Semi-rigid Cables.** The bend radius for semi-rigid cables shall not be less than ten times the outside diameter of the cable.

c. **Right Angle Fitting.** Wherever and whenever possible, right angle fittings shall be used to eliminate stress caused by sharp bends.

d. **Bend Effects.** The bend radius when exceeded will cause stress to the cable. These stresses not only affect the electrical characteristics but physical properties also. When the cable is stressed, fractures to the dielectric and jacket will occur, and the braid shield may break or loosen which will cause a reduction in the corona level as well as causing erratic attenuation at higher frequencies. The center conductor may also migrate through the dielectric to the outer conductor and eventually short the system. These fractures may not be noticed when the stress occurs but is accelerated greatly by ultraviolet rays of sunlight, and by atmospheric ozone which is increased in the presence of corona.

18. **MILITARY SPECIFICATIONS.**

19. **MIL-C-17 CABLES, RADIO FREQUENCY, FLEXIBLE AND SEMI-RIGID.** This specification covers flexible and semi-rigid cables with solid and semi-solid dielectric cores, with single, dual and twin inner conductors. Cables covered by this specification are primarily intended for use as transmission lines to conduct energy in a simple power transfer continuously or intermittently. In general these cables are designed for low loss stable operation from the relatively low frequencies through the higher frequencies in the microwave and radar regions of the frequency spectrum. Cables may also be used as circuit elements, delay lines, or impedance matching devices.

a. **Part Number.** The MIL-C-17 cable specifications cover numerous types of radio frequency cables each designed with unique characteristics (Figures 1 thru 6). Because of the wide variety, each cable type is defined in individual detailed specification sheets. The part number is as follows:

(1) Example M17/001-00001.

(2) M17: Basic specification describing performance requirements.

(3) /001: Detail specification describing specific configuration and electrical properties of the cable type.

(4) -00001: Dash number, which depicts slight difference in the cable type. There are usually only a few dash numbers, if more than one.

b. **Repair And Replacements.** The RF cable shall be repaired in accordance with WP 015 00. Coaxial cables cannot be partially replaced. Older cables can be replaced with new cables when replaced point to point. See the aircraft CFA for guidance. See MIL-C-17 for old RG part number substitutions.

c. Classification. These transmission lines are classed by the applicable military specifications and cables selected shall meet the requirements of these specifications as follows:

(1) MIL–L–3890/1 Lines RF Transmission (Coaxial, Air Dielectric) 50 ohms.

20. **MIL-DTL-3890 LINES, RADIO FREQUENCY TRANSMISSION (COAXIAL AIR DIELECTRIC).** This specification covers the requirements for radio frequency coaxial or air dielectric lines using copper or aluminum conductors. These transmission lines are used to transmit RF energy in the microwave region of the frequency spectrum.

a. **Part Number.** The MIL-L-3890 part number is as follows:

(1) Example: M3890/1-01010

(2) M3890: Basic specification describing the performance characteristics.

(3) /1: Detail specification defines specific cable details.

(4) -01: First two digits define a specific configuration.

(5) 010: Last three digits define a specific length in inches.

b. **Installation and Repair Sensitivity.** These cables are very sensitive to repair and installation. The electrical performance of the cable changes significantly with slight changes in cable configuration. The most notable effects are as follows:

(1) Bow. The natural bow or flex must not be greater than 1/2 inch between any two points 10 feet apart or electrical degradation will occur.

TABLE 1. MIL-DTL-3890 REPLACEMENT CABLES

RG Cable	M3890/Cable	RG Cable	M3890/1 Cable
RG-151/u	/1-10	RG-154/u	/1-04
-152/u	/1-02	-155/u	/1-08
-153/u	/1-06	-382/u	/1-05

(2) Concentricity. The outer and the inner diameters of the conductors at any cross section must not differ more than 1% from the specified diameter or electrical degradation will occur.

CAUTION

Handle cable with care during repair and installation.

c. **Repair and Replacement.** Cables identified with the RG numbers noted in Table 1 may be replaced with the indicated MIL-L-3890 cables.

21. **MIL–DTL–22931 CABLES, RADIO FREQUENCY, SEMI-RIGID, COAXIAL, SEMI-AIR-DIELECTRIC.** This specification covers semi-air-dielectric, coaxial, semi-rigid radio frequency cables with smooth, corrugated, or braided outer conductors. The diameter range is 1/2 to 3 1/4 inches with an impedance of 50 or 75 ohms operating within -67°F to +176°F (-55°C to +80°C) or -67°F to 392°F (-55°C to +200°C). These cables are intended for use in communications equipment.

a. **Part Number**. The MIL–DTL–22931 part number is as follows:

(1) Example: M22931/11-001

(2) M22931: Basic specification describing the performance characteristics.

(3) /11: Detail specification defining the specific cable details.

(4) -001: Defines cable configuration.

NOTE

The cable shall be repaired in accordance with WP 014 00. Cables identified with the RG numbers noted in Table 2 may be replaced with the indicated MIL–DTL–22931 cables.

22. **MIL-C-23806 CABLES, RADIO FREQUENCY, COAXIAL, SEMI-RIGID, FOAM DIELECTRIC.** MIL-C-23806 cables are foam dielectric coaxial cables with a smooth outer conductor. The cables may be jacketed or unjacketed with a nominal diameter size of 1/2 or 7/8 inches. The cable impedance is 50 or 75 ohms. Foam dielectric cables are noted for their low loss characteristics. Attenuation loss in a foam dielectric cable normally is not quite as low as that in an air dielectric cable especially at higher frequencies (see MIL–DTL–22931 and MIL-DTL-3890), but is approximately 15 percent lower than the attenuation in a solid polyethylene dielectric cable of a corresponding size (see MIL-C-17). The average power rating of foam cable (as limited by temperature rise) is between solid polyethylene (which has a lower power rating) and air dielectric (which has a higher power rating) for corresponding cable sizes. Even though foam cables have a greater attenuation loss than corresponding air dielectric cable, the foam cable has one major advantage in that it does not have to be pressurized with dry air or nitrogen.

a. **Part Number.** The MIL-C-23806 part number is as follows:

(1) Example: RG-231/u

(2) RG: Basic cable description which when combined with the remaining parts of the part number (-231/u) determines which detail MIL-C-23806 specification is applicable. For example RG-231/u refers to MIL-C-23806/1. The detail specifications tie the particular RG cable to the basic specification MIL-C-23806.

(3) -231: Basic Cable Design. Digits are three numerical number with or with out a fourth alphabetical

character; (A, B, C, etc.) which indicates a modification of the basic design.

(4) /u: Basic cable classification indicator. The designation “/u” indicates a general utility cable for airborne, shipboard, and ground applications.

b. **Repair and Replacement.** The cable shall be repaired in accordance with WP 015 00. There are no cables that can replace MIL-C-23608 cables.

c. **RG Part Substitutions.** The old RG cables are being replaced by military specification part numbers as needed. The RG cables listed in Table 1 and 2 may not be the only RG cables that may be substituted. When an RG cable is specified, review the appropriate military cable specification for substitution or contact the aircraft CFA for support.

TABLE 2. MIL–DTL–22931 REPLACEMENT CABLE

RG Cable	M22931/Cable	RG Cable	M22931/1 Cable
RG-197/u	/11-001	RG-252/u	/8-003
-232/u	/11-002	-253/u	/8-004
-233/u	/13-001	-254/u	/11-003
-234/u	/15-001	-255/u	/11-004
-236/u	/9-001	-257/u	/13-003
-237/u	/9-002	-258/u	/13-004
-240/u	/13-002	-269A/u	/11-005
-242/u	/15-002	-270/u	/13-005
-244/u	/10-001	-285/u	/17-001
-245/u	/10-002	-318/u	/11-006
-246/u	/12-001	-319A/u	/13-006
-247/u	/12-002	-321/u	/15-003
-248/u	/14-001	-322/u	/15-004
-249/u	/14-002	-378/u	/l3-007
-250/u	/16-001		
-251/u	/16-002		

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FLAT (RIBBON) CABLE AND ASSEMBLIES

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRICAL AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

None

Material Required

None

1 . **INTRODUCTION.**

2 . This work package (WP) describes the various types, names, construction, application, termination, and applicable military specifications of flat flexible cable. The term or description flat flexible cable will bring several thoughts and varied images to mind. Synonymously called ribbon, tape, printed, laminated, calendered, etched, contoured, and woven, these names have been derived from the process of manufacture, construction, application or appearance. Flat flexible cables have certain physical and electrical characteristics which make them especially suited to particular requirements. However, as with conventional round cables, they have disadvantages as well as their many advantages.

3 . **FLAT CABLE (RIBBON).**

4 . A flat cable (ribbon) is two or more parallel twisted, round conductors, placed in the same plane, and held together by an insulating material (Figure 1). The conductors are insulated individually then bonded (Figure 2) or woven together (Figure 3). A flat cable assembly can generally be viewed as a multiconductor flat cable (ribbon) with all conductor ends terminated. In most cases the conductors will end in groups attached to a connector or termination bus. The cable and cable assemblies discussed herein will be limited to a laminated, flat conductor ribbon cable which will be referred to as a laminated ribbon cable, a bonded, round conductor ribbon cable which will be referred to as a bonded ribbon cable, and a woven, round conductor, ribbon cable which will be referred to as a woven ribbon cable.

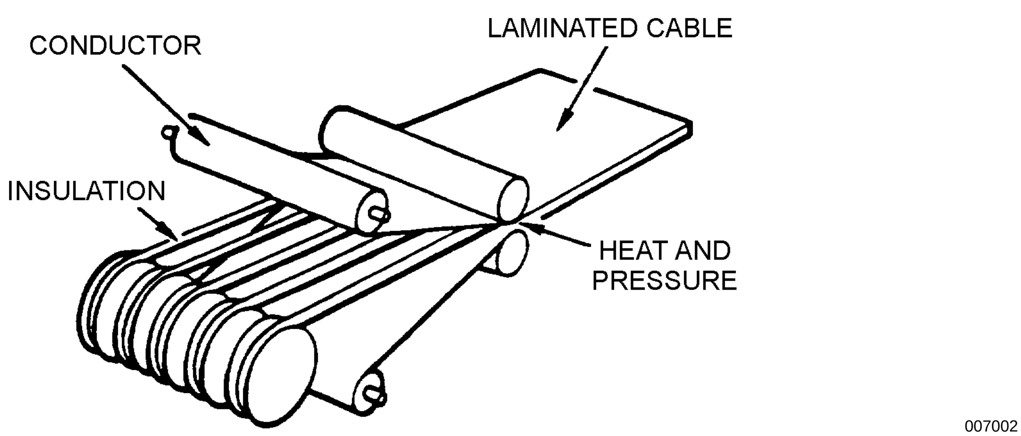

Figure 1. Laminated, Flat Conductor Ribbon Construction

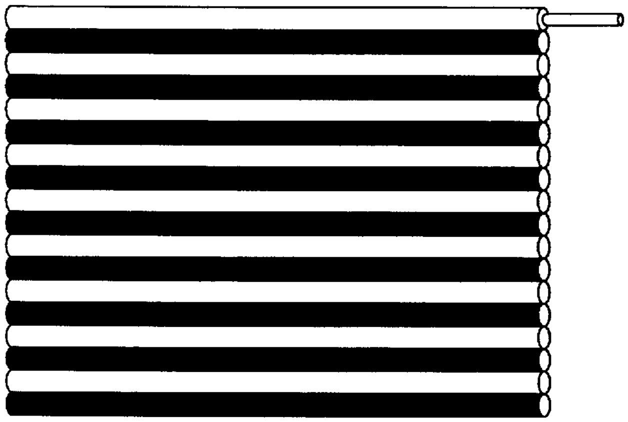

Figure 2. Bonded Ribbon Cable

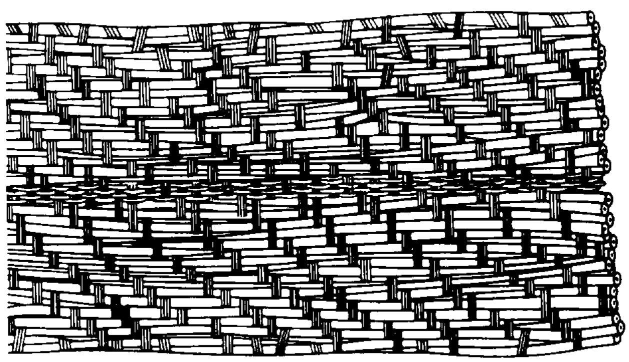

Figure 3. Woven Ribbon Cable

5. FLAT CABLE CONFIGURATIONS.

6. **RIBBON CONFIGURATION.** There are several common terms used in the construction and handling of flat cable that are not common to conventional round cables (Figure 4).

a. **Pitch.** The pitch of a ribbon cable is the center to center distance between adjacent conductors.

b. **Spacing.** The spacing is the distance between the closest edges of adjacent conductors.

c. **Span.** Conductor span is the center to center distance between the first and last conductor.

d. **Caliper.** The caliper is the overall thickness.

e. **Width.** The width is the overall edge to edge distance.

f. **Reference Edge.** The reference edge is most important as this indicates the first or number one conductor, which is closest to this reference edge. The reference edge is usually signified by a thread, stripe, printing, or some other identifying mark such as the part number.

7. **ADVANTAGES.** The conductor placement in ribbon cable offers superior and constant electrical and physical characteristics which make it a desirable choice in electronic interconnection. This along with several other advantages make flat ribbon more desirable on an increasing basis.

a. **Space Saving.** Ribbon cable can fit virtually all applications providing up to 70% space savings over conventional round wire.

b. **Weight Saving.** Ribbon cable may use thinner insulation due to its stable electrical characteristics, and the integrated structure increases strength without increasing conductor size. Therefore a weight savings of up to 80% can be realized over conventional round cable.

c. **Reliability.** Due to the low tolerance fixed conductor spacing, consistent electrical characteristics, increased heat dissipation, and superior abrasion resistance, reliability is increased.

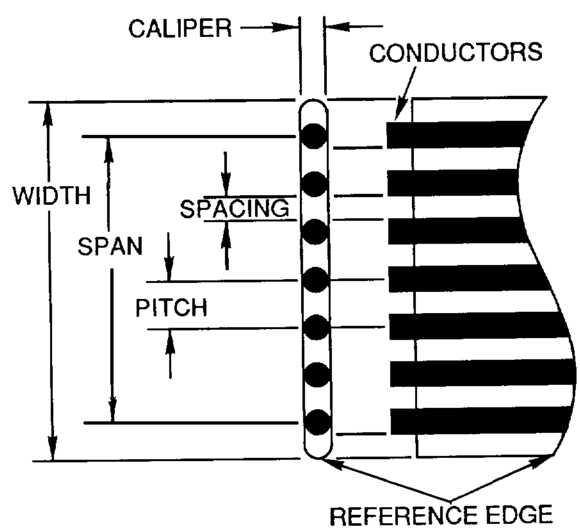

Figure 4. Ribbon Cable Configuration

d. **Elimination of Errors.** Ribbon cable maintains wires in sequence making identification of individual wires easy. Circuit tracing, inspection, troubleshooting, and installation time is easier and less time consuming as is termination.

8 . **BONDED RIBBON CABLE.** Bonded ribbon is a cable that is manufactured by bonding the individually insulated conductors together in a parallel configuration on a flat plane.

a. **CONSTRUCTION.** Bonded ribbon cable is normally constructed using conventionally insulated conductors laid up in a parallel configuration on a flat plane. The individual conductors are then heat or adhesive bonded to form a flat ribbon. The insulated conductors are laid in a closing die which aligns them. Adhesive is applied in a dip and wipe process, and cured in a continuous oven. Heat sealing may also be used where the closing die is heated and closing and bonding are accomplished together.

b. **CONDUCTOR MATERIALS.** Conductors are stranded either bare copper, or coated tin, silver or nickel depending upon the need and application. Size and conductor, design, and wire spacing are determined by the applicable specification.

c. **INSULATION MATERIALS.** Nearly any insulation that meets military specifications may be used.

d. **TERMINATION.** Termination is easily accomplished using conventional methods and tools. The individual conductors can be separated by slitting the bonding and separating to the desired depth. Once lead exposure is obtained standard stripping procedures can be used (WP 009 00).

e. **ADVANTAGES.** The most advantageous feature is that a wide selection of conductor, insulation, and configurations are available. The electrical characteristics remain constant, and conventional tools can be utilized.

9 . **WOVEN RIBBON CABLE.** Woven ribbon cable is normally manufactured by weaving the individually insulated conductors in a parallel configuration on a flat plane using a fabric insulation to maintain wire placement.

a. **CONSTRUCTION.** Woven cable has a unique form of ribbon construction in that the flat laid parallel conductors are held in place by weaving textile threads about them. Twill weave and plain weave are used.

(1) **Plain Weave.** The plain weave uses a filling thread and two warp threads woven mechanically to maintain conductor placement. A typical plain weave is illustrated (Figure 5).

(2) **Twill Weave.** The twill weave is accomplished on the same type loom except the components are woven in a two up, two down alternating pattern (Figure 6).

b. **MATERIALS.** The same materials that are used in bonded cable are also used in woven cable as to conductor and individual insulation. The weaving materials are limited only by the general limitations of the textile and weaving techniques.

c. **TERMINATION.** Lead exposure is accomplished by securing the weave by tape, shrinkable band, or spray seal to the depth required. The weave may then be removed by pulling out the fill thread. When proper lead exposure is obtained the individual conductors may be prepared and terminated with conventional devices (WP 009 00).

d. **CHARACTERISTICS.** The characteristics are essentially identical to bonded cable, but with certain advantages. Conductor separation is more easily accomplished without conductor damage. Natural folding points can be woven in as well as increased mechanical protection and strain relief.

e. **ADVANTAGES.** The woven ribbon has all the advantages of both the laminated ribbon or bonded ribbon. Because of these advantages the woven cable is the preferred method for Ribbonized, Organized, Integrated (ROI) electrical system cable assemblies (see WP 011 02).

10 . **IWS CABLE ASSEMBLY.** The Integrated Wiring System cable assembly is being used extensively for aircraft modifications. Whenever possible, the IWS cable permits the aircraft wiring system to be modularly divided by Wiring Integration Units (WIU's). A WIU

permits complex assemblies such as spider or spaghetti cable assemblies to be modularized thus easy to repair. IWS cable assemblies are repaired in accordance with WP 011 02.

11 . **SPECIFICATIONS.**

12 . **MIL–DTL–49055 CABLES, POWER ELECTRICAL (FLEXIBLE, FLAT, UNSHIELDED), (ROUND CONDUCTOR).** This specification covers flexible, flat, unshielded electrical cables with either solid or stranded round conductors. These cables are suitable for use in aerospace, ground, and shipboard applications where minimum size, weight, and space is desired. These cables are products which are qualified for listing on the applicable qualified products list (QPL).

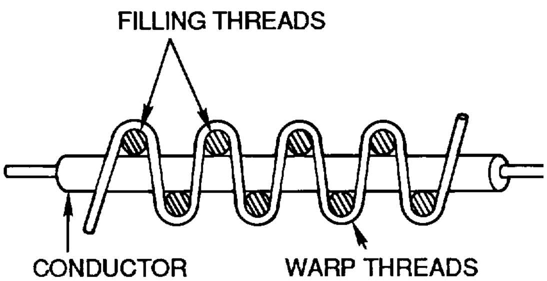

Figure 5. Plain Weave

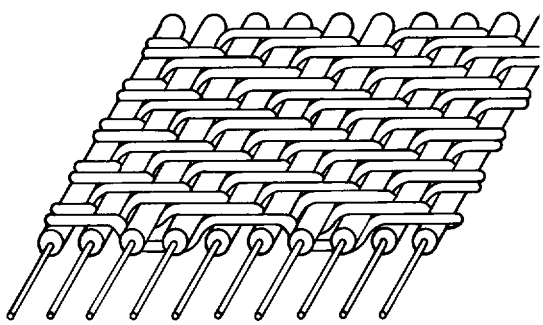

Figure 6. Twill Weave Cable

a. **Classification.** The general specification covers the basic specification for testing and materials. Cables selected shall meet the requirements of the applicable specification.

(1) MIL–DTL–49055/1. This specification covers cables with wire size 26, 7/34 or 28, 7/36 stranding.

(2) MIL–DTL–49055/11. This specification covers cables operating at 302°F (150°C).

(3) MIL–DTL–49055/12. This specification covers cables operating at 392°F (200°C).

b. **Conductors.** The conductors are of stranded copper either bare or coated with tin, silver, or nickel. The stranded conductors are either concentric-unilay or concentric (WP 004 00). The size of the conductor, design, and wire spacing are all determined by the applicable specification.

c. **Insulation.** All insulation shall be easily removed with conventional stripping devices without damage to the conductor or to other conductors. Polyvinyl Chloride (PVC) insulated wire shall not be used on any aerospace vehicle for new installation and repair.

d. **Marking.** Unless otherwise specified cables are marked with a contrasting print along the reference edge at not greater than 12 inch increments. The marking consists of the military part number along with code, name, symbol, and date (Figure 7).

e. **Part Number.** The MIL–DTL–49055 part number is as follows:

(1) Example: M49055/01-01

(2) M49055: Basic specification defining the cables performance characteristics.

(3) /01: Detail specification defining the cable construction.

(4) -01: Defines the number of conductors in the cable. See the specification for details.

f. **Intended Use.** MIL–DTL–49055 cables are suitable for use in aerospace, ground, and shipboard applications where minimum size, weight and space is needed.

13 . **REPAIR AND TERMINATION.** For the repair and termination of flat cable, refer to WP 015 00 and WP 011 02.

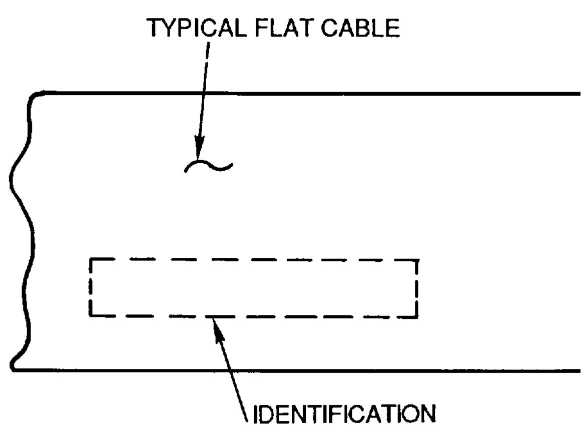

Figure 7. Marking Location MIL–DTL–49055 Cable

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WIRE, CABLE, AND HARNESS MARKING

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRICAL AND ELECTRONIC WIRING

Reference Material

Heating Tools 012 00
Wiring Aerospace Vehicle (previously MIL–W–5088) . . . . SAE AS50881

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

None

1. **INTRODUCTION.**

2. This work package (WP) describes the repair and location of military aircraft circuit identification marking sleeves for cables, wires, and harnesses. Continuous printing of the circuit identification at about three inch intervals is typically required on all cables and wires for the original wiring installation, but marking sleeves are permitted for Organization and Intermediate level maintenance. Depot level wiring maintenance and modifications shall be identified in accordance with SAE AS50881. The purpose of this work package is to describe when and how these sleeves may be used, even though continuous printing on the wiring may have been provided as part of the original wiring installation.

3. Each cable, wire, and harness must be marked with circuit identification codes. The circuit identification codes are defined in SAE AS50881 (previously MIL-W-5088). There are two circuit identification code systems, significant and non-significant. Both the non-significant and significant code systems are described herein for only informational purposes. Circuit identification codes shall always be in accordance with the original aircraft requirements.

NOTE

Proper circuit identification is essential for future maintenance of the aircraft electrical system.

4. **SIGNIFICANT IDENTIFICATION CODES.**

5. Wire identification is significant when it indicates the Electromagnetic Environmental Effects (E^3) classification and circuit function. E^3 classification is indicated by a letter identification code that identifies the E3 category for each wire or cable. Electromagnetic classification codes may vary with aircraft type and may be located at the beginning or end of the circuit identification code. Typical Electromagnetic codes are provided in Table 1.

a. Circuit function is indicated with an equipment identification code (Figure 1).

b. Circuit function is also indicated by circuit function letter (Figure 2).

Table 1. E^3 CLASSIFICATION CATEGORY

E^3 Classification Letter	E^3 Category
X	Wires and cables which are used for special purposes such as pulsed circuits, low level signal circuits, RF-power circuits where interference may vitally effect operation.
E	Wires and cables which emit interference.
P	Wires and cables which carry electrical power.
S	Wires and cables which may be susceptible to interference.
Y	Wires and cables which are passive with respect to Electro Magnetic Compatibility (EMC), in that they do not emit and are not susceptible to interference.

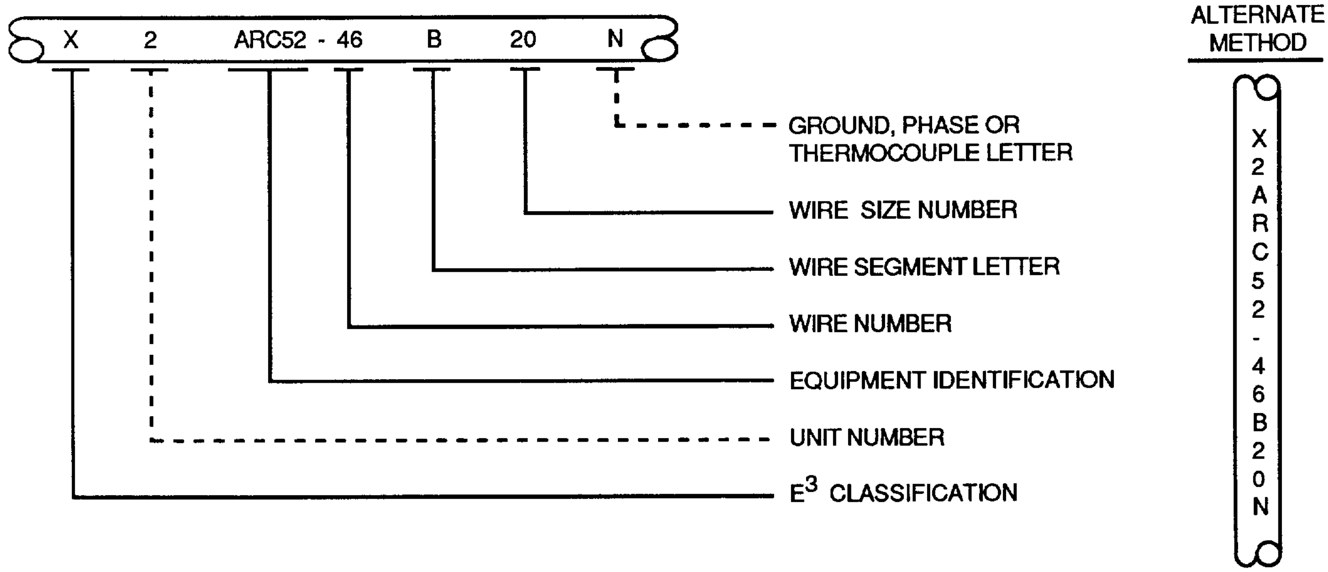


Figure 1. Wire Identification Coding (Circuit Function Letters R, S, T and Y)

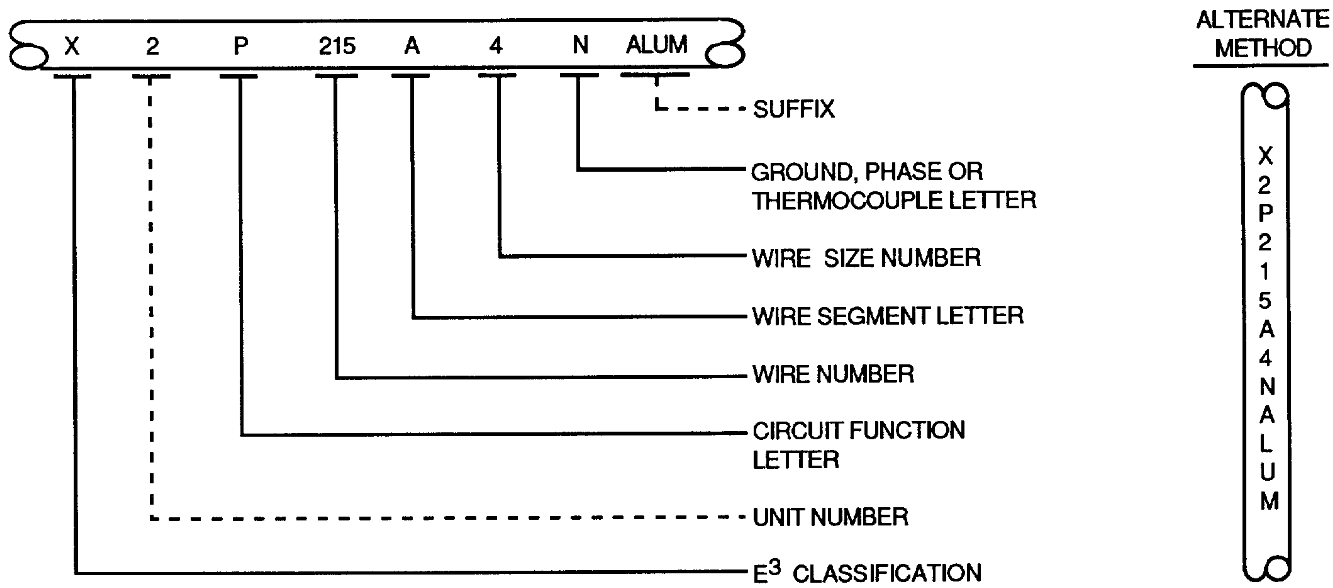


Figure 2. Wire Identification Coding (Except Circuit Function Letters R, S, T and Y)

NOTE

Refer to Table 2 circuit function letters R, S, T and Y for examples of equipment identified by the equipment identification code.

6. **EQUIPMENT IDENTIFICATION CODE.** The equipment identification code is the portion of AN nomenclature following the /, but excluding the hyphen and suffix letters. For example, wires of an AN/APS-45 will be identified APS45, those of AN/ARC-52A will be ARC52 and those wires of MX94 will be MX94. These codes are used to identify the following equipment (Figure 1):

a. Radio (Navigational and Communication)

b. Radar (Pulse Technique)

c. Special Electronics

d. Armament Special Equipment

7. **CIRCUIT FUNCTION LETTER.** Letters are used to identify the circuit function (except letters R, S, T and Y) specified in Table 2 (Figure 2).

a. A wire used for more than one circuit function will be identified with the functionally predominant circuit function letter. When functional predominance is questionable, the wire with the lowest wire number (Paragraph 9) will be used.

Table 2. CIRCUIT FUNCTION LETTERS

Circuit Function Letter	Circuit	Examples
A	Armament	Stores Management System Missiles/Rockets Gun Chemical
B	Photographic	Camera Camera Doors Camera Heating
C	Control Surface	Flight Control Automatic Pilot Hydraulic System Wing Sweep Trim Control Airbrakes
D	Instrument (other than flight or engine instruments)	Position Indicator Pressure Gage Temperature Gage Clock
E	Engine Instrument	Temperature Gage Pressure Gage Quantity meter Flow Meter Tachometer Power Indicator Nozzle Indicator

Table 2. CIRCUIT FUNCTION LETTERS (Cont.)

Circuit Function Letter	Circuit	Examples
F	Flight Instrument	Gyroscopic Instrument Attitude Indicator Compass Altitude Heads Up Display
G	Landing Gear Wing folding	Extension and Retraction Braking Locking Steering Anti-Skid Arrestor Hook Utility Hydraulics
H	Heating Ventilating and De-icing	Heating De-icing Cabin conditioning Galley Equipment Bay Cooling
I	In order to avoid confusion with the numeral one, the letter I shall not be used for circuit or cable identification.	
J	Ignition	Engine Ignition Jet assisted Take-off
K	Engine Control	Vent and Flap Propeller Control Engine Starting Carburetor Supercharging Power Control Nozzle Control Thrust Reverser
L	Lighting (Illumination)	Internal External
M	Miscellaneous (electrical)	Windshield wiper & spray Door Hoist and winch Position (seat and pedal) Cigarette lighter Auxiliary Power Unit Emergency Power Unit
N	Unassigned	
O	In order to avoid confusion with the numeral zero, the letter O shall not be used for circuit or cable identification.	

Table 2. CIRCUIT FUNCTION LETTERS (Cont.)

Circuit Function Letter	Circuit	Examples
P	DC Power	Generation Distribution Battery Rectifier External Power
Q	Fuel and Oil	Valves Pumps Refueling/Defueling Transfer Dump
R	Radio (Navigational and Communication)	Instrument landing Homing Liaison Marker Beacon VHF Radio UHF Radio HF Radio Intercommunication Direction Finding
S	Radar (Pulse Technique)	Radar Altimeter Interception Gun aiming Mapping Navigation Bomb aiming Search Recognition (IFF) Terrain Following
T	Special Electronics	Active Electronic Countermeasures Inertial Navigation Television Reconnaissance Computer Weapon Aiming Chaff Dispensing Infra-Red
U	Miscellaneous (electronic)	Electronic Wiring for which the R, S, or T identification is not applicable shall be assigned the circuit function letter U. An example would be common leads to electronic equipments and systems, interconnection wiring, such as antenna or power circuits common to more than one equipment.
V	Both DC power cables and DC control cables for AC systems shall be identified by the circuit function letter V.	
W	Warning and Emergency (except those listed under other circuits functions)	Bail-out alarm Oxygen indicator Passenger sign Central/Master warning

Table 2. CIRCUIT FUNCTION LETTERS (Cont.)

Circuit Function Letter	Circuit	Examples
X	AC Power	Generation Distribution External Power
Y	Armament Special Equipment (except those listed under circuit function A)	
Z	Experimental Circuits	When flight test and experimental research wiring is installed, the appropriate Circuit Function Letter shall be used, preceded by the letter Z. When any such circuit has been adopted and becomes part of a standard installation, the letter Z shall be removed.

8 . **UNIT NUMBER.** Unit numbers are used where two or more identical items of equipment are installed in the same vehicle. The unit numbers 1, 2, 3 etc. are used to differentiate between wires when it is desired that the equipment have the same basic identification (Figures l and 2).

a. Identical wiring located in left and right wings, nacelles, and major interchangeable structural assemblies may have identical identification and the unit number is not required.

9 . **WIRE NUMBER.** The wire number is used to differentiate between wires in a circuit (Figures 1 and 2).

a. Wires with the same circuit function having a common terminal connection or junction shall have the same wire number, but different wire segment letters (paragraph 10). A different number shall be used for wires not having a common terminal or connection.

b. Each wire will be assigned one or more digits number. As far as practicable the numbers assigned will be in numerical sequence.

c. Numbers 2000 to 4999 inclusive shall be reserved. They are used to identify wires installed by service modifications.

10 . **WIRE SEGMENT LETTER.** A wire segment is a conductor between two terminals or connections. The wire segment letter is used to differentiate between conductor segments in a particular circuit. A different letter shall be used for wire segments having a common terminal or connection. Two permanently spliced wires do not require separate segment letters if the splice is used for modification or repair (Figures 1 and 2).

a. Wire segments shall be lettered in alphabetical sequence and the letter A should identify the first segment of each circuit starting at the power source.

b. If a circuit contains only one wire segment, the wire segment shall be marked A. The letters I and O shall not be used as segment letters. Double letters AA, AB, AC, etc., will be used when more than 24 segments are required.

11 . **WIRE SIZE NUMBER.** The wire size number identifies the size of the wire or cable. Coaxial cables do not have a wire size number. Thermocouple wires use a dash (-) in place of a wire size number (Figures 1 and 2).

12 . **GROUND LETTER.** Any wire (unless otherwise specified) completing a circuit to the ground network of the aircraft electrical system without circuit malfunction will use the ground cable letter N as the wire identification code suffix. The N suffix will also identify all interconnecting ground leads in critical and sensitive electronic systems (Figures 1 and 2).

13 . **PHASE LETTER.** Phase letters are used as a suffix to identify the phase of wires in the three phase power distribution wiring of AC systems (Figure 3 [b] and [c]). The letters A, B, and C will be used to indicate the phase sequence corresponding to T_1, T_2, and T_3 respectively. T_2 will be considered as the grounded phase for grounded delta systems and the wire will be identified with a letter N suffix (Figures 1 and 2).

a. The ungrounded wire on a single phase system will be identified with a letter V suffix (Figure 3 [a]).

14 . **THERMOCOUPLE LETTER.** Thermocouple letters are used as a suffix to identify the thermocouple material. Two letter suffixes are used where space considerations dictate (Figures 1 and 2). The following thermocouple letter suffixes shall be used as applicable:

Preferred Suffix	Material	2 Letter Suffix (Where space considerations dictate)
a. CHROM	Nickel–Nickel Chromium	CR
b. ALML	Nickel–Aluminum/Silicon	AL
c. IRON	Iron	FE
d. CONST	Constantan	CN
e. COP	Copper	CU

15 . **ALUMINUM WIRE IDENTIFIER.** The letters ALUMINUM or ALUM will be added to the wire identification code of aluminum wire (Figure 2).

16 . **SPARE CONTACTS IDENTIFICATION.** Wires attached to spare contacts will be identified by the contact designation.

17 . **HARNESS LETTER.** Each harness will be identified with the letter W and a distinct numerical suffix. Examples W-1, W-2, W-3, etc.

18 . **NON-SIGNIFICANT IDENTIFICATION (Figure 4).**

19 . Non-significant identification does not indicate circuit function and is unique. Each wire in a harness has a unique alpha-numeric identification. The alpha-numeric codes distinguish it from all other identification codes and consists of the following:

a. Wire harness class letter

b. Wire harness number identifier

c. Wire identifier

d. Wire gage number

e. Wire color code (where applicable)

f. Thermocouple wire code (where applicable)

g. Shield code (where applicable)

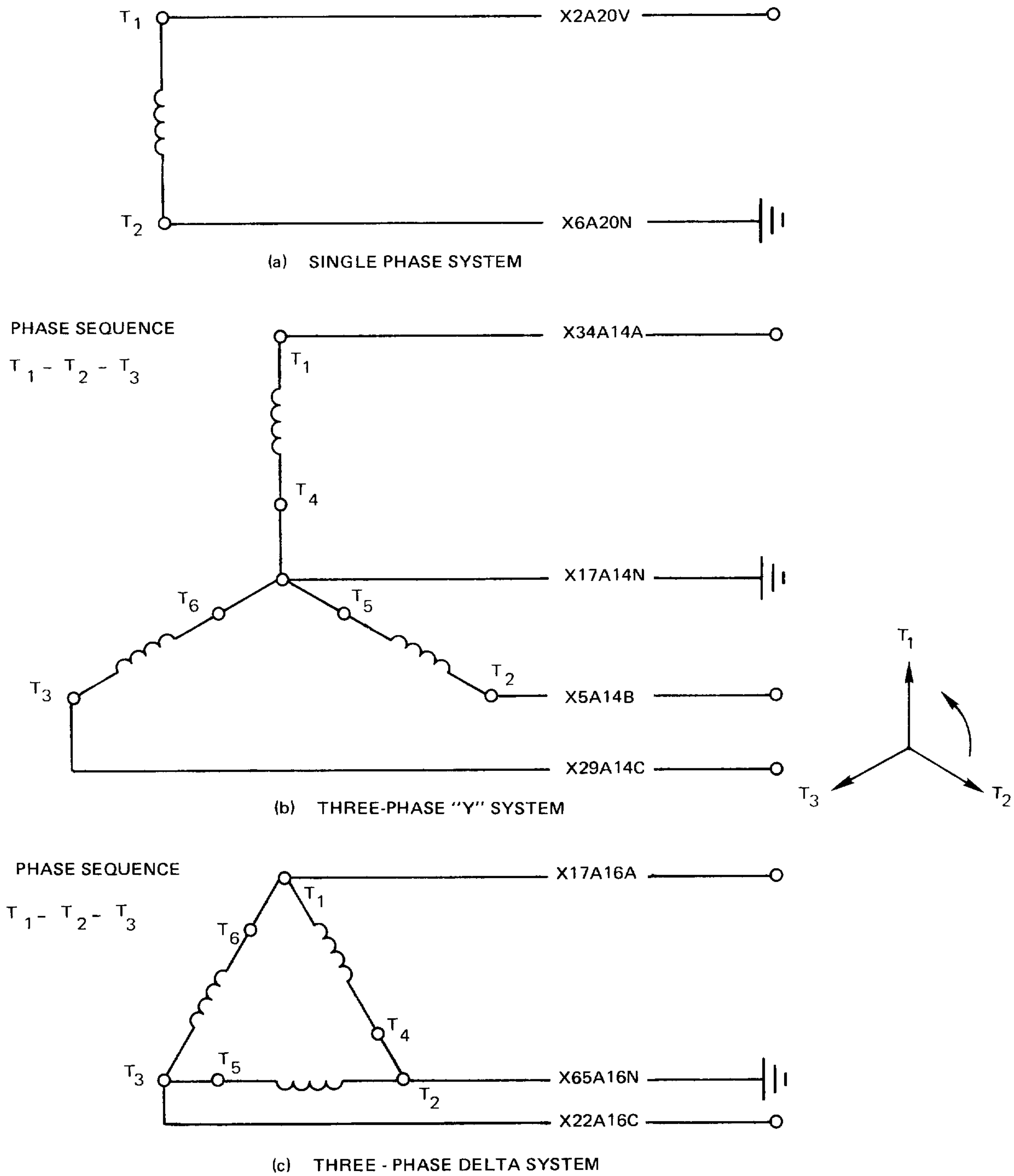
20 . **WIRE HARNESS CLASS LETTER.** Each harness will be identified by the class letter W (Figure 4).

21 . **WIRE HARNESS NUMBER IDENTIFIER.** The number identifier has no more than four digits. Always follows the wire harness class letter (Figure 4).

22 . **WIRE IDENTIFIER.** The identifier distinguishes each wire from all others within a harness. Has no more than four digits (Figure 4).

a. Wires joined by splices are required to have wire to wire continuity of the wire identifier. Harness to harness continuity of the wire identifier is not required, however it is desirable.

b. Wire identifiers 900 to 999 and 9000 to 9999 inclusive are reserved to identify wires installed by service modifications.



(FOR INVERTERS HAVING CONNECTORS WITH PHASE ROTATION C-B-A AT THE PINS, THE CORRESPONDING TERMINAL DESIGNATIONS ARE T1 - T2 - T3 AND THE WIRE IDENTIFICATION PHASE LETTERS SHOULD BE CONSISTENT WITH FIGURE (c) ABOVE.)

Figure 3. Wire Identification for AC Power Wiring

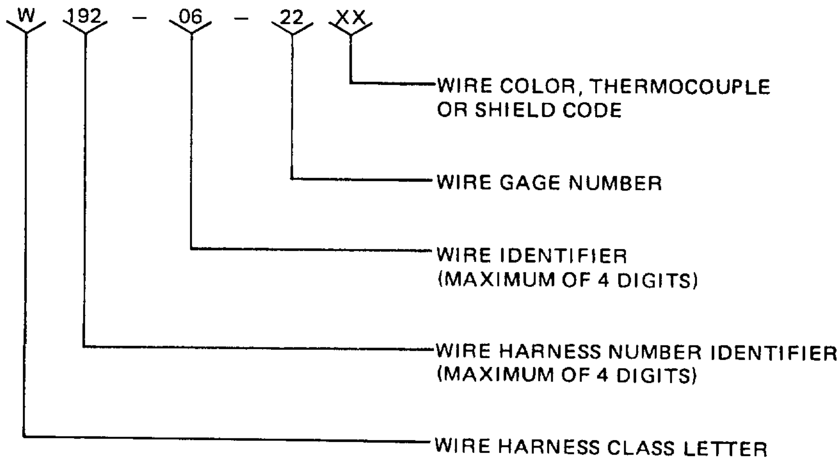


Figure 4. Identification Code Categories For Wire Number W192-06-22XX

23 . **WIRE GAGE NUMBER.** The wire gage number identifies the wire size. The wire gage number may be omitted from coaxial cable and thermocouple wire identification (Figure 4).

24 . **THERMOCOUPLE WIRE CODES.** Use the following letter codes to identify thermocouple wire (Figure 4):

Material	Code
a. Nickel–Nickel Chromium	CR
b. Nickel–Aluminum/Silicon	AL
c. Iron	FE
d. Constantan	CN
e. Copper	CU

25 . **COLOR-CODED CABLE.** Jacketed, shielded or twisted cable consisting of two or more wires which are color coded by single stripes, bands, or solid colors shall be assigned the same wire identifier. The color shall be identified by using the following two letter code following the wire gage number (Figure 4).

Color	Code
Black	BK
Brown	BR
Red	RD
Orange	OR
Yellow	YE
Green	GN
Blue	BL
Violet	VT
Gray	GY
White	WH
Pink	PK

26 . **SHIELD IDENTIFIERS.** Shielded cable having common wire identifiers will be assigned the same letters as the conductors in (paragraph 24). Shields over harnesses or over groups of wires having different wire identifiers assigned in accordance with paragraph 21 shall be assigned separate wire identifiers. The suffix SH will follow the wire-identifier (Figure 4).

27 . **ALUMINUM WIRE IDENTIFIER.** The letters ALUMN (AM if use of ALUMN exceeds 15 characters)

will be added to the wire identification code of aluminum wire.

28 . **WIRE AND CABLE MARKING.**

29 . Unless otherwise specified in the maintenance manual of the aircraft being serviced, the circuit identification codes shall be printed on sleeves or tags and installed during repair or replacement of the wire, cable, or harness as indicated herein.

NOTE

The marking shall not be used as an electrical insulation device, and is not needed, if correct circuit identification is still present on the wire or cable.

30 . **MARKING METHODS.** The two methods of marking wire and cables are as follows:

a. Direct Marking. Direct marking is accomplished by printing the wire or cables outer covering. Direct marking shall be identified at intervals not longer than 3 inches along the entire length or wire or cable.

b. Indirect Marking. Indirect marking is accomplished by printing a heat shrinkable sleeve and installing the printed sleeve on the wire or cables outer covering. Indirect marked wire or cable shall be identified with printed sleeves after the last clamp and within 12 inches of the cable termination and at intervals specified in paragraph 31.

31 . **INDIRECT MARKER INDENTIFICATION LOCATION.** Wire, cable and harness marking locations shall be as follows:

a. Each individual wire not in a cable shall have a circuit identification code printed on a marker in the fashion specified herein. Each wire shall have a marker after the last clamp and within 12 inches of the termination point. Markers shall also be provided at intervals of three feet throughout the length of the wire. Wires less than 6 inches long need not be marked unless previously marked prior to repair. In some cases wire may be continuously marked with one circuit identification and the markers marked with another. For repair purposes, the marker information should always take presence.

b. Each cable circuit identification code (and individual wire color, where applicable) shall be printed on a marker in the fashion specified herein. Each marker shall be placed externally to the outer covering of the cable after the last clamp and within 12 inches of the cable termination. Markers shall also be provided at intervals not greater than three feet apart on the length of the cable.

c. Each harness code, when required, shall be printed on a marker in the fashion specified herein. The marker shall encompass all wires, cables, and harness jacket (if applicable). The marker shall be located at the ends of each major breakout and at intervals of three to four feet throughout the harness.

WARNING

Continuous printing methods such as Inkjet and Laser Marking require specific Quality Control requirements not included herein.

WARNING

Hotstamp marking directly on the wire or cable is not authorized for any application.

32 . **MARKING METHOD.** The marking method described herein is not the only method available for circuit identification marking, but is the one most commonly used and has been proven to meet military aircraft environmental requirements. The methods described herein is the BRADY marker System.

33 . **BRADY WIRE MARKING SYSTEM.**

34 . **DESCRIPTION OF PRINTER.** The Bradymarker XC Plus Printer (BMXC-Plus) is a portable, self-contained dot matrix label/sleeve printing system (Figure 5)

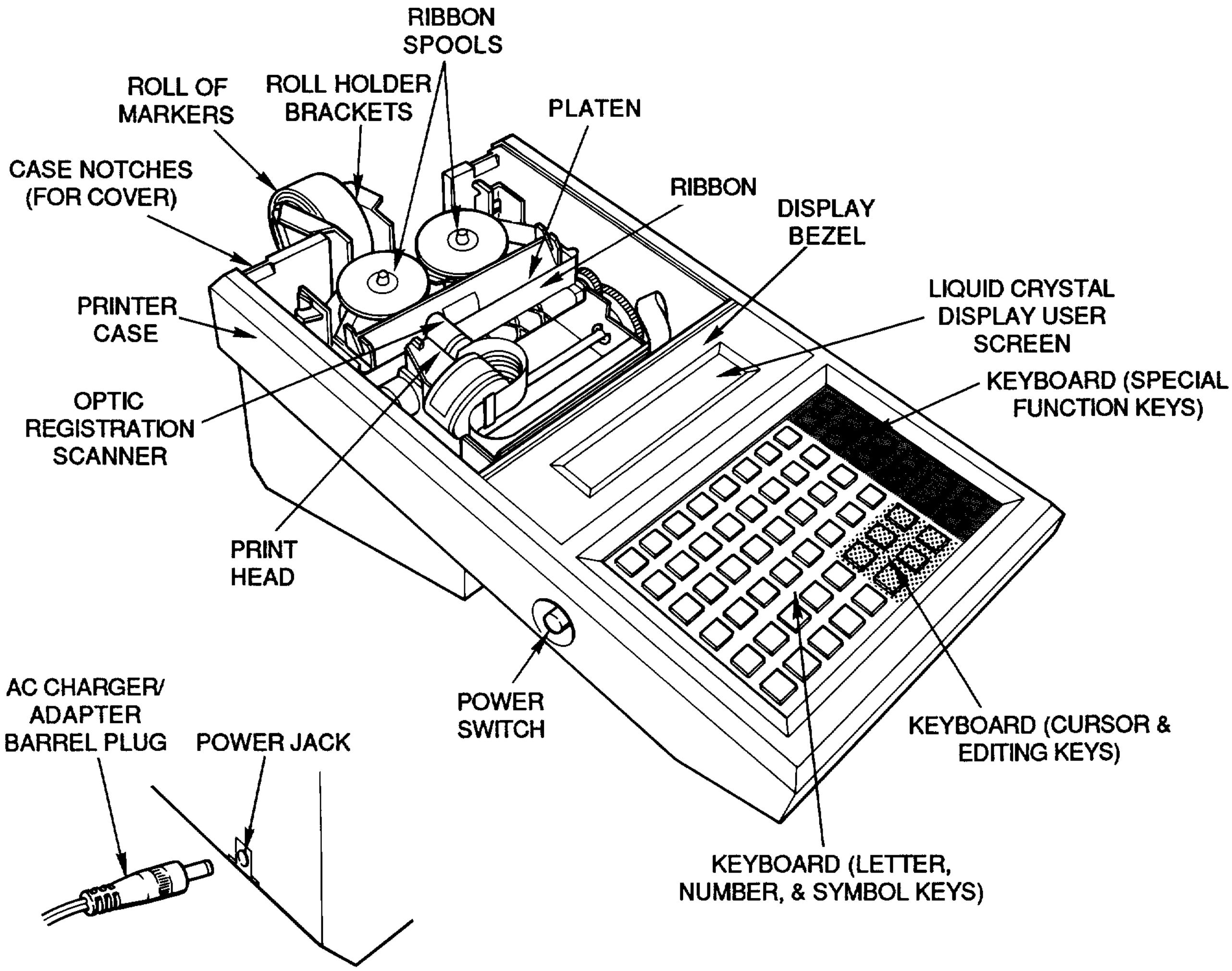


Figure 5. Bradymarker XC Plus Printer.

35 . **PRINTER FEATURES.** The BMXC-Plus printer has important features designed to eliminate errors and save valuable time. These features are as follows:

a. The printer can automatically serialize markers.

b. The printer can store and reprint lists of commonly used markers.

c. The printer has an automatic alignment system that ensures that the printing is always on the mark.

d. The printer can operate on 120V AC power or a rechargeable power pack.

e. The printer has a 2-line LED screen to review data before printing.

f. The printer can display menus for the more advanced features of the printer.

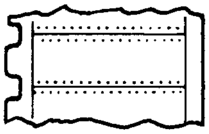


Figure 6. Bradysleeve Wire Marking Sleeve

NOTE

If the BMXC-Plus printer will be used to print sleeves markers for wires with an outside diameter less than .080 inch, the factory installed 1/16 inch drive option is required.

36 . **DESCRIPTION OF SLEEVE.** The sleeving is a self-extinguishing, heat-shrinkable, flat profile polyolefin sleeve specially designed for use in the BMXC-Plus printer. The sleeving has a 2:1 shrink ratio, a shrink temperature of 300°F (150°C), and a service temperature rating of -40°F to 221°F (-40°C to 105°) (Figure 6)

37 . The BMXC-Plus uses a special permanent ink ribbon, part number R2100. The ink in this ribbon is absorbed into the special printable topcoat of the sleeve to provide a permanent, durable legend without any post printing process.

38 . **MARKING SLEEVE SELECTION.** The outside diameter (OD) determines the sleeve to be used with this system (Table 3)

39 . **OPERATING PROCEDURES.** To operate the BMXC-Plus, proceed as follows:

a. Ribbon Installation.

(1) Ensure battery pack is fully charged, or printer is connected to 120V AC power source.

(2) Install R2100 ribbon (Figure 7).

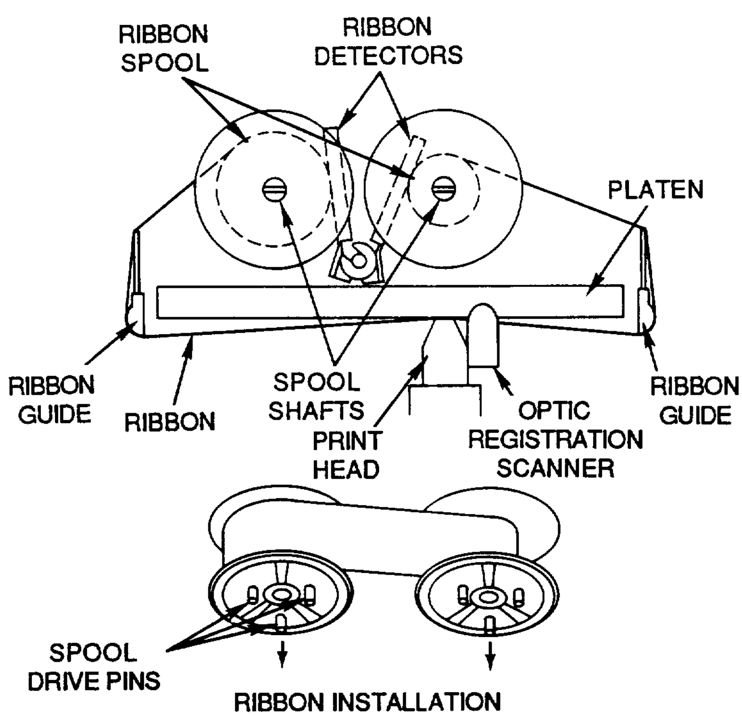


Figure 7. Bradymarker XC Plus Printer.

(a) Place right-side ribbon spool onto spool shaft with spool drive pins pointing down.

(b) Push ribbon detecting lever away from spool shaft, press down on ribbon spool until it clicks in place, then release ribbon detecting lever.

(c) Install left-side ribbon spool in accordance with steps (a) and (b).

(d) Tighten ribbon by turning right-side spool counterclockwise.

b. Printer Setup. Set the printer for marker size, format, type size, and loading labels.

NOTE

The printer remembers the last setting for marker size, format and type size. If not being changed proceed to step c.

(1) Marker Size.

(a) If printer has never been used, enter marker size code shown on inside of marker roll core.

(b) If printer has been used, press MENU key, then S for Size, and enter marker size code shown on inside of marker roll core.

(2) Format. Printer will automatically bring up on screen to select marker format.

(a) Wire format repeats legend down length of marker.

(b) Component format vertically centers legend.

(3) Type Size. Printer will automatically bring up a screen to select type size.

(a) Select preferred type size.

(4) Loading Labels. The printer has a fixed position bracket on the left side and an adjustable position bracket that adjusts for 3/4, 1 1/4 or 13/4 inch side liners (Figure 8).

(a) Remove top cover and adjustable roll holding bracket and open material guide to farthest position.

(b) Turn power ON.

(c) Turn printer around so that back of printer is facing operator.

(d) Unwind 10 inches of markers from roll.

(e) While facing back of printer, insert markers with label or face of sleeve pointed downward and liner notch on right side of liner toward fixed position bracket.

(f) Fold slight upward bend (30°) into end of markers ensuring marker is cut straight and clean.

Table 3. WMS and SBS Sleeve Selection

Wire OD Range		Part No.	
Min	Max	1 inch Length (Note 1)	1 1/2 inch Length (Note 2)
.040	.065	SBS-111-322 (Note 3)	SBS-117-322 (Note 3)
.065	.110	SBS-111-322	SBS-117-322
.080	.130	WMS-111-322	WMS-117-322
.120	.230	WMS-211-322	WMS-217-322
.230	.375	WMS-411-322	WMS-417-322
.375	.540	WMS-611-322	WMS-617-322

NOTES:
1. Can contain up to 11 normal sized characters with 12 characters per line and 7 large characters with 8 per line.
2. Can contain up to 17 normal sized characters with 12 characters per line and 11 large characters with 8 per line.
3. Cannot be shrunk tight on wires with OD less than .065 inch. Recommend these sleeves not be shrunk.

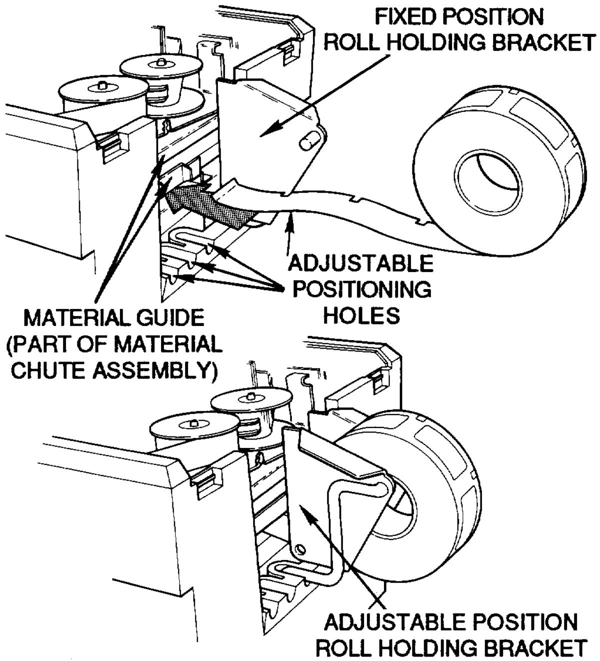


Figure 8. Loading Labels

(g) Insert markers between material guides with notched side of marker tightly against roll holding bracket.

(h) Push markers forward until markers butt up against drive roller inside printer.

(i) While continuing to push markers forward, press and hold FEED key, driver roller should begin to pull markers into printer.

(j) After 1 inch of markers have been pulled through drive roller, release FEED key.

(k) Position roll on roll holding bracket and while holding roll, mount other roll holding bracket into appropriate slot in printer case.

(l) Ensure both roll holding brackets are pushed as far down as possible into case.

(m) Move material guide to proper position next to liner.

(n) Turn printer around so that keyboard is facing operator.

(o) Press and hold FEED key until leading edge of markers are visible above ribbon.

(p) Release FEED key. Printer should advance to top of first available marker.

(q) Replace top cover.

c. Entering Legends. The legend entry screen will only allow the number of lines and characters per line that will fit on the marker.

(1) Entering Text.

(a) Type in any combination of numbers, letters, symbols or spaces. Legend should automatically center on marker.

(b) To justify legend, press MENU key, then J,and then R or L.

(c) After first line is completed, press ENTER to move to second line, if required, or press PRINT to print marker.

(d) ENTER key does not require pressing after last line.

(2) Editing Text. To change text or insert additional characters, perform the following:

(a) Move cursor to desired position for inserting, replacing, or deleting a character.

(b) To change cursor style, press INSERT key.

(c) To insert a character, press INSERT key until a solid cursor line is present.

(d) To replace a character, press INSERT key until a flashing cursor line is present.

(e) Type in additional or replacement text or press DELETE key to eliminate a character.

(3) Serialized Markers. To print markers with consecutive alphanumeric serial numbers, perform the following:

(a) Position cursor at character(s) to be serialized.

(b) Press SERIAL key.

d. Printing Markers. The BMXC-Plus printer can print only a single marker each time the PRINT key is pressed or any quantity of markers may be selected.

(1) Single Marker Printing.

(a) To print markers from legend entry screen, press PRINT key.

(b) To print a single marker each time, PRINT key is pressed, press MENU, then S for single.

(2) Multiple Marker Printing.

(a) To select multiple quantity, press MENU, then Q for quantity, then M for multiple markers.

(b) Immediately after pressing print key, input quantity desired, then press ENTER key.

(c) If serialized, increment the serial number by inputting quantity, then press ENTER key.

e. Wire List Memory.

(1) Creating Wire List. To create a wire list, proceed as follows:

(a) Press MENU key.

(b) Press L to select list submenu.

(c) Press C to create a new list.

(d) Select any available list name (non-flashing alpha character), press ENTER.

NOTE

Each time SAVE key is pressed, the wire legend will be saved into the list name specified.

(2) Printing Wire List. To print markers from previously stored list, proceed as follows:

(a) Press MENU key.

(b) Press L to select list submenu.

(c) Press P to print on existing list.

(d) Select proper list name and press ENTER. Display screen will display marker size and type size.

(e) Verify correct markers are loaded and press Y.

(f) If multiple marker option is selected, immediately after pressing Y, input quantity desired and press ENTER key.

(g) If serialized legend in list, input number and press ENTER key.

40 . **BRADY LS2000 LABELING SYSTEM.**

41 . **DESCRIPTION.** The Brady LS2000 is a portable, self–contained, high resolution, shuttle head impact printer (Figure 9)

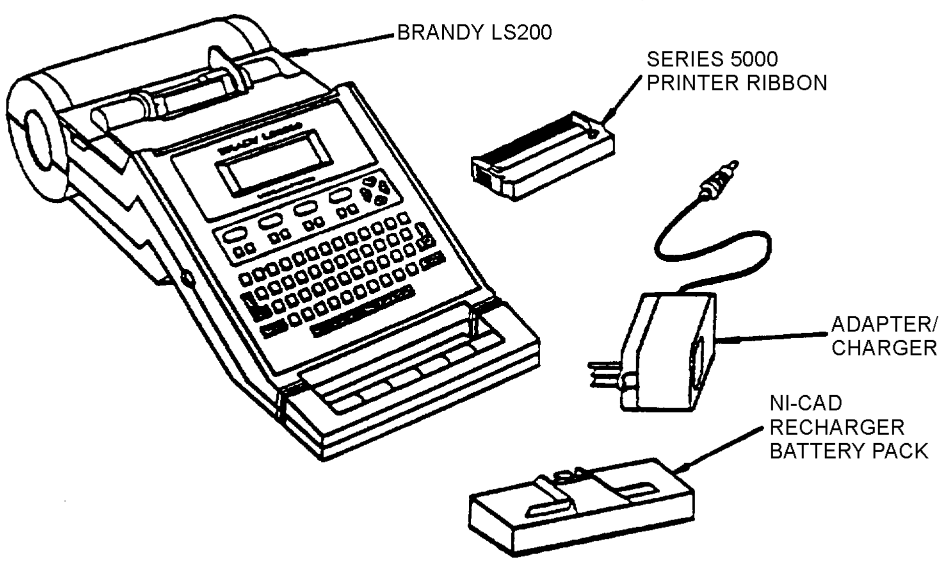


Figure 9. Brady LS2000 Labeling System

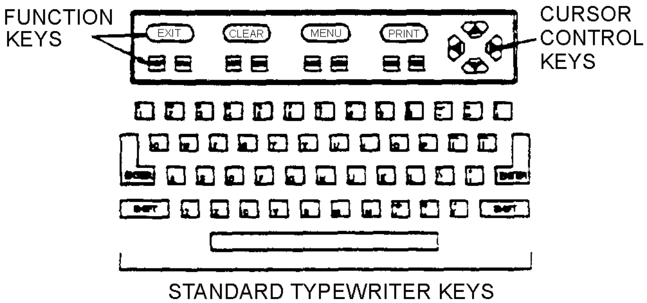


Figure 10. LS2000 Keyboard

42 . **FEATURES.** The LS2000 has important features designed to eliminate errors and save valuable time. These features are:

a. A 32K Random Access Memory (RAM) for storage and reprint of commonly used numbers.

b. An RS232 serial port for down loading from a personal computer (PC).

c. A 4-line by 20 character Supertwist LED screen to preview printing data.

d. The ability to operate on 120V AC or from a rechargeable power pack.

e. An optical registration system for precise print registration.

43 . **KEYBOARD.** The keyboard of the LS2000 is divided into three groups and categorized by key functionality (Figure 10)

44 . **Typewriter Keys.** Similar to standard typewriters, this section of keys consist of upper and lower-case letters, numbers, punctuation marks, and special symbols. To activate the symbols appearing in blue, press SHIFT plus the key containing the desired symbol.

45 . **Cursor and Editing Keys.** This group of keys is used to control the movement of the cursor and enables text editing. The function of each key is contained in Table 4

46 . **Function Keys.** The use of each function key while in the TEXT EDITOR is contained in Table 5.

47 . **BATTERY.** Operating the LS2000 with the AC adapter/charger connected to the unit, simultaneously charges the rechargeable battery pack. Whether the power switch is ON or OFF, the battery pack will continue to charged by the adapter/charger (Figure 12)

48 . It is recommended to charge the battery for a minimum of 16 hours before operating the printer solely on battery power. To maintain a full charge, and to extend battery life it is good practice to use the AC adapter/charger when possible.

49 . If AC power fails, or the AC voltage is too low while using the printer, the printer automatically switches to battery power, without interruption. When AC power is restored it automatically switches back to AC power mode.

50 . When the battery has reached a minimum level of power, the printer will emit short continuous beeps until the AC adapter/charger is connected. To extend life of the battery, restore the battery to full power (recharge for at least 16 hours) before operating the printer using battery power.

WARNING

The lithium cell contained within the LS2000 is considered hazardous, toxic waste, and must not be incinerated or thrown away in the shop trash; contact the Hazardous Waste Disposal Officer for proper disposal.

Do not expose lithium cells to extreme heat, battery may explode.

51 . **INITIALIZATION.** Initialization of the printer simply means to electronically prepare the printer for any future use and it only needs to occur one time. It occurs in the background during the first power on session of the printer. What this means is that a few of the screens in this setup procedure appear automatically, and in the sequence that they do, only

during the printer’s initial setup. During any future use of the printer, you can freely maneuver among these menus to accommodate individual editing requirements.

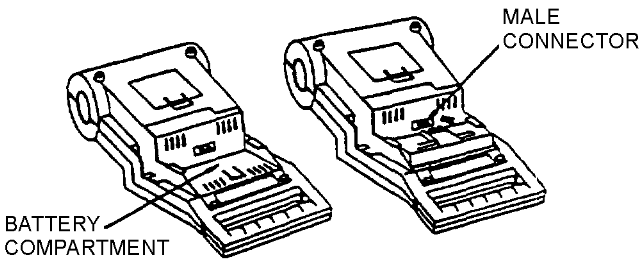


Figure 11. Battery Installation

52 . **Preparation For Operation.** With the power OFF, follow the below procedures to set up the LS2000 for operation.

53 . **Battery Installation.**

WARNING

To prevent a hazard and destruction of the battery, the battery pack should be stored inside the battery compartment at all times. Avoid bridging the female connector on the battery pack with electrically conductive material.

There is a danger of explosion if the battery is incorrectly replaced.

a. Place the LS2000 upside down on a stable surface with the handle toward the operator to expose the battery compartment (Figure 11)

b. Place the NiCad battery pack at the top of the battery compartment with flat surface of battery facing down and female connector facing away.

c. Gently slide battery pack toward male connector located at rear of battery compartment.

d. The battery pack is secure once connectors are properly seated and a audible click is heard.

Table 4. Cursor and Editing Keys Functions

Key	Function
ENTER	Activates a screen selection or, when used while composing a legend, inserts a non visible end of line character and moves the cursor down to the next line. In general, pressing the ENTER key instructs the printer to accept a screen as displayed.
SHIFT + ENTER	Toggles between upper and lowercase characters. Upon pressing keys, unit beeps one time to indicate lowercase mode, and beeps twice to indicate in uppercase mode.
Cursor Control Keys	Moves the cursor one space to the left, right, up or down. Cursor moves in the direction of the arrow as indicated on the key.
SHIFT +	Moves cursor to beginning of current line.
SHIFT +	Moves cursor to end of current line.
SHIFT +	Moves cursor to beginning of first line.
SHIFT +	Deletes to character at the cursor position.
SHIFT + DELETE	Backspaces as it deletes characters.
INSERT	Toggles between the text entry modes of insert and overwrite. A flashing block cursor indicates that the printer is in the insert mode. A single line cursor line indicates that the printer is in the overwrite mode.
SPACE BAR	Moves the cursor 1 position to the right. Will erase the character at the current cursor position if in overwrite mode, or add a space if in the insert mode.

Table 5. Text Editor Function Keys

Key	Function
EXIT	Backs you out one level in the menu tree. Press this key to terminate or pause printing markers. Press this key to move from a submenu back to main menu or from the main menu to TEXT EDITOR screen. Press and hold this key when the message, Enter New Legend, is displayed in order to display the Editor Status (summary of defined parameters).
CLEAR	Clears all character from TEXT EDITOR screen.
MENU	Moves from the TEXT EDITOR screen to the main menu. While in the main menu, press and hold this key to display current setup status.
PRINT	Activates the printing function.
HELP	Press and hold the key down for help instructions appropriate to current activity.
SERIAL	Toggles the serialization status (on/off) of a character at the cursor.
SAVE	Stores current legend to a previously created list.
RECALL	Enables viewing of legends in a previously created list.
REPRINT	Prints a duplicate of the last marker printed.
FEED	Advances marker roll to next marker. (You must be in TEXT EDITOR).
SHIFT + FEED	Back feeds the marker roll through the printer (you must be in TEXT EDITOR).

54 . **Turning AC Adapter/Charger Connection.**

NOTE

Operating the printer with the AC adapter/ charge connected simultaneously charges the battery pack The battery pack should be charged for 16 hours before attempting to operate the printer exclusively on battery power.

a. Insert the adapter/charger's barrel plug connector into the port located at rear of printer (Figure 12)

b. Connect the adapter/charger box to an outlet

55 . **Turning Power ON.**

a. Locate power ON/OFF button found along left side of printer (Figure 13).

NOTE

Pushing the power button only partially in will not turn the power on and the display will remain blank.

b. Gently push power button in until two clicks are heard. After a few seconds the screen will appear.

c. The screen will display a series of interactive screens pertaining to labels chosen to create.

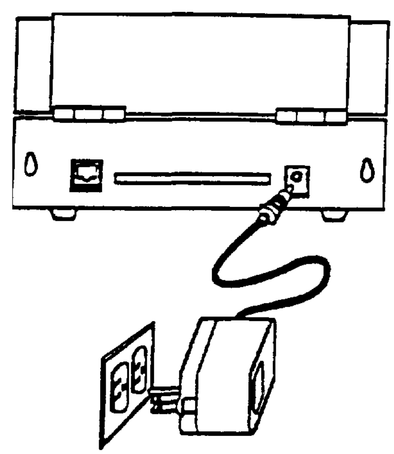


Figure 12. AC Connections

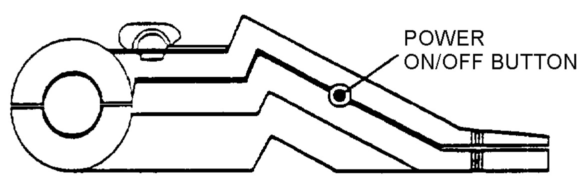


Figure 13. Power ON/OFF Button

56 . **Marker Selection.**

a. Select a marker or sleeve from within the screen as either a 1) Standard Part, 2) Permasleeve, or 3) Terminal Block.

b. Press ENTER.

c. There are two methods used to select items within the display screen.

(1) Press the first letter of the selection. Pressing first leper of the selection will automatically activate the choice.

(2) Move the cursor by pressing control keys. The cursor will move in same direction as designated by cursor arrows (Figure 10)

d. Selections made will appear in uppercase lettering with flashing black cursor.

e. Press ENTER to activate selection.

57 . **Entering Marker Size Code.**

a. Locate marker size code from Table 6 through Table 9 using Figure 14 as a guide for dimensions.

b. The marker size code can be found on both the package of markers and on the inside of the markers roll core.

c. To determine the size code from the stock number, locate first set of numbers contained in the stock number (Figure 14).

d. In the size code screen, enter the size code of selected marker.

e. Press ENTER.

58 . **Type Style, Font Scaling, and Format.**

a. In the Type Style screen NORMAL is highlighted. For this set up procedure, press ENTER to select NORMAL type style.

b. In the Normal Scaling screen, the character height, line spacing, and character width are determined The number of lines that can be entered and number of characters per each line allowed for marker size is displayed on third line of this screen. For this procedure, press ENTER to select predetermined font scaling.

c. In the Format screen, COMPONENT LABEL is highlighted. For this procedure component label product should be used. Press ENTER to select the COMPONENT LABEL format.

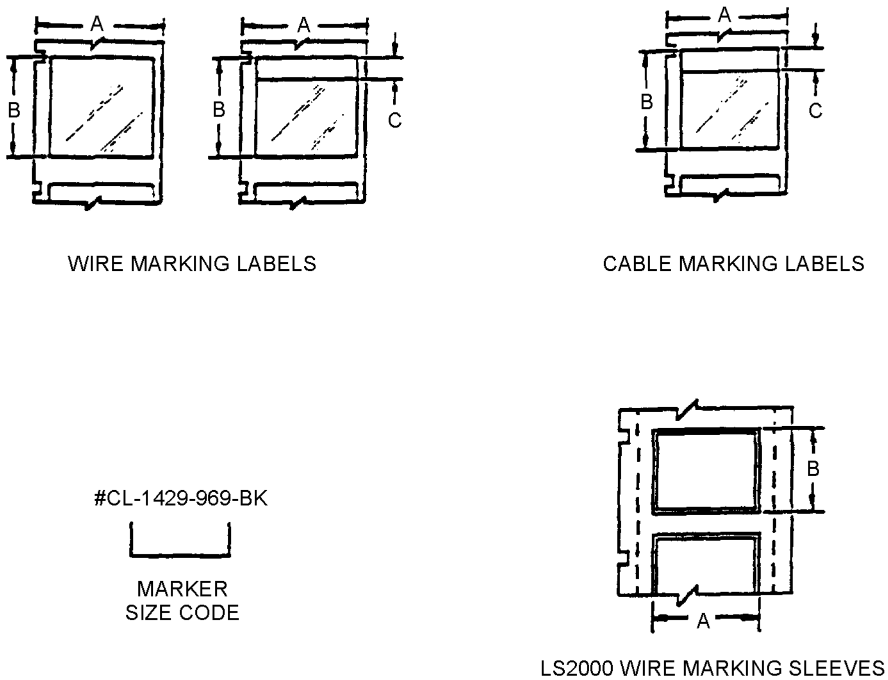


Figure 14. Label and Sleeve Dimensions with Marker Size Code

NOTE

System defaults to uppercase; press SHIFT key in combination with any character to appear in lowercase. Press both SHIFT and ENTER keys to Lock-in lowercase type style.

Holding down any character in the standard keys will detain the help screen long enough for information provided to be read.

59 . **Text Label.** The EDITOR screen is now displayed and the message “Enter New Legend” is displayed.

a. To activate any characters appearing in blue, press in combination with SHIFT key.

b. To delete any character, 1) press SHIFT + DELETE; characters to left of cursor will be deleted, or 2) place cursor under any character and press DELETE.

c. Press ENTER to advance to next line in legend.

d. Enter text desired for label.

e. Do not enter any more commands before installing markers and ribbon.

60 . **Ribbon Installation.**

a. Release cover of printer by placing fingers in notch under cover on both sides of printer and pull-up. Lay cover back until it rests on hinges (Figure 15)

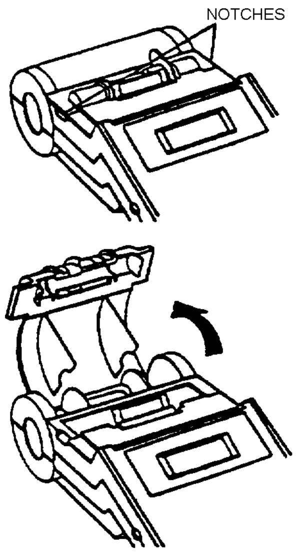


Figure 15. Printer Cover

b. Expose ribbon compartment by lifting cover on the house tear bar. Place a finger to either side of tear bar and tilt cover back toward front of printer (Figure 16)

c. Hold ribbon cartridge over ribbon compartment with exposed ribbon facing toward back of printer and small notch in ribbon cartridge facing down.

d. Tilt exposed portion of ribbon down and position ribbon along side of plastic shield closest to front of printer. Gently bring back of ribbon cartridge down and press it into ribbon compartment until a click is heard.

e. Tighten ribbon in cartridge by placing your thumb over ribbon advance knob and turn clockwise.

f. Locate platen gap adjustment (Figure 17)

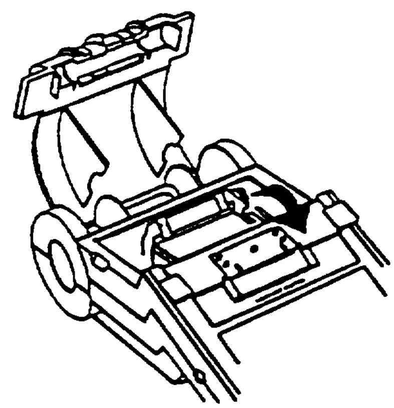


Figure 16. Ribbon Compartment

Table 6. Wire Marking Labels

Stock Number	Marker Size Code	Labels Per Rolls	Labels Material	Label Dimensions Inch (mm)			Maximum Lines of Print		Maximum Characters Across			
				A	B	C	Nor.	Half	Lg.	Nor.	Sm.	Half
6 to 10 Gauge Wire (AWG Based on THHN Wire - Maximum Wire Diameter 0.026 in (6.60 mm)												
WML-905-502	905	250	General Purpose Vinyl Cloth	0.50 (12.70)	1.25 (31.75)	N/A	9	19	3	5	7	9
WML-905-632	905	250	Flame Retardant Low Profile Tedlar	0.50 (12.70)	1.25 (31.75)	N/A	9	19	3	5	7	9
WML-305-292	305	250	Self Laminating Vinyl	0.50 (12.70)	1.25 (31.75)	0.50 (12.70)	3	7	7	5	7	9
WML-911-502	911	250	General Purpose Vinyl Cloth	1.00 (25.40)	1.25 (31.75)	N/A	9	19	7	11	15	19
WML-911-632	911	250	Flame Retardant Low Profile Tedlar	1.00 (25.40)	1.25 (31.75)	N/A	9	19	7	11	15	19
6 to 10 Gauge Wire (AWG Based on THHN Wire - Maximum Wire Diameter 0.026 in (6.60 mm) (Cont)												
WML-311-292	311	250	Self-Laminating Vinyl	1.00 (25.40)	1.25 (31.75)	0.50 (12.70)	3	7	7	11	15	19
WML-917-502	917	250	General Purpose Vinyl Cloth	1.50 (36.10)	1.25 (31.75)	N/A	9	19	11	17	23	29

Table 6. Wire Marking Labels (Cont)

Stock Number	Marker Size Code	Labels Per Rolls	Labels Material	Label Dimensions Inch (mm)			Maximum Lines of Print		Maximum Characters Across			
				A	B	C	Nor.	Half	Lg.	Nor.	Sm.	Half
WML-317-292	317	250	Self-Laminating Vinyl	1.50 (36.10)	1.25 (31.75)	0.50 (12.70)	3	7	11	17	23	29
WML-2007-502	2007	250	General Purpose Vinyl Cloth	0.50 (12.70)	1.25 (31.75)	N/A	10	20	3	5	7	9
WML-2015-502	2015	250	General Purpose Vinyl Cloth	1.00 (25.40)	1.25 (31.75)	N/A	10	20	7	11	15	19
WML-2411-502	2411	250	General Purpose Vinyl Cloth	0.80 (20.32)	1.50 (38.10)	N/A	12	24	5	8	11	14
WML-0811-292	0811	250	Self-Laminating Vinyl	0.80 (20.32)	1.50 (38.10)	0.50 (12.70)	4	8	5	8	11	14
WML-0807-292	0807	250	Self-Laminating Vinyl	0.80 (20.32)	1.25(31.75)	0.50 (12.70)	4	8	3	5	7	9
WML-0815-292	0815	250	Self-Laminating Vinyl	1.00 (25.40)	1.25 (31.75)	0.50 (12.70)	4	8	7	11	15	19
WML-0823-292	0823	250	Self-Laminating Vinyl	1.50 (36.10)	1.25 (31.75)	0.50 (12.70)	4	8	11	17	23	29
10 to 12 Gauge Wire (AWG) Based on THHN Wire - Maximum Wire Diameter - 0.21 in (5.30 mm)												
WML-705-502	705	250	General Purpose Vinyl Cloth	0.50 (12.70)	1.00 (25.40)	N/A	7	15	3	5	7	9
WML-705-632	705	250	Fame Retardant Low Profile Tedlar	0.50 (12.70)	1.00 (25.40)	N/A	7	15	3	5	7	9
WML-205-292-1	205	250	Self-Laminating Vinyl	0.50 (12.70)	1.00 (25.40)	0.375 (9.53)	2	5	3	5	7	9
WML-711-502	711	250	General Purpose Vinyl Cloth	1.00 (25.40)	1.00 (25.40)	N/A	7	15	7	11	15	19
WML-711-632	711	250	Flame Retardant Low Profile Tedlar	1.00 (25.40)	1.00 (25.40)	N/A	7	15	7	11	15	19
WML-211-292-1	211	250	Self-Laminating Vinyl	1.00 (25.40)	1.00 (25.40)	0.375 (9.53)	2	5	7	11	15	19
WML-0607-292-1	0607	250	Self-Laminating Vinyl	0.50 (12.70)	1.00 (25.40)	0.375 (9.53)	3	6	3	5	7	9
WML-0615-292-1	0615	250	Self-Laminating Vinyl	1.00 (25.40)	1.00 (25.40)	0.375 (9.53)	3	6	7	11	15	19
WML-1615-502	1615	250	General Purpose Vinyl Cloth	1.00 (25.40)	1.00 (25.40)	N/A	8	16	7	11	15	19
WML-1607-502	1607	250	General Purpose Vinyl Cloth	0.50 (12.40)	1.00 (25.40)	N/A	8	16	3	5	7	9
10 to 16 Gauge Wire (AWG Based on THHN Wire - Maximum Wire Diameter - 0.16 in (4.10 mm)												
WML-505-502	705	250	General Purpose Vinyl Cloth	0.50 (12.70)	0.75 (19.05)	N/A	5	11	3	5	7	9
WML-505-632	705	250	Flame Retardant Low Profile Tedlar	0.50 (12.70)	0.75 (19.05)	N/A	5	11	3	5	7	9
WML-205-292-75	205	250	Self-Laminating Vinyl	0.50 (12.70)	0.75 (19.05)	0.375 (9.53)	2	5	3	5	7	9
WML-511-502	711	250	General Purpose Vinyl Cloth	1.00 (25.40)	0.75 (19.05)	N/A	5	11	7	11	15	19
WML-511-632	711	250	Flame Retardant Low Profile Tedlar	1.00 (25.40)	0.75 (19.05)	N/A	5	11	7	11	15	19
WML-211-292-75	211	250	Self-Laminating Vinyl	1.00 (25.40)	0.75 (19.05)	0.375 (9.53)	2	5	7	11	15	19
WML-517-502	0607	250	General Purpose Vinyl Cloth	1.50 (38.10)	0.75 (19.05)	N/A	5	11	11	17	23	29
WML-1207-502	0615	250	General Purpose Vinyl Cloth	0.50 (12.40)	0.75 (19.05)	N/A	8	12	3	5	7	9
WML-1207-502	1615	250	Flame Retardant Low Profile Tedlar	0.50 (12.40)	0.75 (19.05)	N/A	8	12	3	5	7	9
WML-1215-502	1607	250	General Purpose Vinyl Cloth	1.00 (25.40)	0.75 (19.05)	N/A	8	12	7	11	15	19
WML-0607-292-75	0607	250	Self-Laminating Vinyl	0.50 (12.40)	0.75 (19.05)	0.375 (9.53)	3	6	3	5	7	9

Table 6. Wire Marking Labels (Cont)

Stock Number	Marker Size Code	Labels Per Rolls	Labels Material	Label Dimensions Inch (mm) A	B	C	Maximum Lines of Print Nor.	Half	Maximum Characters Across Lg.	Nor.	Sm.	Half
WML-0615-292-75	0615	250	Self-Laminating Vinyl	1.00 (25.40)	0.75 (19.05)	0.375 (9.53)	3	6	7	11	15	19
16 TO 22 Gauge Wire (AWG) Based on THHN Wire - Maximum Wire Diameter - 0.11 in (2.80 mm)												
WML-305-502	350	500	General Purpose Vinyl Cloth	0.50 (12.70)	0.50 (12.70)	N/A	3	7	3	5	7	9
WML-305-632	305	500	Flame Retardant Low Profile Tedlar	0.50 (12.70)	0.50 (12.70)	N/A	3	7	3	5	7	9
WML-0807-502	0807	500	General Purpose Vinyl Cloth	0.50 (12.70)	0.50 (12.70)	N/A	4	8	3	5	7	9

**Table 7. Cable Marking Labels
Self-Laminating White/Transparent Vinyl (B-292)**

Stock Number	Marker Size Code	Labels Per Roll	Label Dimensions Inch (mm) A	B	C	Maximum Lines of Print Nor.	Half	Maximum Characters Across Lg.	Nor.	Sm.	Half
WML-511-292	511	100	1.00 (25.40)	2.50 (63.50)	0.75 (19.05)	5	11	7	11	15	19
WML-711-292	517	100	1.50 (38-10)	2.50 (63.50)	0.75 (19.05)	5	11	11	17	23	29
WML-711-292	711	100	1.00 (25.40)	4.00 (101.60)	1.00 (25.40)	7	15	7	11	15	19
WML-717-292	717	100	1.50 (38.10)	4.00 (101.60)	1.00 (25.40)	7	15	11	17	23	29
WML-1215-292	1215	250	1.00 (25.40)	2.25 (57.15)	0.75 (19.05)	6	12	7	11	15	19
WML-1215-292-25	1215	100	1.00 (25.40)	2.50 (63.50)	0.75 (19.05)	6	12	7	11	15	19
WML-1223-292	1223	100	1.50 (38.10)	2.50 (63.60)	0.75 (19.05)	6	12	11	17	23	29
WML-1231-292-22	1231	250	2.00 (50.80)	2.25 (57.15)	0.75 (19.05)	6	12	15	24	31	39
WML-1231-292-30	1231	100	2.00 (50.80)	8.00 (76.20)	0.75 (19.05)	6	12	15	24	31	39
WML-2431-292-60	2431	75	2.00 (50.80)	6.00 (152.40)	1.50 (38.10)	12	24	15	24	31	39
WML-2431-292-75	2431	75	2.00 (50.80)	7.50 (190.50)	1.50 (38.10)	12	24	15	24	31	39

Table 8. Portable Printing Sleeves Heat-Shrink White Polyolefin (B-341)

Stock Number	Marker Size Code	Sleeves Per Roll	Range of Wire Dia. In (Mm)		Approx. Wire Gage (Note 1)	Sleeve Dimension In. (mm)		Maximum Line of Print		Maximum Characters Across			
			Min.	Max.		A	B	Nor.	Half	Lg.	Nor.	Sm.	Half
1.00 LN. Marker Width													
PSBXP-111-125	111	500	0.062 (1.57)	0.110 (2.79)	18 - 16	1.00 (25.40)	0.235 (6.00)	1	3	7	11	15	19
PSBXP-111-187	111	500	0.094 (2.39)	0.150 (3.81)	16 - 12	1.00 (25.40)	0.335 (8.50)	1	3	7	11	15	19
PSBXP-211-250	211	500	0.125 (3.18)	0.215(5.46)	12 - 10	1.00 (25.40)	0.439 (11.20)	2	5	7	11	15	19
PSBXP-311-375	311	250	0.188 (4.78)	0.320 (8.13)	8 - 6	1.00 (25.40)	0.645 (16.40)	3	7	7	11	15	19
PSBXP-411-500	411	250	0.250 (6.35)	0.450 (11.43)	4 - 1	1.00 (25.40)	0.851 (21.60)	4	9	7	11	15	19
1.25 IN. Marker Width													
PSBXP-114-125	114	500	0.062 (1.57)	.110 (2.79	18 - 16	1.25 (31-75)	.235 (6.00)	1	3	10	14	19	24
PSBXP-114-187	114	500	0.094 (2.39)	0.150 (3.81)	16 - 12	1.25 (31-75)	0.335 (8.50)	1	3	10	14	19	24
PSBXP-214-250	214	500	0.125 (3.18)	0.215 (5.46)	12 - 10	1.25 (31-75	0.439 (11.20)	2	5	10	14	19	24
PSBXP--314-375	314	250	0.188 (4.78)	0.320 (8.13)	8 - 6	1.25 (31-75)	0.645 (16.40)	3	7	10	14	19	24
PSBXP-414-500	414	250	0.250 (6.35)	0.450 (11.43)	4 - 1	1.25 (31-75)	0.851 (21.60)	4	9	10	14	19	24
2.00 In. Marker Width													
PS-0231-094W	0231	500	0.047 (1.19)	0.080 (2.03)	22 - 18	2.00 (50.80)	0.182 (4.63)	1	2	15	24	31	39
PS-0231-125W	0.231	500	0.062 (1.57)	0.110 (2.79)	18 - 16	2.00 (50.80)	0.235(5.97)	1	2	15	24	31	39
PS-0331-187W	0231	500	0.094 (2.38)	0.150 (3.81)	16 - 12	2.00 (50.80)	0.335 (8.51)	1	3	15	24	31	39
PS-0531-250W	0531	500	0.125 (3.18)	0.215 (5.46)	12 - 10	2.00 (50.80)	0.439 (11.16)	2	5	15	24	31	39
PS-0831-375W	0831	250	0.188 (4.78)	0.320 (8.13)	8 - 6	2.00 (50.80)	0.645 (16.38)	4	8	15	24	31	39
PS-1031-500W	1031	250	0.250 (6.35)	0.450 (11.43)	4 - 1	2.00(50.80)	0.851 (21.62)	5	10	15	24	31	39
PS-2231-1000W	2231	100	0.450 (11.43)	0.950 (24.13)	1 - 500	2.00 (50.80)	1.66 (42.16)	11	22	15	24	3l	39

NOTES:

l. Based on National Electric Code insulation measurement of THHN wire.
2. Sleeves may be slit at factory for shorter marker lengths. Depending on overall length, sleeves ma be slit in halves, thirds or fourths. Contact. your Brady Industrial Products distributor or Customer Service Representatives for ordering information.

Table 9. Portable Printing Sleeves Heat-Shrink Yellow Polyolefin (B-341)

Stock Number	Marker Size Code	Sleeves Per Roll	Range of Wire Dia. In (Mm) Min.	Range of Wire Dia. In (Mm) Max.	Approx. Wire Gage (Note 1)	Sleeve Dimension In. (mm) A	Sleeve Dimension In. (mm) B	Maximum Line of Print Nor.	Maximum Line of Print Half	Maximum Characters Across Lg.	Maximum Characters Across Nor.	Maximum Characters Across Sm.	Maximum Characters Across Half
2.00 IN. Marker Width													
PS-0231-094Y	0231	500	0.047 (1.19)	0.080 (2.79)	22 - 18	2.00 (50.80)	0.182 (4.63)	1	2	15	24	31	39
PS-0231-125Y	0231	500	0.062 (1.57)	0.110 (2.79)	18 - 16	2.00 (50.80)	0.235 (5.97)	1	2	15	24	31	39
PS-0331-187Y	0231	500	0.094 (2.38)	0.150 (3.81)	16 - 12	2.00 (50.80)	0.335 (8.51)	1	3	15	24	31	39
PS-0531-250Y	0531	500	0.125 (3.18)	0.215 (5.46)	12 - 10	2.00 (50.80)	0.439 (11.16)	1	2	15	24	31	39
PS-0831-375Y	0831	250	0.188 (4.78)	0.320 (8.13)	8 - 6	2.00 (50.80)	0.645 (16.38)	2	5	15	24	31	39
PS-1031-500Y	1031	250	0.250 (6.35)	0.450 (11.43)	4 - 1	2.00 (50.80)	0.851 (21.62)	4	8	15	24	31	39
PS-2231-1000Y	2231	100	0.450 (11.43)	0.950 (24.13)	1 - 500	2.00 (50.80)	1.66 (42.16)	5	10	15	24	31	39

NOTES:

1. Based on National Electric Code insulation measurement of THHN wire.
2. Sleeves may be slit at factory for shorter marker lengths. Depending on overall length, sleeves ma be slit in halves, thirds or fourths. Contact your Brady Industrial Products distributor or Customer Service Representatives for ordering information.

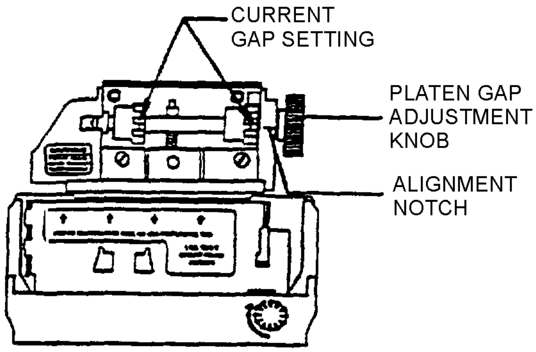


Figure 17. Platen Gap

g. Determine setting for marker from Table 10 (also under printer cover) and turn platen gap adjustment knob until value appears alongside alignment knob.

61 . **Marker Tape Installation.**

a. Release cover of printer by placing fingers in notch under cover on both sides of printer and pull-up. Lay cover back until it rests on hinges (Figure 15)

b. Remove roll spindle from the printers crib and slide off blue adjustable spindle guide (Figure 18)

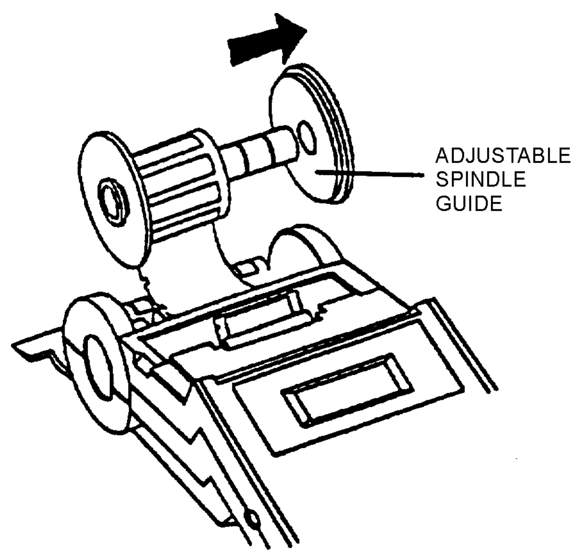


Figure 18. Adjustable Spindle

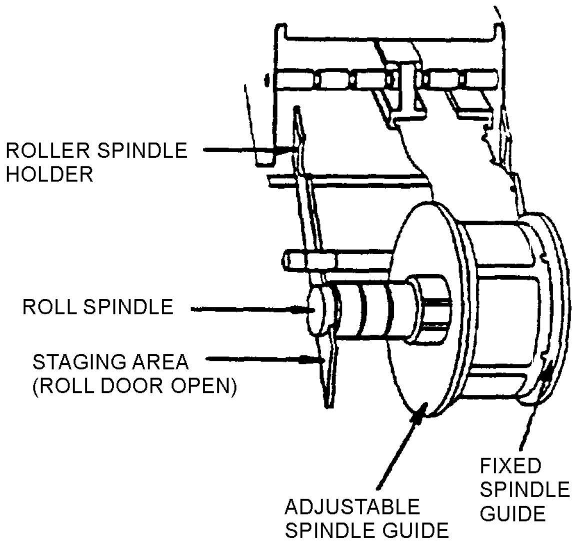


Figure 19. Spindle Guide

c. Holding roll of markers with notches to the left, slit roll of markers all the way to left side of roll spindle. With flat of adjustable spindle guide facing roll of markers, return guide onto spindle.

d. Position blue guide in one of slots on spindle close to roll of markers.

e. Place spindle in stage area of printer with blue adjustable spindle guide facing to right.

f. Locate the fixed and adjustable material guides found just beyond the spindle holder. Push adjustable material guide up in order to slide it from one slot to another along material guide detent shaft (Figure 19).

g. Slide the adjustable guide to a position along the shaft that fits the marker liner most comfortably. Assure that guide is positioned in one of grooves along shaft.

h. Feed roll into slots of material guides until marker will not advance any further into printer.

i. Press FEED button located on function control panel of keyboard. Markers will advance to a position ready for, printing.

j. Move roll spindle from stage area to spindle holder.

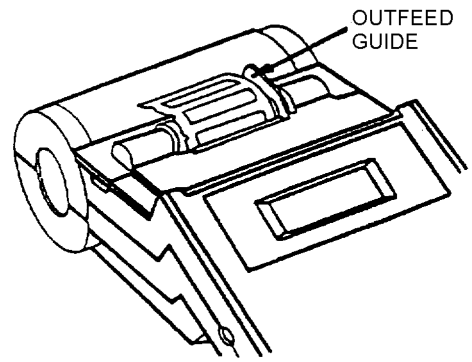


Figure 20. Outfeed Guide

k. Return ribbon compartment cover to its Original position, close printer cover.

l. Adjust blue outfeed guide to keep marker liner properly aligned as it advances out of printer. If necessary, readjust outfeed guide once the markers have advanced during a printing session (Figure 20).

m. After completing set up procedure the printer may be tuned OFF. When it is turned on again the TEXT EDITOR screen will appear, refer to Paragraph 60.

62 . **SCREENS AND MENUS.**

63 . **Text Editor.** After the printer has been initialized (Paragraph 60) the TEXT EDITOR screen will appear each time the screen is turned on. One of the following screens will appear.

a. ENTER NEW LEGEND. When this prompt is flashing, text for a new label can be entered, using previously defined parameters.

b. <CLEAR>TO ERASE. When this prompt is flashing, previously entered text can be edited or cleared.

c. LEGEND HAS BEEN TRUNCATED. This prompt indicates that characters/lines (data) of a current legend have exceeded the setup parameters designated in the EDITOR status.

64 . **Amending Parameters.** To amend any parameters previously defined, complete the following procedure:

a. Press MENU button to call up MAIN MENU.

65 . **LABEL PRINTING.**

NOTE

The text for labels should be displayed on the screen.

To terminate printing at any time press EXIT.

a. Press PRINT and Copy Quantity appears on the screen.

b. Enter the number of copies to be printed.

c. Press PRINT or ENTER, roll marker will begin to advance and printer will start to print labels.

d. Once printing has ended. a new legend can be entered by pressing CLEAR.

e. To duplicate a marker just printed, press REPRINT. (The reprint command will print a duplicate of a serialized marker without incrementing any serialized characters.)

f. Press the first letter of selection from any menu or submenu to make a selection or using cursor control keys highlight selection.

g. Press ENTER.

66 . **CREATING A LEGEND USING MAIN MENU.**

67 . **Setting Marker Size.** The LS2000 can print a Wide variety of marker sizes. The parameters allowed by the legend are determined by the printable area on the marker selected (code size), so marker size must be identified. To set or change the marker size complete the following procedure:

a. Select MARKER option from main menu.

b. Select the type of marker being used (Standard Part, PermaSleeve or Terminal Block).

c. Key in new size in SIZE CODE display screen.

d. Press ENTER.

68 . **Size Code.** Each roll of markers is identified by a stock number which includes the marker size code (Figure 14) The marker size code defines both the maximum number of print lines on each marker and the maximum number of characters on each line.

Table 10. Platen Gap Setting

Stock Code	Material	Gap Setting
B-122	Permanent Paper	1
B-292	Self-Laminating Vinyl	2 or 3
B-319	Non-Shrink Bradysleeve	3 or 4
B-321	Heat Shrink Bradysleeve	3 or 4
B-322	Self-Extinguishing Bradysleeve	3 or 4
B-341	Heat-shrink Permasleeve	5 or 6
B-502	Vinyl Cloth	2 or 3
B-607	Tamper Evident Vinyl	1
B-619	Polyester	2
B-621	Translucent Polyester	2
B-632	Tedlar	1
B-637	Tedlar Film	2
B-652	Polyimide Film	2 or 3
B-969	Metalized Polyester	2

a. Maximum number of lines and characters assumes the character width, character height and line spacing are scaled at their baseline size of 1.

b. The number of lines is based on a HALFHIGH type size. The number of characters is based on a SMALL type size.

69 . **Selecting Format.** The LS2000 can print markers in one of the following formats: Wiremarker Component Label, or Strip Wiremarker.

a. To select a format press PRINTER from main menu.

b. When PRINTER screen appears, select FORMAT.

NOTE

If wiremarker format is selected, the number of strips across that are to be printed will have to be indicated. The marker size code for strip markers refers to size of each strip, not total print area across all strips.

c. Choose one of print formats displayed on screen:

(1) Wiremarker Format. The wiremarker format is designed to automatically repeat the text of a legend down the length of a marker as many times as possible, considering the number of lines available in the marker. For example, maker size code 0531 allows a maximum of 5 lines per marker. When printing a 2-line legend, the legend will be repeated 2 times, for a total of 4 lines. The 5th line will be blank.

(2) Component Label Format. The component label format is designed to print all lines of a legend one time before advancing to the next marker.

(3) Strip Wiremarker Format. The strip wiremarker format is designed to be used with the strip, series of labels or PermaSleeve labels. The strip wiremarker is similar to the wiremarker format except that it is designed to print duplicate markers on a multiple across label (also referred to as butt cut set). The legend composed in this format will be duplicated in each strip of the butt cut set. It should be noted that the set is considered a single marker for serializing or printing.

70 . **Selecting Printer Modes.** The LS2000 will print in 1 of 2 modes, single marker mode or multiple marker mode. To set the printing mode:

a. Select PRINTER from main menu followed by Q to select quantity.

b. Select SINGLE or MULTIPLE marker mode. The printer will remain in the mode selected until modified.

71 . **Single Marker Mode.** This mode instructs the LS2000 to print 1 marker for each print command. It allows time to proof the marker for accuracy or edit the legend. Switch to the multiple marker mode to increase the quantity to print, per print command.

72 . **Multiple Marker Mode.**

a. Instructs the LS2000 to print multiple markers without hesitation. Enter any number 1 - 999.

b. Notice that if the printer has been set in multiple marker mode, the screen will always prompt to enter the number of duplicate copies required per each print command.

c. After entering legend, simply press PRINT. Enter the number of identical markers to be printed and press ENTER to activate the command. (Press EXIT to terminate a print session in progress.)

73 . **Type Size.** The LS 2000 will print in 5 different type sizes (Figure 22)

Small	16 character per inch (CPI)
Normal	12 characters per inch
Large	8 characters per inch
Halfhigh	20 characters per inch
Rotated	16 characters per inch

74 . These sizes represent the initial baseline size of each type style. Each type style can be scaled up to 5 times its original size in both height and width dimensions. To set or change the type style and size complete the following steps.

a. Select TYPE– option from main menu.

b. Use cursor control keys to change style and size parameters.

c. Press left and right arrows or press first letter of selection to move between categories.

d. Press up and down arrows to increase or decrease the values within each category.

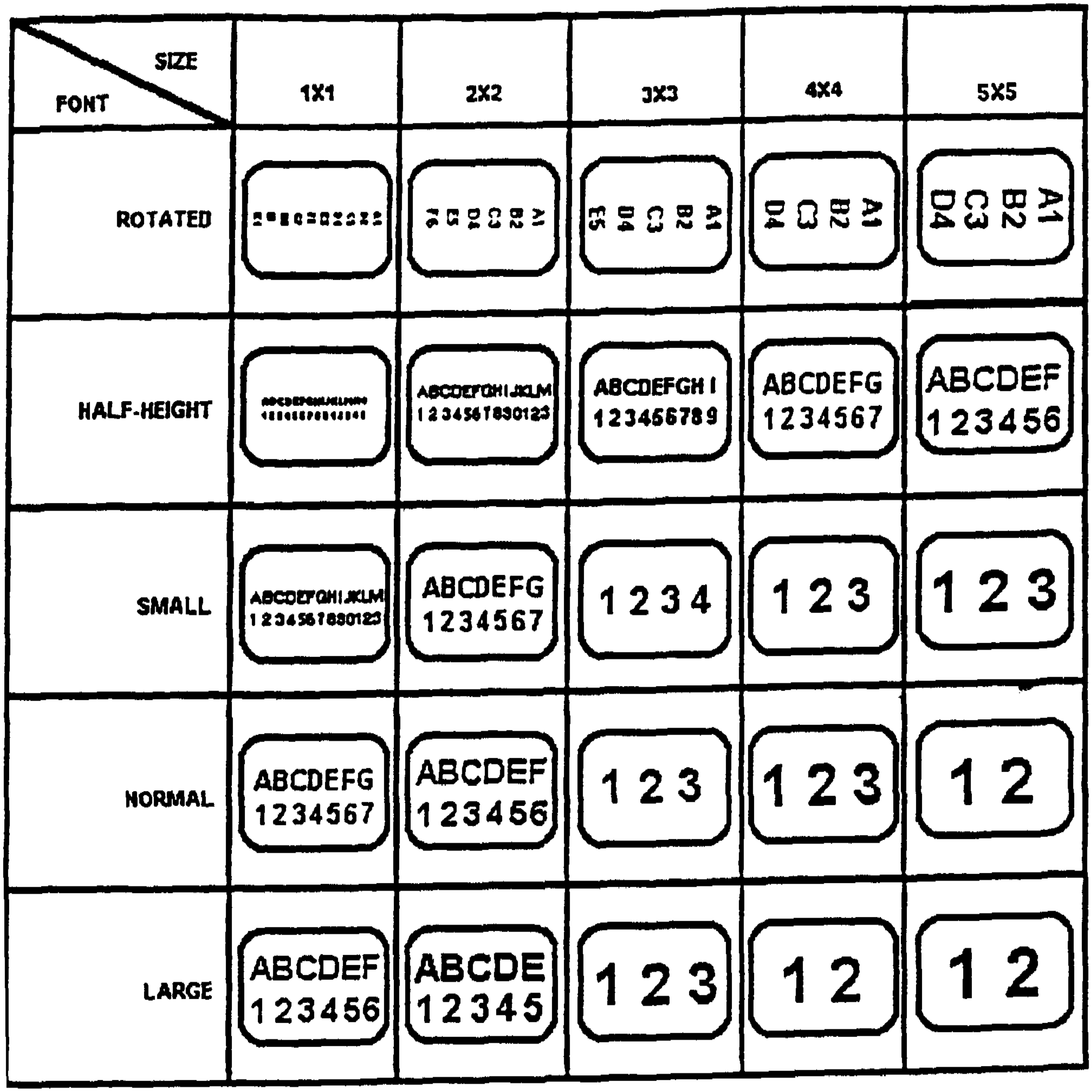


Figure 21. LS2000 Type Sizes

NOTE

The number of lines/characters will automatically change as a result of increasing or decreasing the scaling parameters. The type size combined with the marker size will determine the maximum number of characters that can be printed on each line of print.

75 . For every increase of 1, the distance between lines of text increases by 1/2 of a print dot (0.00625 inch).

This feature becomes very useful when printing characters containing ascenders and descenders.

76 . **Width Spacing.** The third position on the scaling screen is for setting width scaling. This allows the scaling of the width of the character from its baseline size of 1, up to 5.

77 . **PRINTING FROM THE EDITOR.** The easiest way to print markers is directly from within the TEXT EDITOR. To print a single marker of the legend currently displayed in the TEXT EDITOR, press PRINT.

a. If in the multiple marker mode, prompt will indicate to enter quantity desired to be printed.

b. If in the single marker mode, printer will immediately print just 1 marker.

78 . **MENU TREE.** The general structure of the software is displayed in the menu tree (Figure 22). When you reach the options level of menu operations, the printer indicates that it accepts your input or selection with a brief 3-beep tone and will return to the TEXT EDITOR.

79 . **PRINTING PERMASLEEVE MARKERS.** When creating a legend for Permasleeve marker, assure that you choose Permasleeve from the marker submenu. This is important because the Permasleeve has a larger lead margin than other markers and the printer will not print in the proper location on the sleeve if another type is chosen.

a. Loosen two platen removal screws in platen assembly until they are loose from the printer frame (Figure 24)

80 . **Platen Assembly.**

CAUTION

Never backfeed Permasleeve material through the printer with sleeves removed from the carrier. The exposed adhesive will cause damage to the printer mechanism.

a. Clean the drive roller using isopropyl alcohol and a clean rag using steps in paragraph 85.

b. Install bottom door.

CAUTION

Excessive force on the optic eye bracket will cause misalignment of the optic eye and the printer will have to be sent for repair.

c. Remove bottom ribbon.

81 . When printing Permasleeve markers, it is recommended to run the printer with the adapter/charger connected to assure proper feeding of markers. Also assure printhead gap is set to 6.

82 . **MAINTENANCE AND CLEANING.**

WARNING

Isopropyl alcohol TT-I-735, is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

83 . **Drive Roller.** Lint and dust may build up on the drive roller resulting in the slipping of material when feeding it through the printer. To clean the drive roller, complete the following steps.

a. Remove the bottom door located on the underside of the printer.

b. The drive roller is a rubberized roller located directly under the fixed and adjustable material guide Push down on adjustable material guide and slide left/right in order to access the entire drive roller (Figure 23)

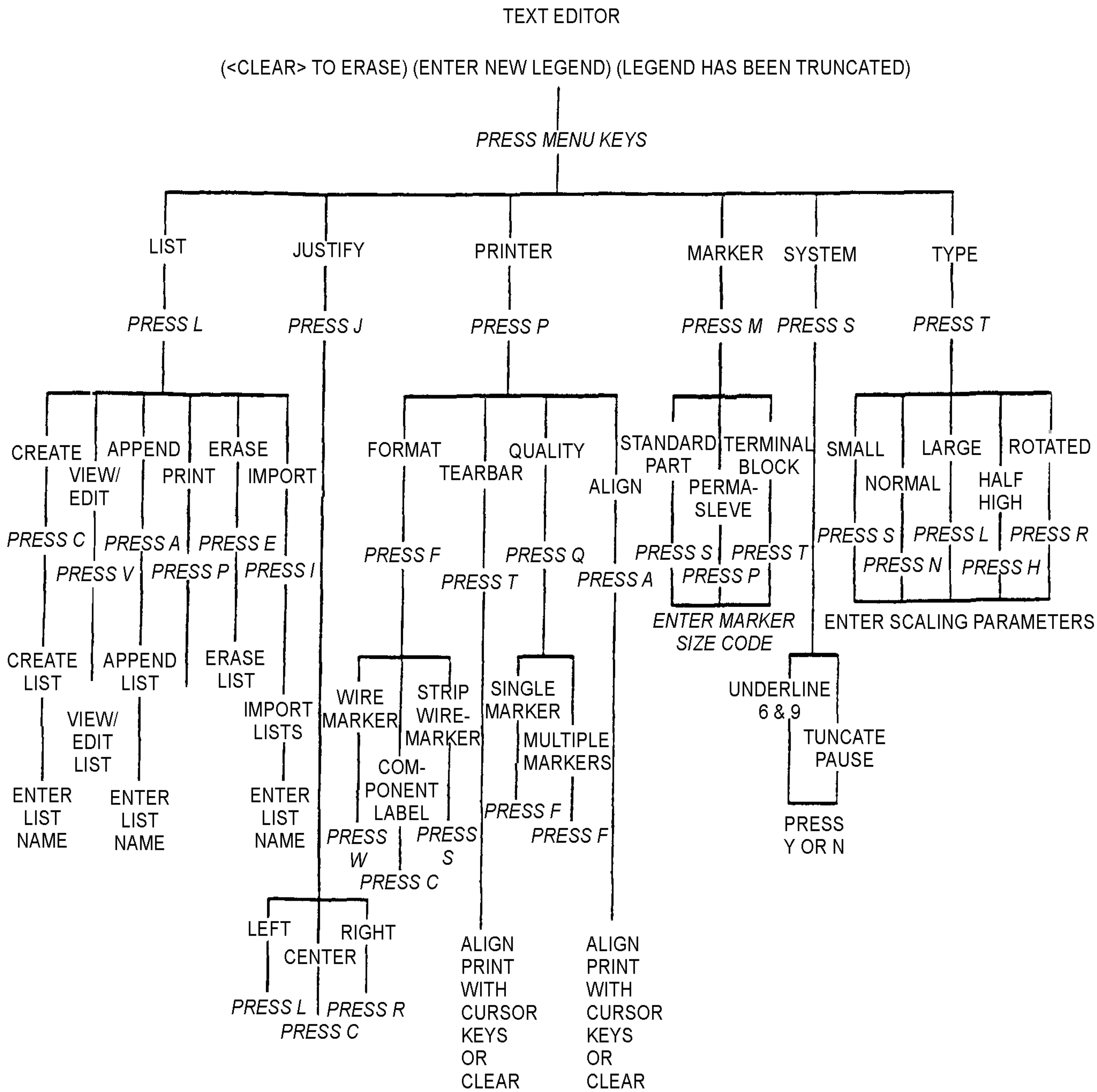


Figure 22. Menu Tree

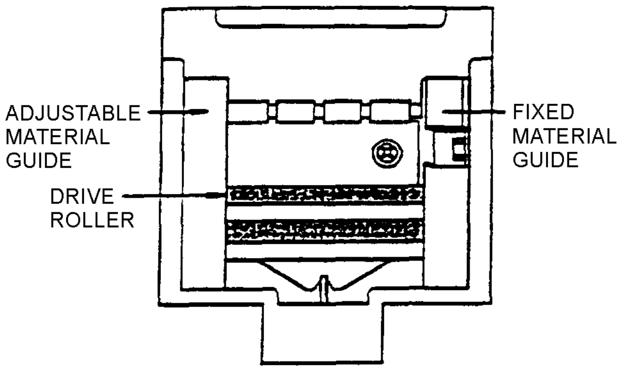


Figure 23. Drive Roller

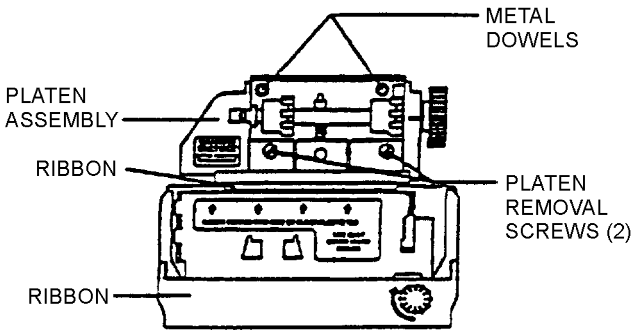


Figure 24. Platen Assembly

c. Gently lift platen assembly up until platen assembly frame clears metal dowels.

d. Remove platen from printer assuring not to disturb optic eye.

e. Remove any lint, ink or adhesive build-up on The face using isopropyl alcohol and a clean rag.

f. Before installing platen assembly, clean printhead and material clamp.

84 . **Printhead Mask.** The printhead mask is a clear, thin plastic shield with 7 holes punched in it. It is located between the platen and printer assemblies. With platen assembly removed, clean outside surface of printhead mast using isopropyl alcohol and a cotton swab. Remove any black, lint around printer (Figure 25)

85 . **Material Clamp.** The material clamp is a thin metal foil that forces the label material against the platen assembly during operation. Clean tabs of material clamp using isopropyl alcohol and a cotton swab. Assure material clamp fingers are not excessively flexed.

86 . **Platen Assembly Installation.**

CAUTION

Do not bend the material clamp down or bend the optic eye bracket.

a. Gently place platen assembly onto printer frame by aligning holes of platen assembly frame over metal dowels on printer frame (Figure 24)

b. Tighten platen removal screws into printer frame.

c. Install printer ribbon.

87 . **Tear-Off Blade Cover Bar.** The cover bar shields the label material from the tearbar during printing process. It is located along the ribbon cover door on top of printer. Clean cover bar using isopropyl alcohol and a clean rag.

88 . **TROUBLESHOOTING.** Refer to Table 11 for printing problems and probable corrective actions.

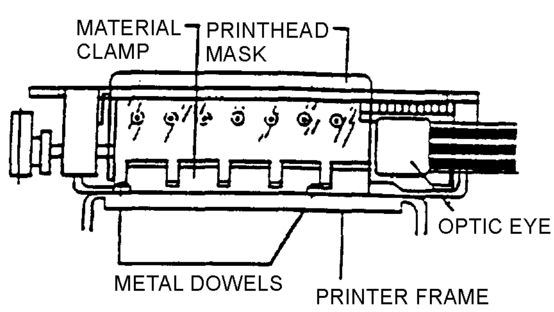


Figure 25. Material Clamp

Table 11. TROUBLESHOOTING

Symptom	Probable Cause	Corrective Action
Labels not advancing.	Label is stuck on material.	Remove label from path by removing the platen assembly.
	Labels are not inserted into material guides correctly.	Reinsert material if necessary.
	Dirty drive roller, platen, mask, or material clamp.	Clean printer.
	Adjustable material guide is not in grooved clamp.	Move guide into one of the slots and try feeding. Ensure guide is centered in slot.
	Bent material clamp.	Check platen assembly; remove the assembly. Inspect the material clamp fingers for damage. If bent down, send the printer to a depot maintenance repair facility.
Printing is faint and hard to read.	Ribbon is worn.	Change ribbon. (Ribbon should last approximately 250,000 characters or 3 to 6 months, depending on environment.)
	Batteries are low.	Connect adapter charger to printer. Attempt to print while still connected. If printer works, charge for at least 16 hours.
	Wrong printhead gap setting.	Adjust printhead setting.
	Ribbon is installed incorrectly.	Remove ribbon and reinstall.
	Ribbon is not advancing due to broken printer gear.	Send the printer to a depot repair facility.
Printing runs of the label.	Incorrect material size code entered.	Check the material size code on inside of the roll core or marker packaging and enter the correct size code. Be sure not to enter a zero in the size code if not specified. Use spacebar to remove the unwanted character.
	Printing not aligned properly.	Align the print on the label.
	Optic eye failure.	Send the printer to a depot repair facility.
Label is missing characters.	Printing over ribbon weld.	Printer will periodically strike the ribbon weld. Turn the manual ribbon advance knob on the ribbon clockwise to advance the ribbon past the weld.
	Broken printhead pin or inoperative solenoid. Markers will consistently have missing areas of print.	Send printer to a depot maintenance facility.
	Platen assembly was installed incorrectly	Check the platen assembly; inspect. the material clamp fingers for damage. If bent down, send printer to a depot maintenance facility.
Printer is smearing labels.	Printhead gap is too small.	Adjust printed setting.
	Platen, mask, material clamp, or tearbar cover is dirty.	Clean printer.
	Ribbon is not installed correctly.	Remove the reinstall ribbon.

Table 11. TROUBLESHOOTING (Cont.)

Symptom	Probable Cause	Corrective Action
Printer will not operate on batteries.	Batteries are not charged.	Connect the adapter/charger to the printer. Charge the battery for at least 16 hours before operating solely on battery power.
	Battery's life has expired.	Battery life is approximately two to three years, depending on use and care of battery.
	Blown fuse.	Send printer to a depot maintenance facility.
Scanning error or feed malfunction message.	Wrong product selection.	Change product selection.
	Label is stuck inside printer.	Remove the bottom cover and inspect for a stuck label. If not found in this compartment, remove the label from the printer by removing the platen assembly.
Errors:	Optic eye failure.	Send printer to a depot maintenance facility.
Markers skewed right or markers skewed left.	Material is wandering right or left.	Verify that adjustable material guide is in the correct position and resting in a groove along the guide shaft. Check that the printer cover is closed and the outfeed guide is properly adjusted.
Printer is emitting a beeping tone.	Optic eye bracket has been bent.	Send printer to a depot maintenance facility.
	Battery power is low.	Connect the adapter/charger to the printer. Charge the battery for at least 16 hours before operating solely on battery power.
Errors (Cont.)		
Continuous tone coming from unit and printer has locked-up .	Label is stuck in printer.	Inspect for proper gap setting. Adjust the setting and then turn the printer OFF, then ON. If this does not solve the problem, inspect to see if a label is stuck inside the printer. Remove the label by removing the bottom cover or the platen assembly.
	Ribbon cartridge has locked-up.	Remove ribbon cartridge from printer and attempt to free it by pulling on the ribbon and advancing the ribbon gear, or change the ribbon.

89 . **BRADY MARKER SLEEVE INSTALLATION.** To install the marker sleeves after printing, perform the following:

a. Press FEED to move last printed sleeve above tear bar and tear sleeve along perforation to remove from printer (Figure 26)

NOTE

If wire has been stripped, use a scrap piece of unstripped wire to open end of marker.

b. Hold marker, printed side up, and press end of wire on lip of sleeve to open sleeve (Figure 27)

c. Push sleeve onto wire with gentle twisting motion.

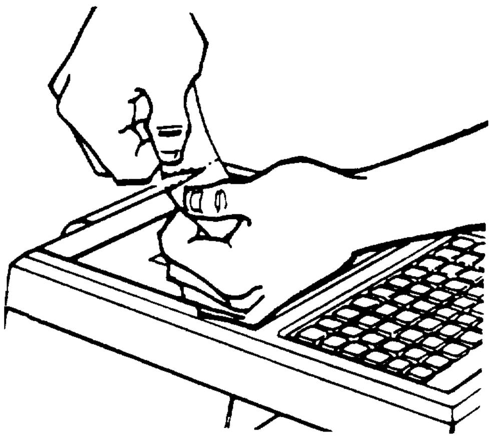


Figure 26. Removing Marker from Printer

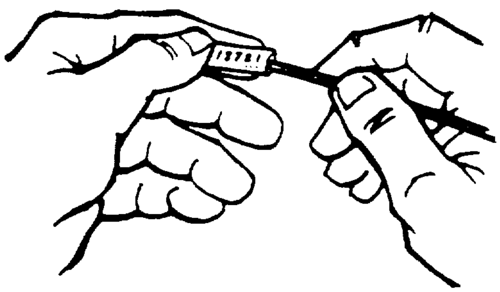


Figure 27. Inserting Wire into Marker

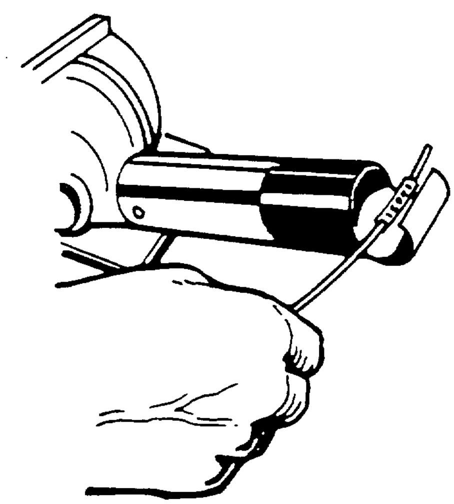


Figure 28. Shrinking Marker on Wire

d. Shrink marker sleeve, using heat gun with shrink tubing attachment (Figure 28)

90 . **TEMPORARY WIRE AND CABLE MARKING PROCEDURE.**

91 . A temporary wire marking procedure may be used only with approval of the authorized maintenance department head (Figure 29)

a. With pen or typewriter, write wire number on good quality white paper.

b. With pair of scissors trim excess paper, leaving just enough for one wrap around wire to be marked, with number fully visible.

c. Position marked paper on wire so that shielding, ties, clamps, or supporting devices need not be removed to read number.

d. Obtain clear plastic sleeve long enough to extend 1/4 inch past paper marker edges and wide enough to overlap itself when wrapped around paper marker and wire.

e. Slit clear sleeve lengthwise and place around paper marker and wire.

f. Secure each end of clear sleeve with lacing tape spot tie to prevent loosening of sleeve.

92 . **MARKER INSTALLATION WITH LACING TAPE.**

93 . A marker may be secured to the cable with lacing tape (Figures 30 through 32).

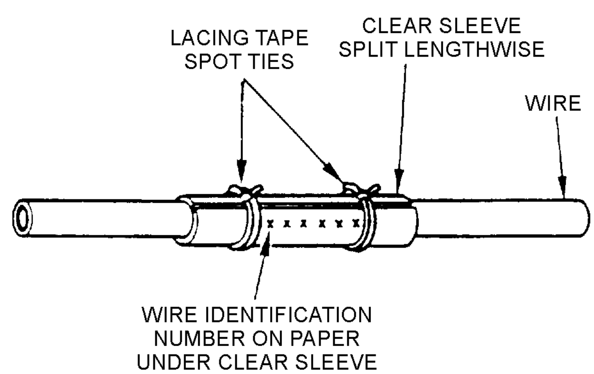


Figure 29. Temporary Wire Identification Marker

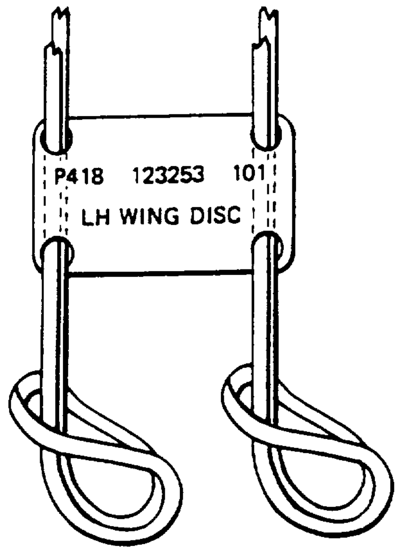


Figure 30. Installing Tape to Marker

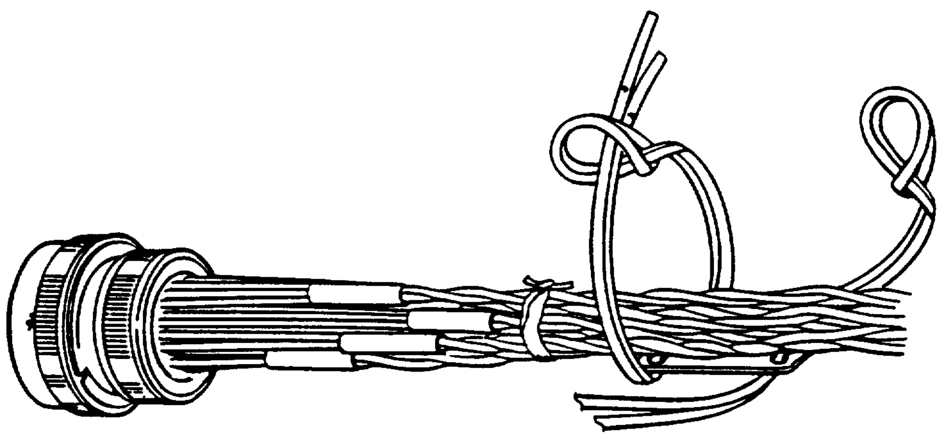


Figure 31. Installing marker to Harness

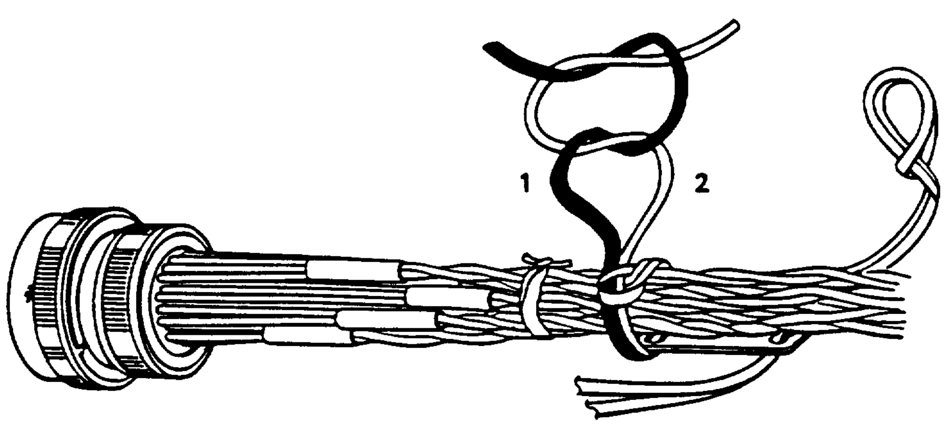


Figure 32. Securing Marker to Harness.

WIRE AND CABLE STRIPPING

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRICAL AND ELECTRONIC WIRING

Reference Material

Low Frequency, Multiconductor Round Cable Description and Replacements 005 00
Wire Characteristics and Substitutions 004 00
Installation Practices, Aircraft Electric and Electronic Wiring, Wire and Cable Stripping . . . . . . NAVAIR 01–1A–505.3
Wire, Electric, Polyimide Insulated Cooper or Copper Alloy MIL–DTL–81381
Cable, Electric, Filter Line, Radio Frequency Absorptive MIL–C–85485
Wire, Electric, Polyvinyl Chloride Insulated MIL–W–5086
Wire, Electric, Fluoropolymer Insulated Copper or Copper Alloy MIL–W–22759
Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane–imide Polymer or Polyarylene Insulated
Copper or Copper Alloy MIL–W–81044

Alphabetical Index

Subject — Page No.

Record of Applicable Technical Directives

None

1 . **INTRODUCTION.**

2 . This work package (WP) covers the procedures, tools, and specifications required for the proper preliminary preparation and stripping of wires and cables. Wire and cable selection are covered in WP 004 00 and WP 005 00. Before wires and cables can be assembled to connectors, terminals, and splices the insulation and shielding, if applicable, must be stripped to expose the center conductor.

3 . **WIRE PREPARATION.**

CAUTION

Ensure that proper cutting tools are used and that cutting surfaces are clean, sharp, and free from nicks.

Support Equipment Required

Part Number / Type Designation	Nomenclature
45–169	Custom Stripmaster Wire Stripper
45–170	Custom Stripmaster Wire Stripper
45–171	Custom Stripmaster Wire Stripper
45–172	Custom Stripmaster Wire Stripper
45–173	Custom Stripmaster Wire Stripper
45–174	Custom Stripmaster Wire Stripper
45–178	Custom Stripmaster Wire Stripper
45–179	Custom Stripmaster Wire Stripper
45–1513	Custom Stripmaster Wire Stripper
45–1551	Custom Stripmaster Wire Stripper
45–1608	Custom Stripmaster Wire Stripper
45–1609	Custom Stripmaster Wire Stripper
45–1610	Custom Stripmaster Wire Stripper
45–1611	Custom Stripmaster Wire Stripper
45–1654	Custom Stripmaster Wire Stripper
45–1672	Custom Stripmaster Wire Stripper
45–1924	Custom Stripmaster Wire Stripper
45–631	Custom Stripmaster Lite Wire Stripper
45–632	Custom Stripmaster Lite Wire Stripper
45–633	Custom Stripmaster Lite Wire Stripper
45–634	Custom Stripmaster Lite Wire Stripper

Support Equipment Required (Cont.)

Part Number / Type Designation	Nomenclature
45–635	Custom Stripmaster Lite Wire Stripper
45–636	Custom Stripmaster Lite Wire Stripper
45–637	Custom Stripmaster Lite Wire Stripper
45–640	Custom Stripmaster Lite Wire Stripper
45–2112	Custom Stripmaster Lite Wire Stripper
45–2114	Custom Stripmaster Lite Wire Stripper
45–2118	Custom Stripmaster Lite Wire Stripper
45–2124	Custom Stripmaster Lite Wire Stripper
45–2125	Custom Stripmaster Lite Wire Stripper
45–2128	Custom Stripmaster Lite Wire Stripper
45–2129	Custom Stripmaster Lite Wire Stripper
45–2131	Custom Stripmaster Lite Wire Stripper
45–2132	Custom Stripmaster Lite Wire Stripper
45–2133	Custom Stripmaster Lite Wire Stripper
45–2138	Custom Stripmaster Lite Wire Stripper
45–2139	Custom Stripmaster Lite Wire Stripper
45–128	Cable Stripper
45–129	Cable Stripper
45–162	Coaxial Cable Stripper
45–163	Coaxial Cable Stripper
45–164	Coaxial Cable Stripper
45–165	Coaxial Cable Stripper
45–100	V–Notch Stripper
45–101	V–Notch Stripper
45–123	T–Cutter
45–350	Lite–Strip Optical Fiber Stripper
35–053	Cable Shear, Hand
	Cable Shear, Bench
	Vise, Saw

4 . **GENERAL.**

5 . **STRIPPING PROCEDURES.**

6 . **GENERAL STRIPPING PROCEDURES**. When stripping wire or cable observe safety precautions to avoid personal injury to yourself and to others.

a. Use the correct tool for the task.

b. Ensure that blades are clean, sharp, and free of grease, oil and solvents.

c. Ensure that all insulation is removed from the stripped wire as some wire has a transparent layer between the conductor and the insulation.

d. Where stripped insulation remains on the wire, remove by twisting the insulation in the direction of the natural lay.

e. Ensure that insulation is cut clean with no frayed edges and trim if necessary.

f. In cases where insulation to be stripped is greater than 3/4 inch long, it is easier to accomplish in two or more operations.

g. Retwist conductor strands by hand, if necessary, to restore the natural lay and tightness of strands.

CAUTION

When using pliers to retwist conductor strands, use with care to prevent damaging or cutting wire strands. When using hands to retwist conductor strands, assure hands are clean and free of oil, grease, and solvents before handling stripped conductor as these affect solderability and conductivity.

h. Nicked or broken strands must be within tolerance (Table 1). Longitudinal scratches in copper wire are not considered cause for rejection or rework.

Table 1. Allowable Nicked or Broken Strands of Wire

Number of Strands per Conductor*	Total Allowable Nicked or Broken Strands
1 and 7	None Nicked, Broken or Severed
19	2 Nicked, None Broken or Severed
37	4 Nicked, None Broken or Severed
More than 37	6 Nicked, None Broken or Severed

*No nicked or broken strands are permitted for aluminum conductor regardless of the number of conductor strands.

A. Select proper wire stripper from table 2 or 3.
B. Place wire into exact center of correct cutting slot for wire size to be stripped. The exposed end is amount of insulation to be stripped, adjust wire in slot to strip correct amount of insulation.

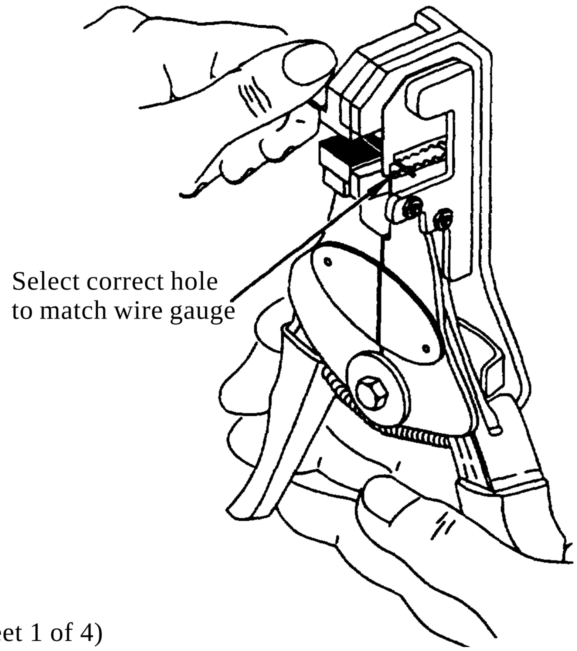


Figure 1. Wire Stripping (Sheet 1 of 4)

C. Slowly partially close handles and allow wire to center itself in size slot as the wire gripper or jaws apply pressure to wire.
D. Close handles with firm steady pressure and strip insulation from wire.

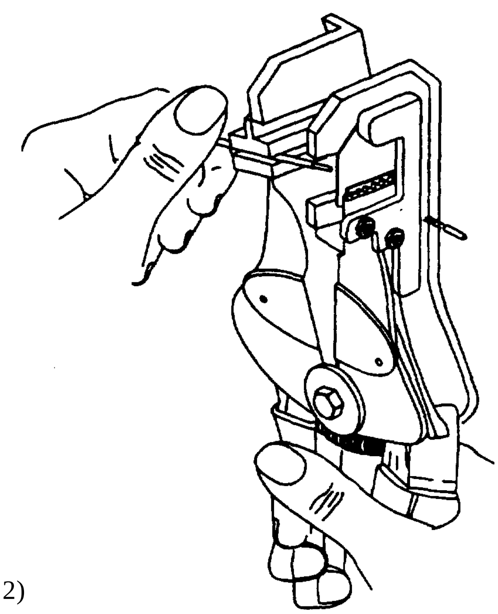


Figure 1. Wire Stripping (Sheet 2)

E. Partially release handle pressure to allow jaws to open and remain separated. Remove stripped wire from stripper. Partial pressure release is a mechanical feature which prevents jaws from fully closing and damaging or bird caging of stripped end of wire.

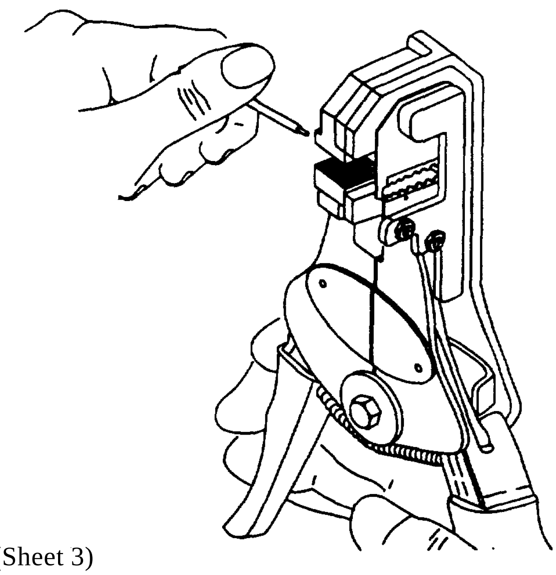


Figure 1. Wire Stripping (Sheet 3)

F. After stripping, twist strands of wire firmly together in same direction as normal lay of wire

G. Inspect wire for broken or nicked strands and frayed or ragged insula–tion. Restrip wire if necessary.

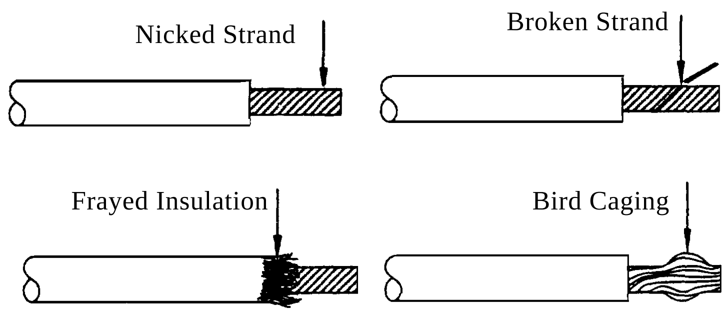


Figure 1. Wire Stripping (Sheet 4)

7. **MILITARY COPPER AND ALUMINUM WIRE STRIPPING.** The procedure and proper use of the hand stripping tools are discussed in the following text. Refer to the general stripping procedures for proper methods.

a. Select the proper hand stripping tool by wire type to be stripped (See Table 4).

b. The handles must be fully open and the stripping jaws open prior to stripping. When either the handles or jaws are closed, recycle the handles and start the procedure again.

c. Upon determination of the proper wire size, place the wire perpendicular in the corresponding size slot in the stripper. The exposed end is the amount of insulation to be stripped, adjust the wire in the size slot to strip the correct amount (See Figure 1)

d. Slowly, partially close the handles and allow the wire to center itself in the size slot as the wire gripping feature or jaws apply pressure to the wire.

e. Close the handles with a firm steady pressure to strip the insulation from the wire (see Figure 1).

f. Upon completion of the stripping partially release the handle pressure to allow the jaws to open and remain separated. Remove the stripped wire. The partial pressure release is a mechanical feature which prevents the jaws from fully closing and damaging or bird–caging the stripped end of the wire (see Figure 1).

NOTE

Some tools will have automatic stops or an automatic wire release to prevent bird–caging.

g. With the stripped wire removed, sharply squeeze the handles closed to release the mechanical lock and release handles to allow stripper to return to the starting position.

8. **INSPECTION OF STRIPPED WIRE.** Inspect stripped wire as follows:

a. Visually inspect the wire and determine if any of the following conditions exist (see Figure 1).

(1) Nicked or cut strands (see Table 1).

(2) Frayed insulation.

(3) Broken wire strands (see Table 1)

(4) Bird–caged strands.

CAUTION

Care should be exercised when smoothing insulation or twisting conductors as nicked, frayed, or broken strands can cause injury.

b. When the above conditions exist and are within the limits of Table 1, correct and reshape conductor strands by twisting the strands in the same direction of the normal lay of wire. Do not over twist. Some scraping or longitudinal scratches are permissible provided the base metal is not exposed when viewed without magnification.

c. If only untwisting or birdcaging occurs due to human error, correct and reshape conductor strands by twisting the strands in the same direction on the normal lay of the wire. The conductor is recommended only to be twisted by hand. If pliers are required due to the size of the strands, caution shall be taken to prevent damage to the conductor. The conductor shall not be over twisted.

d. The wire insulation shall not be punctured, crushed, or cut by the tool. The insulation deformation shall not exceed 20% of the insulation thickness. The insulation shall not have gouges, ragged edges, be loose nor frayed. The end of the insulation shall be cut as squarely and cleanly as required to meet any soldering or crimping requirements.

e. When the above conditions exist and are out of tolerance limits, cut off stripped portion and start the procedure again, wire length permitting. When wire length does not permit, start again with a new length of wire.

9 . **STRIPPED LENGTH INSPECTIONS**. Length of the strip is dependent upon the termination application. Inspect the length as follows:

a. The last insulation slug should not be removed until immediately prior to termination.

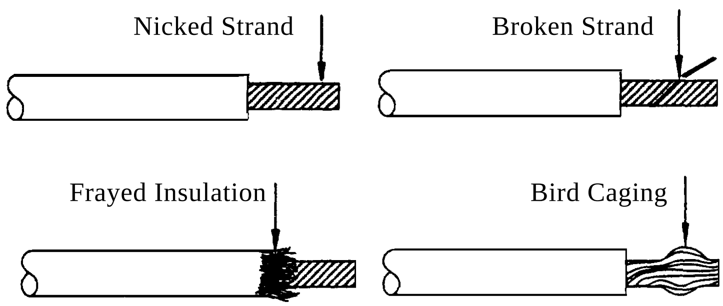


Figure 2. Unacceptable Stripped Wire Conditions

b. For termination to contacts crimped by indenters or soldered, the length of stripped portion of the conductor shall be at least long enough to reach the bottom of the barrel or beyond the inspection hole.

c. For termination to terminals or splices crimped by form dies, the length of the stripped portion of the conductor shall be long enough to reach the conductor stop or extend beyond the crimp barrel.

d. The length of the stripped portion of the conductor must also include the maximum exposed length of conductor between the insulation and the barrel. The length of the exposed area is application sensitive.

10 . **AEROSPACE STANDARD FOR WIRE STRIPPER TOOLS.** The Aerospace Standard AS5457 provides technical information for wire stripper tools used to strip aerospace wire sizes 10–30 AWG. The AS includes inspection criteria for the tool and the stripped end of electrical wire.

11 . The wire stripper tool shall have either die–type blade design with a counter–bored hole sized to the insulation and an inner cutting hole sized to the conductor. The wire stripper tool shall typically have a single–squeeze operation and plastic or cushioned hand grips for handling ease. Adjustable wire stops are recommended.

12 . The blades of wire stripper tools can have different profiles. The preferred profile is shown in Figure 3. When the wire stripper tool is closed the edges of the blades shall be in the same plane and form a cutting circumference whose diameter is greater than the maximum diameter of the conductor of the wire to be stripped (see Figure 4).

13 . **THERMAL STRIPPER TOOL**. Some wires with PVC insulation may be stripped using thermal stripping tools. Thermal stripping is recommended for these wires to reduce the possibility of conductor damage. Proper safety and procedures should be adhered to. Refer to general stripping procedures paragraph 6. Use thermal strippers as follows:

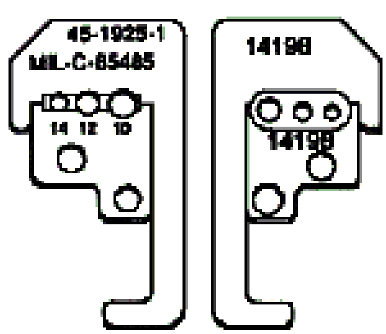


Figure 3. Preferred Wire Stripper Blade Profile.

WARNING

Thermal strippers can cause serious burns. Keep flammables away from thermal strippers. Do not leave thermal strippers unattended during operating or cool down.

Insulation emits toxic fumes during thermal stripping. Use adequate ventilation to avoid breathing toxic fumes. Overexposure will cause dizziness or headaches.

a. Ensure that stripping blades are free and clear before power is applied.

b. Insert wire into proper size slot in stripping blades.

c. Close stripping blades to apply heat.

d. Apply slight pulling pressure on wire to separate insulation.

e. When insulation is separated, pull wire from stripping blades.

f. Allow wire to cool before handling. Inspect for the following:

(1) Insulation is not charred or blistered.

(2) Installation is not pulled in strings adhering to the conductor.

(3) All insulation is removed from the conductor.

(4) Conductor is not damaged.

g. Allow the thermal stripping tool to cool before cleaning.

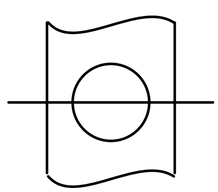


Figure 4. Acceptable Wire Stripper Blade Cavity Is Cylindrical and Forms a Complete Perimeter.

14. **STRIPPING THERMOCOUPLE WIRE.** The procedure for stripping thermocouple wire is the same as for conventional wire using hand stripper tools.

CAUTION

Assure no damage to the insulation of individual conductors beneath outer jacket occurs during stripping.

Assure that equal amounts of both wires are removed when cutting thermocouple wiring. If lengths removed are not equal, wrong temperature indications will occur.

a. Cut the outer jacket of the thermocouple cable using a sharp blade or knife. Slit the outer jacket between parallel conductor wires. Remove the outer jacket (see Figure 6).

b. Insert the wire into the correct stripping die to strip 3/8 ± 1/16 inch of insulation. Squeeze the handles as far as they will go to strip insulation (see Figure 7 and paragraph 8).

c. Release handles slightly to remove the wire from the stripper. Assure the strands are twisted together in the normal direction of lay with no broken strands (see Figure 2 and paragraph 9).

15. **CABLE STRIPPING.** Cut all cables to proper length as directed by the applicable drawings or wiring diagrams. Exercise care and cut wire so that cut is clean, square, and not deformed, see Figure 8.

16. **CABLE JACKET STRIPPING.** The general procedures for stripping cable wires are the same as in Paragraph 6.

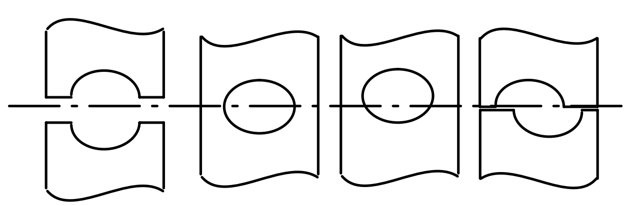


Figure 5. Unacceptable Wire Stripper Blade Cavities Have Asymmetrical Shapes. Do Not Form Complete Perimeters.

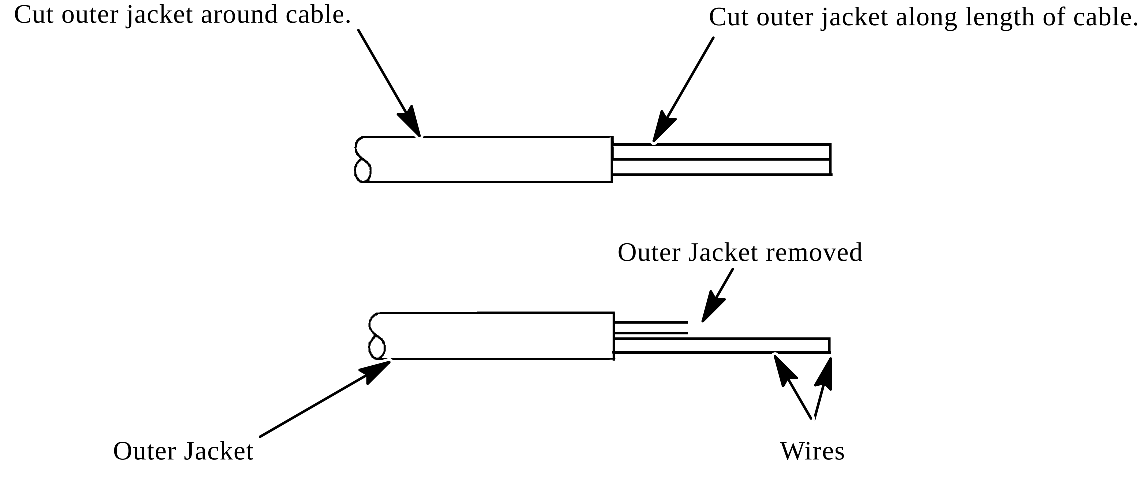


Figure 6. Removing Outer Jacket

17. **CABLE JACKET STRIPPING, SWIVEL BLADE STRIPPER TOOL.** The swivel blade stripper (see Figure 9) is a hand tool used to strip cable jackets with cable diameters of 1/4 to 1 1/2 inches and is available in three sizes as shown in Figure 2 and Figure 9. This tool has a swivel blade which automatically turns to the direction the tool is moved, which enables circular cuts to be made or axial cuts to be made. This type of tool may be used to strip a variety of insulations including, but not limited, to PVC, rubber, neoprene, Teflon, nylon, fiberglass, and fabric. As with all hand tools, exercise care to avoid injury and damages to wires and wire strands.

Table 2. Round Cable Slitting and Ringing Tools

Cable Size O.D.	Cable Stripper Part No.	Blade Replacement Part No.
.25 in. to .75 inch	45–128	L–7486
.75 in. to 1.5 inch	45–129	L–7486

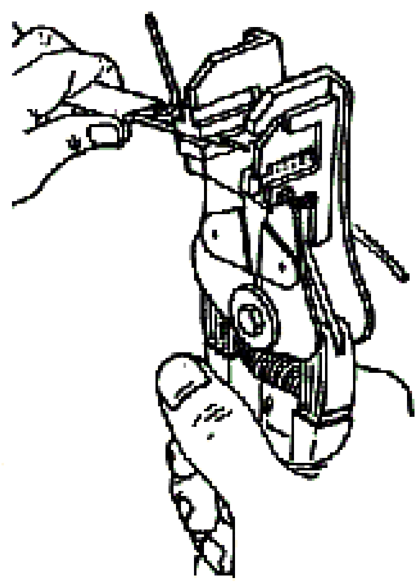


Figure 7. Insulation Removal

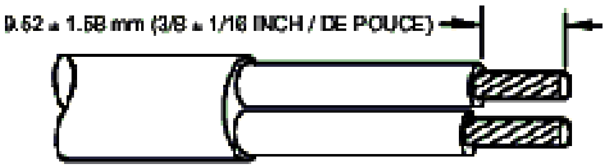


Figure 8. Completed Strip

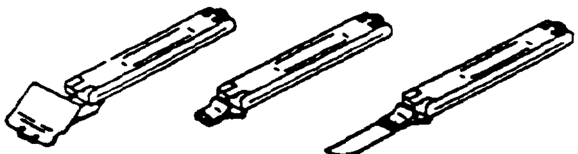


Figure 9. Swivel Blade Cable Strippers

18 . **CABLE JACKET CIRCULAR CUT, SWIVEL BLADE STRIPPER TOOL.** The procedure and proper use of this tool is discussed in the following:

a. Adjust blade depth by turning the adjustment knob on the end of the tool.

b. Place wire on tool to gage cutting depth required, adjust blade depth to cutting depth required. See Figure 10.

c. Push spring tension guide open and place wire in the tool where stripping is to be accomplished. Release spring tension guide. Jacket is now ready to be stripped.

d. Rotate tool around cable jacket to complete circular cut (see Figure 11). If cut is not complete readjust blade depth and repeat the procedure.

e. Non–concentric cable is not uncommon and can be stripped as concentric cable. Blade adjustment is set for the thinnest part of the jacket. Proceed as above; when cut is completed remove jacket with pliers.

19 . **CABLE JACKET AXIAL CUT, SWIVEL BLADE STRIPPER TOOL.** The procedure and proper use of the tool is discussed as follows:

a. Adjust the blade as for the circular cut.

b. Push spring tension guide open and place wire in the tool as for the circular cut.

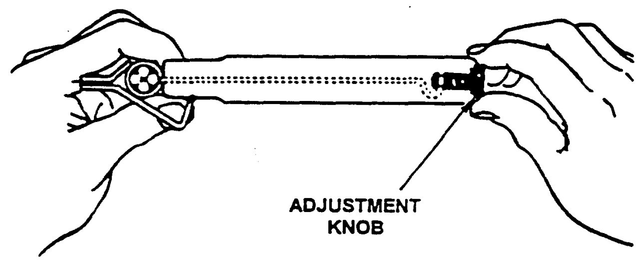


Figure 10. Blade Depth Adjustment

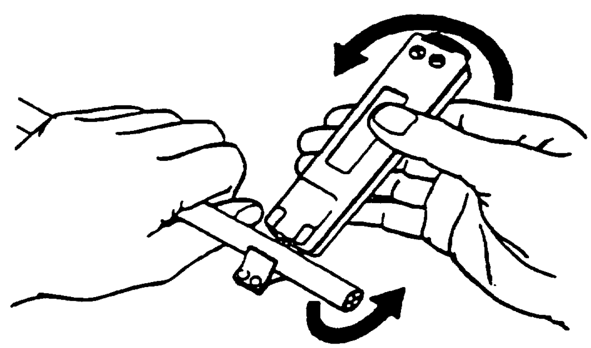


Figure 11. Swivel Blade Stripper Tool, CIrcular Cut

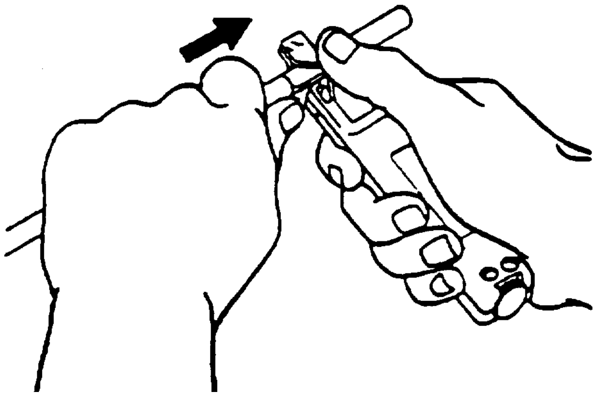


Figure 12. Swivel Blade Tool, Axial Cut

c. Place thumb firmly on back of the guide to prevent blade from riding out of jacket. Rotate cable slightly and pull tool toward the end of the cable (see Figure 12).

d. Due to the nature of some spongy or extra hard jackets the axial cut is difficult to accomplish. When this situation exists, make a circular cut at the beginning of the axial cut, and flex the cable to severe any remaining jacket.

e. Use a pair of pliers and peel off jacket along the scored lines.

20 . **STRIPPING COAXIAL CABLE.** The stripping process of coaxial cable is critical, as damage to the jacket, outer conductor, dielectric, or inner conductor will cause system degradation and possible failure. Refer to general stripping procedures for proper methods and safety precautions.

21 . **COAXIAL CABLE HAND STRIPPER TOOL.** Coaxial cable strippers are unique in that they have two blades located on each side of the tool and a round blade attached to the front (see Figure 13). Circular stripping blades are located on each side of the tool. These may be adjusted individually for the type of strip desired. By flipping one or both of these blades the stripping dimension can be varied. Wider dimensions can be obtained by spacing with blades. The depth of the cut is also adjustable. An axial stripping blade is the round blade attached to the front of the stripper, and is used to slit the cable axially. There are four types of coaxial cable strippers. Table 3 lists the part number, cable outer diameter size, and the stripping dimensions.

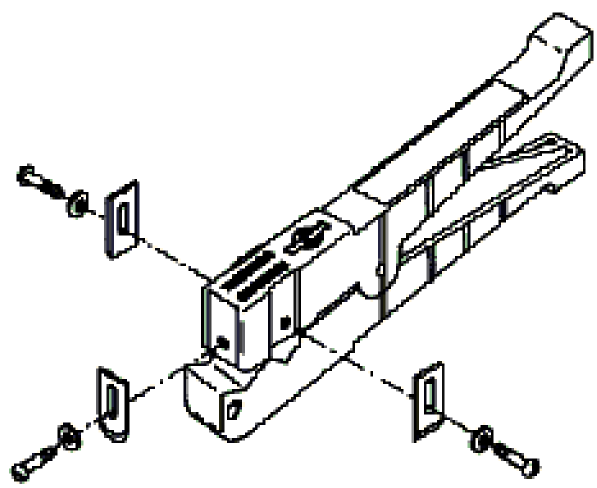


Figure 13. Coaxial Cable Strippers

Table 3. Coaxial Cable Stripping Tools

Cable Size O.D.	Stripping Dimensions	Cable Stripper Part No.	Blade Replacement Part No.
up to .125 inch	.230 to .275 inch	45–162	L–9225
.125 to .219 inch	.230 to .275 inch	45–163	L–9225
.25 to .5625 inch	.230 to .275 inch	45–164	L–9226
.188 to .313 inch	.48 to .53 inch	45–165	L–9225

Round Slitting Blade Replacement Part No. for 45–162, 45–163, 45–164, 45–165: L–9214

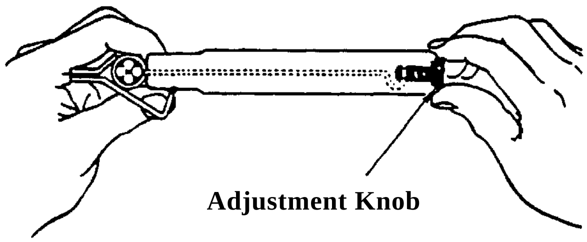


Figure 14. Coaxial Stripper Blade Adjustment

22 . **COAXIAL CABLE STRIPPING, COAXIAL CABLE STRIPPING TOOL.** The procedure and proper use of the coaxial cable stripping tool as follows:

a. Adjust the blades to the applicable stripping dimensions. Do not tighten the screws (see Figure 14).

b. Adjust the cutting depth of the blades so that the jacket will be scored without damage to the shield. Tighten the screws.

c. Position the tool on the cable so that an excess length of cable will be left when stripping operations are complete.

d. Spin the tool around the cable until maximum cutting depth is obtained (see Figure 15).

e. With the rounded blade installed in front of the tool, place the cable in the front notch and pull through.

f. Peel off the jacket.

g. Adjust the blades to the dimension of exposed dielectric needed. Do not tighten the screws.

h. Adjust cutting depth of the blades so that the shield will be scored without damage to the dielectric. Tighten screws.

i. From cable jacket, measure applicable shield strip dimension (see WP 015 00). The inside blade must score shield at this point.

j. Position the tool on cable in accordance with step i.

k. Spin tool around cable until maximum cutting depths obtained (see Figure 15).

l. Pull off excess shield.

m. The dielectric may be stripped using a hand strip tool, or by insertion of stripped portion of cable in tool opposite of step c and repeat operations.

n. Flex dielectric to severe score cuts and pull off dielectric.

23 . **TRIAXIAL CABLE STRIPPING.** Triaxial cables are cut and stripped the same as coaxial cables.

24 . HAND STRIPPING TOOLS.

25 . Select the proper hand stripping tool by wire type to be stripped (Table 4 and 5).

a. Use the correct tool for the task.

b. Assure that blades are clean, sharp and free of grease, oil and solvents.

c. Assure that all insulation is removed from the stripped wire. Some wire has a transparent layer between the conductor and the insulation.

d. Where stripped insulation remains on the wire, remove by twisting the insulation in the direction of the natural lay.

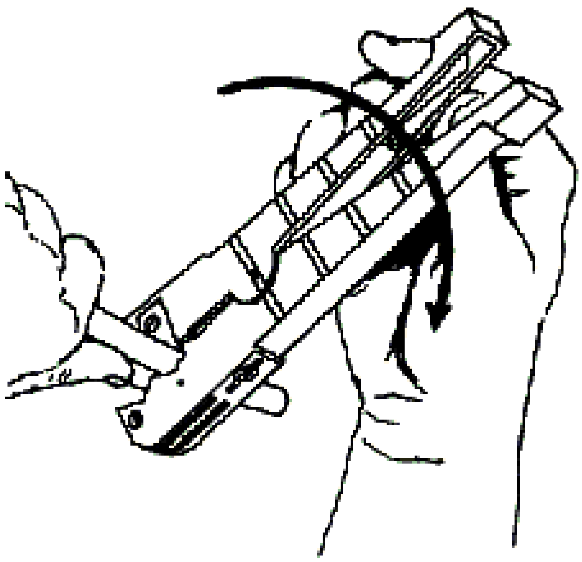


Figure 15. Coaxial Cable Stripping

e. Assure that insulation is cut clean with no frayed edges (see Figure 16). Trim, if necessary.

f. In cases where insulation to be stripped is greater than 3/4 inch long, it is easier to accomplish in two or more operations.

g. Twist conductor strands by hand or by pliers, if necessary, to restore the natural lay and tightness of strands.

h. Nicked or broken strands must be within tolerance (Table 1). Longitudinal scratches in copper wire are not considered cause for rejection or rework.

26. **T–CUTTER.** T–Cutter mold features hardened–steel, shear type blades that cut up to 1/2 inch fine stranded cable and AWG 10 solid wire. Its primary application is construction/maintenance production (Figure 17).

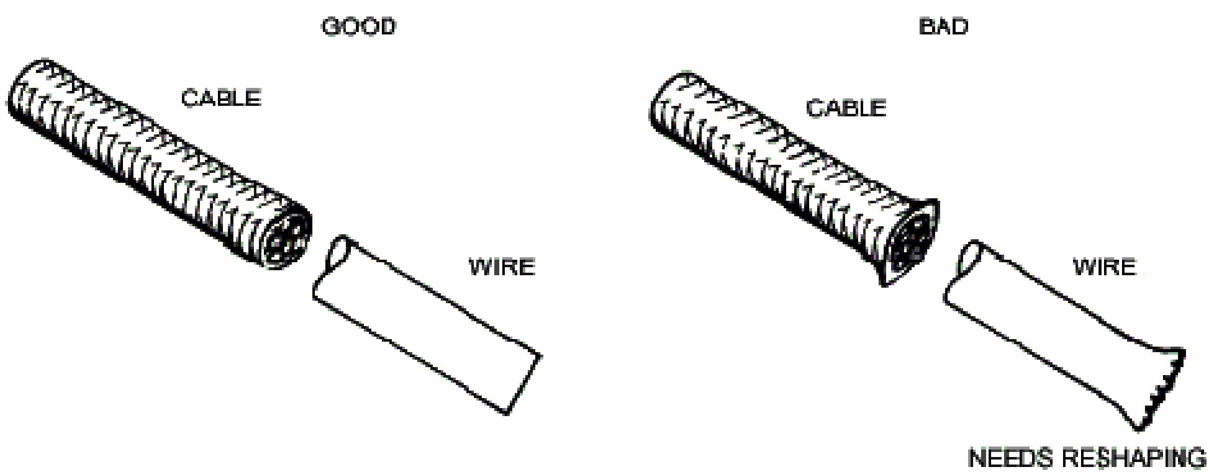


Figure 16. After Cutting

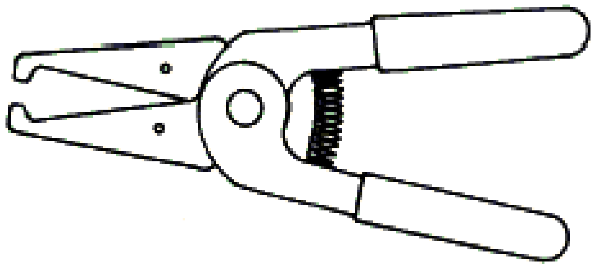


Figure 17. T–CUTTER

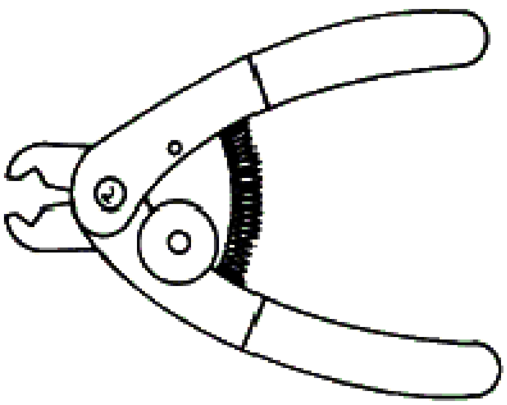


Figure 18. V–NOTCH STRIPPER

27 . **V–NOTCH STRIPPER.** V–notch stripper model both strips and cuts solid and stranded copper and aluminum wire from AWG 10 to 28. Features a convenient dial–type adjustment. Its primary application is construction/maintenance production (Figure 18)

28 . **Shear Type Cutters.** A shear type cutter is one where the blades pass each other. This type cutter will preserve the symmetry of the wire (Figure 19)

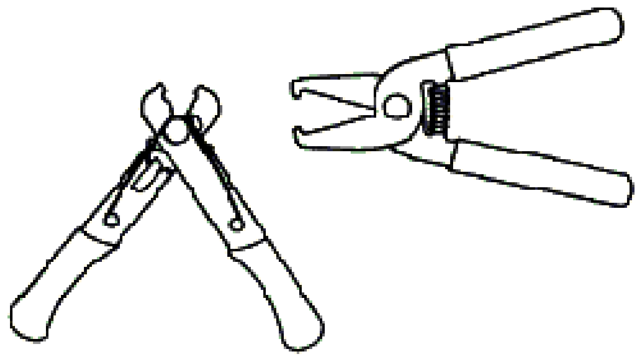


Figure 19. Shear Type Cutter

29 . **LITE–STRIP OPTICAL FIBER STRIPPER.** Lite–strip optical fiber stripper model precisely strips outer cable jacket insulations, tight buffer tube installations, and mechanically strippable coatings (Figure 20). Features of this model are as follows:

a. Blades are knife–type, made of hardened steel and replaceable.

b. Precision–ground, dual V–Notch blades strip a wide range of outer cable jacket insulation sizes.

c. Built–in blade guides ease positioning of optical fiber in the proper stripping hole.

d. Strips buffer and cladding to within 1/4 inch of outer cable insulation.

e. Plastic grips offer comfort and handling ease.

f. Convenient flat design fits easily into pocket, pouch, or tool kit.

g. Has an optional, adjustable wire stop.

Table 4. Hand Stripping Tools

Wire Type	Gage	Stripper Part No.	Blade Set Part No.
MIL–W–22759/9 and /10	16–26 10–14	45–174 45–173	L–5563 L–5562
MIL–W–22759/11 /12/16/17	16–26 10–14	45–1654 45–1611	45–1654–1 45–1611–1
MIL–W–22759/18 and /19	16–26 10–14	45–1551 45–1608	45–1551–1 45–1608
MIL–W–5086/1 and /2*	16–26 10–14	45–171 45–170	L–5211 L–5210
MIL–W–5086/4 /5 and /7	16–26 10–14	TBP TBP	TBP TBP
MIL–W–5086/6*	16–26	45–171	L–5211
MIL–W–22759/32 and /33	26–30 16–26 10–14	45–178 45–1513 45–1611	L–5561 45–1513–1 45–1611–1
MIL–W–22759/34 /35/41/42/43	16–26 10–14	45–1610 45–1611	45–1610–1 45–1611–1
MIL–W–81044 /6 and /7	16–26 10–14	45–171 45–170	L–5211 L–5210
MIL–W–81044 /9 and /10	16–26 10–14	45–174 45–173	L–5563 L–5562
MIL–W–81044 /12 and /13	26–30 16–26 10–14	45–178 45–1513 45–1611	L–5561 45–1513–1 45–1611–1
Wire wrapping (thin insulation) solid wire	24–30 30	45–169 45–179	L–9300 L–7625
General purpose stripping of plastic, fiberglass and other hard to strip insulations	26–30 16–26 10–14	45–172 45–171 45–170	L–5436 L–5211 L–5210
8.4 MIL MIL–DTL–81381/11 /12 /13 /14 /22 KAPTON	16–26 10–14	45–1654 45–1608	45–1654–1 45–1608–1
5.8 MIL MIL–DTL–81381 /1/2/5/6/7/8/9/10/21 KAPTON	16–26 10–14	45–1551 45–1609	45–1551–1 45–1609–1
4.6 MIL MIL–DTL–81381/17 /18/19/20 KAPTON	16–26	45–1672	45–1672–1
MIL–DTL–81381/3 and /4 KAPTON	16–26 10–14	45–1610 45–1611	45–1610–1 45–1611–1
MIL–C–85485/9 /10/11/12	16–26 10–14	45–1610 45–1611	45–1610–1 45–1611–1
MIL–C–85485/5 and /8	16–26	45–1924	
55A6251 55A6283 55A6315	16–26	45–1610	45–1610–1
*Possibly To Be Provided			
Wire Stripper Gripper Pad Replacement: Wire gauge 10–14 use Gripper Set Part Number: LB–197 Wire gauge 16–30 use Gripper Set Part Number: LB–198			

Table 5. Lite Hand Stripping Tools

Wire Type	Gauge	Lite Wire Stripper Part No.	Lite Wire Stripper Blade Set Part No.
MIL–DTL–81381/3 /4	16–22	45–635	LB–915
	20–26	45–636	LB–916
	24–30	45–637	LB–917
MIL–DTL–81381/17	16–22	45–2124	45–2124–1
	20–26	45–2125	45–2125–1
	24–30	45–640	LB–920
MIL–DTL–81381/18 /19 /20	16–22	45–2124	45–2124–1
	20–26	45–2125	45–2125–1
	20–26	45–2118	45–2118–1
MIL–DTL–81381/11 /12 /13 /14 /22	24–30	45–640	LB–920
	20–26	45–2114	45–2114–1
	16–24	45–2132	45–2132–1
	16–22	45–2124	45–2124–1
	20–26	45–2125	45–2125–1
MIL–DTL–81381/1 /2 /5 /6 /7 /8 /9 /10 /21	16–22	45–2124	45–2124–1
	20–26	45–2125	45–2125–1
	24–30	45–640	LB–920
MIL–W–81044/6/7	16–22	45–632	LB–912
	20–26	45–633	LB–913
	24–30	45–634	LB–914
MIL–W–81044/12/13	16–24	45–2131	45–2131–1
	16–24	45–2138	45–2138–1
	16–24	45–2132	45–2132–1
	16–24	45–2133	45–2133–1
MIL–W–5086/6*		N/A	N/A
MIL–W–5086/4/5/7		N/A	N/A
MIL–W–5086/1/2*		N/A	N/A
MIL–W–22759/9 /10	16–22	45–635	LB–915
	20–26	45–636	LB–916
	24–30	45–637	LB–917
MIL–W–22759/34/35/41/42/43	24–30	45–640	LB–920
	16–24	45–2133	45–2133–1
	20–26	45–2118	45–2118–1
MIL–W–22759/32	16–24	45–2133	45–2133–1
	16–24	45–2132	45–2132–1

Table 5. Lite Hand Stripping Tools (Cont.)

Wire Type	Gauge	Lite Wire Stripper Part No.	Lite Wire Stripper Blade Set Part No.
MIL–W–22759/33	16–24	45–2128	45–2128–1
	16–24	45–2129	45–2129–1
	20–26	45–2131	45–2131–1
MIL–W–22759/18/19	24–30	45–640	LB–920
	20–26	45–2114	45–2114–1
	16–24	45–2132	45–2132–1
	16–22	45–2124	45–2124–1
	20–26	45–2125	45–2125–1
MIL–W–22759/11/12	16–24	45–2138	45–2138–1
	18–26	45–2139	45–2139–1
	24–30	45–640	LB–920
MIL–W–22759/16/17	16–24	45–2131	45–2131–1
	20–26	45–2112	45–2112–1
MIL–W–81044/9/10	16–22	45–635	LB–915
	20–26	45–636	LB–916
	24–30	45–637	LB–917
MIL–C–85485/9/10/11/12		N/A	N/A
MIL–C–85485/5/8		N/A	N/A
Wire wrapping (thin insulation solid wire)	24–30	45–631	LB–911
General purpose stripping of plastic, fiber-glass, and other hard to strip insulations	16–22	45–632	LB–912
	20–26	45–633	LB–913
	24–30	45–634	LB–914
55A6315		N/A	N/A
55A6283		N/A	N/A
55A6251		N/A	N/A

Lite Wire Stripper Gripper Pad Replacement – Gripper Set Part Number: LB–1188

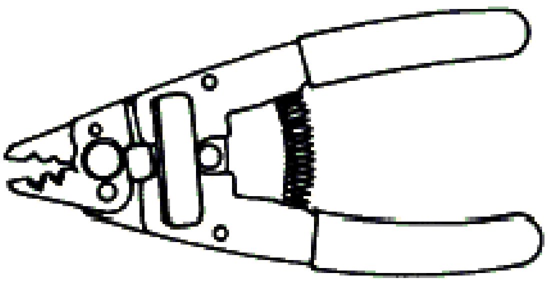


Figure 20. Lite–Strip Optic Fiber Stripper

30 . **STRIPMASTER WIRE STRIPPER.** Stripmaster wire stripper is a versatile production workhorse featuring single–squeeze operation. It strips wire clean up to a full 7/8 inch. Automatic feature holds jaws open for removing wire without crushing end. Ideal for lighter–gage wire (Figure 21). Features of this model are as follows:

a. Knife–type stripping blades penetrate the insulation like a knife for a clean cut.

b. Sturdy, die–cast body and frame.

c. Comfortable, cushioned hand grips.

d. Has an optional, adjustable wire stop.

31 . **SWIVEL–BLADE CABLE STRIPPER.** Swivel–blade cable strippers are used for both end or center stripping of coaxial and power cables from 1/4 inch to 1 1/2 inches outside diameter (OD). Strips insulation up to 5/32 inch thick including PVC, rubber, Neoprene, Teflon, polyethylene, Nylon, Kapton, fiberglass, fabric, and others (Figure 22).

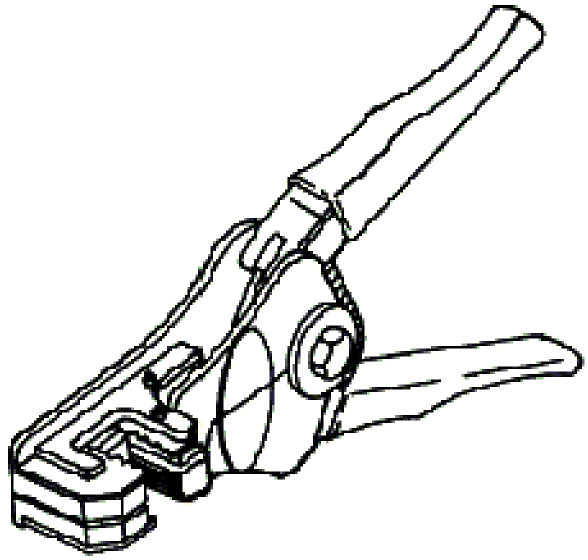


Figure 21. Stripmaster Wire Stripper

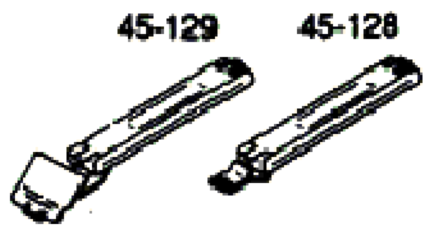


Figure 22. Swivel–Blade Cable Strippers.

a. 45–128. Cable stripper for 1/4 inch to 3/4 inch OD.

b. 45–129. Cable stripper for 3/4 inch to 1 1/2 inches OD.

32 . **COAXIAL CABLE STRIPPERS.** Coaxial cable strippers are unique in that they have two blades located on each side of the tool, and a round blade attached to the front (Figure 23).

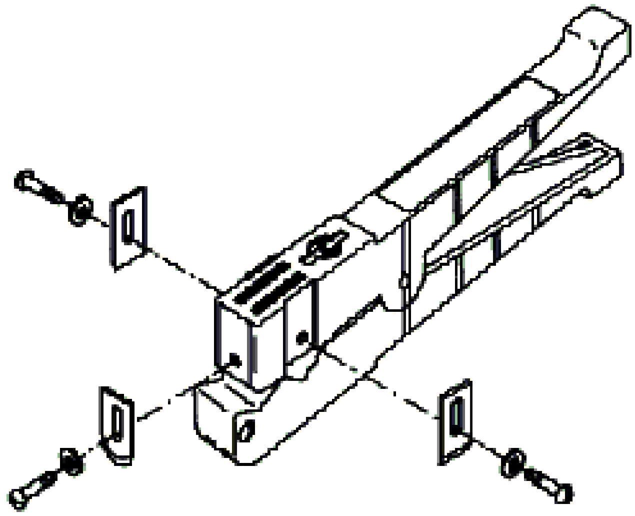


Figure 23. Coaxial Cable Strippers

a. Circular Stripping Blades. These blades are the two blades located on each side of the tool. These may be adjusted individually for the type of strip desired. By flipping one or both of these blades the stripping dimension can be varied. Wider dimensions can be obtained by spacing with blades. The depth of cut is also adjustable.

b. Axial Stripping Blade. This blade is the round blade attached to the front of the stripper, and is used to slit the cable axially. To slit the cable place cable in front notch of the tool and pull the cable through.

c. Types. There are four types of coaxial cable strippers (Table 3). This table lists the part number, cable outer diameter size, and stripping dimensions.

33 . **CUTTING COPPER WIRE.**

CAUTION

Do not use diagonal pliers to cut wire as conductor will be deformed.

Ensure the cutting surfaces are free of oil, grease, solvents and metal chips to ensure proper solderability, prevent corrosion and aid in conductivity.

34 . **LIGHT GAGE OR COPPER ALLOY.** Copper wire or copper alloy of light gage should be cut with a shear type cutter to ensure the cut is clean, square and not deformed. Wire sizes 8 and larger should be cut with cable shears.

35 . **HEAVY GAGE.** Heavy gage wire may be cut with a fine tooth hacksaw. A fine tooth hacksaw blade consists of 20 teeth or more per inch. A bench vise may be used to protect the wire and to avoid personal injury.

36 . **CUTTING COAXIAL CABLE.**

CAUTION

Ensure the cutting surfaces are free of oil, grease, solvents and metal chips to ensure proper solderability, prevent corrosion and aid in conductivity.

37 . When cutting coaxial cable or triaxial cable, care must be exercised not to damage the dielectric as severe system degradation will occur. A diagonal type cutter shall not be used as crimping will occur before the cutting action and is not repairable. A fine tooth hacksaw maybe used to cut cable, but the use of a vise is not recommend, as pressure applied will damage the dielectric. A swivel–blade stripper maybe used as a clean cut is afforded at a controlled rate.

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HARNESS INSTALLATION

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

NONE

Support Equipment Required

Nomenclature	Part Number/Type Designation
Hand Tool, Strap Installation	MS90387
Loop, Strap Fastener	GE21E1
Pliers, Padded Conduit	AT508K
Pliers, Slip Joint	–
Shears, Full Bypass	MFE–100
Tool, Clamp Assembly	ADEL560
Wrench, Strap	BT–BS–609 or BT–BS–610

Materials Required

Nomenclature	Part Number/Type Designation
Bag, Plastic	—
Clamp, Cushioned Metal	MS21919
Clamp, Plastic	MS25281
Grommet, Caterpillar	NASM22529
Grommet, Donut	MS35489
Shipping Cap, Plastic	MS90376, NAS831 or NAS837
Strap, Self-Clinching	AS33671
Tape, Black Non-Adhesive Self-Bonding	A–A–59163 TYPE II, 5970-00-955-9976
Tape, Finish C, Glass Tying, Size 2	—
Tape, Finish C, Glass Tying, Size 2	—
Tape, Finish C, Polyester Tying, Size 2	—
Tape, Finish C, Polyester Tying, Size 3	—
Tape, High-Temperature Pressure-Sensitive	A–A–59474
Tape, Non-Adhesive Silicone	—
Tape, Red Non-Adhesive Self-Bonding	A–A–59163 TYPE II, NSN 5970-00-955-9976
Tape, Self-Adhesive, Color	—
Tubing, Plastic	—

1. **INTRODUCTION.**

2. This Work Package (WP) provides general instruction for the removal and installation of a harness or cable from the aircraft for the purpose of repair. When available, maintenance personnel should always look first to the aircraft maintenance manual for guidance. The information provided herein should not be used for design or modification on the electrical wiring. Design and modifications should be performed in accordance with SAE–AS50881.

3. **DESCRIPTION.**

4. Harnesses are an assembly of wires and/or cables and their terminations fabricated so that it may be installed or removed as a unit. Harnesses are either open or protected (overbraided).

5. **OPEN HARNESS.** Open harnesses are preferred for maintenance considerations. The wires or cables within the harness are uncovered which enables visual inspection and ease of repair when necessary.

6. **PROTECTED HARNESS.** Protected harnesses are typically the same as open harnesses except the wall thickness of the wires within the harness are thinner which requires the harness to have a protected covering. The thin wall wire, called lightweight wire, has small diameters and weigh less than unprotected wires. The protected harness will be smaller and weigh less than an open harness for the same number of wires used except at selected specialized Intermediate Maintenance Activities (IMA). Refer to WP 011 00. Protected harnesses are not conducive to maintenance support. A typical protected harness is shown in Figure 1.

7 . **GROUP.** A group is a number of wires and/or cables and their terminations secured together within the structure of a harness. A group is typically secured together and contains wires and/or cable routed to a single item of equipment or aircraft area. The diameter of a group is typically two inches or less.

8 . **BUNDLE.** A bundle is any number of harnesses, or branches routed and supported together along some distance within the aircraft.

9 . **HARNESS OR BUNDLE REMOVAL.** The removal of any harness or group of terminated wires should be performed in accordance with the aircraft maintenance manual. The information provided herein is for guidance when the manual is not available. Remove harness or bundle as follows:

WARNING

Make sure all electrical and hydraulic systems are off.

a. Make sure all connecting points have identifying markers. If the marker is not present, replace the lost marker (WP 008 00). This includes each wire when singular contacts must be removed (Paragraph 9).

b. When several wires are grouped at junction boxes, terminal boards, panels, etc., retain the identity of the group within a bundle by spot ties, as shown in Figure.

c. At each clamp location, wrap the harness or bundle with a self-adhesive color tape. In some cases the bundle may already be build-up with a tape.

d. Remove the wired contacts from terminal blocks and/or connectors shared with other bundles or harnesses in accordance with the appropriate terminal block or connector work package. Replace all unwired cavities with appropriate sealing plugs.

e. As each connector is disconnected cover the connector with a plastic bag, and when available, a MS90376, NAS831 or NAS837 plastic shipping cap. Removed contacts should also be similarly protected unless the harness is planned to be totally replaced. Loosen or remove the clamps to release the bundle or harness. Clamps which are removed should be remounted with all accessories included, unless the clamp needs replacement.

f. When a connector is not removed from the bundle or harness to extract the bundle or harness from the aircraft, protect the connector as shown in Figure 3. Attach connector to the nearest primary support location.

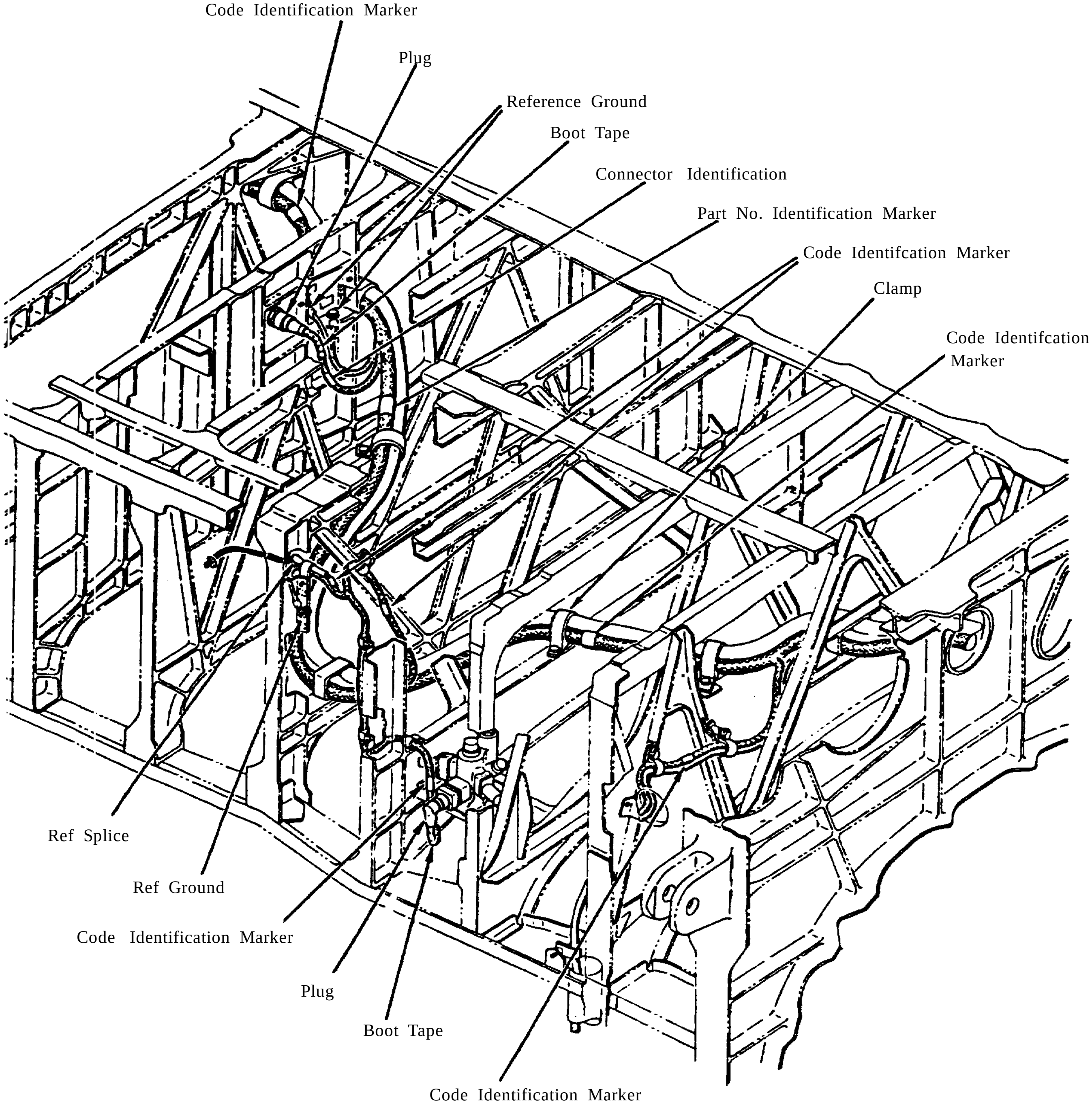


Figure 1. Typical Protected Harness Installation

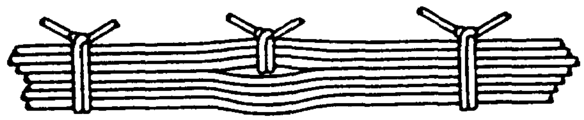


Figure 2. Group and Bundle Ties

NOTE:
Heat shrinkable end caps (also known as SSC end caps) in accordance with SAE AS81765/1, are acceptable to be used for protecting the end of open connectors.

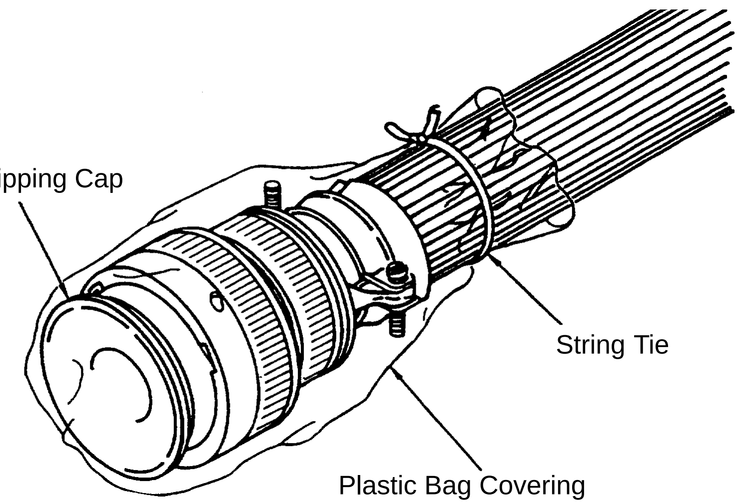


Figure 3. Connector Disconnected Protection

(1) BEFORE COUPLING, MATING HALVFS MUST BE EXAMINED FOR:

A. PROPERLY SEATED CONTACTS
B. ALL CAVITIES FILLED WITH CONTACTS (EXCEPT UNUSED COAX)
C. NO VISIBLE BENT CONTACTS
D. ALL UNWIRED CAVITIES WITH ENVIRONMENTAL SEALS WITH PROPER SEALING PLUGS
E. APPLICABLE BACKSHELL TIGHTENED ON CONNECTOR, AND, WHERE CABLE CLAMP CLAMP IS USED, SADDLE BARS TIGHTEN

(2) AFTER EXAMINATION AND MATING, VERIFY CONNECTOR HAS LOCKED AND/OR IS TIGHT, DEPENDING ON TYPE.

NOTE

WHEN A THREAD CONNECTOR HAS NO INDICATOR LINE, MAKE CERTAIN THAT IT HAS BEEN SUFFICIENTLY TIGHTENED.

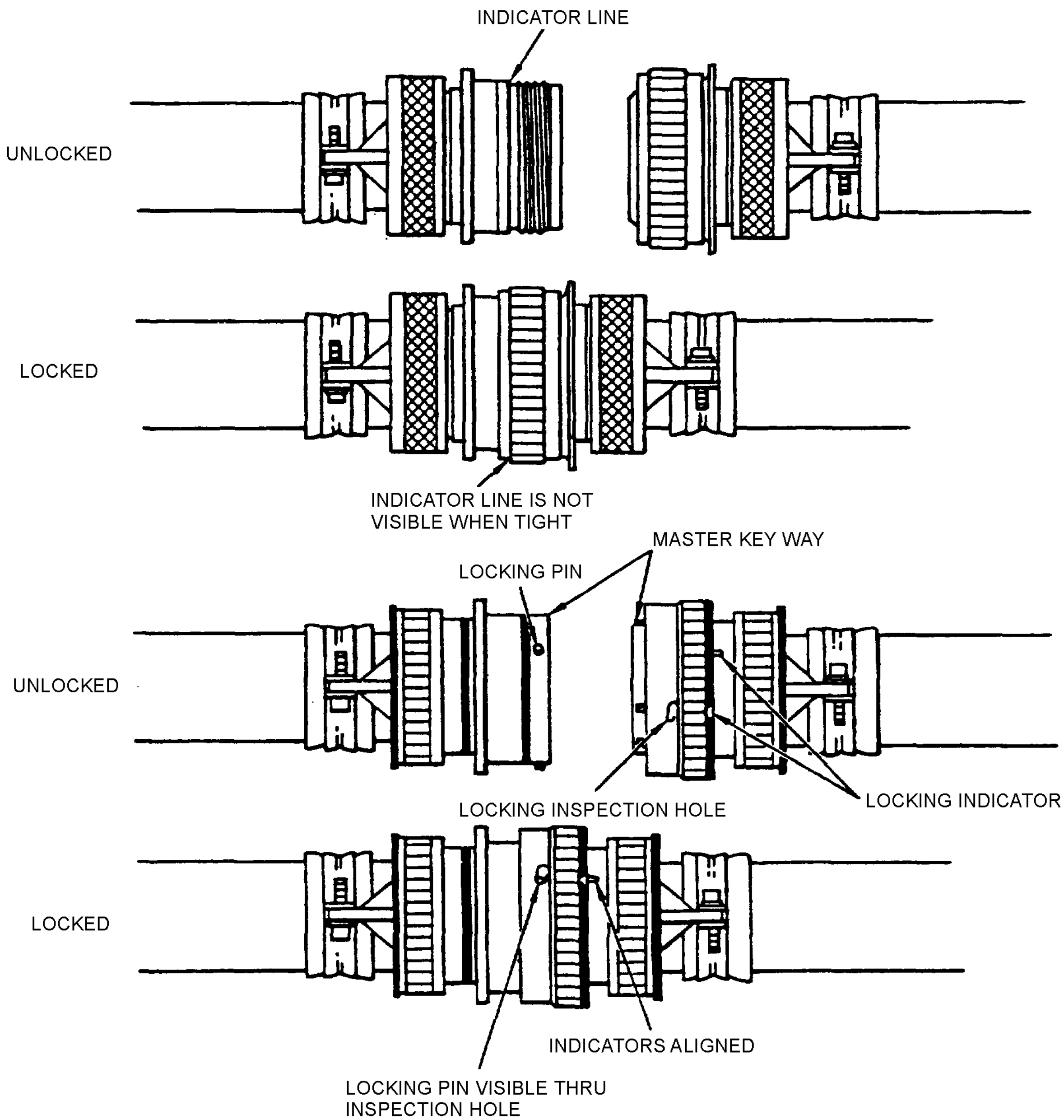


Figure 4. Mating or Coupling Connectors

10 . **BUNDLE OR HARNESS REPAIR.** Repair the bundle or harness as required by the appropriate component work package. The repair of the harness or group as an assembly is provided in WP 011 00.

11 . **BUNDLE OR HARNESS INSTALLATION.**

WARNING

Make sure all electrical and hydraulic power systems are off.

12 . Install the repaired or new harness as follows:

CAUTION

Avoid excessive tightening of cable, clamps and spot ties on coaxial (coax) cable. The dielectric of some coax cables is made of soft material and can easily be damaged. Route coax cable as directly as possible. Avoid unnecessary or sharp bends to preserve dielectric integrity.

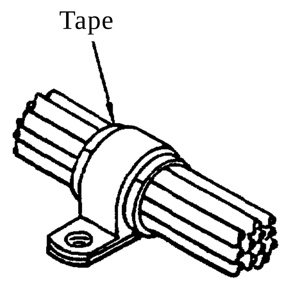
a. Lay the bundle or harness out loosely in the clamp areas.

b. Loosely secure the bundle or harness in the clamps. If clamps are missing or require replacement, see paragraph 39 for more guidance.

c. Inspect the connection or contact for damage then couple the connectors. Insert the contacts in their respective locations in accordance with the appropriate connector work package and verify that the connectors are completely mated and contacts securely inserted (paragraph 55). A typical example is shown in Figure 4. Each connector type has an indicator.

d. At each mating location, adjust the bundle or harness to accommodate drip loops (paragraph 21), proper bending of the wires at the connector or terminal block interfaces (paragraph 55), and minimum wire bending requirements (paragraph 22)

e. Tighten the clamps at the nearest mating locations. The bundle or harness should not be moveable through the clamp. If the bundle or harness is loose, wrap with self-adhesive tape until tape is sufficiently built up to permit the clamp to secure the bundle or harness (Figure 5).



Permissible application of tape where needed for proper clamping of coax cable. Tape wraps must be sufficient to ensure a snug fit of clamp on cable. Cable must be free from distortion or strain caused by unduly tight–clamping.

Figure 5. Tape Support

CAUTION

Use a red or black non-adhesive self-bonding tape, A–A–59163 TYPE II, NSN 5970-00-955-9976 or NSN5970-00-955-9976.

f. Between each remaining clamp, adjust the bundle or harness to accommodate minimum bending, (paragraph 22), flexing (paragraph 23), slack (paragraph 49), and chafing (paragraph 24). Tighten the clamps.

g. Inspect the bundle or harness for wire bird caging and general wire separation. Tighten the bundle or harness diameter with lacing or straps (paragraph 59 or 70).

CAUTION

Straps may not be authorized on some aircraft.

13 . **GENERAL INSTALLATION INSTRUCTIONS.** Install wiring so that it is mechanically and electrically sound, and neat in appearance. Wherever practicable, route wires and bundles parallel with, or at right angles to, the stringers or ribs of the area involved (Figure 6).

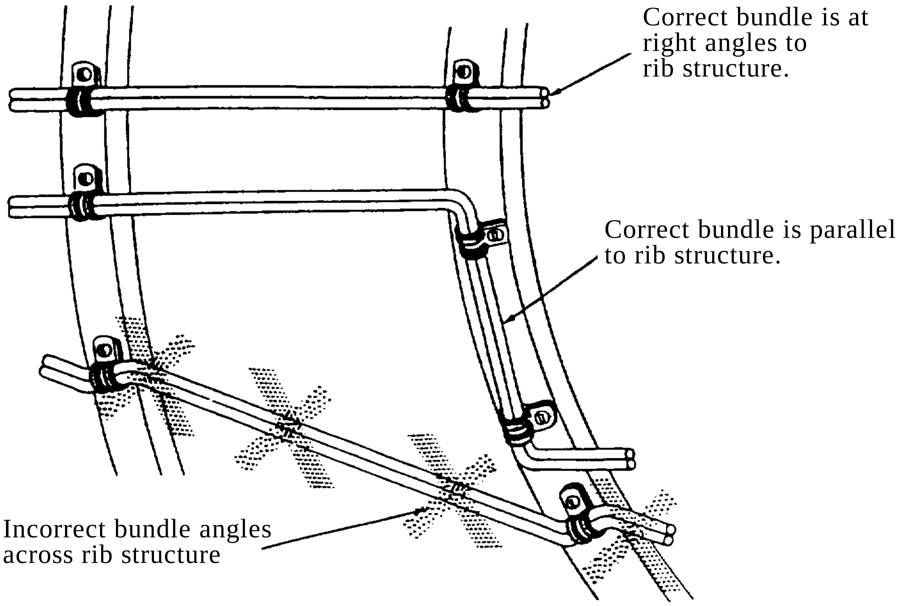


Figure 6. Routing Bundles

NOTE

Route coaxial cable as directly as possible. Avoid unnecessary bends in coaxial cable. When possible, locate attachments at each frame rib on runs along the length of the fuselage, or at each stiffener on runs through the wings.

14 . **GENERAL ROUTING PRECAUTIONS.** When installing electrical wiring in aircraft, observe the following precautions:

a. Do not permit wire or wire bundles to have moving, or frictional contact with any other object.

b. Do not permit wire or wire bundles to contact sharp edges of structure, holes, etc. (paragraphs 23 and 24).

c. Do not damage threads of attaching hardware by over-tightening or cross threading.

d. Do not subject wire bundles to sharp bends during installation. (paragraph 22).

e. Do not allow dirt, chips, loose hardware, lacing tape scraps, etc., to accumulate in enclosures or wire bundles.

f. Do not hang tools or personal belongings on wire bundles.

g. Do not use installed wire bundles or equipment as footrests, steps, or handholds.

h. Do not compensate for wires that are too long by folding wire back on itself and hiding such folds within bundles.

i. Do not twist or pull wire bundles during assembly or installation so that pins are pulled from connectors, or connectors or wires are otherwise damaged.

j. Do not stretch wires to mate connectors; and allow sufficient slack to permit easy mating.

k. Do not paint electrical wires, connectors (unless specifically authorized), switches or other electrical devices (paragraph 54)

l. Do not use any installation tools other than those specifically authorized.

m. Do not install fuel quantity indicating wiring with power distribution wiring or system power wiring.

CAUTION

Never support any wire or wire bundle from a plumbing line carrying flammable fluids or oxygen. Clamps may be used only to insure separation.

15 . **FLAMMABLE LINES.** When wiring must be routed parallel to flammable lines for short distances, maintain as much fixed separation as possible, six inches or more (Figure 7). When a six inch clearance cannot be maintained, the bundle and flammable line shall be clamped as shown in (Figure 8) so that there will be no relative motion between them. When a two–inch clearance cannot be maintained, the bundle shall be clamped as shown in (Figure 9). The minimum clearance shall be 1/2 inch. Route the wires on a level with, or above, the plumbing lines. Space clamps so that if a wire is broken at a clamp it will not contact the line. If the separation is less than two inches but more than 1/2 inch, use a nylon sleeve over the wire bundle to give further protection. Use two cable clamps back to back, to maintain a rigid separation.

16 . **GENERAL INSTALLATION SUPPORT.** Where possible, bind and support wire and wire bundles to meet the following requirements:

a. Prevent chafing of cables.

b. Secure wires and wire bundles routed through bulkheads and structural members.

c. Fasten wires in junction boxes, panels, and bundles for proper routing and grouping.

d. Prevent mechanical strain that would tend to break the conductors and connections.

e. Facilitate reassembly to equipment and terminal boards.

f. Prevent interference between wires and other equipment.

g. Permit replacement or repair of individual wires without removing the entire bundle.

h. Prevent excessive movement in areas of high vibration.

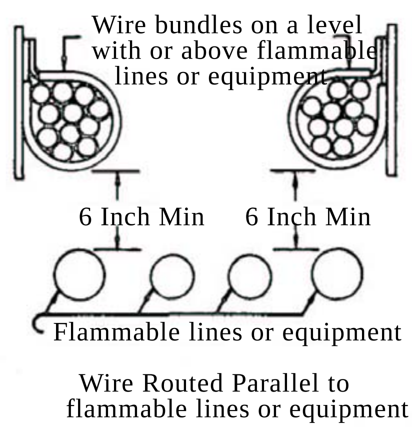


Figure 7. Installation of Wiring Near Flammable Lines.

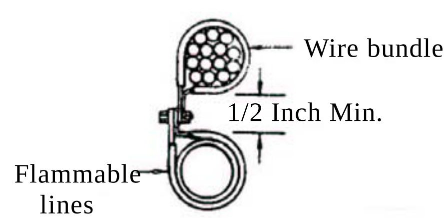


Figure 8. Alternate Installation.

17 . **GENERAL INSTALLATION PROTECTION.** Where possible install and route wires and wire bundles to protect them from the following:

a. Chafing or abrasion.

b. High temperature.

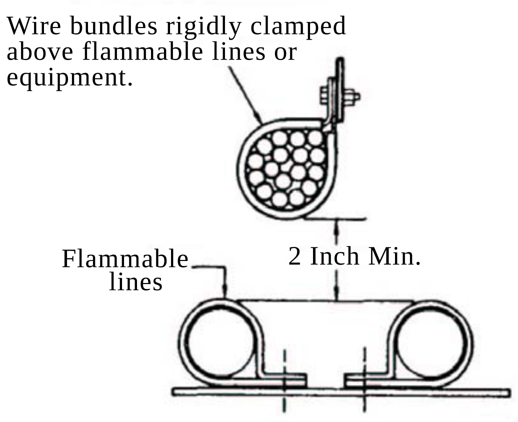


Figure 9. Secondary Alternate Installation.

c. Use of wire bundles as handholds, or steps, or as support for personal belongings and equipment.

d. Damage by personnel moving within the aircraft.

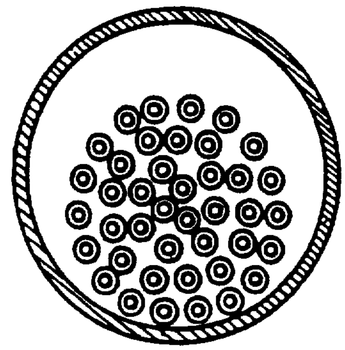
e. Damage from cargo stowage or shifting.

f. Damage from battery acid fumes, spray, or spillage.

g. Damage from solvents and fluids.

h. Abrasion in wheel wells where exposed to rocks, ice, mud, etc.

18 . **INSTALLATION OF WIRES IN CONDUIT.** Measure the bundle wires before installing in conduit. The bundle diameter must not exceed 80% of the internal diameter of the conduit. (Figure 10).



Diameter of wire bundle, not more than 80% of inside diameter of conduit

Figure 10. Conduit Capacity

CAUTION

No ties or splices are permitted inside a conduit.

a. For replacing existing wire/harness in conduit tie cable lacing to end of existing wire and use the lacing to pull the new wire/harness through conduit.

19 . **FEEDING WIRES INTO CONDUIT.** Feed wires through a short length of conduit by taping the end of the bundles together and pushing it gently through. Longer runs of conduit or conduit with complex bends will require a leader. Make a leader out of a flannel or other soft cloth patch attached to a string long enough to pass completely through the conduit. The patch should fit loosely in conduit (Figure 11). Use compressed air at no more than 35 psi to blow patch and attached string through the conduit. Tie wire bundle securely to string and tape over junction to cover all wire ends. Pull string through conduit while carefully feeding wires into other end. After wire is installed, remove tape and detach string.

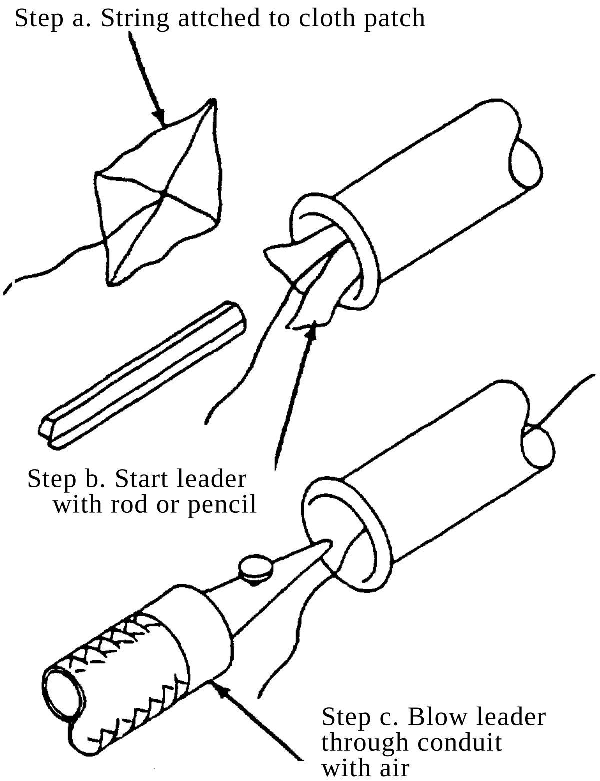


Figure 11. Leader for Conduit

20 . **SUPPORTING WIRES AT END OF RIGID CONDUIT.** MS21919 cable clamp should be available to support wires at each end of conduit. Place the cable clamp in a direct line with the conduit end to prevent chafing of wires at edge of conduit. The cable clamp should be as close to end of conduit as practicable, but never more than 10 inches away (Figure 12).

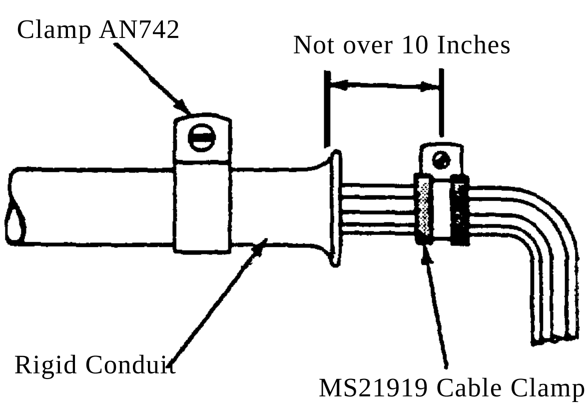


Figure 12. Support for Wire at Conduit End

NOTE

Do not leave wire slack inside conduit. Wires should be free, but not taut, inside conduit.

21 . **DRIP LOOP.** Where wiring is dressed downward to a connector, terminal block, panel, or junction box, a trap, or drip loop, shall be provided in the wiring to prevent fluids or condensation from running into the above devices. Potted connectors are exempt from this requirement (Figure 13).

22 . **RADIUS OF BEND.** Wiring bend radius shall comply to the following requirements (Figure 14):

a. For wiring groups, bundles or harnesses and cables individually routed and supported, the minimum bend radius shall be ten times the outside diameter of the largest included wire or cable. At the point where wiring breaks out from the group, harness or bundle, the minimum bend radius shall be ten times the diameter of the largest included wire or cable, provided the wiring is suitably supported at the breakout point. If wires used as shield terminators or jumpers are required to reverse direction in a harness, the minimum bend radius of the wire shall be three times the diameter at the point of reversal provided the wire is adequately supported.

b. The minimum bend radius, as measured on the inside radius of a protected harness, shall be six times its outer diameter. In no case shall the bend radius of a protected harness be less than ten times the diameter of the largest included wire or cable.

CAUTION

Never bend coaxial cable to a smaller radius than six times the outside diameter.

c. The minimum radius for flexible type coaxial cables shall not be less than six times the outside diameter. For semi-rigid types, the radius shall not be less than ten times the outside diameter.

d. When it is not possible to hold the bending radius of the single wires to the above limits, enclose the bend in tight plastic tubing for at least two inches each side of the bend.

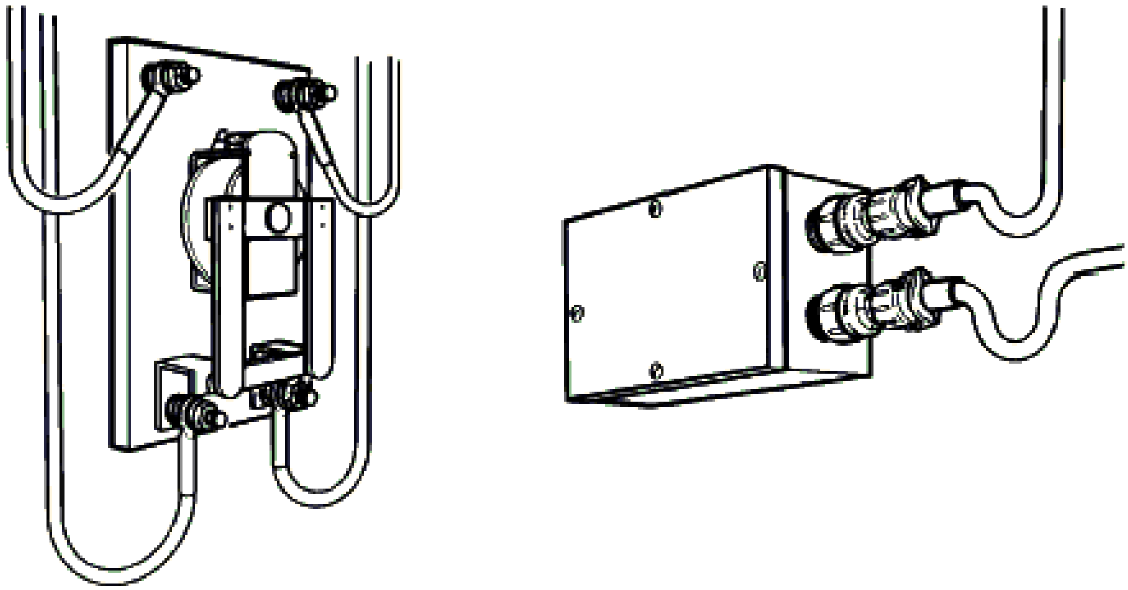


Figure 13. Drip Loop

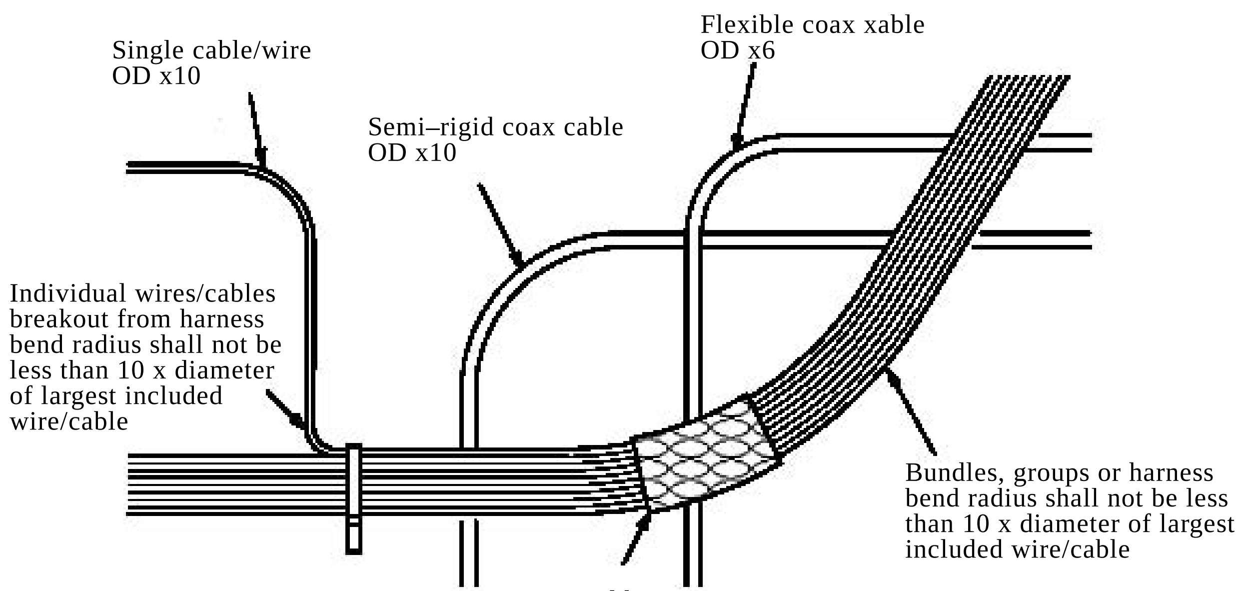


Figure 14. Bend Radius

23 . **WIRING NEAR MOVING PARTS.** Wiring attached to assemblies where relative movement occurs (such as at hinges and rotating pieces; control sticks, control wheels and columns, and flight control surfaces) shall be installed, or protected in such a manner as to prevent deterioration of the wiring by the relative movement of the assembly parts. This deterioration includes abrasion of one wire or cable upon another and stress twisting and bending. Bundles shall be installed to twist instead of bending across hinges. Cables in the vicinity of line replaceable units (LRU) and weapon replaceable assemblies (WRA) shall be protected against damage caused by flexing, pulling, abrasion, and other effects of frequent removal and replacement of equipment (Figure 15).

24 . **CHAFING.** Chafing shall be prevented by routing and clamping bundles to prevent contact with edges of equipment and structure. Where physical separation of at least 3/8-inch cannot be maintained, the edges shall be covered with suitable protection strips or grommets (paragraph 25). Grommets and protection strips shall be securely fastened in place. Shielded cables shall have an external insulating cover (Figures 16 and 17).

25 . **GROMMET INSTALLATION.**

26 . Grommets for maintenance usage and replacements are provided in Table 1. The grommets consist of two types: donut and caterpillar.

27 . **DONUT GROMMET.** Donut grommets should be in accordance with MS35489. Donut grommets consist

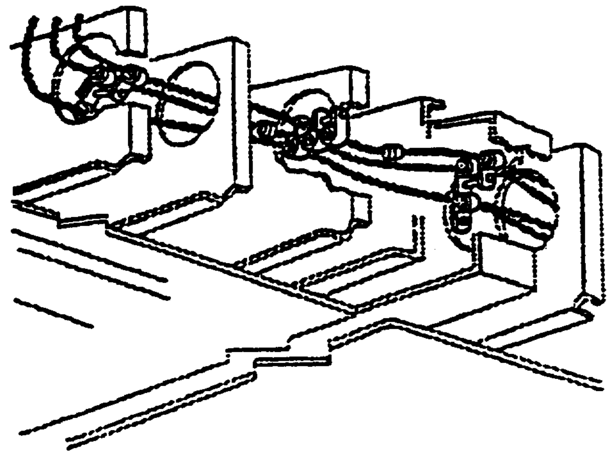


Figure 16. Chafing Protection

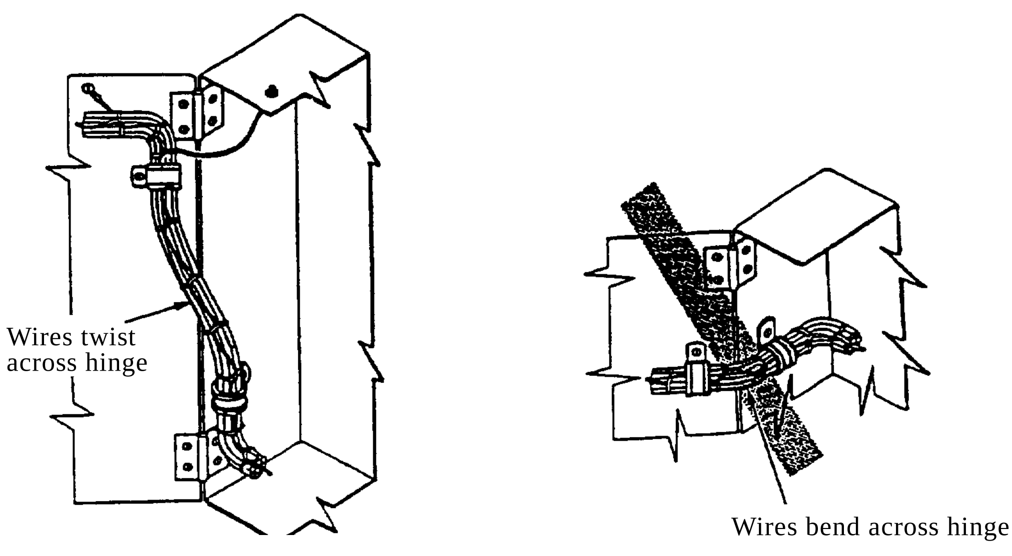


Figure 15. Support at Hinged Areas

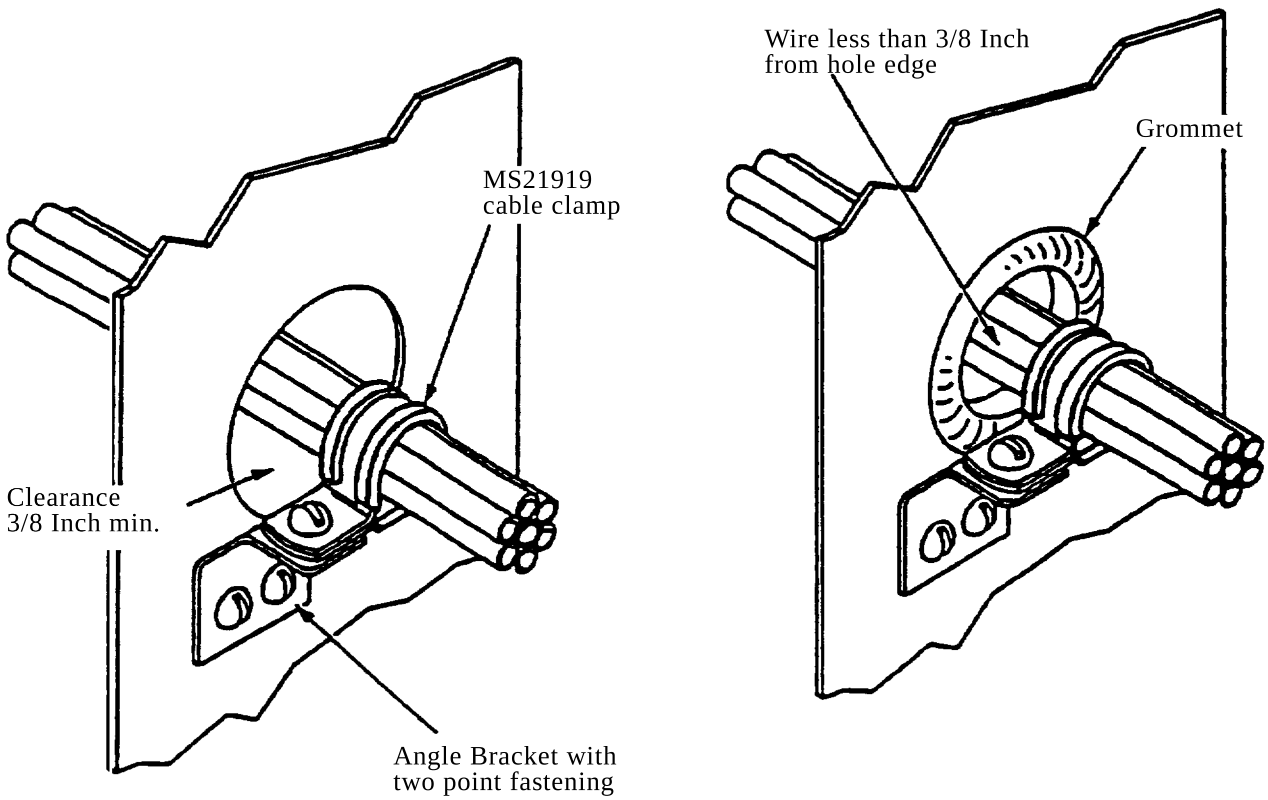


Figure 17. Methods of Chafing Prevention

of rubber and are resistant to hot oils and coolants. The grommet has a maximum temperature application of 250°F. An example of the grommet is shown in Figure 17. The grommet should be replaced with an unsplit grommet whenever possible. When grommet must be split, it shall be split as shown in Figure 18.

28 . **MS35489 Part Number.** An example of the part number is as follows:

a. Example: MS35489-14X

b. MS35489: Basic and detail specification number representing NASM3036 basic specification and MS35489 detail specification for a donut grommet.

c. -14: Represent a specific size grommet for a particular hole size and edge thickness.

d. x: When present represents a silicone rubber. No letter represents a synthetic rubber.

29 . **MS35489 Grommet Replacement.** When an engineering drawing, maintenance manual, etc. or no information on the grommet is provided, use the silicone rubber grommet (i.e. MS35489-14X).

30 . **MS35489 Grommet Installation.** The grommet should be installed as follows:

a. Measure the diameter of the hole and edge wall thickness.

b. Using the information provided in MS35489 specification, choose the correct silicone rubber grommet.

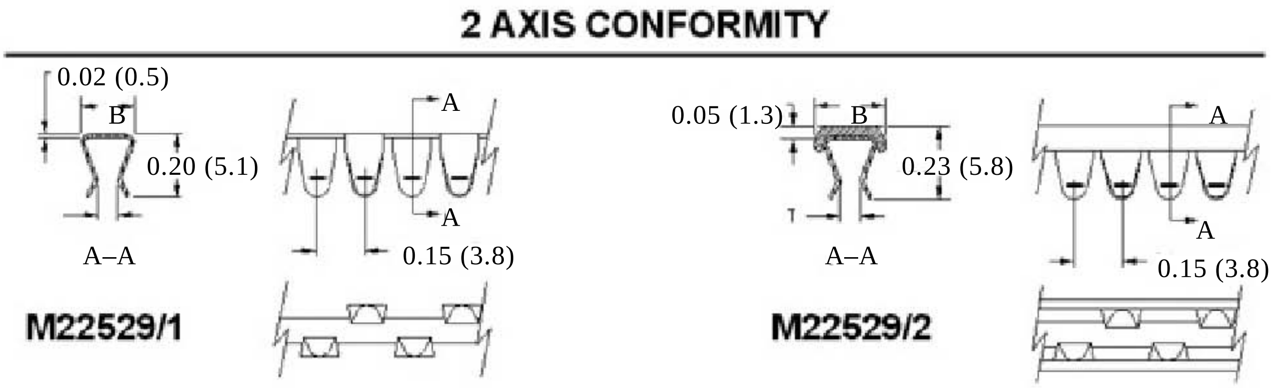


Figure 18. Lightening Hole Grommet Mounting.

TABLE 1. CATERPILLAR GROMMET REPLACEMENT

Obsolete NASM21266-	Sheet Thickness (in.)	Replacements M22529/2-	Replacements M22529/3-	Sheet Thickness (in.)
-1	.015 - .052	-1C-85	-1C-85	.025 - .036
-2	.052 - .085	-2C-85	-2C-85	.036 - .063
-3	.085 - .128	-3C-85	-3C-85	.059 - .074
-4	.128 - .192	-4C-85		.070 - .09
-5	.192 - .255	-5C-85		.090 - .111
-6	.255 - .318	-6C-85		.105 - .134
-7	.318 - .380	-7C-85		.178 - .198
-8	.380 - .510	-8C-85		.240 - .260
N/A	N/A	-1C-*		.025 - .036
N/A	N/A	-2C-*		.036 - .063
N/A	N/A	-3C-*		.059 - .074
N/A	N/A	-4C-*		.070 - .093
N/A	N/A	-5C-*		.090 - .111
N/A	N/A	-6C-*		.105 - .134
N/A	N/A	-7C-*		.178 - .198
N/A	N/A	-8C-*		.240 - .260

NOTES:

* - Indicates the number of castles listed in table 2 for the mounting edge thickness (-1, -2, etc.) and the length required, (paragraph 35).

c. Pressure inserts the grommet in the hole.

CAUTION

Do not damage the grommet.

d. If the grommet will not fit without apparent damage, cut the grommet as shown in Figure 18.

31. **CATERPILLAR GROMMET.** Caterpillar grommets should be in accordance with NASM22529/2 and /3 detail specifications. The composite coated steel grommet has a maximum temperature application of 290°F. When the NASM21266 nylon caterpillar grommet is specified in an aircraft manual or engineering drawing, use the NASM22529/2 or /3 composite grommet. For a specified sheet thickness, substitute the NASM21266 grommet with the NASM2259/2 or /3 grommet as shown in Table 1.

32. **NASM22529 Part Number.** The caterpillar part number is as follows:

a. Example: M22529/2-1C-85

(1) M22529: Basic specification number representing NASM22529, which defines the general requirement for caterpillar grommet.

(2) /2: Detail specification number representing NASM22529/2 which defines the specific details of a particular caterpillar grommet.

(3) -1: Thickness of the material on which the grommet can be mounted.

(4) C: Denotes a precut length requirement.

(5) -85: Represents the number of castles in a precut length at intervals of 0.015 inches (Figure 18).

b. Example: M22529/2-4R-25

(1) M22529: Basic specification number (see previous example).

(2) /2: Detail specification number (see previous example).

(3) -4: Thickness of the material on which the grommet can be mounted.

(4) R: Indicates grommets are mounted on a reel.

(5) -25: Indicates the length of the reel grommet (i.e. 25 feet).

Table 2. Circular Hole Grommet Edging Cut Lengths

Cut Length		
Nominal Hole Diameter	L Length	In Castles
2.000	6.00	40
2.250	6.90	46
2.250	7.65	51
2.750	8.40	56
3.000	9.15	61
3.250	10.05	67
3.500	10.80	72
3.750	11.55	77
4.000	12.30	82
4.250	13.20	88
4.500	13.95	93
4.750	14.70	98
5.000	15.45	103
5.250	16.35	109
5.500	17.10	114
5.750	17.85	119
6.000	18.60	124

33 . **NASM22529 Description.** An illustration of the grommet is provided in Figure 19. The grommet is a green, epoxy coated stainless steel strip with teeth (castles) staggered on each side of the strip. From center to center the castles are 0.15 inches apart. The surface, opposite castles is a gray elastomer cushion used to reduce the abrasion characteristics of the hole or edge on which the strip is mounted. The strip is secured on the edge of the hole by separating the castles (spring loaded) when pressing on the strip.

34 . **NASM22529/2 Flat Edge Hole Installation.** To install grommets on non-lightening, flat edge feed through holes as shown in Figure 17 perform the following:

CAUTION

Do not use NASM22529/2 grommet in horn shaped lightening strike hole (paragraph 35).

a. Examine the NASM21266 nylon grommet, which is glued to the feed through hole, for breaking of teeth or separation from the edge.

b. Remove the old grommet when needed. Be sure all old excess material is removed and discarded to avoid FOD.

c. Measure the diameter of the hole and edge wall thickness. Determine the length needed to cover the hole from Table 2 for the measured wall thickness.

d. Measure the required grommet length.

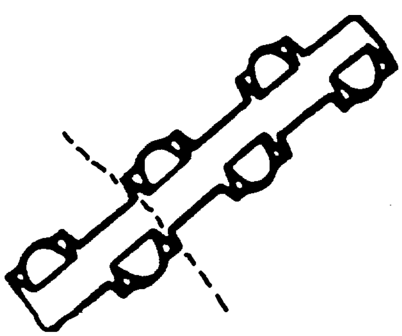


Figure 19. Cut Grommet

e. Using a full bypass shears (part number MFE-100) shown in Figure 20, hold the grommet as shown in Figure 21.

CAUTION

Safety glasses should be used.

f. Cut the grommet between the castles at a 90° angle as shown in Figure 19. To assure the absence of deformation of adjacent castles close to the cut-off, be sure to grip both sides of the cut.

g. Cut the grommet at a 45° angle as shown in Figure 19.

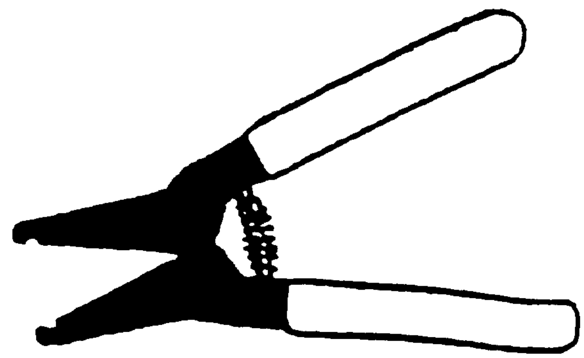


Figure 20. Bypass Shears

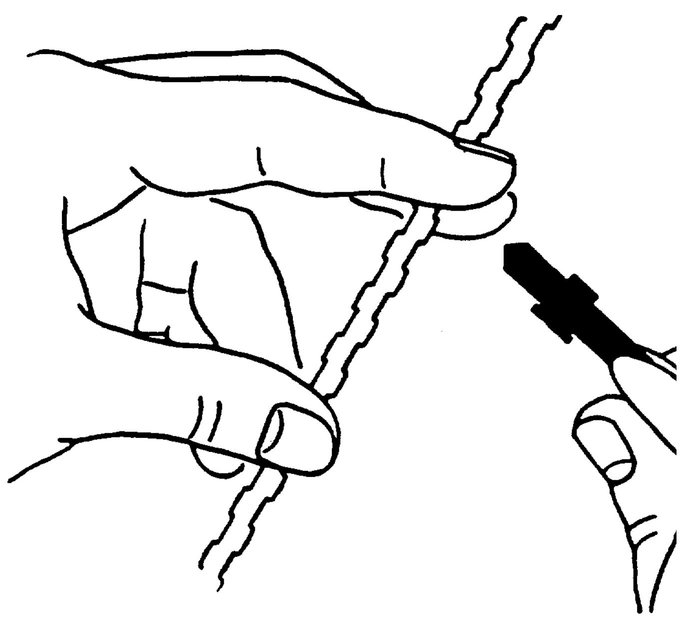


Figure 21. Gripping Grommet

h. Install the grommet by compressing the grommet firmly on the hole edge with the slit between the two ends of the grommet located at the top of the hole. If it appears that the bundle wire were to become loose and rub against the split, it should be located in such a manner that the wire pressure will be on the opposite side from the split. Be sure grommet is completely compressed firmly on the edge of the hole as shown in Figure 22.

i. If the width of the split is greater than 0.3 inches, replace the grommet.

35 . **NASM22529/3 Lightening Hole Installation.** To install grommets in horn shaped lightening holes as shown in Figure 22, follow the same procedure as for the NASM22529/2 flat edge hole except use a M22529/3 grommet. The NASM22529/3 part number format is the same as for the NASM22529/2 part number. However, the NASM22529/3 grommet must be cut at a 90° angle instead of a 45° as shown in Figure 23.

36 . **TAPE OR TUBE PROTECTION.** If there is a possibility that the wire without a protective outer jacket may be soaked or chafing in any location, use plastic tubing or tape to protect it. This tubing or tape should extend past the area in both directions and be tied at each end. If the wire has a low point between the tubing ends, the lowest point should have a 1/8-inch drainage hole as shown in Figure 23. Punch the hole in the tubing after the installation is complete and the low point definitely established. Use a hole punch to cut a half circle. Be careful not to damage any wires inside the tubing or tape when using the punch. The tape shall be non-adhesive silicon tape.

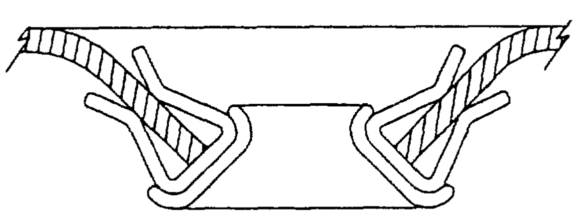
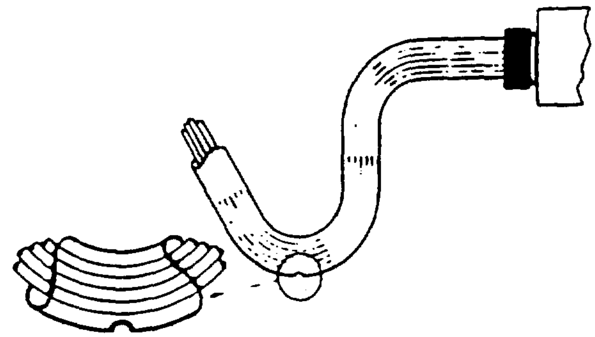


Figure 22. Lightening Hole Grommet Mounting



Drainage hole 1/8 Inch diameter at lowest point in tubing. Make the hole after installation is complete and lowest point is firmly established

Figure 23. Drainage Hole in Low Point of Tubing or Tape

CAUTION

If it is necessary to move or repair wires which have a protective jacket with a drainage hole at the low point, make sure drainage hole is still at the low point afterward. If the location of the low point has changed, punch a new hole in the protective jacket at the new low point.

37 . **WIRING CLAMPS.** Wires, cables, bundles, and harnesses are clamped to the aircraft structure by MS21919 cushioned metal clamps for primary support and SAE–AS25281 plastic clamps for secondary support.

38 . **MS21919 Part Number.** An example of a MS21919 part number is as follows:

a. Example: MS21919 WDG-8.

b. MS21919: Basic specification describing the clamps.

c. W: Indicates the base of the open end of the loop has a wedge to assist locking the clamp together (Figure 24). Applicable for sizes 2 through 48 only.

d. D: Defines the band material (Table 3).

e. G: Defines the cushion material (Table 3).

f. -8: Defines the cable thickness, which the band can hold (Table 6).

39 . **Clamp Replacements.** When engineering drawings, mainframe manuals, etc. specify the canceled part numbers as shown in Table 4 and 5, replace the clamp as indicated.

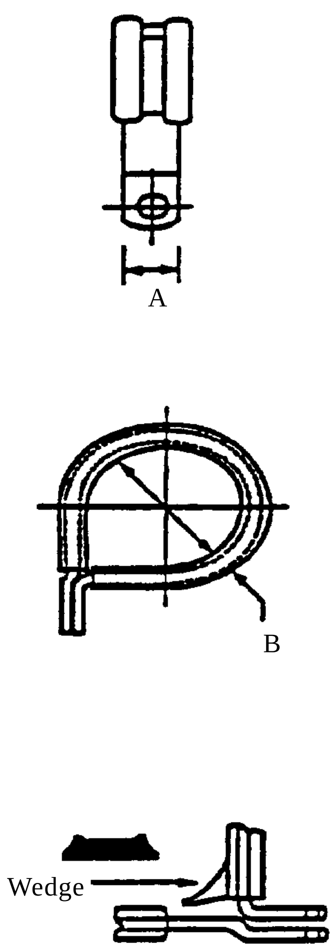


Figure 24. MS21919 Clamp

WARNING

MS25281 nylon cable clamps may only be used to support wire bundles up to two inches in diameter in open wiring, or inside junction boxes and on the back of instrument panels.

CAUTION

Do not use plastic cable clamps where the ambient temperature may exceed 185°F.

NOTE

MS25281 plastic cable clamps, spaced at intervals not to exceed 24 inches, may be used for wire support provided every fourth clamp is a rubber cushion type (MS21919). The use of plastic cable clamps on other than horizontal runs should be avoided.

40 . **MS25281 Part Number.** Examples of MS25281 nylon clamps are as follows:

a. Example: MS25281-F6.

b. MS25281: Detail specification representing the details of the clamp and the SAE–AS23190 performance characteristics.

c. - F: One digit code indicating whether the clamp has a flat center surface (-F) or has ribs (-R) (Figure 25).

d. 6: Define the cable thickness, which the clamp can hold (Table 6).

41 . **CLAMP INSTALLATION.**

42 . **CLAMP SIZE AND RESTRICTIONS.** If a clamp needs to be replaced and is not specified by the aircraft maintenance manual, use a MS21919 WCJ-* for sizes -2 through -48 and MS21919 CJ-* for sizes -50 through -66. MS21919 clamps may be used, if the MS25281 clamps are not available. Use Table 6 to determine the size of the clamp.

Table 3. Material Clamp Codes

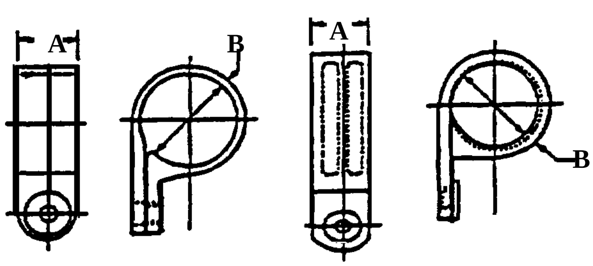
Material Codes Authorized	Max Temperature
DE=Aluminum Band with Ethylene Propylene Cushion	(212°F)
DF=Aluminum Band with Nitrile Cushion	(212°F)
DC=Aluminum Band with Chloroprene Cushion	(212°F)
CE=Cres Band with Ethylene Proplene Cushion	(275°F)
CF=Cres Band with Nitrile Cushion	(212°F)
CH=Cres Band with Silicone Cushion	(400°F)
CG=Cres Band with Chloroprene Cushion	(212°F)
CJ=Cres Band with Fluorosilicone Cushion	(450°F)
F=Low Carbon Steel Bands with Nitrile Cushion	(212°F)
G=Low Carbon Steel Bands with Chloroprene Cushion	(212°F)
H=Low Carbon Steel Bands with Silicone Cushion	(400°F)

Table 4. Clamp Replacement for -2 through -48.

CANCELLED PART NUMBER	REPLACEMENT PART NUMBER
MS21919WB (F, G, H) ( )	MS21919W (F, G, H) ( )
MS21919B (F, G, H) ( )	MS21919W (F, G, H) ( )
MS21919D (F, G) ( )	MS21919WD (F, G) ( )
MS21919C (F, G, H) ( )	MS21919WC (F, G, H) ( )
MS21919 (F, G, H) ( )	MS21919W (F, G, H) ( )
MS21919DH ( )	MS21919WCH ( )
MS21919WDH ( )	MS21919WCH ( )

Table 5. Clamp Replacement for -50 through-66

CANCELLED PART NUMBER	REPLACEMENT PART NUMBER
MS21919WC (F, G, H) ( )	MS21919C (F, G, H) ( )
MS21919WD (F, G) ( )	MS21919D (F, G) ( )
MS21919WB (F, G, H) ( )	MS21919 (F, G, H) ( )
MS21919B (F, G, H) ( )	MS21919 (F, G, H) ( )
MS21919DH ( )	MS21919CH ( )
MS21919WDH ( )	MS21919CH ( )
MS21919 (F, G, H) ( )	MS21919 (F, G, H) ( )



Flat inner diameter **Ribbed inner diameter**

Figure 25. SAE–AS25281 Clamp

43 . **RF Coaxial Cable Restriction.** Support of the individual coaxial cables and of bundles containing coaxial cables shall be subject to the following additional clamping restrictions:

a. Both primary and secondary clamps shall be installed so as not to exert greater pressure on the cable than the minimum required to prevent slipping.

b. Pressure shall be evenly distributed around bundles containing coaxial cables, or around the coaxial cables, if individually supported.

Table 6. Clamp Sizes

Clamp Dash No.	Cable Thickness	Dash No.	Cable Thickness
1	1/16	27	1 5/8
2	1/8	28	1/ 3/4
3	3/16	29	1 3/4
4	1/4	30	1 7/8
5	5/16	31	1 7/8
6	3/8	32	2.0
7	7/16	33	2.0
8	1/2	34	2 1/8
9	9/16	35	2 1/8
10	5/8	36	2 1/4
11	11/16	37	2 1/4
12	3/4	38	2 3/8
13	13/16	40	2 1/2
14	7/8	42	2 1/2
15	15/16	43	2 1/2
16	1	44	2 3/4
17	1 1/16	45	2 3/4
18	1 1/8	46	2 3/4
19	1 3/16	48	3.0
20	1 1/4	50	3.0
21	1 5/16	52	3 1/4
22	1 3/8	54	3 1/4
23	1 7/16	56	3 1/2
24	1 l/2	58	3 1/2
25	1 9/16	66	4.0
26	1 5/18	64	4.0

Note

1 MS25281 - F* is not available in sizes - 21 through 66.
2 MS25281 - R* is not available in sizes - 33 through 66.

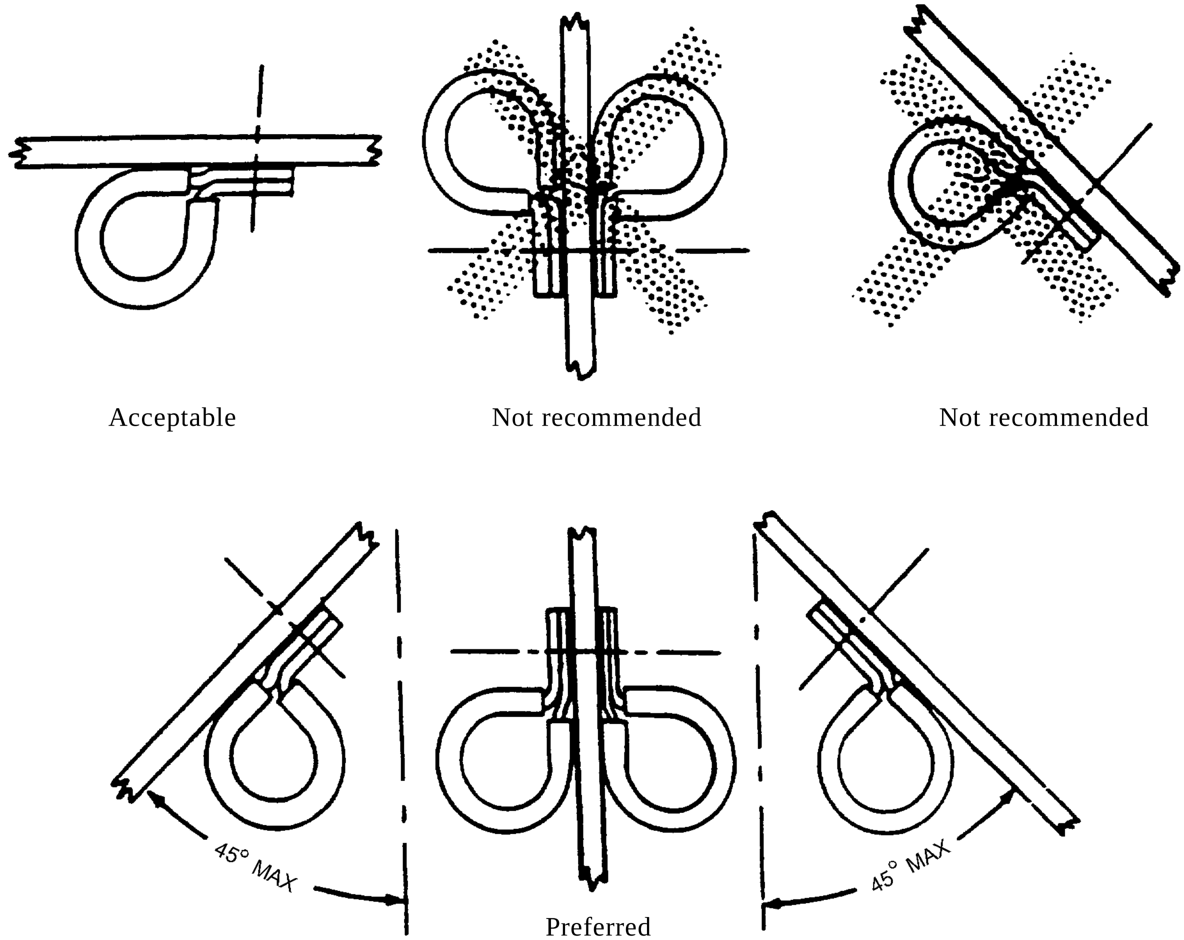


Figure 26. Preferred Angle for Cable Clamps

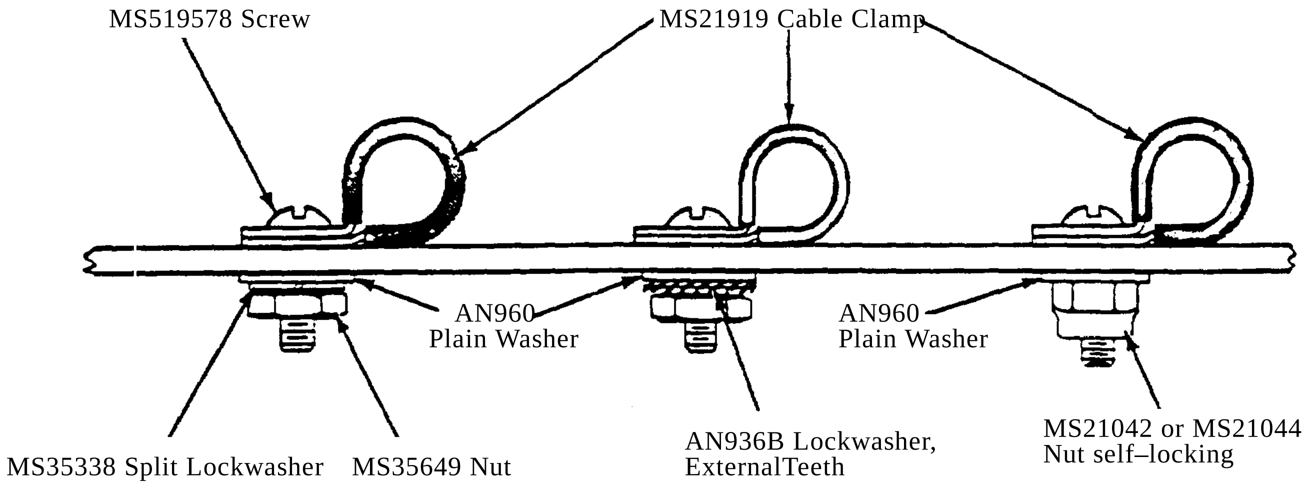


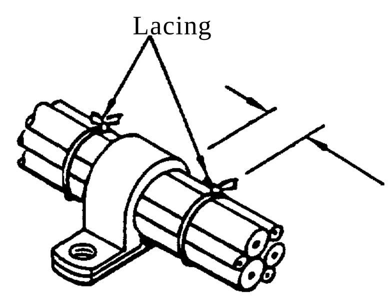
Figure 27. Typical Mounting Hardware for MS21919 Cable Clamps

c. The clamp shall not deform the cables so that the electrical characteristics of the cables are degraded.

44 . **Installing Clamps.** Install MS21919 cable clamps as shown in Figure 26. The mounting screw should be above the wire bundle, if possible. It is also desirable that the back of the cable clamp rest against a structural member. Use hardware, as shown in Figure 27, to mount cable clamps to structure. Be careful not to pinch wires in cable clamp. If the wire bundle is smaller than the nearest clamp size, or if a clamp of the proper size is not available, wrap the wire bundle with the necessary number of turns of non-adhesive insulating tape so that the bundle will be held securely in the clamp. Typical examples of how clamps are to be mounted are shown in Figures 28 through 33.

NOTE

MS21919 cable clamps are cushioned with insulating material to prevent abrasion of



String ties must be applied, as shown, for harness supported with plastic clamps, to prevent pinching of wires between clamp ears

Figure 28. Plastic Clamp

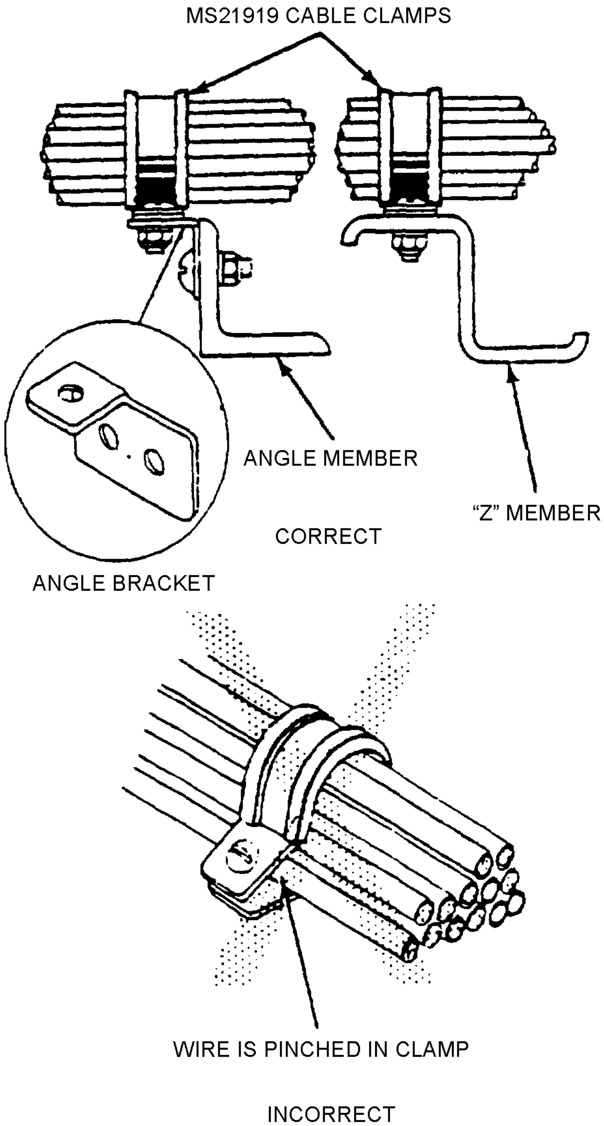


Figure 29. Attaching Cable Clamp to Structure

wires. Never use metal clamps without cushions to hold wires.

When installing plastic cable clamps, use a large diameter metal washer under the screw head or nut adjacent to the clamp.

45 . **CABLE CLAMP TOOLS**

46 . **PLIER, SLIP JOINT.** This tool to facilitate the installation of cable clamps is shown in Figure 34. Similar to conventional multiple slip joint pliers, the tool compresses and holds the clamp with the securing bolt in place while a nut is being installed on the bolt.

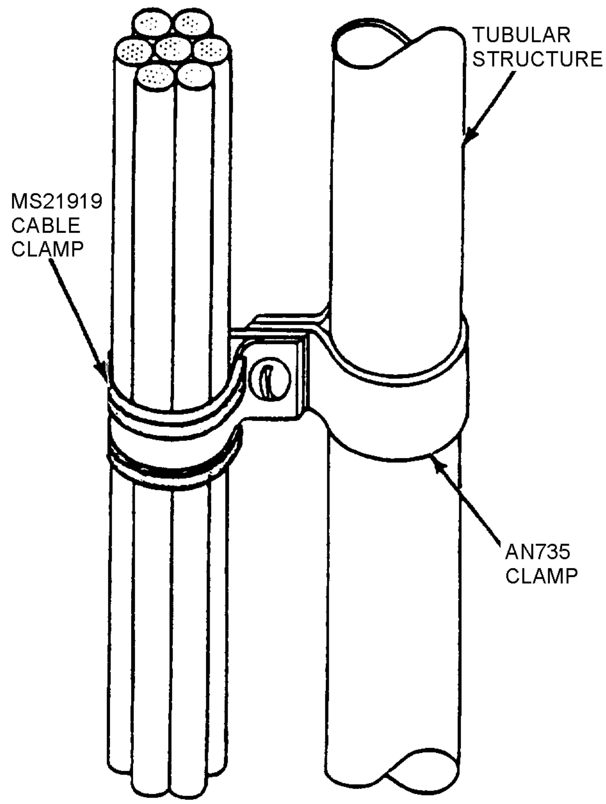


Figure 30. Installing Cable Clamps to Tubular Structure

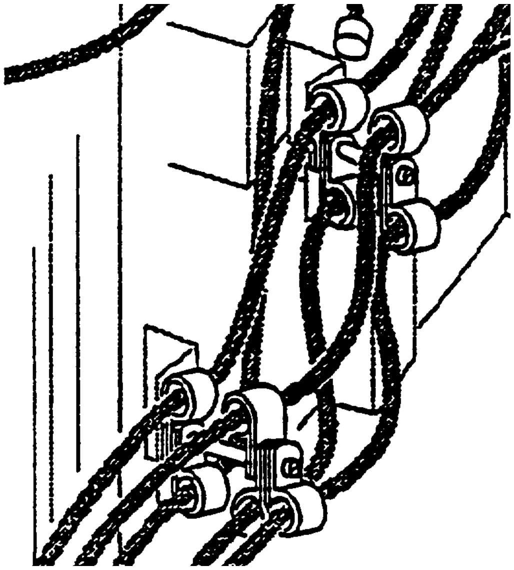


Figure 31. Plastic Clamps Routing

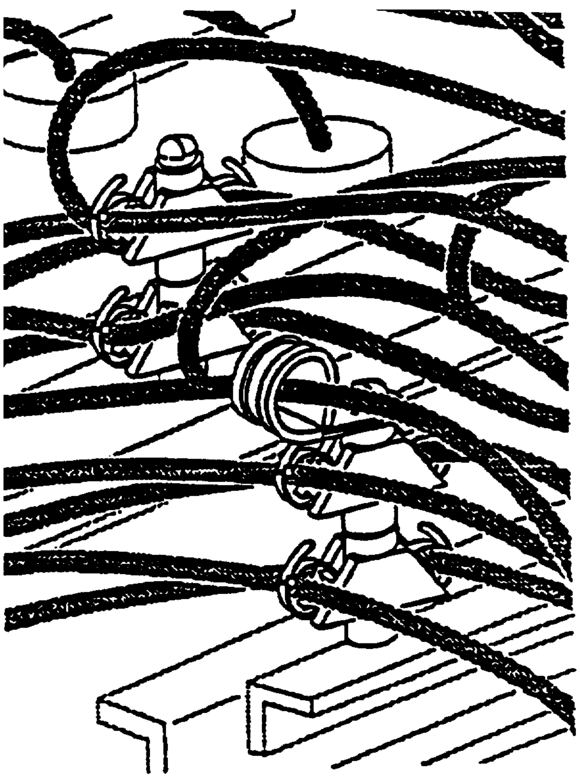


Figure 32. Cushion Clamps Routing

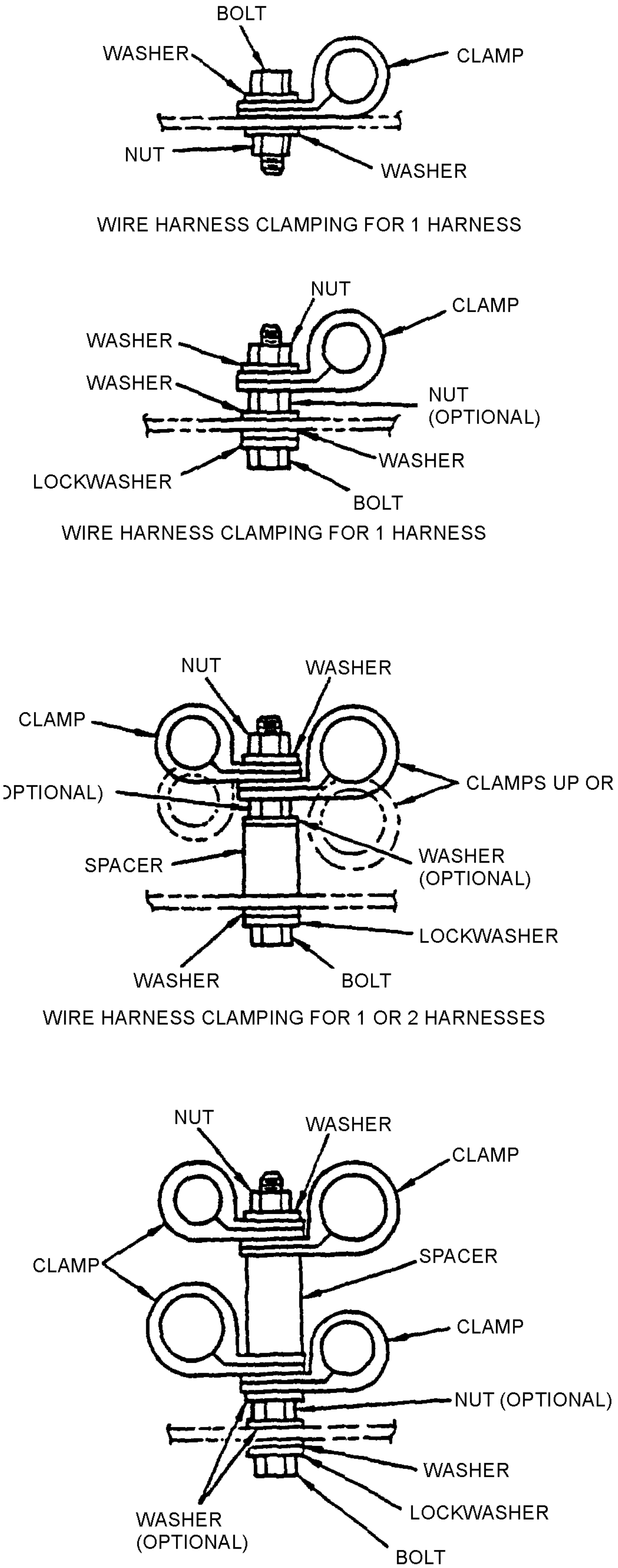


Figure 33. Wire Harness Clamping for 1 or 2 Harness

47 . **ADEL560 ASSEMBLY TOOL.** The ADEL560 clamp assembly tool simultaneously closes and holds the clamp in position while both hands are free to secure the harness in place. After clip is bolted in place, the tool is easily removed by depressing handle until prongs clear (Figure 35).

NOTE

This loop is to be used only with metal cushioned clamps (MS21919).

WARNING

The loop possesses a potential FOD hazard if lost in the aircraft during the removal or installation of clamps in confined spaces.

48 . **GE21E1 LOOP, STRAP FASTENER.** A loop can be used as an aid to hold the clamp closed (Figure 36).

c. To prevent mechanical strain on the wires, cables, junctions, and supports.

d. Drip loops.

49 . **SLACK**.

50 . Do not install single wires or wire bundles with excessive slack. Slack between support points such as cable clamps should normally not exceed 1/2-inch. (Figure 37). This is the maximum that it should be possible to deflect the wire with moderate hand force. This may be exceeded if the wire bundle is thin and the clamps are far apart, but the slack must never be so great that the wire bundle can touch any surface against which it may abrade. Allow a sufficient amount of slack near each end for any or all of the following:

a. To permit ease of maintenance.

b. To allow replacement of terminals at least twice.

51 . **CONNECTOR INSTALLATION.**

52 . **CONNECTOR INSPECTION.** Inspect the connector in accordance with the appropriate WP 022 00 through WP 027 00 before mating. Be sure all contacts are seated, and all unwired contact cavities have contacts and sealing plugs. Examine for bent or splayed contacts. Be sure the accessory is tight on the back of the connector, and the saddle clamp is tight on the wire bundle.

53 . **CONNECTOR COUPLING.** Assemble connector to the receptacle as follows:

WARNING

Unless otherwise required by specific equipment technical data, power should be removed from the affected circuit to avoid shock hazard and possible arcing of connector.

CAUTION

Do not use excessive force to mate connector to receptacle.

a. Locate the proper position of the plug in relation to the receptacle by aligning the key of one part with the groove or keyway of the other part. (Figure 4).

CAUTION

Do not twist wire bundle excessively to achieve proper mating of plug and receptacle.

Do not misconnect plug and receptacle by forcing pins into the resilient insert, either by misalignment of properly mating connector or by joining connectors with identical shells but differently keyed insert arrangements.

b. Start the plug into the receptacle with a light forward pressure and engage the threads of coupling ring and receptacle.

c. Alternately push in the plug and tighten the coupling ring until the plug is completely seated.

d. When mating a connector with bayonet lock coupling, make sure that all locking rivets of the coupling are engaged.

54 . **CONNECTOR CODING.** As a design objective, receptacles whose plugs are interchangeable are not located in close proximity to each other. However, when installation requirements are such that these receptacles are in adjacent locations, use clamps on the wires to make it physically impossible to connect a plug into the wrong receptacle. Also, the connector plug body may be color coded on the flange or mounting area of the receptacle.

a. Use one bright color, such as red, green, or yellow, for each matching pair.

b. Paint only the shell of plugs - not the coupling rings.

c. Paint only the mounting flange of the receptacle.

g. A bayonet connector is fully mated when the connector-locking pin can be visually seen in the inspection hole.

h. A self-locking connector is typically coupled until the moveable indicator is aligned with index marks on coupling ring. (Figure 38). In fully mated condition the locking indicator shall be aligned within orange color bands. The mating window is optional. The manufacturer shall provide details of the operation and function of the self–locking feature.

i. If safety (lock) wiring is required, use WP 019 00 for guidance.

Table 7. MS27488 Sealing Plugs and Superseded Part No.

Connector or Module Contact Cavity Size	Superseding Part No.	Superseded Military Specification Part No.					
22 & 23	MS27488–22	M81511/39–22					
20	MS27488–20	M81511/39–20	M83723/28–20	MS25251–20	MS27186–1	MS27187–3	MS3187–20–2
16	MS27488–16	M81511/39–16	M83723/28–16	MS25251–16	MS27186–2	MS27187–1	MS3187–16–2
12	MS27488–12	M81511/39–12	M83723/28–12	MS25251–12	MS27186–3	MS27187–2	MS3187–12–2
8	MS27488–8		M83723/28–8	MS25251–8			MS3187–8–2
4	MS27488–4		M83723/28–4			MS27187–4	MS3187–4–2
0	MS27488–0		M83723/28–0				MS3187–0–2

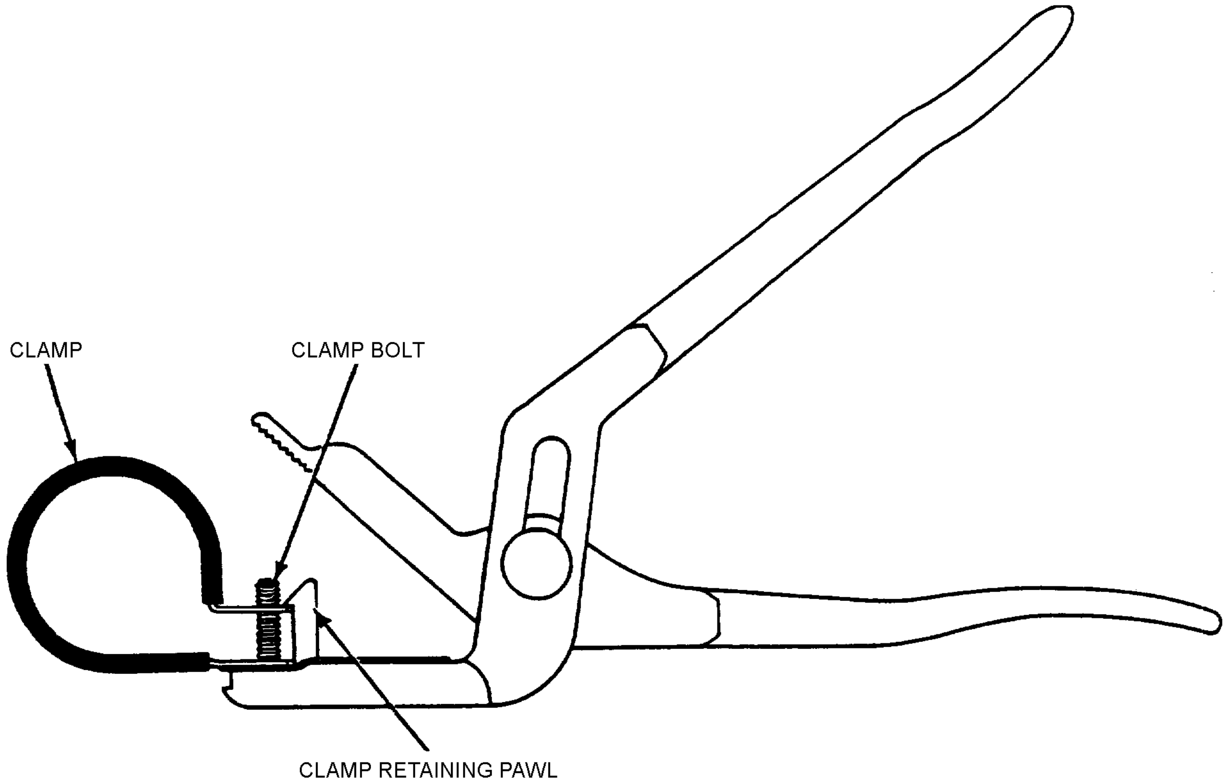


Figure 34. Slip Joint Pliers

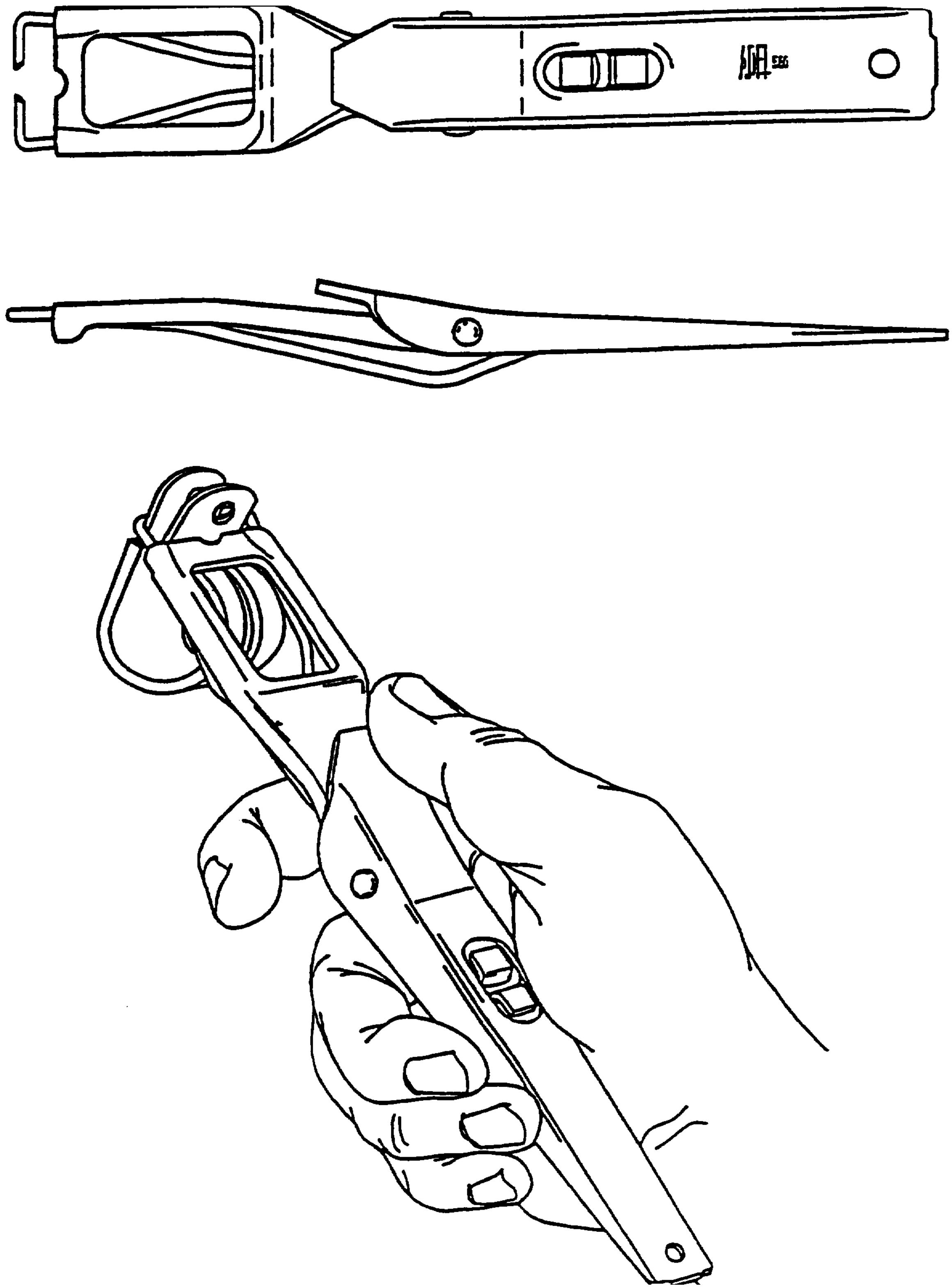


Figure 35. ADEL 560

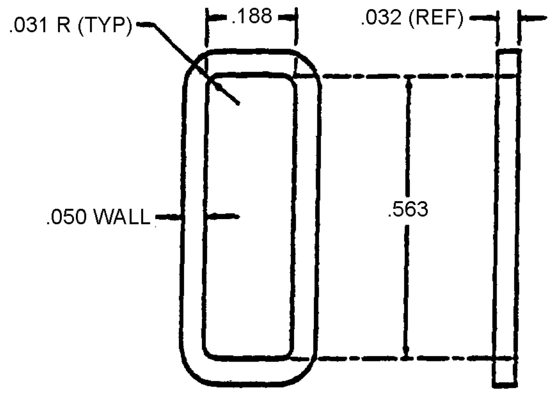


Figure 36. GC21E1 Loop, Strap Fastener

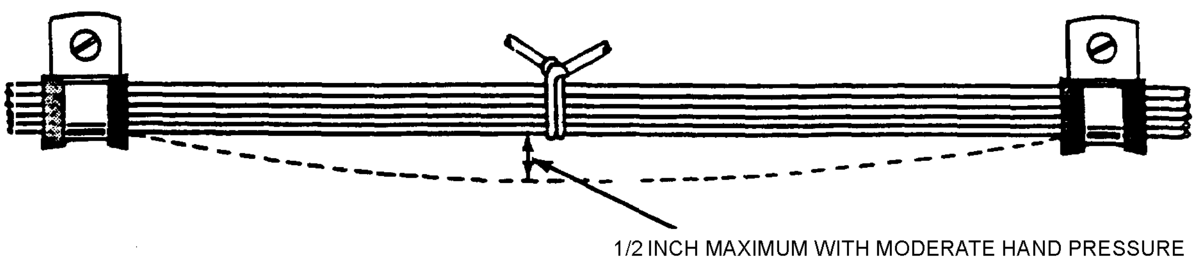


Figure 37. Slack Between Supports

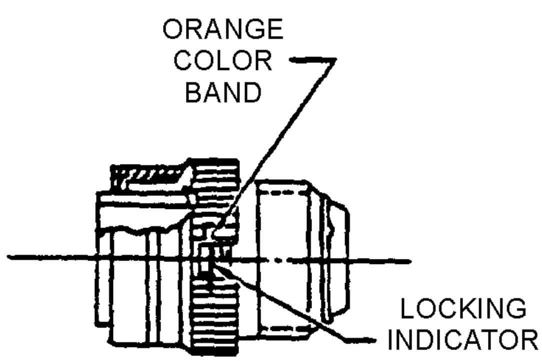


Figure 38. Self-Locking Connector

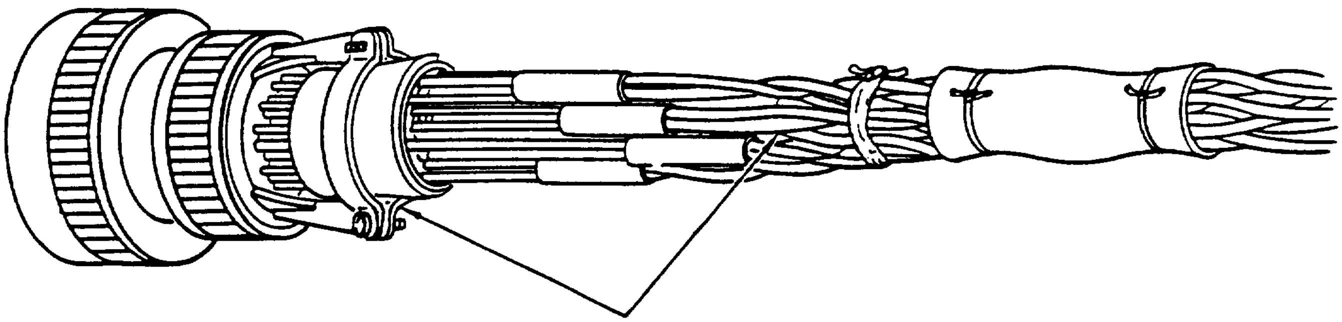


Figure 39. Comb Twisted Wires

NOTE

Avoid painting the threaded surface or insert of plug or receptacle.

55 . **CONNECTOR MATED INSPECTION.** After the connector is completely mated, inspect the assembly as follows:

a. Comb out all wires, except when directed otherwise, so that wires will be parallel to each other in the group or bundle. Twisted wire terminating into a connector with a cable clamp may be untwisted from its original lay a maximum of 3 inches from clamp. Twisted wire may be closer than 3 inches as long as it does not cause interference with servicing of contacts, and is interwoven properly (Figure 39). A useful tool for combing out wires is shown in Figure 40, Make this tool from a piece of 1/8-inch nylon or other smooth insulating material. Be sure all sharp edges are rounded to protect wire insulation.

b. Examine assembly to be sure all marking sleeves are present (see WP 008 00).

c. Examine connector and accessory to confirm the wires are routed correctly from the back of the connector as shown in Figure 41.

56 . **CONNECTOR UNCOUPLING.** Uncouple connector as follows:

a. Use a strap wrench or padded conduit pliers to loosen coupling rings which are too tight to be loosened by hand.

b. Alternately, pull on the plug body and unscrew coupling ring until connector is separated.

CAUTION

Do not pull on attached wires.

c. Protect disconnected plugs and receptacles with caps or bags as shown in Figure 3 to keep debris from entering and causing faults.

57 . **TYING WIRE GROUPS OR BUNDLES.**

58 . **INTRODUCTION.** Wire groups and bundles may be required to be laced or tied to provide ease of installation, maintenance, and inspection. This section describes and illustrates the recommended procedures for lacing and tying wire groups or bundles, using knots, tapes, or plastic cable straps.

59 . **LACING TYPES.** The following tying types may be used to provide secondary support to harnesses and bundles:

a. For low vibration applications, use finish C polyester tying tapes, size 2 or 3 in accordance with A-A-52081.

b. For medium or high vibration applications, use finish C, glass tying tapes, sizes 2 or 3 in accordance with A-A-52083.

c. For high temperature applications (above 185°F), use pressure sensitive tapes.

60 . **GENERAL PRECAUTIONS.** When lacing or tying wire groups or bundles, observe the following precautions:

a. Lace or tie bundles tightly enough to prevent slipping, but not so tightly that the cord or tape cuts into or deforms the insulation. Be especially careful when lacing or tying coaxial cable, which has a soft dielectric insulation between the inner and outer conductors.

b. Do not use ties on the part of a wire group or bundle located inside a conduit.

c. When tying wire bundles behind connectors, start ties far enough back from the connector to avoid splaying of contacts (Figure 41).

61 . **CONTINUOUS LACING.** Continuous lacing may be used only on those wire groups or bundles which are to be installed in panels or junction boxes. Use double cord lacing on groups or bundles larger than one inch in diameter. Use either single or double cord lacing on groups or bundles one inch or less in diameter. For lacing groups which branch off a main bundle (Figure 42).

NOTE

Lacing (continuous-tying) shall not be used except in panels or junction boxes.

62 . **Single Cord Lacing.** Lace a wire harness bundle with a single cord as follows (Figure 43):

a. Start the lacing at the thick end of the wire group or bundle with a knot consisting of a clove hitch with an extra loop.

b. At regular intervals along the wire group or bundle, and at each point where a wire or wire group branches off, continue the lacing with half hitches.

NOTE

Space half hitches so that the group or bundle is neat and securely held.

c. End the lacing with a knot consisting of a clove hitch with an extra loop.

d. Trim the free ends of the lacing cord to 3/8-inch minimum.

63 . **Double Cord Lacing.** Lace a wire group or bundle with a double cord as follows (Figure 44):

a. Start the lacing at the thick end of the wire group or bundle with a bowline on a bight.

b. At regular intervals along the wire group or bundle, and at each point where a wire group branches off, continue the lacing with half hitches, holding both cords together.

NOTE

Space half hitches so that the group or bundle is neat and securely held.

c. End the lacing with a knot consisting of a half hitch, using one cord clockwise and the other counter clockwise, and then tying the cord ends with a square knot with an extra loop (Figure 44).

d. Trim the free ends of the lacing cord to 3/8-inch minimum.

64 . **Lacing Branch-Offs.** Lace a wire group that branches off the main wire bundle as follows (Figure 42):

a. Start the branch-off lacing with a starting knot located on the main bundle just past the branch off point. When single cord lacing is used, make this starting knot as described in paragraph 62 , step a; when double cord lacing is used, make it as described in paragraph 63 , step a.

b. Continue the lacing along the branched off wire group, using regularly spaced half hitches. Where a double cord is used, both cords are held together.

NOTE

Space half hitches so that the group or bundle is neat and securely held.

c. End the lacing with the regular knot used in single and double cord lacing, as described in paragraph 62 , step c, and paragraph 63 , step c, respectively.

d. Trim the free ends of the lacing cord to 3/8-inch minimum.

65 . **TYING.** Tie all wire groups or bundles where supports are more than 12 inches apart. Space ties 12 inches or less apart. Make ties as follows:

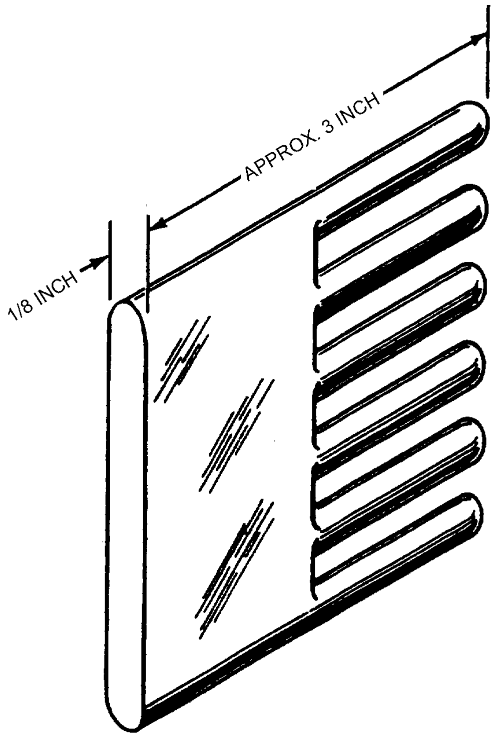


Figure 40. Comb for Straightening Wires in Bundles

66 . **TEMPORARY TIES.** Temporary ties are used to aid in making up and installing wire groups or bundles. Remove these ties when the installation is complete.

a. Wrap cord around wire group or bundle, as shown in Figures 45 through 47.

b. Make a clove hitch, followed by a square knot with an extra loop.

c. Trim free ends of cord to 3/8-inch minimum.

CAUTION

Cut temporary ties with scissors or diagonal pliers only. Do not use a knife or other sharp edged instrument which may damage the installation.

67 . **TYING WIRE GROUPS INTO WIRE BUNDLES.** Tie wire groups into bundles as described in Figure 43, treating the wire groups the same as for individual wires.

68 . **PRESSURE SENSITIVE TAPE.** When pressure-sensitive tape is used, apply in accordance with MIL–I–24391. See Figure 48.

a. Wrap tape around wire group or bundle three times, with a two-thirds overlap for each turn.

b. Heat-seal the loose tape end with the side of a soldering iron heating element.

NOTE

Do not use tape which may require frequent maintenance for securing wire groups or bundles.

69 . **HIGH TEMPERATURE PRESSURE-SENSITIVE TAPE.** Use A–A–59474 high temperature insulation tape to tie all wire groups and cable bundles in areas where the temperature may go above 185°F.

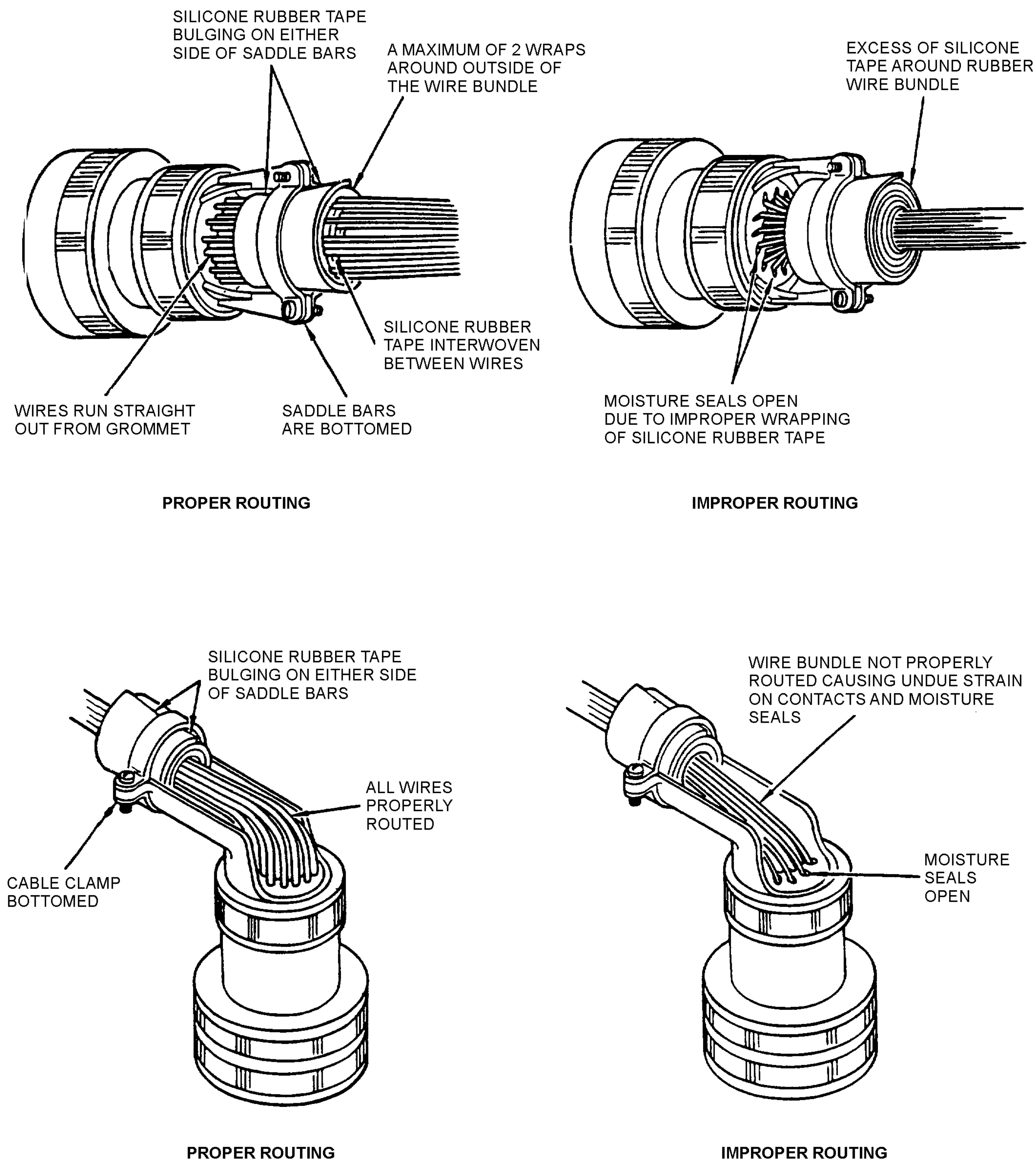


Figure 41. Wire Routing, Connectors and Terminal Modules, Environmentally Sealed (Sheet 1 of 4)

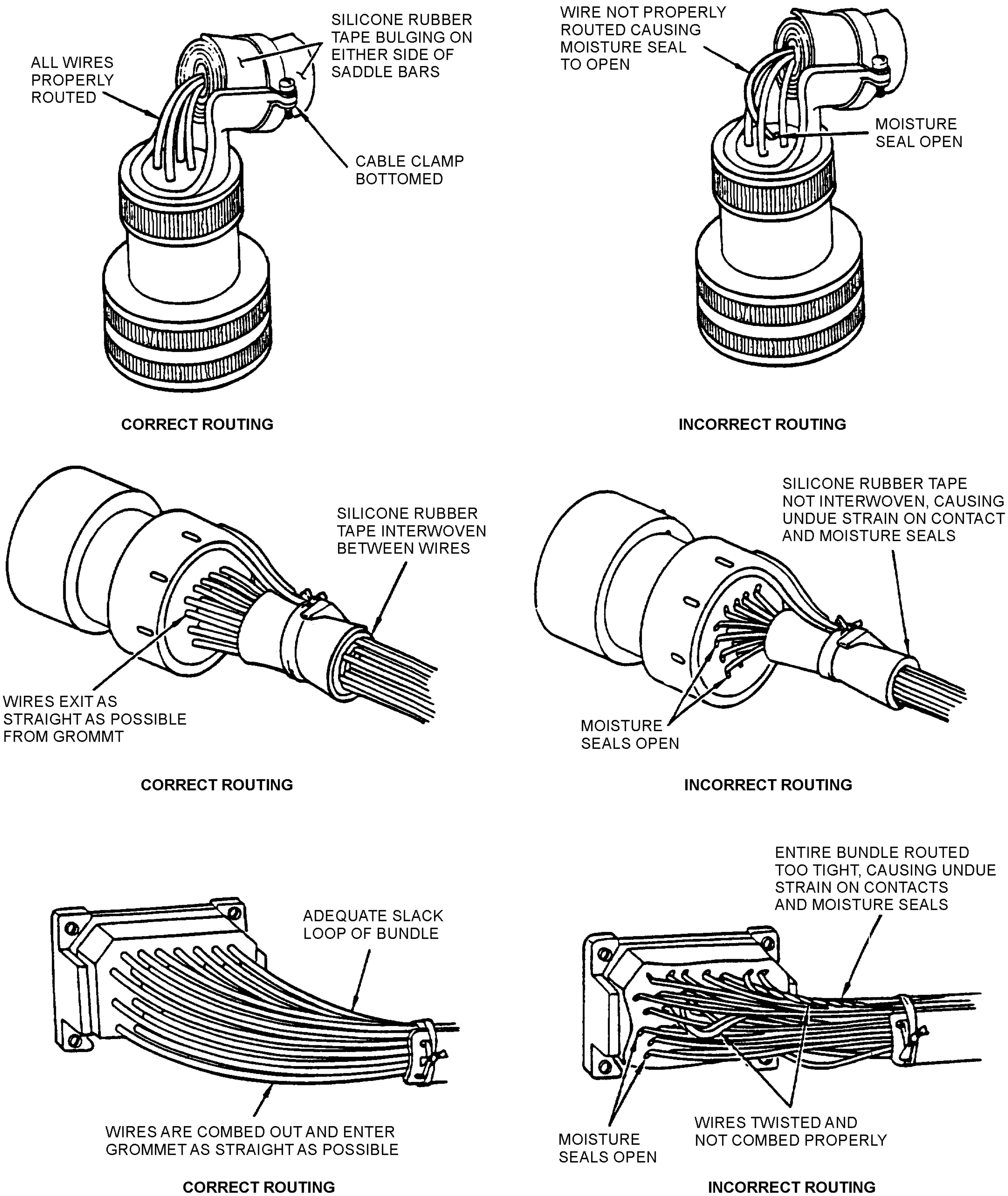


Figure 41. Wire Routing, Connectors and Terminal Modules, Environmentally Sealed (Sheet 2)

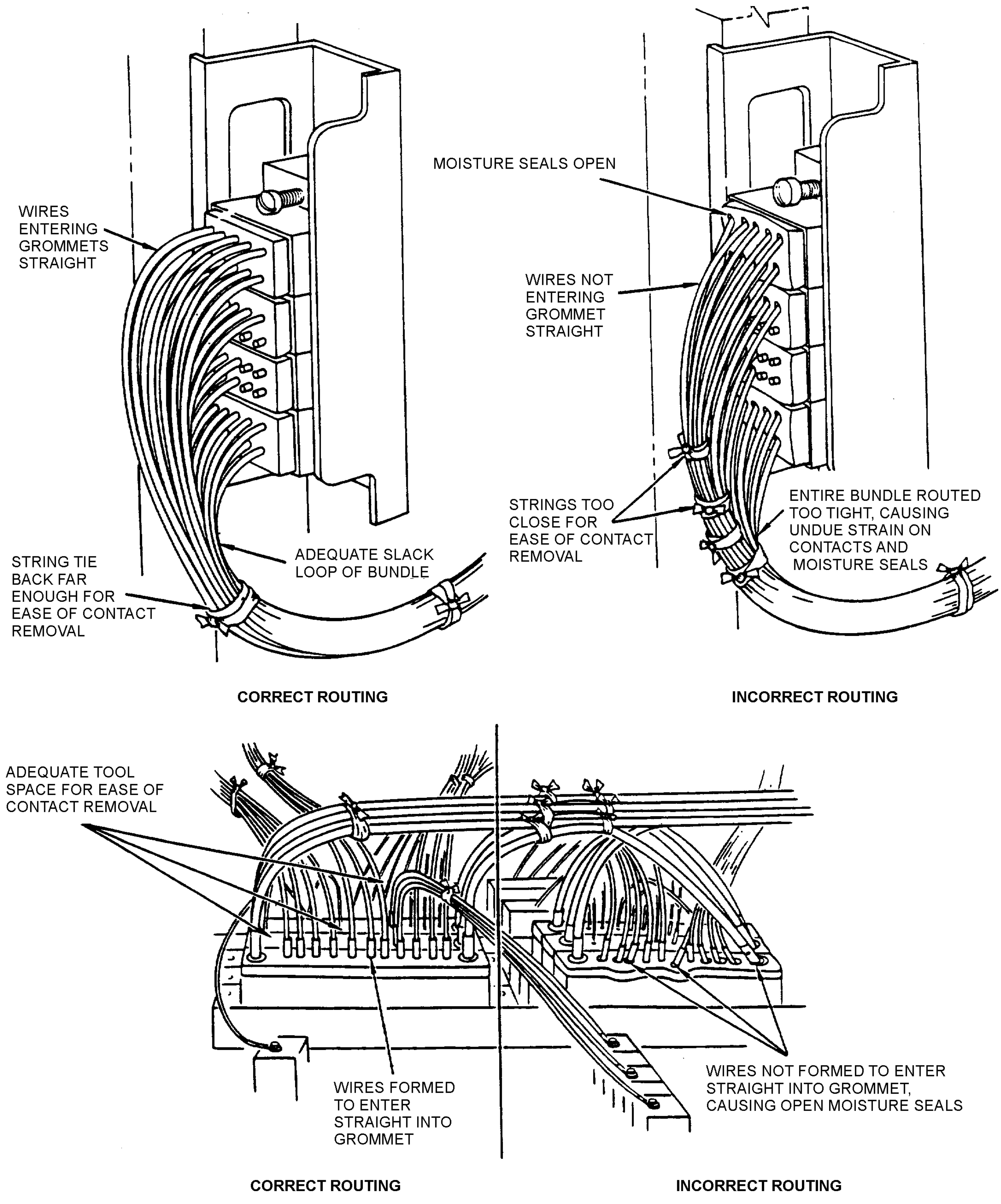
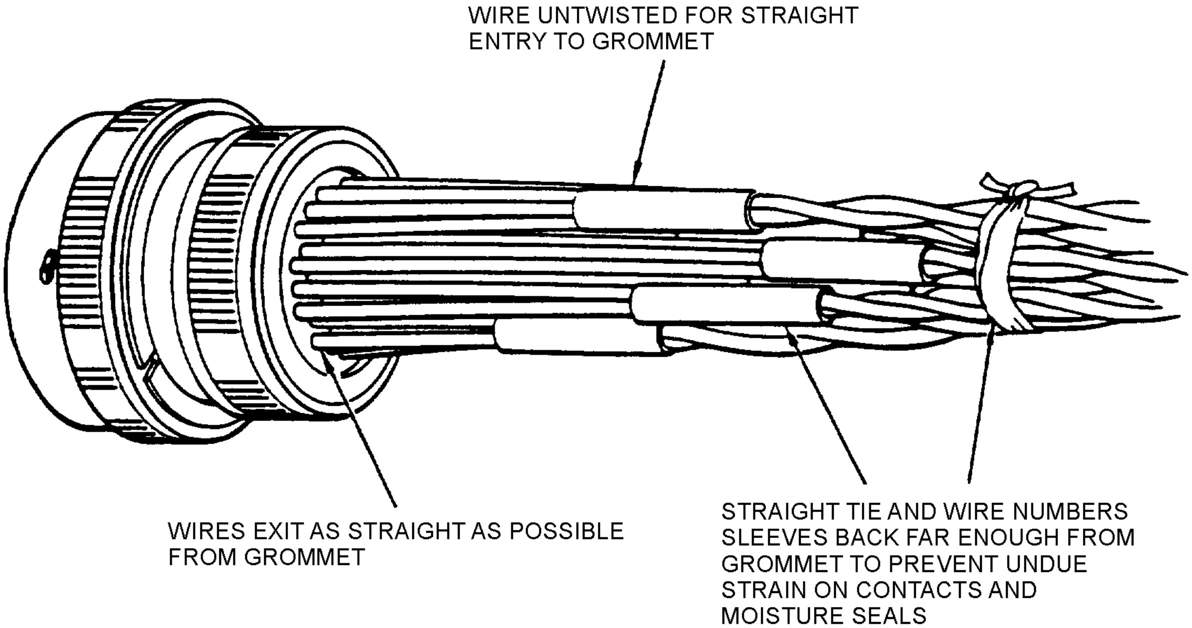
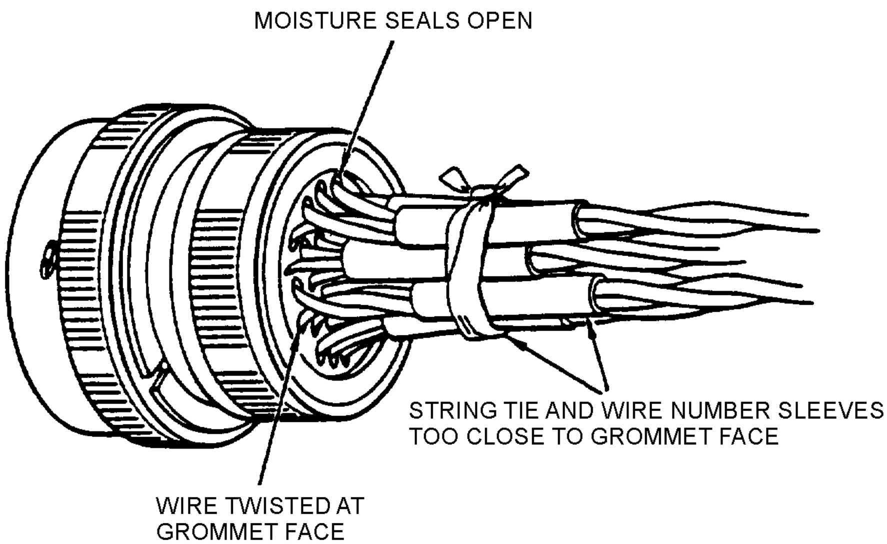


Figure 41. Wire Routing, Connectors and Terminal Modules, Environmentally Sealed (Sheet 3)



CORRECT ROUTING



INCORRECT ROUTING

Figure 41. Wire Routing, Connectors and Terminal Modules, Environmentally Sealed (Sheet 4)

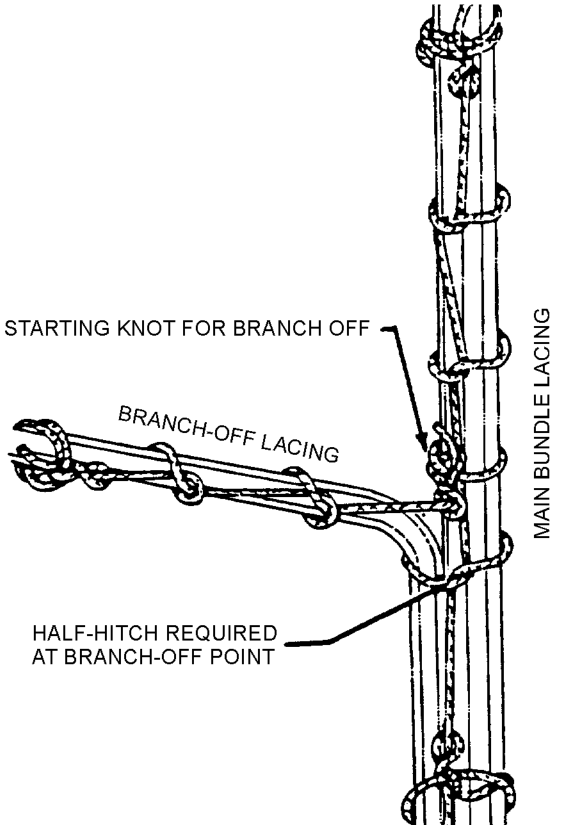


Figure 42. Lacing A Branch-off

WARNING

MIL-I-15126 insulation tape (including the glass fiber type) is highly flammable and should not be used in a high temperature environment. A–A–59474 insulation tape is designed for high-temperature operation (suitable for continuous operation at 500°F) and should be used in all high temperature environments.

70 . **SELF-CLINCHING CABLE STRAPS.** Straps are adjustable, lightweight, flat plastic devices used for tying and supporting cable assemblies and wire bundles. The strap configuration is shown in figure 49. The straps are of two types: (1) a MS3367 cable securing strap shown by the bold lines in Figure 49 and (2) an MS3368 identification and securing strap illustrated by the broken lines in Figure 49. Only the black MS3367 (–0) colored strap is authorized for use on aircraft. The black is ultra-violet light resistant and is restricted as follows:

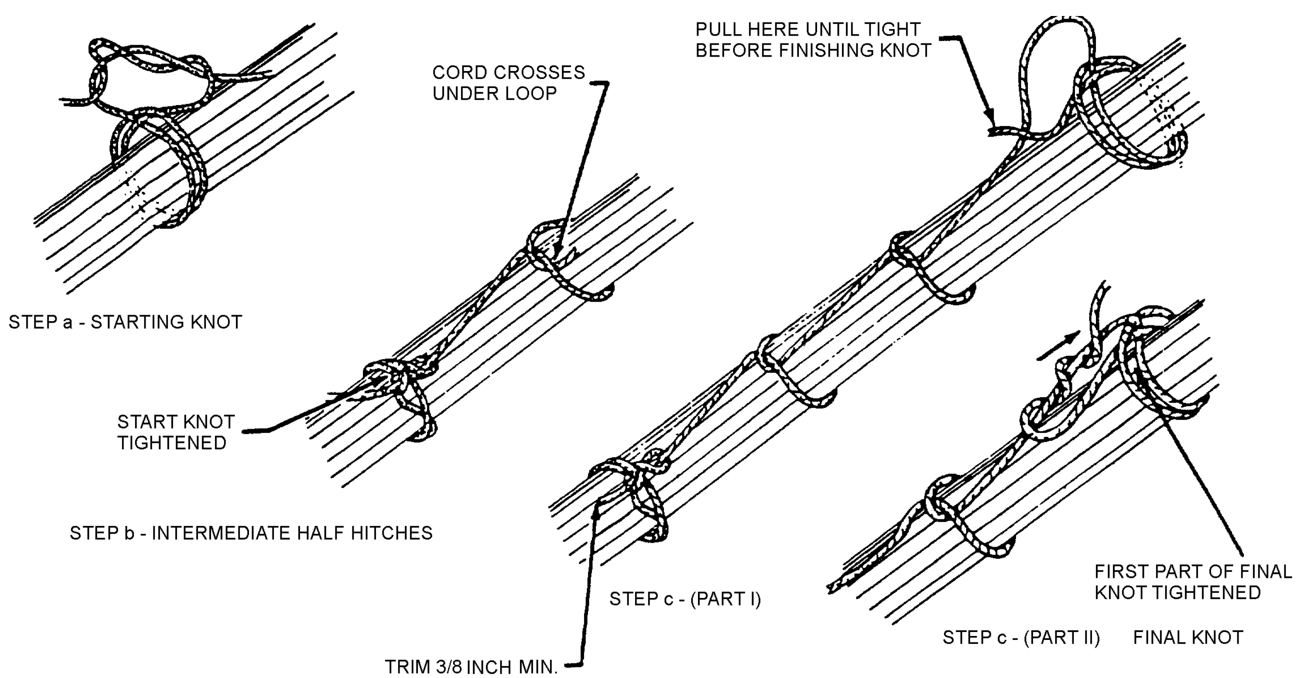


Figure 43. Single Cord Lacing

CAUTION

Straps must not be used for the following applications

a. In temperature environments which exceed 85°C (185°F).

b. On coaxial cables or bundles containing coaxial cables which do not have hard dielectrics.

c. In areas where excess material from strap cuttings or failure of the mounted strap would allow plastic to fall into moveable parts.

d. On the outside of cables or bundles which will be dragged through tight or unreachable spaces during final aircraft installation.

e. In very high vibration areas.

f. In swamp areas.

g. Inside bundles or harnesses.

71 . **Cable Strap Installation.** Using the Military hand tool listed in Table 7 and illustrated in Figure 50 and Figure 51, perform the following:

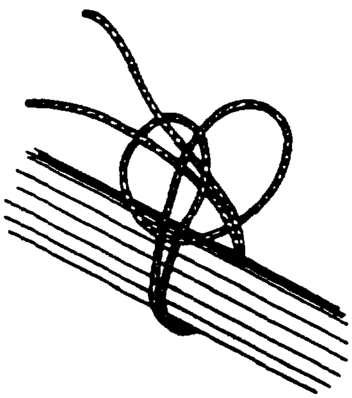
a. From Table 7, select a strap size and appropriate tool for the wire bundle diameter being secured.

(1) Refer to paragraph 70 for restrictions on strap usage.

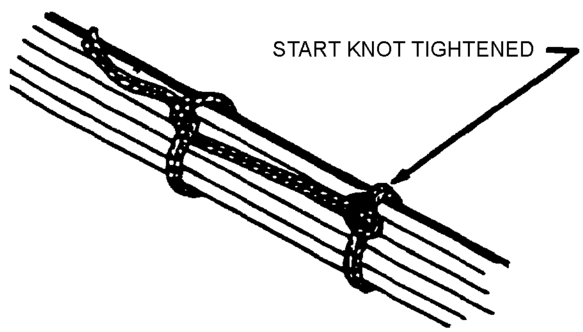
b. Slip strap tip around the bundle with boss side up.

c. Thread tip through eye then hand pull strap tight against the bundle.

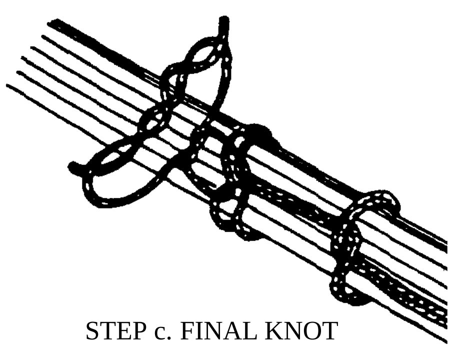
d. Adjust the tool index line to the tension locator value specified in Table 7. If standard changes in the tension adjustment knob does not align the index line



STEP a - STARTING KNOT - BOWLINE ON A BIGHT



STEP b - INTERMEDIATE HALF HITCHES



STEP c. FINAL KNOT

Figure 44. Double Cord Lacing

with the required tension locator value, the knob may be pulled out and rotated until alignment occurs.

e. Pass the free end of the cable tie through the slot in the end of the tool, then push tool snugly against the boss.

f. While holding strap firmly against side of tool and tool face squarely against boss, pump handle several times without fully activating the tool's cutting knife. Once the strap has been stretched to its maximum, squeeze handle slowly and firmly until strap is cut.

WARNING

The strap must be cut flush with the boss surface in order to eliminate painful cuts and scratches from protruding strap ends.

g. If strap end is not flush with boss head, remove the strap and install a new strap in its place or trim the strap end flush.

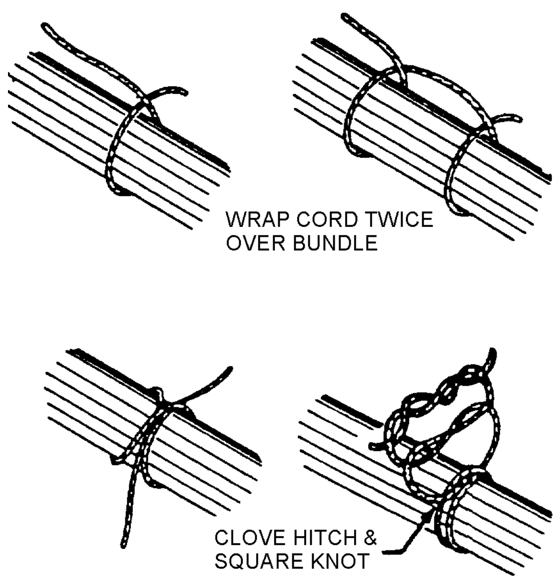


Figure 45. Bundle Ties

h. Pick up for appropriate disposal all broken straps and strap ends that were cut off.

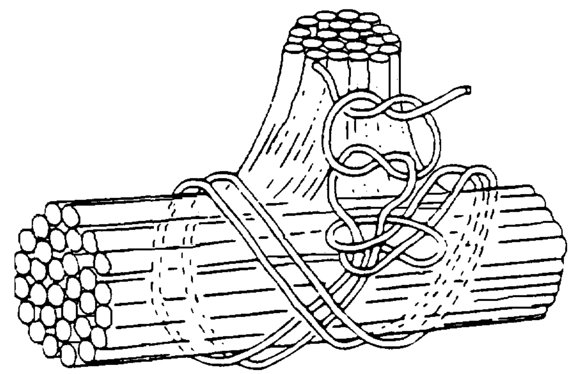


Figure 46. 90° Bundle Tie

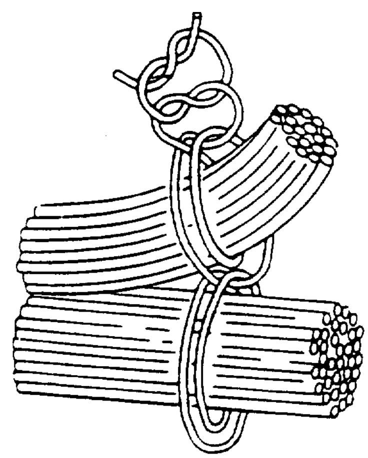


Figure 47. Bundle Breakout

Table 8. Self-Clinching Plastic Cable Straps and Installation Tools

MS Part No.	MAX. Strap Width (in.)	For Bundle Diameter (in.)	MS Tool No. MS90387-x	Tension Setting
MS3367-1-0	0.190	1/16 - 1-3/4	-1	7
MS3367-2-0	0.192	1/16-4	-1	7
MS3367-3-0	0.310	3/16 - 3/1/2	-2	8
MS3367-4-0	0.100	1/16 - 5/8	-1	2
MS3367-5-0	0.146	1/16 - 1-1/4	-1	5
MS3367-6-0	0.310	3/16 - 8	-2	8
MS3367-7-0	0.192	1/16 - 3	-1	7
AS33681-1-0	0.190	3/8 - 1-3/4	-1	7
AS33681-2-0	0.190	3/4- 4	-1	7
AS33681-3-0	0.190	3/8 - 1-3/4	-1	7
AS33681-4-0	0.190	3/8 - 1-314	-1	7
AS33681-5-0	0.100	3/16 - 518	-1	2

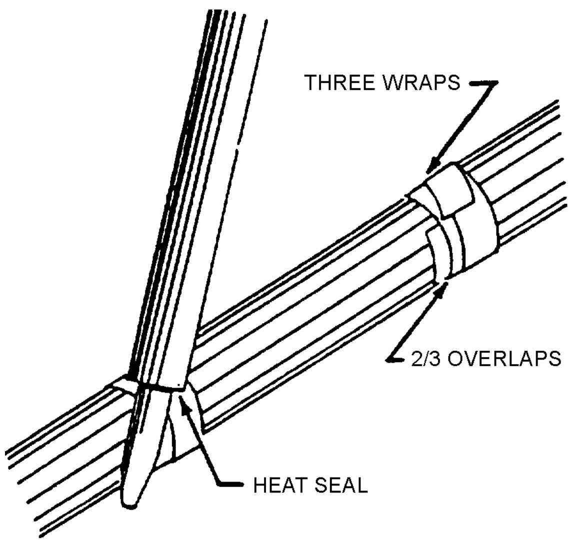


Figure 48. Securing with Tape

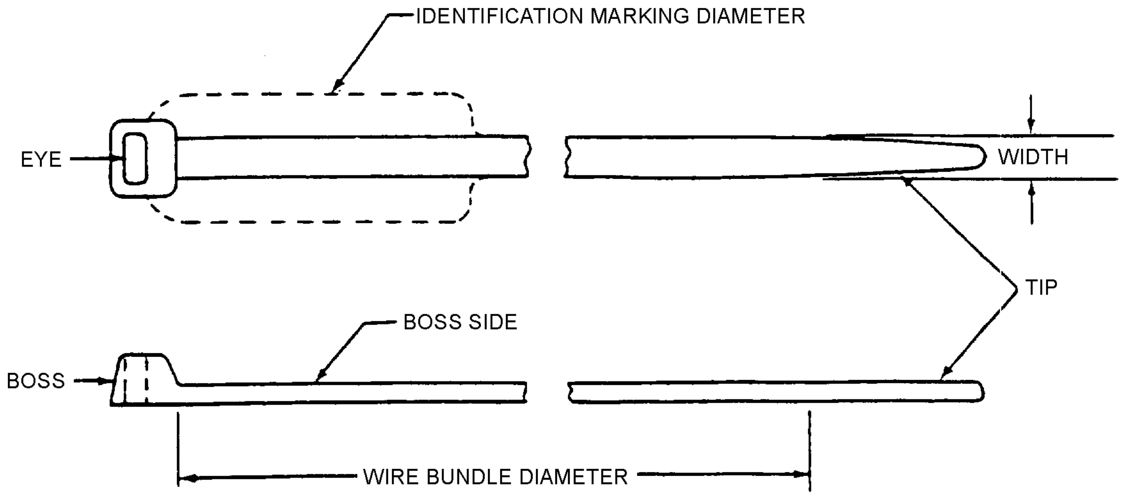


Figure 49. Strap Configuration

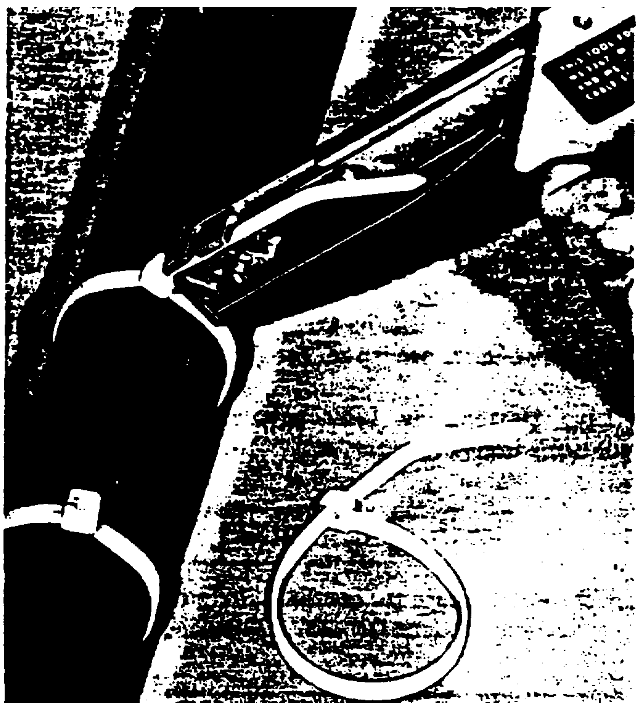


Figure 50. Installing Self-Clinching Plastic Cable Straps

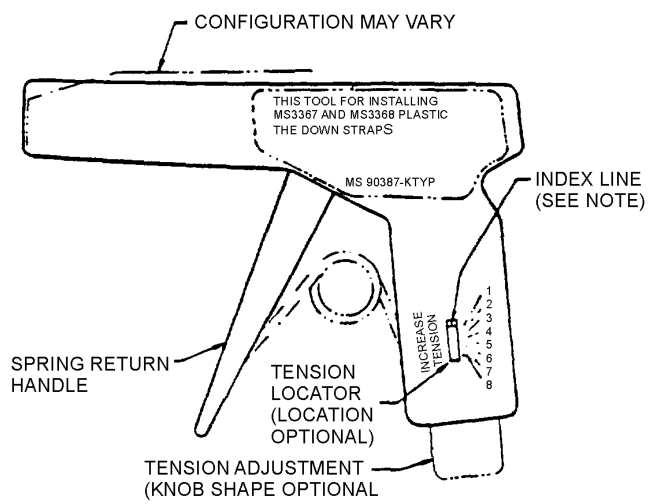


Figure 51. MS90387 Adjustable Hand Tools for Installing Self-Clinching Plastic Tiedown Straps

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OPEN AND OVERBRAIDED HARNESS REPAIR

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part No./Type Designation
AMP Crimp Tool	49935
AMP Crimp Tool	69335–0
Heat Gun	HT-900B
Heat Gun	HT-920B
Heat Gun	HT–71002
Heat Gun	MCH–100–A
Inspection Gage	M22520/3-9
Inspection Gage	M22520/3-10
Crimp Tool	M22520/5-01
Die Set	M22520/5-100
Crimp Tool	M22520/37-01
Inspection Gage	M22520/39-01

Materials Required

Nomenclature	Specification/ Part Number
Alcohol, Isopropyl	TT-I-735
Cap, End	MS25274-1
Cap, End	MS25274-2
Cap, End	MS25274-3
Cap, End	MS25274-4
Sleeving, Heat Shrink	CRN-T
Solder Sleeve Shield Termination	SAE–AS83519
Solvent, Dry Cleaning	MIL–PRF–680, Type II
Tape, Lacing and Tying	A–A–52080 thru A–A–52084
Tape, Non-Adhesive Self-Bonding	A–A–59163 TYPE II, NSN 5970-00-949-4846
Tape, Non-Adhesive Self-Bonding	A–A–59163 TYPE II, NSN 5970-00-955-9976
Tape, Non-Adhesive, Self-Bonding, Black	A–A–59163 TYPE II, NSN 5970-00-955-9976
Tape, Non-Adhesive, Self-Bonding, Red	A–A–59163 TYPE II, NSN 5970-00-949-4846
Tape, Self Bonding Silicone Rubber	A–A–59474
Tubing, Heat Shrink	SAE–AMS–DTL–23053
Wire, Heavy Wall	MIL-W-22759

1. **INTRODUCTION.**

2. A harness assembly is basically a point(s)-to-point(s) electrical distribution system consisting of various components, such as wire, cable, connectors, etc. The repair or replacement of these typical components is covered in appropriate work packages (WP) of this manual. This WP will cover those components and processes most directly related to the harness protection and construction. Examples are; harness forming, external protection methods, boots, sleeves, tapes, etc.

3. **HARNESS TYPES.**

4. A harness is either open (unprotected), or protected (covered). An open harness is usually a round group of wires and cables bundled together by ties, straps or sometimes tape, and has no protective jacket. The harness could also be square with wires stacked as flat cables or ribbons (see WP 005 00). The wire has a thick insulation wall to provide mechanical protection. The protected harness is constructed similarly to an open harness except it has a protected jacket. The wires have thinner insulation, because the jacket provides the mechanical protection. The jacket could be metal, cloth, insulation, or a combination of these. The types of harnesses that will be discussed herein are as follows:

a. Open Harness

b. Round Overbraided Harness

c. Round Metallic Overbraided Harness

5. The environmental sealed harness repair (WP 011 01) and integrated wire system (WP 011 02) are discussed in separate Work Packages, because of their unique characteristics. The actual repairs of the components in these unique harnesses are covered in the various work packages for the components or herein.

6. **HARNESS REPAIR.**

7. **OPEN HARNESS REPAIR.** An open harness should be repaired in accordance with the appropriate work package for the component that is damaged. For example, if a wire or a cable is chafed or broken, repair it in accordance with (WP 015 00). The few unique repair characteristics, which are more associated with the harness components, are covered under the other harness repair sections. Examples are as follows:

a. Multiple Splicing

b. Additional Mechanical Protection

c. New Wire Additions

d. End Caps

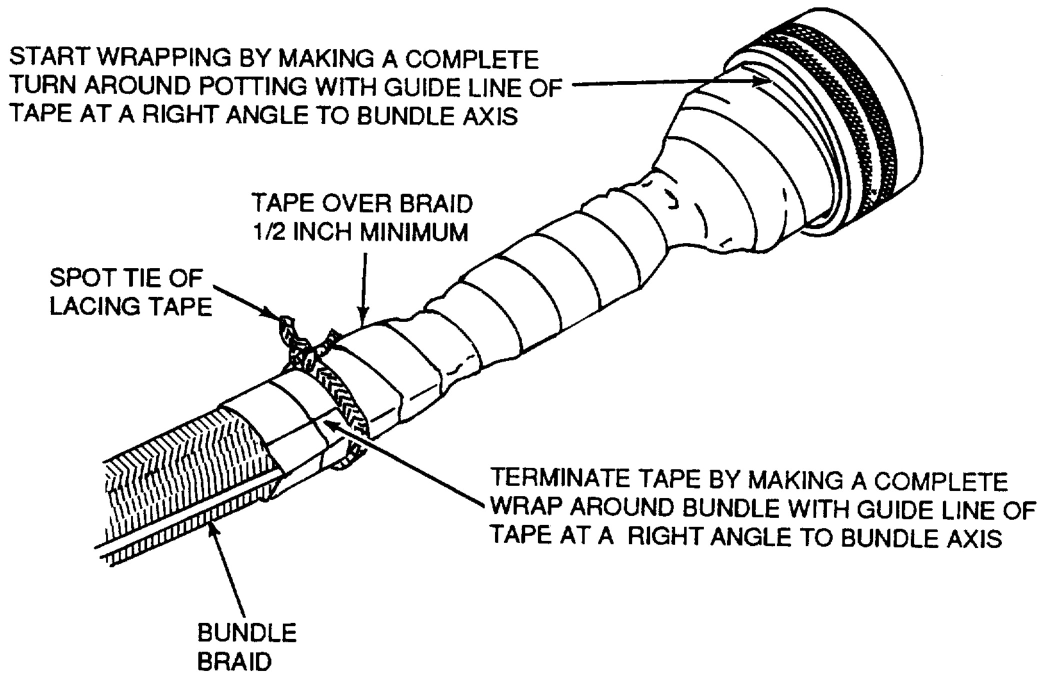


Figure 1. Tape Protective Boot

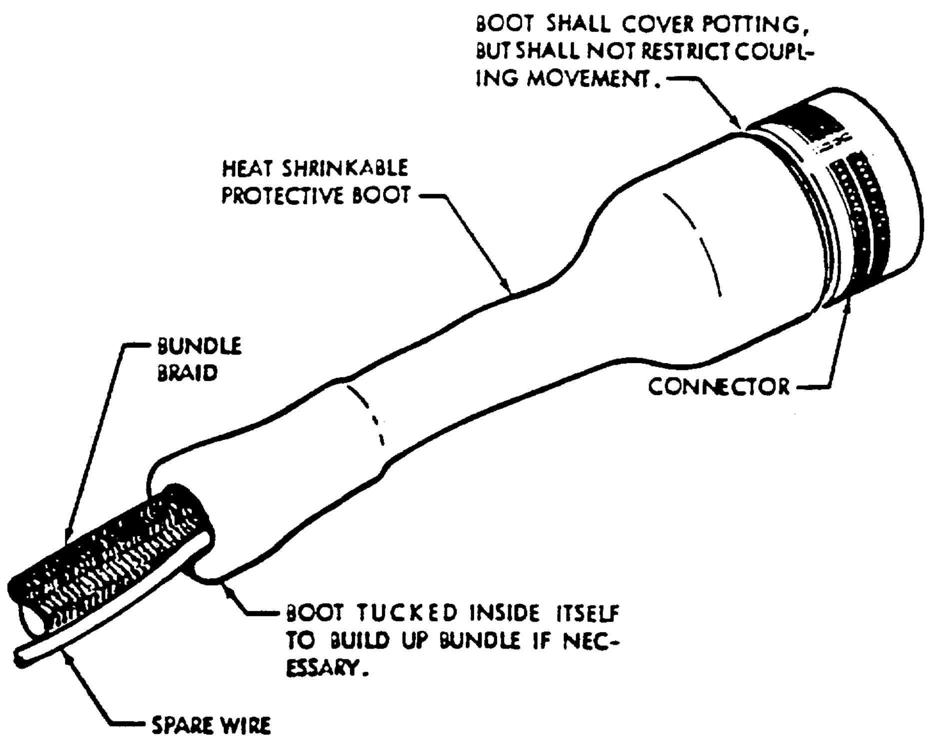


Figure 2. Shrink Protective Boot

8 . **ROUND OVERBRAIDED HARNESS REPAIR.**

9 . **Protected Potting Boot Repair.** Since most overbraid ends near the end of the connector termination point, a boot must be fabricated from the end of the braid over the wire and over the back of the potting compound, which is connected to the connector. A protective boot (Figure 1) or a shrink protective boot (Figure 2) may be used.

CAUTION

Use a red or black non-adhesive self-bonding tape, A–A–59163, TYPE II NSN 5970-00-949-4846 or NSN 5970-00-955-9976.

NOTE

For best results when using non-adhesive self-bonding tape, the hands should be completely free from dirt and oil.

10 . **Fabricating Tape Protective Boot.** When a new boot must be fabricated use self–bonding tape as described below (Figure 1).

NOTE

When using silicone self-bonding tape, the hands should be completely free from dirt or oil.

a. Starting at the connector, wrap tape one complete turn around the potting.

b. Using the same continuous length of tape wrapped around the connector, spiral-wrap, with a 50% overlap, a single layer over exposed wires and onto braid.

NOTE

To achieve a neat appearing boot, follow guide line on tape and keep tape stretched tightly.

c. Overlap the tape onto the bundle braid a minimum of 1/2 inch to prevent wire exposure even when flexing the bundle.

d. Terminate the silicone tape by wrapping at least a full turn of tape around the bundle, keeping the guide line at a right angle to the horizontal axis of the bundle.

NOTE

Do not keep tape under tension while applying this last wrap.

e. With lacing tape, make a spot tie on the tape termination at the braid end (WP 010 00).

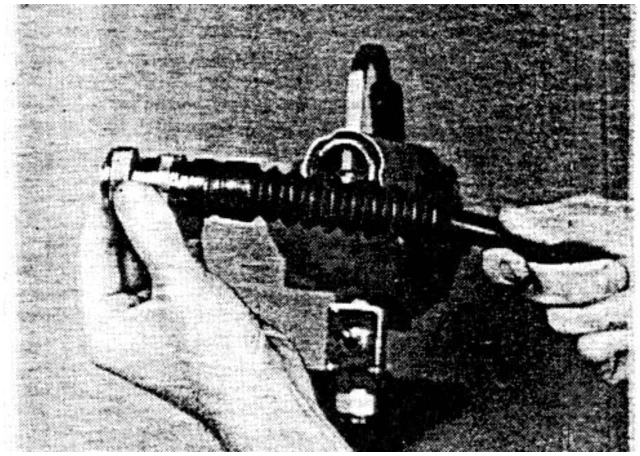


Figure 3. Heating Convoluted Boot

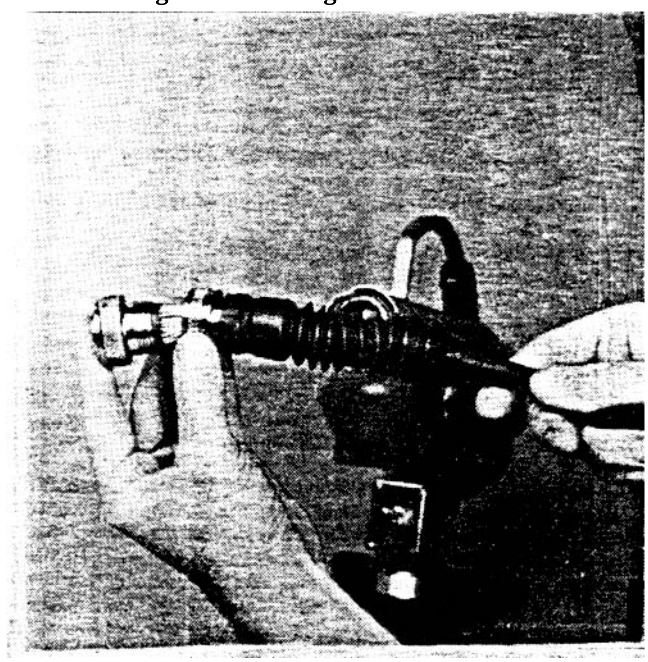


Figure 4. Heating & Retracting Convoluted Boots

11 . **Shrink Boot Repair.** Repair the shrink boot as shown below. The figures demonstrate the technique on a connector accessory although it is also applicable to potted connectors.

12 . **Boot Removal and Reinstallation.** Remove and reinstall a boot from a cable assembly as follows:

WARNING

The HT–900B, HT–920B, HT–71002, and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT–900B/HT–920B/HT–71002 heat gun in an enclosed area can be hazardous. discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

a. Heat the convoluted boot (Figure 3) with heat gun until warm to the touch, then pull the loosened adapter away from the connector exposing the wire conductors that are entering the connector. Hold in retracted position until cool and boot remains retracted (Figures 4 and 5).

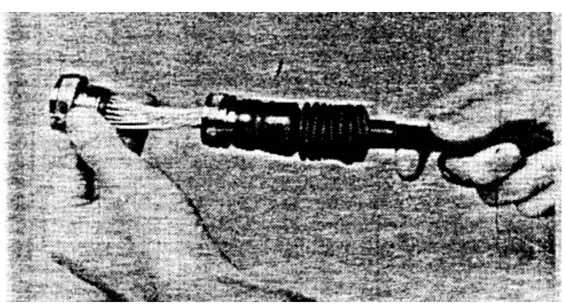


Figure 5. Convoluted Boot in Retracted Position.

b. Heat the shrink boot with heat gun until warm to touch, then pull the adapter and boot back exposing the connector backside with enough clearance to allow repair (Figure 6).

c. In some cases the boot may have to be cut off. When a boot has to be cut off, score (cut) the boot lengthwise, taking care not to cut through the boot into the cable jacket (Figure 7).

d. Peel the boot from the cable jacket and connector with pliers (Figure 8).

e. Heat the boot with a heat gun until warm to touch.

f. Reinstall convoluted and shrink boots by heating the boot with a heat gun until warm to the touch, slide backshell and boot up to rear of connector and tighten backshell coupling ring.

13 . <u>**New Boot Installation.**</u> The following steps should be followed when installing a new boot on a connector harness assembly:

a. Degrease connector backshell or adapter with suitable cleaning solvent.

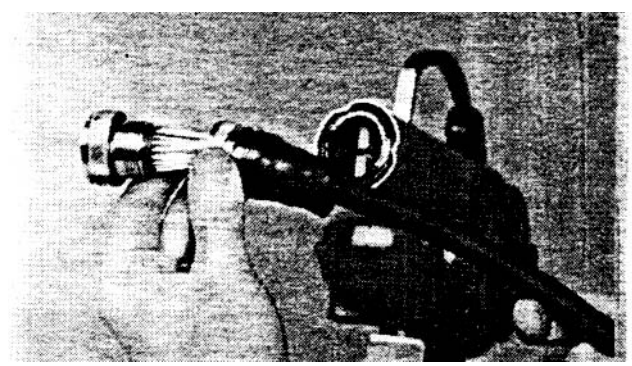


Figure 6. Heating and Retracting Shrink Protective Boot.

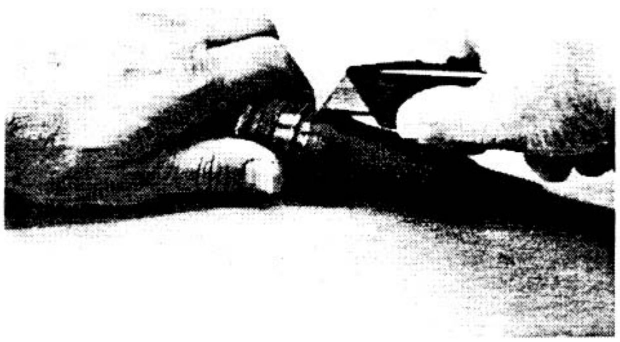


Figure 7. Cutting Standard Boot.

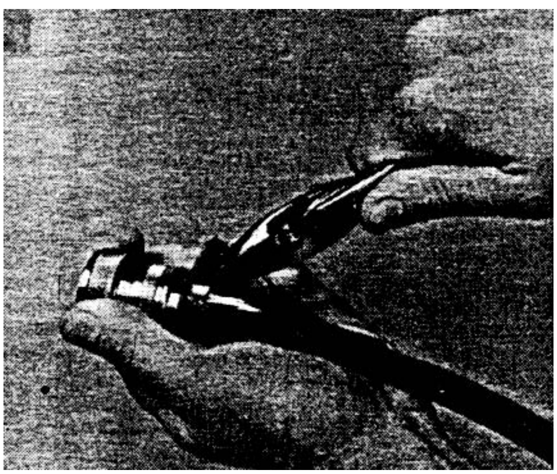


Figure 8. Peeling Standard Boot Off of Cable Assembly

b. Apply adhesive to cable and connector bonding areas in accordance to the manufacturer's instructions only if needed. Some boots are pre-coated with an adhesive in the bonding areas.

c. Install new boot over end of cable.

NOTE

Boots can be installed over connectors in most cases. Occasionally, it may be necessary to disassemble a connector to install the repair boot.

WARNING

The HT–900B, HT–920B, HT–71002, and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT–900B/HT–920B/HT–71002 heat gun in an enclosed area can be hazardous. discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

d. Shrink the boot starting at the connector end and proceeding to the cable end with a heat gun (Figure 9).

e. If required, cure the adhesive according to recommended curing instructions.

14. **Protected Braid Repair.** When the braid must be partially replaced, the braid may be replaced by non-adhesive self-bonding tape or shrink sleeving.

15. **Tape Braid Repair.** The tape shall be attached to the braid as follows:

CAUTION

Use extreme care when removing braid to prevent wire damage. When using scissors or knife, carefully cut along harness to distance required. Ensure cutting edges face outboard to prevent wire damage.

a. Cut braid axially (lengthwise) along harness to distance required. Ensure cutting edge faces outboard to prevent wire damage.

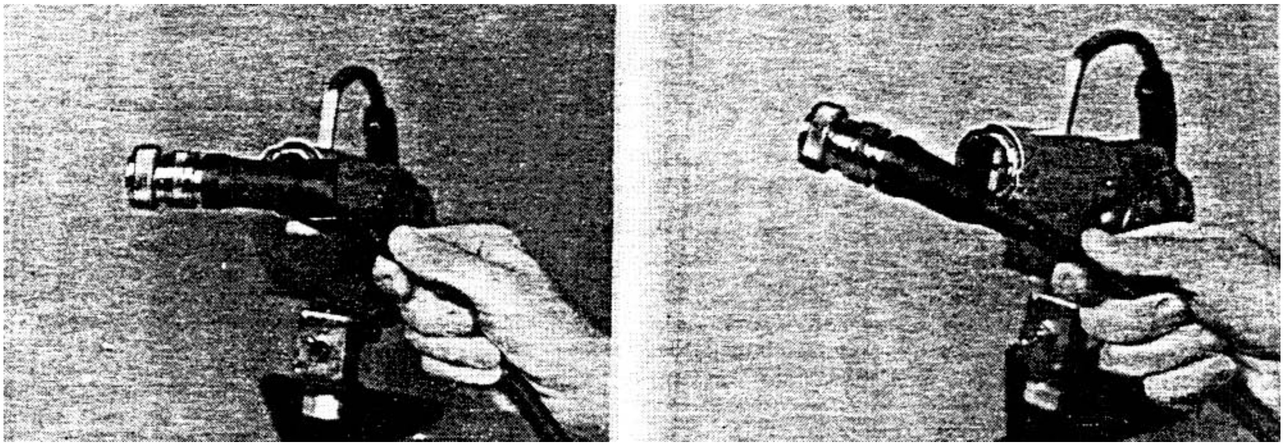


Figure 9. Shrinking Boot With Heat Gun

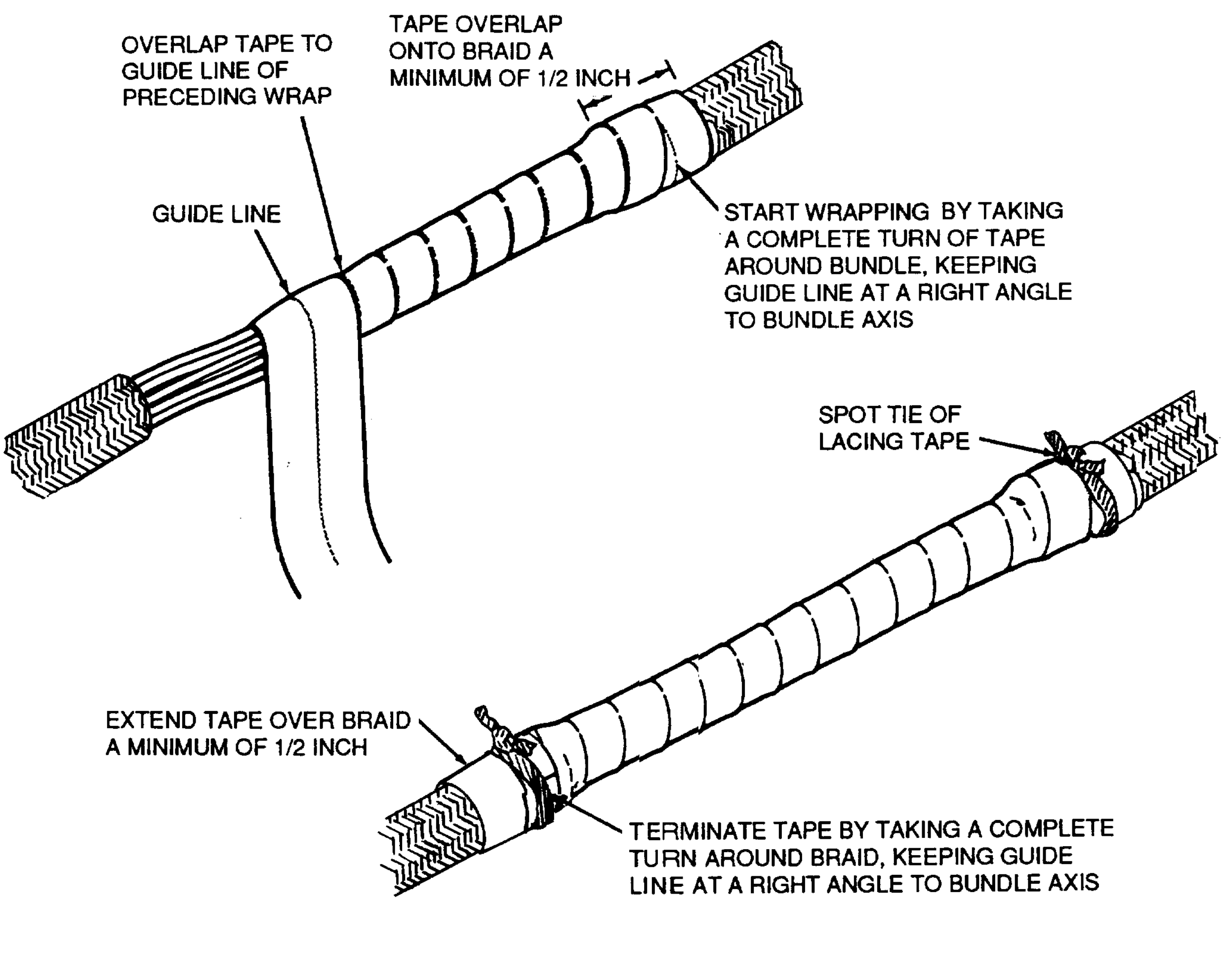


Figure 10. Tape Braid Repair

b. At required distance cut braid circumference at each end of axial cut and remove braid.

c. Inspect harness for possible damage incurred during cutting and repair as necessary.

NOTE

The use of the HT–900B/HT–920B/HT–71002/MCH–100–A are the recommended heat sources and are qualified for use on fueled aircraft.

d. Repair the bundle braid exposed area as follows (Figure 10):

NOTE

For best results when applying non-adhesive tape, the hands should be free of dirt or oil.

e. Wrap tape around braid for one complete turn beginning within 1/2 inch of braid end.

f. Using the same continuous length of tape, spiral wrap, with a 50% overlap, a single layer over wires and onto the opposite braid end for a minimum of 1/2 inch.

g. Terminate the tape by wrapping it a full turn around braid, keeping the guide line at a right angle to axis of the bundle.

NOTE

Do not keep tape under tension while applying this last wrap.

h. Make a spot tie of lacing tape at both ends of tape (WP 010 00).

16 . **Heat Shrinkable Sleeve Braid Repair.** Heat shrinking insulation sleeving is an electrical insulating sleeving that will shrink to a predetermined size upon the application of heat. There are many varied sizes, colors, compositions, and uses. Refer to the applicable SAE AMS–DTL-23053 specification when selecting heat shrinkable insulation sleeving. The braid shall be repaired with a sleeve as follows:

WARNING

The HT–900B, HT–920B, HT–71002, and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT–900B/HT–920B/HT–71002 heat gun in an enclosed area can be hazardous. discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

a. Select proper size and constructed heat shrinkable insulation sleeving from appropriate military specification.

b. The item to be covered must be clean and free of grease and oil.

c. Wire and braid strands must lie smooth and flat so as not to pierce the tubing.

d. Select correct reflector for heat gun in accordance with manufacturer’s instructions.

e. Begin shrinking the tubing at the end where it overlaps the braid. Heat the end of the tubing until it shrinks fully onto the braid, thus locking the tubing in place. Continue by moving the hot air gradually along the length of the tubing, shrinking each portion fully over the bundle before continuing on.

f. If there is an excess length of tubing when the end is reached, the excess can be cut off before shrinking is completed. Finish shrinking the tube so that the entire length of tubing is shrunk fully and tightly onto the bundle.

g. Allow the heat-shrink to cool before handling.

h. If the heat-shrinkable item is fully shrunk and does not fit tight, it is too large. Remove it and try a smaller size.

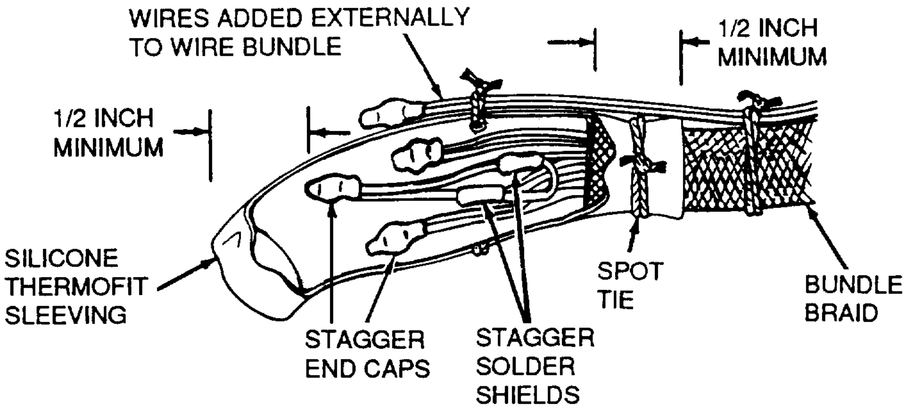


Figure 11. End Cap Area with Parallel Splices.

17 . **End Caps (Stub Splice).** End caps or stub splices are used to terminate parallel wires/dead ending a wire. There are numerous ways to provide an end cap/stub splice. A stub splice is also known as a parallel connector.

18 . **Military End Caps (Stub Splices).** End caps should be selected from MS25274 by the proper size listed in Table 1.

19 . **Military End Caps (Stub Splice) Repair.** Repair the military end cap (stub splice) as follows:

a. Select proper moisture resistant end cap.

b. Cut wire to proper length, ensure end is cut square.

c. Insert wire into end cap and crimp using crimp tool M22520/5-01 with die set M22520/5-100.

d. Ensure end cap is securely crimped to wire.

e. When more than one wire in a harness is end capped, ensure wires are cut to stagger end caps to maintain harness dimensions (Figure 11).

Table 1. End Caps by Wire Size

Wire AWG	Part No.	Color
26 - 24	MS25274-1	Yellow
22 - 18	MS25274-2	Red
16 - 14	MS25274-3	Blue
12 - 10	MS25274-4	Yellow

20 . **Covering Military End Cap (Stub Splice).** The military end cap must be covered for environmental protection. The caps may be covered with heat shrinkable insulation which is the preferred method, or with self-bonding tape.

21 . **End Cap (Sleeve Covered).** When using heat shrinkable insulation sleeving proceed as follows:

NOTE

Before covering the splice area, ensure the individual end caps have been completely insulated and splices have been staggered to limit bundle enlargement. Cut sleeving so it will be 1 1/2 inches longer. This is necessary so the sleeving can be doubled back and string tied.

a. Select proper size heat shrinkable insulation sleeving and approved heat source HT-900B/HT-920B, HT–71002/MCH–100–A with proper reflector (paragraph 17, step a).

b. Cut sleeving to a length to overlap braid by 1/2 inch and extend over longest end cap by 1/2 inch after being shrunk.

WARNING

The HT–900B, HT–920B, HT–71002, and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT–900B/HT–920B/HT–71002 heat gun in an enclosed area can be hazardous. discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

c. Apply heat to end over braid area first until sleeve grips firmly.

d. Continue to apply heat uniformly around circumference toward free end of sleeve.

e. Shrink each section before proceeding or distortion will result.

f. With lacing tape spot tie sleeve at braid end.

22 . **End Cap (Tape Covered).** When proper heat shrinkable insulation sleeving or approved heat source is not available the end caps may be covered by the use of selfbonding tape as follows:

NOTE

For best results when applying tape, hands should be free of dirt or oil.

a. Starting on braid end of the end cap area, wrap the tape one complete turn around braid.

b. Using the same continuous length of tape, spiral wrap, with a 50% overlap, a single layer over wires to the opposite end (free end) of end cap area.

NOTE

To achieve a neat appearing tape wrapping, follow the guide line on the tape and keep the tape stretched tightly.

c. Terminate the tape by wrapping it a full turn around the longest end cap keeping the guide line at a right angle to the end cap area.

NOTE

Do not keep tape under tension while applying this last wrap.

d. Make a spot tie of lacing tape at both ends of the silicone tape.

23 . **Parallel Connector (End Cap/Stub Splice).** AMP or McDonnell parallel connectors are installed as follows:

a. Remove insulation from the wire approximately 0.75 inch.

b. Select proper size parallel connector (Tables 2 and 3).

NOTE

If Table 2 and 3 show an asterisk (*) insert a stripped piece of scrap wire in the connector.. After crimping, cut scrap wire flush with connector to prevent connector from cracking and to create a reliable splice. AMP tool , part number 49935 should be used for crimp connectors 34130, 34137 and 34138. For . Crimp connector 34318 use AMP tool, part number 69355–0.

c. Crimp connector in appropriate nest of hand tool.

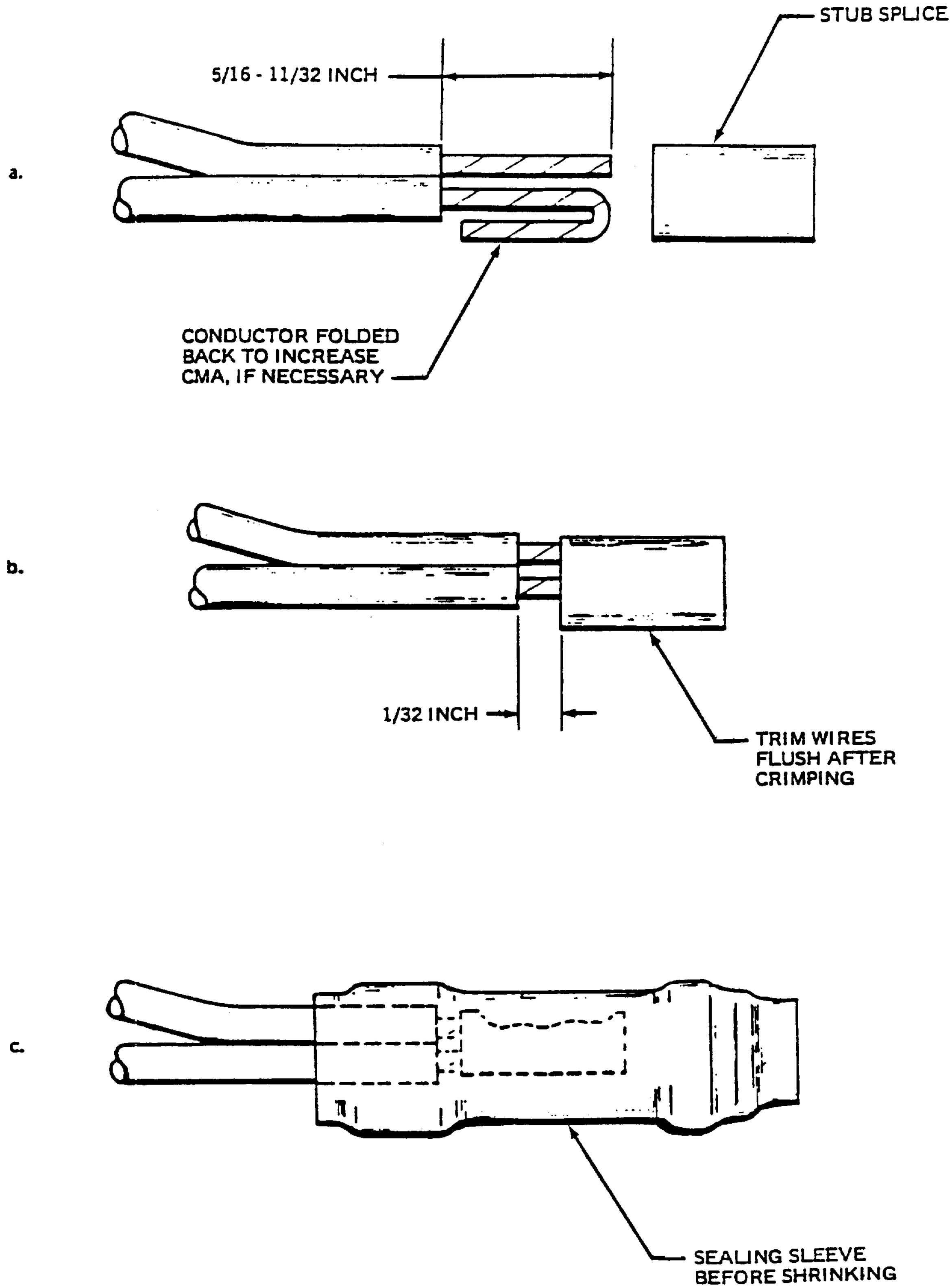


Figure 12. Environmental Sealed Stub Splice Installation

Table 2. Slices Caps, and Sleeving of Wires of Same Gage

Parallel Connector AMP Part Number	Parallel Connector McDonnell Standard Number	Shrinkable End Cap Raychem Part Number	Shrinkable End Cap McDonnell Standard Number	Shrinkable CRN-T Sleeve	Number of Wires of Same Gage #22	#20	#18	#16	#14	#12
34130	5M392-1	D-300-08	5M250-5	1/4 in. Slate	2, 3	2				
34137	5M392-2	D-300-12	5M250-5	1/4 in. Slate	4, 5	3	2	2		
34138	5M392-3	D-300-12	5M250-5	3/8 in. Brown	6*, 7, 8, 9, 10	4*, 5, 6, 7	3, 4, 5	3, 4	2	
34318	5M392-4	D-300-18	5M250-6	1/2 in. Black			6*, 7, 8	5*, 6, 7	3*, 4	3

*Refer to Paragraph 24, step c.

Table 3. Splices, Caps, and Sleeving of Wires of Mixed Gage

Parallel Connector AMP Part	Parallel Connector McDonnell Standard	Shrinkable End Cap Raychem Part	Shrinkable End Cap McDonnell Standard	Shrinkable CRN-T	Number of Wires of Mixed Gages						
34130	5M392-1	D-300-08	5M250-5	1/4 in. Slate	1 #22, 1 #20						
34137	5M392-2	D-300-12	5M250-5	1/4 in. Slate	4 #22, 1 #20	3 #22, 1#20	2 #22, 1 #20	1 #20, 1#18	3 #20, 1#22	2 #20, 2 #22	2 #20, 1#18
34138	5M392-3	D-300-12	5M250-5	3/8 in. Brown	9 #22, 1# 20	6 #22, 1 #20	3 #18, 1 #20	1 #22, 1 #20, 3 #18	6 #22, 2 #18	2 #18, 1 #20, *	
34318	5M392-4	D-300-18	5M250-6	1/2 in. Black	2 #22, 1 #20, 6 #18	3 #16, 1 #12					

*Refer to paragraph 24, step c.

Table 4. Splices and Self-Sealing End Caps

AMP Parallel Connector	Self-Sealin g End-Cap	McDonnell Standard No.
34130	D-300-08	5M904-1
34137	D-300-12	5M904-2
34138	D-300-12	5M904-2
34318	D-300-18	5M904-3

NOTE

Connector must be centered in the nest. Connector weld seam must be in the nest section of the crimping tool as shown in Figure 14. Position wires in connector to allow maximum of 0.2 inch between connector and wire insulation after crimping (Figure 13).

d. Remove wire protruding from end of connector. Flush cutoff is necessary to prevent puncture of end cap.

e. The stub splicing procedure completed thus far must meet dimensional requirements (Figure 13).

f. The preferred method for insulating the stub splice is as follows (Figure 13):

(1) Select proper size self-sealing end cap (Table 4).

(2) Position end cap on stub splice and shrink.

g. Alternative method for insulating the stub splice is as follows (Figure 15).

(1) Select proper size CRN end cap (Tables 2 and 3).

(2) Position end cap on stub splice and heat shrink.

(3) Select shrinkable sleeving or CRN-T sleeving (Tables 2 and 3).

(4) Cut sleeve approximately 1.2 inches in length.

(5) Position sleeve over end cap and heat shrink (paragraph 18, step a).

h. When shielded wires are stub spliced, shields are also terminated and joined (Figure 16).

i. Completed stub splice assembly must meet dimensional requirements (Figure 11).

j. Stagger splices in stub splice area as much as available space will permit; also, if wires are shielded, stagger shield ferrules.

k. Before covering the splice area, inspect for the following:

(1) Individual stub splices have been completely insulated.

(2) Splices have been staggered to limit bundle enlargement.

24. **Sealed Stub Splice (End Cue).** Raychem sealed stub splice is installed as follows:

a. Remove 5/16 to 11/32 inch of insulation from wire.

b. Select the correct size stub splice by comparing the total Circular Mil Area (CMA) of the wires to be spliced (Table 5) with the CMA range of the crimp barrel (Table 6). The total CMA of the wires to be crimped together must fall within the range listed for a particular crimp barrel. The total CMA of the wires to be spliced can be increased by doubling one or more wires back (Figure 12).

Table 5. Circular Mil Area (CMA) of Common Conductor Sizes

AWG No.	CMA
26	304
24	475
22	754
20	1216
18	1900
16	2426
14	3831
12	6088

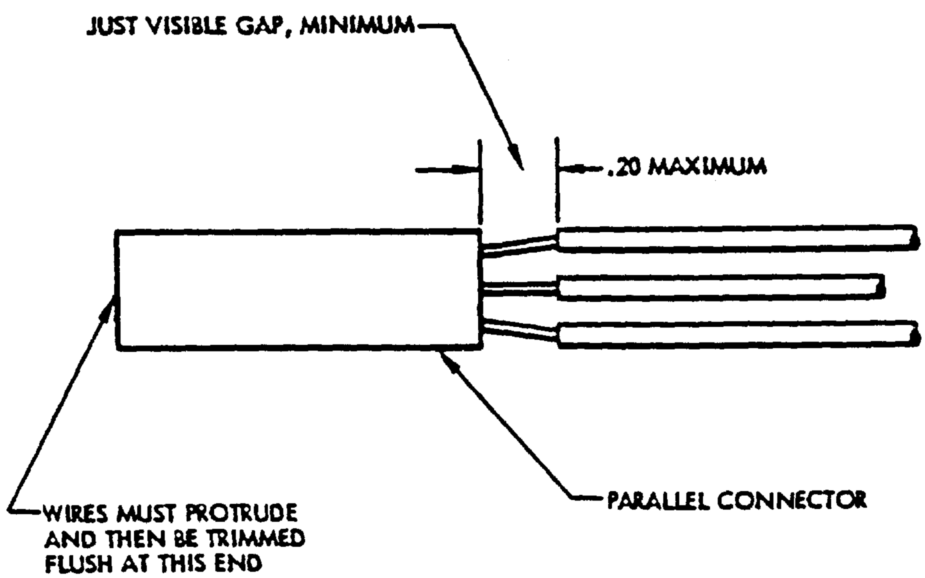


Figure 13. Connector Location and Wire Trimming

Table 6. Sealed Stub Splices And Sealed In-Line Splices Selection Guide

Raychem Part #								
1 Color Code Stripe On Crimp For Tin and Silver Plated Conductor	2 Color Code Stripes On Crimp For Nickel Plated Conductor	Color	CMA Range Of Crimp Barrel Min	CMA Range Of Crimp Barrel Max	Sealing Insert Type, End 1	Max. No. Of Wires	Sealing Insert End 2	Max No. of Wires
D-436-36	D-436-82	Red	304	1510		2		2
D-436-37	D-436-83	Blue	779	2680		2		2
D436-38	D-436-84	Yellow	1900	6755		2		2
D-436-52	D-436-85	Blue	779	2680		6		2
D-436-53	D-436-87	Yellow	1900	6755		6		2
D-436-42	D-436-89	Blue	779	2680		6		6
D-436-43	D-436-90	Yellow	1900	6755		6		6
D-436-58	D-436-75	Blue	779	2680		2		Stub Splice
D-436-59	D-436-76	Yellow	1900	6755		2		Stub Splice
D-436-60	D-436-77	Blue	779	2680		10 (2 Per Hole)		Stub Splice
D-436-61	D-436-78	Yellow	1900	6755		10 (2 Per Hole)		Stub Splice

c. When using sealed stub splices with multi-hole inserts, feed the wires through the multiple holes (2 per hole, max) and out the large single hole before crimping:

d. Insert the wires into the crimp barrel so that the insulation is approximately 1/32 inch from the crimp barrel.

e. Crimp the splice using the M22520/37-01 crimp tool. Calibrate the tool with an M22520/39-01 gauge. Stub-splice crimp barrels must be centered in the indenter jaws, not against the crimp locator (Figure 17).

f. If any wire strands extend from the end of the crimp barrel, trim them flush.

g. Slide the sealing sleeve over the crimp barrel until it stops.

h. Heat the sealing sleeve with hot air until it shrinks and the sealing rings melt and start oozing out the ends (paragraph 17, step a). No further insulation is required.

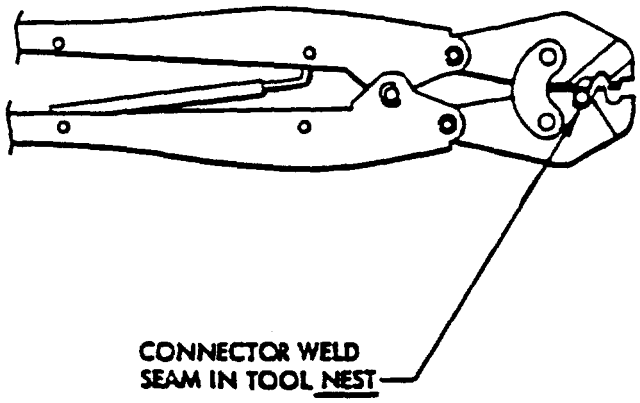


Figure 14. Parallel Connector Crimping

25 . **Covering Parallel Connectors.** Parallel connectors shall be covered in accordance with paragraph 22 or 23.

26 . **Covering Environmental Stub Splices.** Environmental stub splices shall be covered in accordance with paragraph 22 or 23.

27 . **Parallel In-Line Splices.** Parallel in-line splices are used when it is necessary to splice wires in the boot area of a connector.

28 . **AMP Parallel In-Line Splice Installation (End Cap).** Install AMP parallel in-line splices and cover with end caps as follows:

a. Determine proper AMP parallel connector per Figure 18 and Table 2.

b. Determine proper self-sealing end cap per Figure 18 and Table 3.

c. Remove wire insulation approximately 0.35 inch.

d. Modify self-sealing end cap as shown in Figure 19.

e. Install modified end cap over the wire as shown in Figure 18.

f. Insert stripped wires in AMP connector.

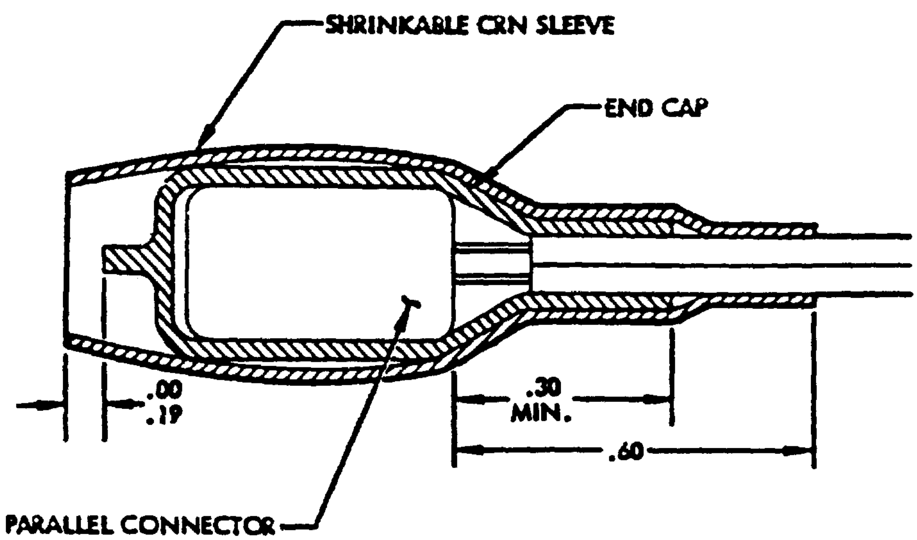


Figure 15. Shrinkable End Caps and Sleeve Installation

NOTE

For a more dependable splice, and also to eliminate the possibility of the connector cracking during the crimping operation, the connector must be at least 75% filled. Filling the connector may be accomplished by inserting a stripped scrap piece of wire in the connector. After crimping, cut the scrap wire flush with the connector.

g. Crimp the connector in the appropriate nest of the AMP No. 49935 crimping tool. (Figure 14).

h. The crimped splice shall have the ends of the wires visible and flush with the connector.

i. Position self-sealing end cap over crimped connector so that end cap will be approximately centered over the connector.

j. Heat shrink end cap.

k. End cap shall be completely shrunk and have no cracks or tears.

29 . **AMP Parallel In-Line Slice (Sleeve).** Install AMP parallel in-line splices and cover with sleeves as follows:

a. Knowing the wire combination to be spliced, select the proper AMP parallel connector from Figure 20.

b. With the AMP parallel connector as a guide, remove the insulation from the wire slightly more than the length of the connector.

c. From Figure 20, determine the correct CRN-T sleeving to be used on the splice assembly. A SAE AMS–DTL-23053 sleeve can also be used as an alternative. Cut the CRN-T sleeve(s) to be used for wire build-up approximately 0.3 inch in length (Figures 20, Details D and E). Cut the CRN-T sleeve, which covers the entire assembly, approximately 1.0 inch in length (Figure 20, Detail F).

NOTE

In cases where the wire diameter is considerably smaller than the parallel connector, build-up of the wire with CRN-T sleeve(s) is necessary to fully support the wire where it emerges from the connector.

d. Slide the CRN-T sleeve(s) used for build-up over the appropriate wire(s). The CRN-T sleeve insulating the entire splice assembly may be put over the wire(s) at either end.

e. Insert the wires in the connector as shown in Figure 20.

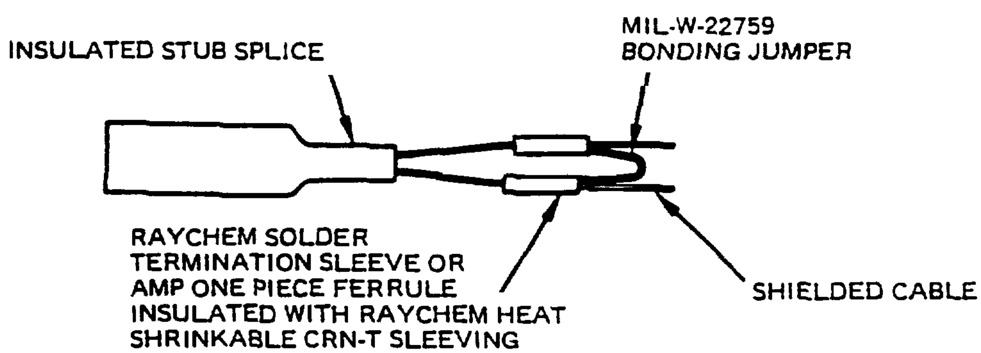


Figure 16. Shielded Stub Splice

NOTE

For a more dependable splice, and also to eliminate the possibility of the connector cracking during the crimping operation, the connector must be at least 75% filed. Filling the connector may be accomplished by inserting a stripped scrap piece of wire in the connector. After crimping, cut the scrap wire flush with the connector.

f. Crimp the connector in the appropriate nest of the AMP No. 49935 hand tool.

NOTE

Connector must be centered in the crimping tool. Connector weld seam must be in the nest section of the crimping tool (Figure 14).

g. The crimped splice shall have the ends of the wires visible and flush with the connector as shown in Figure 20.

h. Slide CRN-T build-up sleeves) up against connector and shrink in place. Shrinking process is described in paragraphs 13 and 32.

i. Shrink outer CRN-T sleeve over entire splice assembly.

j. If there is more than one splice in the boot area, stagger splices to limit bundle enlargement. Stagger shield terminations if wires are shielded (Figure 18).

k. Recover boot area. Refer to paragraph 13.

30 . **Parallel In-Line Splice (Military Splice).**

a. Select the correct size sealed splice using Tables 5 and 6. Determine the total Circular Mil Area (CMA) of the wires to be crimped in each end of the crimp barrel. Choose a crimp barrel size from Table 6 that will accommodate the total CMA of the wire(s) to be crimped in each separate end.

b. Strip 5/6 to 11/32 inch of insulation from wires in accordance with WP 009 00. If a wire must be doubled back to increase its diameter, strip 5/8 inch of insulation.

c. If necessary, double wire(s) back to increase the CMA, so that the total CMA of the wire(s) falls within the CMA range of the crimp barrel.

d. Position the crimp barrel in the appropriate die of the M22520/37-01 crimp tool, so that one end of the crimp barrel butts against the crimp locator (Figure 17). Lock in place by partially closing the handles without denting the crimp barrel.

e. Insert the wire fully into the crimp barrel, and crimp by closing the handles until the ratchet releases.

f. Before completing the splice, slide the sealing sleeve, which will be shrunk later, back over one of the wires.

g. Reverse the position of the crimp barrel in the crimp tool die. The attached wire will extend through the slot in the crimp locator.

h. Lock the crimp barrel in place by partially closing the handles, insert the other wire(s) and crimp as before.

WARNING

Only use authorized heat gun on aircraft (paragraph 17, step a)

i. Slide the sealing sleeve over the crimp barrel, center it, and heat with hot air to shrink the sleeve. Heat the middle first to lock the sleeve in place; then heat the ends until the sealing rings melt and ooze out around the wire. To ensure a good seal, allow to cool before handling.

31 . **Parallel In-Line Splice (Raychem).**

a. Proceed according to paragraph 31, steps a through c.

b. Insert the wires for one end through the sealing sleeve, making sure that the wires are not twisted between the insert and the crimp barrel (Figure 21, Detail A).

c. Crimp the splice according to paragraph 31, steps d and e.

d. Reverse the position of the crimp barrel in the crimp tool die. The attached wires will extend through the slot in the crimp locator.

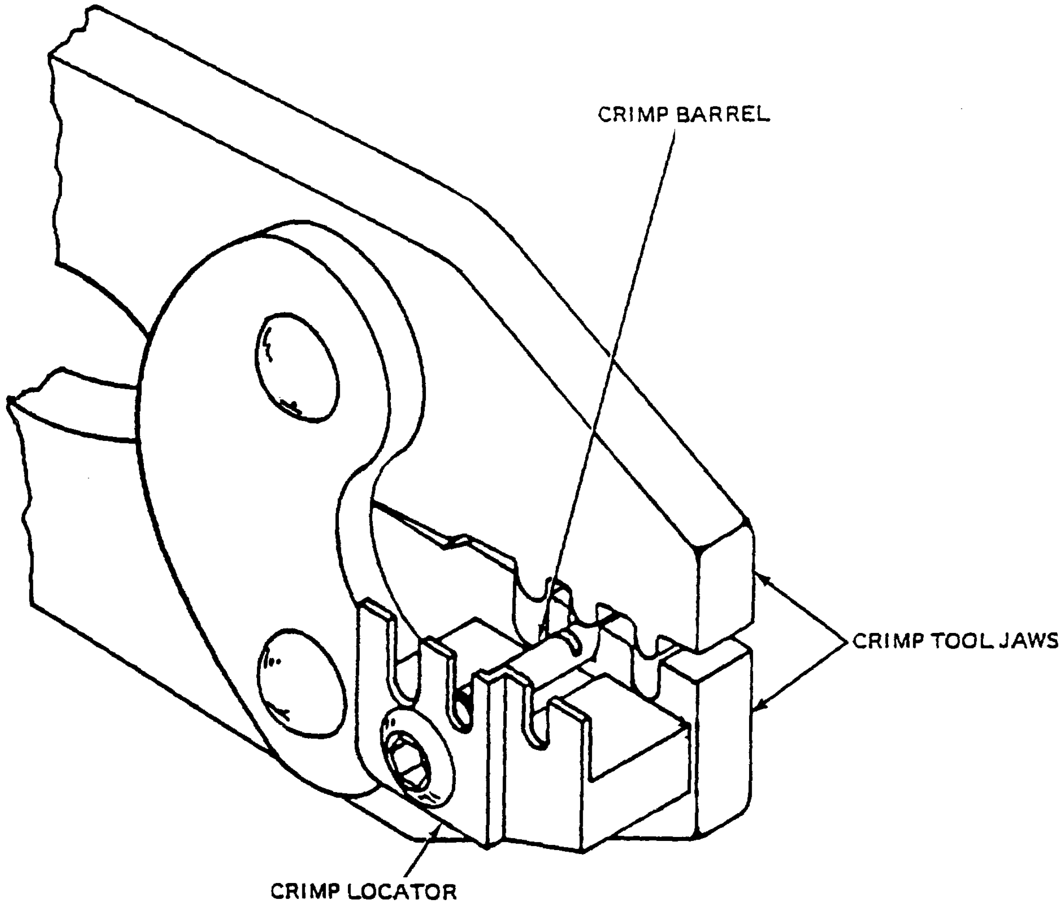


Figure 17. Locating Sealed Splice Crimp Barrel in M22520/37 Crimp Tool

e. Insert the wires for the other end through the separate sealing insert, making sure that the wires are not twisted between the insert and the crimp barrel (Figure 21, Detail C).

f. Insert the wires into the crimp barrel and crimp as before.

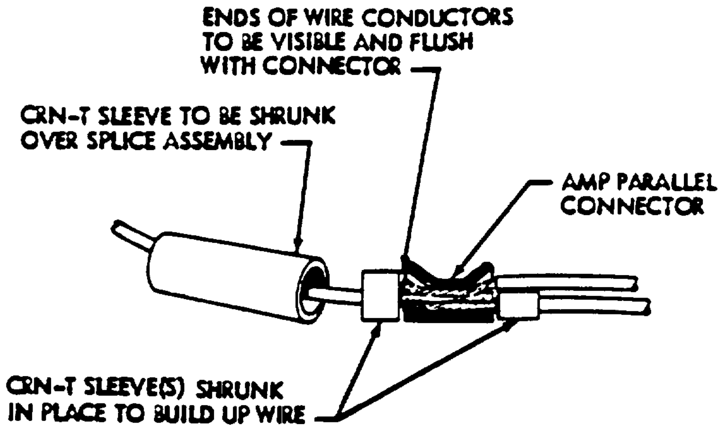
g. Slide the separate sealing insert up against the end of the crimp barrel, and slide the sealing sleeve over the crimp barrel and sealing insert. Make sure that the separate sealing insert is pushed up against the crimp barrel and is inside the sealing sleeve before applying heat (Figure 21, Detail E).

WARNING

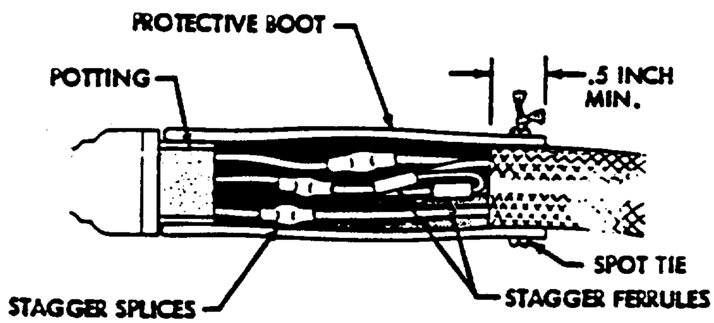
Only use authorized heat gun on aircraft (paragraph 17, step a)

h. Shrink the sealing sleeve by applying hot air first to the end with the separate insert, to lock it in place; then heat the middle, and finally the opposite end, with the pre-installed sealing ring. The ends should be heated until the sealing rings melt and ooze out around the wires. To ensure a good seal, allow to cool before handling.

32 . **SPLICING HARNESS WIRES.** Insulated permanent splices may be used to assemble, incorporate changes, or facilitate repair. Table 7 list the splices to use, strip dimensions, and tools.



CRIMPED PARALLEL IN-LINE SPLICE (ALTERNATE)



PARALLEL IN–LINE SPLICE INSULATED WITH PROTECTIVE BOOT

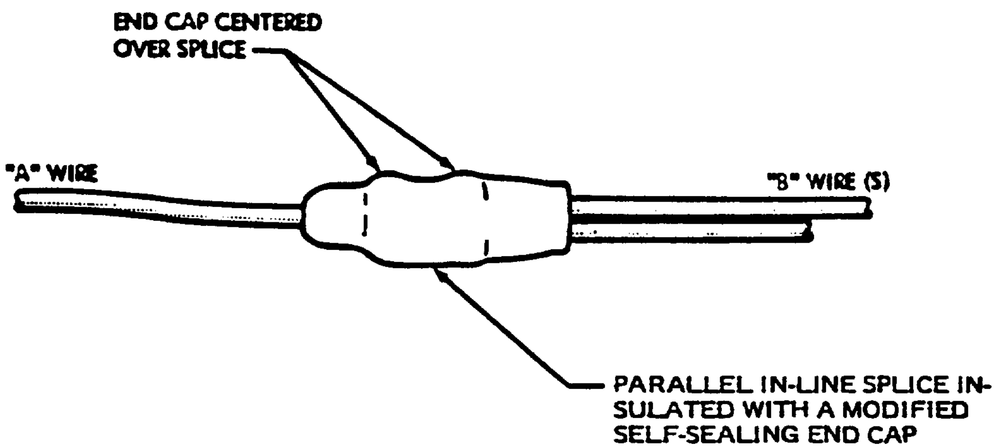


Figure 18. Construction of Parallel In-Line Splices

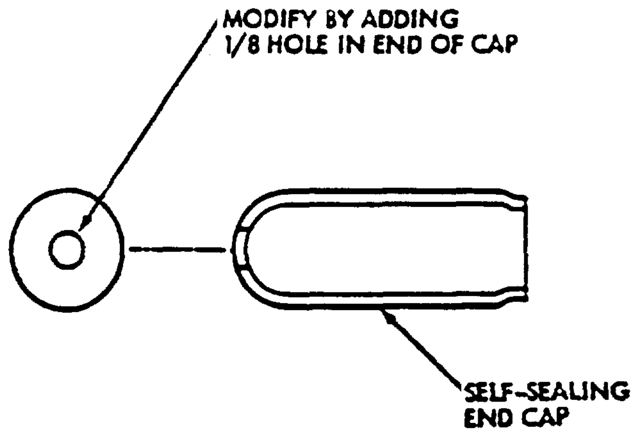


Figure 19. Modifying Self-Sealing End Cap

a. Gain access to damaged cable by pulling back outer harness as shown in Figure 23.

b. Choose the correct splice and tool from Table 7.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean insulation at ends of wires to be spliced with Isopropyl Alcohol.

d. If multiple wires must be repaired, tag both ends of damaged wires.

e. If a jumper wire is not required, remove a 2 inch section of wire in the damaged area as shown in Figure 23.

f. Repair wire in accordance with WP 013 00.

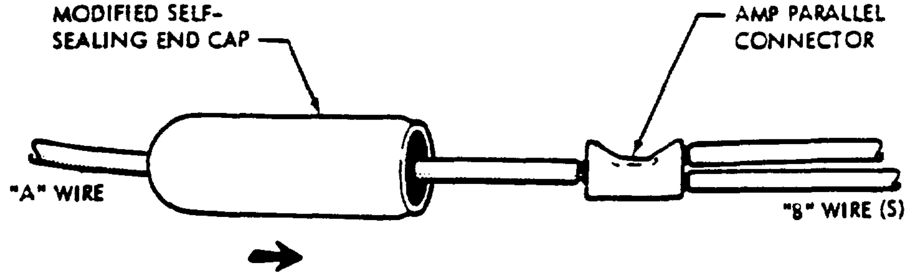
g. If jumper wire must be used remove 6 inches of wire as shown in Figure 24.

h. Use a MIL-W-22759 wire with same size conductor as a jumper wire.

i. Cut the jumper wire approximately one-half inch longer than the wire section being replaced.

Table 7. Splice Tooling

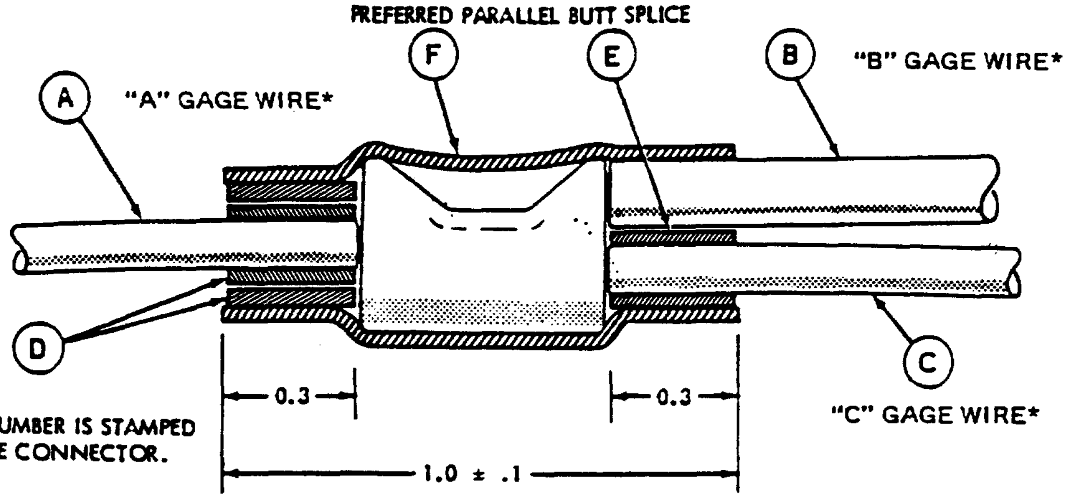
Wire Gage	Splice Part No.	Color Band	Strip Dimension (+1/16,-0)	Crimp Tool	Inspection Gage
20 thru 26	M81824/1-1	Red	1/4	M22520/37-01	M22320/39-01
16, 18	M81824/1-2	Blue	5/16	M22520/37-01	M22520/39-01
12, 14	M81824/1-3	Yellow	5/16	M22520/37-01	M22520/39-01



"A" WIRE (S)		"B" WIRE (S)		END CAP		PARALLEL CONNECTOR		* SIZE
NO.	GAGE	NO.	GAGE	RAYCLAD PART NUMBER	McDONNELL STANDARD NUMBER	AMP PART NUMBER	McDONNELL STANDARD NUMBER	
1	22	2	22	D-300-08	5M904-1	34130	5M392-1	22-16
1	22	3	22	D-300-08	5M904-1	34137	5M392-2	16-14
2	22	3	22	D-300-08	5M904-1	34137	5M392-2	16-14
3	22	3	22	D-300-12	5M904-2	34137	5M392-2	16-14
1	20	2	20	D-300-12	5M904-2	34137	5M392-2	16-14
1	20	2	20	D-300-12	5M904-2	34137	5M392-2	16-14
1	20	3	20	D-300-12	5M904-2	34137	5M392-2	16-14
1	20	5	20	D-300-12	5M904-2	34138	5M392-3	12-10
1	18	2	18	D-300-12	5M904-2	34138	5M392-3	12-10
1	16	2	16	D-300-12	5M904-2	34138	5M392-3	12-10

*THIS NUMBER IS STAMPED ON THE CONNECTOR.

PREFERRED PARALLEL BUTT SPLICE



* THIS NUMBER IS STAMPED ON THE CONNECTOR.

WIRE COMBINATIONS			CRN-T SLEEVES			PARALLEL CONNECTOR		* SIZE
A GAGE	B GAGE	C GAGE	D BUILD-UP	E BUILD-UP	F OUTER	AMP PART NUMBER	McDONNELL STANDARD NO.	
22	20	—	WHITE + RED	——	GREEN	34130	5M392-1	22-16
22	20	22	WHITE + RED + GREEN	WHITE	SLATE	34137	5M392-2	16-14
20	20	—	RED	——	GREEN	34130	5M392-1	22-16
20	20	20	RED + GREEN	——	SLATE	34137	5M392-2	16-14
18	18	—	RED + GREEN	GREEN	SLATE	34137	5M392-2	16-14
18	18	18	RED + GREEN	——	SLATE	34138	5M392-3	12-10

*MIL-W-22759 (FLUORPOLYMER-INSULATED)

Figure 20. Construction of Alternative Parallel In-Line Splices

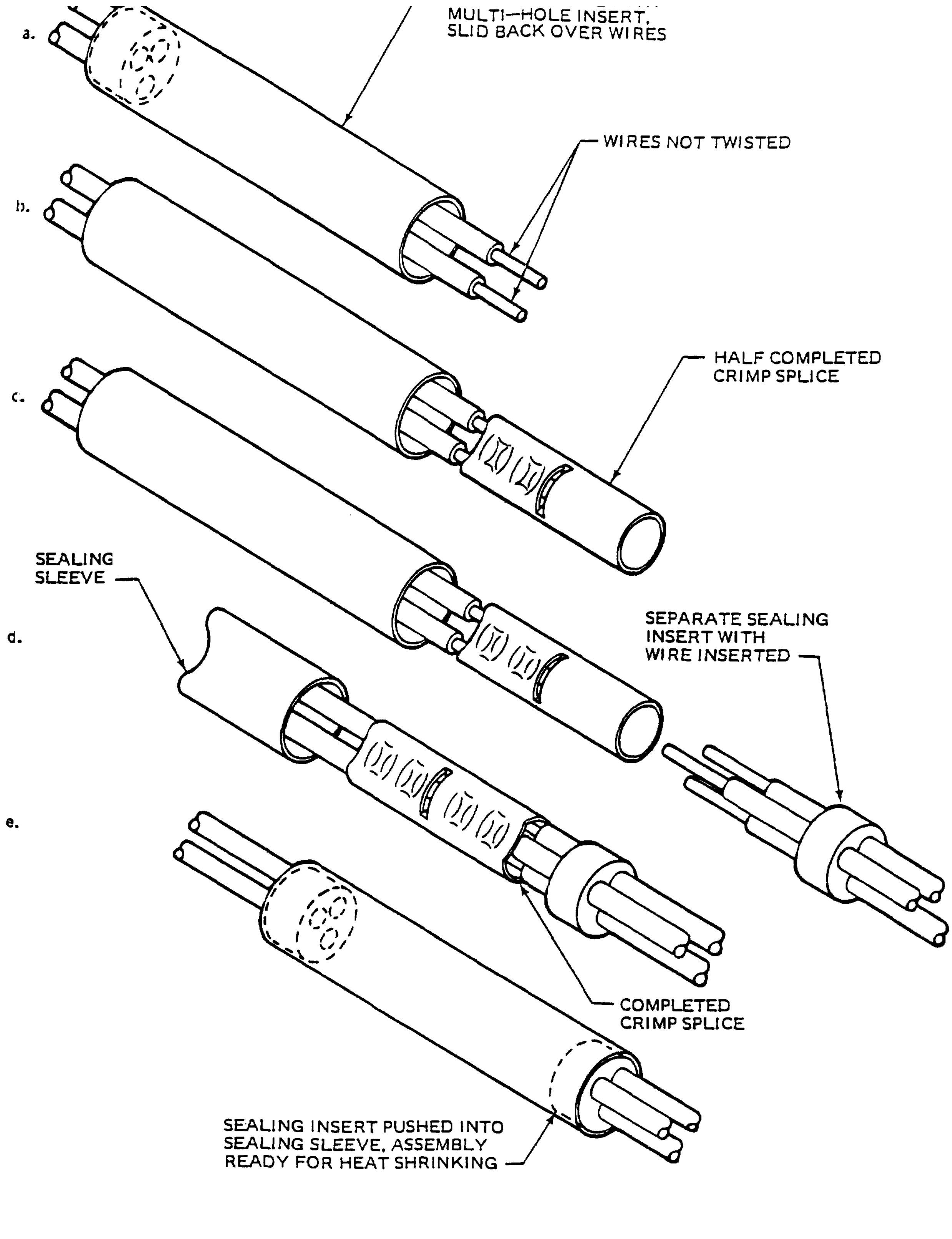


Figure 21. Installation of Sealed Multi-Splices

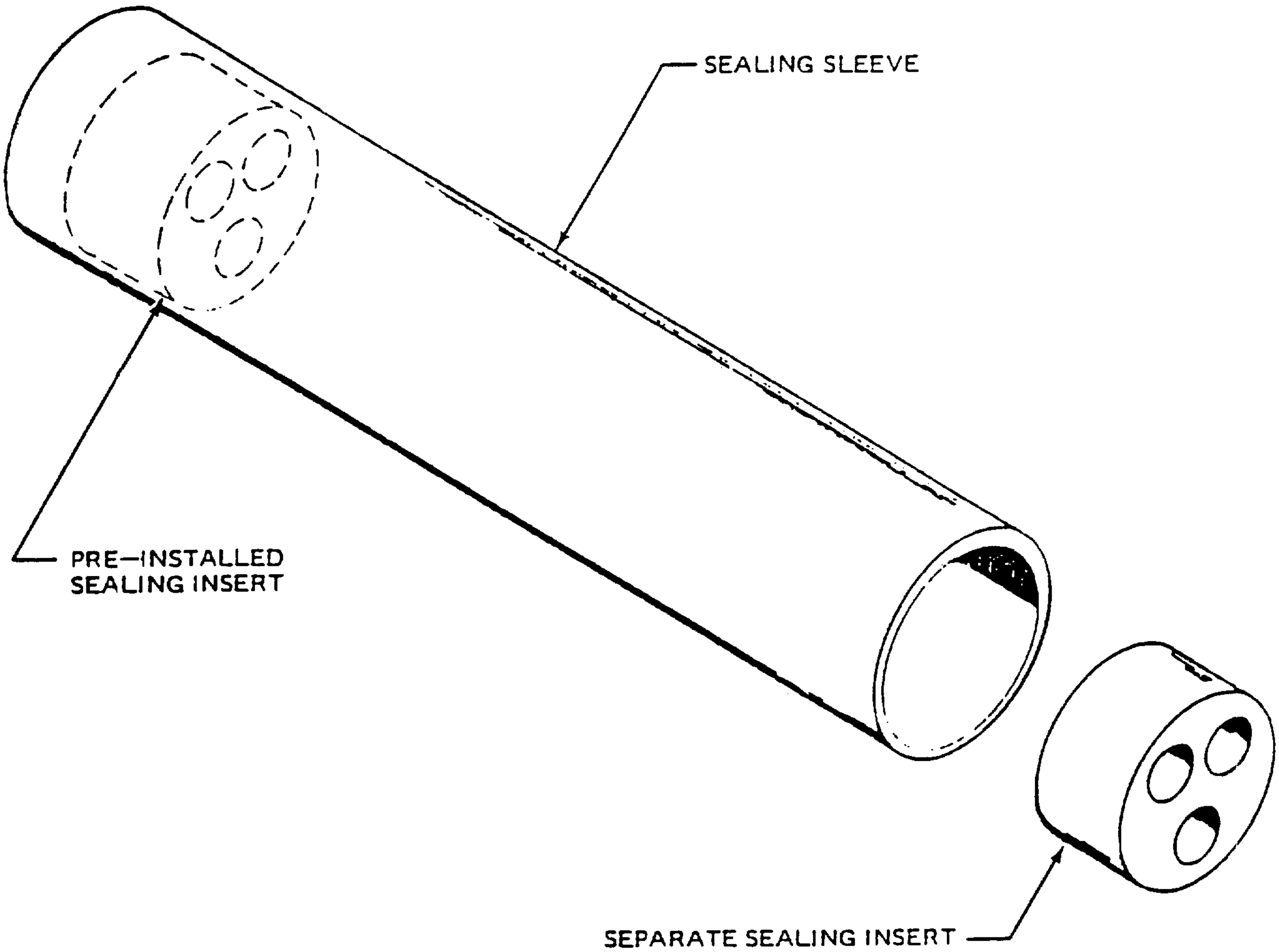


Figure 22. Sealing Sleeve for Sealed Multi-Splice

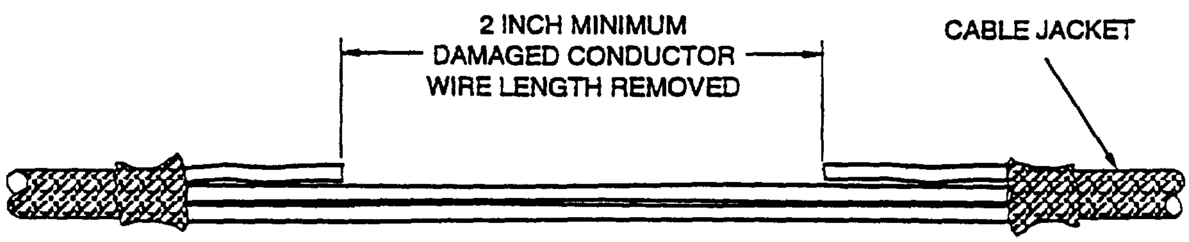


Figure 23. Damaged Wire Removal

j. If multiple jumpers are being used, stagger the jumper splices as shown in Figure 24 and Figure 25.

k. Splice the wire in accordance with WP 015 00 and WP 013 00.

l. Repair the harness in accordance with paragraph 15 or 16.

33 . **Harness Shielded Cable Splicing.** Repair a shield cable in a harness in accordance with WP 016 00. Follow the procedure in paragraph 44 to repair the harness after making the cable repair.

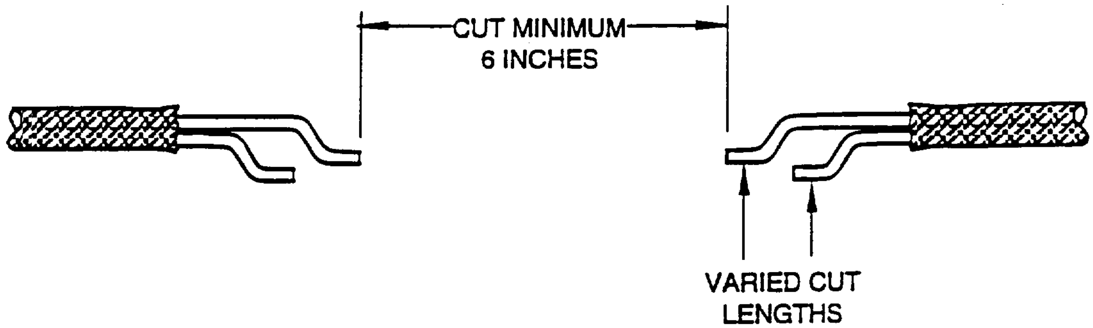


Figure 24. Jumper Wire Repair

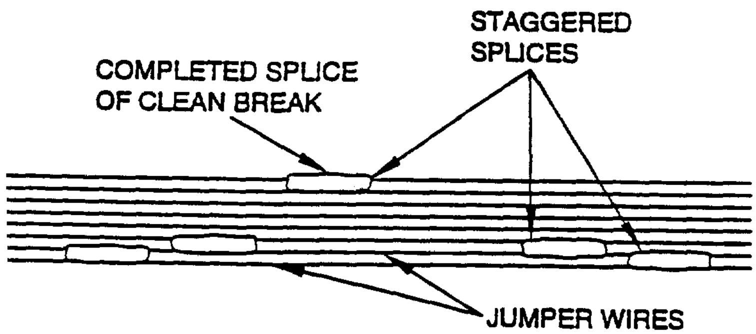


Figure 25. Staggered Splices

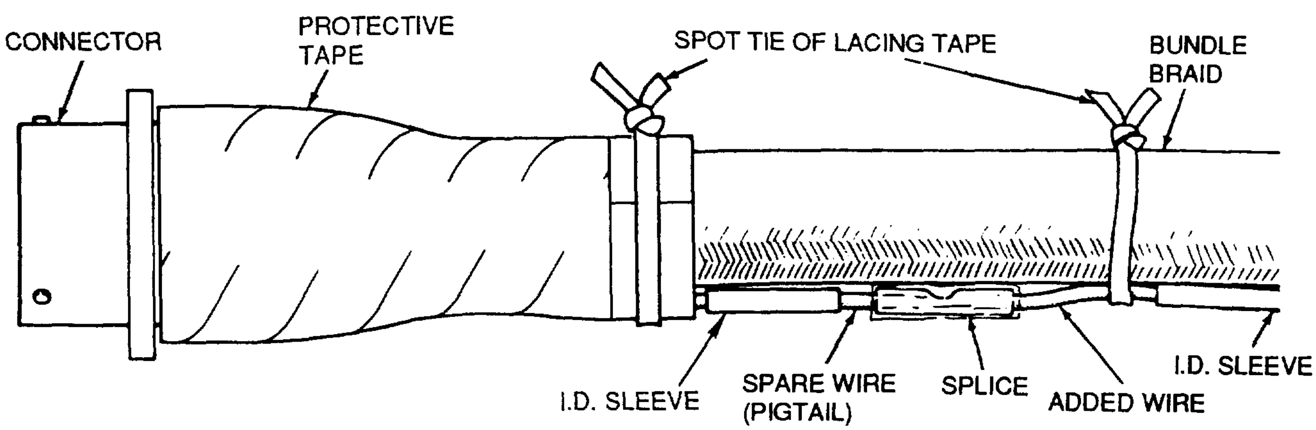


Figure 26. Adding Unshielded Wire

34 . **Adding Unshielded Wires.** When it becomes necessary to add wires to the harness, route added wires parallel and external to the existing harness. Secure added wires to the harness using lacing tape. The listed procedures should be followed (Figure 26):

a. If necessary, remove protective tape.

b. Cut spare wire directly behind end cap.

c. Identify both pigtail and new wire using proper marking procedures (WP 008 00).

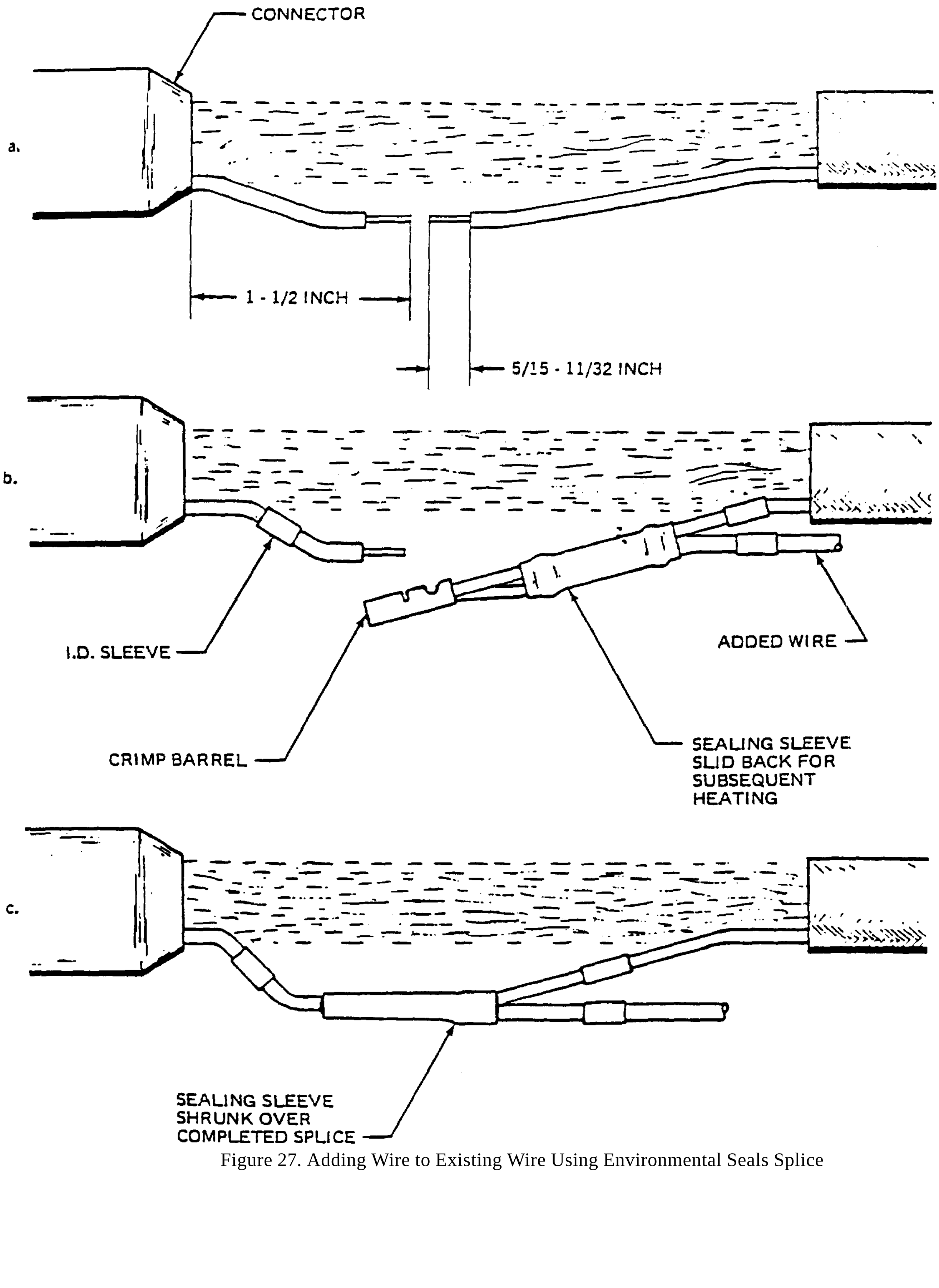


Figure 27. Adding Wire to Existing Wire Using Environmental Seals Splice

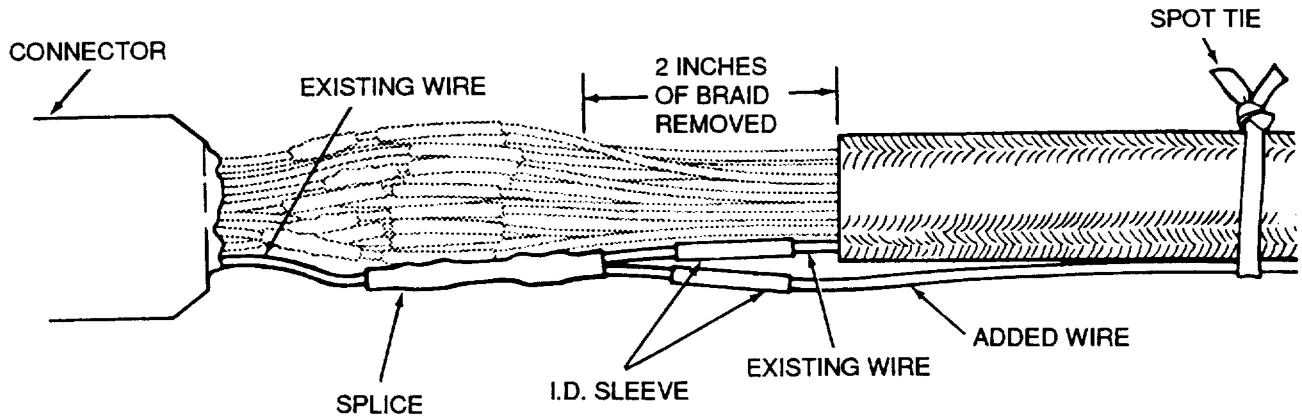


Figure 28. Adding Wire to Existing Wire

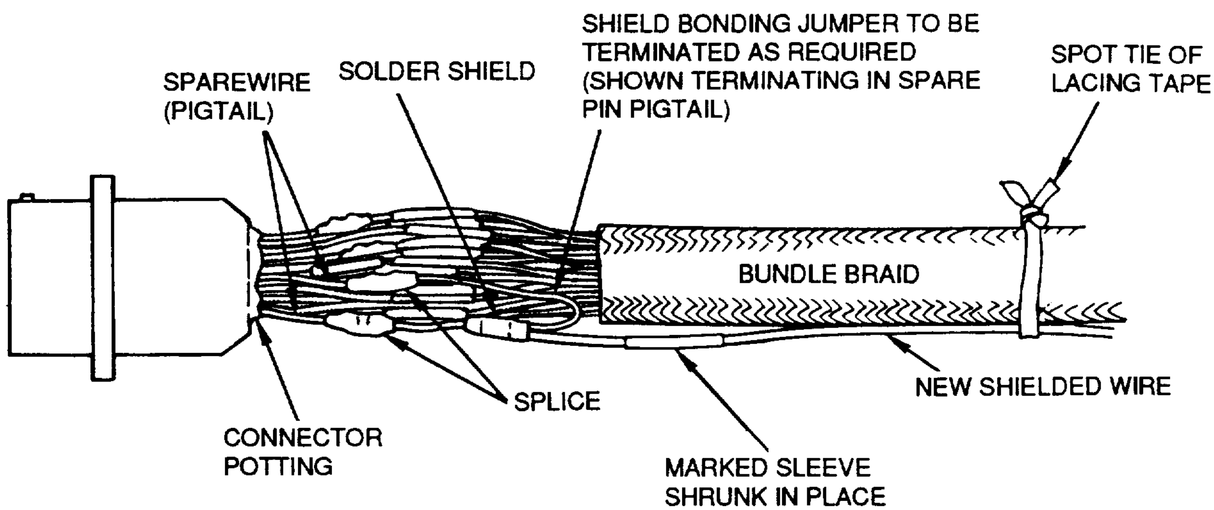


Figure 29. Adding Shielded Wire

d. Cut existing wire 1 1/2 inches from connector potting or connection insert (Figure 27, Detail A).

e. Identify added wire using proper marking procedure (WP 008 00).

f. Prepare both ends of existing wire and added wire (WP 015 00).

g. Twist existing wire in harness with added wire and slide sealing sleeve over these twisted wires.

h. Splice added wire (22 AWG) to spare wire with M81824/1 splice (WP 015 00).

i. Secure added wire with lacing tape.

j. If protective boot has been removed, replace boot (Paragraphs 13 and 14).

35 . **Adding Wire To Existing Wire.** When it becomes necessary to add a wire to an existing wire in the harness, route added wire parallel and external to the existing harness. Secure added wires to the harness using lacing tape and proceed as follows (Figures 27 and 28).

a. Remove protective tape.

b. Remove 2 inches of braid (paragraph 16).

c. Slip the crimp barrel of the splice over the wires as shown in Figure 27, Detail B. Crimp as specified in WP 013 00.

d. Shrink sleeve over crimp barrel as shown in Figure 27, Detail C.

e. Replace protected boot (Paragraph 14).

CAUTION

Only heavy wall MIL–W–22759/34, /35, /41–/46 wire size 22 and larger shall be routed outside the protected harness.

36 . **Adding Shielded Wires.** When shielded wires need to be added for changes or modification route parallel and external to the harness. Secure the added wires to the harness with lacing tape. The following procedures should be followed (Figure 29):

a. Remove protective tape or boot.

b. Remove 2 inches of braid (paragraph 16).

c. Cut spare wire 2 inches from connector potting or connect insert.

d. Identify added wire using proper marking procedures (WP 008 00).

e. Prepare spare wire and added wire (WP 015 00).

f. Terminate shield (WP 016 00).

g. Splice added wire to spare wire with M81824/1 splice (WP 015 00).

h. Terminate shield termination wire to a spare wire, or to another shield termination wire (paragraph 37).

i. Repair bundle braid (paragraph 16).

j. Replace or repair protective boot (paragraphs 13 and 14).

CAUTION

Only heavy wall MIL-W-22759/34, /35, /41–/46 wire size and larger shall be routed outside the protected harness.

37 . **Replacing Wires.** Wires that need to be replaced shall be routed parallel and external to the harness. Secure replaced wires to the harness using lacing tape. Wires to be replaced shall be due to one of the following:

a. Wires damaged to an extent where splicing would be impractical.

b. Electrically open wires.

c. Shielded wires with the shield shorted to the conductor at some unknown point under the braid.

38 . **Replace Unshielded Wires.** The procedure to replace unshielded wires is as follows. The new wires shall be routed parallel and external to the harness and secured with lacing tape (Figures 30 and 31).

a. Remove protective tape, or boot.

b. Cut wire to be replaced 1 inch from braid.

c. Identify new wire using proper marking procedure (WP 008 00).

d. Prepare end of new wire and end of old wire to be spliced (WP 015 00).

e. Cap end of wire to be replaced that protrudes from braid.

f. Splice new wire and cut wire using M81824/1 splice (WP 015 00).

g. Replace protective tape (Paragraphs 13 and 14).

39 . **Replace Shielded Wires.** Use the following procedure for replacement of a shielded wire. The new shielded wire shall be parallel and external to the harness and secured with lacing tape (Figure 32).

a. Remove protective tape, or boot.

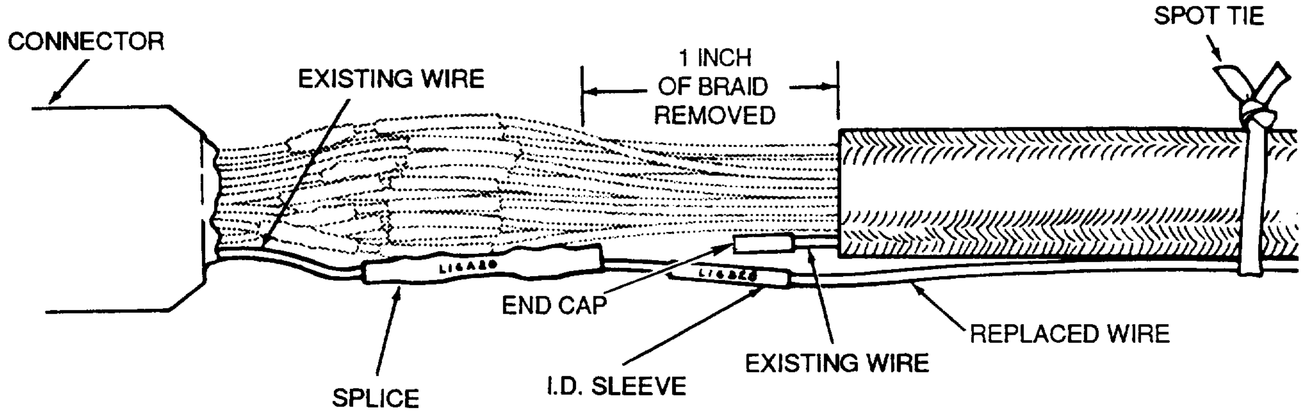


Figure 30. Replacing Unshielded Wire at Potted

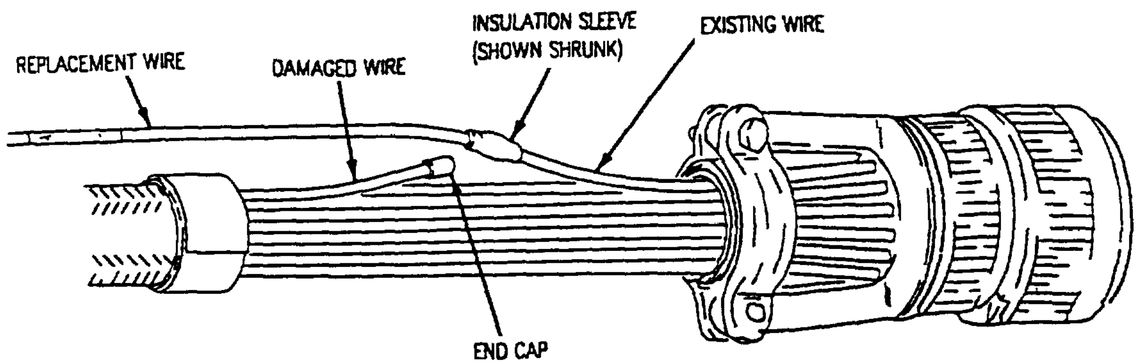


Figure 31. Replacing Wire Behind Connector Accessory

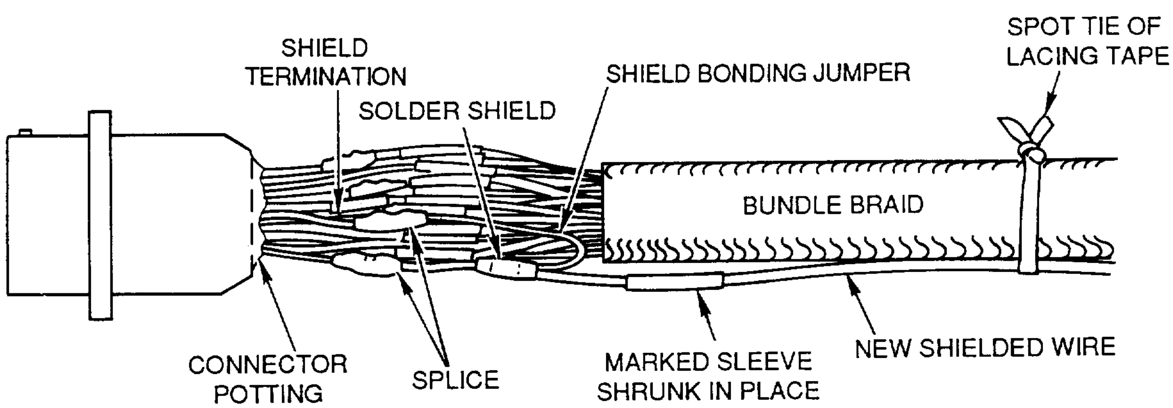


Figure 32. Repairing Shielded Wires

b. Cut wire to be replaced 1 inch from braid.

c. Cut shield termination wire 1 inch from and braid.

d. Identify new wire using proper marking procedure (WP 008 00).

e. Prepare cut wire, cut shield termination wire, and new wire in accordance with WP 015 01.

f. Cap end of wire to be replaced that protrudes from braid.

g. Terminate shield (WP 016 00).

h. Splice new wire to cut wire and shield termination wire to cut shield termination wire using M81824/1 splice (WP 015 00).

i. Replace protective boot (paragraphs 13 and 14).

40 . **Terminating Overbraided Harnesses.**

41 . **Termination of Shielded Harness in Connector with EMI Backshell.**

a. Slide ferrule/cable clamp and adapter/backshell over harness.

NOTE

Tubular braid may be used in place of the wire mesh on wire harnesses containing four or less wires.

b. If used, slide tubular braid over harness.

c. Install connector using procedure in applicable NAVAIR 01-1A-505.Series manual or aircraft connector repair manual.

d. Maintaining a 50% overlap, wrap wire bundle with silicone adhesive teflon tape under any area where metal mesh tape will be applied (Figure 33, Detail A).

NOTE

Use A–A–59474 TYPE I CLASS 4 Teflon tape (NSN 5970-01-012-4280).

e. Install adapter/back shell and tighten using procedure in applicable NAVAIR 01-1A-505.Series or aircraft connector repair manual.

f. Build up outside diameter of harness to inside diameter of an adapter/backshell assembly with silicone rubber tape (Detail B).

CAUTION

Overheating may cause damage to wiring beneath shield.

g. Solder (WP 017 00) wire mesh tape/tubular braid to shield (Detail B).

h. Wrap wire mesh tape toward connector over tapered portion of adapter and secure with silicone adhesive teflon tape (Detail C).

i. If tubular braid is used, trim excess length.

j. Secure wire mesh tape with ferrule/cable clamp (Detail D).

k. Secure harness to cable clamp using plastic tiedown strap (Detail E).

CAUTION

Do not cover backshell drain holes when wrapping with self-bonding silicone tape.

l. Wrap silicone rubber tape one complete turn around the cable clamp and maintaining 50% overlap, continue wrapping until 1 inch of the overbraid is covered (Detail F).

m. Secure silicone rubber tape end with polyester lacing tape (Detail F).

42 . **Termination of Overbraided Harness in Environmental Type Connector with Molded Plastic Cable Clamps.**

a. Slide cable clamp locking nut and molded cable clamp overbraided harness.

b. Install connector using procedure in applicable NAVAIR 01-1A-505.Series or aircraft connector repair manual.

c. Cut silicone rubber tape into triangular section (Figure 34, Detail A).

d. Wrap silicone rubber tape, cut portion parallel to connector insert one complete turn starting 1/8 inch forward of cable clamp support area.

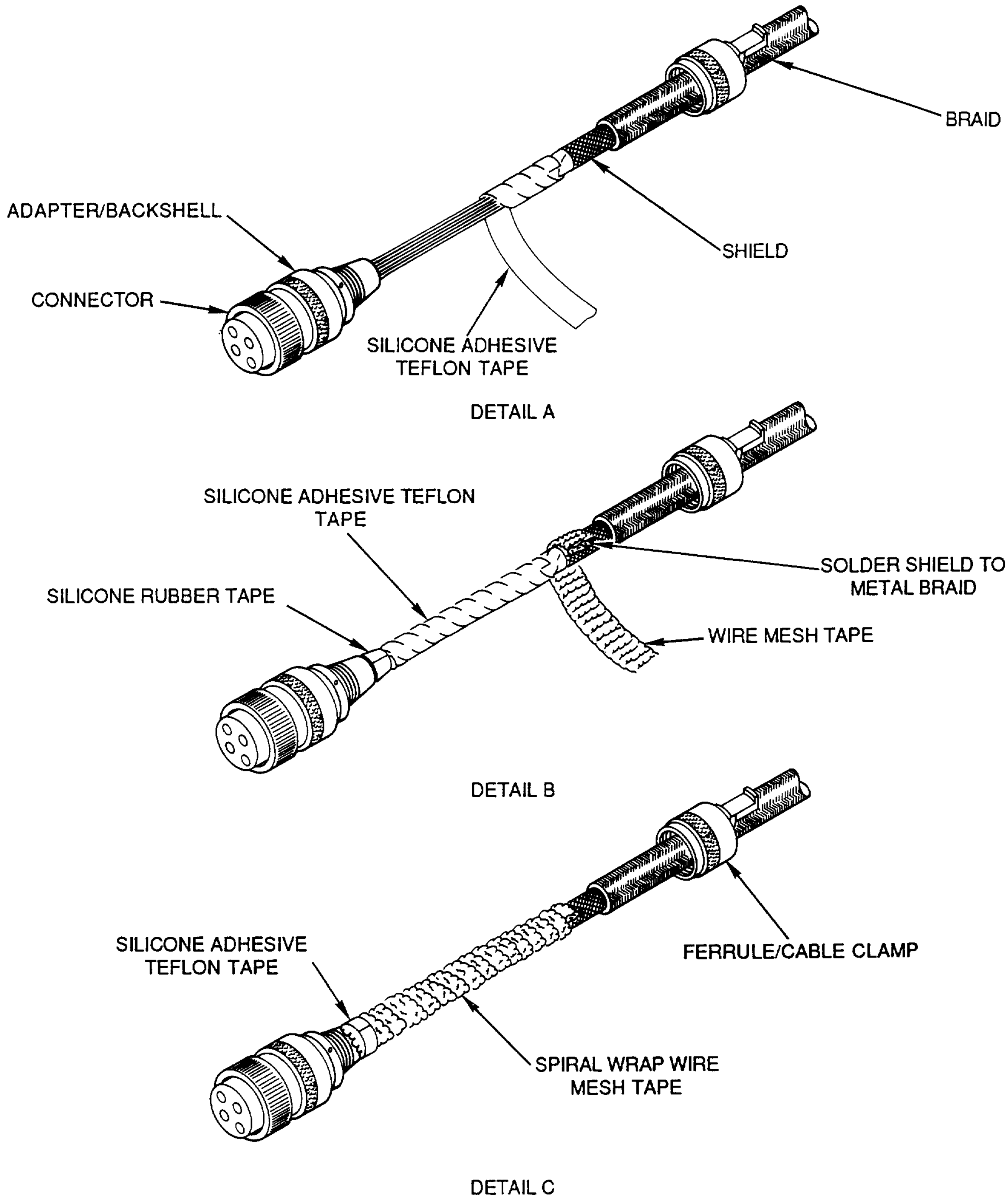


Figure 33. Fabrication of Harness Terminated with EMI Backshell (Sheet 1 of 2)

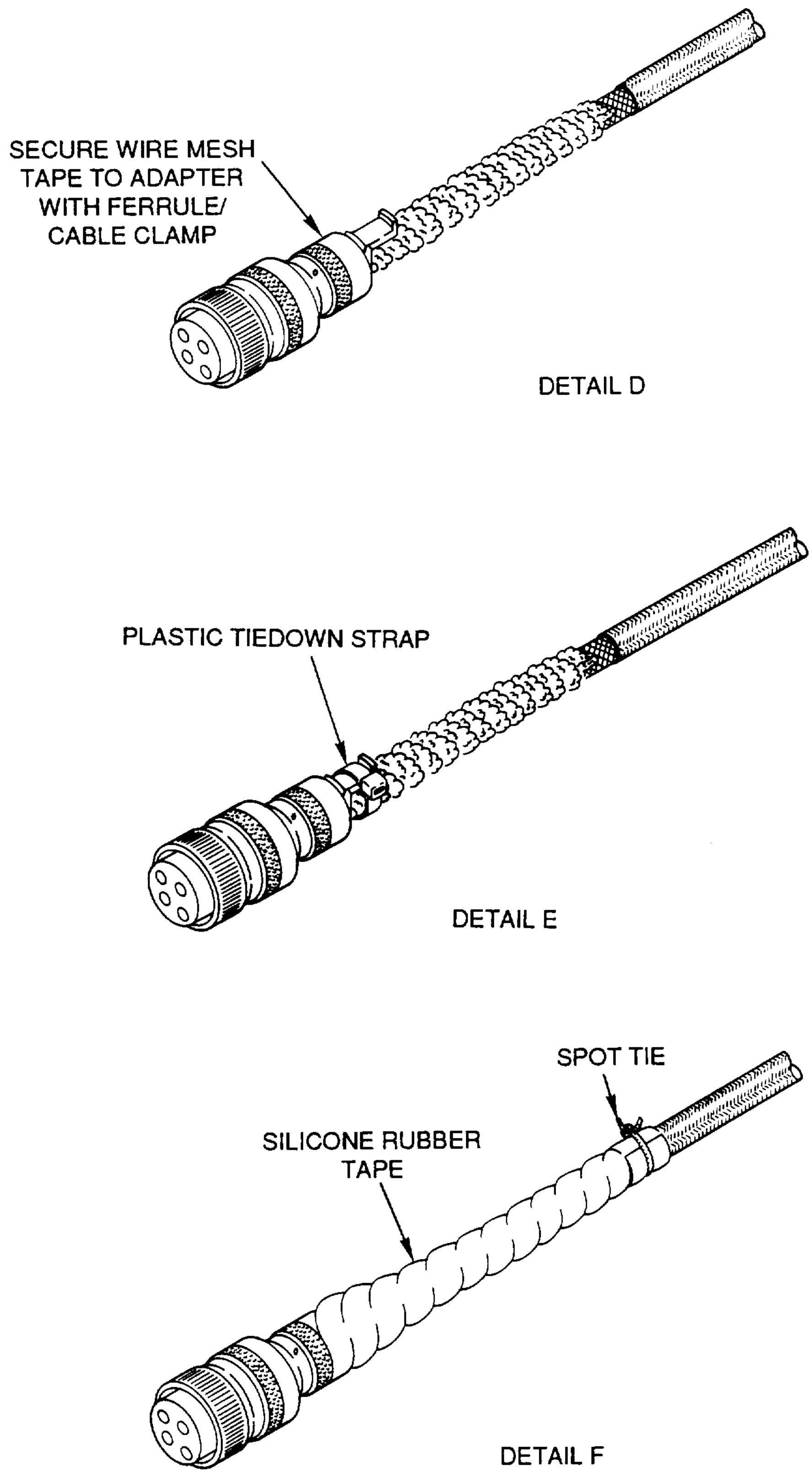


Figure 33. Fabrication of Harness Terminated with EMI Backshell (Sheet 2)

e. Using 50% overlap, continuously wrap silicone rubber tape over exposed wiring until a minimum of 1/2 inch of overbraid is covered (Detail B).

f. Keeping tape guideline perpendicular to cable axis, terminate silicone rubber tape by wrapping one full turn around cable assembly.

g. Cut silicone rubber tape and tie with polyester lacing tape.

h. Build up cable diameter under cable clamp fingers with silicone rubber tape to provide good clamping between clamp fingers and cable assembly.

NOTE

Tape buildup under cable clamp fingers will separate to provide a strain relief condition.

i. Plastic cable clamp should be cut if necessary to enable cable clamp to slide freely over cable assembly.

CAUTION

Apply force on cable assembly toward connector to prevent stress on grommet or contacts.

j. Position cable clamp over back of connector and tape buildup.

k. Slide cable clamp locking nut over cable clamp and screw onto connector finger tight. Ensure edge of clamp fingers are even with tape buildup.

l. Install plastic tiedown strap and trim (Detail C).

43 . **Termination of Shielded Harness in Connector With 90° Backshell.**

a. Slide backshell nut, backshell and adapter over harness.

NOTE

Tubular braid may be used in place of the wire mesh on wire harnesses containing four or less wires.

b. If used, slide tubular braid over harness.

c. Install connector using procedure in applicable NAVAIR 01-1A-505.Series or aircraft connector repair manual.

d. Install adapter and backshell and tighten (Figure 35, Detail A).

e. Maintaining a 50% overlap, wrap wire bundle with silicone adhesive teflon tape under any area where metal mesh tape will be applied (Detail B).

f. Buildup outside diameter of harness to inside diameter of backshell assembly with silicone rubber tape and install backshell cover with lock washer and screw (Detail C).

CAUTION

Overheating may cause damage to wiring beneath shield.

g. Solder (WP 017 00) wire mesh tape/tubular braid to shield.

h. Wrap wire mesh tape toward connector over tapered portion of backshell assembly and secure with silicone adhesive teflon tape (Detail D).

i. If tubular braid is used, trim excess length.

j. Secure wire mesh tape with backshell nut (Detail E).

k. Install plastic tie down strap and trim.

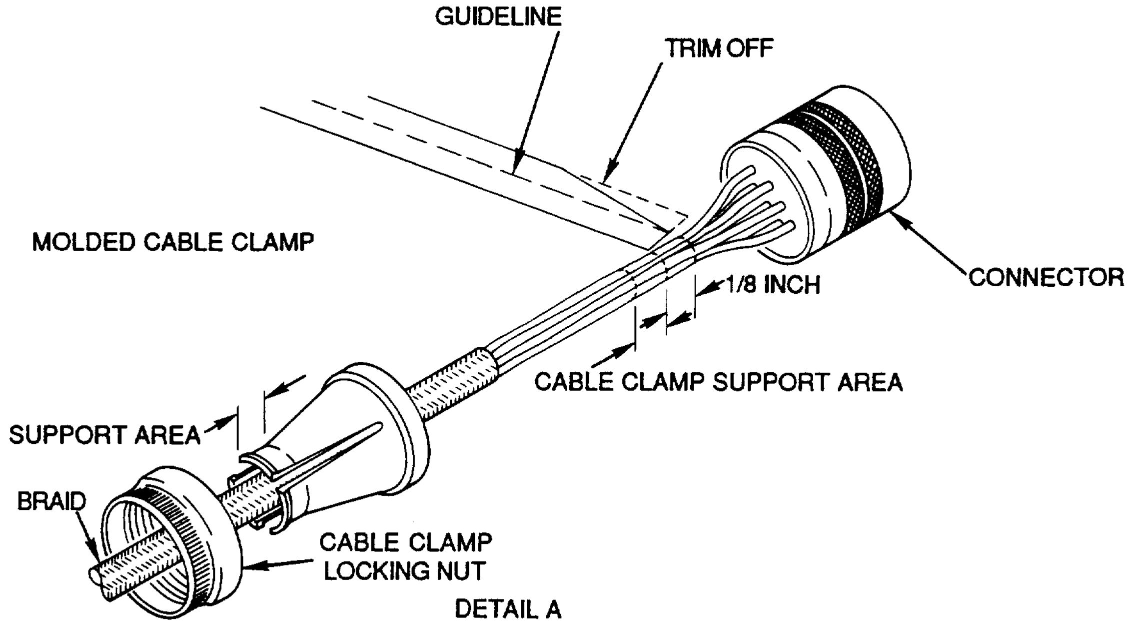
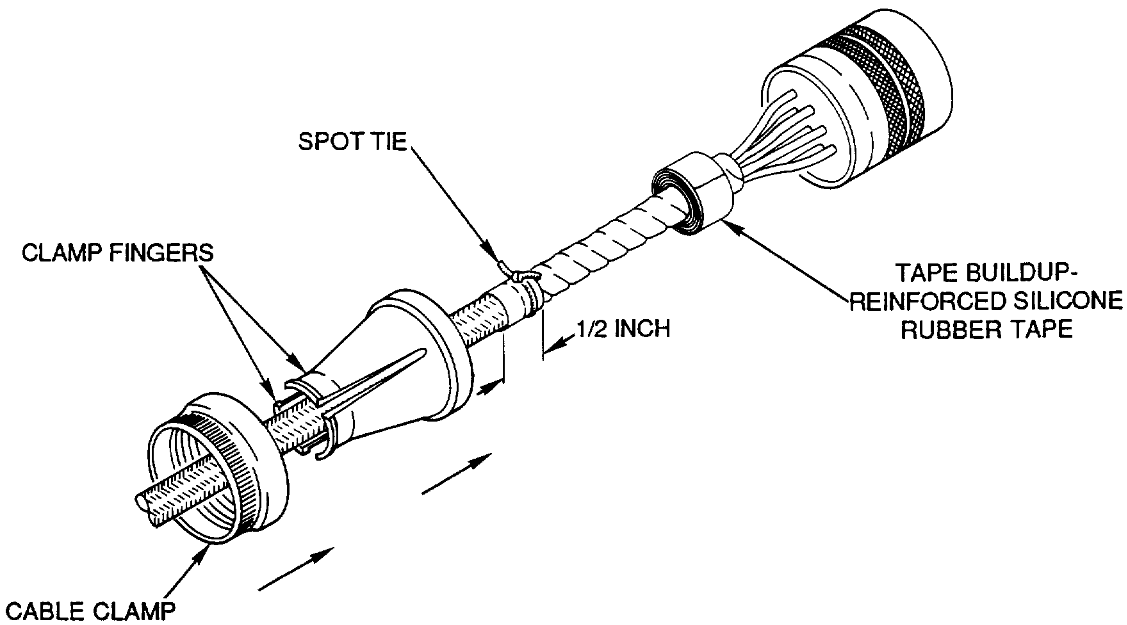
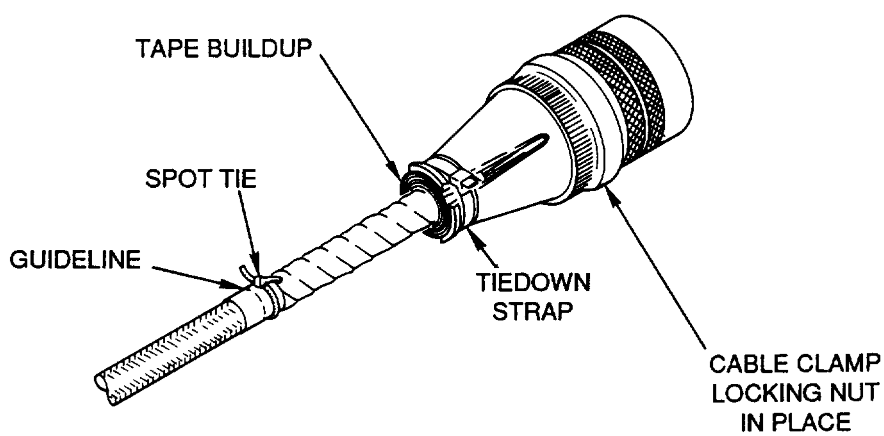


Figure 34. Termination of Overbraided Harness with Environmental Connector with Molded Plastic Cable Clamp
(Sheet 1 of 2)



DETAIL B



DETAIL C

Figure 34. Termination of Overbraided Harness with Environmental Connector with Molded Plastic Cable Clamp (Sheet 2)

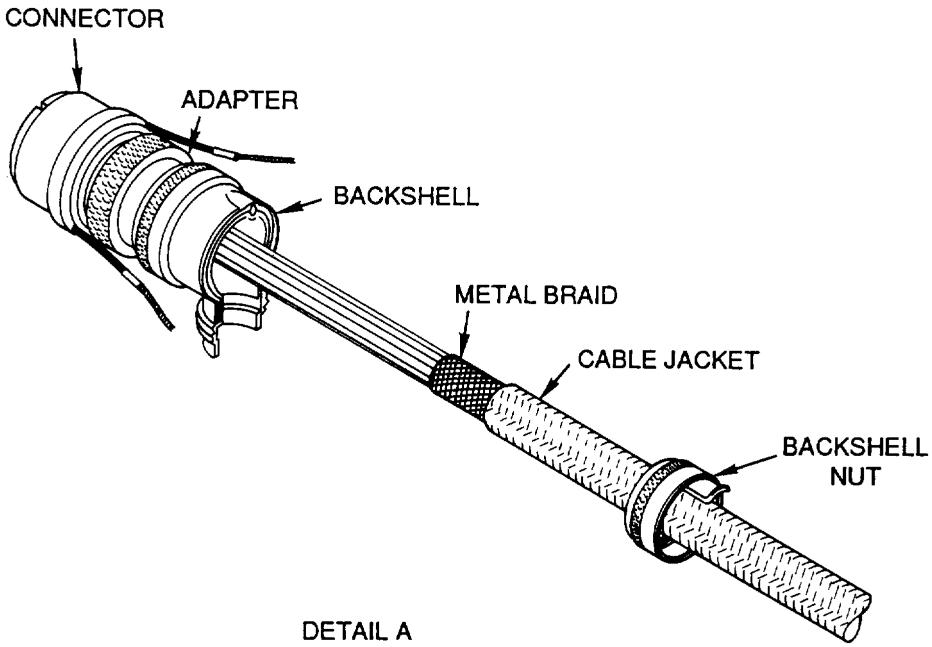


Figure 35. Termination of Overbraided Harness with Connector with 90° Backshell (Sheet 1 of 3)

l. Wrap silicone rubber tape one complete turn around backshell nut and maintaining a 50% overlap, continue wrapping until one inch of the overbraid is covered (Detail F).

m. Secure silicone rubber tape with polyester lacing tape.

44. **METALLIC OVERBRAIDED HARNESS REPAIR.** A metallic overbraided harness is a harness with a metal shield covered by an overbraided cloth. Repair a metallic overbraided harness as follows:

a. Using scissors cut completely around outer harness covering, pull back each side at least 6 inches from damage and secure with lacing cord. A minimum of 12 inches is required for repairs (Figure 36).

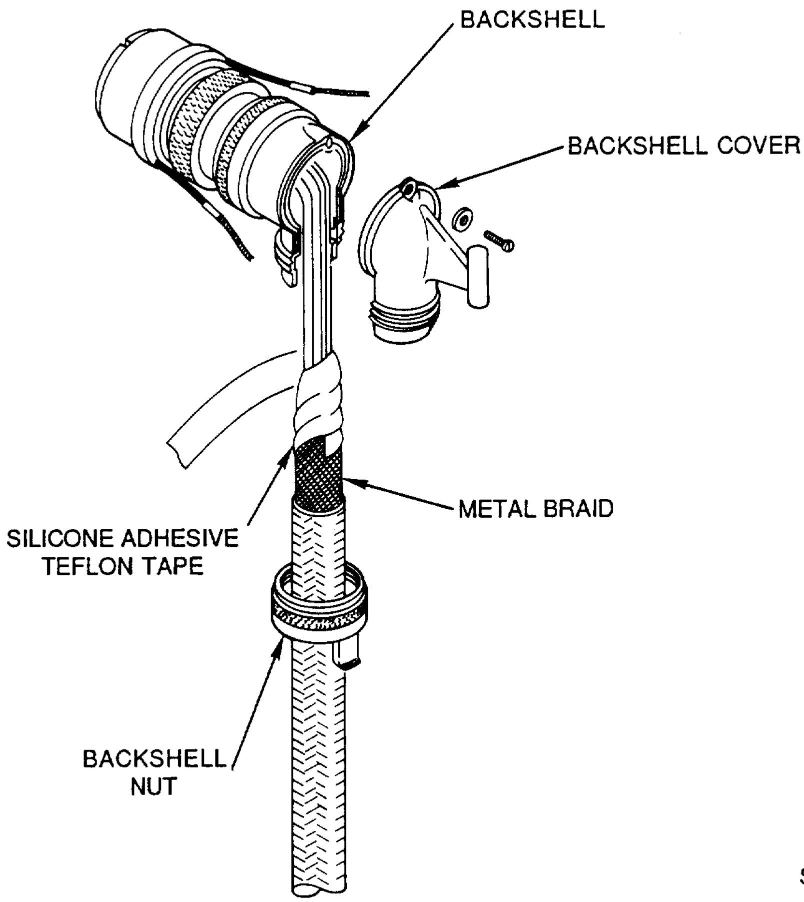
b. Using wire cutters/scissors cut completely around metallic overbraid, pull back each side at least 4 inches from damage and secure with lacing cord. A minimum of 8 inches is required for repairs (Figure 37).

c. Uncover all areas of wire damage (Figure 38).

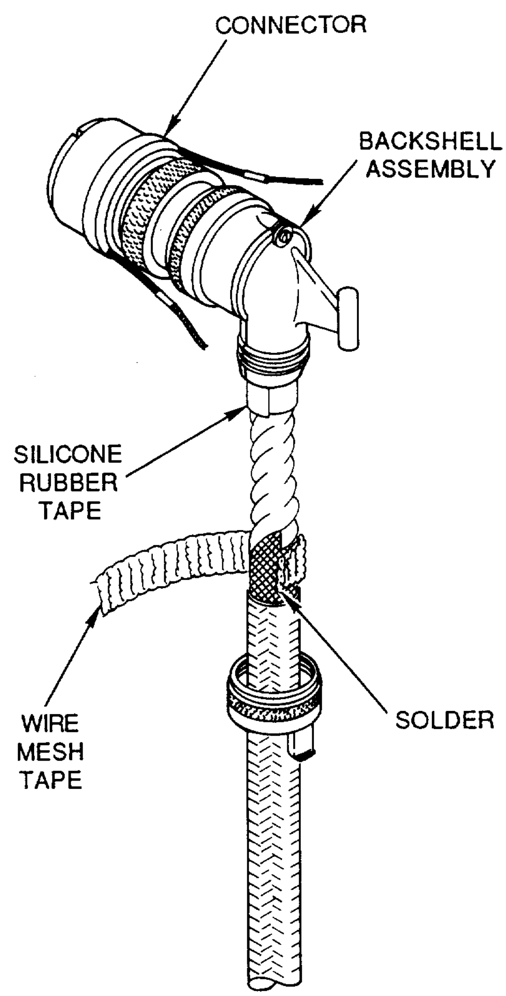
d. Determine the length of the damaged area (Figure 39), and pull the braid and shield further back in accordance with Table 8.

Table 8. Harness Area Removal

Length of Damaged Area (Inches)	Length of Outer Jacket to Be Removed (Inches)
Less Than 2	5
2 To5	8
5 To 8	11



DETAIL B



DETAIL C

Figure 35. Termination of Overbraided Harness with Connector with 90°
Backshell (Sheet 2)

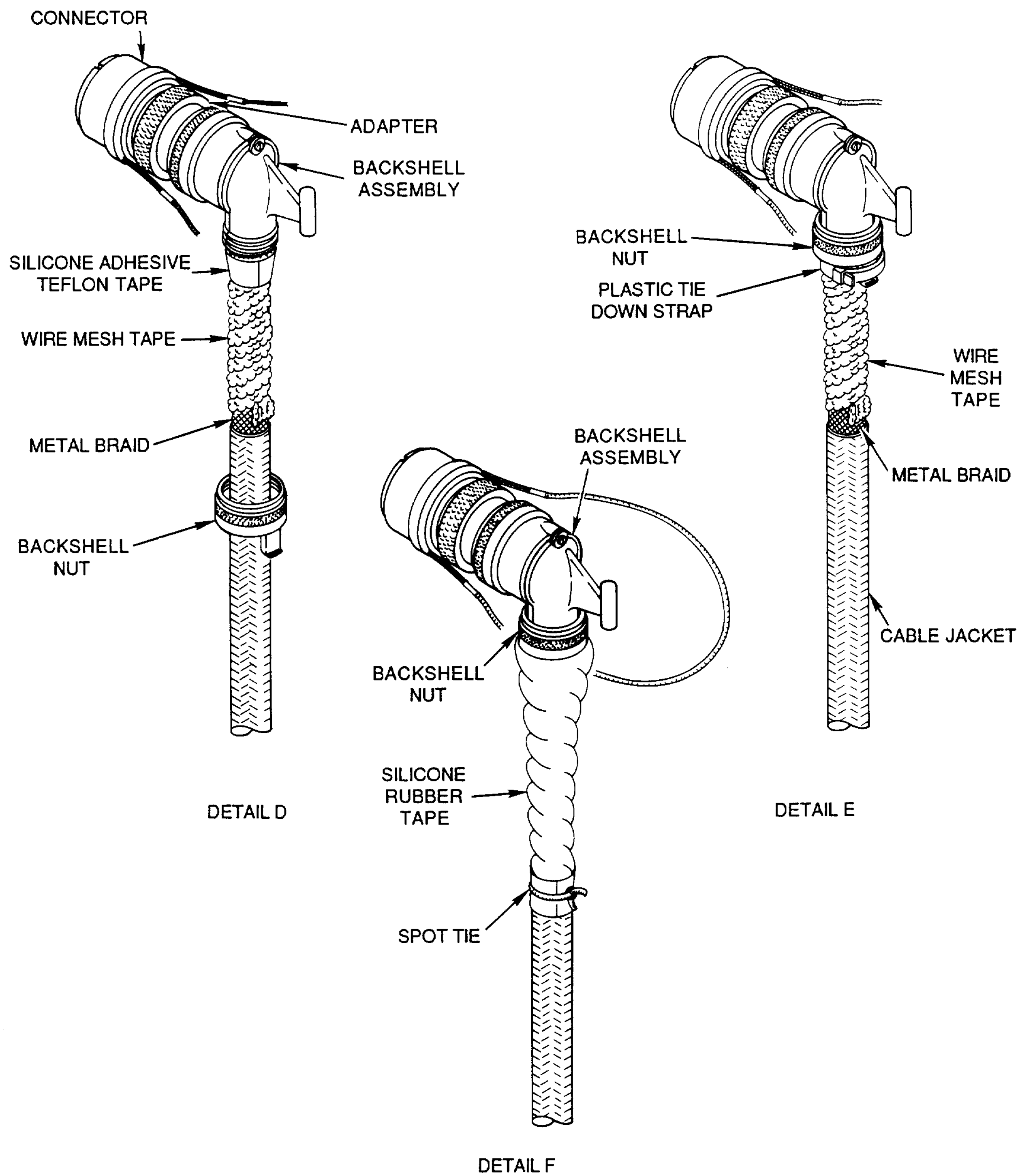


Figure 35. Termination of Overbraided Harness with Connector with 90° Backshell (Sheet 3)

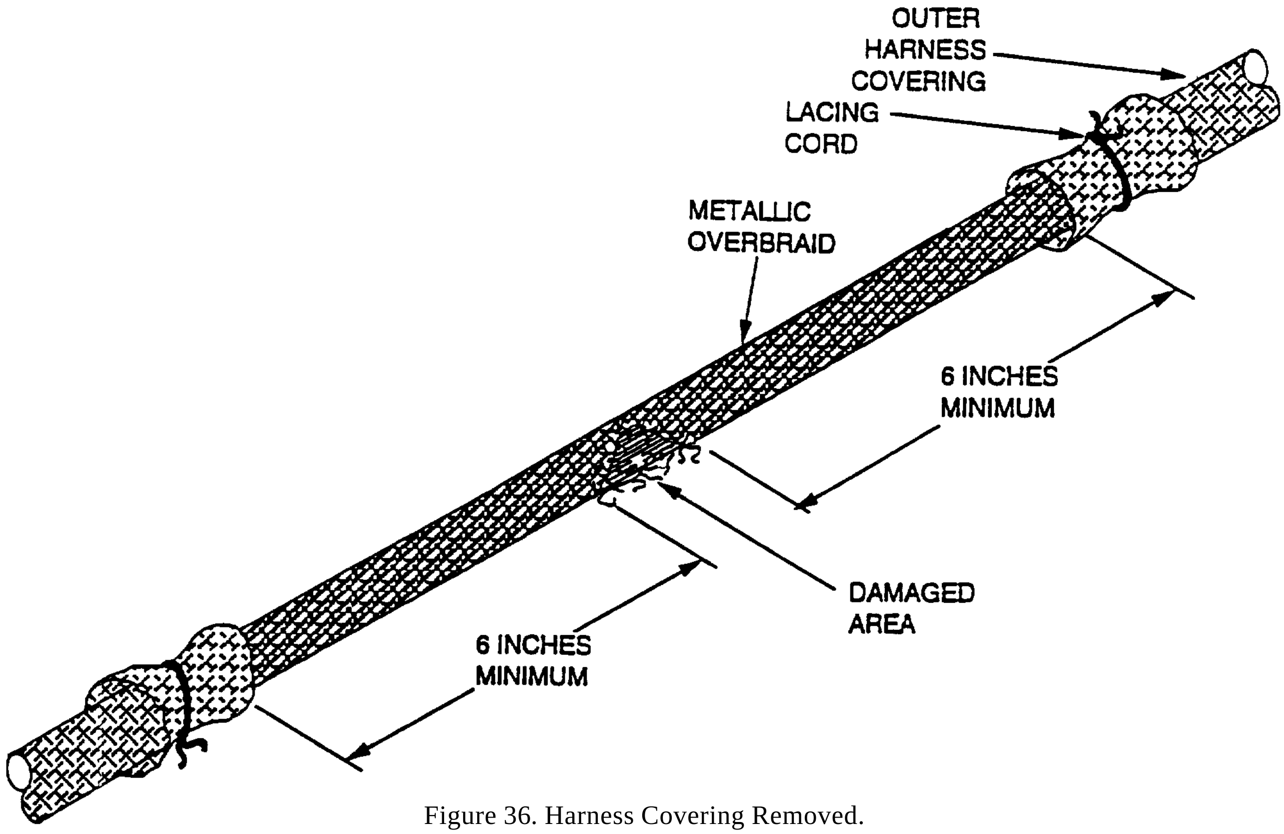


Figure 36. Harness Covering Removed.

e. Using sharp knife, carefully score cable shield jacket around cable diameter and along area to be removed (Figure 40).

f. Flex the wire until shield jacket separates, then remove jacket.

g. Repair the damaged wire in accordance with WP 013 00 and paragraph 38 or 39. If wire is damaged at a single point, and there is some slack in the wire, the existing wire can usually be repaired with a sealed splice (Figure 41). If a wire has damage along its length, the damaged segment must be cut out and replaced by a jumper wire installed using two splices (Figure 42).

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

h. Cut temporary lacing cord that secured the metallic overbraid, then milk both ends as close together as possible. Using scissors, trim frayed areas to allow for smooth repair (Figure 43). Using isopropyl alcohol clean and dry metallic overbraid 2 1/2 inches on both sides of damaged area to ensure adhesion of copper foil tape.

i. Using adhesive copper foil tape, beginning 2 inches on either side of damage and extending 2 inches beyond damage, wrap copper foil tape around metallic overbraid while applying pressure to ensure adhesion of foil to overbraid, overlapping each wrap 50 percent (Figure 44).

j. Cut lacing cord securing outer harness covering, milk both ends as close together as possible. Using scissors trim frayed areas to allow for smooth repair (Figure 45).

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

k. Using isopropyl alcohol remove any dirt and/or moisture from outer harness covering.

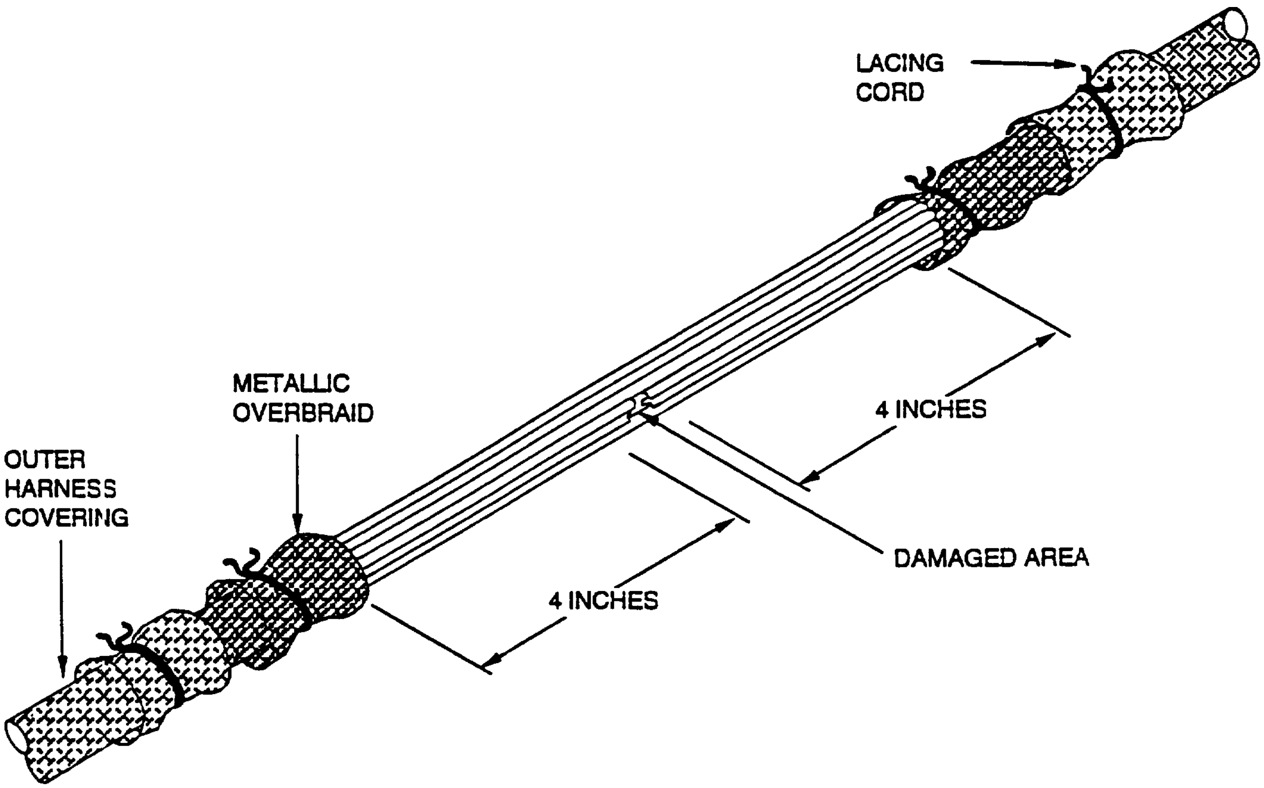


Figure 37. Harness Shield Removed

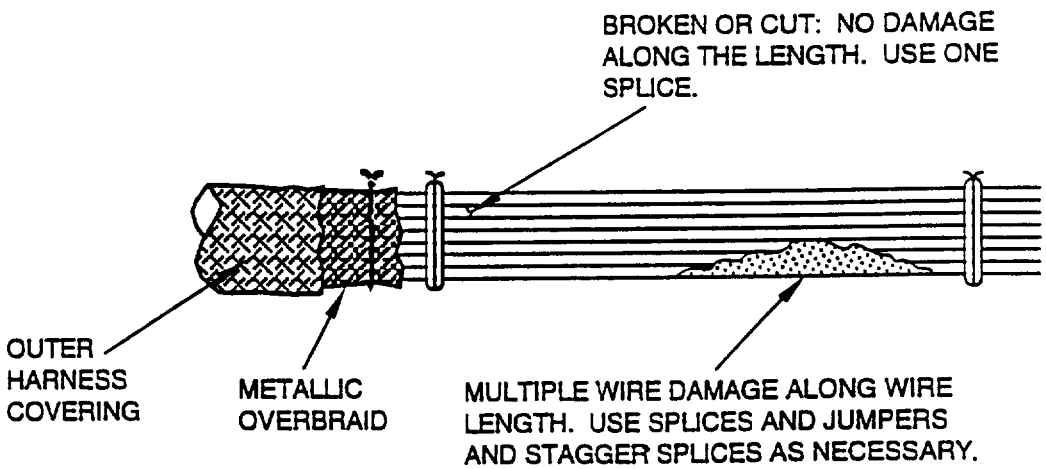


Figure 38. Examine Wire for Damage

l. Using self–bonding silicone tape, beginning 3 inches on either side of damage and extending 3 inches beyond damage, wrap tape around harness, overlapping each wrap 50 percent (Figure 46).

m. Secure ends of tape with lacing cord (Figure 47).

45 . **Connector Accessory Entry Protection.** On a protected harness the rear entry of connector should be protected as shown in Figure 48. To repair wires or cable in this area, remove the accessory as follows:

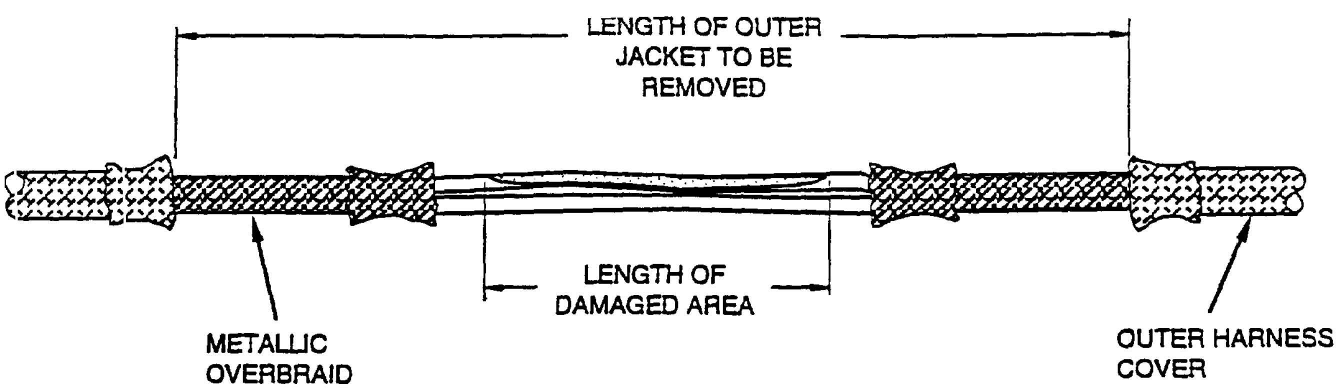


Figure 39. Wire Damaged Area

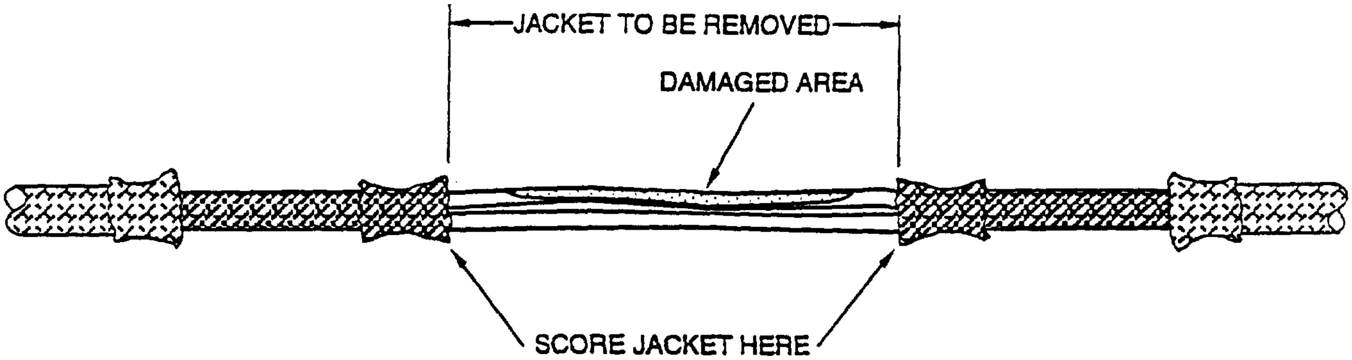


Figure 40. Shield Jacket Removal

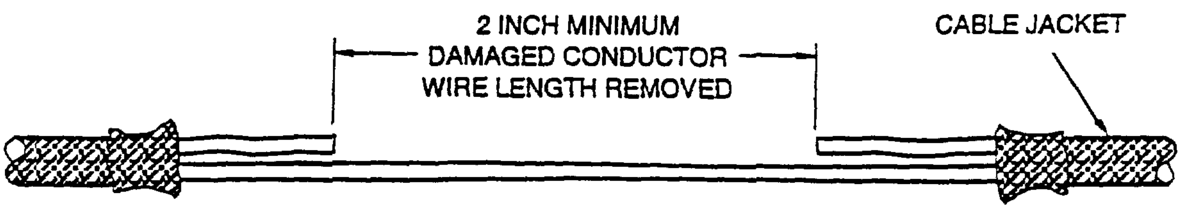


Figure 41. Single Wire Splice Repair

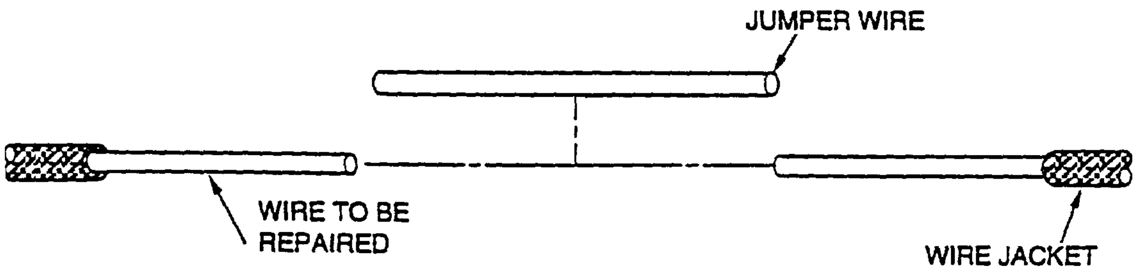


Figure 42. Jumper Wire Splice Repair

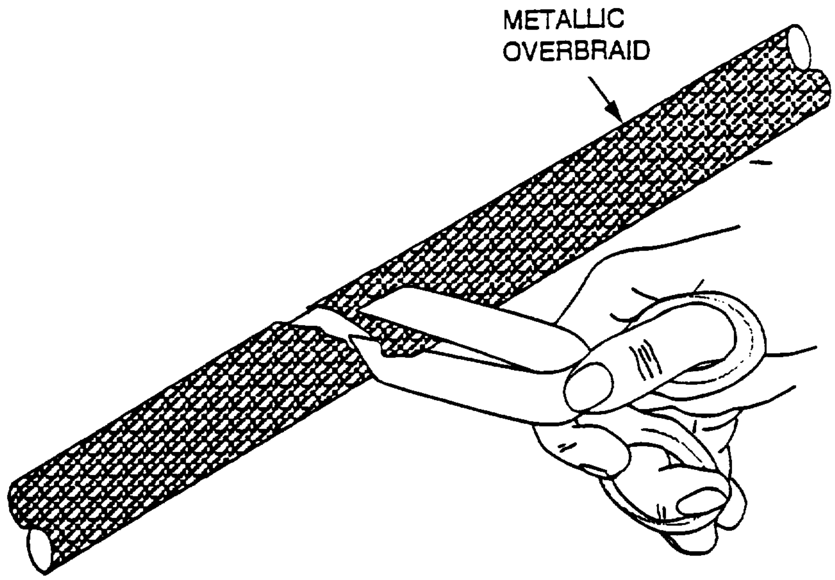


Figure 43. Trimming Metallic Shield

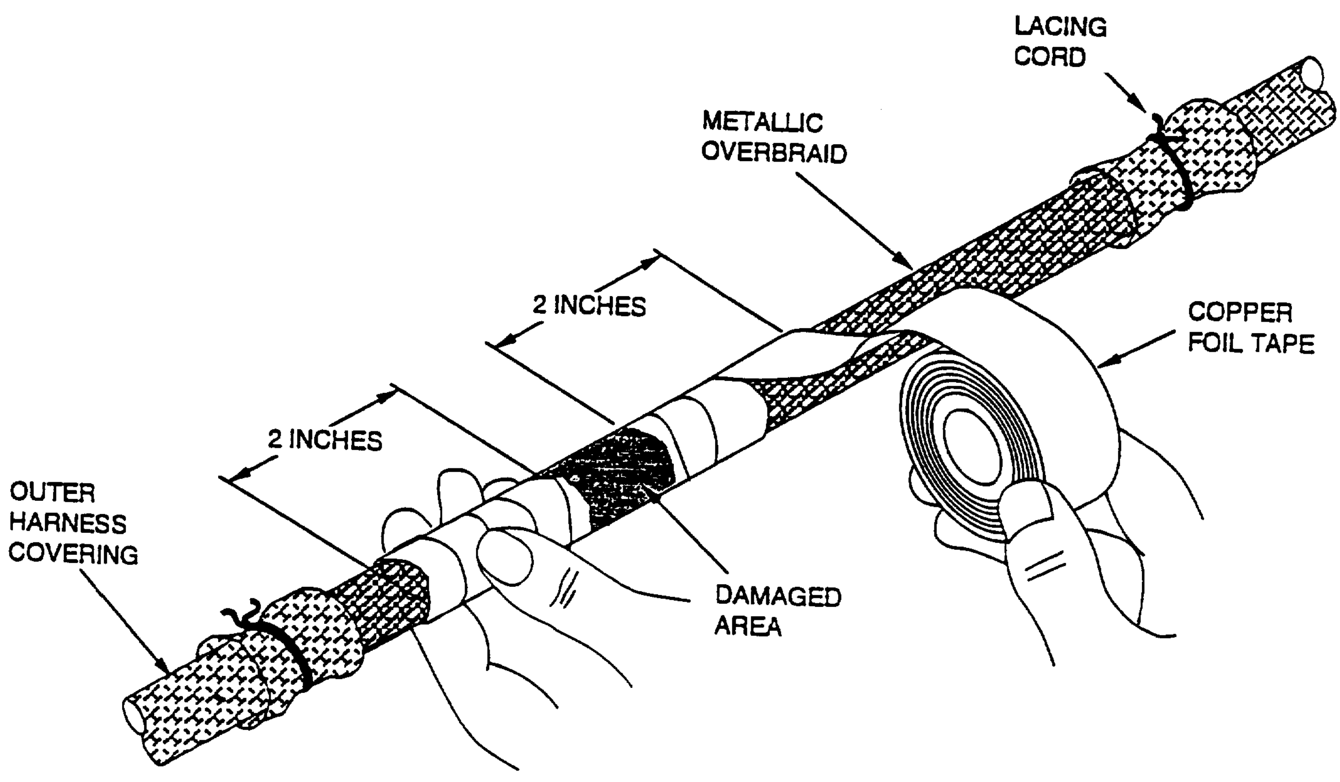


Figure 44. Repair Metallic Overbraid (Shield)

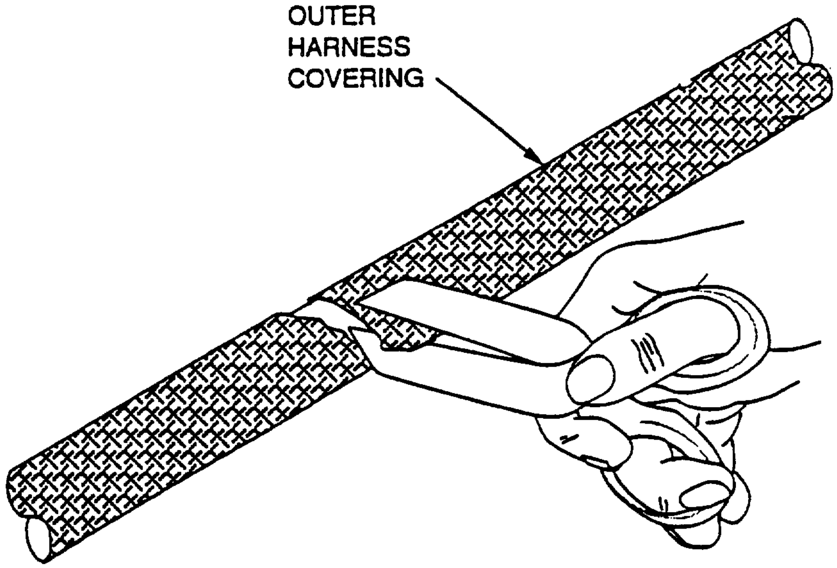


Figure 45. Overbraid Trimming

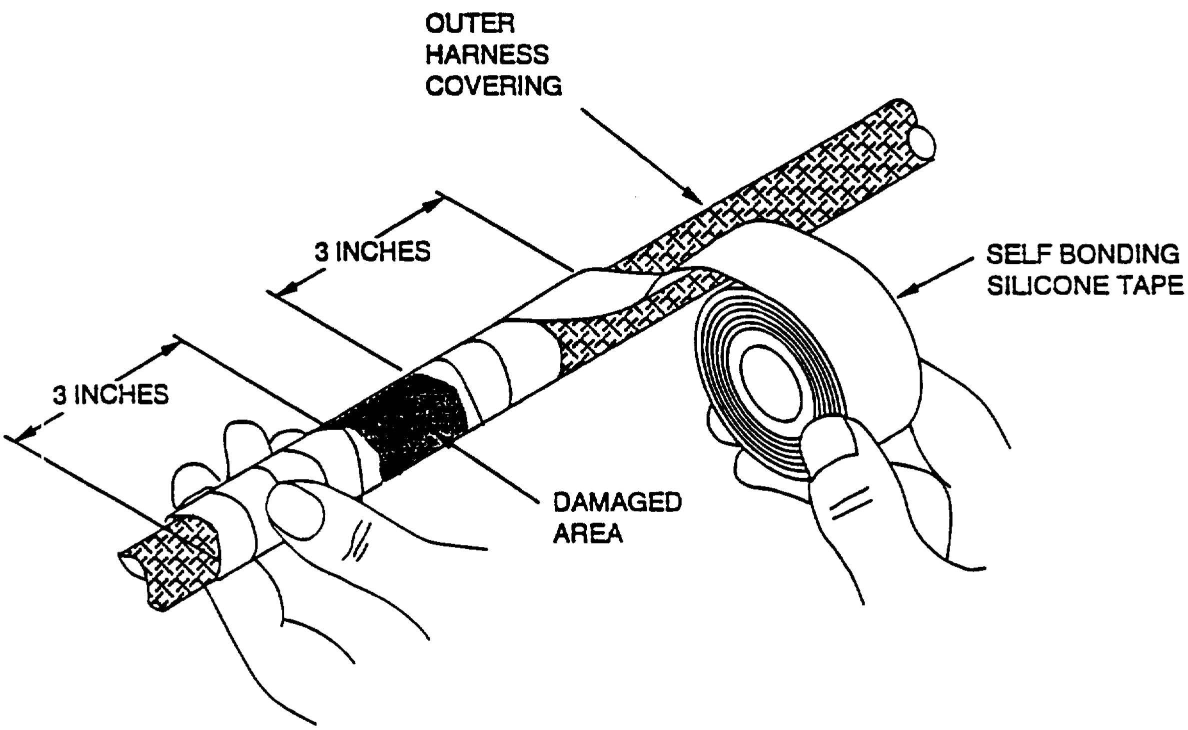


Figure 46. Overbraid Repair

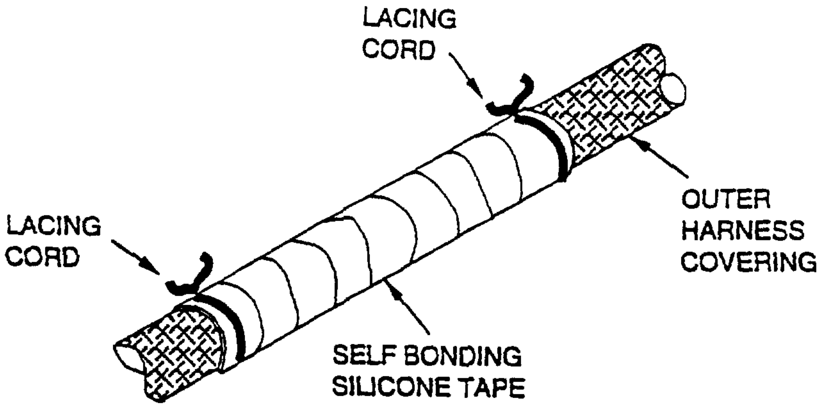


Figure 47. Securing Overbraid Tape

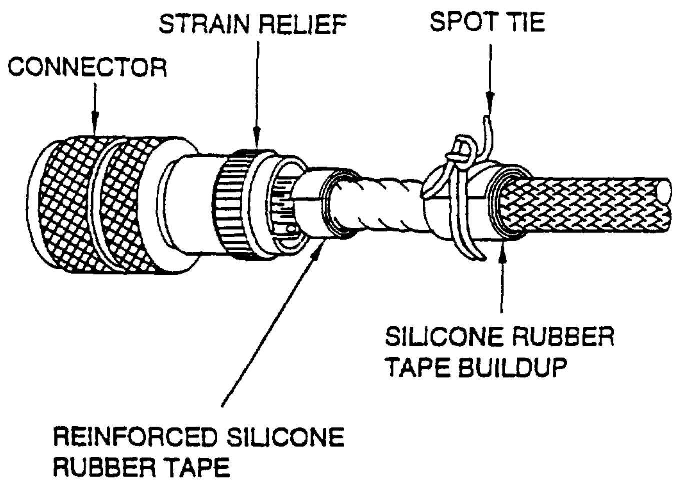


Figure 48. Saddle Clamp Removal

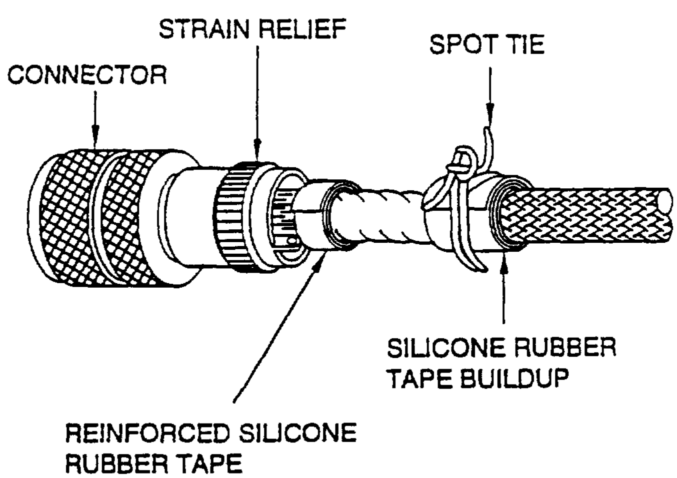


Figure 49. Typical Accessory Protection

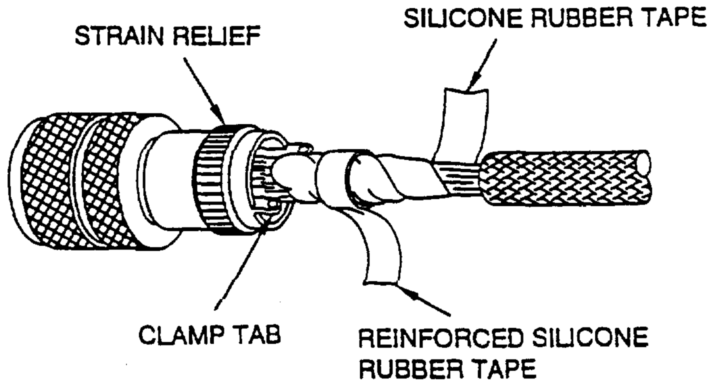


Figure 50. Accessory Tape Removal

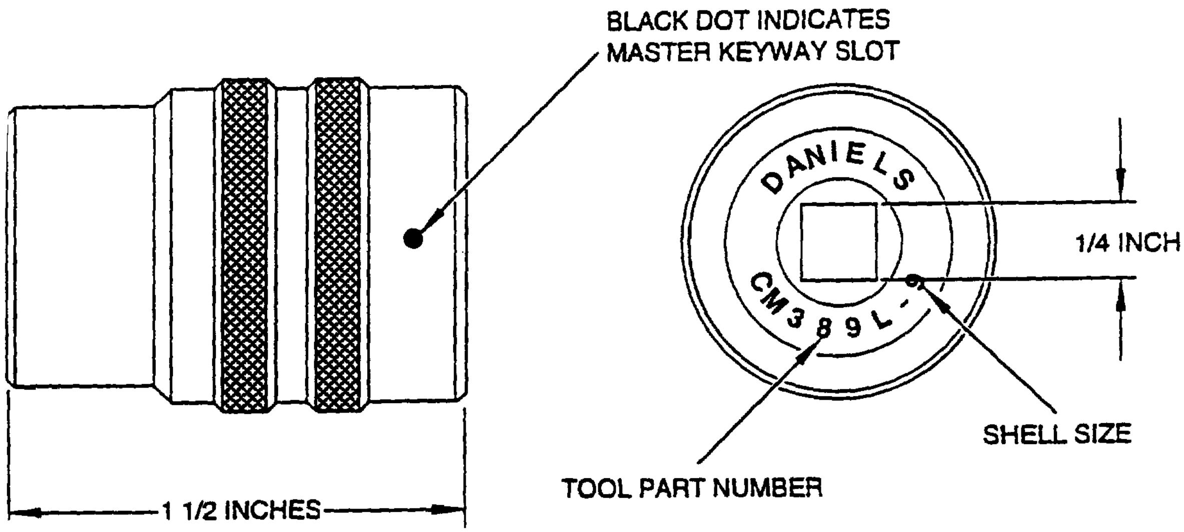


Figure 51. Daniels Accessory Adapter

a. Hold connector stationary with adapter tool and T–Handle. Install strap wrench around strain relief and apply counter clockwise force to loosen strain relief (Figure 53).

b. Loosen the cable clamp screws. If necessary, remove one side of the saddle clamp but retain the loose screw in the saddle clamp (Figure 48).

c. Cut and remove any spot tie or straps (Figure 49).

d. Cut and unwrap tapes (Figure 50).

CAUTION

When cutting boot material extreme care must be taken not to nick or scrape insulation.

e. Mate adapter tool (Figure 51) into the front of the connector (Figure 52). The adapter tool part breakdown as follows:

(1) Example: CM389L–9

(2) CM: Daniels Manufacturing Corporation Product Identification

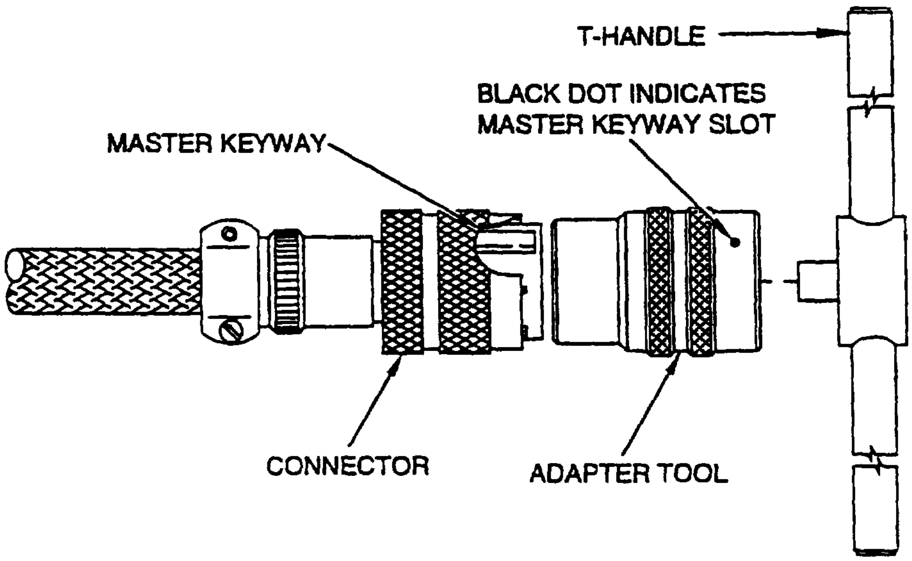


Figure 52. Accessory Adapter In Connector

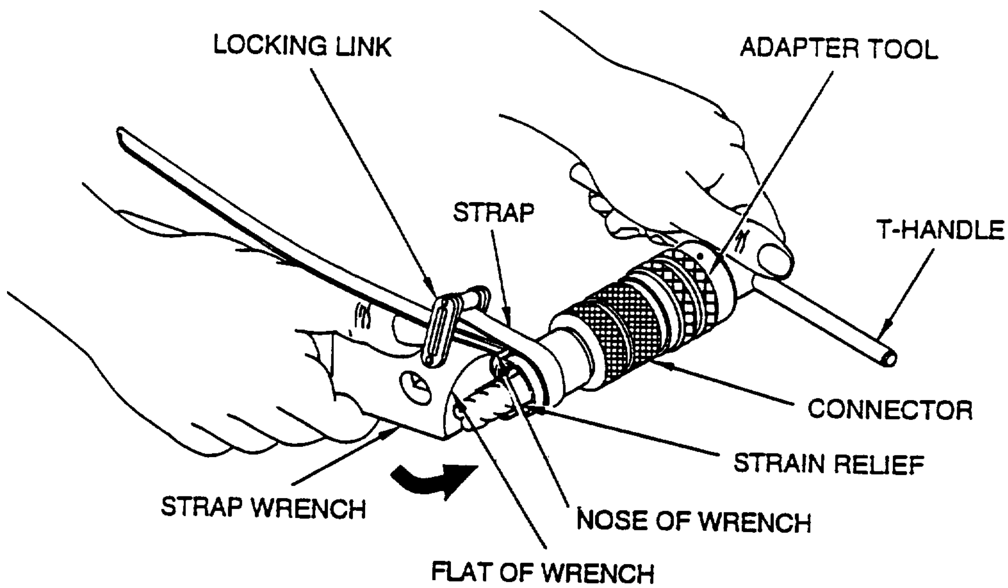


Figure 53. Accessory Removal

(3) 389L: Abbreviated connector part number for which adapter fit (i.e. 3891 fit M38999L connectors, 5015 fit M5015 connectors, etc.). WP 025 00 for details.

(4) –9: Connector shell size.

f. Remove strain relief from connector and slide back on cable (Figure 54).

g. Repair the wire in accessory area as needed.

h. Assemble cable (harness) by sliding strain relief along cable assembly. Engage threads of strain relief to connector. Hand tighten to connector. Hold connector stationary with applicable adapter tool and T–Handle. Install strap wrench around strain relief. Apply force clockwise, as viewed from rear of connector, an additional 1/4 turn (Figure 55).

i. Torque strain relief to 50 inch–pounds (shell sizes 8 through 18) or 100 inch–pounds (shell sizes 20 through 24).

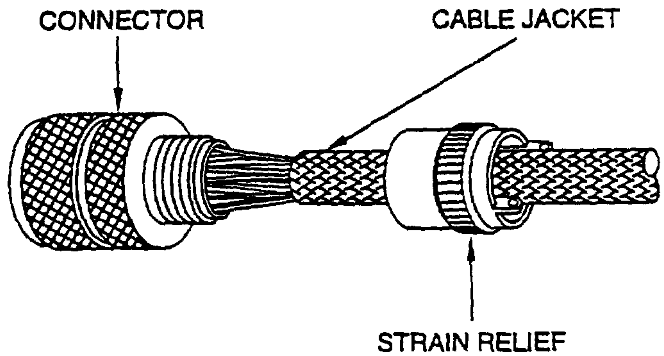


Figure 54. Accessory Removed

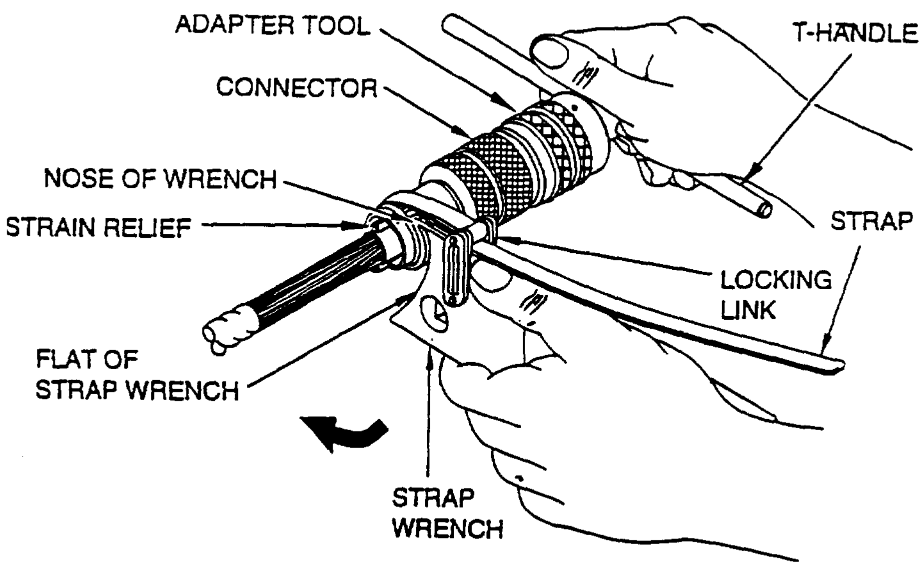


Figure 55. Assembly Accessory

j. Wrap 1 to 2 turns of non–adhesive rubber tape over exposed wires and buildup layers of rubber tape near cable clamp (Figure 56).

k. Install cable clamp. Do not tighten screws. Slide both tapes forward under cable clamp.

l. Tighten screws until metal to metal contact is obtained.

m. Continue to wrap tape over exposed wire and onto cable jacket one width of tape (Figure 57).

n. Spot tie tape buildup.

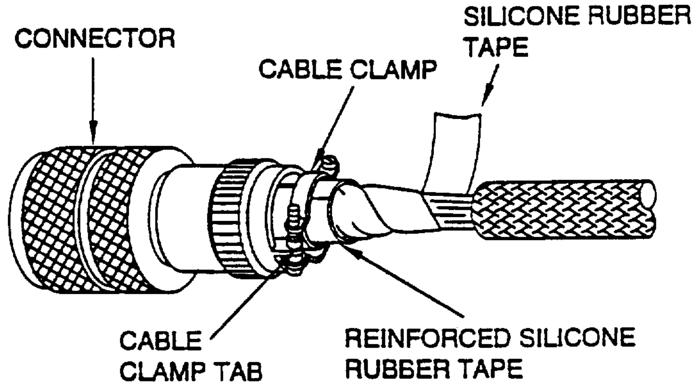


Figure 56. Accessory Tape Wrapping

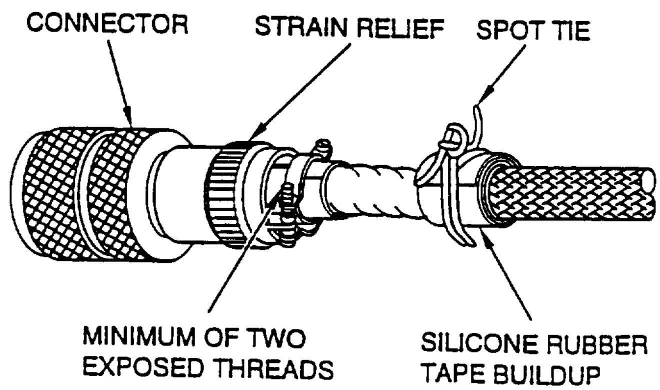


Figure 57. Final Rear Accessory Assembly

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ENVIRONMENTAL SEALED HARNESS REPAIR

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Connector Accessories 024 00
Open and Overbraided Harness Repair 011 00
Military Standard Circular Connectors 020 00
Wire and Cable Splicing and Repair 014 00

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Paddle, Wooden	—
Wrench, Torque 0-150 in. lbs.	—
Wrench, Torque 150-250 in. lbs.	—
Gun, Sealing	—
Tip, Boot and Tubing Gun, Sealing	979648
Heat Gun	AA-400
Heat Gun	CV-5700
Reflector	MG-2
Pliers, Connector	Model 11-6147-1
Knife, Thermal	Model 2A
Reflector	TG-12
Reflector	TG-13
Reflector	TG-13A
Reflector	TG-21
Reflector	TG-22
Reflector	TG-23
Reflector	TG-24
Tool, Heating	MCH–100–A
Tool, Heating, Infrared	IR-550

Materials Required

Nomenclature	Part Number/Type Designation
Adhesive	RTV-108
Adhesive	S-1009
Adhesive	S-1030
Adhesive	S-1125
Alcohol, Isopropyl	TT–I–735
Boot, Bulbous	202A100 Series
Boot, Bulbous	202D100 Series
Boot, Low Profile	200D200 Series
Compound, Molding	—
Compound, Thread Coating	—
Cord, Lacing	—
Emery Cloth #320	—
Sandpaper	—
Spot Tie	—
Tape	—
Tubing	RP-4800
Tubing	VPB-RT
Uni-Boot	202C600 Series

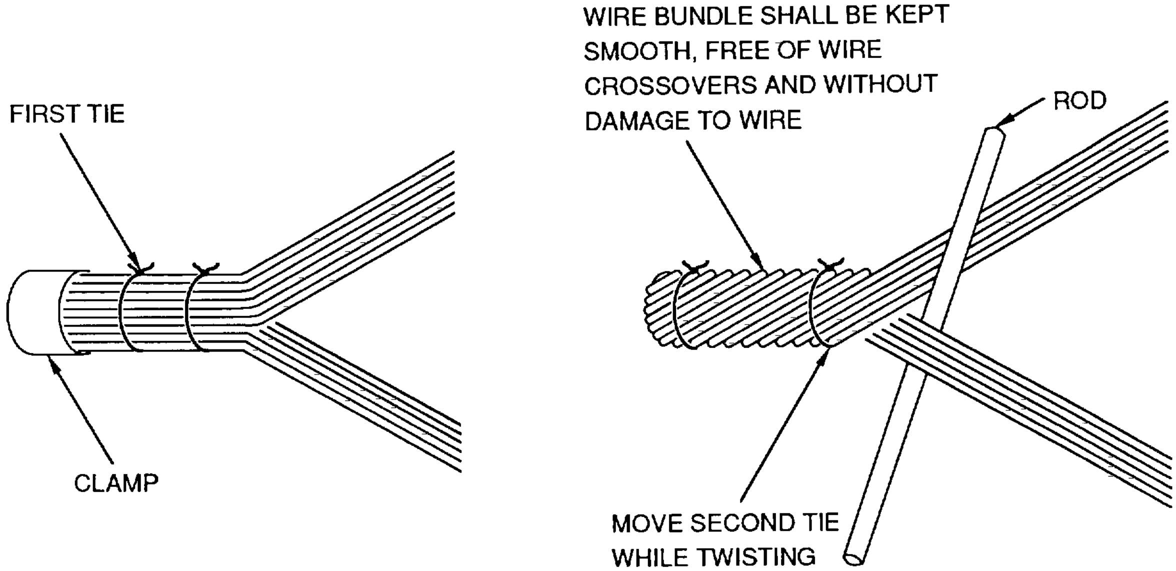


Figure 1. Bunch Twist Wire Bundle

1 . **INTRODUCTION.**

2 . **DESCRIPTION.** Cable harness components feature controlled wall thicknesses that permit small, lightweight cable assemblies without sacrificing performance. Heat-shrinkable components conform to components being covered to present an attractive appearance.

3 . Cable harness tubings and molded shapes protect wire bundles and provide connector terminations maximum support and mechanical protections. Adhesives are used to ensure rugged bonding and sealing in severe environments. Adapters with spin couplings provide easy access to the back sides of connector for repairs.

4 . **CABLE HARNESS ASSEMBLY.**

5 . **WIRE LAYUP.** Layup wire forming harness using the following procedure:

a. Layup harness but do not terminate the connector.

b. Twist cables to provide flexibility (Paragraph 7).

c. Select and cut appropriate size shrinkable tubing to desired length allowing 10 percent shrinkage for each leg of harness.

6 . **WIRE TWISTING.** Bunch twisting shall be accomplished on all wires unless specified differently on engineering drawing. Do not twist wiring in the following categories:

a. Wire bundles or branches shorter than four inches in length.

b. Branches containing five or less wires smaller than 16 AWG.

c. Branches containing three or less wires of any gage.

7 . **Bunch Twisting Wire Bundle.** To bunch twist a wire bundle, proceed as follows

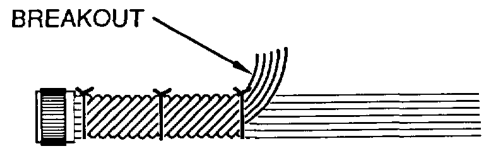
a. Gather wires to be twisted and anchor at one end.

b. Spot tie cable close to anchor and draw tight to form a compact bundle.

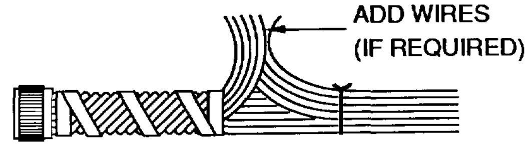
c. Apply a second spot tie close to first tie that will be moved along the cable as it is twisted maintaining a compact bundle.

d. Separate bundle into two equal groups and using a rod (such as a soldering aid) to maintain separation twist two groups (Figure 1).

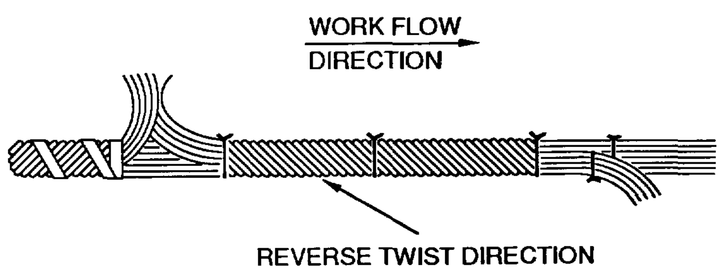
A. TWIST TO FIRST BREAKOUT AND SPOT TIE.



B. REPLACE SPOT TIES ON TRUNK WITH TAPE. IF WIRES ARE TO BE ADDED TO BREAKOUT, LAY THEM IN AND SPOT TIE BREAKOUT. DO NOT TWIST BREAKOUT AT THIS TIME.



C. REVERSE TWIST DIRECTION AND TWIST TO NEXT BREAKOUT SPOT TYING AS REQUIRED. SPOT TIE BOTH SIDES OF BREAKOUT.



D. REPLACE SPOT TIES ON TRUNK. TWIST BRANCH IN DIRECTION WHICH WILL TIGHTEN BREAKOUT AND TAPE.

E. REVERSE TRUNK TWIST DIRECTION. TWIST AND SPOT TIE TO NEXT BREAKOUT. REPLACE TRUNK SPOT TIE WITH TAPE.

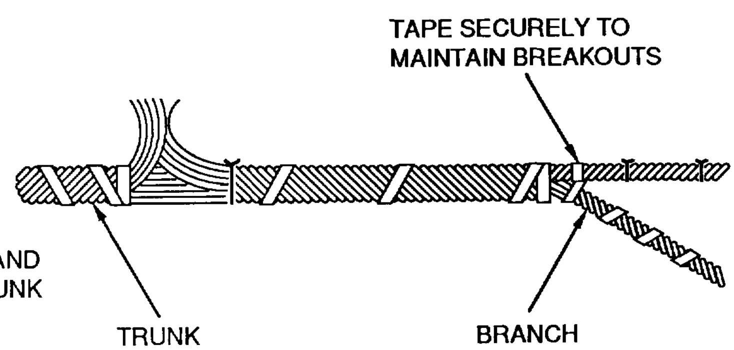
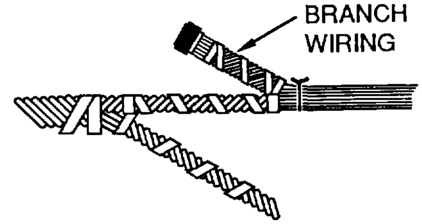


Figure 2. Cable/Harness Fabrication Twisting (Sheet 1 of 2)



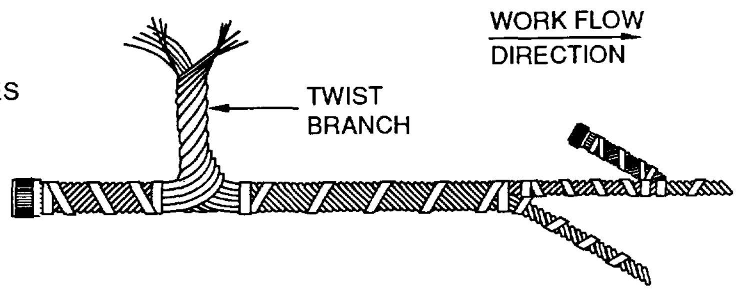


Figure 2. Cable/Harness Fabrication Twisting (Sheet 2)

e. Move second spot tie along twisted portion of cable to maintain round compact bundle. Additional spot ties may be required to maintain compactness.

f. Comb wires as twisting is continued and allow individual wire to rotate removing any buildup of twist in wires. For maximum flexibility remove as much of inducted twist as possible.

g. Continue twisting wires until required cable length is obtained.

8 . **Cable/Harness Fabrication Twisting.** Cable or harness fabrication twisting is accomplished by performing procedure (Figure 2)

9 . **Taping Harness Breakouts.** Taping harness breakouts by performing procedure (Figure 3)

10 . **SHRINK TUBING INSTALLATION.** To install heat-shrinkable tubing over twisted wire bundle perform the following procedure:

a. Slide tubing over wire bundle.

b. Starting at the inside and working toward connector end, shrink tubing with heat gun and reflector (Figure 4)

c. Ensure enough wire has been left at connector end to terminate wires to connector.

11 . **TRANSITION INSTALLATION.** To install transitions, perform the following procedure:

a. Pass jacketed wire bundles through legs in transition and position over wire junction. If more than one transition is used, do not begin bonding and shrinking until all transitions are properly positioned.

b. Beginning with innermost transition, abrade with sandpaper the portion of tubing to be covered by transition.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean abraded area and inside of transition with Isopropyl Alcohol to ensure secure bonding.

A. START TAPING BY APPLYING 2 TO 3 WRAPS IN STEP 1.

B. FOLLOW TAPING SEQUENCE AS ILLUSTRATED IN STEPS 1 THRU 4.

C. COMPLETE TAPING BY APPLYLING 2 TO 3 WRAPS OF TAPE SHOWN IN STEP 5.

D. FOR DIFFICULT TO ANCHOR BREAKOUTS, STEPS 1 THRU 5 MAY BE REPEATED.

NOTE

JUNCTIONS MUST BE TAPED SECURELY TO MAINTAIN BREAKOUT ORIENTATION AND HARNESS INTEGRITY.

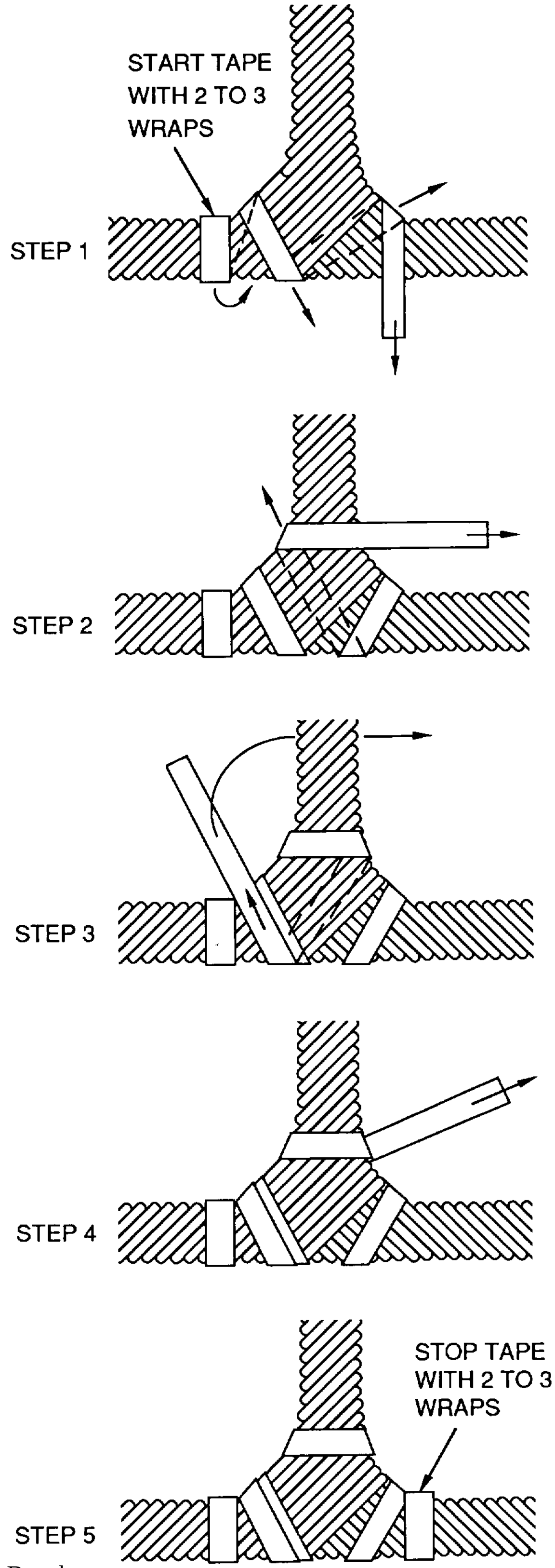


Figure 3. Taping Harness Breakouts

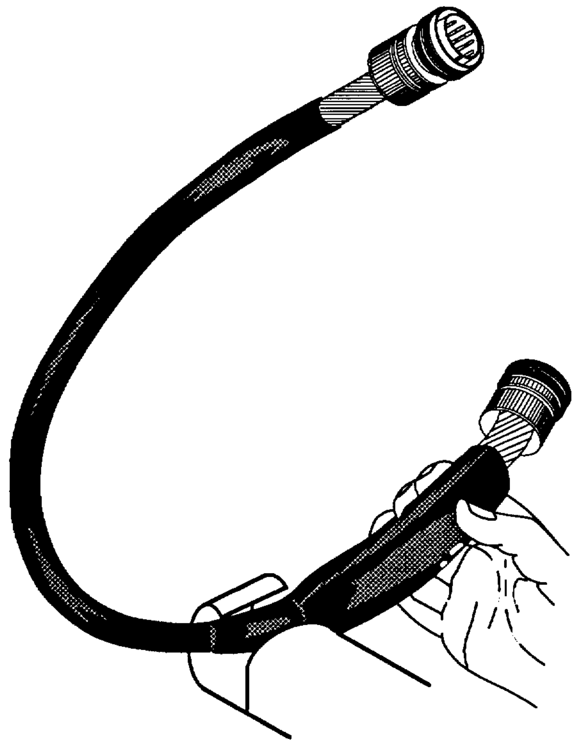


Figure 4. Heat Shrink Tubing Installation

d. Coat tubing with adhesive and ensure transition is properly positioned.

e. Starting at center of transition and proceeding to each leg, completely shrink transition using heat gun with or without reflector (Figure 5)

12 . **CONNECTOR TERMINATION, JACKET AND ADAPTER PREPARATION.** To prepare harness assembly for termination, perform the following procedure:

a. Slip boot, grooved adapter and A or E type backshell over cable assembly wiring.

b. Crimp or solder wires to connector in accordance with WP 022 00 and WP 025 00.

c. After terminating wires to connector slide backshell and grooved adapter forward and thread in place.

d. If jacketed cable is used slip boot, grooved adapter and A or E type backshell over jacketed cable assembly.

e. Crimp or solder wires to connector in accordance with WP 022 00 and WP 025 00.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

f. Abrade end of tubing with sandpaper and clean with Isopropyl Alcohol.

g. Abrade inside of boot with sandpaper and clean with Isopropyl Alcohol.

13 . **HEAT-SHRINKABLE BOOT INSTALLATION.** To install the heat shrink boot, perform the following procedure:

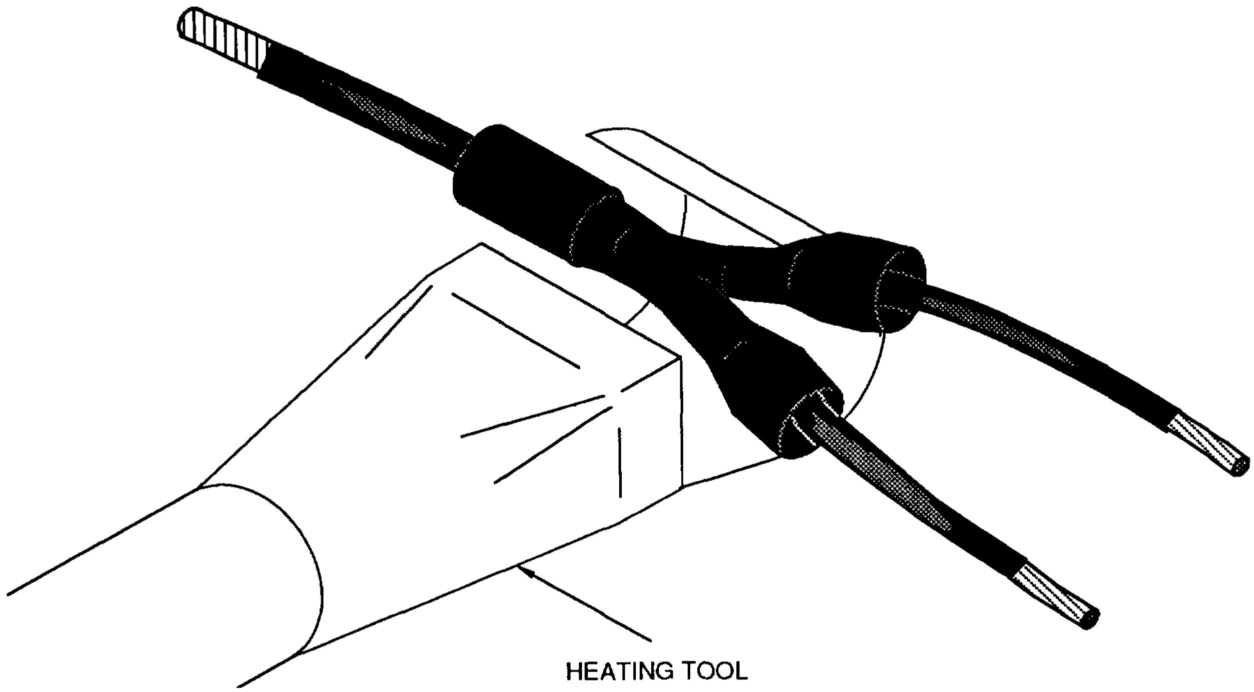


Figure 5. Transition Installation

a. Coat end of tubing and adapter with thin coat of adhesive.

(1) If using a grooved adapter coat knurled area behind groove.

(2) If A type backshell is used coat threaded area of backshell with adhesive.

(3) If E type backshell is used coat entire outside surface, ensure no excess adhesive makes contact with connector coupling nut.

b. Position heat-shrinkable boot over adapter or backshell.

(1) If using a lipped boot and grooved adapter position boot over groove.

(2) If using A type backshell position boot completely over threaded area.

(3) If using E type backshell position boot as close as possible to front of backshell without interfering with coupling nut.

(4) If using 90 degree boot position angle in respect to polarizing key.

c. Using heat gun and reflector, start at large end of boot and shrink until boot contacts A or E type backshell or boot is fully seated on adapter.

d. When large end is fully recovered over appropriate adapter begin moving heat toward small end of boot until boot shrinks on cable.

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e. Remove excess adhesive immediately after shrinking with cloth moistened with Isopropyl Alcohol.

f. Leave undisturbed until adhesive cures.

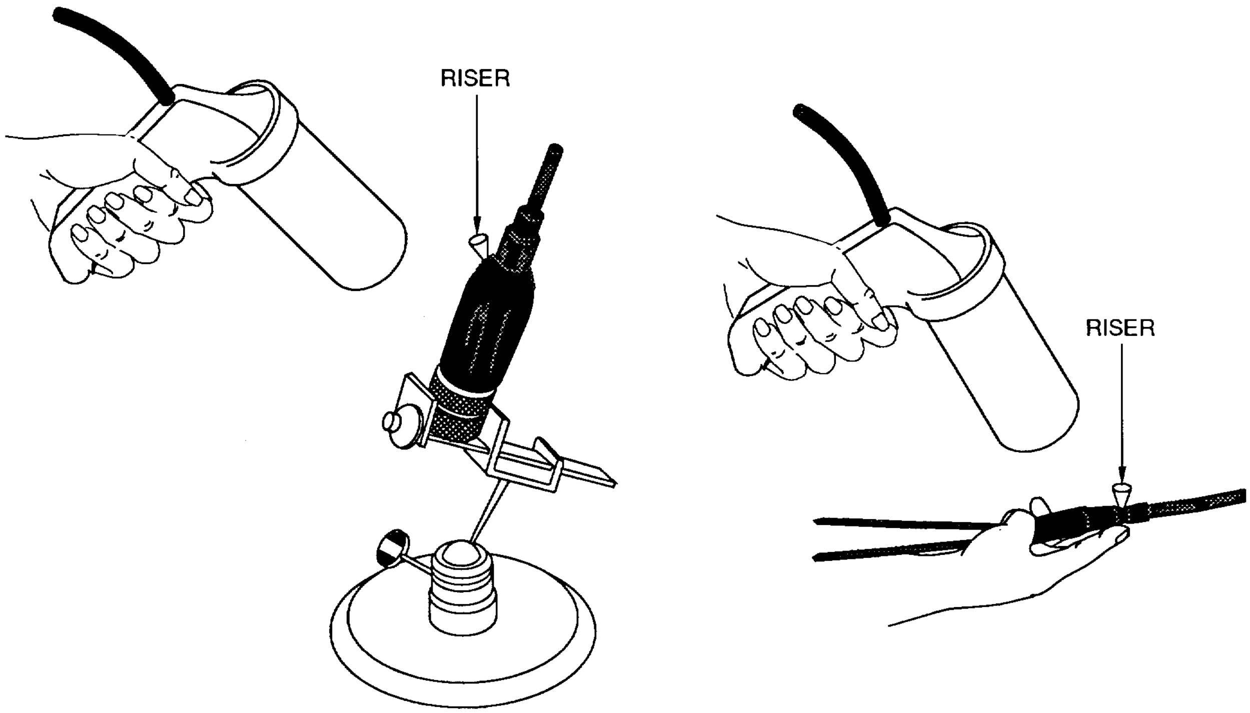

Figure 6. Molding Compound Injection

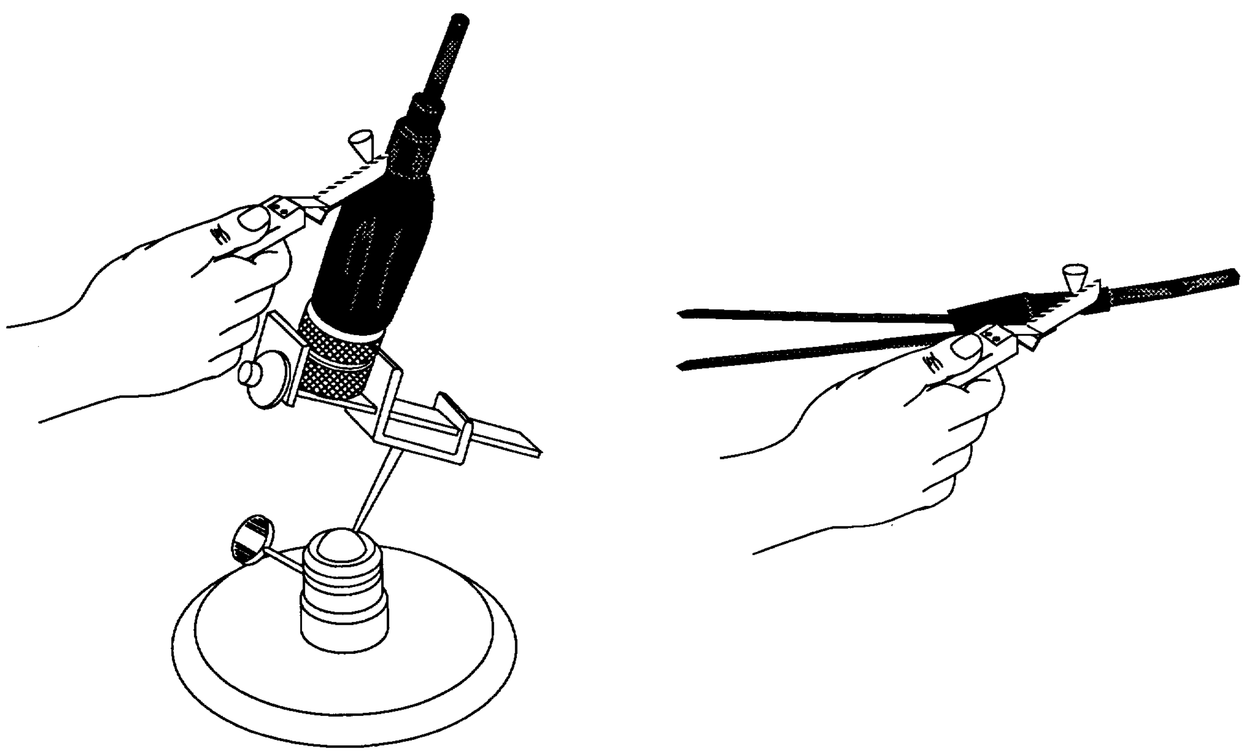

Figure 7. Cutting Riser

14 . **ENVIRONMENTAL HARNESS MOLDING.** The boots and transitions are injected with molding compound which provide a complete environmental seal at wire junctions. Use the following procedure to environmentally seal these junctions (Figure 6).

a. Place cone-shaped riser in hole of boot or transition and inject molding compound into boot or transition until riser is filled.

b. Withdraw sealing gun from molded components and insert small plug in hole.

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c. Clean excess compound from molded components using Isopropyl Alcohol.

d. Allow molding to cure at room temperature or with heat depending on type compound used.

e. After compound is completely cure, cut riser flush with surface of component (Figure 7)

15 . **CONNECTOR AND CONTACT REPAIR.**

16 . **RE-ENTRY TO CONNECTORS WITH SPIN COUPLING ADAPTERS.** Uni-boots and bulbous boots can usually be reused. Low profile boots, however, may not provide enough access to rear of connector, and may have to be cut off and replaced. Perform the following procedure to gain entry to the connector.

a. Disconnect cable.

b. Using connector pliers with plastic jaws, turn coupling ring counterclockwise (Figure 8)

c. Using heat gun and appropriate reflector, heat boot until it is warm to touch and becomes flexible (Figure 9)

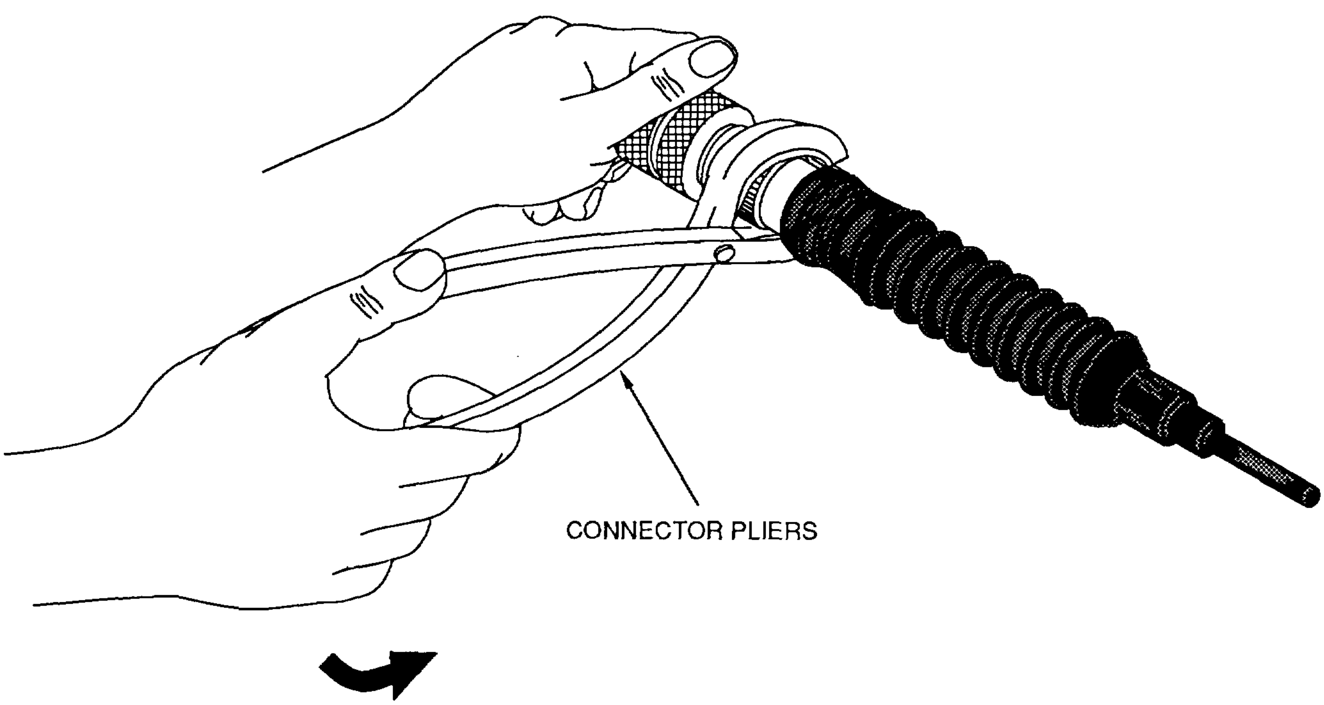

Figure 8. Removing Coupling Ring

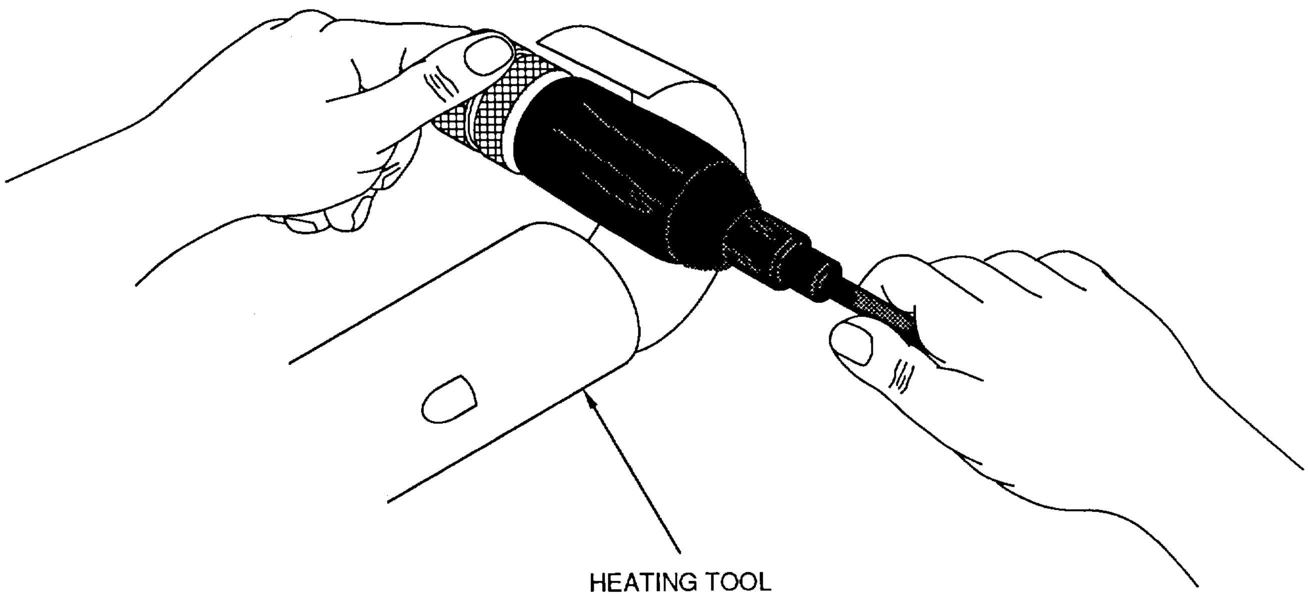

Figure 9. Heating Boot

d. Pull adapter and boot back from connector, exposing wiring, and hold boot back until cool (Figure 10)

e. If boot is damaged, boot must be replaced.

17 . **RE-ENTRY TO CONNECTORS WITHOUT SPIN COUPLING ADAPTERS.** To gain access to rear of connectors having solid or no adapter, the boot must be removed and a new boot installed. Perform the following procedure:

a. Disconnect cable.

b. Remove boot.

18 . **CONTACT REMOVAL AND INSERTION.** Use the following procedure to remove and install contacts in the connector:

a. Re-enter connector.

b. Identify and mark conductors as required to permit proper contact reinstallation.

c. Remove, repair and insert contacts in accordance with WP 022 00.

d. Insert contacts and sealing plugs into any unused contact cavities.

e. Reclose connector.

19 . **CONNECTOR RECLOSING WITH SPIN COUPLING ADAPTERS.** Use this procedure to reattach a spin coupling adapter with boot to rear of connector where boot was folded back.

CAUTION

Do not direct hot air at ends of boot where adhesive joints are located.

a. Using heat gun with reflector, heat boot until it is warm and flexible.

b. Pull adapter to connector while boot is warm and flexible.

c. Orient connector and adapter so connector will mate without twisting harness.

d. Coat threads with thread coating compound.

e. Screw coupling ring onto connector (Figure 11)

f. Tighten coupling ring to torque values specified in Table 1.

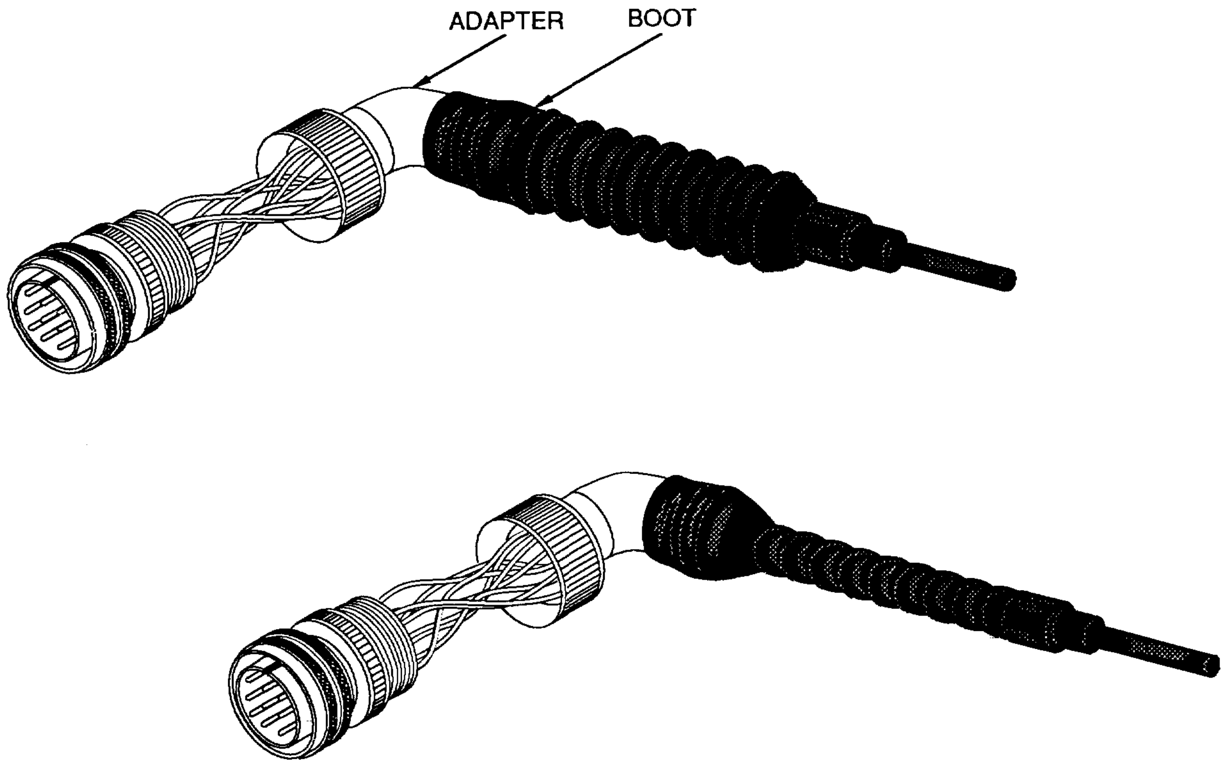

Figure 10. Adapter and Boot Pulled Back

Table 1. Adapter Coupling Ring Torque Values

Connector Shell Size	Torque Value (In-Lbs) Heavy Duty	Torque Value (In–Lbs) Light/ Medium Duty	Connector Shell Size	Torque Value (In-Lbs) Heavy Duty)	Torque Value (In–Lbs) Light/ Medium Duty
8	65–70	40–45	22	150–155	85–90
10	85–90	40-45	24	150–155	85–90
12	120–125	40-45	28	165–170	N/A
14	130–135	40-45	32	165–170	N/A
16	130–135	40-45	36	165–170	N/A
18	130–135	40-45	40	180–185	N/A
20	150–155	85–90	44	180–185	N/A
			48	180–185	N/A

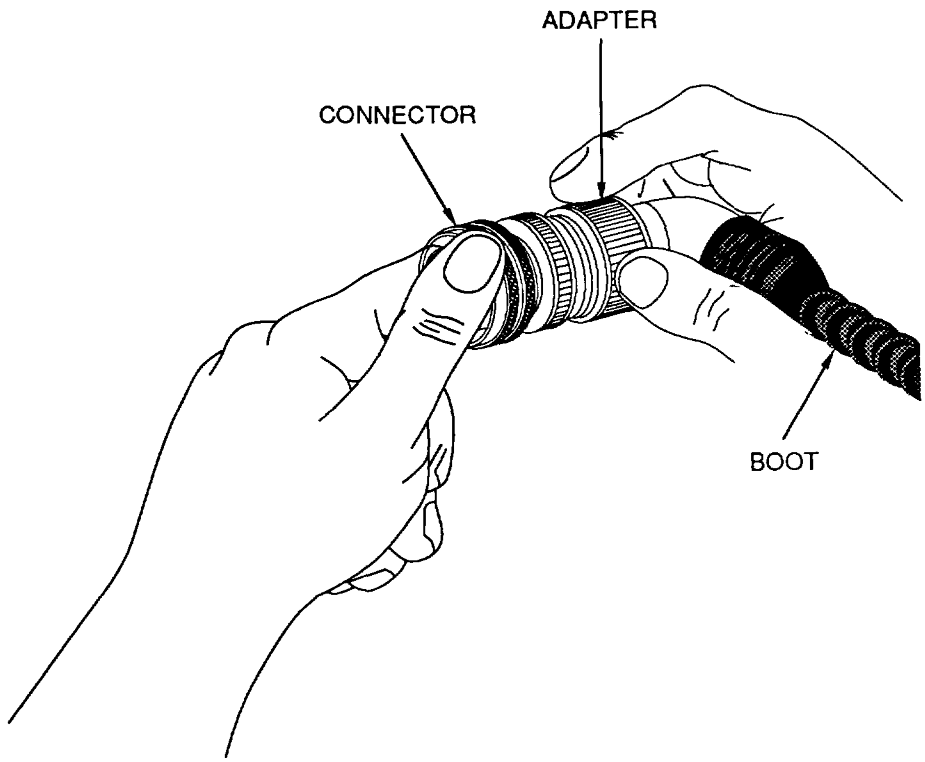

Figure 11. Coupling Installation

20 . **CONNECTOR RE-ORIENTATION.** If connector is attached to a spin coupling adapter such that cable is twisted or bent in wrong direction, re-align connector and adapter as follow:

a. Loosen adapter coupling ring with connector pliers.

b. Rotate connector to proper position.

c. Tighten coupling ring to torque value specified in Table 1

21 . **HARNESS REPAIR.**

22 . **BOOT REPLACEMENT.** The following procedures are for the replacement of damaged boots and for gaining access to rear of a connector which has a non-reenterable boot and/or adapter.

23 . **Boot Removal.** To remove the boot use the following procedure:

a. Score boot lengthwise with cutting tool ensuring not to cut through boot into cable jacket.

b. Using heat gun with reflector heat entire boot including the adhesive bond areas at both ends.

c. Peel boot from connector or adapter and cable jacket.

d. Clean excess adhesive from connector or adapter.

24 . **Boot Installation.** To install a new boot, perform the following procedure:

a. Determine material, size, and configuration of boot to be installed.

b. Select repair boot (Table 2 or Table 3).

c. If inside diameter of new boot is too small, either remove connector or select larger size boot.

Table 2. Repair Boot Selection

Connector or Adapter Dia. at Boot Interface	Jacket Min. Dia.	Non-Adapter Bulbous Boot	Bulbous	Adapter Boots	
				Low Profile	Uni-Boot
.35 - .40 inch	.20 inch	202A111	—	—	202C611
.40 - .50 inch	.25 inch	202A121	202D121	—	202C611
.50 - .60 inch	.30 inch	202A132	202D121	202D211	202C621*
.60 - .70 inch	.30 inch	202A132	202D132	202D221	202C621*
.70 - .80 inch	.30 inch	202A142	202D142	202D221	202C632*
.80 - .90 inch	.35 inch	202A142	202D142	202D232	202C632*
.90 - 1.0 inch	.40 inch	202A153	202D153	202D242	202C642*
1.0 - 1.2 inch	.45 inch	202A153	202D153	202D242	202C642*
1.2 - 1.4 inch	.55 inch	202A163	202D163	202D253	202C653*
1.4 - 1.6 inch	.65 inch	202A174	202D174	202D263	202C653*
1.6 - 1.8 inch	.65 inch	202A174	202D174	202D263	202C653*
1.8 - 2.0 inch	.80 inch	202A185	202D185	202D274	202C653*
2.0 - 2.2 inch	.80 inch	202A185	202D185	202D285	—
2.2 - 2.4 inch	.80 inch	202A185	202D185	202D285	—
2.4 - 2.6 inch	1.1 inch	202A196	202D196	202D296	—
*Requires shimming at J end Use short length of heat-shrinkable jacket material or repair tubing.					

Table 3. Boot and Transition Material Selection

Harness System Nomenclature	Harness Jacket Material	Boot or Transition Material	Adhesive
10	RT-102 Polyolefin	Flexible Polyolefin -4, -71	S-1030
15	NT-FR Neoprene	Semi-rigid Polyolefin-3	S-1009
20	NT-FR Neoprene	EPB-51	S-1009
25	DR-25	-25 Elastomer	S-1125
30	VPB	VPB-50	S-1125
35	Viton	Viton -12	S-1125
Silicone	SFR	SFR-6	GE RTV-108

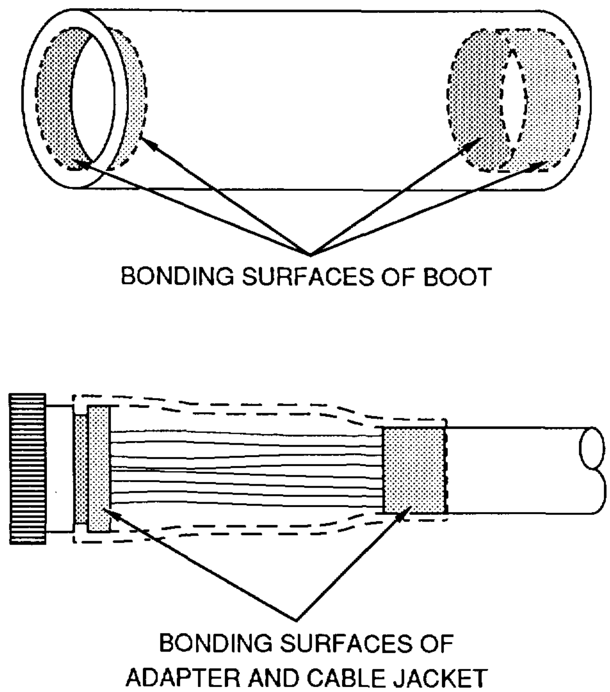

Figure 12. Abrading Bonding Surfaces

d. Abrade bonding surfaces of jacket and boot using emery cloth (Figure 12).

e. Wipe loose particles from abraded surfaces with clean cloth.

WARNING

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f. Clean boot attachment surface of adapter or connector with Isopropyl Alcohol.

g. Select proper adhesive from Table 3 and apply adhesive to bonding areas of cable jacket and connector/adapter.

h. Slide new boot over harness and position boot over connector or adapter. Ensure end of boot marked H is toward connector and J is toward cable jacket (Figure 13).

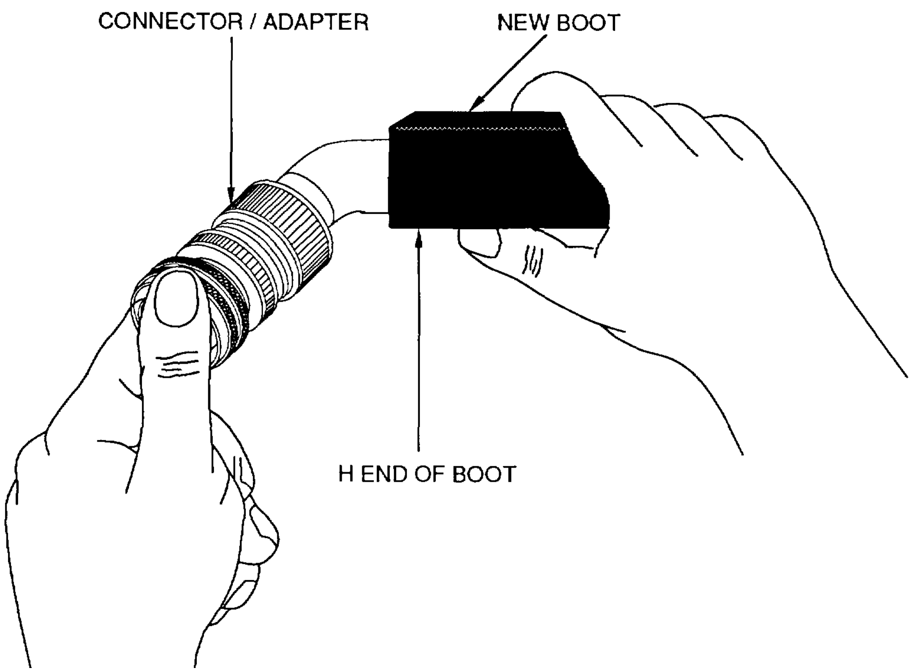

Figure 13. Shrinking Toward Cable End

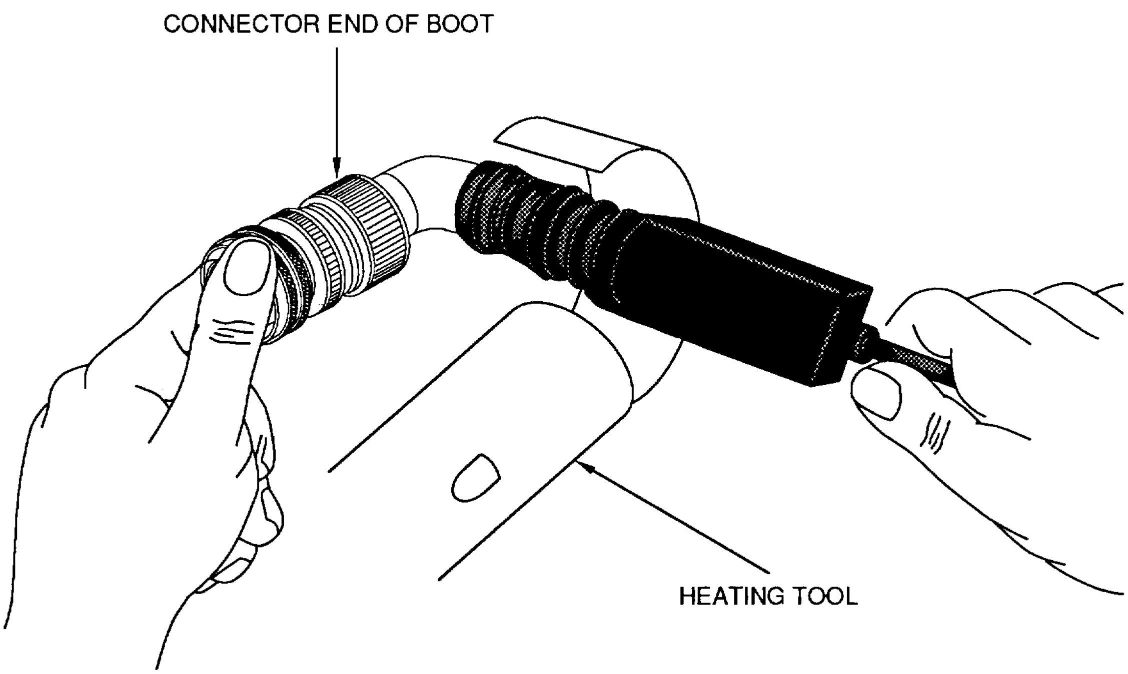

Figure 14. Shrinking Boot Over Connector Adapter

i. Using heat gun and reflector shrink boot onto backshell adapter or connector first, then work toward cable end of boot (Figure 14).

j. Clean excess adhesive from each end of boot For hot melt adhesive use wooden paddle.

(1) For hot melt adhesive use wooden paddle.

(2) For thermosetting (epoxy) adhesive use clean cloth or tissue.

k. Cure adhesive. Ensure bond line is not moved or stressed**.**

25 . **ADAPTER REPLACEMENT.** Use the following procedures to replace solid, spin-coupling, and shield adapters. If adapter is replaced the attached boot must also be replaced (Paragraph 24).

26 . **Adapter Removal.**

a. Disconnect connector.

CAUTION

Take care not to cut into cable jacket.

b. Score boot lengthwise with cutting tool.

c. Using heat gun with reflector heat entire boot including adhesive bond areas, until boot is warm and flexible.

d. Using pliers peel boot from jacket.

e. Using connector pliers with plastic jaws turn adapter or coupling ring counterclockwise and remove (Figure 15).

f. Identify and mark conductors to permit proper re-installation.

g. Remove contacts or unsolder wires from connector in accordance with WP 022 00 and WP 025 00.

h. Remove adapter (Figure 15)

(1) For adapters without shields simply remove adapter.

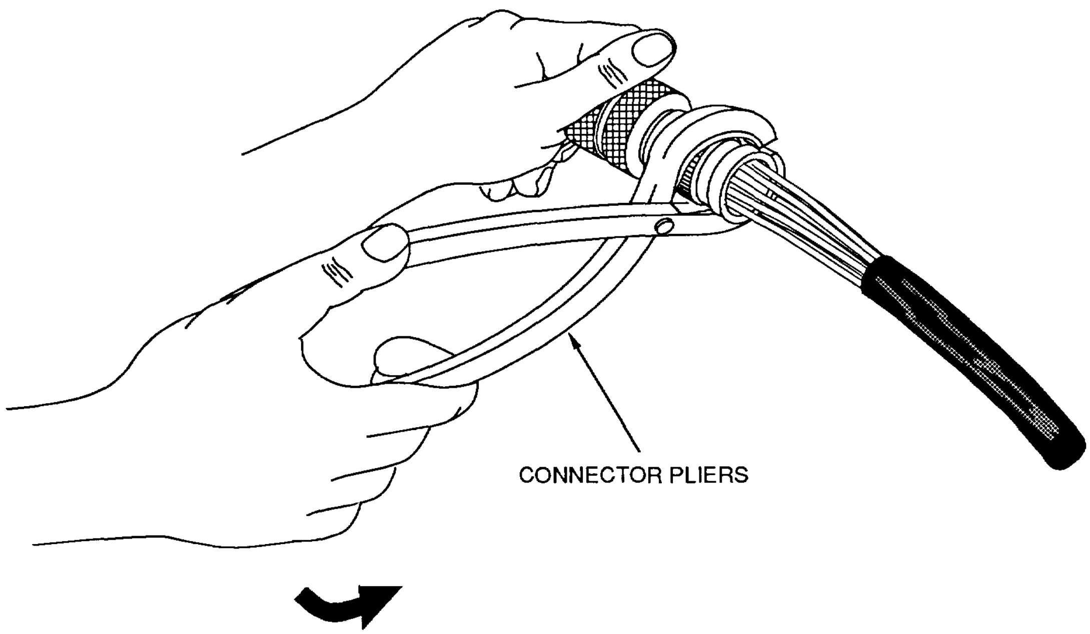

Figure 15. Removing Adapter or Coupling Ring

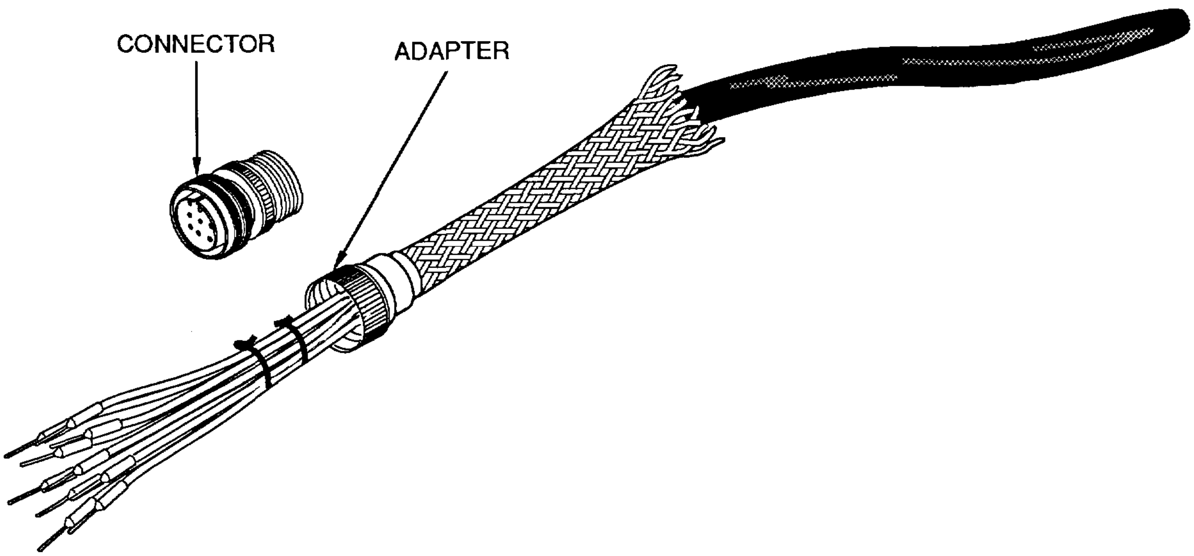

Figure 16. Adapter Removal and Installation

(2) For shielded adapters separate adapter shield from cable shield and remove adapter from cable.

(3) If shields are tied together with lacing cord cut cord and pull adapter from cable.

(4) If shields are tied together with wire whipping unsolder and unwrap wire.

(5) If shields are soldered together use infrared or hot air heating tool to melt solder while carefully pulling adapter.

27 . <u>**Adapter Installation.**</u> If cable has shield braid ensure that the braid is straightened out and smoothed. Remove excess solder from braid.

a. Slide new heat-shrinkable boot back over cable, ensure the end marked J goes on first and the end marked H goes toward adapter (Figure 17)

b. If braid splice is used, slide splice onto cable.

c. Slide new adapter over cable (Figure 16)

d. Using procedures in WP 022 00 and WP 025 00, insert contacts into proper contact cavities in connector or resolder wire to connector terminals.

e. Fill all unused cavities with contacts and sealing plugs.

f. Coat threads of adapter with thread coating compound.

g. Attach adapter to connector so harness does not twist (Figure 18)

h. Tighten adapter or coupling ring to proper torque (Table 1).

i. Install new boot (Paragraph 24).

28 . **JACKET REPAIR.** This procedure is for using heat-shrinkable repair tubing to make moisture tight repairs to damaged harness jacketing without removing connectors.

a. Inspect shield and component wiring for damage.

(1) If shield is damaged refer to WP 011 00.

(2) If wiring is damaged, refer to WP 015 00.

b. Clean any oil, dirt, or grease from repair area.

c. Abrade cable jacket with emery cloth in repair area.

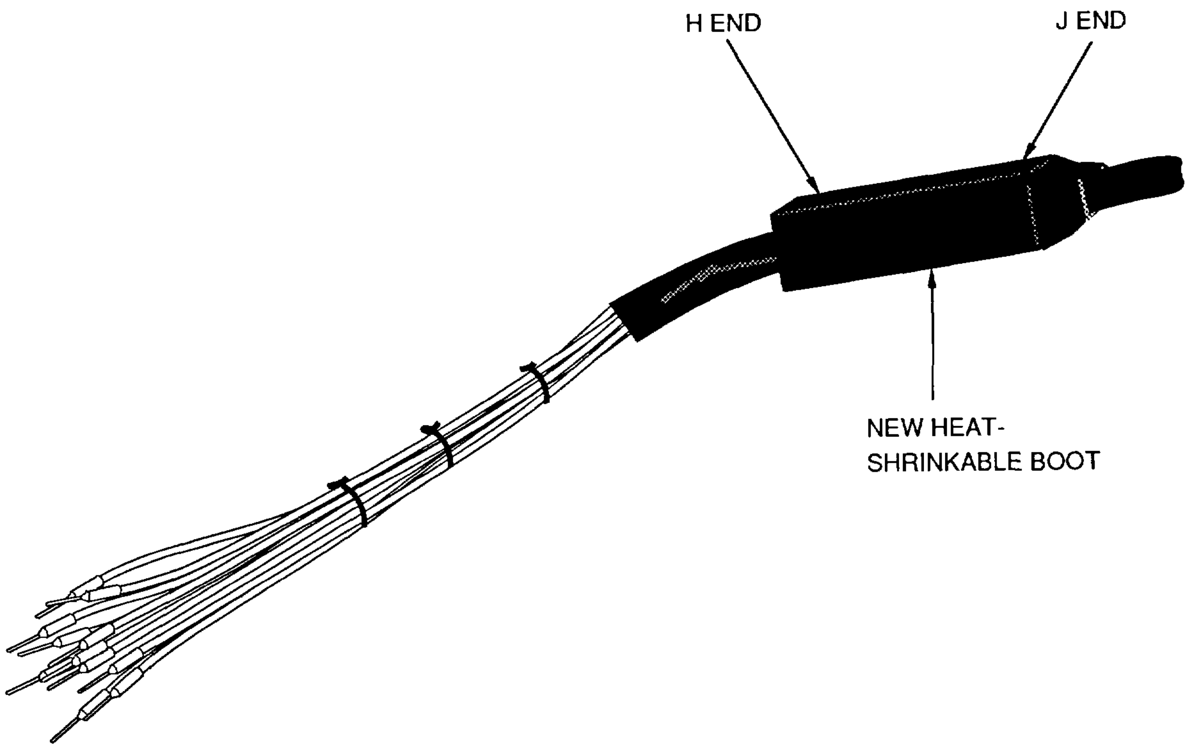

Figure 17. Installing New Boot

d. Wipe loose particles from abraded surface with clean cloth or tissue.

e. Using lacing cord spiral wrap damaged area and tie at both ends and center.

f. Select repair tubing material and adhesive (Table 4).

g. Select diameter of repair tubing (Table 5 and Table 6).

h. Select repair tubing installed length.

(1) Six-inch if damaged area is less than one inch long.

(2) Twelve-inch if damaged area is one to six inches long.

(3) VPB tubing increases slightly in length as it shrinks in diameter.

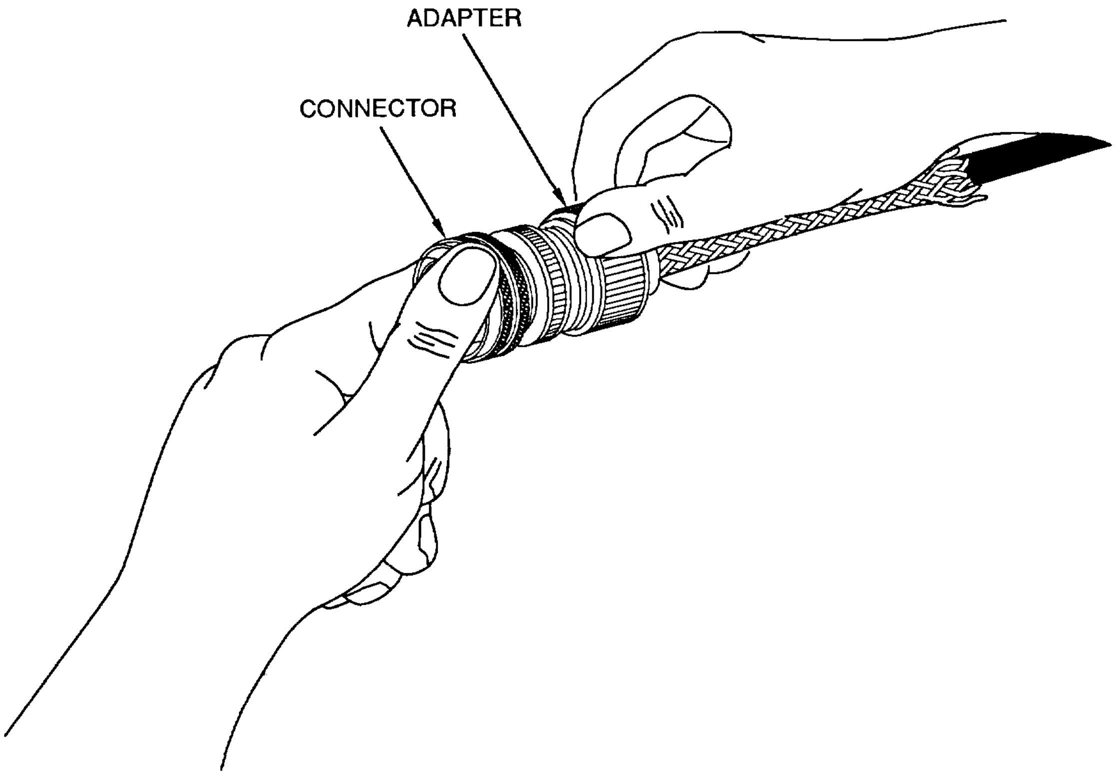

Figure 18. Adapter to Connector Installation

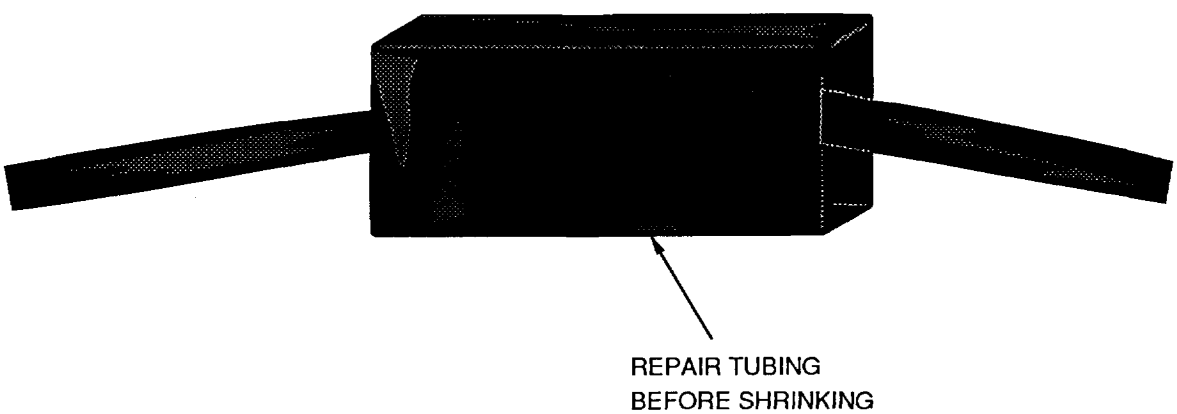

Figure 19. Repair Tubing Before Shrinking

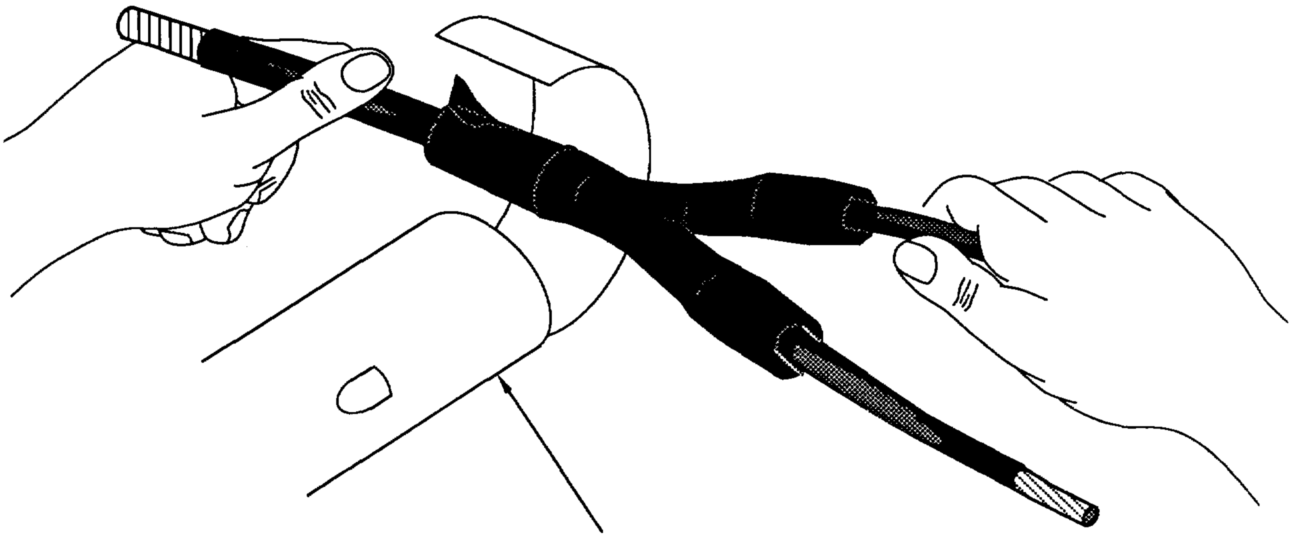

Figure 20. Heating Transition

Table 4. Repair Tubing Material Selection

Harness Jacket System Nomenclature	Harness Jacket Material	Repair Tubing Material	Adhesive
10	RT-102 Polyolefin	RP-4800	S-1030
—	RT-876 Polyolefin	RP-4800	S-1030
15, 20	NT-FR Neoprene	RP-4800 or VPB-RT	S-1009 S-1030
25	DR-25 Elastomer	VPB-RT	S-1125
30	VPB-Elastomer	VPB-RT	S-1125
35	Viton	VPB-RT	S-1125
—	SFR Silicone	RP-4800	Silicone

Table 5. VPB-RT Repair Tubing Diameter Selection

Cable Jacket Diameter Range	Maximum Connector Diameter	VPB-RT Repair Tubing Part Number
.25 - 0.35 in.	.7 in.	VPB-RT-3/4 -*
.35 - 0.50 in.	.9 in.	VPB-RT-1 -*
.50 - 0.70 in.	1.4 in.	VPB-RT-1 1/2 -*
.70 - 1.00 in.	1.9 in.	VPB-RT-1 -*
1.00 - 1.75 in.	2.8 in.	VPB-RT-3 -*
*Length callout: -6 = 6 inch; -12 = 12 inch. See Step 10.		

Table 6. RP-4800 Repair Tubing Diameter Selection

Cable Jacket Diameter Range	Maximum Connector Diameter	RP-4800 Repair Tubing Part Number
.3 - 0.6 in.	1.0 in.	RP-4800-1
.6 - 0.8 in.	2.0 in.	RP-4800-2
.8 - 1.1 in.	3.0 in.	RP-4800-3
1.1 - 1.6 in.	4.0 in.	RP-4800-4

(4) RP-4800 tubing shrinks considerably in length as it shrinks in diameter. Installed length is marked on tubing in six inch increments.

i. Using heat gun with reflector shrink tubing starting at center of repair area and work toward each end.

WARNING

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j. Clean excess adhesive from each end of repair tubing.

k. Cure adhesive. Bond must be moved or stressed during cure time.

29 . **TRANSITION REPAIR.** Transitions with minor damage, such as a cut or hole, can be repaired using tubing if the damaged area is located so the repair tubing will extend a minimum of one inch each way from damaged area. Transitions with major damage, such as splitting, must be replaced.

30 . **TRANSITION REPLACEMENT.** A transition with major damage can be covered with a new transition of the same size and material.

31 . **TRANSITION REMOVAL.**

a. Score transition lengthwise along each leg with cutting tool. Ensure not to cut through transition into cable.

b. Use heat gun with reflector heat r\transition until warm and flexible.

c. Using pliers, remove warm transition from cable.

d. Inspect cable for damaged shield and component wiring.

(1) If shield is damaged, refer to WP 011 00.

(2) If wiring is damaged, refer to WP 015 00.

32 . **TRANSITION INSTALLATION.**

a. Abrade surfaces to be bonded (jacket and transition) using emery cloth.

b. Clean loose particles from abraded surface with clean cloth or tissue.

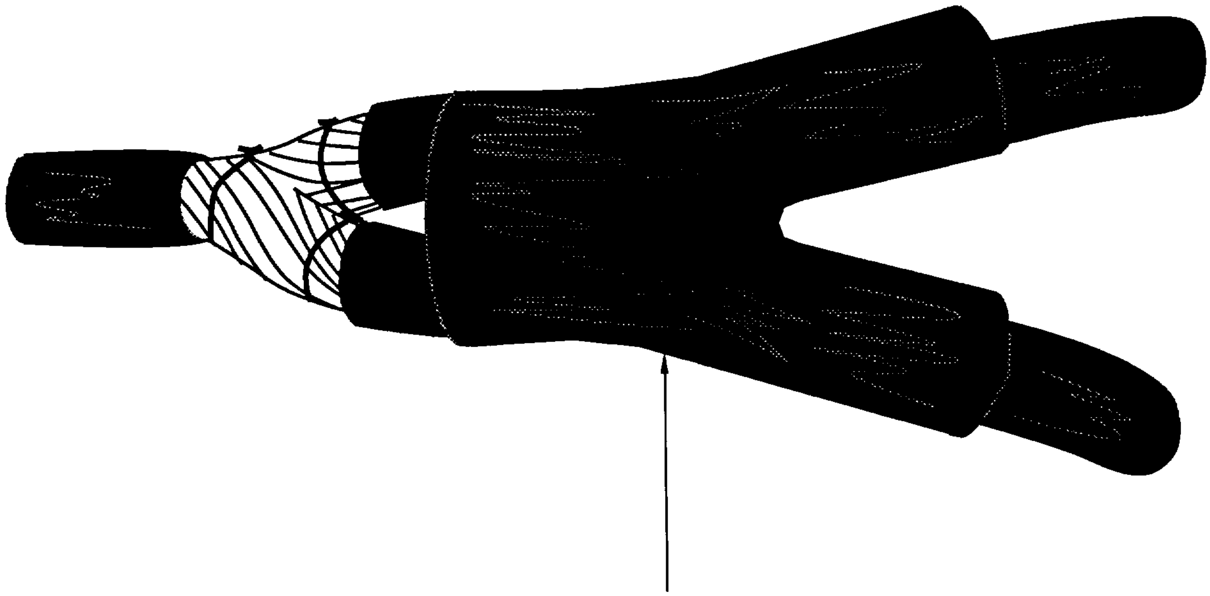

Figure 21. Transition Installation

WARNING

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c. Degrease inner surface of transition with Isopropyl Alcohol.

d. Apply adhesive to repair area.

e. Place repair tubing over cable and center over repair area (Figure 19)

f. If harness is shielded ensure that shield in transition area is smooth and uniform with no frayed ends which could split new transition.

g. Slide new transition over harness (Figure 21)

(1) If connector and boot are too large to permit transition to pass over remove connector in accordance with WP 022 00 and WP 025 00.

h. Apply adhesive to bonding areas (Figure 22)

i. Position transition onto cable so junction occurs within transition.

j. Using heat gun with reflector shrink transition.

k. Clean excess adhesive from each end of transition

l. If connectors and boots were removed, reinstall.

(1) Install boot (Paragraph 24).

(2) Install connector in accordance with WP 022 00 and WP 025 00.

m. Cure adhesive. Ensure bond line is not moved or stressed during cure time.

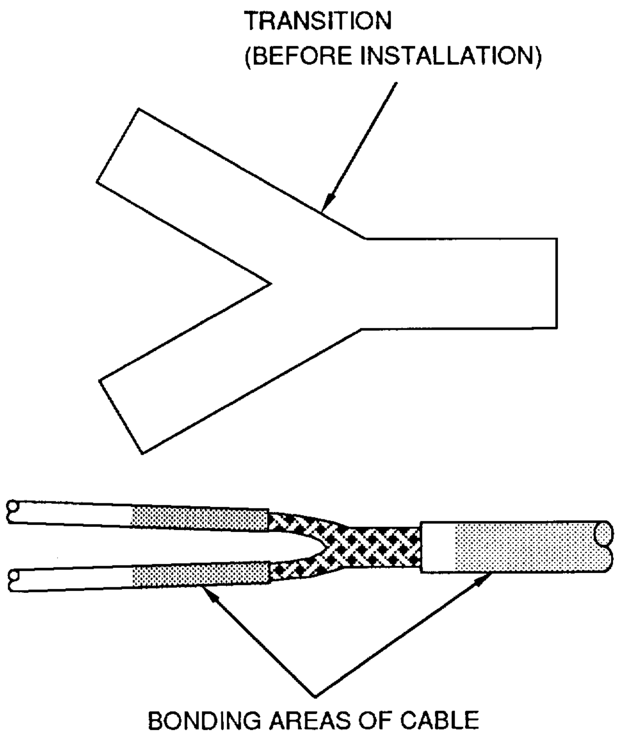

Figure 22. Adhesive Application

33 . ADHESIVE BOND JOINT REPAIR. Joints where boots and transitions are bonded to cable jackets require repair if any gap is visible at the interface. To repair perform the following procedure:

a. Wipe off any dirt, oil, or grease in area to be repaired.

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b. If oil or grease is present or suspected, clean area to be bonded with Isopropyl Alcohol and allow to dry for a minimum of five minutes.

c. Use an applicator stick to work adhesive into space between jacket and boot or transition (Figure 23)

d. Using heat gun heat bond area to ensure that boot or transition is fully shrunk onto jacket.

e. Clean excess adhesive from bond area.

f. Cure adhesive. Ensure bond line is not moved or stressed during cure time.

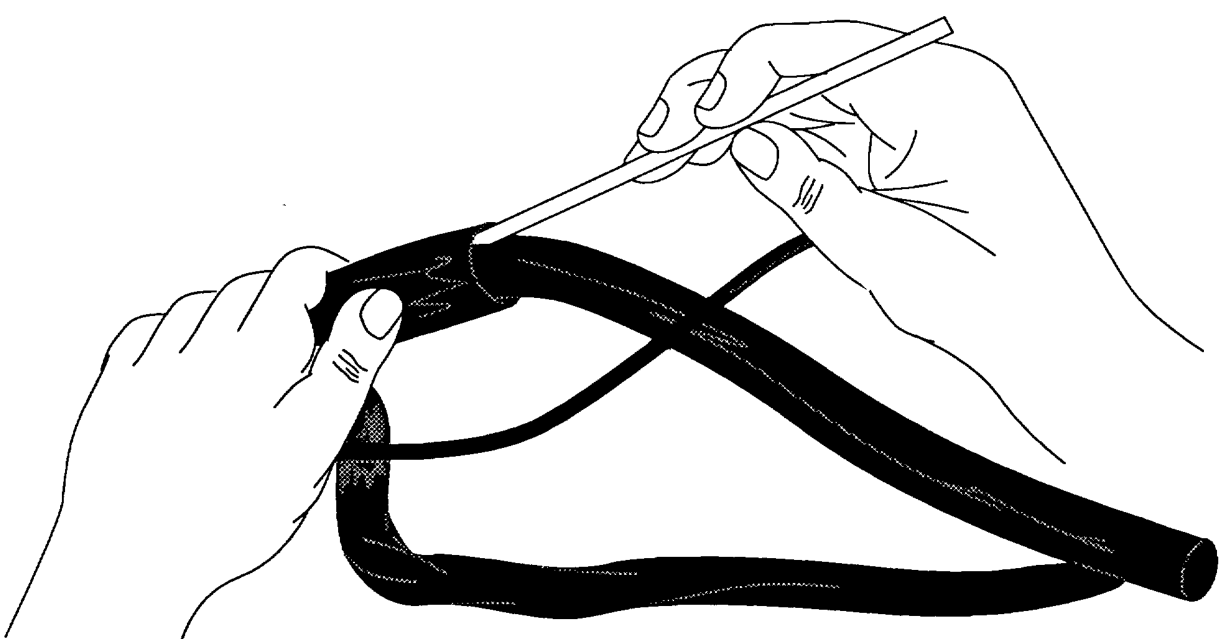


Figure 23. Inserting Adhesive

RIBBONIZED, ORGANIZED, INTEGRATED ROI

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Iron, Soldering	—
Knife, Exacto	—
Ruler, 12 Inch	—
Scissors, Small Line Splicing	—
Scribe	—
Strippers, Wire	45-1610
Ideal 45-123 Cutters, Wire	45-1611
Strippers, Wire	45-4987
Multimeter	—
Tool, Crimp	AD-1377
Tool, Banding	DBS1100
Tool, Heating	HT-900B/HT-920B
Tool, Heating	MCH–100–A

Materials Required

Nomenclature	Part Number/Type Designation
Alcohol, Isopropyl	TT–I–735
Bands, 1/4 In.	4–138
Braid, Metallic	A–A–59569
Crimp Splice, Red	M81824/1–1
Crimp Splice, Blue	M81824/1–2
Crimp Splice, Yellow	M81824/1-3
Marker, Harness I.D.	HT-WM9
Solder, Soft	J–STD–004, J–STD–005, J–STD–006
Tape, Adhesive Copper Foil	Flexishield 8015
Tape, Clear Teflon	CHR, M-60
Tape, Lacing and Tying	A–A–52080 thru A–A–52084
Tape, Self Bonding Silicone	A–A–59163, Type II
299-947-110, Type III, Class I	Tape, Teflon
Wire	M22759/41, /42
Wire, Filterline	M85485/9, /10

1. **INTRODUCTION.**

2. This Work Package (WP) covers the repair of a Ribbonized, Organized, Integrated (ROI) harness. An ROI harness is designed to reduce weight by designating specified signals on specific wires. By knowing what signals are on which wires, the relative location of the wires needed to eliminate cross talk can be fixed by the ribbon configuration. This eliminates the need for the braid. The other advantages of a flat cable are discussed in WP 005 00.

3. **DESCRIPTION.**

4. ROI harness is typically constructed of conductors in a ribbonized format with copper foil separators between each ribbon of conductors. The copper foil separators are grounded to the backshell with metallic braid tails. The outer harness may be wrapped in a copper foil shield or a metallic overbraid. The ribbon bundle in most cases will be covered with a cloth overbraid.

5. **REPAIR PROCEDURES.**

6. **ROI HARNESS REPAIR.** ROI harness may be repaired using several methods depending upon the extent of the damage. First inspect amount of damage to ROI harness.

7. **ROI DAMAGE INSPECTION.** To inspect damage and determine appropriate repair method. Perform the following steps:

a. Remove clamps and disconnect connectors if necessary to allow for adequate inspection of damage.

b. Inspect harness for appropriate repair procedure as follows:

(1) Damage outer harness covering, refer to Figure 1 for repair.

(2) Damage outer harness covering and metallic overbraid, refer to Figure 2 for repair.

(3) Damage outer harness covering, metallic overbraid, and copper foil shield, refer to Figure 3 for repair.

(4) Damaged outer harness covering, metallic overbraid, copper foil shield and wire ribbons, refer to Figure 4 for repair.

(5) Harness is severed or damage to conductors in ribbons is greater than 75 percent, refer to Figure 5 for repair.

(6) Damage to branch transition area of multi-legged ROI harness, refer to Figure 6 for repair.

(7) Damage to copper foil shield at termination end, refer to Figure 7 for repair.

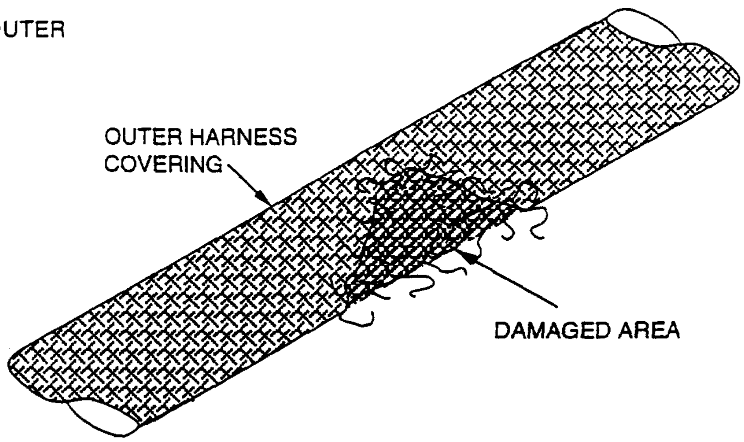
(8) Damage to shield braid terminations, refer to Figure 8 for repair.

(9) Damage to connector backshell, refer to appropriate WP for repair.

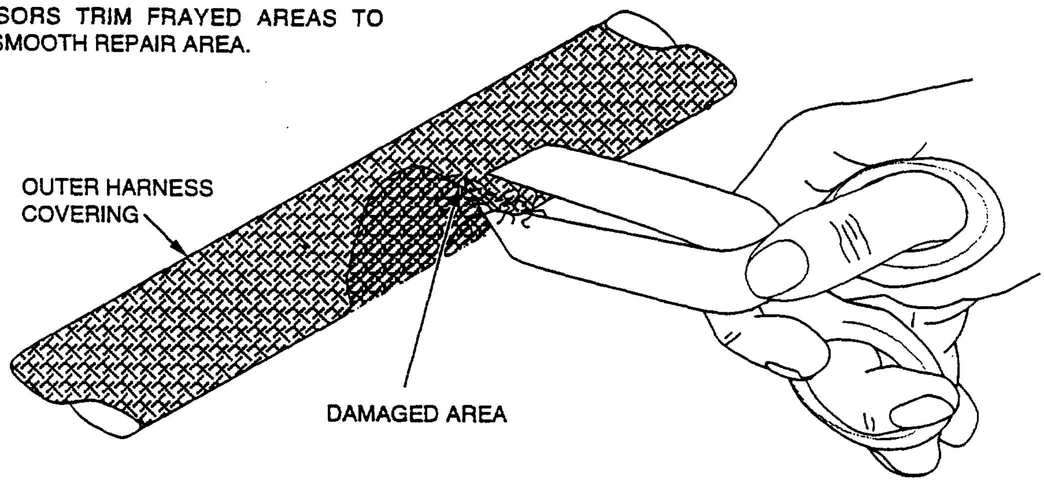
(10) Damage to connector, refer to appropriate WP for repair.

1. OUTER HARNESS COVERING REPAIR.

A. ENSURE DAMAGE IS CONFINED TO OUTER HARNESS COVERING.



B. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR AREA.



WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.

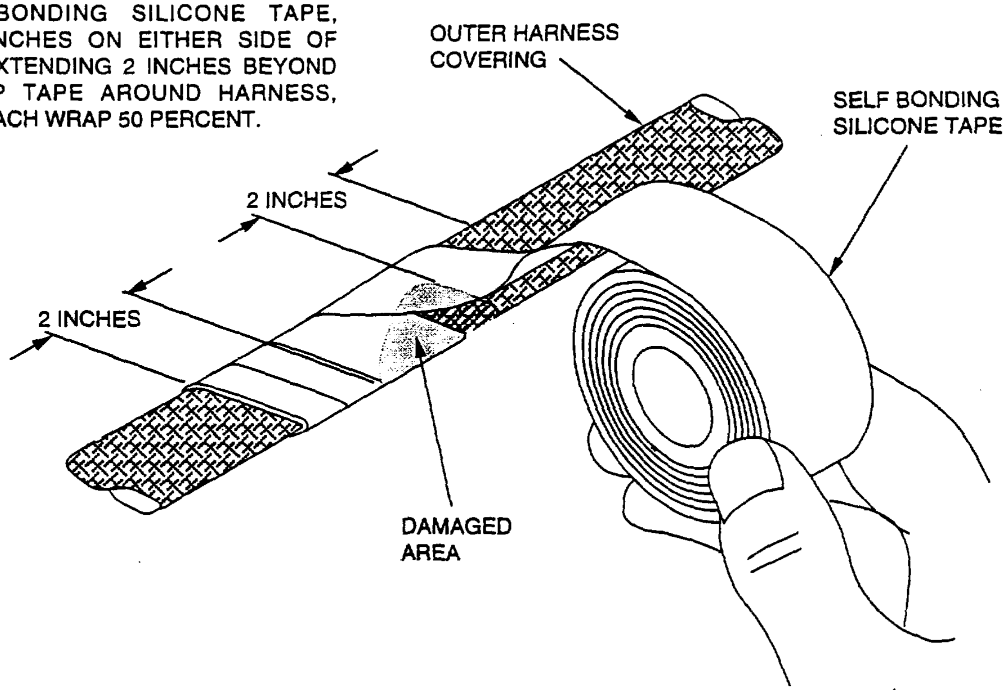
C. USING ISOPROPYL ALCOHOL, REMOVE ANY DIRT AND/OR MOISTURE FROM DAMAGED AREA TO EXTEND 3 INCHES ON BOTH SIDES.

Figure 1. Outer Harness Covering Repair (Sheet 1 of 2)

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

D. USING SELF BONDING SILICONE TAPE, BEGINNING 2 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 2 INCHES BEYOND DAMAGE, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.



E. SECURE ENDS OF TAPE WITH LACING CORD.

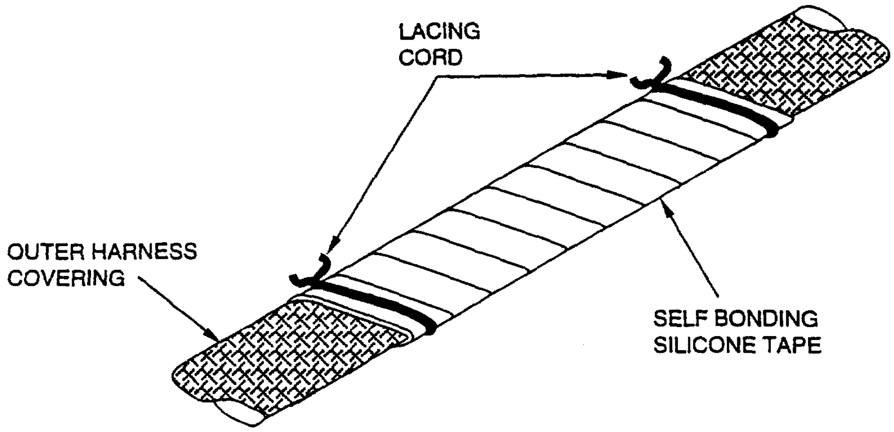
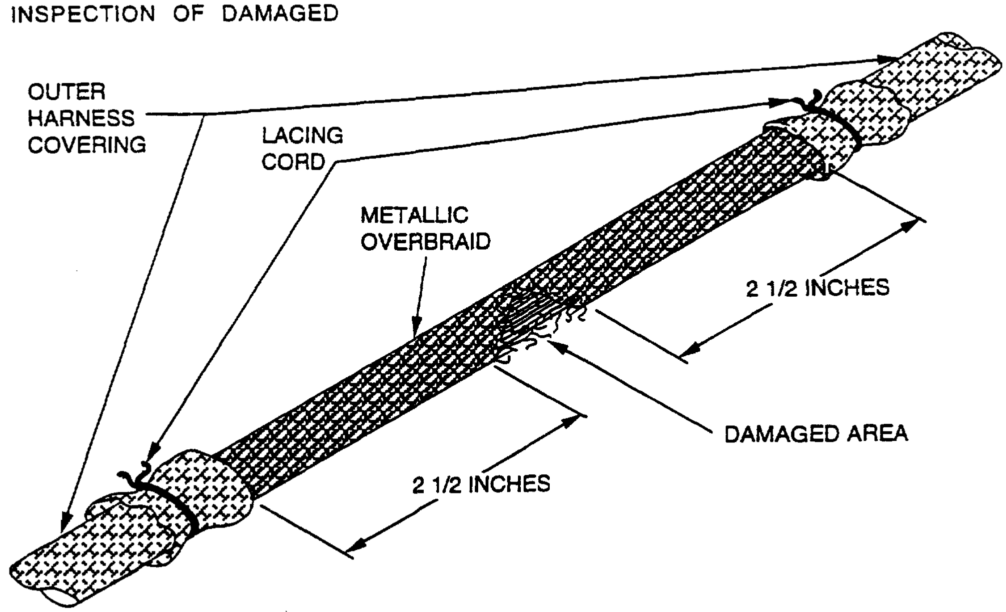


Figure 1. Outer Harness Covering Repair (Sheet 2)

2. OUTER HARNESS COVERING AND METALLIC OVERBRAID REPAIR.

A. USING SCISSORS CUT COMPLETELY AROUND OUTER HARNESS COVERING, PULL BACK BOTH SIDES AT LEAST 2 1/2 INCHES FROM DAMAGE AND SECURE WITH LACING CORD TO ALLOW FOR DETAILED INSPECTION OF DAMAGED AREA.



B. USING WIRE CUTTERS/SCISSORS TRIM DAMAGED METALLIC OVERBRAID AWAY FROM WIRE RIBBONS TO ALLOW FOR DETAILED INSPECTION.

CAUTION

ENSURE COPPER FOIL SHIELDS AND WIRE RIBBONS ARE NOT DAMAGED BEFORE PROCEEDING WITH REPAIR.

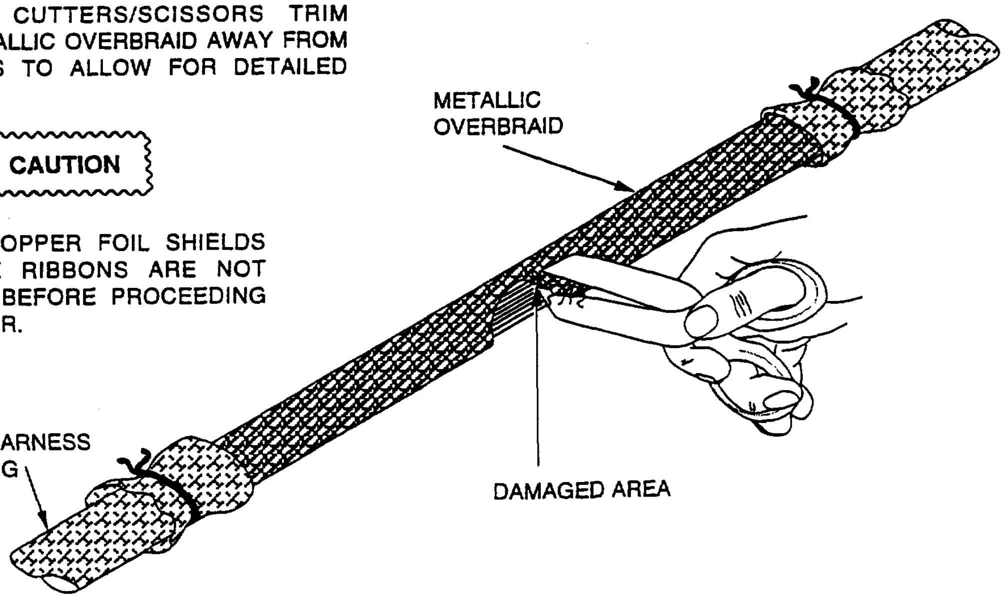


Figure 2. Outer Harness Covering and Metallic Overbraid Repair (Sheet 1 of 4)

C. TRIM AND SMOOTH EDGES OF METALLIC OVERBRAID.

WARNING

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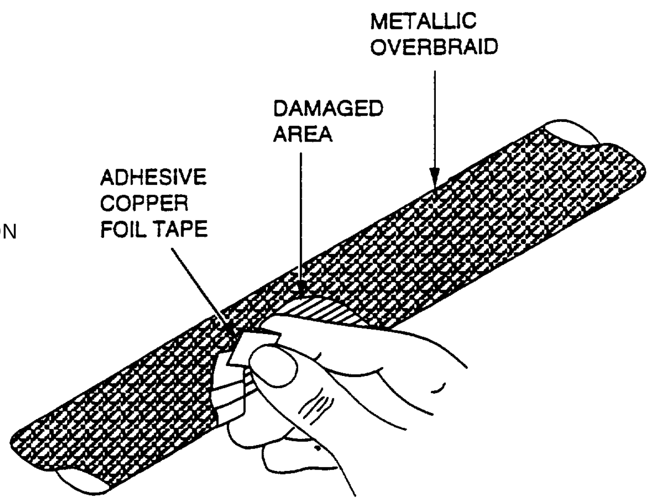
D. USING ISOPROPYL ALCOHOL CLEAN AND DRY METALLIC OVERBRAID 2 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

E. WHEN INSPECTION AND CLEANING IS COMPLETE, SEAL EDGES OF OVERBRAID USING 1 INCH PIECES OF ADHESIVE COPPER FOIL TAPE EXTENDING OVER AND UNDER OVERBRAID AND OVERLAPPING EACH PIECE 50 PERCENT.



CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

F. USING ADHESIVE COPPER FOIL TAPE, BEGINNING 2 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 2 INCHES BEYOND DAMAGE, WRAP COPPER FOIL TAPE AROUND METALLIC OVERBRAID WHILE APPLYING PRESSURE TO ENSURE ADHESION OF FOIL TO OVERBRAID, OVERLAPPING EACH WRAP 50 PERCENT.

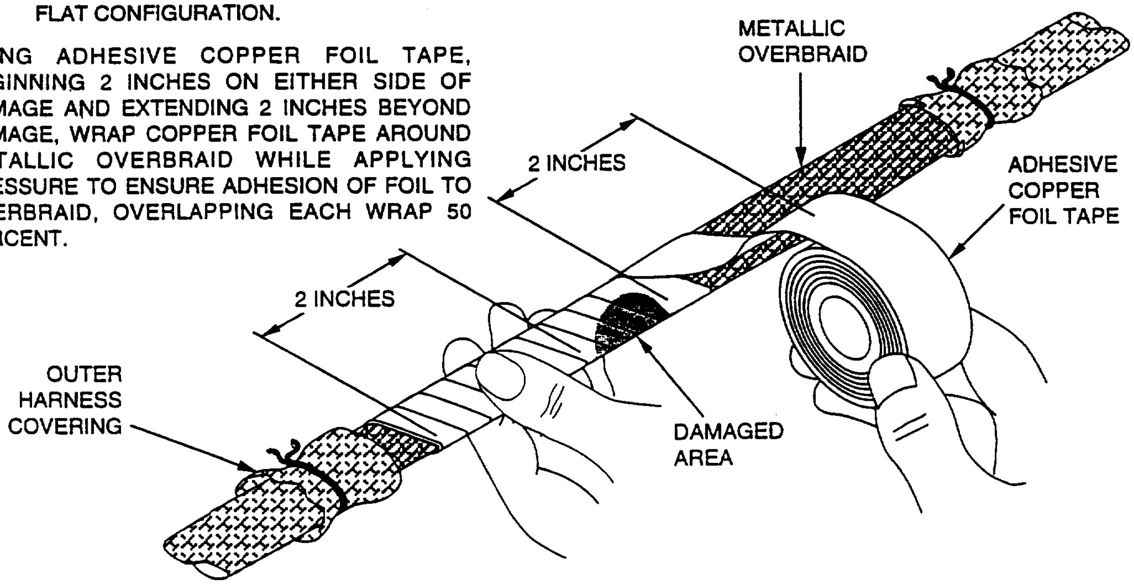
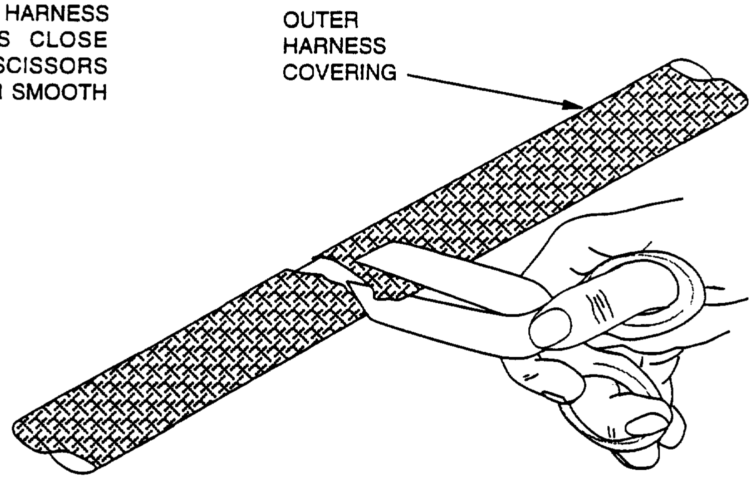


Figure 2. Outer Harness Covering and Metallic Overbraid Repair (Sheet 2)

G. CUT LACING CORD SECURING OUTER HARNESS COVERING, WORK BOTH ENDS AS CLOSE TOGETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.



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H. USING ISOPROPYL ALCOHOL REMOVE ANY DIRT AND/OR MOISTURE FROM OUTER HARNESS COVERING.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

I. USING SELF BONDING SILICONE TAPE, BEGINNING 3 INCHES ON EITHER SIDE OF DAMAGED AND EXTENDING 3 INCHES BEYOND DAMAGED, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.

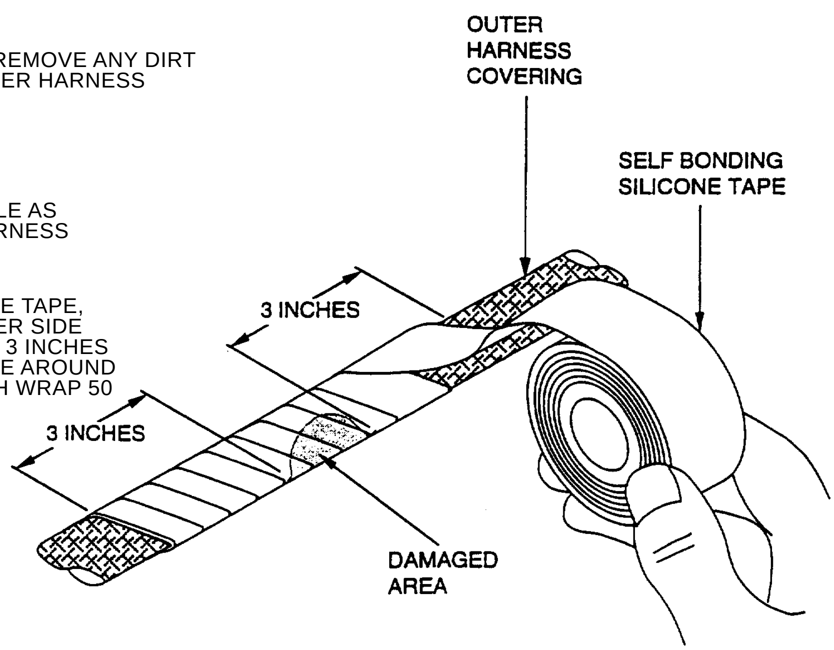


Figure 2. Outer Harness Covering and Metallic Overbraid Repair (Sheet 3)

J. SECURE ENDS OF TAPE WITH LACING CORD.

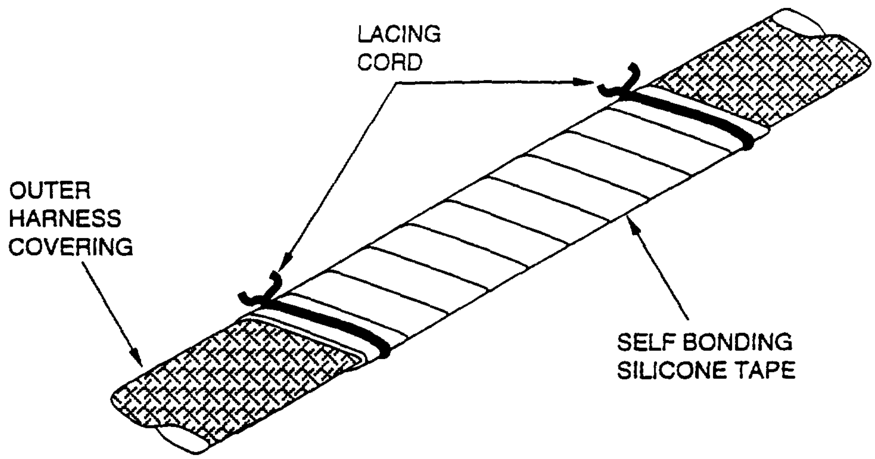


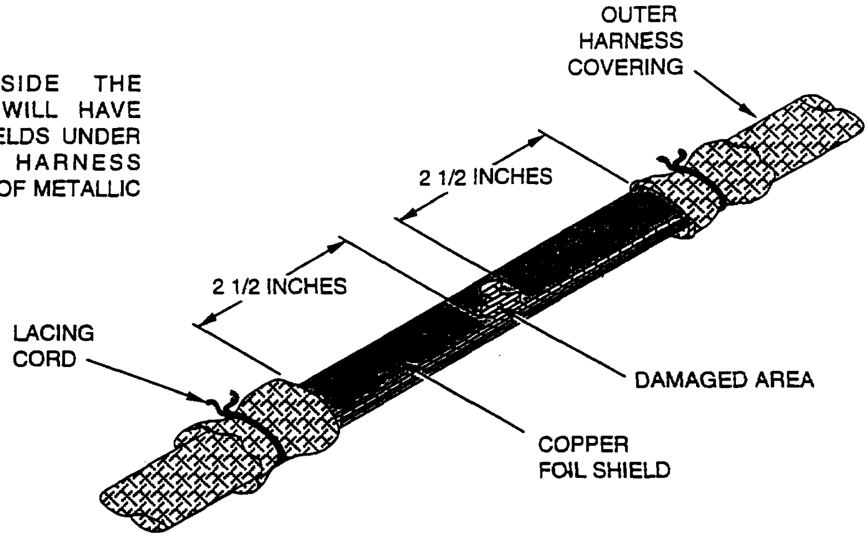
Figure 2. Outer Harness Covering and Metallic Overbraid Repair (Sheet 4)

3. COPPER FOIL SHIELD REPAIR.

A. USING SCISSORS CUT COMPLETELY AROUND OUTER HARNESS COVERING, PULL BACK BOTH SIDES AT LEAST 2 1/2 INCHES FROM DAMAGE AND SECURE WITH LACING CORD TO ALLOW FOR DETAILED INSPECTION OF DAMAGED AREA.

NOTE

HARNESSES INSIDE THE AVIONICS BAYS WILL HAVE COPPER FOIL SHIELDS UNDER THE OUTER HARNESS COVERING IN LIEU OF METALLIC OVERBRAID.



CAUTION

ENSURE WIRE RIBBONS ARE NOT DAMAGED BEFORE PROCEEDING WITH REPAIR.

B. INSPECT COPPER FOIL SHIELD FOR DAMAGE, IF UNDER 50 PERCENT OF WIDTH PROCEED TO STEPS C THRU G, IF OVER 50 PERCENT OF WIDTH, PROCEED TO STEPS H THRU Q.

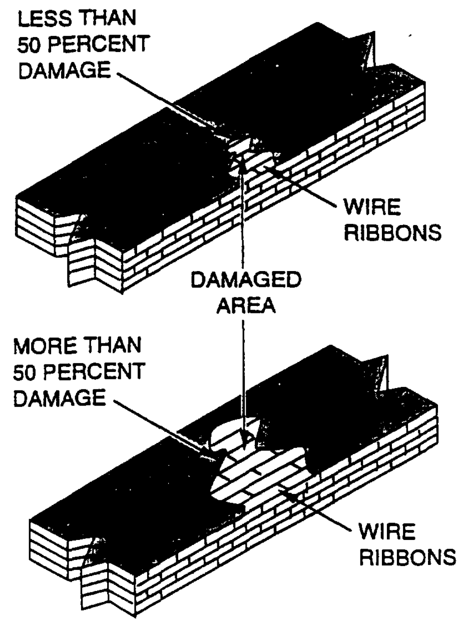


Figure 3. Copper Foil Shield Repair (Sheet 1 of 6)

WARNING

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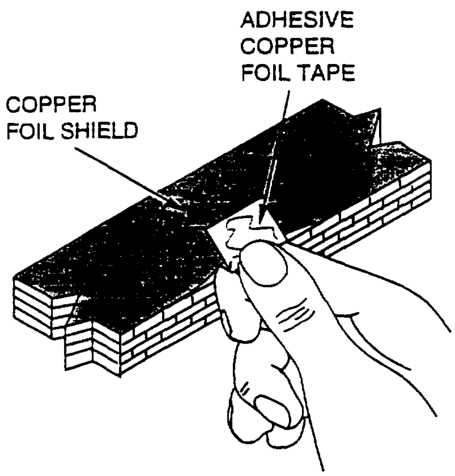

C. REMOVE ANY OXIDATION FROM THE TINNED COPPER FOIL SHIELD WITH A COMMON PENCIL ERASER FOR APPROXIMATELY ONE INCH AROUND DAMAGED AREA.

D. USING ISOPROPYL ALCOHOL CLEAN AND DRY COPPER FOIL SHIELD ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

E. USING A PIECE OF ADHESIVE COPPER FOIL TAPE TWICE THE SIZE OF DAMAGED AREA. RE–ESTABLISH EDGE BY FOLDING AND PLACING ALONG DAMAGED AREA.

F. PLACE A PIECE OF ADHESIVE COPPER FOIL TAPE COVERING WIDTH OF COPPER FOIL SHIELD AND TWICE THE LENGTH OF DAMAGED AREA.

G. PROCEED TO STEPS N THRU Q.

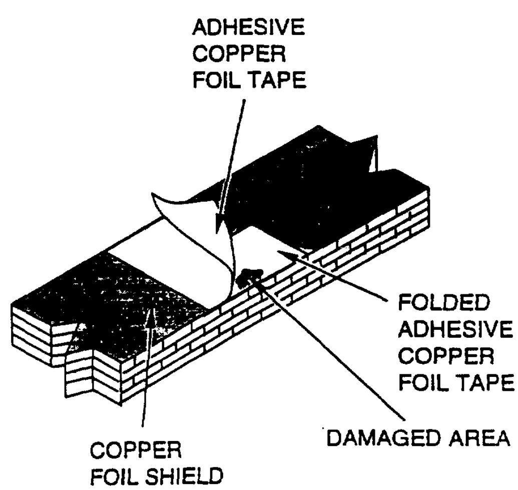

Figure 3. Copper Foil Shield Repair (Sheet 2)

H. REMOVE ANY OXIDATION FROM THE TINNED COPPER FOIL SHIELD WITH A COMMON PENCIL ERASER FOR APPROXIMATELY ONE INCH AROUND DAMAGED AREA.

WARNING

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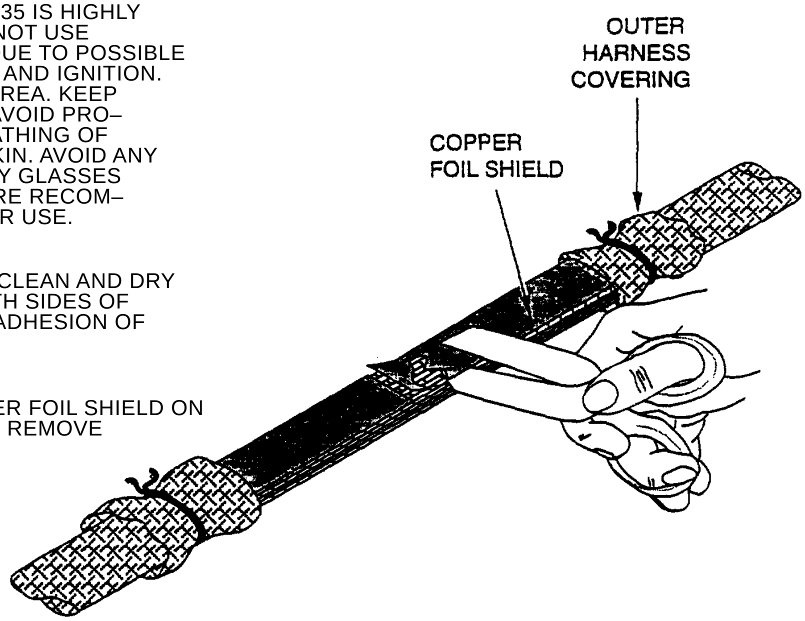
I. USING ISOPROPYL ALCOHOL CLEAN AND DRY COPPER FOIL SHIELD ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

J. USING SCISSORS, CUT COPPER FOIL SHIELD ON BOTH SIDES OF DAMAGED TO REMOVE DAMAGED FOIL.



K. USING 2 PIECES OF ADHESIVE COPPER FOIL TAPE TWICE THE SIZE OF DAMAGED AREA, RE-ESTABLISH BOTH EDGES BY FOLDING AND CONNECTING COPPER FOIL SHIELD ALONG DAMAGED AREA.

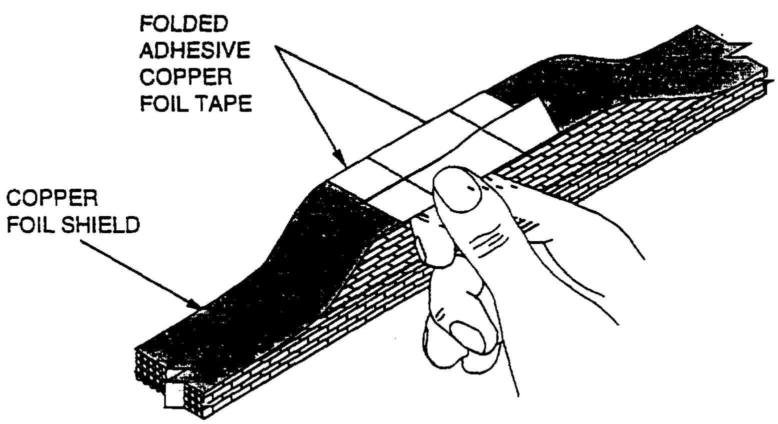
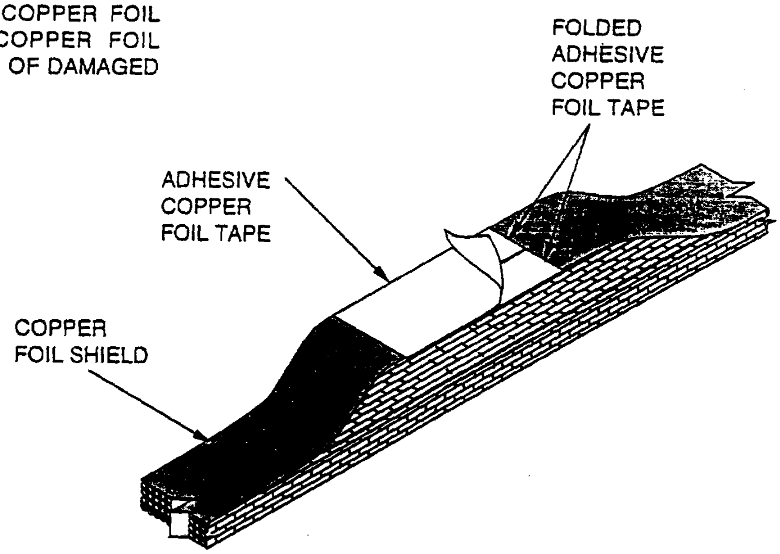


Figure 3. Copper Foil Shield Repair (Sheet 3)

L. PLACE A PIECE OF ADHESIVE COPPER FOIL TAPE COVERING WIDTH OF COPPER FOIL SHIELD AND TWICE THE LENGTH OF DAMAGED AREA.



CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

M. USING TEFLON TAPE, BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP TEFLON TAPE AROUND COPPER FOIL SHIELDS AND WIRE RIBBONS WHILE APPLYING PRESSURE TO ENSURE ADHESION OF TAPE, OVERLAPPING EACH WRAP 50 PERCENT.

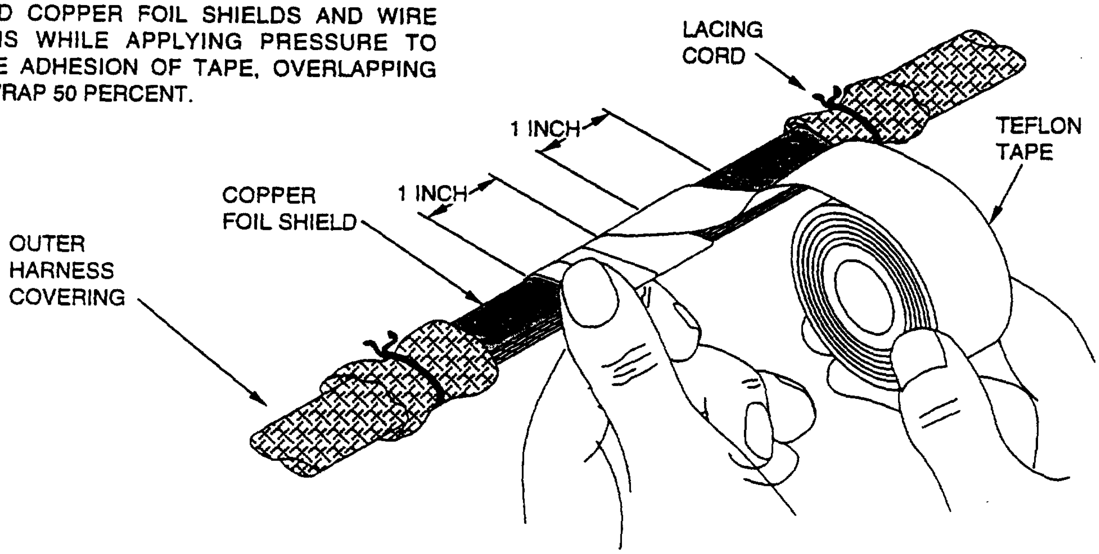
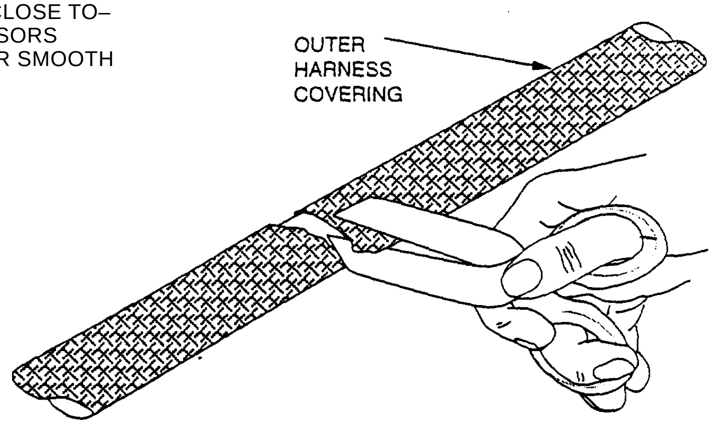


Figure 3. Copper Foil Shield Repair (Sheet 4)

N. CUT LACING CORD SECURING OUTER HARNESS COVERING. WORK BOTH ENDS AS CLOSE TOGETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.



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O. USING ISOPROPYL ALCOHOL REMOVE ANY DIRT AND/OR MOISTURE FROM OUTER HARNESS COVERING.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION

P. USING SELF BONDING SILICONE TAPE, BEGINNING 3 INCHES ON EITHER SIDE OF DAMAGED AND EXTENDING 3 INCHES BEYOND DAMAGED, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.

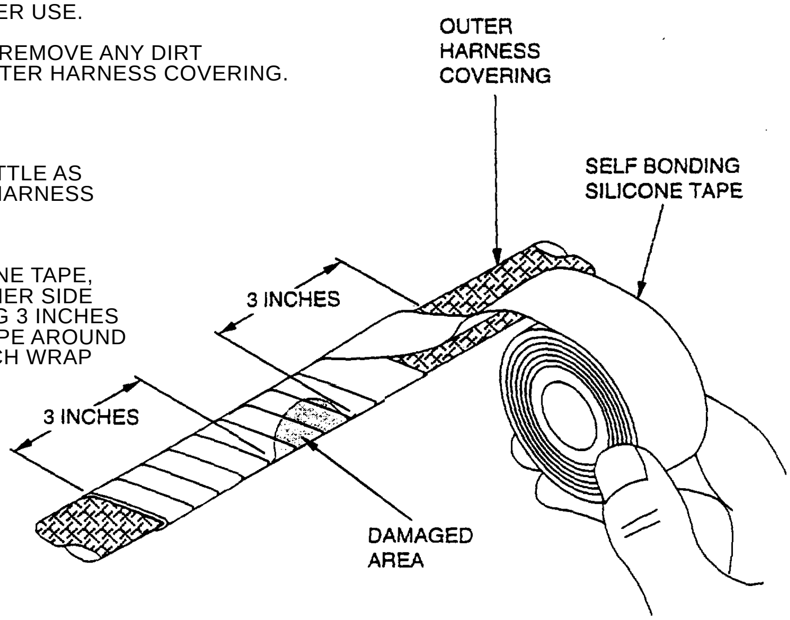


Figure 3. Copper Foil Shield Repair (Sheet 5)

Q. SECURE ENDS OF TAPE WITH LACING CORD.

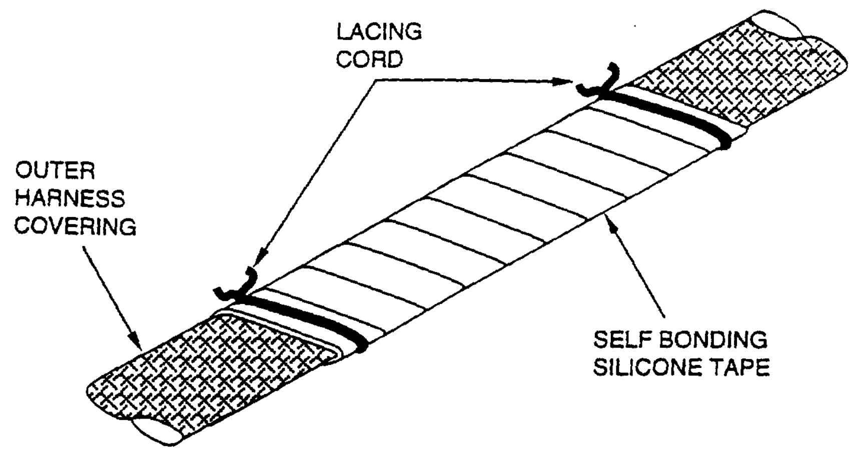


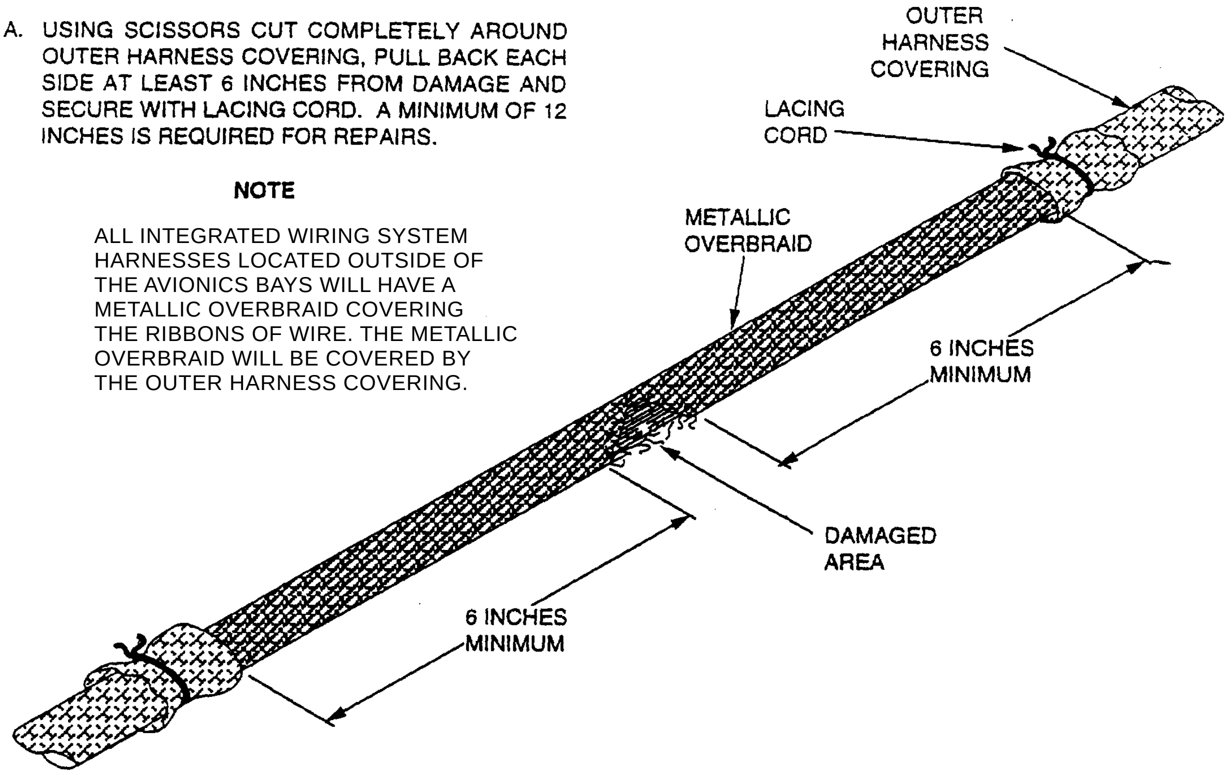
Figure 3. Copper Foil Shield Repair (Sheet 6)

4. **WIRE RIBBON REPAIR.**

A. USING SCISSORS CUT COMPLETELY AROUND OUTER HARNESS COVERING, PULL BACK EACH SIDE AT LEAST 6 INCHES FROM DAMAGE AND SECURE WITH LACING CORD. A MINIMUM OF 12 INCHES IS REQUIRED FOR REPAIRS.

NOTE

ALL INTEGRATED WIRING SYSTEM HARNESSES LOCATED OUTSIDE OF THE AVIONICS BAYS WILL HAVE A METALLIC OVERBRAID COVERING THE RIBBONS OF WIRE. THE METALLIC OVERBRAID WILL BE COVERED BY THE OUTER HARNESS COVERING.



B. USING WIRE CUTTERS/SCISSORS CUT COMPLETELY AROUND METALLIC OVERBRAID, PULL BACK EACH SIDE AT LEAST 4 INCHES FROM DAMAGE AND SECURE WITH LACING CORD. A MINIMUM OF 8 INCHES IS REQUIRED FOR REPAIRS.

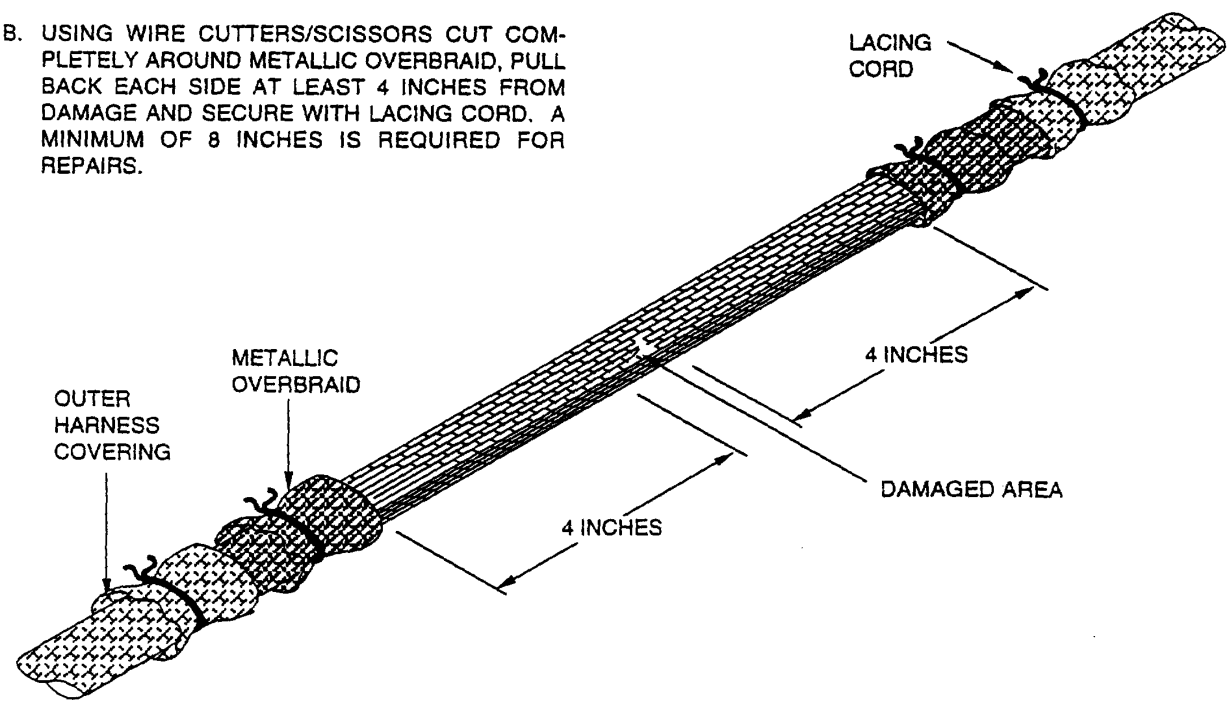
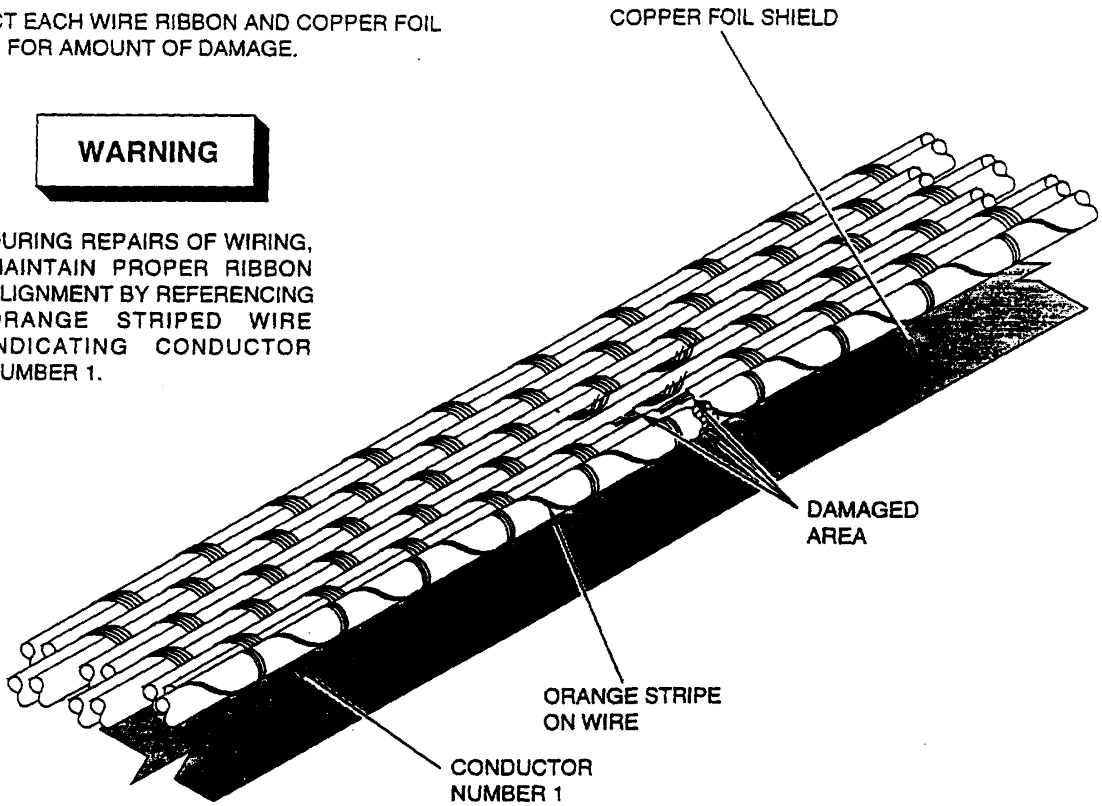


Figure 4. Wire Ribbon Repair (Sheet 1 of 12)

C. INSPECT EACH WIRE RIBBON AND COPPER FOIL SHIELD FOR AMOUNT OF DAMAGE.

WARNING

DURING REPAIRS OF WIRING, MAINTAIN PROPER RIBBON ALIGNMENT BY REFERENCING ORANGE STRIPED WIRE INDICATING CONDUCTOR NUMBER 1.



D. USING SCRIBE REMOVE WEAVE FOR APPROXIMATELY 2 INCHES ON EACH SIDE OF DAMAGE. WEAVE THREAD MAY BE REMOVED BY USING SCRIBE TO PICK WEAVE FROM BETWEEN THE CONDUCTORS.

E. SECURE WEAVE BY TYING LOOSE WEAVE THREAD INTO A KNOT AROUND FIRST OR LAST CONDUCTOR IN RIBBON.

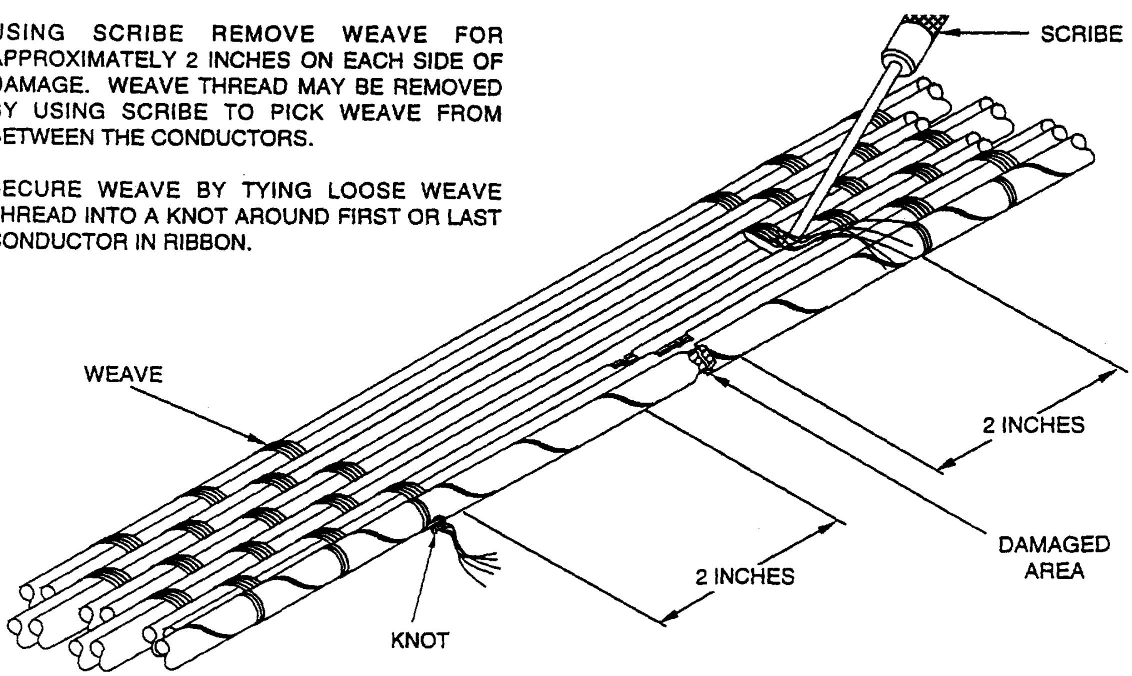
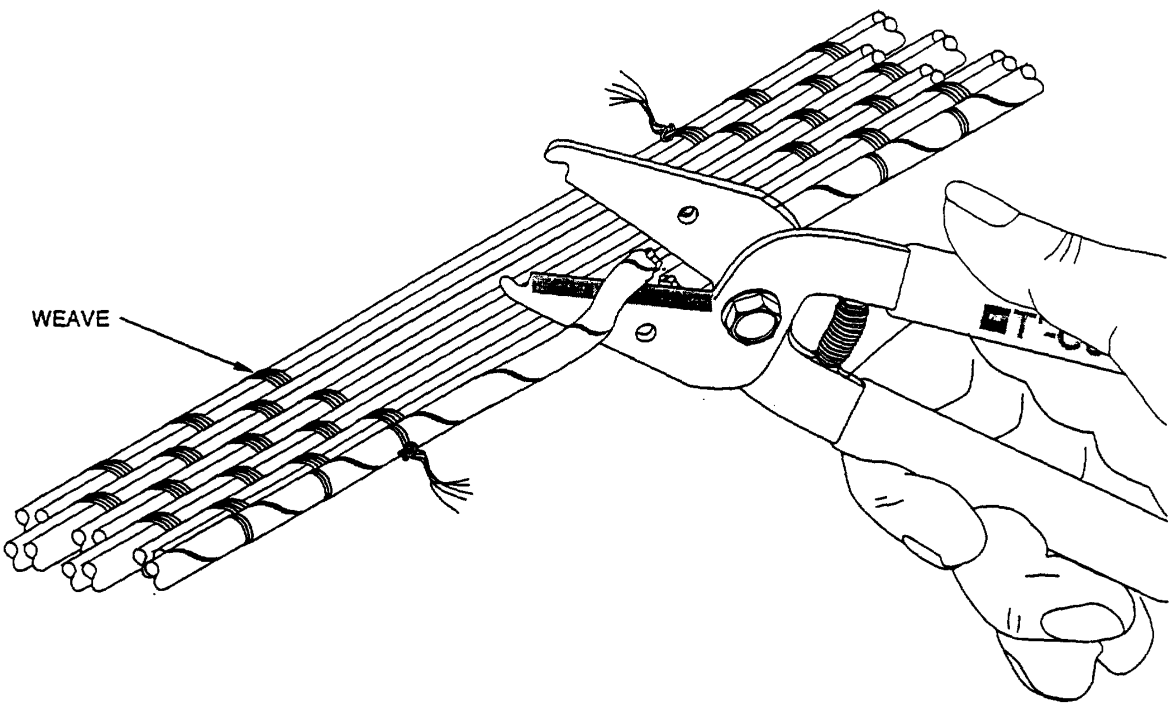
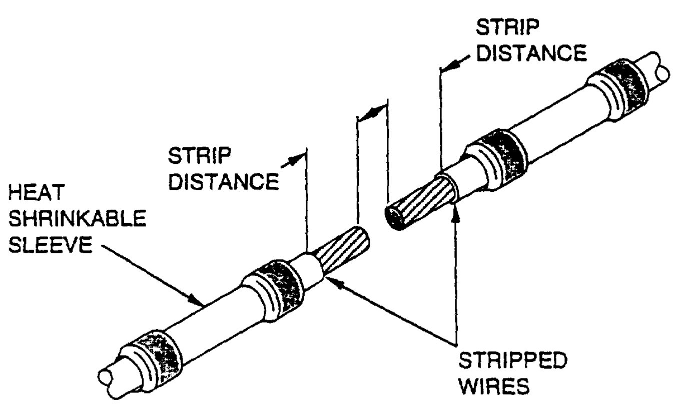


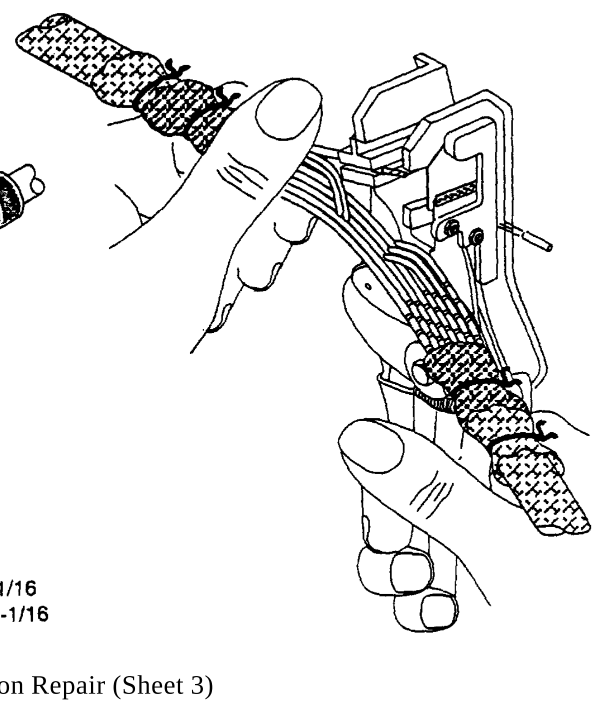
Figure 4. Wire Ribbon Repair (Sheet 2)

F. USING WIRE CUTTERS SEVER ANY NICKED OR DAMAGED WIRES THAT ARE NOT SEVERED BY INITIAL DAMAGE.



G. USING WIRE STRIPPERS (WP 009 00) STRIP BOTH ENDS OF DAMAGED WIRE. PLACE HEAT SHRINKABLE SLEEVE ON DAMAGED WIRES.





WIRE STRIP DISTANCE

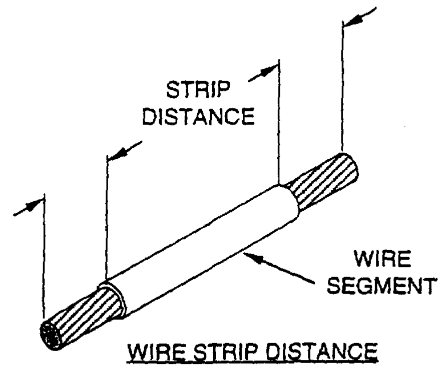
FOR WIRE SIZE 20-26 = 1/4 INCH +0 -1/16
FOR WIRE SIZE 12-18 = 5/16 INCH +0 -1/16

Figure 4. Wire Ribbon Repair (Sheet 3)

NOTE

REFER TO APPROPRIATE HARNESS ASSEMBLY WP FOR WIRE TYPE.

H. ADD WIRE AS NEEDED TO COMPENSATE FOR DAMAGED AREA, ENSURE WOVEN LAYER MAINTAINS SAME LENGTH. STRIP WIRE TO APPROPRIATE LENGTH.



WIRE STRIP DISTANCE

FOR WIRE SIZE 20-26 = 1/4 INCH +0 -1/16
FOR WIRE SIZE 12-18 = 5/16 INCH +0 -1/16

I. USING WIRE I.D. NUMBERS AND WIRE RIBBON POSITION AS A REFERENCE, CRIMP DAMAGED WIRES TOGETHER USING APPROPRIATE SPLICES (WP 015 00).

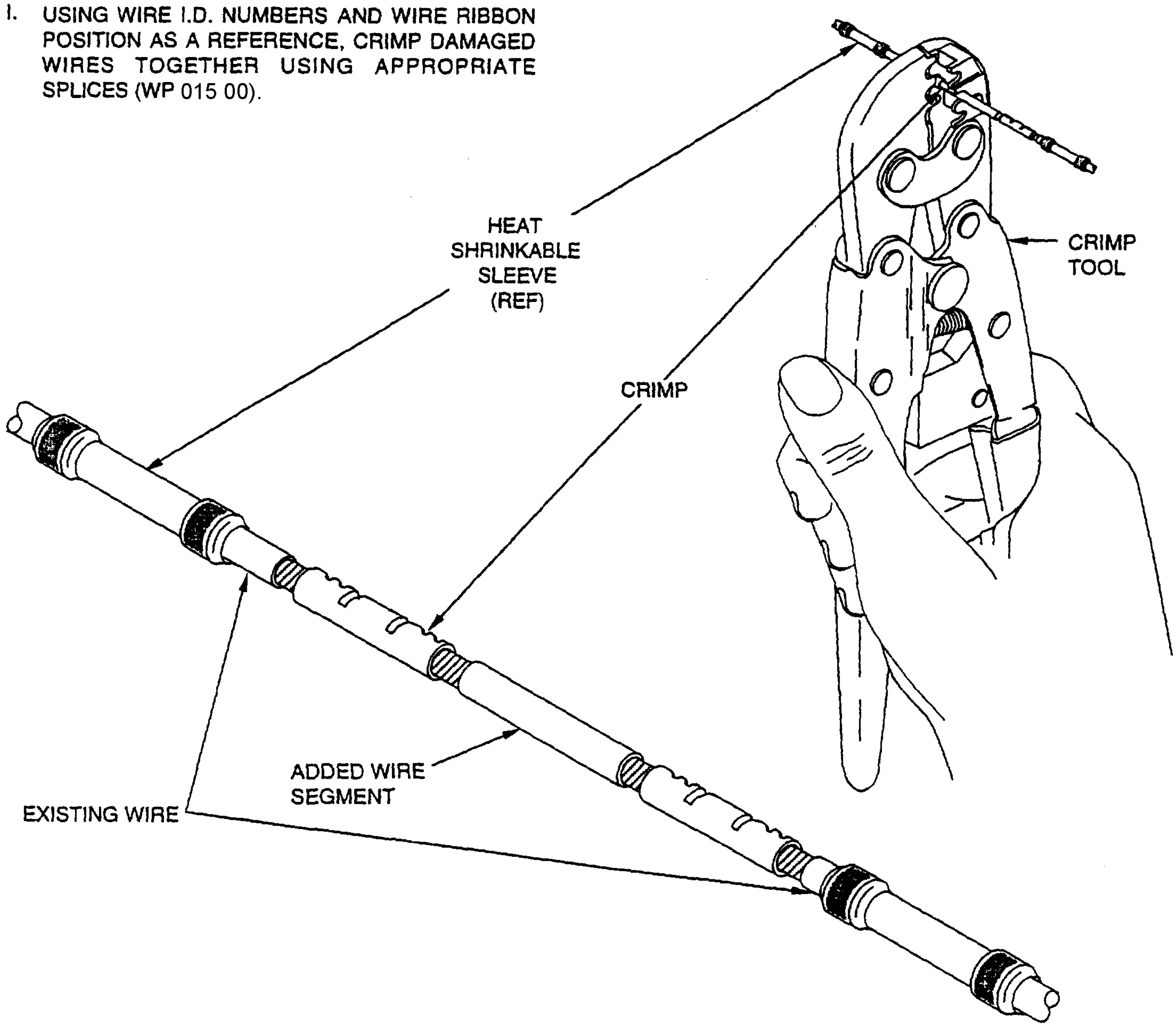
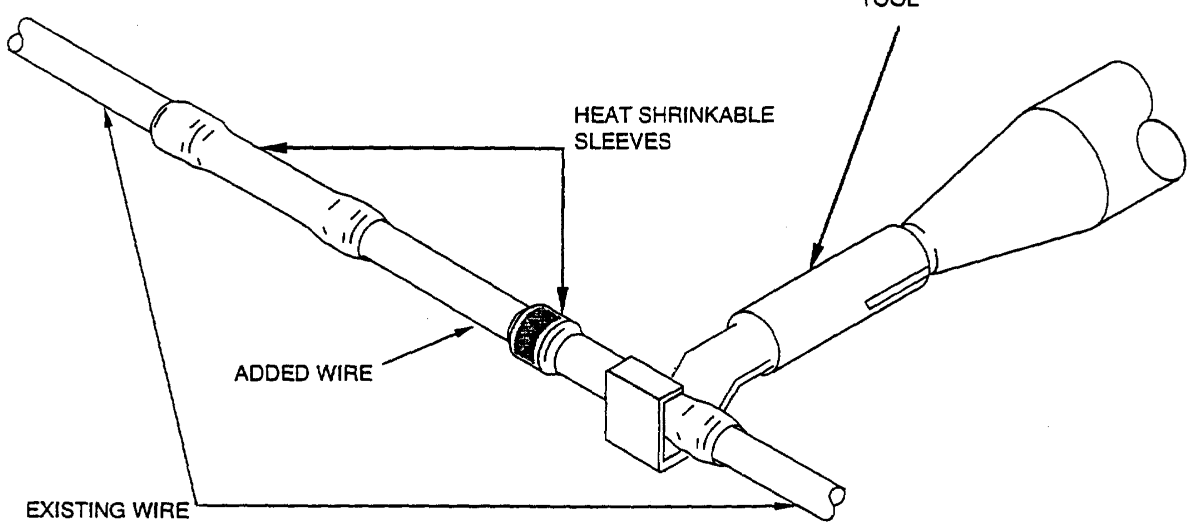


Figure 4. Wire Ribbon Repair (Sheet 4)

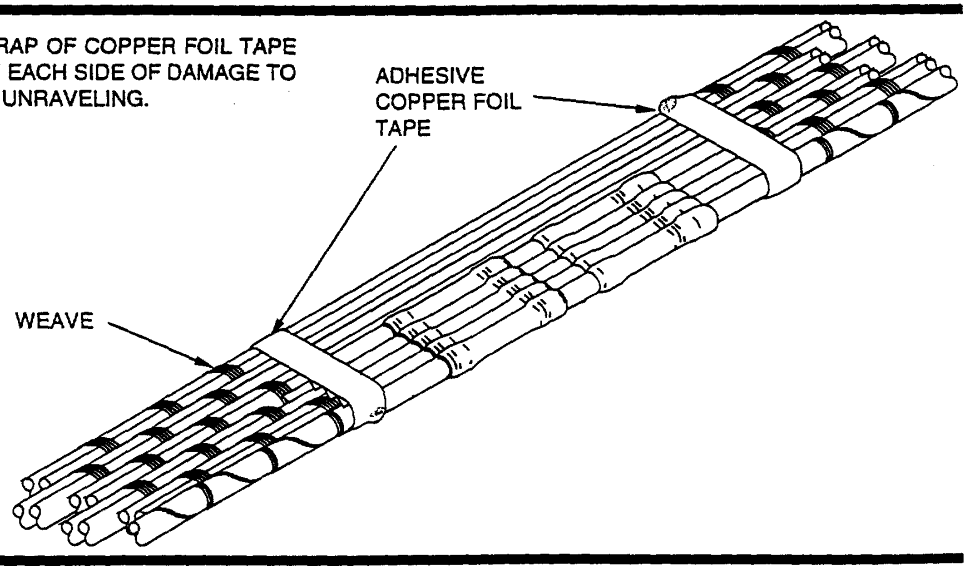
NOTE

FOR PREPARATION, USE AND OPERATION OF HEAT GUN. REFER TO WP 012 00

J. SLIDE HEAT SHRINKABLE SLEEVE OVER SPLICE AND USING HEATING TOOL SHRINK SLEEVE.



K. PLACE A SINGLE WRAP OF COPPER FOIL TAPE AROUND WEAVE ON EACH SIDE OF DAMAGE TO PREVENT FURTHER UNRAVELING.



L. REPEAT STEPS H THRU K FOR EVERY DAMAGED WIRE ON RIBBON.

M. PERFORM CONTINUITY CHECK FOR ALL SPLICED WIRES USING MULTIMETER.

Figure 4. Wire Ribbon Repair (Sheet 5)

CAUTION

DO NOT FORCE SPLICED WIRES TOGETHER. MAINTAIN THEIR NATURAL SPACING.

M. PLACE SPLICED WIRES BACK IN ORIGINAL RIBBON POSITION. IF NUMBER OF SPLICED WIRES EXCEED 50 PERCENT, A NEW RIBBON WILL BE NEEDED. PROCEED TO STEPS P THRU R.

WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.

N. USING ISOPROPYL ALCOHOL CLEAN AND DRY WIRE RIBBON 1 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

O. BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP ADHESIVE COPPER FOIL TAPE AROUND ENTIRE RIBBON WHILE APPLYING PRESSURE TO ENSURE ADHESION OF TAPE TO RIBBON, OVERLAPPING EACH WRAP 50 PERCENT. PROCEED TO STEP S.

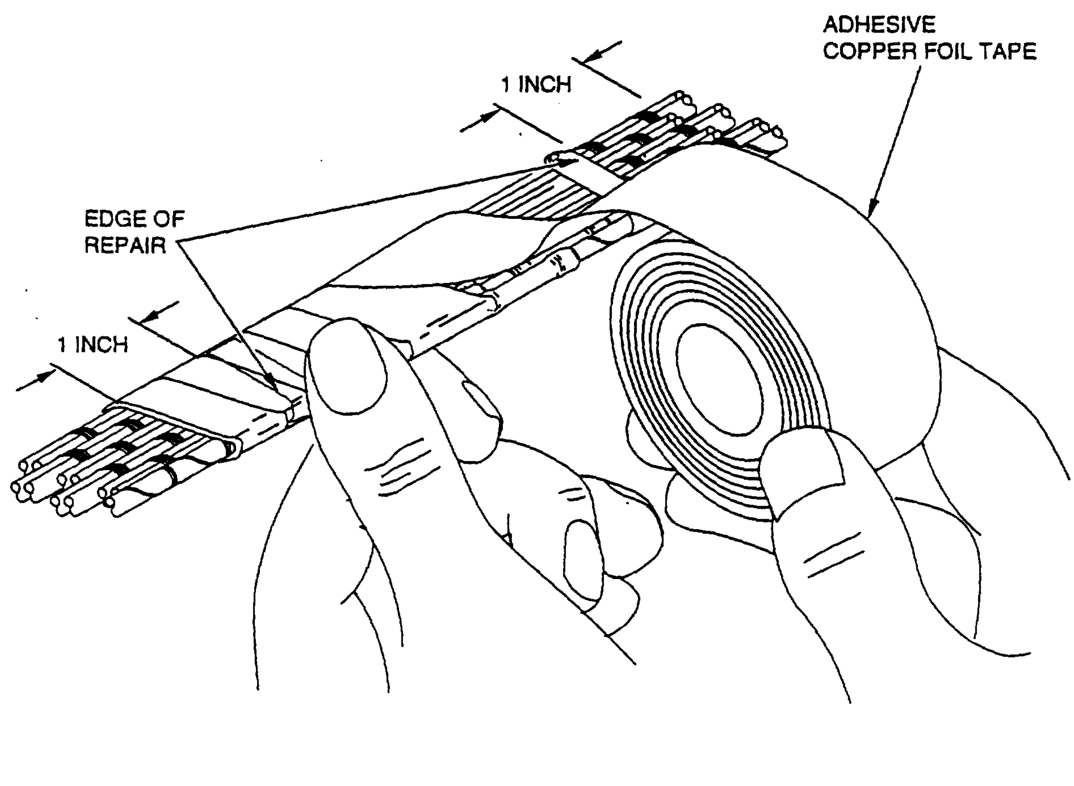


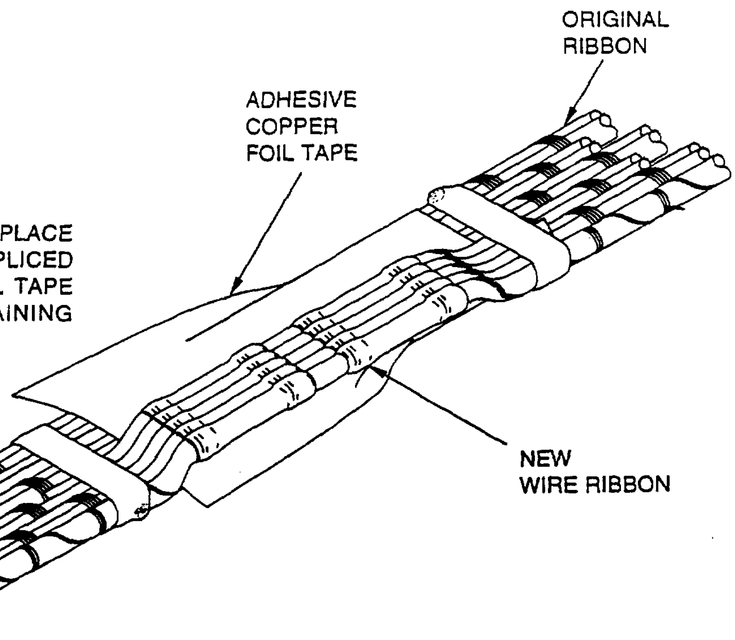
Figure 4. Wire Ribbon Repair (Sheet 6)

P. FORM A NEW RIBBON BY LIFTING THE DAMAGED WIRES ABOVE THE ORIGINAL RIBBON.

CAUTION

DO NOT FORCE THE SPLICED WIRES TOGETHER. MAINTAIN THEIR NATURAL SPACING.

Q. USING ADHESIVE COPPER FOIL TAPE, PLACE BETWEEN UNDAMAGED WIRES AND SPLICED WIRES. FOLD ADHESIVE COPPER FOIL TAPE OVER UNDAMAGED WIRES MAINTAINING RIBBON FLAT CONFIGURATION.



CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

R. USING ADHESIVE COPPER FOIL TAPE, BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP COPPER FOIL TAPE AROUND ENTIRE RIBBON WHILE APPLYING PRESSURE TO ENSURE ADHESION OF FOIL TO RIBBON, OVERLAPPING EACH WRAP 50 PERCENT.

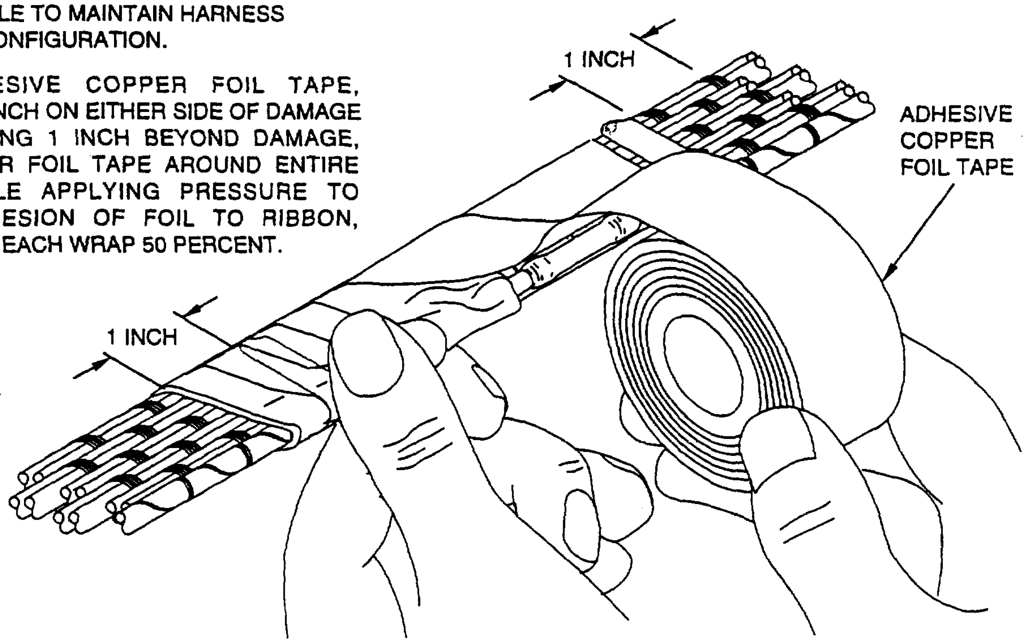


Figure 4. Wire Ribbon Repair (Sheet 7)

WARNING

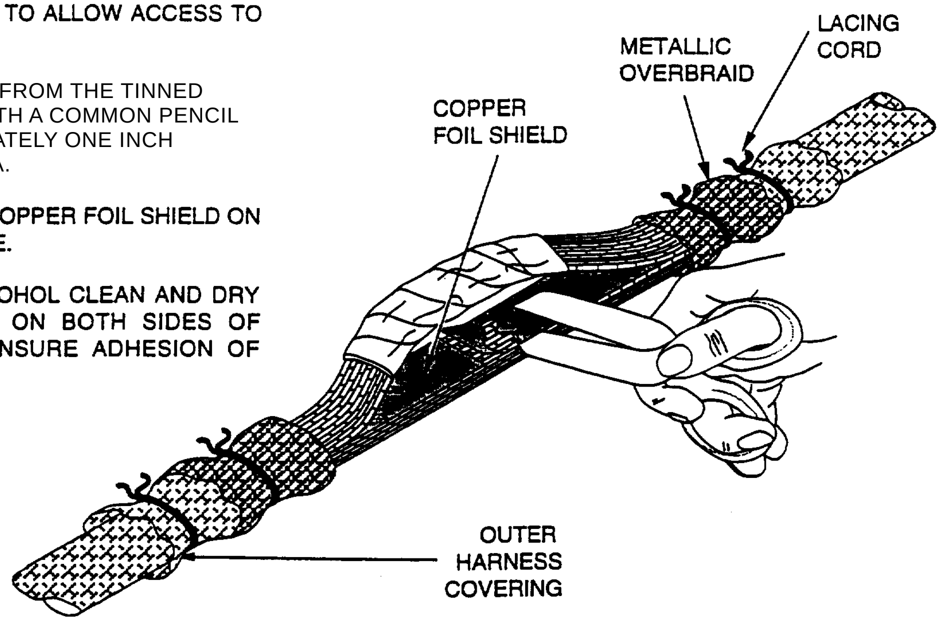
ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PRO–LONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOM–MENDED. WASH HANDS AFTER USE.

S. LIFT REPAIRED RIBBON TO ALLOW ACCESS TO COPPER FOIL SHIELD.

T. REMOVE ANY OXIDATION FROM THE TINNED COPPER FOIL SHIELD WITH A COMMON PENCIL ERASER FOR APPROXIMATELY ONE INCH AROUND DAMAGED AREA.

U. USING SCISSORS CUT COPPER FOIL SHIELD ON BOTH SIDES OF DAMAGE.

V. USING ISOPROPYL ALCOHOL CLEAN AND DRY COPPER FOIL SHIELD ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.



W. USING 2 PIECES OF ADHESIVE COPPER FOIL TAPE TWICE THE SIZE OF DAMAGED AREA, RE-ESTABLISH BOTH EDGES BY FOLDING AND CONNECTING COPPER FOIL SHIELD ALONG DAMAGED AREA.

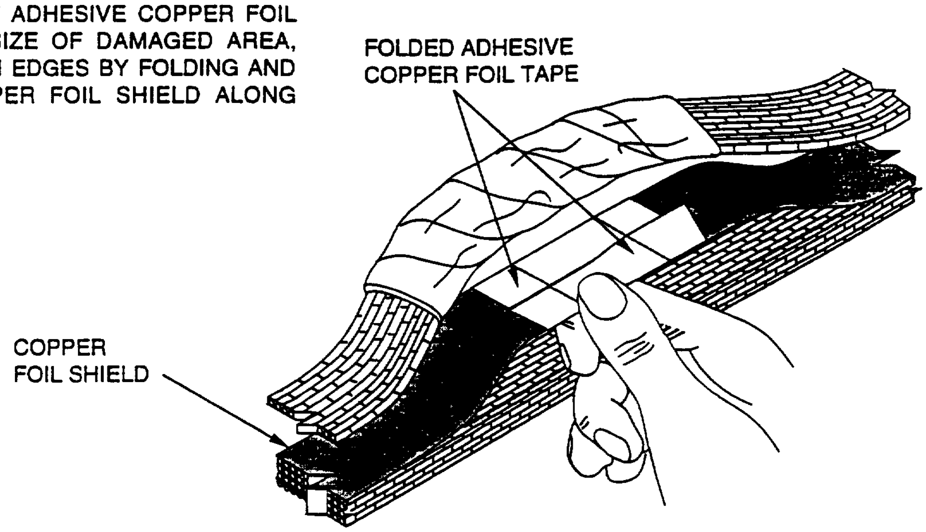
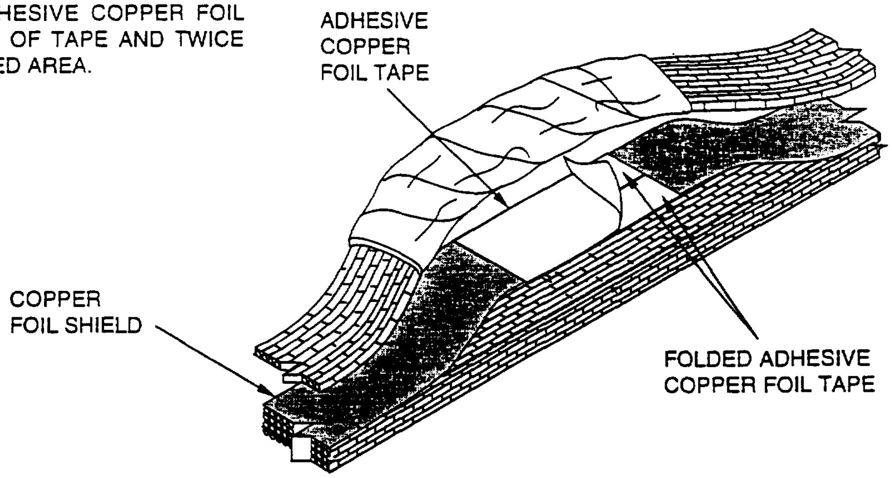


Figure 4. Wire Ribbon Repair (Sheet 8)

X. PLACE A PIECE OF ADHESIVE COPPER FOIL TAPE COVERING WIDTH OF TAPE AND TWICE THE LENGTH OF DAMAGED AREA.



Y. REPEAT STEPS D THRU R FOR EACH RIBBON WITH DAMAGED WIRES IN HARNESS ASSEMBLY.

Z. REPEAT STEPS S THRU X FOR EACH COPPER FOIL SHIELD.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AA. USING TEFLON TAPE, BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP TEFLON TAPE AROUND WIRE RIBBONS WHILE APPLYING PRESSURE TO ENSURE ADHESION OF TAPE, OVERLAPPING EACH WRAP 50 PERCENT.

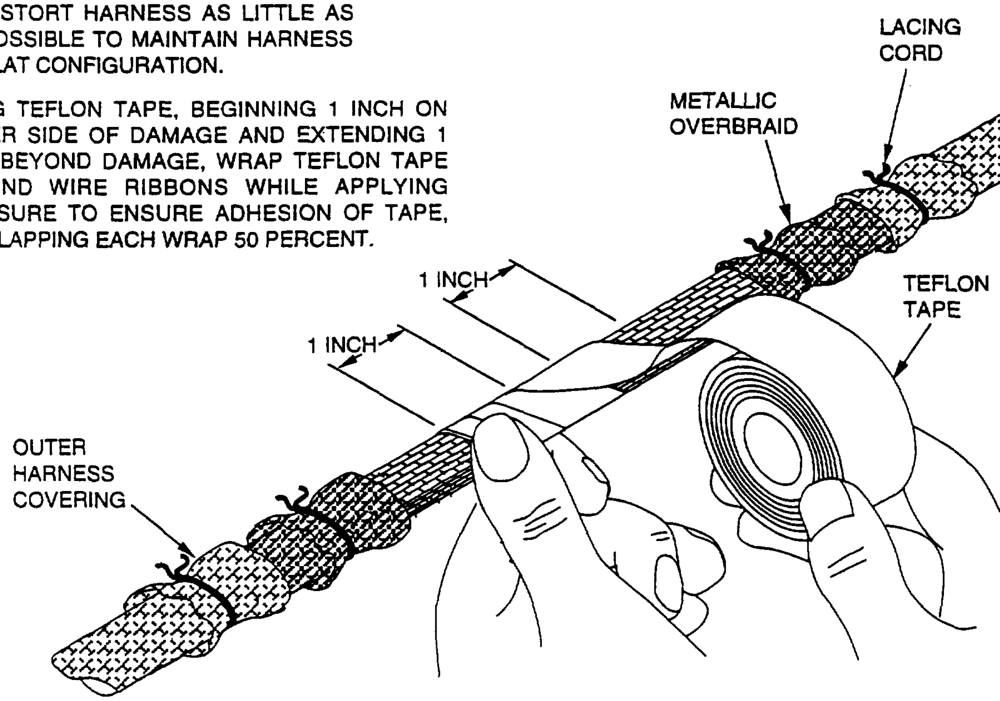


Figure 4. Wire Ribbon Repair (Sheet 9)

AB. CUT LACING CORD SECURING METALLIC OVERBRAID. WORK BOTH ENDS AS CLOSE TOGETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.

WARNING

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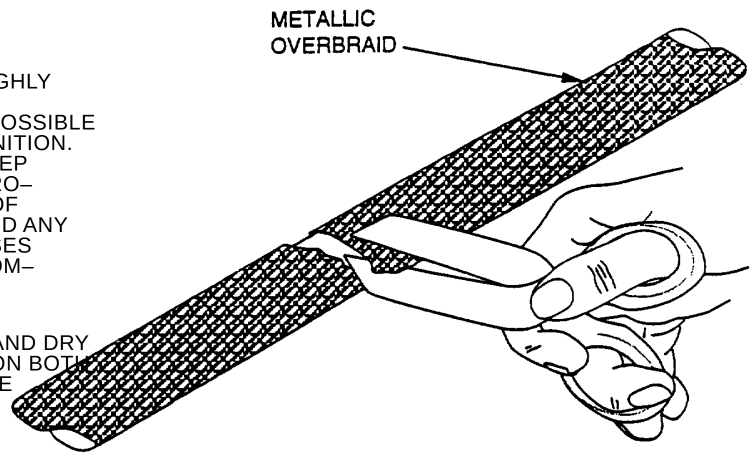
AC. USING ISOPROPYL ALCOHOL CLEAN AND DRY METALLIC OVERBRAID 2 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.



CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AD. USING ADHESIVE COPPER FOIL TAPE, BEGINNING 2 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 2 INCHES BEYOND DAMAGE, WRAP COPPER FOIL TAPE AROUND METALLIC OVERBRAID WHILE APPLYING PRESSURE TO ENSURE ADHESION OF FOIL TO OVERBRAID, OVERLAPPING EACH WRAP 50 PERCENT.

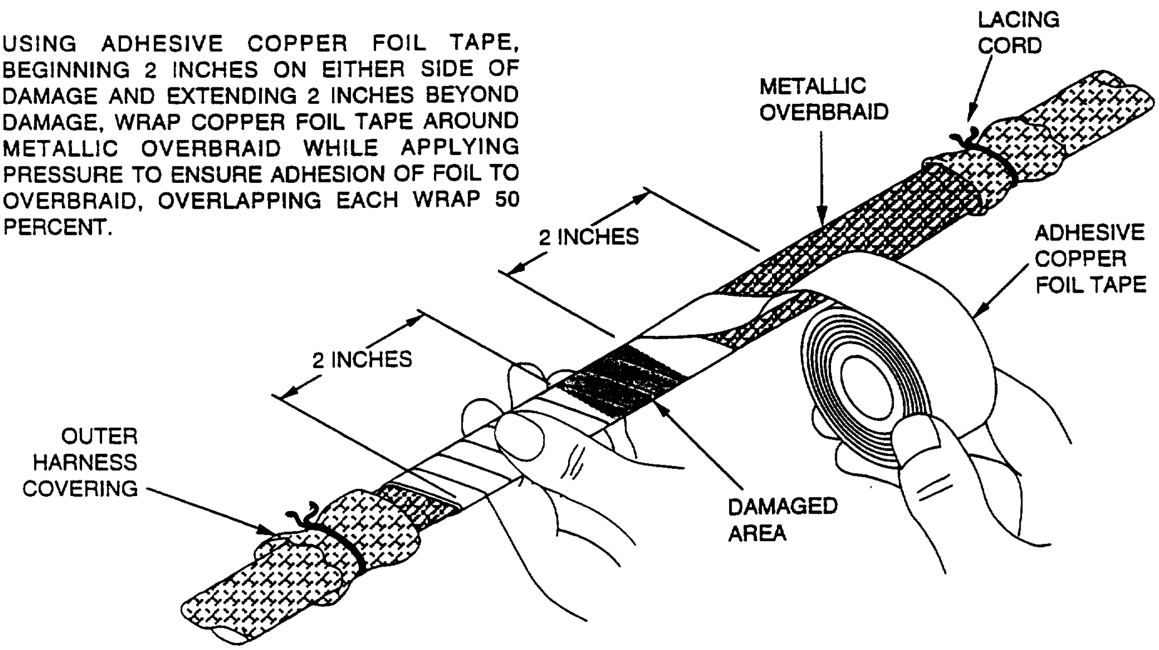


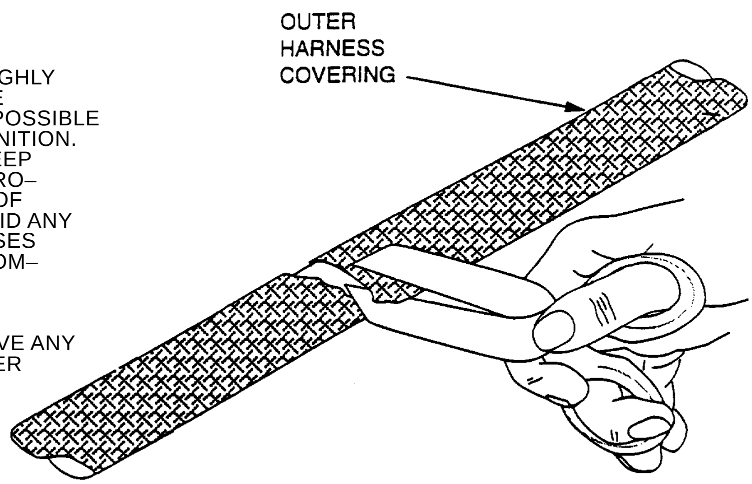
Figure 4. Wire Ribbon Repair (Sheet 10)

AE. CUT LACING CORD SECURING OUTER HARNESS COVERING. WORK BOTH ENDS AS CLOSE TOGETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.

WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.

AF. USING ISOPROPYL ALCOHOL, REMOVE ANY DIRT AND/OR MOISTURE FROM OUTER HARNESS COVERING.



CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AG. USING SELF BONDING SILICONE TAPE, BEGINNING 3 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 3 INCHES BEYOND DAMAGE, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.

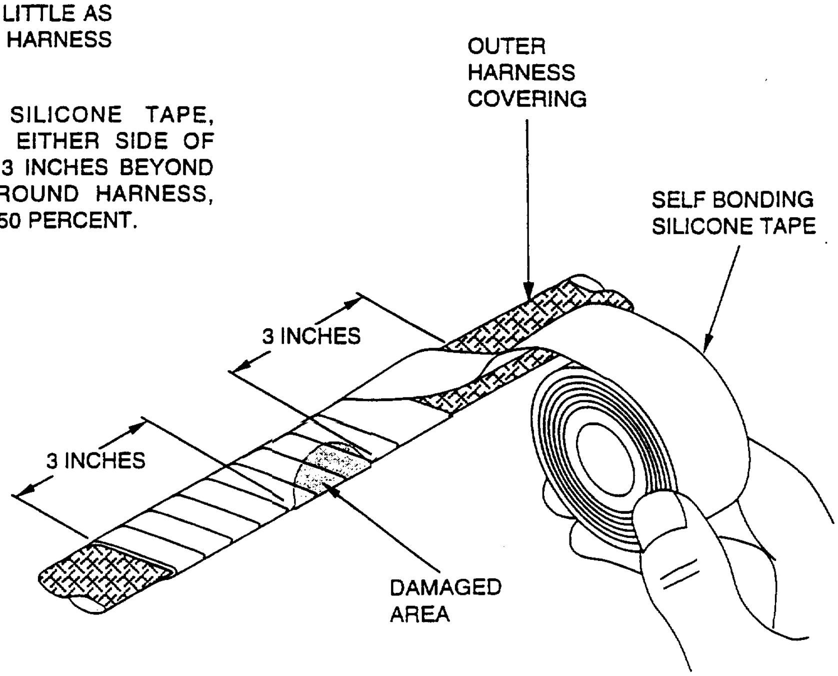


Figure 4. Wire Ribbon Repair (Sheet 11)

H. SECURE ENDS OF TAPE WITH LACING CORD.

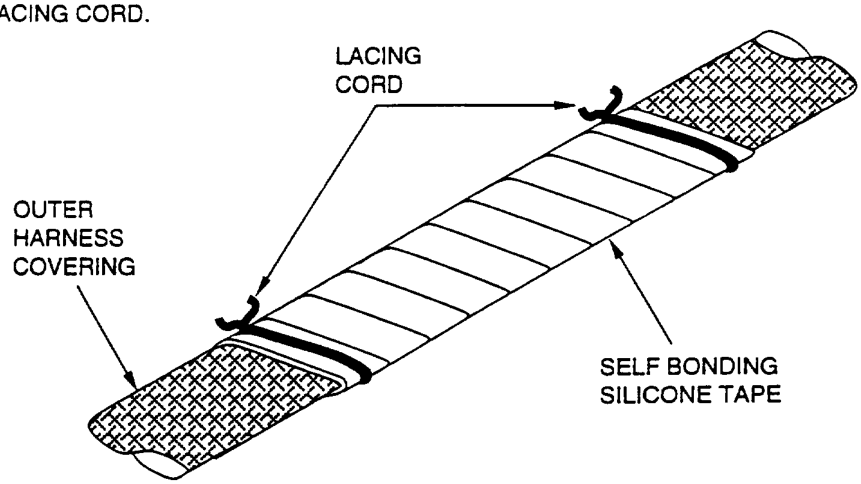


Figure 4. Wire Ribbon Repair (Sheet 12)

5. SEVERED HARNESS REPAIR.

A. PULL BACK EACH SIDE OF OUTER HARNESS COVERING AT LEAST 8 INCHES FROM DAMAGE AND SECURE WITH LACING CORD. A MINIMUM OF 16 INCHES IS REQUIRED FOR REPAIRS.

NOTE

IF DAMAGE TO CONDUCTORS IN ANY RIBBON IS GREATER THAN 75 PERCENT, THE RIBBON SHOULD BE REPAIRED USING THE SEVERED HARNESS REPAIR METHOD.

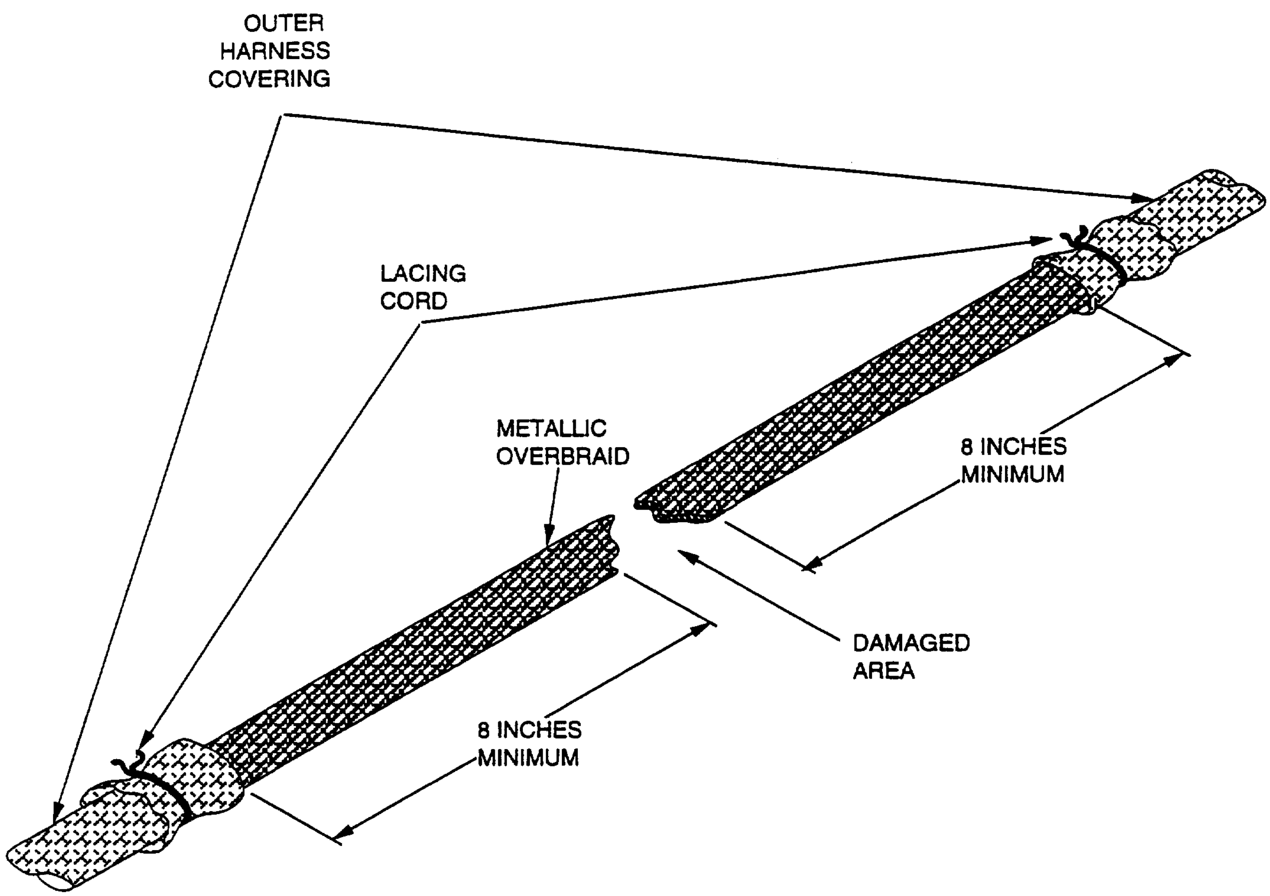


Figure 5. Severed Harness Repair (Sheet 1 of 14)

B. PULL BACK EACH SIDE OF METALLIC OVERBRAID AT LEAST 6 INCHES FROM DAMAGE AND SECURE WITH LACING CORD. A MINIMUM OF 12 INCHES IS REQUIRED FOR REPAIRS.

C. EXAMINE EACH RIBBON IN THE HARNESS TO DETERMINE APPROPRIATE REPAIR METHOD.

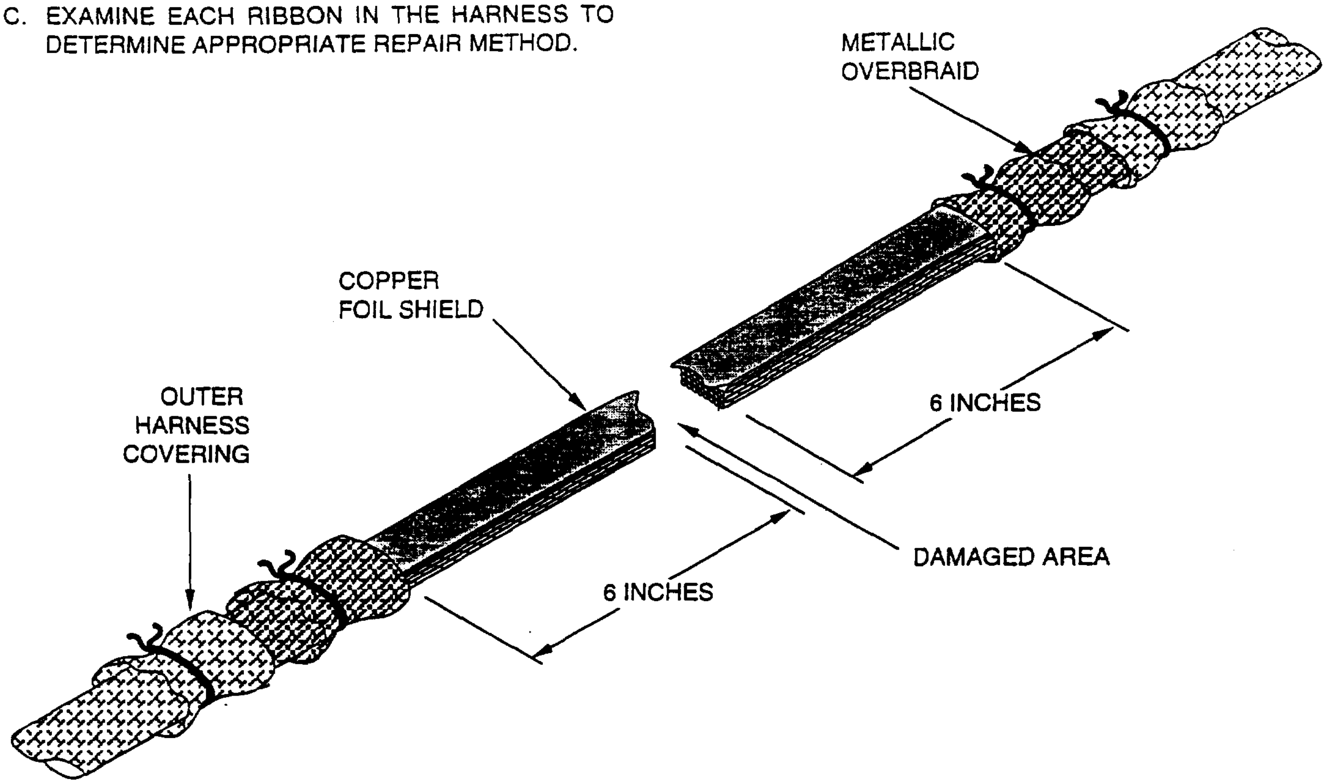


Figure 5. Severed Harness Repair (Sheet 2)

D. DRAW A PERPENDICULAR LINE WITH A MARKER ACROSS RIBBON A. PLACE LINE AT LEFT EDGE OF THE DAMAGE. THE LINE WILL BE USED AS A REFERENCE LINE FOR ALL OTHER RIBBON MARKINGS. USE A STRAIGHT EDGE AS A DRAWING AID TO ENSURE A PERPENDICULAR LINE ACROSS EACH RIBBON.

E. MOVE TO RIBBON B AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 2 INCHES TO THE LEFT OF THE REFERENCE LINE ON RIBBON A.

F. MOVE TO RIBBON C AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 4 INCHES TO THE LEFT OF THE REFERENCE LINE ON RIBBON A.

G. MOVE TO RIBBON D AND DRAW A PERPENDICULAR LINE ACROSS RIBBON AT THE SAME POINT AS REFERENCE LINE ON RIBBON A.

H. MOVE TO RIBBON E AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 2 INCHES TO THE LEFT OF REFERENCE LINE ON RIBBON A. THIS LINE WILL BE RIGHT ABOVE LINE ON RIBBON B.

I. MOVE TO RIBBON F AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 4 INCHES TO THE LEFT OF THE REFERENCE LINE ON RIBBON A. THIS LINE WILL BE RIGHT ABOVE LINE ON RIBBON C.

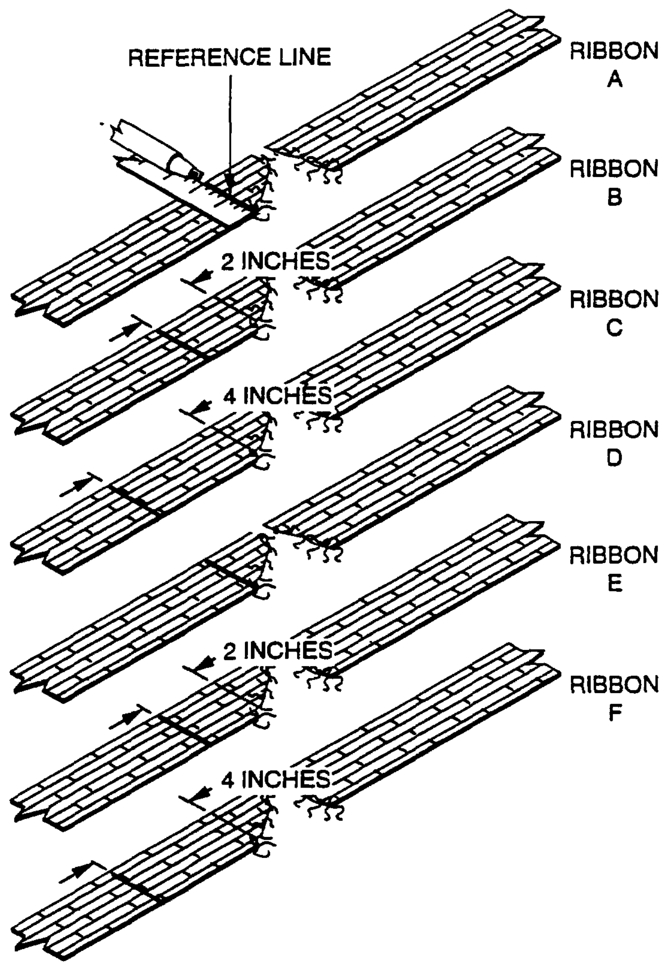


Figure 5. Severed Harness Repair (Sheet 3)

J. DRAW A PERPENDICULAR LINE WITH A MARKER ACROSS RIBBON C. PLACE LINE AT RIGHT EDGE OF THE DAMAGE. THE LINE WILL BE USED AS A REFERENCE LINE FOR ALL OTHER RIBBON MARKINGS. USE A STRAIGHT EDGE AS A DRAWING AID TO ENSURE A PERPENDICULAR LINE ACROSS EACH RIBBON.

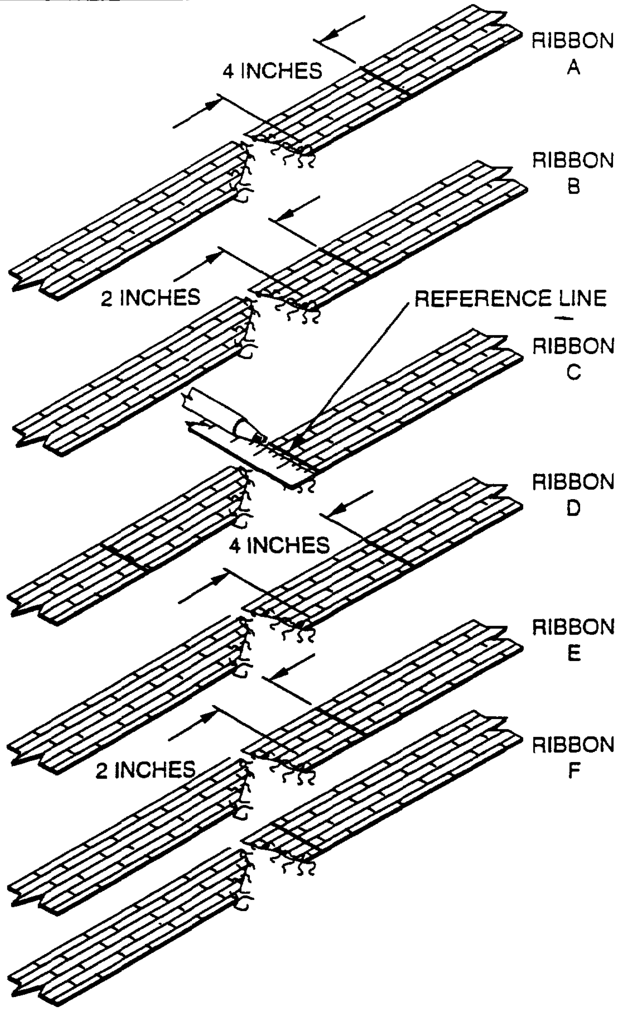
K. MOVE TO RIBBON B AND DRAW A PERPENDICULAR LINE ACROSS RIBBON TWO INCHES TO THE RIGHT OF THE REFERENCE LINE ON RIBBON C.

L. MOVE TO RIBBON A AND DRAW A PERPENDICULAR LINE ACROSS RIBBON FOUR INCHES TO THE RIGHT OF THE REFERENCE LINE ON RIBBON C.

M. MOVE TO RIBBON F AND DRAW A PERPENDICULAR LINE ACROSS RIBBON AT THE SAME POINT AS REFERENCE LINE ON RIBBON C.

N. MOVE TO RIBBON E AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 2 INCHES TO THE RIGHT OF REFERENCE LINE ON RIBBON A. THIS LINE WILL BE RIGHT ABOVE LINE ON RIBBON B.

O. MOVE TO RIBBON D AND DRAW A PERPENDICULAR LINE ACROSS RIBBON 4 INCHES TO THE RIGHT OF THE REFERENCE LINE ON RIBBON A. THIS LINE WILL BE RIGHT ABOVE LINE ON RIBBON A.



P. LIFT COPPER FOIL OUT OF WAY TO ALLOW ACCESS TO DAMAGED WIRE RIBBON.

WARNING

DURING REPAIRS OF WIRING, MAINTAIN PROPER RIBBON ALIGNMENT BY REFERENCING ORANGE STRIPED WIRE INDICATING CONDUCTOR NUMBER 1.

Q. CUT RIBBON A AT THE LINES DRAWN PERPENDICULARLY ACROSS THE RIBBON. CUT COPPER FOIL TAPE ON BOTH SIDES OF DAMAGED AREA.

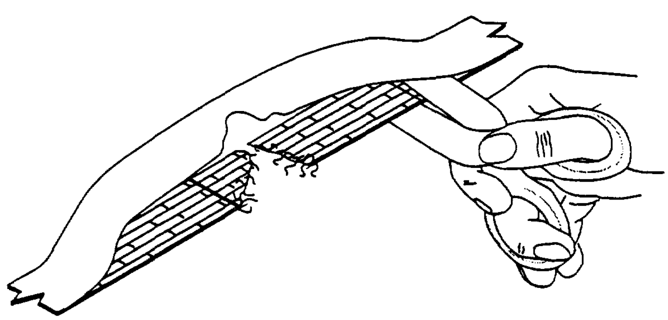
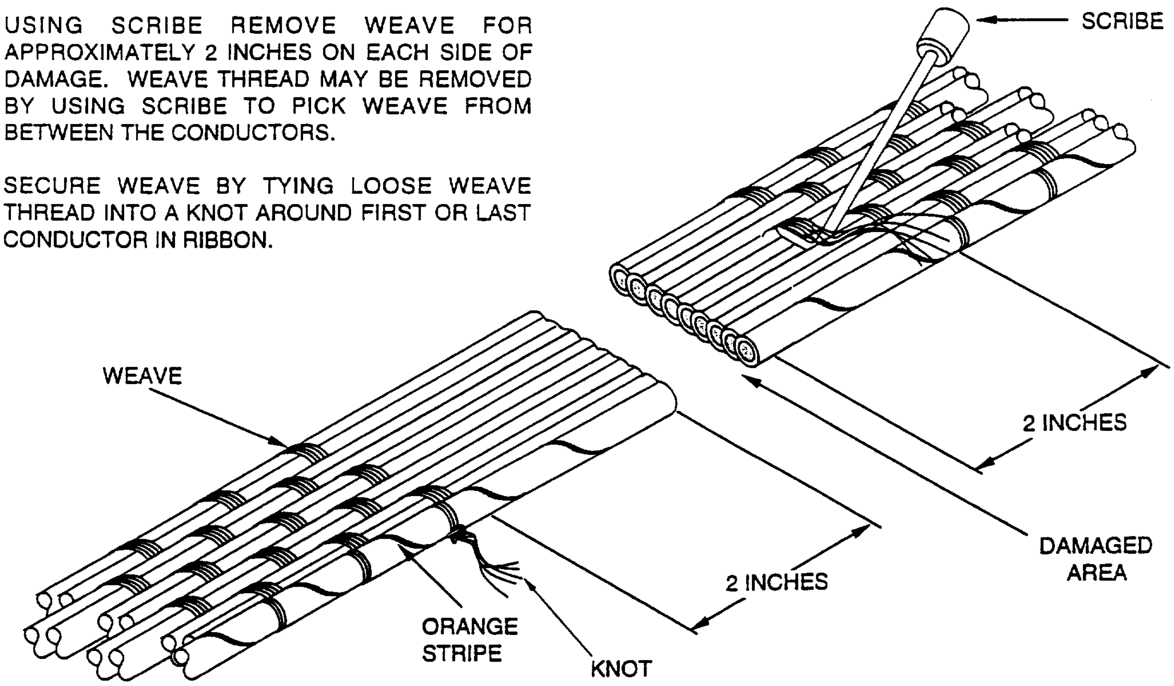


Figure 5. Severed Harness Repair (Sheet 4)

R. USING SCRIBE REMOVE WEAVE FOR APPROXIMATELY 2 INCHES ON EACH SIDE OF DAMAGE. WEAVE THREAD MAY BE REMOVED BY USING SCRIBE TO PICK WEAVE FROM BETWEEN THE CONDUCTORS.

S. SECURE WEAVE BY TYING LOOSE WEAVE THREAD INTO A KNOT AROUND FIRST OR LAST CONDUCTOR IN RIBBON.



T. STARTING WITH CONDUCTOR NUMBER 1; USING WIRE STRIPPERS (WP 009 00) STRIP BOTH ENDS OF DAMAGED WIRE. PLACE HEAT SHRINKABLE SLEEVE ON BOTH DAMAGED WIRES.

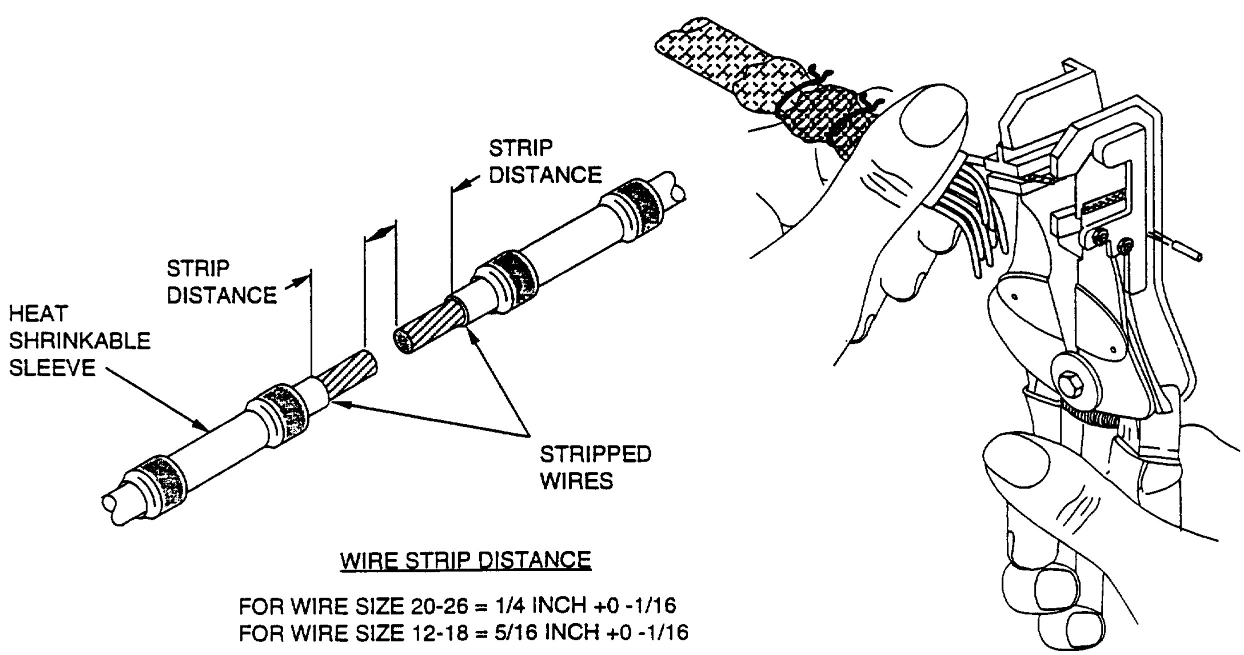
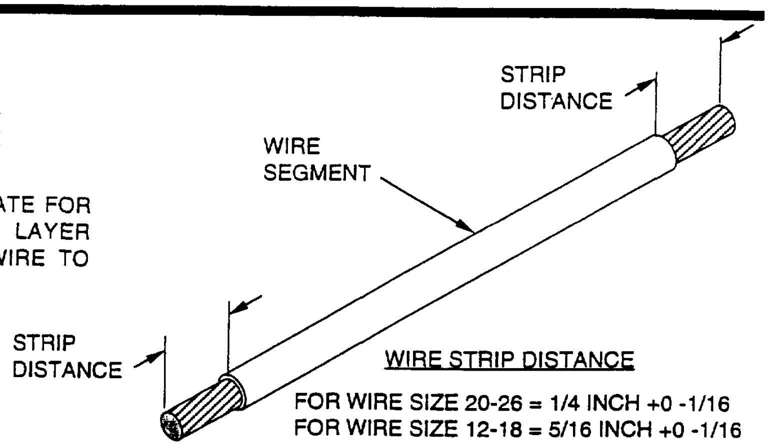


Figure 5. Severed Harness Repair (Sheet 5)

NOTE

REFER TO APPROPRIATE HARNESS ASSEMBLY WP FOR WIRE TYPE.

U. ADD WIRE AS NEEDED TO COMPENSATE FOR DAMAGED AREA, ENSURE WOVEN LAYER MAINTAINS SAME LENGTH. STRIP WIRE TO APPROPRIATE LENGTH.



V. USING WIRE I.D. NUMBERS AND WIRE RIBBON POSITION AS A REFERENCE, CRIMP DAMAGED WIRES TOGETHER USING APPROPRIATE SPLICES (WP 015 00)

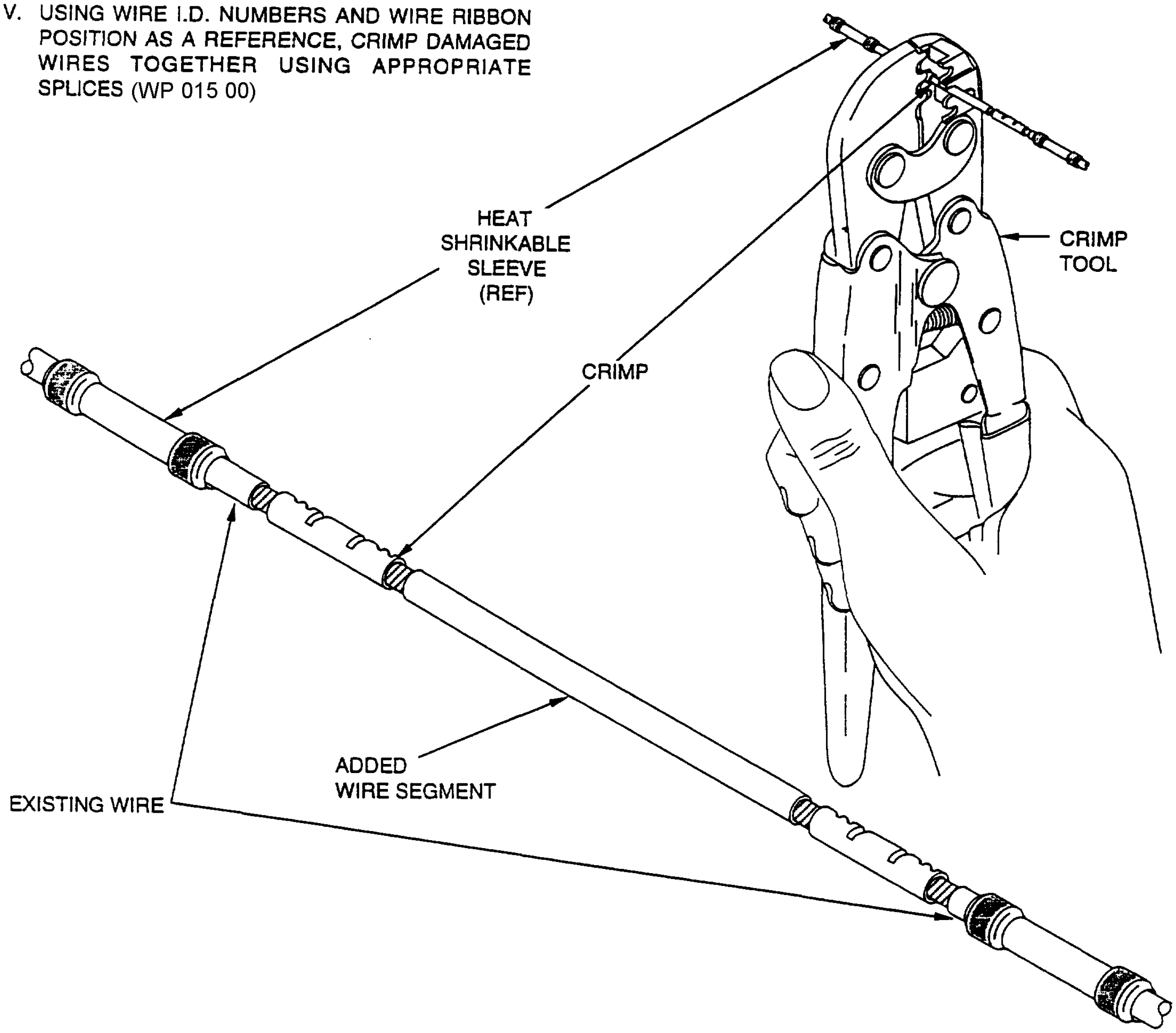
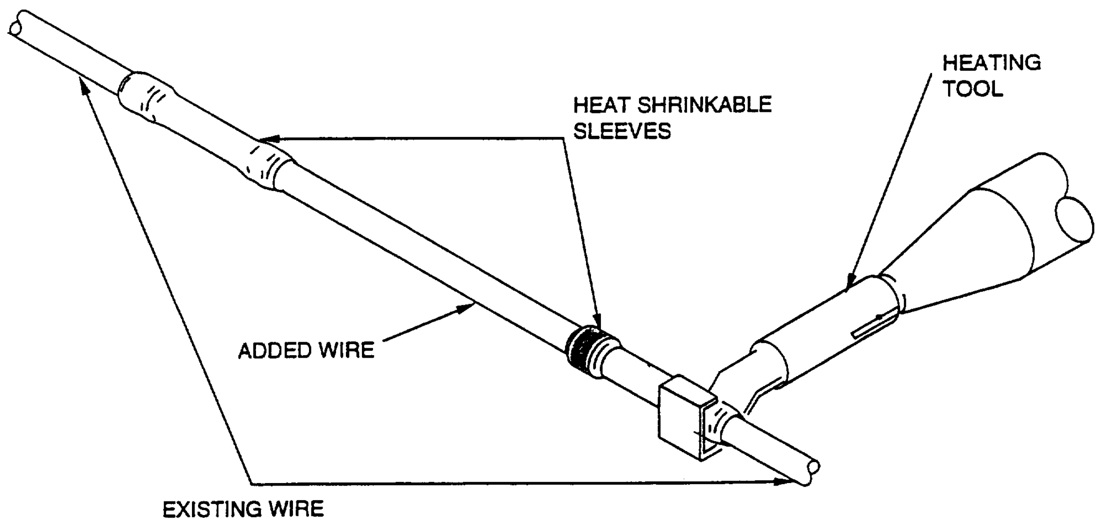


Figure 5. Severed Harness Repair (Sheet 6)

NOTE

FOR PREPARATION, USE AND OPERATION OF HEAT GUN. REFER TO WP 012 00

W. SLIDE HEAT SHRINKABLE SLEEVE OVER SPLICE AND USING HEATING TOOL, SHRINK SLEEVE.



X. REPEAT STEPS T THRU W FOR EVERY DAMAGED WIRE ON RIBBON.

Y. PERFORM CONTINUITY CHECK FOR ALL SPLICED WIRES USING MULTIMETER.

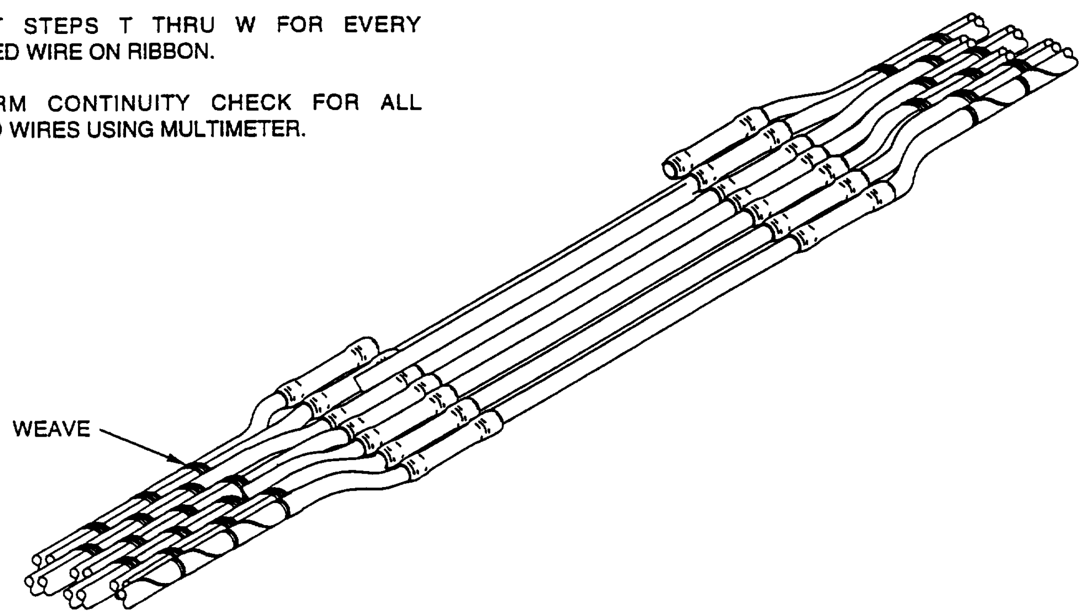


Figure 5. Severed Harness Repair (Sheet 7)

Z. PLACE A SINGLE WRAP OF ADHESIVE COPPER FOIL TAPE AROUND RIBBON ON EACH SIDE OF DAMAGE TO PREVENT FURTHER UNRAVELING.

CAUTION

DO NOT FORCE THE SPLICED WIRES TOGETHER. MAINTAIN THEIR NATURAL SPACING.

AA. FORM A NEW RIBBON BY LIFTING EVERY OTHER WIRE ABOVE THE ORIGINAL RIBBON.

AB. LIFT REPAIRED AREA, USING ADHESIVE COPPER FOIL TAPE WRAP AROUND SPLICES ON ORIGINAL RIBBON MAINTAINING RIBBON FLAT CONFIGURATION.

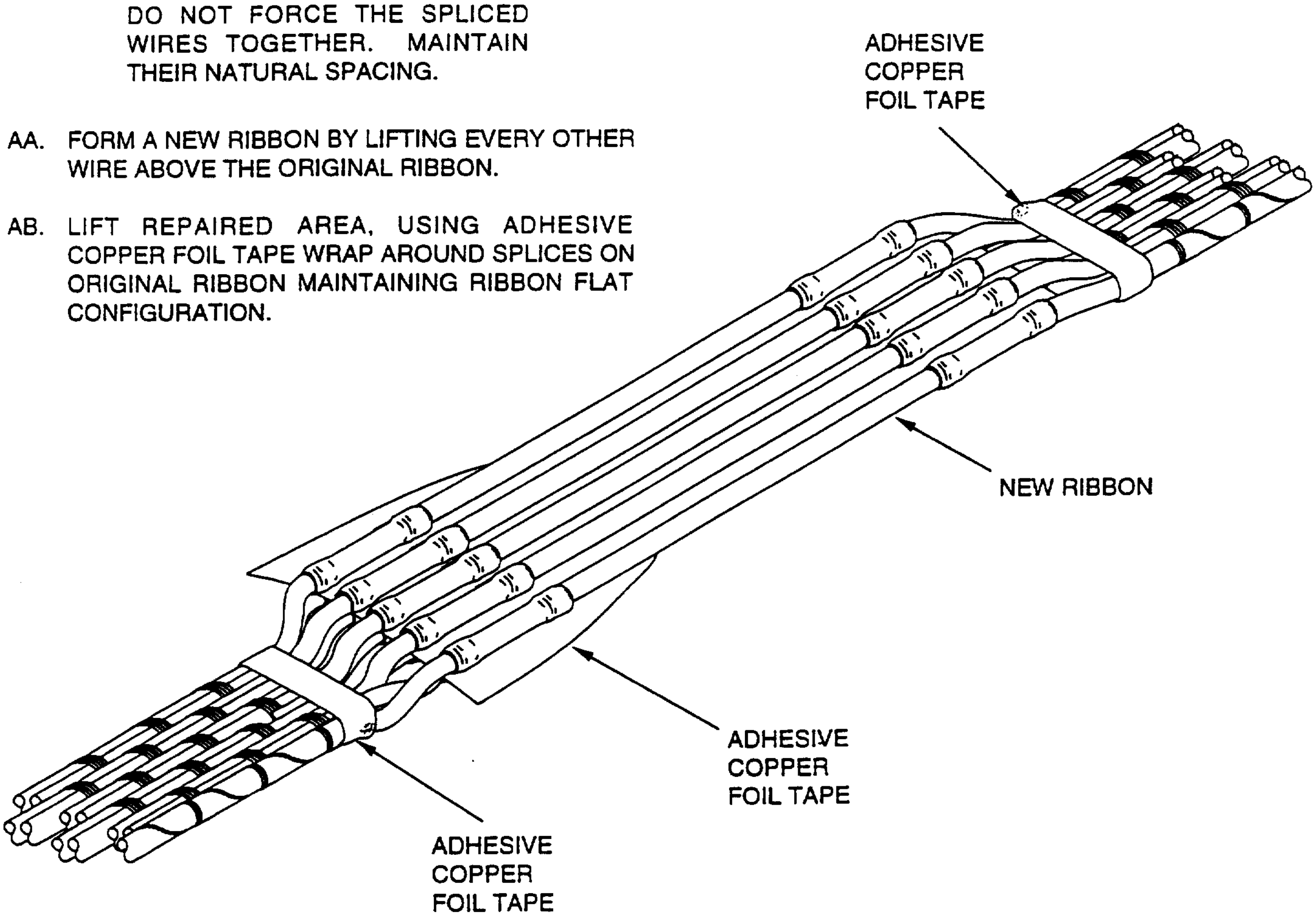


Figure 5. Severed Harness Repair (Sheet 8)

WARNING

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AC. USING ISOPROPYL ALCOHOL CLEAN AND DRY WIRE RIBBON 1 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AD. USING ADHESIVE COPPER FOIL TAPE, BEGINNING 1 INCH ON EITHER SIDE OF SPLICES AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP COPPER FOIL TAPE AROUND SPLICES WHILE APPLYING PRESSURE TO ENSURE ADHESION OF FOIL TO SPLICES, OVERLAPPING EACH WRAP 50 PERCENT.

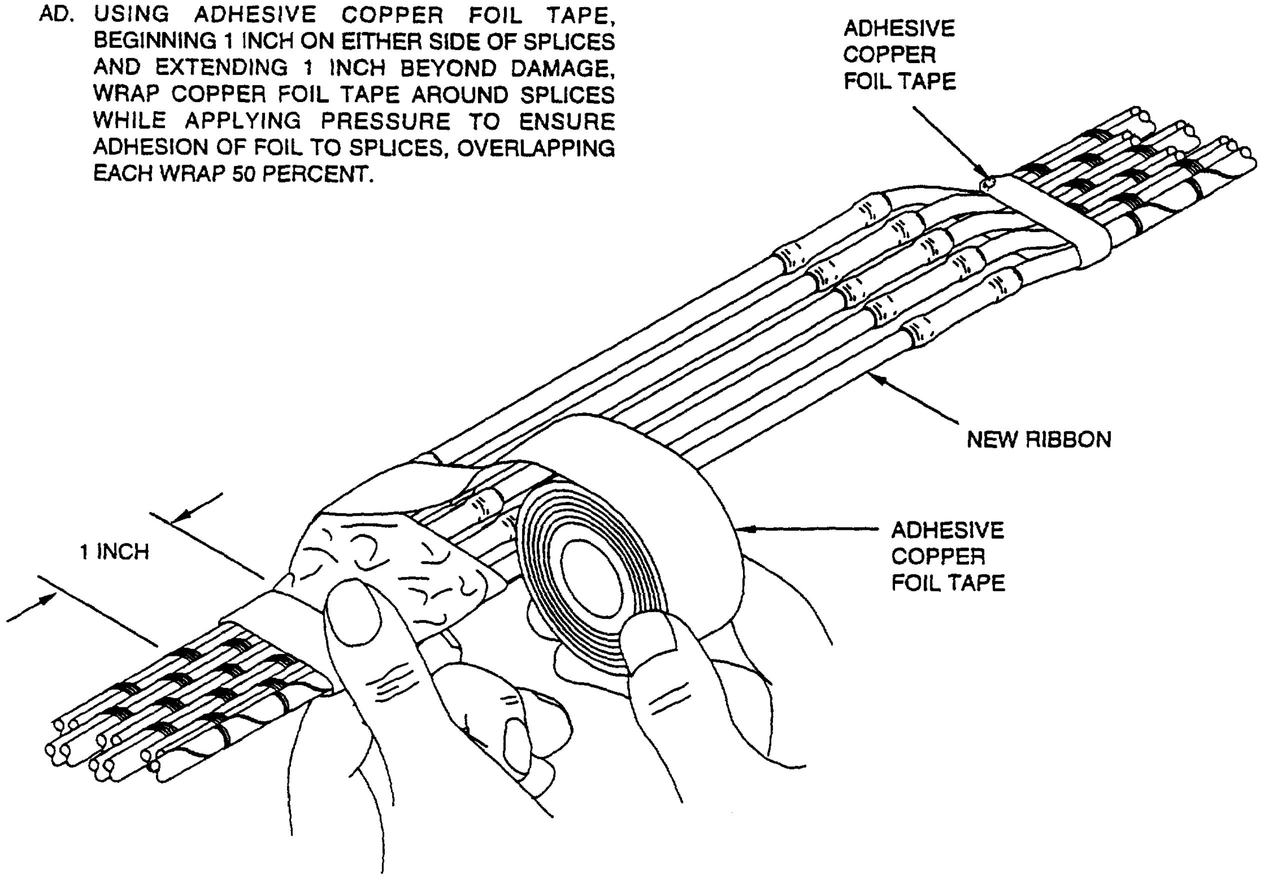

Figure 5. Severed Harness Repair (Sheet 9)

AE. REMOVE ANY OXIDATION FROM THE TINNED COPPER FOIL SHIELD WITH A COMMON PENCIL ERASER FOR APPROXIMATELY ONE INCH AROUND DAMAGED AREA.

WARNING

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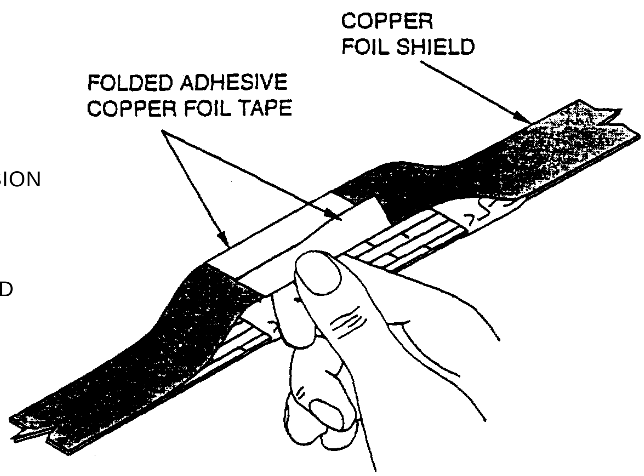
AF. USING ISOPROPYL ALCOHOL, CLEAN AND DRY COPPER FOIL SHIELD 1 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

AG. USING 2 PIECES OF ADHESIVE COPPER FOIL TAPE TWICE THE SIZE OF DAMAGED AREA. RE–ESTABLISH BOTH EDGES BY FOLDING AND CONNECTING COPPER FOIL SHIELD ALONG DAMAGED AREA.



AH. PLACE A PIECE OF ADHESIVE COPPER FOIL TAPE COVERING WIDTH OF COPPER FOIL SHIELD AND TWICE THE LENGTH OF DAMAGED AREA.

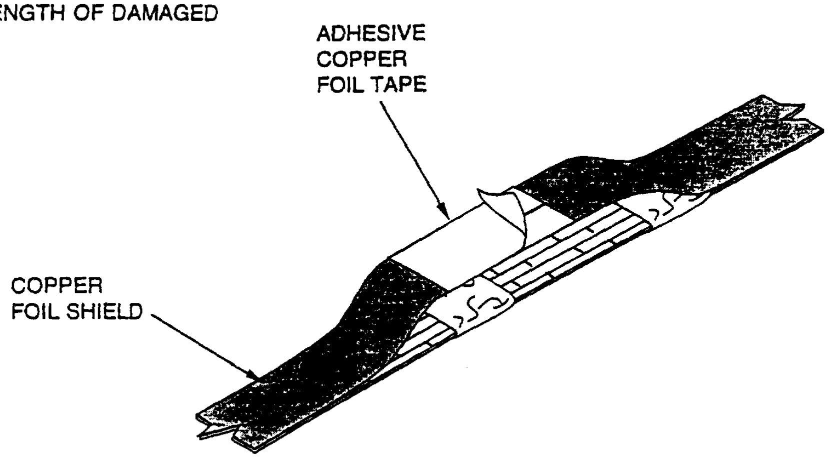
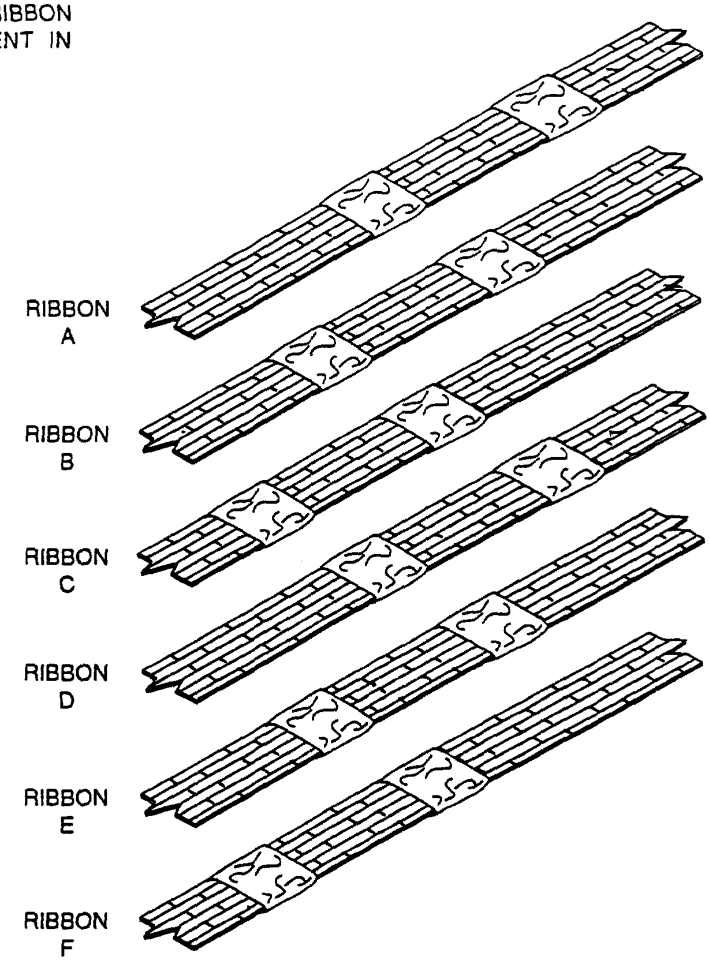


Figure 5. Severed Harness Repair (Sheet 10)

AI. REPEAT STEPS Q THRU AD FOR EACH RIBBON DAMAGED GREATER THAN 75 PERCENT IN HARNESS ASSEMBLY.



AJ. REPEAT STEPS AE THRU AH FOR EACH COPPER FOIL SHIELD.

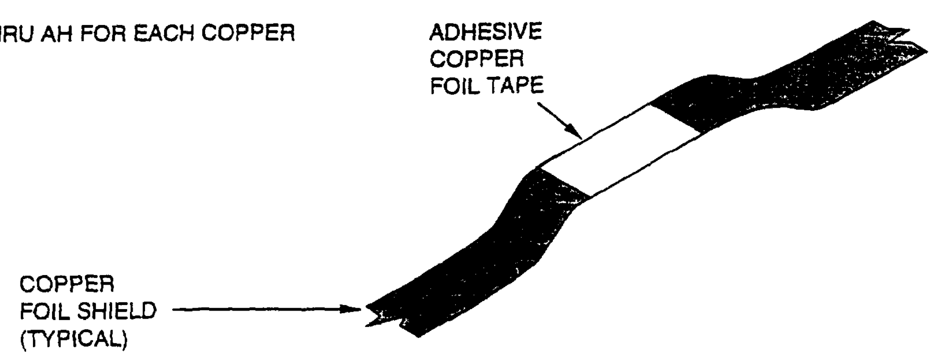
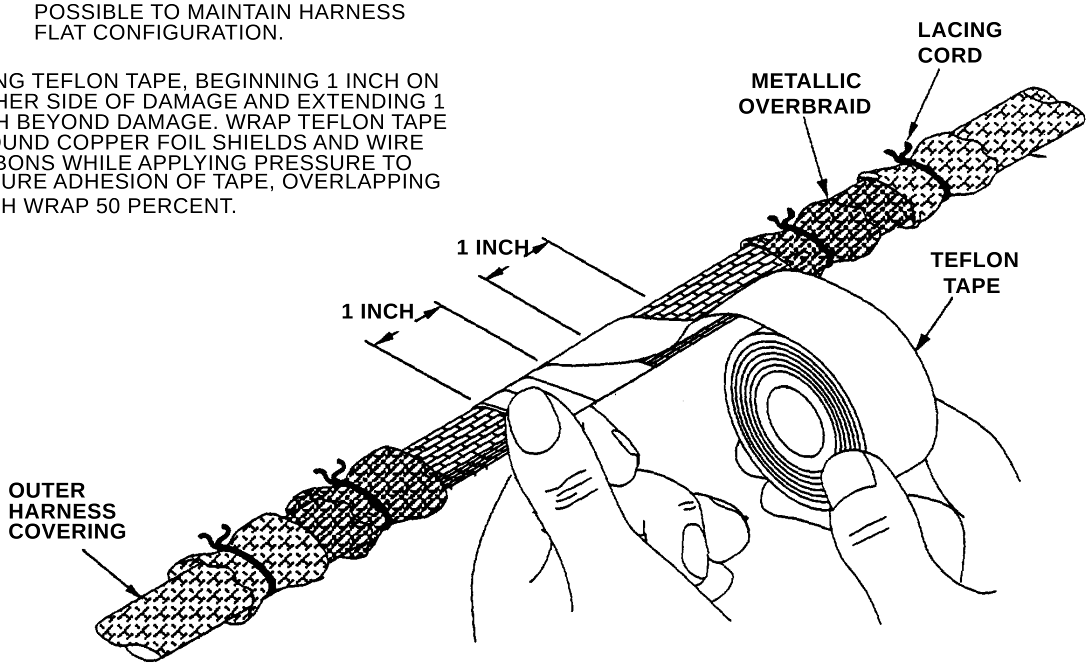


Figure 5. Severed Harness Repair (Sheet 11)

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

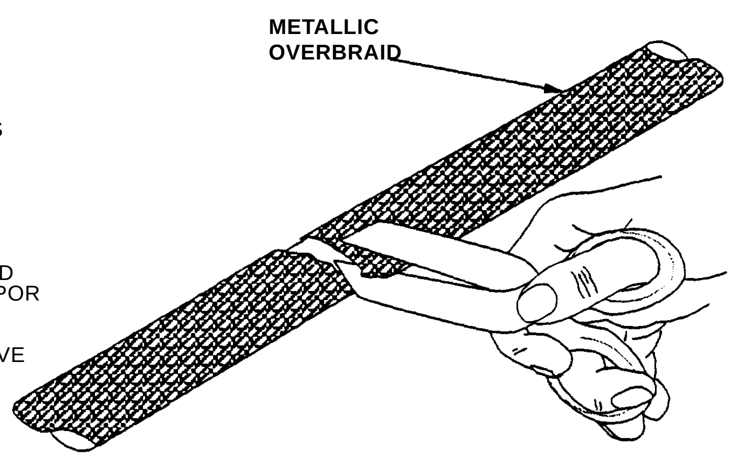
AK. USING TEFLON TAPE, BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE. WRAP TEFLON TAPE AROUND COPPER FOIL SHIELDS AND WIRE RIBBONS WHILE APPLYING PRESSURE TO ENSURE ADHESION OF TAPE, OVERLAPPING EACH WRAP 50 PERCENT.



AL. CUT LACING CORD SECURING METALLIC OVERBRAID. WORK BOTH ENDS AS CLOSE TO–GETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.

WARNING

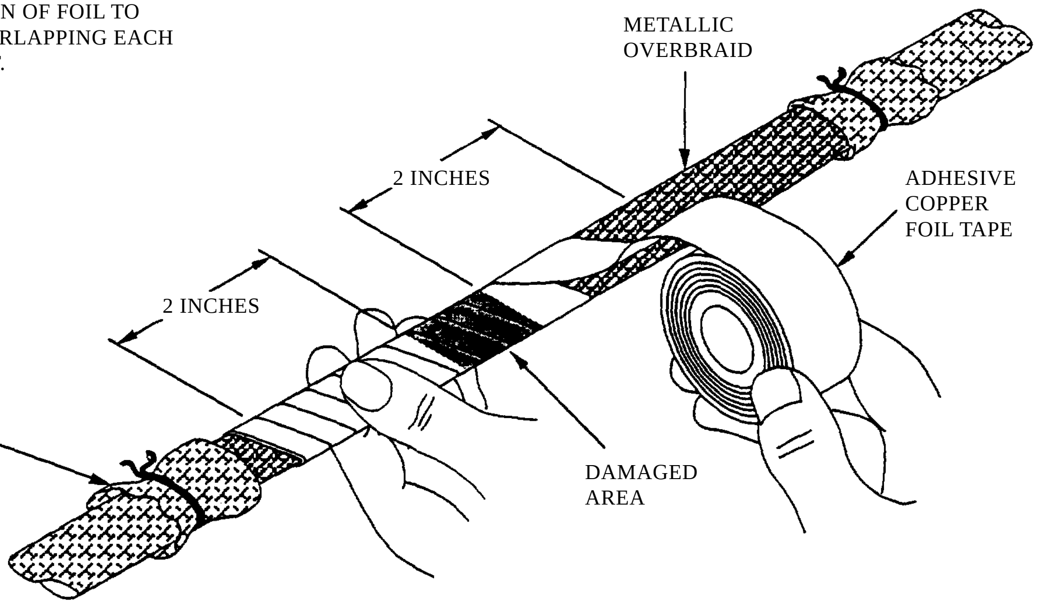
ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENT–ILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.



AM. USING ISOPROPYL ALCOHOL CLEAN AND DRY METALLIC OVERBRAID 2 1/2 INCHES ON BOTH SIDES OF DAMAGED AREA TO ENSURE ADHESION OF COPPER FOIL TAPE.

Figure 5. Severed Harness Repair (Sheet 12)

AN. USING ADHESIVE COPPER FOIL TAPE BEGINNING 2 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 2 INCHES BEYOND DAMAGE, WRAP COPPER FOIL TAPE AROUND METALLIC OVER–BRAID WHILE APPLY PRESSURE TO ENSURE ADHESION OF FOIL TO OVERBRAID, OVERLAPPING EACH WRAP 50 PERCENT.



AO. CUT LACING CORD SECURING OUTER HARNESS COVERING. WORK BOTH ENDS AS CLOSE TO–GETHER AS POSSIBLE. USING SCISSORS TRIM FRAYED AREAS TO ALLOW FOR SMOOTH REPAIR.

WARNING

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AP. USING ISPROPYL ALCOHOL, REMOVE ANY DIRT AND/OR MOISTURE FROM OTHER HARNESS COVERING.

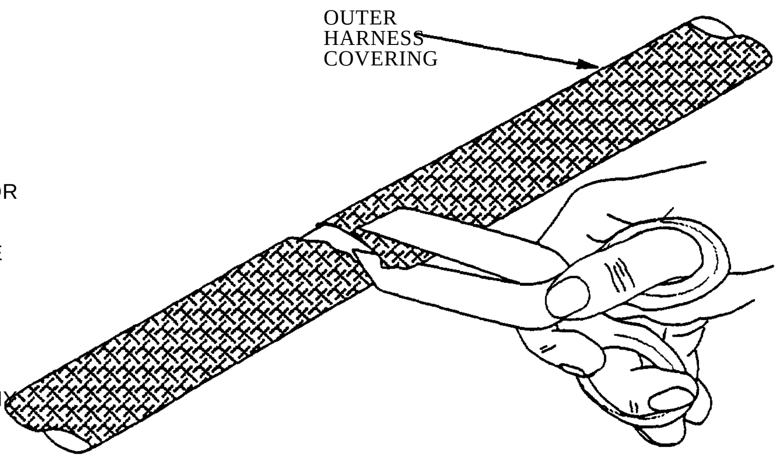
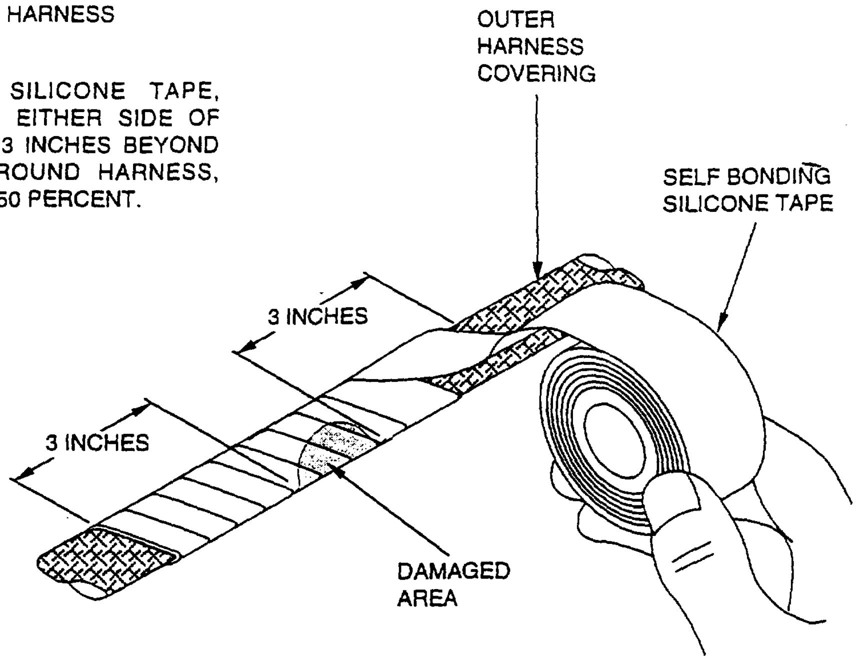


Figure 5. Severed Harness Repair (Sheet 13)

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AQ. USING SELF BONDING SILICONE TAPE, BEGINNING 3 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 3 INCHES BEYOND DAMAGE, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.



AR. SECURE ENDS OF TAPE WITH LACING CORD.

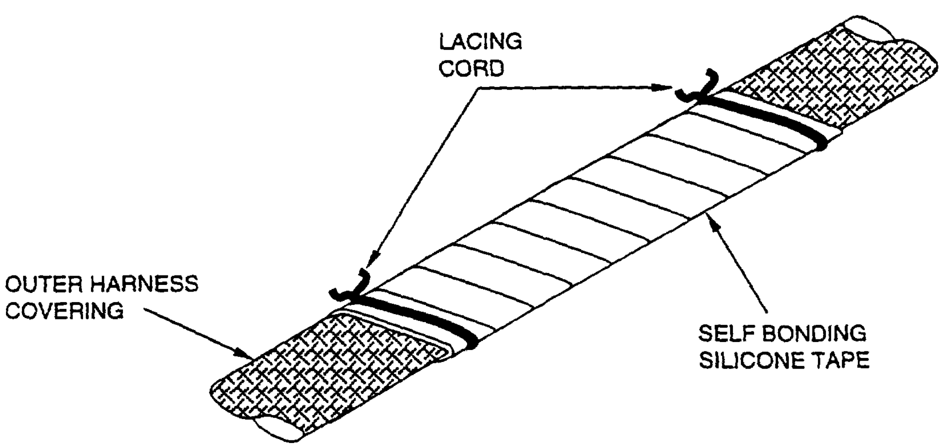
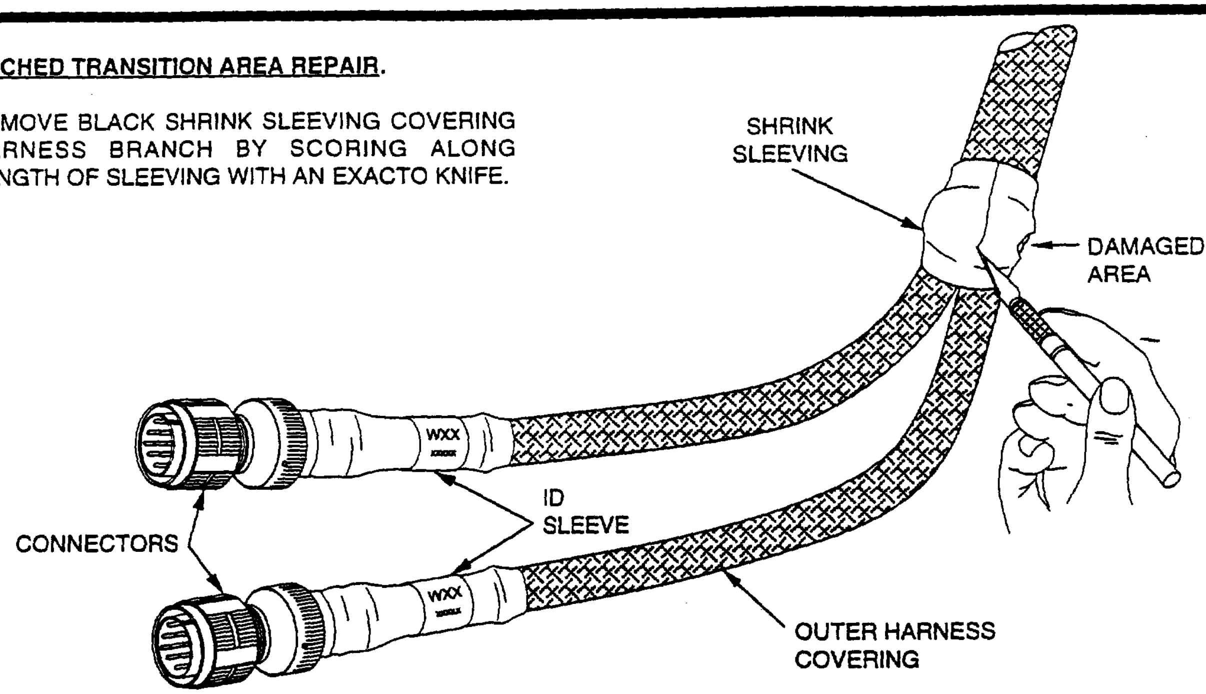


Figure 5. Severed Harness Repair (Sheet 14)

6. BRANCHED TRANSITION AREA REPAIR.

A. REMOVE BLACK SHRINK SLEEVING COVERING HARNESS BRANCH BY SCORING ALONG LENGTH OF SLEEVING WITH AN EXACTO KNIFE.



NOTE

FOR PREPARATION, USE AND OPERATION OF HEAT GUN. REFER TO WP 012 00

B. USING HEATING TOOL WITH SMALL NOZZLE AND NEEDLE NOSE PLIERS, APPLY HEAT AND WITH PLIERS PEEL OFF SLEEVING AND TUBING.

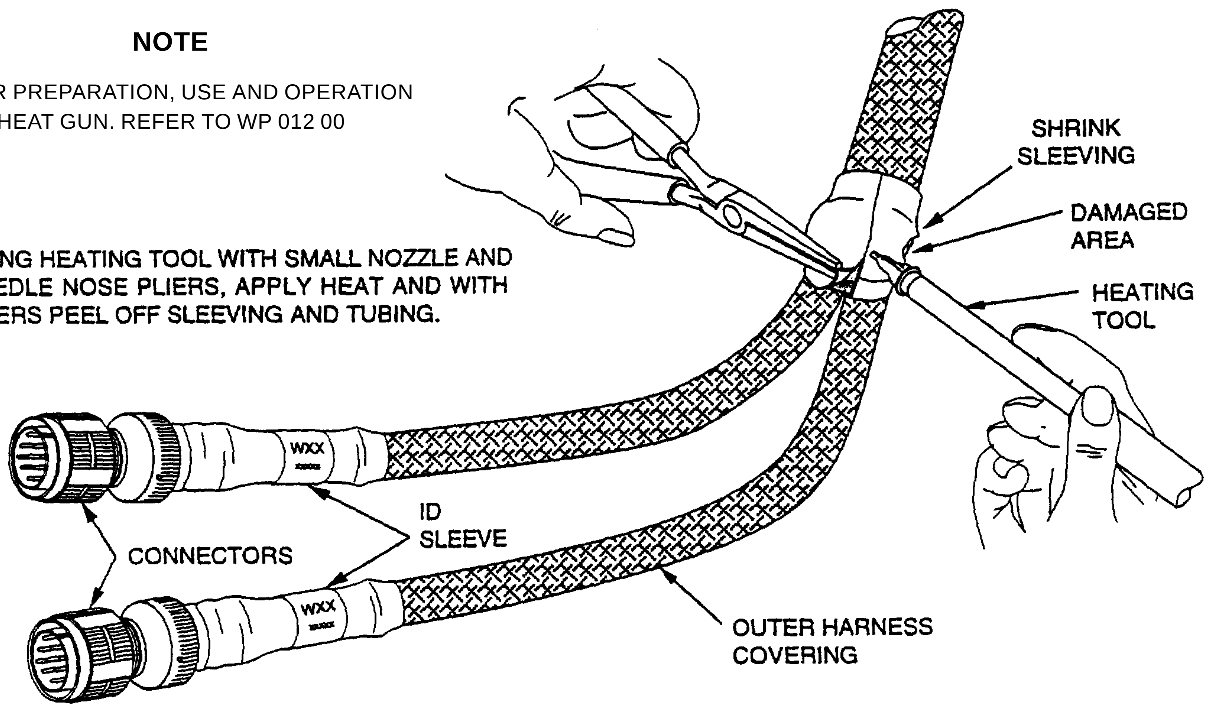
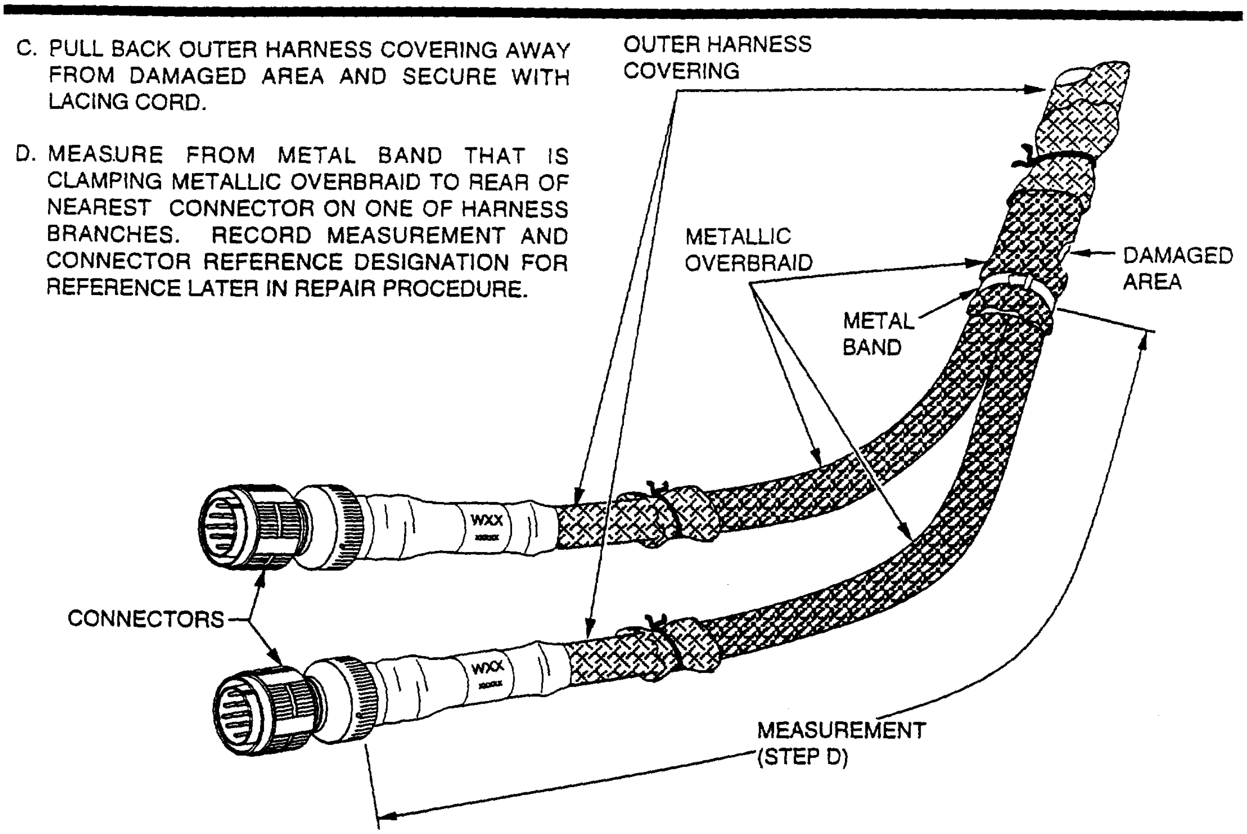


Figure 6. Branched Transition Area Repair (Sheet 1 of 13)



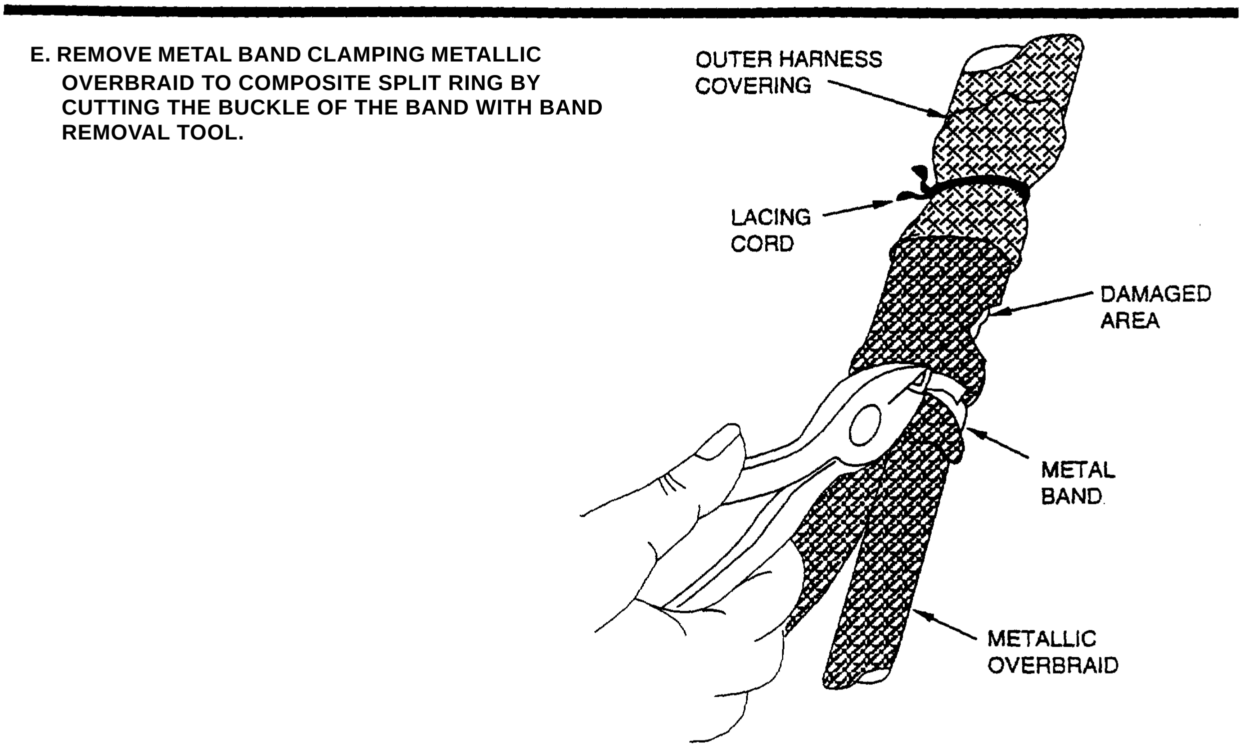
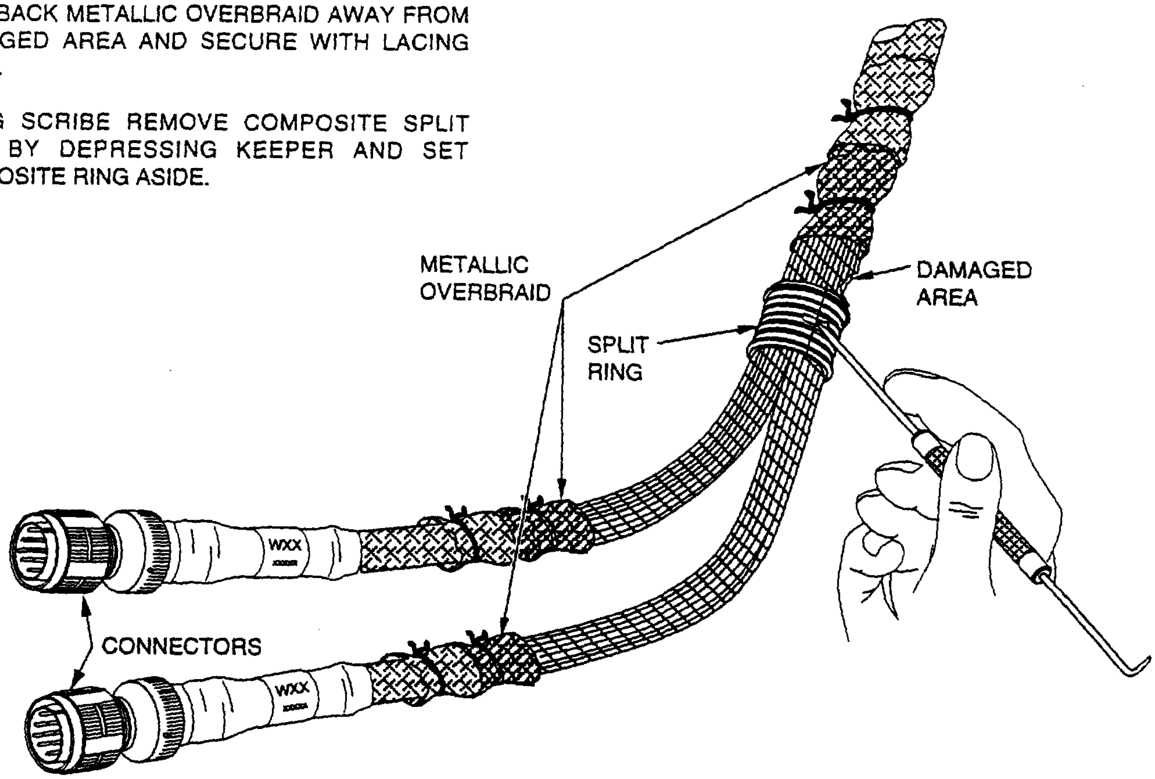


Figure 6. Branched Transition Area Repair (Sheet 2)

F. PULL BACK METALLIC OVERBRAID AWAY FROM DAMAGED AREA AND SECURE WITH LACING CORD.

G. USING SCRIBE REMOVE COMPOSITE SPLIT RING BY DEPRESSING KEEPER AND SET COMPOSITE RING ASIDE.



H. DETERMINE THE AMOUNT OF DAMAGE AND REPAIR USING THE PROCEDURES IN FIGURES 3 THRU 5.

I. INSPECT DAMAGE TO COMPOSITE SPLIT RING TO DETERMINE APPROPRIATE METHOD OF REPAIR.

J. IF COMPOSITE SPLIT RING IS DAMAGED BEYOND USE AND SPARE SPLIT RING IS NOT AVAILABLE PROCEED TO STEPS K THRU W. IF COMPOSITE SPLIT RING IS NOT DAMAGED BEYOND USE OR SPARE SPLIT RING IS AVAILABLE PROCEED TO STEPS X THRU AI.

Figure 6. Branched Transition Area Repair (Sheet 3)

K. CUT LACING CORD SECURING METALLIC OVERBRAID ON EACH BRANCHED HARNESS LEG, WORK METALLIC OVERBRAID ON EACH LEG BACK OVER REPAIRED AREA AS FAR AS POSSIBLE.

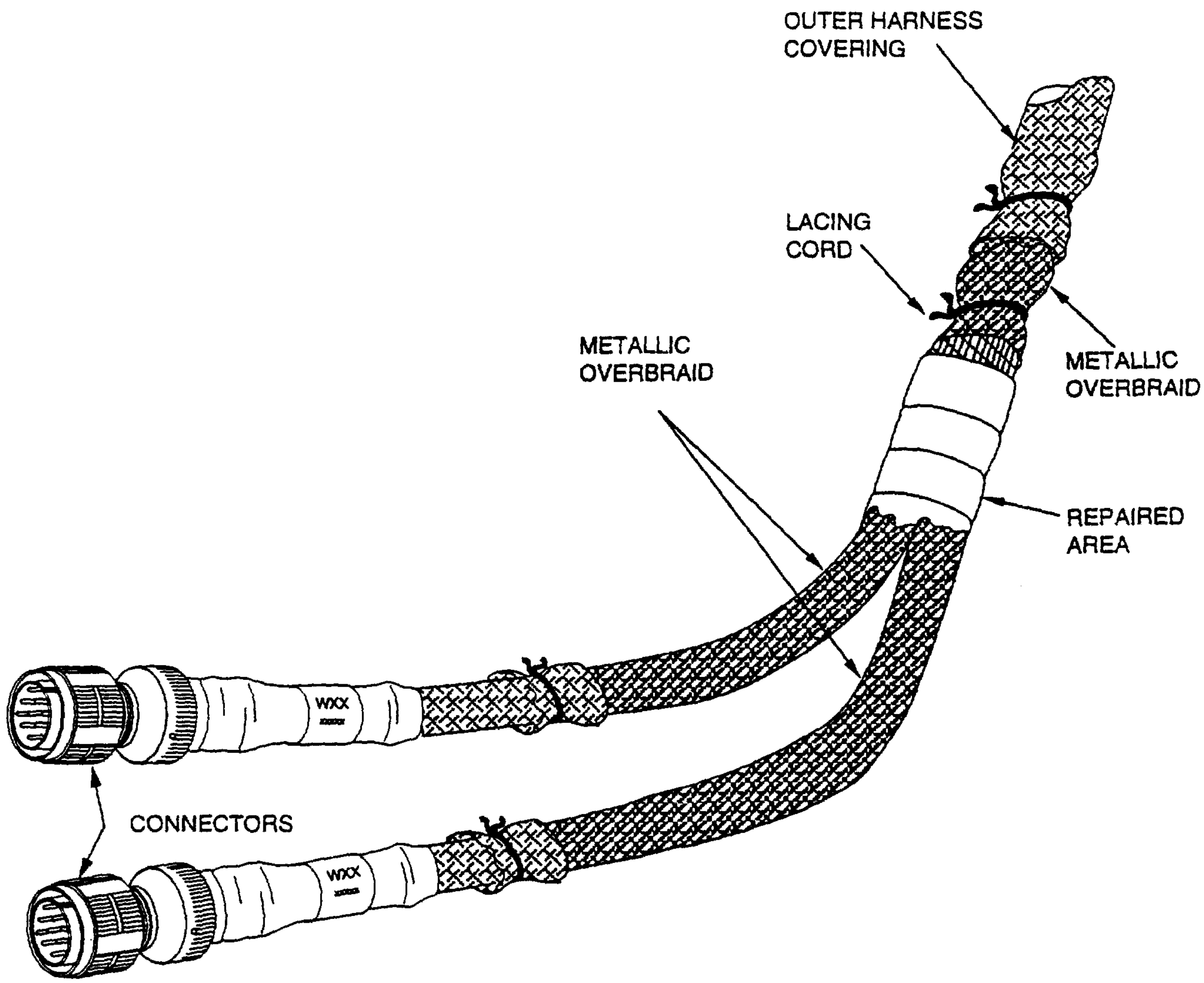


Figure 6. Branched Transition Area Repair (Sheet 4)

WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PRO–LONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOM–MENDED. WASH HANDS AFTER USE.

L. CLEAN INSULATION AT ENDS OF WIRES TO BE SPLICED, WITH ISOPROPYL ALCOHOL.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

M. HOLDING METALLIC OVERBRAID IN PLACE BY WRAPPING EACH HARNESS LEG WHERE OVERBRAID ENDS USING ADHESIVE COPPER FOIL TAPE BEGINNING 2 INCHES ON METALLIC OVERBRAID AND CONTINUING 2 INCHES ON WIRE RIBBONS FOR EACH HARNESS LEG WHILE APPLYING PRESSURE TO ENSURE ADHESION OF COPPER FOIL TAPE, OVERLAPPING EACH WRAP 50 PERCENT.

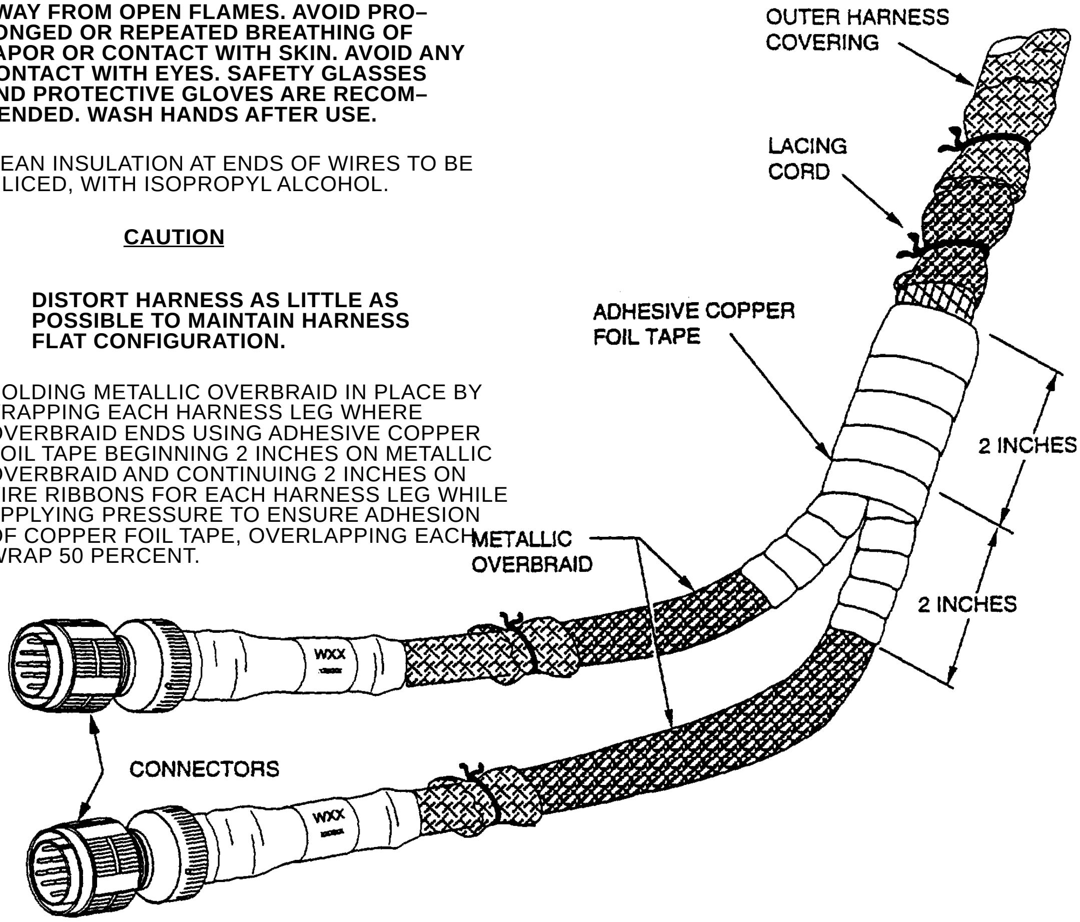


Figure 6. Branched Transition Area Repair (Sheet 5)

WARNING

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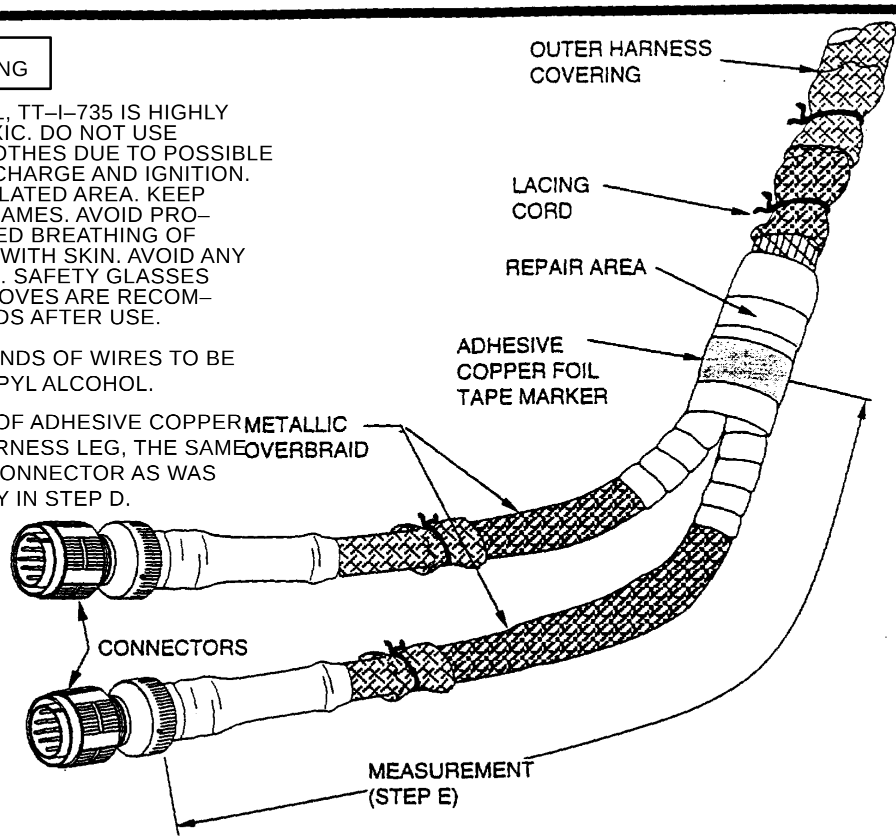
N. CLEAN INSULATION AT ENDS OF WIRES TO BE SPLICED, WITH ISOPROPYL ALCOHOL.

O. PLACE A SINGLE WRAP OF ADHESIVE COPPER FOIL TAPE AROUND HARNESS LEG, THE SAME DISTANCE FROM THE CONNECTOR AS WAS MEASURED PREVIOUSLY IN STEP D.



WARNING

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P. CLEAN INSULATION AT ENDS OF WIRES TO BE SPLICED WITH ISOPROPYL ALCOHOL.

Q. TAPE FIRST LEG TO NEXT ADJACENT HARNESS LEG USING ADHESIVE COPPER FOIL TAPE CONTINUE ADDING A HARNESS LEG WITH EACH WRAP OF ADHESIVE COPPER FOIL TAPE UNTIL ALL HARNESS LEGS ARE TAPED TOGETHER AND BRANCH AT APPROXIMATE POINT AS BEFORE HARNESS WAS DAMAGED.

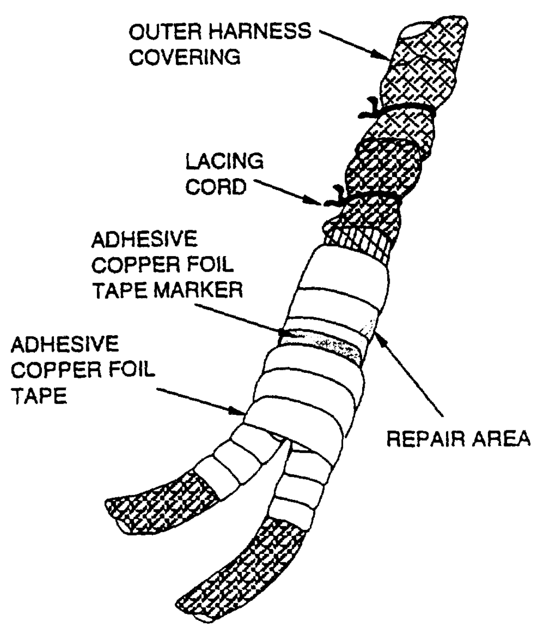

Figure 6. Branched Transition Area Repair (Sheet 6)

WARNING

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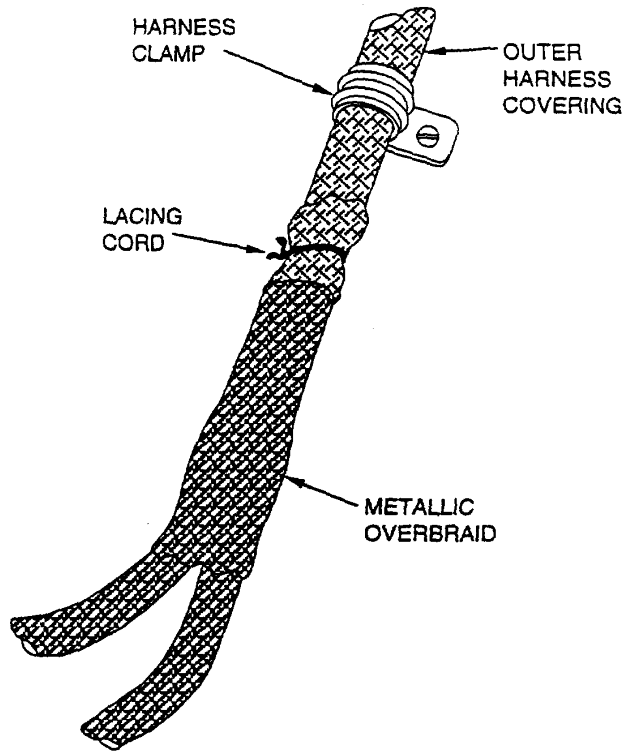
R. CLEAN INSULATION AT ENDS OF WIRES TO BE SPLICED WITH ISOPROPYL ALCOHOL.

S. PULL METALLIC OVERBRAID FROM MAIN HARNESS LEG OVER INDIVIDUAL HARNESS LEGS. REACH BACK TO LAST HARNESS CLAMP THAT WAS NOT REMOVED AND WORK METALLIC OVERBRAID TOWARD REPAIR AREA IN ORDER TO COVER AS MUCH OF HARNESS AS POSSIBLE.



T. HOLDING METALLIC OVERBRAID FROM MAIN HARNESS LEG TIGHT, WRAP ADHESIVE COPPER FOIL TAPE OVER METALLIC OVERBRAID COVERING APPROXIMATELY 2 INCHES ON MAIN HARNESS LEG AND 2 INCHES OVER BRANCHED HARNESS LEG.

U. INSPECT METALLIC OVERBRAID TO ENSURE THAT IT DID NOT SLIDE BACK AWAY FROM REPAIR AREA. REPEAT WRAP WITH ADHESIVE COPPER FOIL TAPE OVER REPAIR AREA IF NECESSARY.

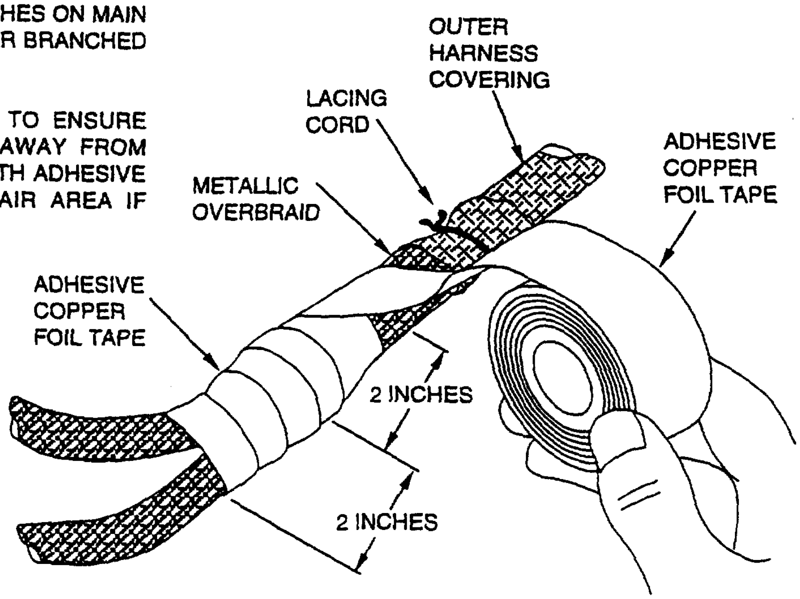
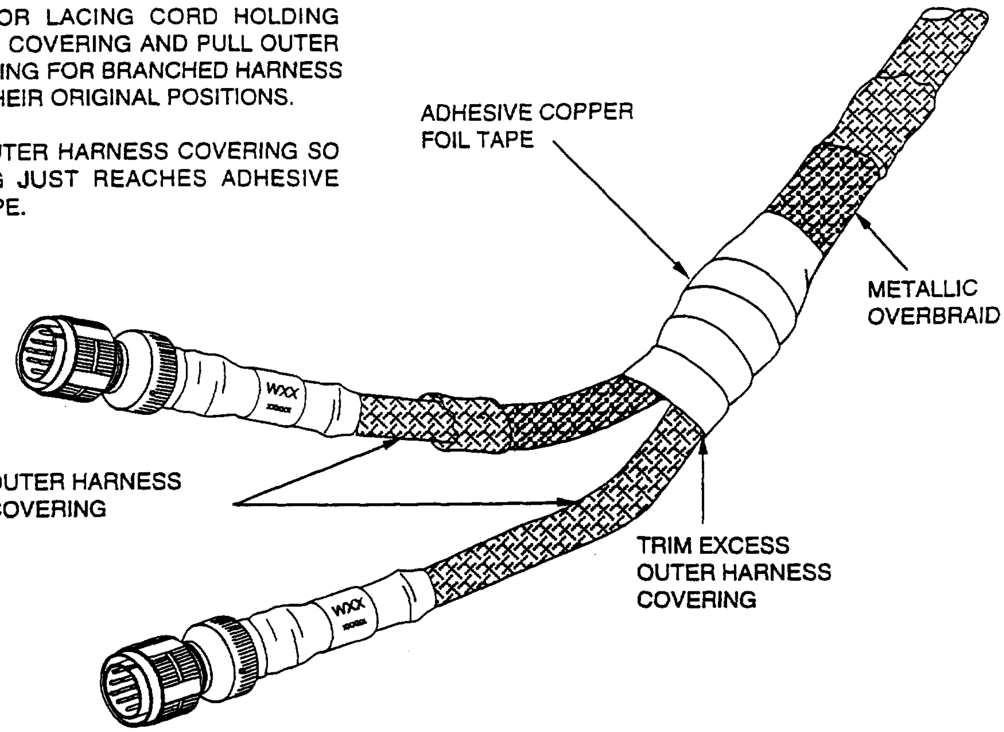


Figure 6. Branched Transition Area Repair (Sheet 7)

V. REMOVE TAPE OR LACING CORD HOLDING OUTER HARNESS COVERING AND PULL OUTER HARNESS COVERING FOR BRANCHED HARNESS LEGS BACK TO THEIR ORIGINAL POSITIONS.

W. TRIM EXCESS OUTER HARNESS COVERING SO THAT EACH LEG JUST REACHES ADHESIVE COPPER FOIL TAPE.



X. PULL OUTER HARNESS COVERING FROM MAIN HARNESS LEG BACK OVER REPAIR AREA COVERING AS MUCH OF HARNESS AS POSSIBLE, SECURE WITH LACING CORD.

WARNING

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Y. CLEAN INSULATION AT ENDS OF WIRES TO BE SPLICED WITH ISOPROPYL ALCOHOL.

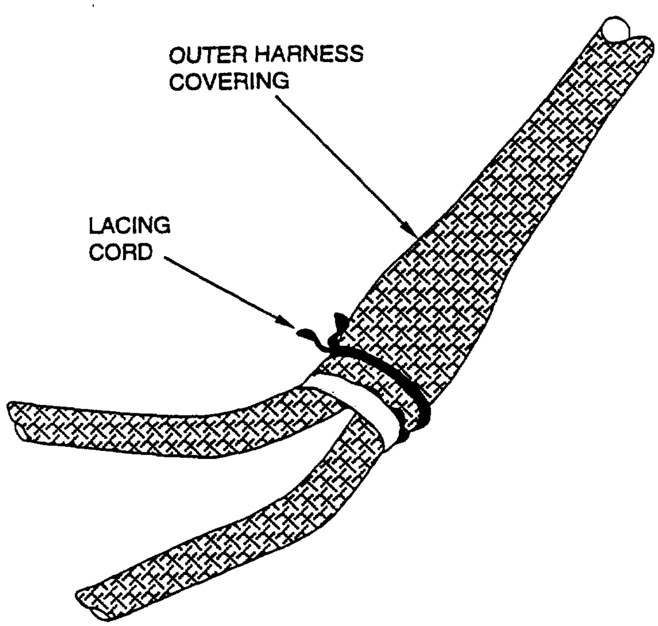
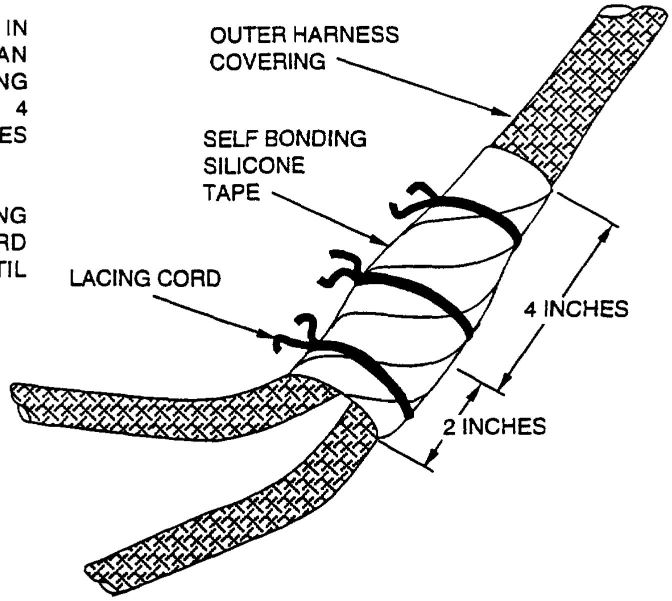


Figure 6. Branched Transition Area Repair (Sheet 8)

Z. HOLDING OUTER HARNESS COVERING IN PLACE, WRAP REPAIR AREA WITH AN OVERLAPPING WRAP OF SELF BONDING SILICONE TAPE WITH APPROXIMATELY 4 INCHES ON MAIN HARNESS LEG AND 2 INCHES ON BRANCHED LEGS.

AA. TERMINATE OVERLAPPING SELF BONDING SILICONE TAPE BY TYING LACING CORD AROUND HARNESS TO HOLD TAPE UNTIL BONDING OCCURS.



AB. CHECK BRANCHED HARNESS LEGS TO ENSURE THAT ALL LEGS WILL REACH APPROXIMATELY THE SAME LENGTH AS BEFORE DAMAGE AND THAT ALL CONNECTORS ON BRANCHED LEGS ARE STILL MATEABLE.

AC. CUT LACING CORD SECURING METALLIC OVERBRAID ON EACH BRANCHED HARNESS LEG. WORK METALLIC OVERBRAID ON EACH LEG BACK OVER REPAIRED AREA AS FAR AS POSSIBLE.

NOTE

SHOULD THE SIZE OF THE REPAIR CAUSE THE HARNESS DIAMETER TO INCREASE SIGNIFICANTLY, THEN A LARGER SIZE COMPOSITE SPLIT RING WILL BE REQUIRED.

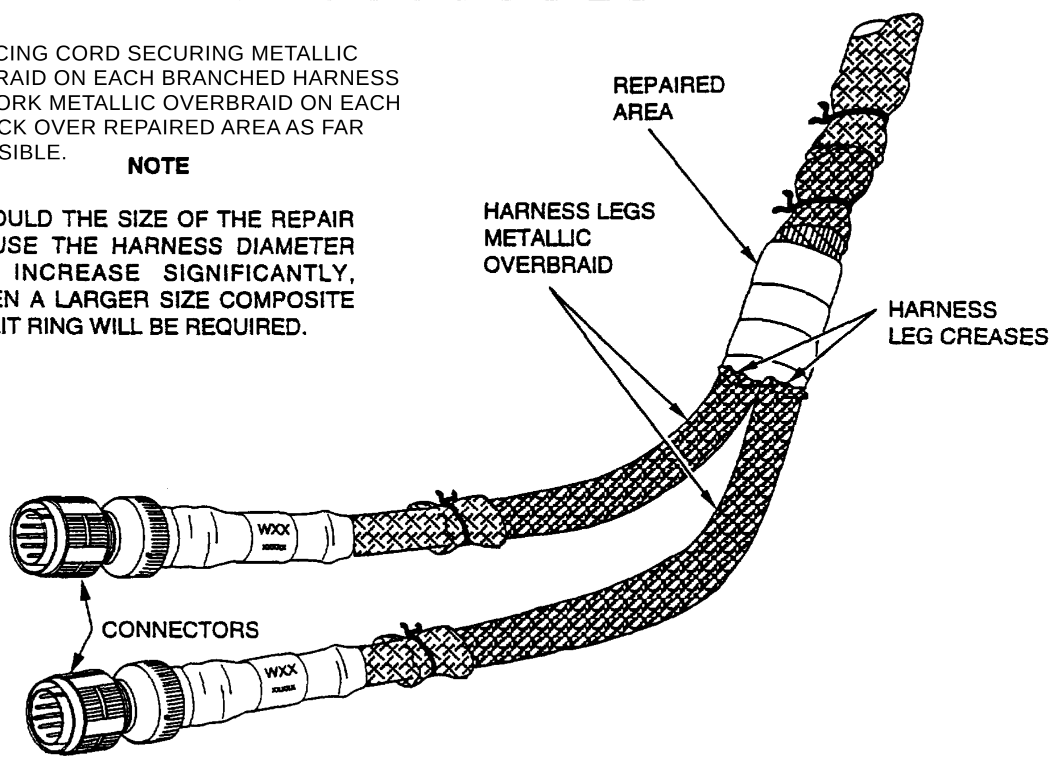


Figure 6. Branched Transition Area Repair (Sheet 9)

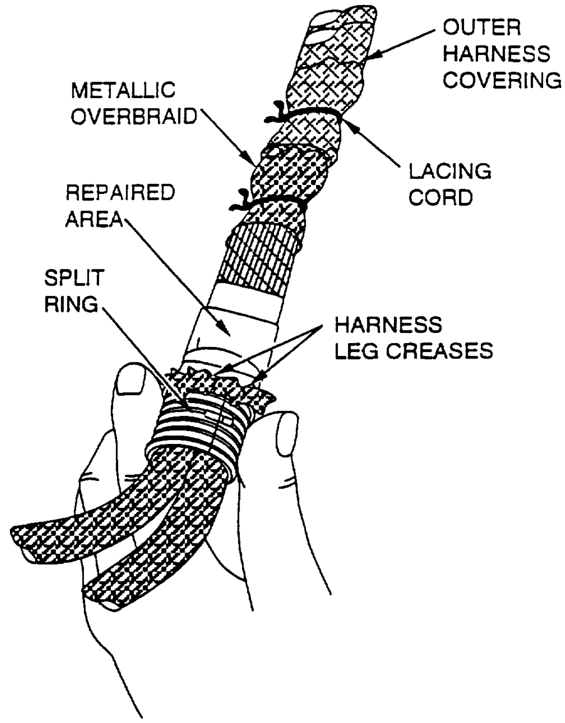
AD. LOCATE THE CREASES ON HARNESS LEG METALLIC OVERBRAIDS WHERE THEY WERE ORIGINALLY FOLDED BACK OVER COMPOSITE SPLIT RING.

AE. USING CREASE AS A GUIDE INSTALL REPLACEMENT COMPOSITE SPLIT RING BY PLACING ON EACH SIDE OF HARNESS AND PRESS UNTIL IT SNAPS TOGETHER.

AF. FOLD THE METALLIC OVERBRAIDS ON EACH HARNESS LEG BACK OVER COMPOSITE SPLIT RING AT THE ORIGINAL CREASE MARK. SPACE INDIVIDUAL METALLIC OVERBRAIDS AROUND COMPOSITE SPLIT RING CIRCUMFERENCE.

NOTE

AVOID PLACING METALLIC OVERBRAIDS ON TOP OF EACH OTHER IF POSSIBLE.



AG. PULL METALLIC OVERBRAID FROM MAIN HARNESS LEG OVER COMPOSITE SPLIT RING. REACH BACK TO LAST HARNESS CLAMP THAT WAS NOT REMOVED AND WORK METALLIC OVERBRAID TOWARD REPAIR AREA IN ORDER TO KEEP METALLIC OVERBRAID PULLED AS TIGHT AS POSSIBLE.

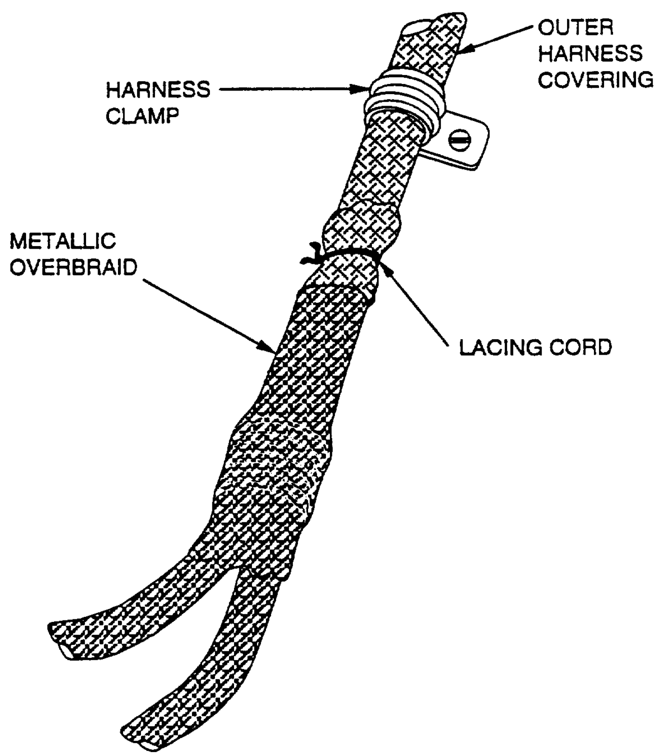
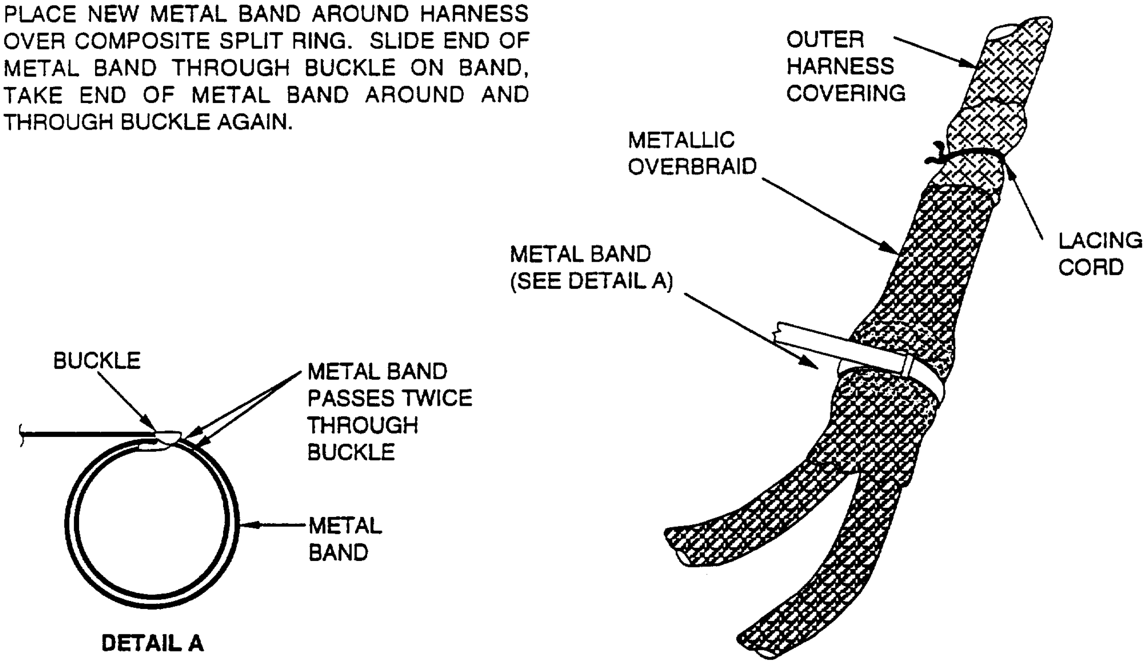


Figure 6. Branched Transition Area Repair (Sheet 10)

AH. PLACE NEW METAL BAND AROUND HARNESS OVER COMPOSITE SPLIT RING. SLIDE END OF METAL BAND THROUGH BUCKLE ON BAND, TAKE END OF METAL BAND AROUND AND THROUGH BUCKLE AGAIN.



AI. ENSURE METAL BAND IS CENTERED OVER COMPOSITE SPLIT RING USING BANDING TOOL (WP 011 00) TIGHTEN METAL BAND AROUND HARNESS.

NOTE

PULL ON EACH METALLIC OVERBRAID TO VERIFY THE METAL BAND IS HOLDING METALLIC OVERBRAIDS TIGHTLY.

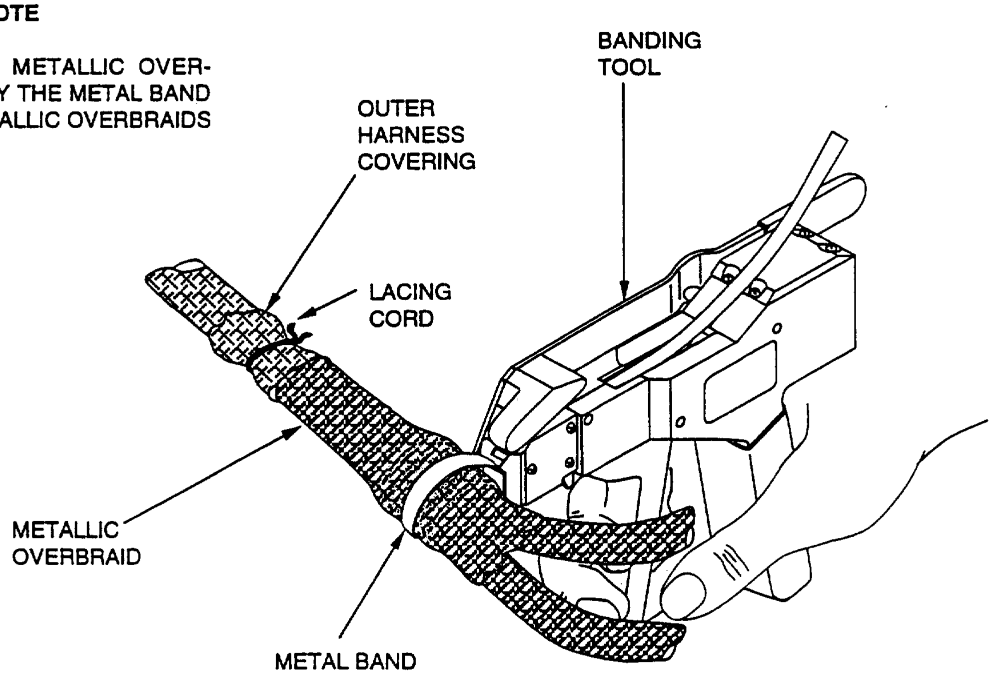
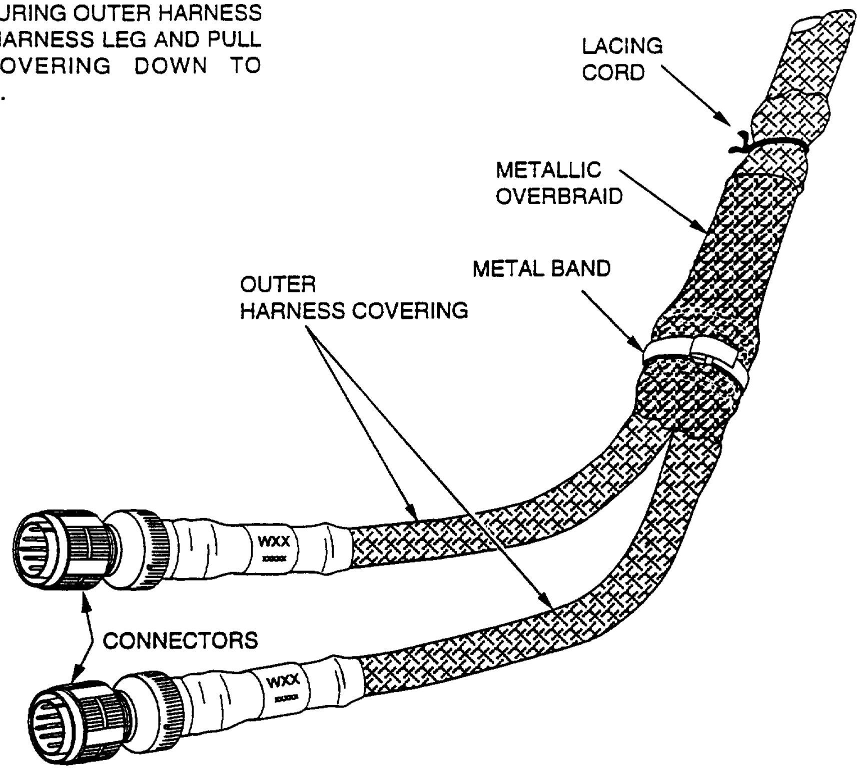


Figure 6. Branched Transition Area Repair (Sheet 11)

AJ. CUT LACING CORD SECURING OUTER HARNESS COVERING FOR EACH HARNESS LEG AND PULL OUTER HARNESS COVERING DOWN TO COMPOSITE SPLIT RING.



AK. CUT LACING CORD SECURING OUTER HARNESS COVERING FOR MAIN HARNESS LEG AND PULL OUTER HARNESS COVERING TOWARD COMPOSITE SPLIT RING, COVERING AS MUCH OF METALLIC OVERBRAID AS POSSIBLE.

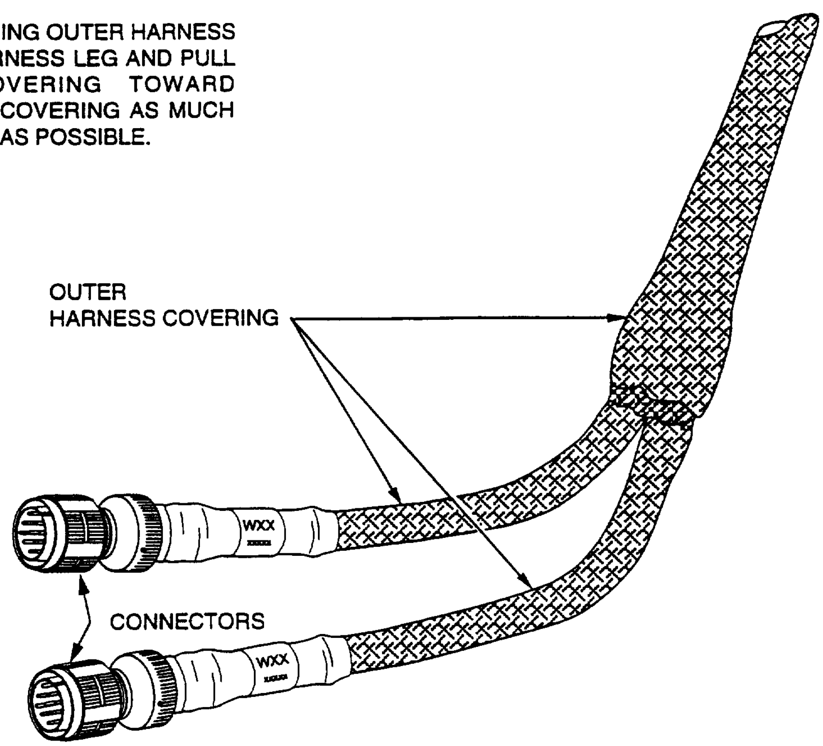
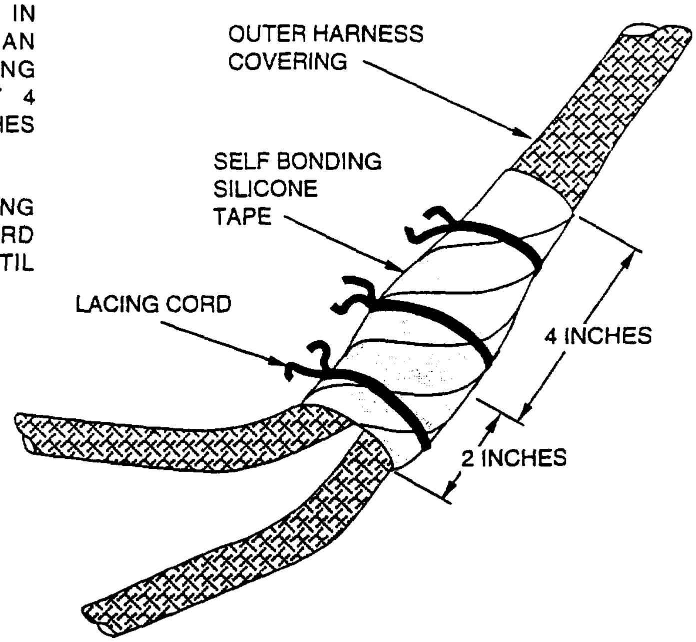


Figure 6. Branched Transition Area Repair (Sheet 12)

AL. HOLDING OUTER HARNESS COVERING IN PLACE, WRAP REPAIR AREA WITH AN OVERLAPPING WRAP OF SELF BONDING SILICONE TAPE WITH APPROXIMATELY 4 INCHES ON MAIN HARNESS LEG AND 2 INCHES ON BRANCHED LEGS.

AM. TERMINATE OVERLAPPING SELF BONDING SILICONE TAPE BY TYING LACING CORD AROUND HARNESS TO HOLD TAPE UNTIL BONDING OCCURS.



AN. CHECK BRANCHED HARNESS LEGS TO ENSURE THAT ALL LEGS WILL REACH APPROXIMATELY THE SAME LENGTH AS BEFORE DAMAGE AND THAT ALL CONNECTORS ON BRANCHED LEGS ARE STILL MATEABLE.

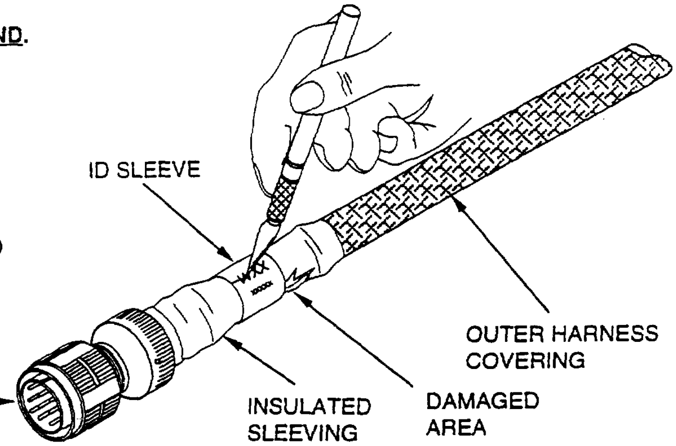
Figure 6. Branched Transition Area Repair (Sheet 13)

7. COPPER FOIL SHIELD REPAIR AT TERMINATION END.

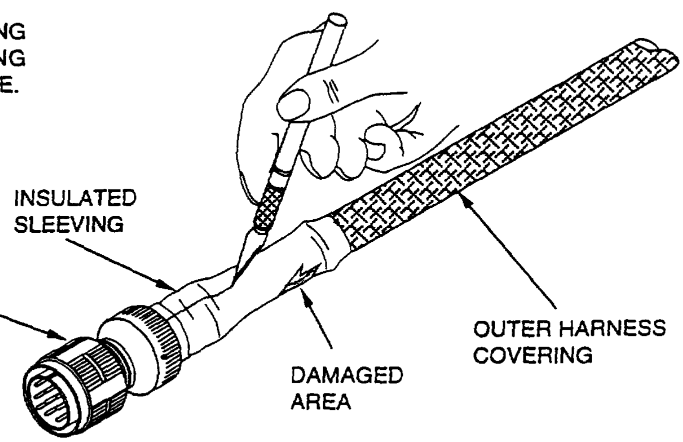
NOTE

ANY BROKEN SOLDER JOINT BETWEEN COPPER FOIL AND BRAID TAIL WILL REQUIRE RESOLDERING.

A. REMOVE WHITE HARNESS ID SLEEVE AND RETAIN.



B. REMOVE BLACK SHRINK SLEEVING COVERING HARNESS BRANCH BY SCORING ALONG LENGTH OF SLEEVING WITH AN EXACTO KNIFE.



NOTE

FOR PREPARATION, USE AND OPERATION OF HEAT GUN. REFER TO WP 012 00

C. USING HEATING TOOL WITH SMALL NOZZLE AND NEEDLE NOSE PLIERS, APPLY HEAT AND WITH PLIERS PEEL OFF SLEEVING AND TUBING.

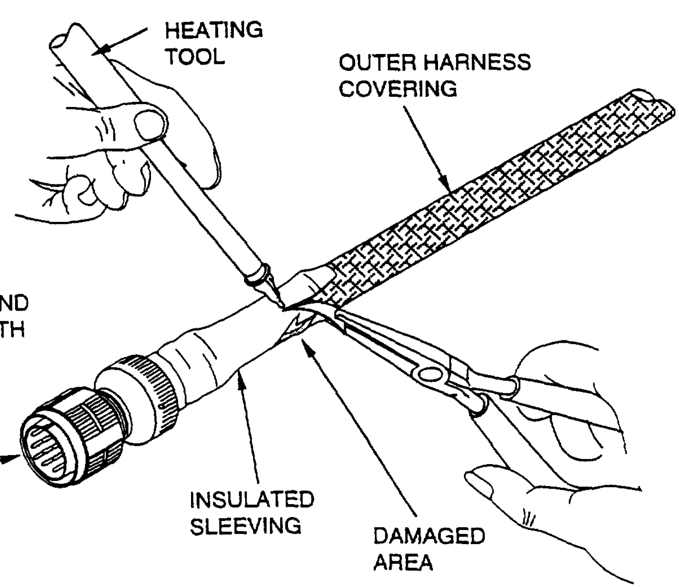
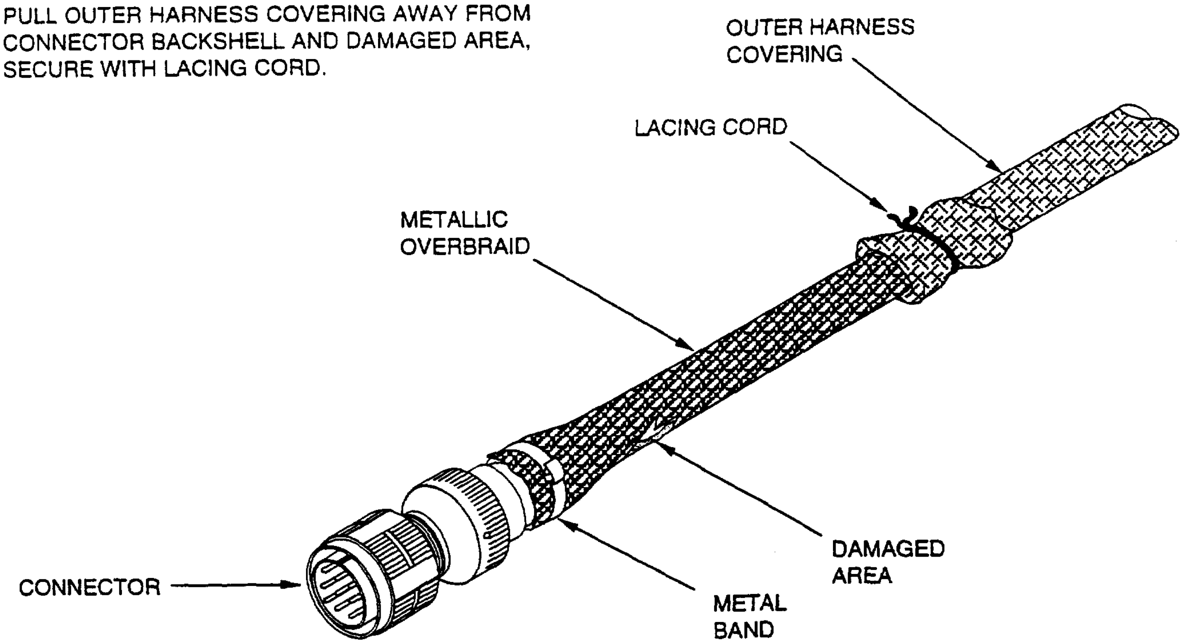


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 1 of 12)

D. PULL OUTER HARNESS COVERING AWAY FROM CONNECTOR BACKSHELL AND DAMAGED AREA, SECURE WITH LACING CORD.



E. USING BAND REMOVAL TOOL CUT METAL BAND AT BUCKLE AND REMOVE.

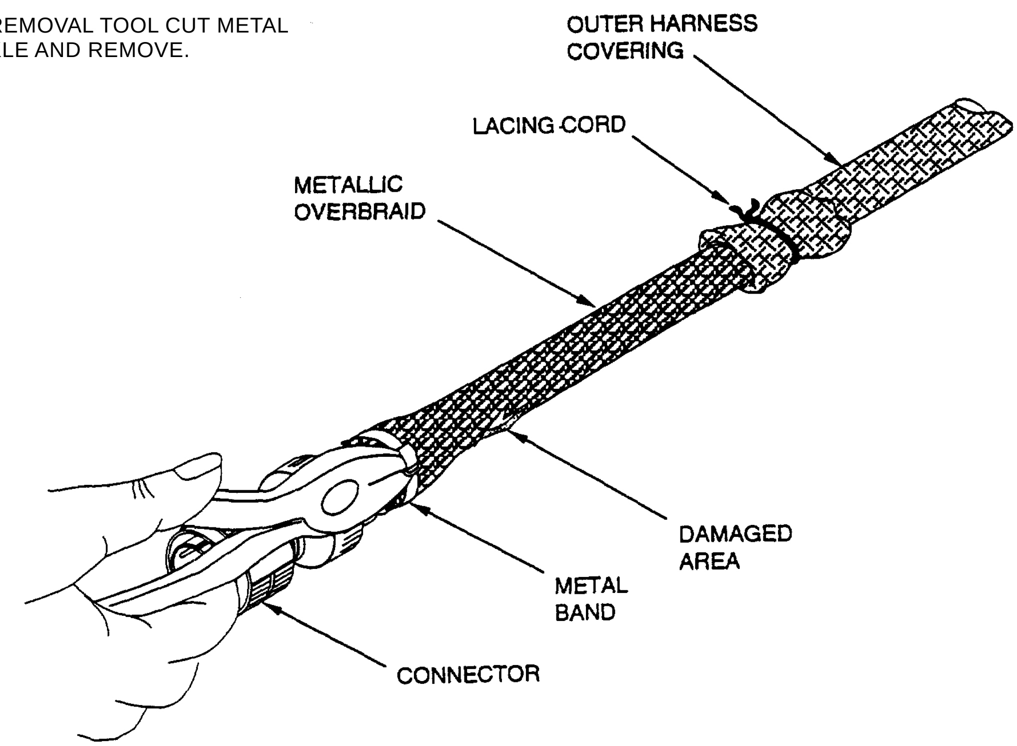
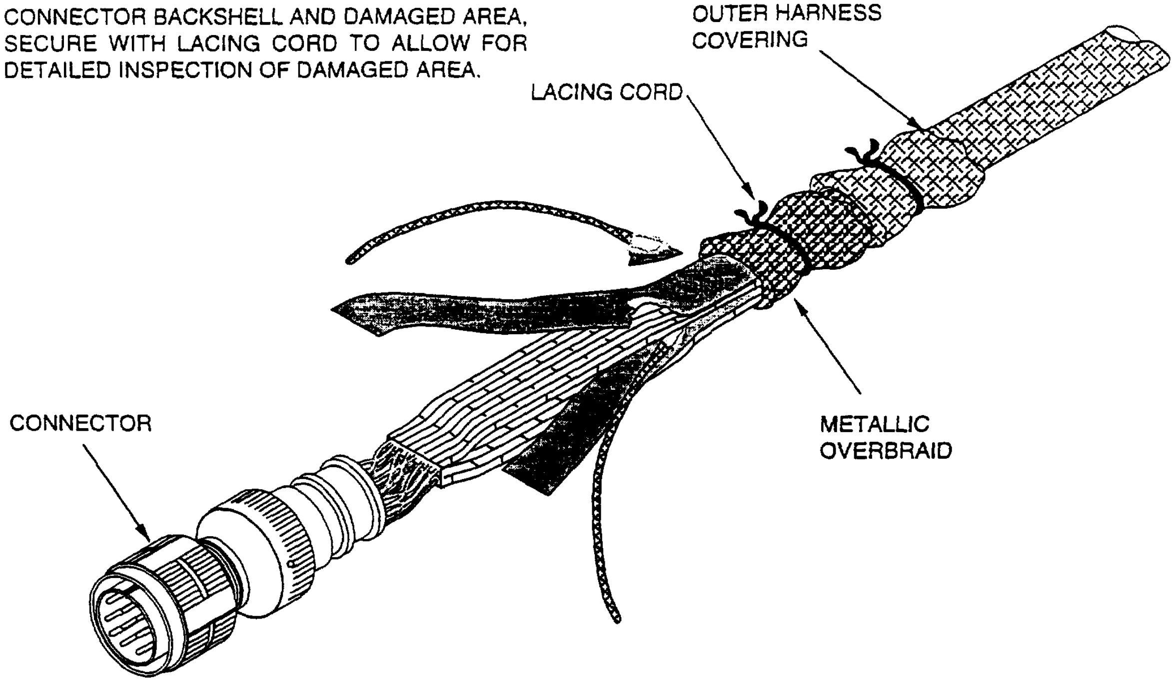


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 2)

F. PULL METALLIC OVERBRAID AWAY FROM CONNECTOR BACKSHELL AND DAMAGED AREA, SECURE WITH LACING CORD TO ALLOW FOR DETAILED INSPECTION OF DAMAGED AREA.



G. IF BRAID TAIL IS DAMAGED REFER TO FIGURE 8 FOR REPAIR.

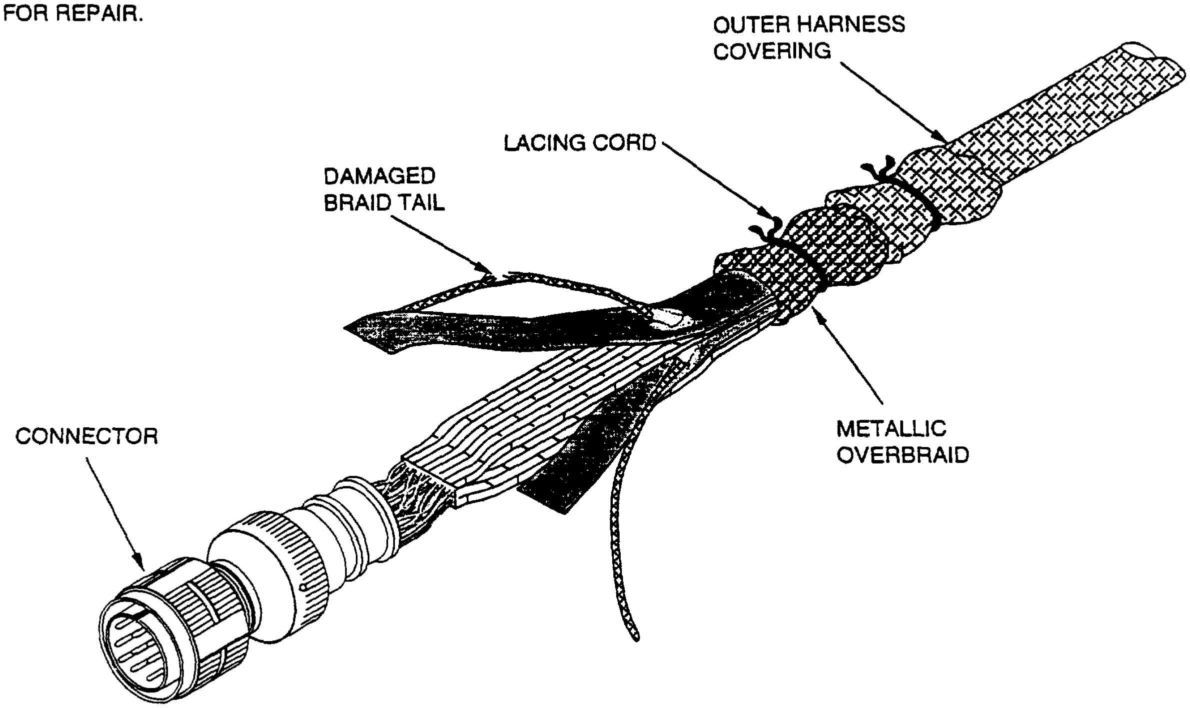
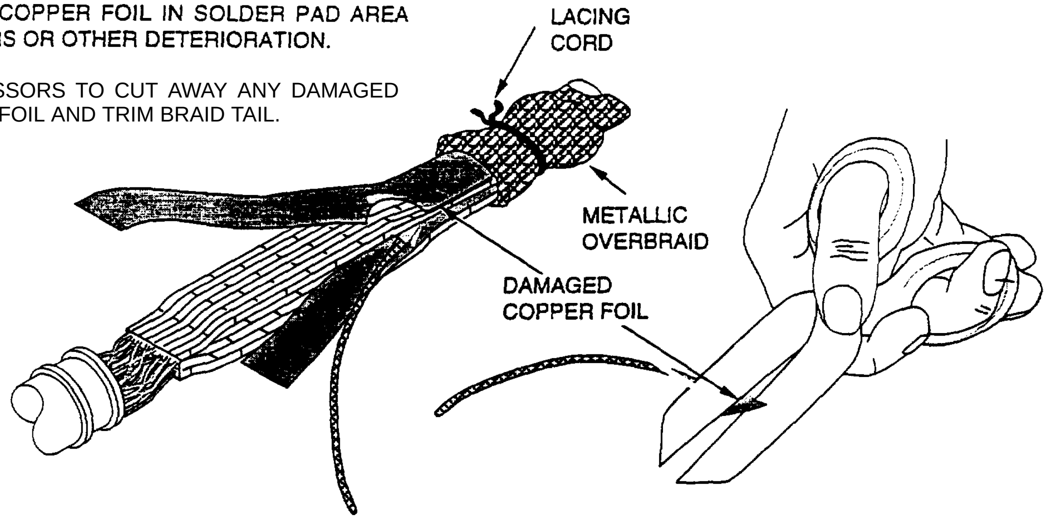


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 3)

H. INSPECT COPPER FOIL IN SOLDER PAD AREA FOR TEARS OR OTHER DETERIORATION.

I. USE SCISSORS TO CUT AWAY ANY DAMAGED COPPER FOIL AND TRIM BRAID TAIL.



WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POS–SIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.

J. USING ISOPROPYL ALCOHOL CLEAN AND DRY COPPER FOIL SHIELD TO ENSURE ADHESION OF COPPER FOIL TAPE.

K. USING 1 CR 2 PIECE/PIECES OF ADHESIVE COPPER FOIL, TAPE TWICE THE SIZE OF DAMAGED AREA, RE–ESTABLISH EDGE/EDGES BY FOLDING AND PLACING ALONG DAMAGED AREA.

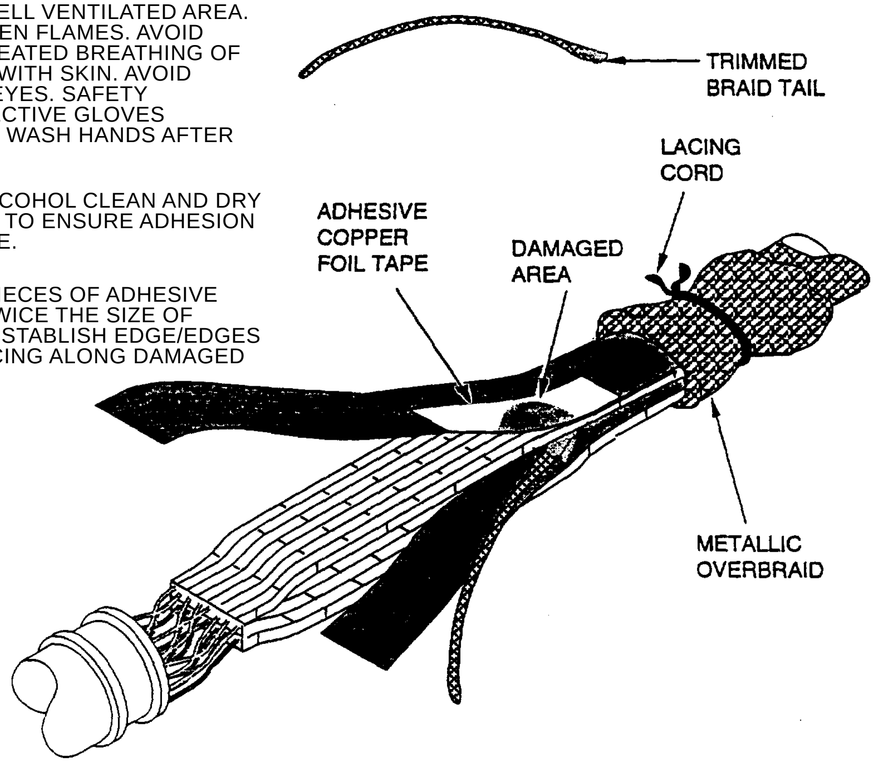
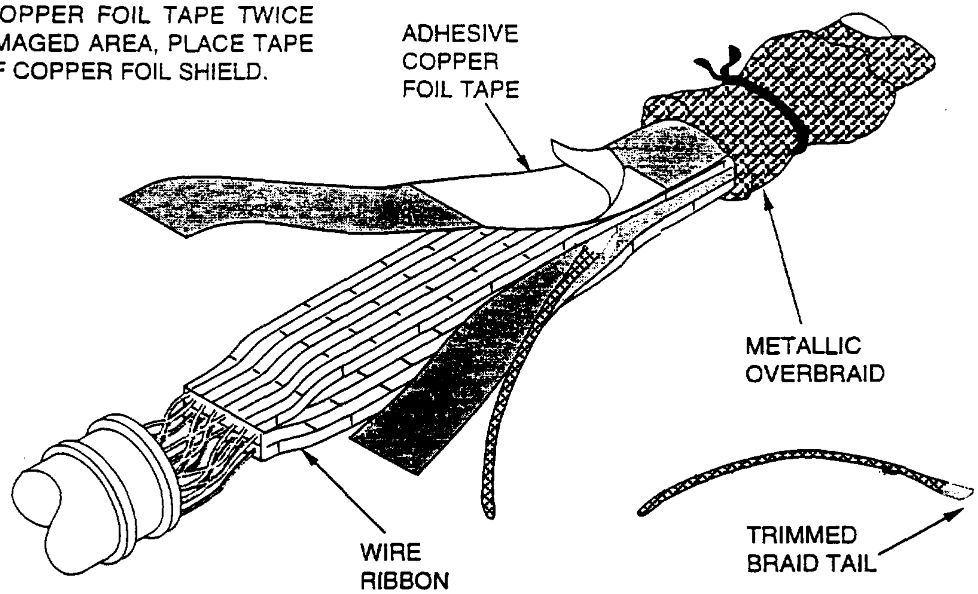


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 4)

L. USING ADHESIVE COPPER FOIL TAPE TWICE THE LENGTH OF DAMAGED AREA, PLACE TAPE COVERING WIDTH OF COPPER FOIL SHIELD.



CAUTION

BEFORE SOLDERING ENSURE WIRES ARE PULLED AWAY FROM COPPER FOIL SHIELD TO PREVENT DAMAGE TO WIRES.

M. USING SOLDERING IRON RETIN THE TINNED END OF BRAID TAIL.

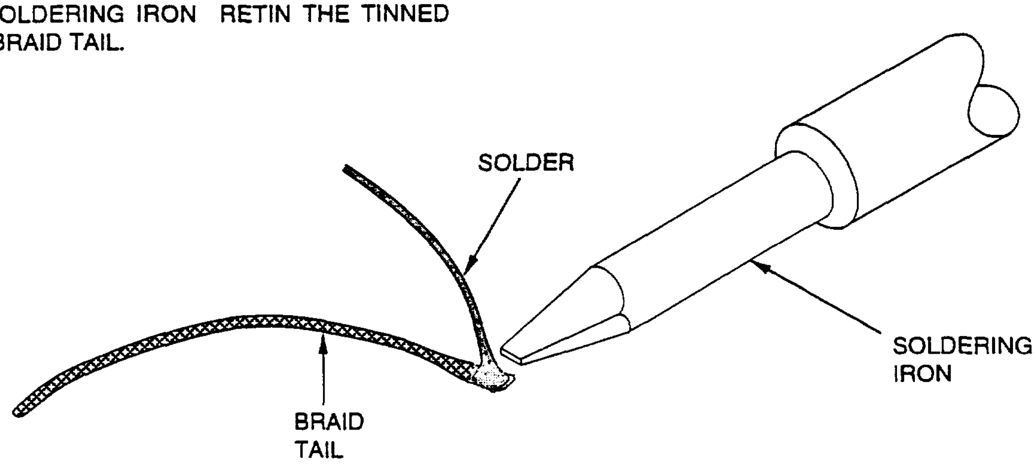


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 5)

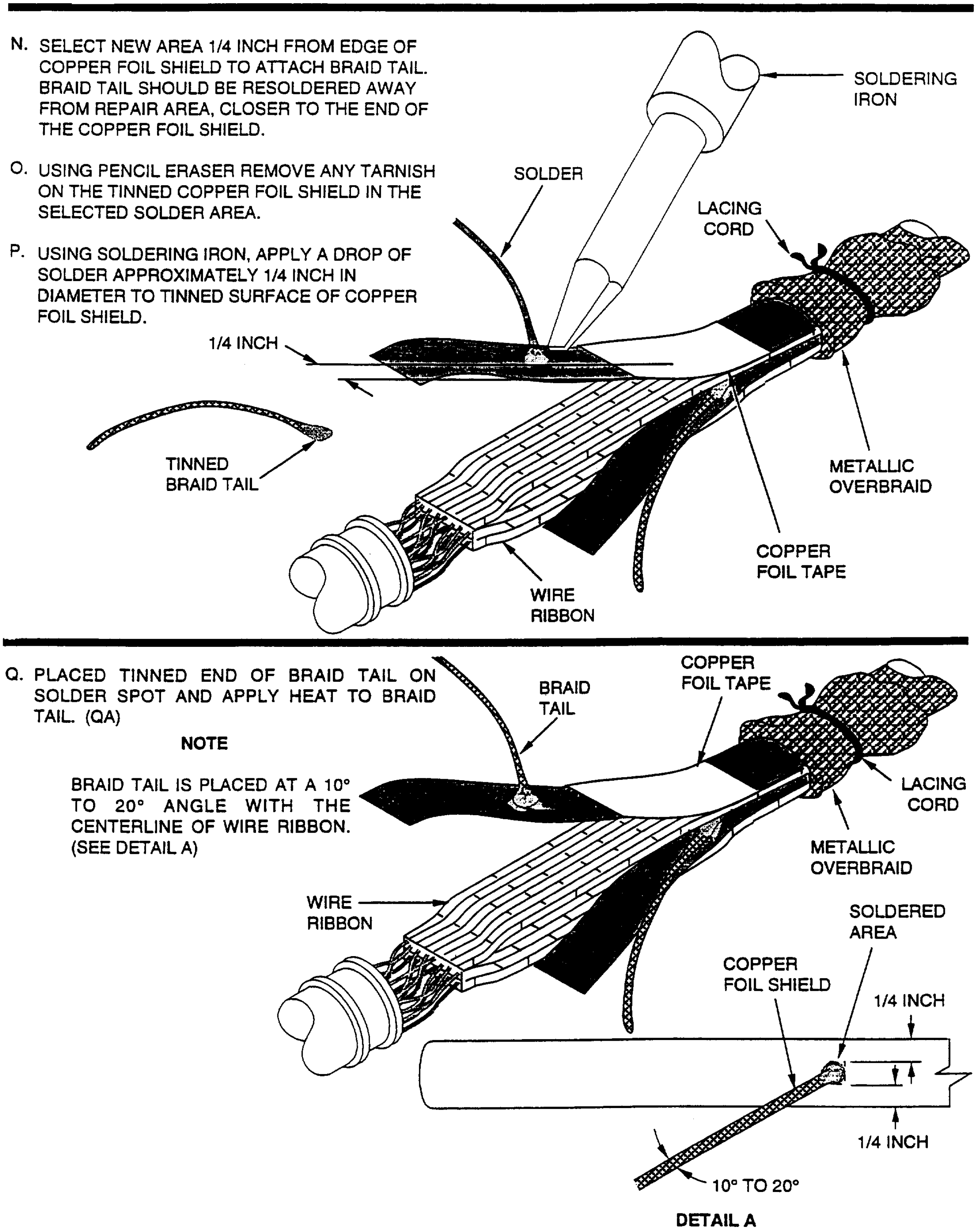
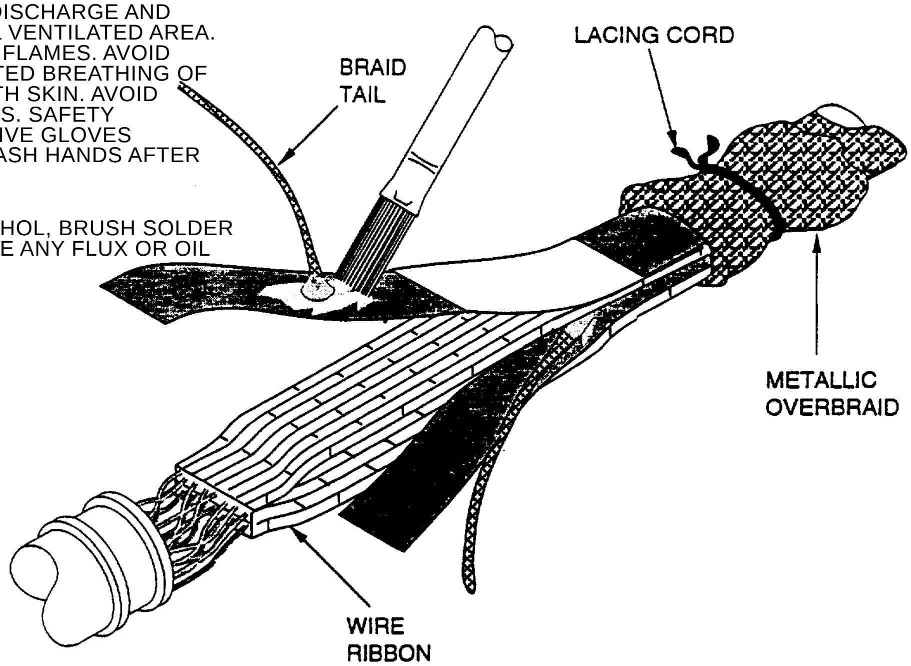


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 6)

WARNING

ISOPROPYL ALCOHOL, TT–I–735 IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE SYNTHETIC WIPE CLOTHES DUE TO POSSIBLE ELECTROSTATIC DISCHARGE AND IGNITION. USE IN A WELL VENTILATED AREA. KEEP AWAY FROM OPEN FLAMES. AVOID PROLONGED OR REPEATED BREATHING OF VAPOR OR CONTACT WITH SKIN. AVOID ANY CONTACT WITH EYES. SAFETY GLASSES AND PROTECTIVE GLOVES ARE RECOMMENDED. WASH HANDS AFTER USE.

R. USING ISOPROPYL ALCOHOL, BRUSH SOLDER CONNECTION TO REMOVE ANY FLUX OR OIL PRESENT.



S. PLACE BRAID TAILS EVENLY ON ONE SIDE OF BANDING AREA OF BACKSHELL.

T. USING CLEAR TEFLON TAPE WRAP A SINGLE LAYER AROUND RIBBON WIRES COVERING BRAID TAILS TO ENSURE BRAID TAILS REMAIN IN POSITION.

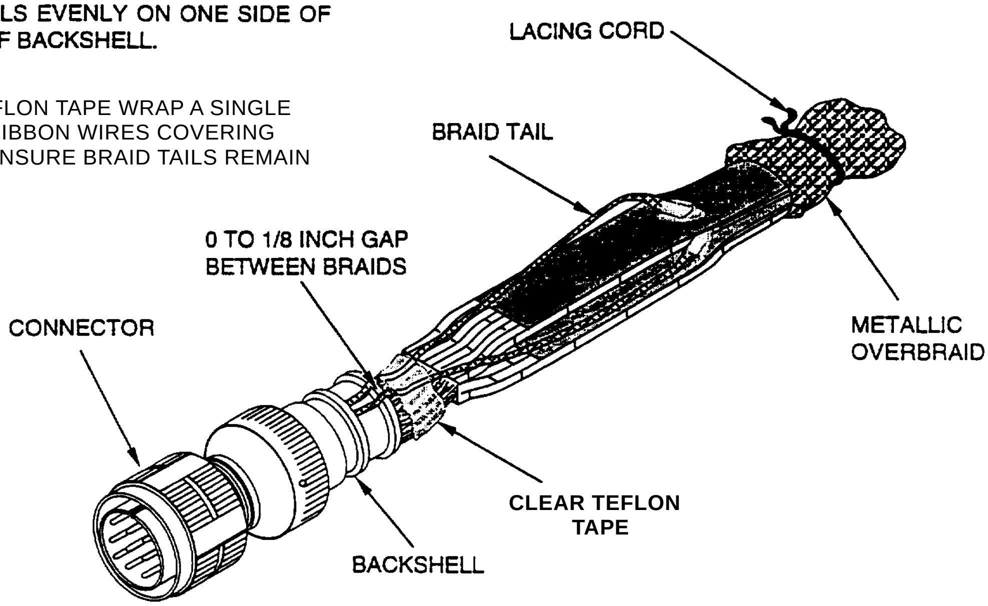


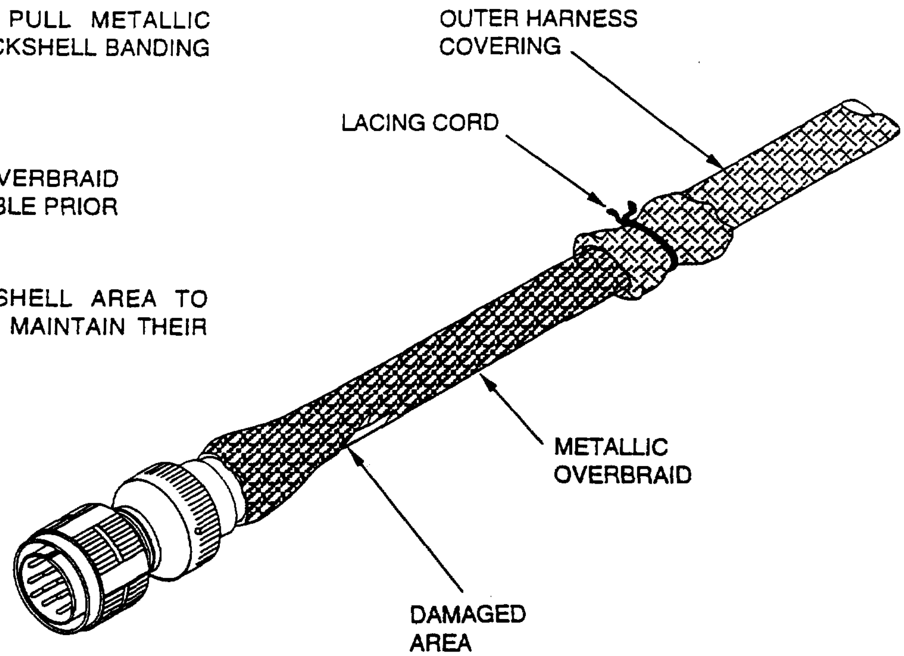
Figure 7. Copper Foil Shield Repair at Termination End (Sheet 7)

U. CUT LACING CORD AND PULL METALLIC OVERBRAID BACK OVER BACKSHELL BANDING AREA.

NOTE

ENSURE METALLIC OVERBRAID IS AS TIGHT AS POSSIBLE PRIOR TO BANDING.

V. VISUALLY INSPECT BACKSHELL AREA TO ENSURE THAT BRAID TAILS MAINTAIN THEIR POSITIONS ON BACKSHELL.



W. PLACE METAL BAND OVER BRAID TAILS AND METALLIC OVERBRAID. USING BANDING TOOL (WP 011 00) CRIMP METAL BAND TO CONNECTOR BACKSHELL BANDING AREA.

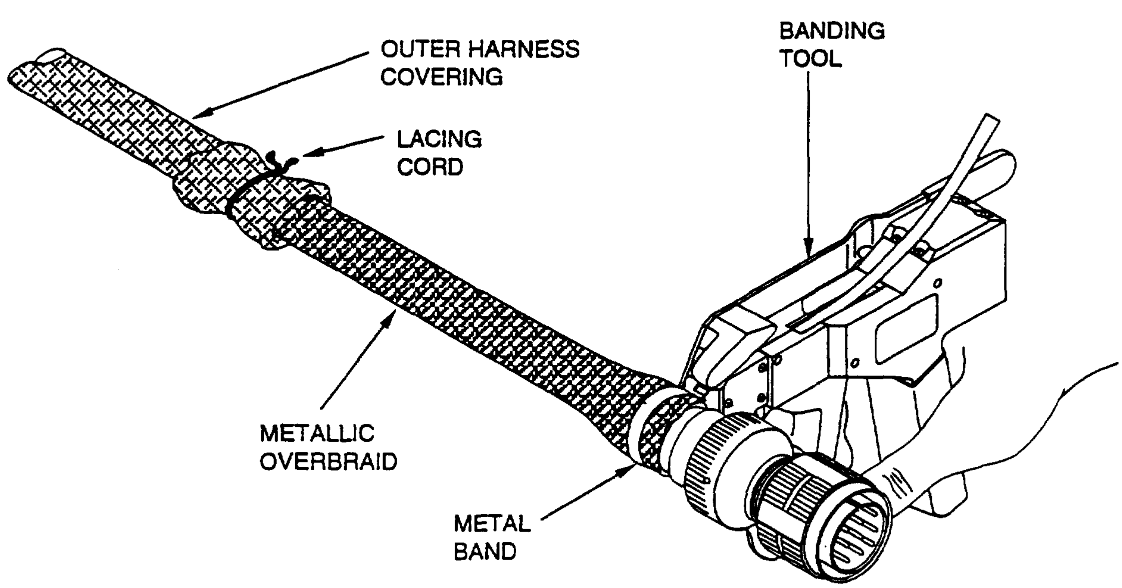
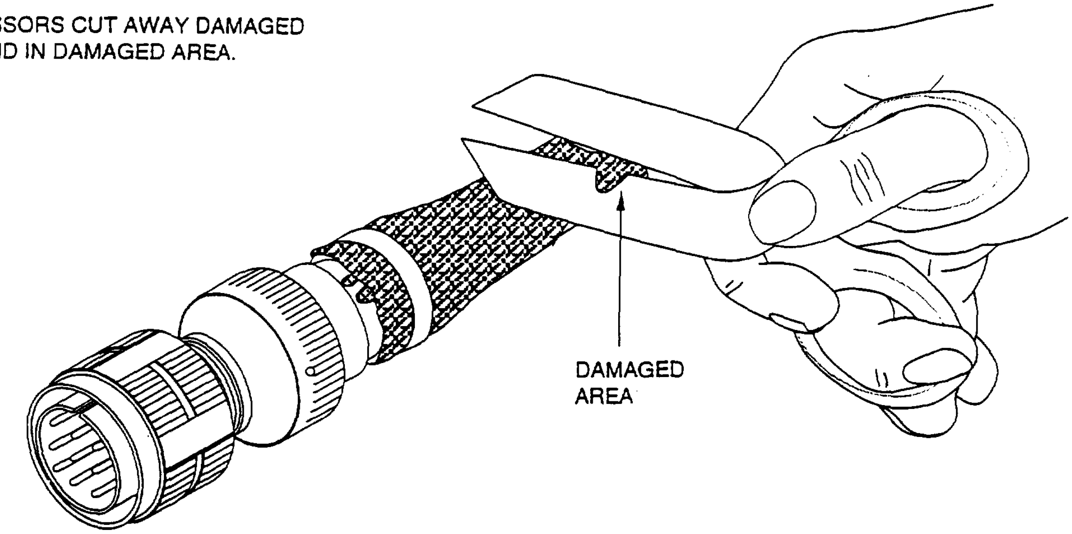


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 8)

X. WITH SCISSORS CUT AWAY DAMAGED OVERBRAID IN DAMAGED AREA.



WARNING

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CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

Y. USING ISOPROPYL ALCOHOL CLEAN AND DRY METALLIC OVERBRAID TO ENSURE ADHESION OF COPPER FOIL TAPE.

Z. BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGED, WRAP ADHESIVE COPPER FOIL TAPE AROUND METALLIC OVERBRAID WHILE APPLYING PRESSURE TO ENSURE ADHESION OF TAPE TO OVERBRAID, OVERLAPPING EACH WRAP 50 PERCENT.

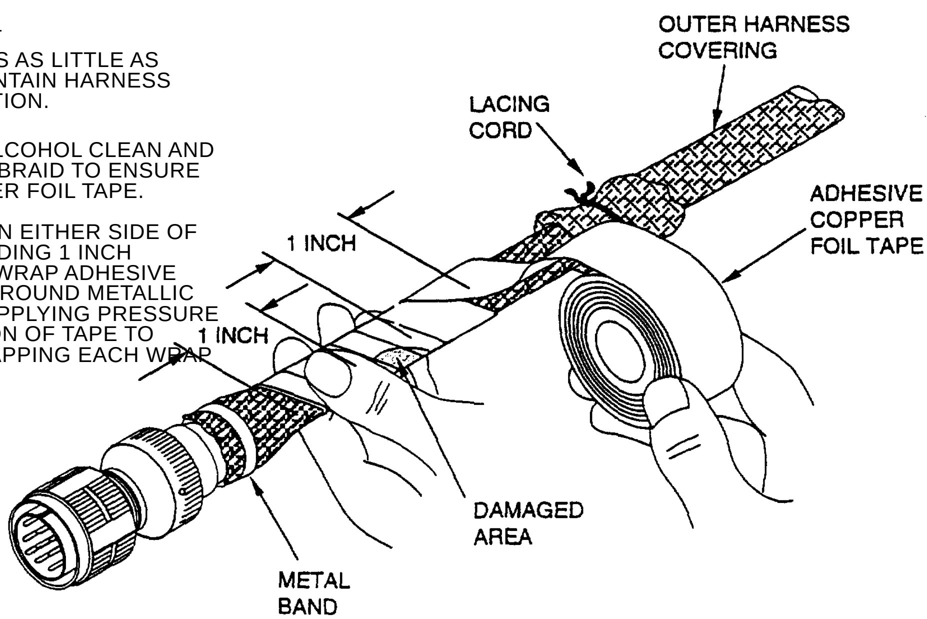
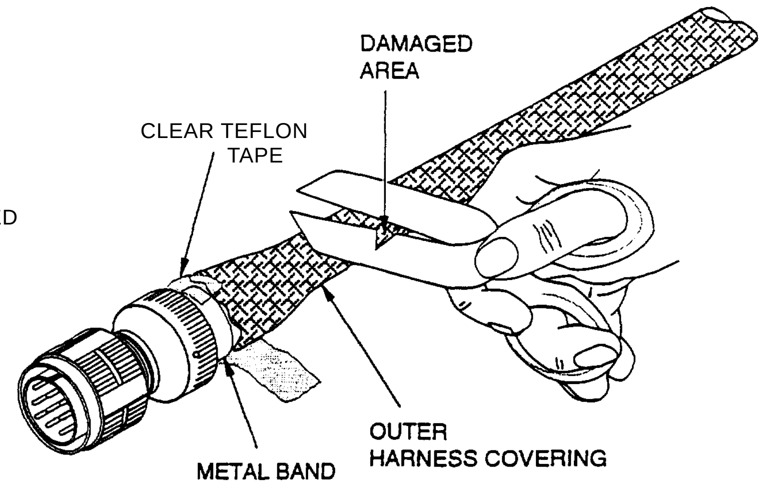


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 9)

AA. CUT LACING CORD AND PULL OUTER HARNESS COVERING TOWARD CON–NECTOR BACKSHELL.

AB. USING CLEAR TEFLON TAPE WRAP A SINGLE LAYER AROUND METAL BAND AT BACKSHELL.

AC. USING SCISSORS CUT AWAY DAMAGED OUTER HARNESS COVERING.



WARNING

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AD. USING ISOPROPYL ALCOHOL, CLEAN AND DRY OUTER HARNESS COVERING TO ENSURE ADHESION OF SELF BONDING SILICONE TAPE.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

AE. USING SELF BONDING SILICONE TAPE, BEGINNING 3 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 3 INCHES BEYOND DAMAGE, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.

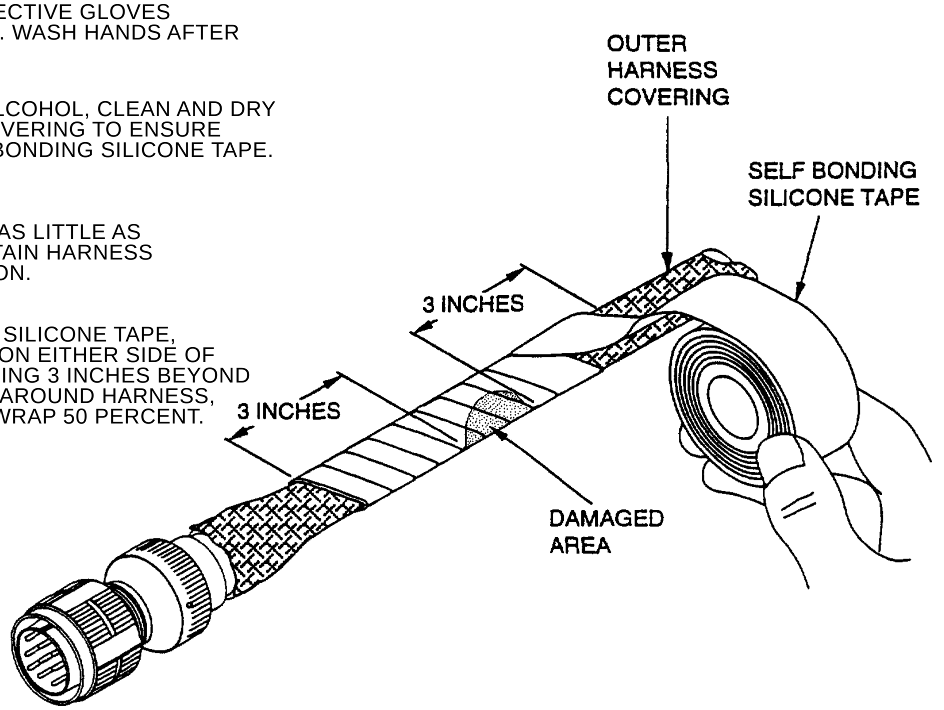
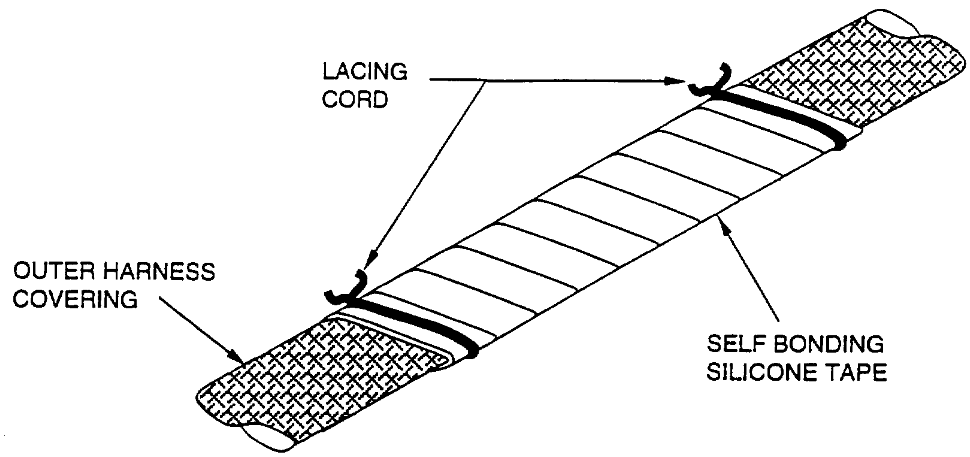


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 10)

AF. SECURE ENDS OF TAPE WITH LACING CORD.



AG. USING SELF BONDING SILICONE TAPE, BEGINNING ON CONNECTOR BACKSHELL AND EXTENDING 1 INCH BEYOND REPAIR, WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.

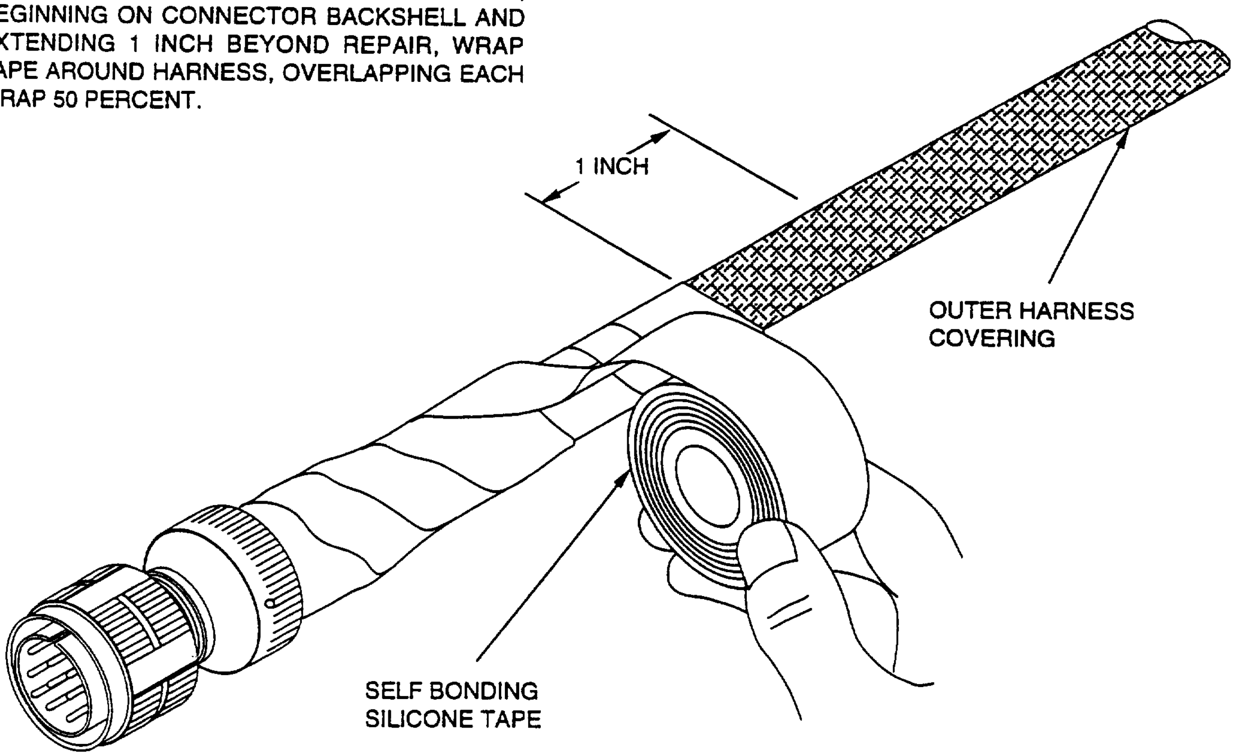
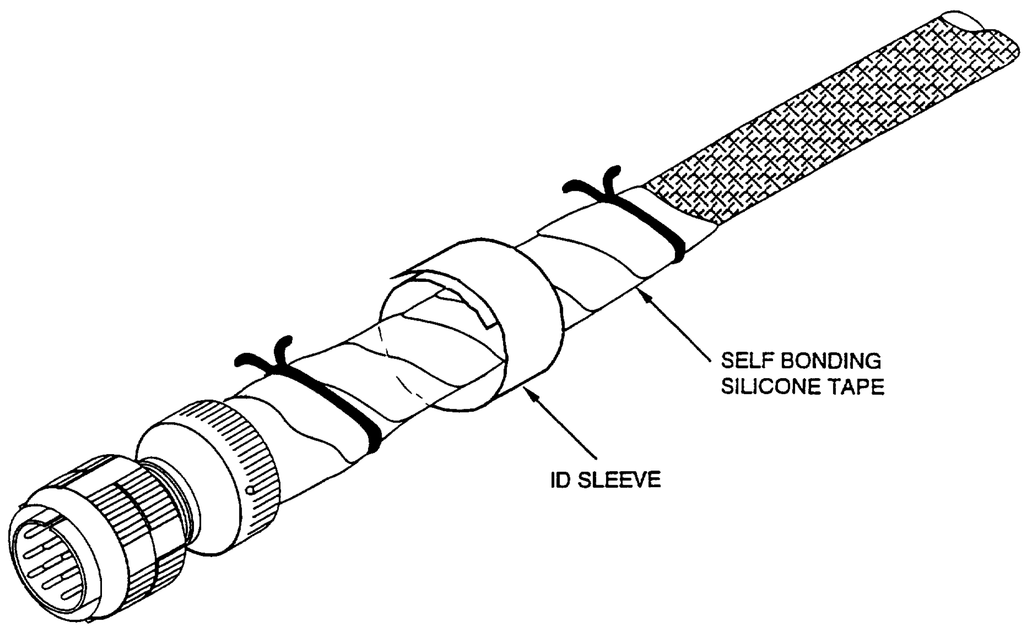


Figure 7. Copper Foil Shield Repair at Termination End (Sheet 11)

AH. MARK ID SLEEVE IAW WP 008 00



AI. MARK ID SLEEVE IAW WP 008 00

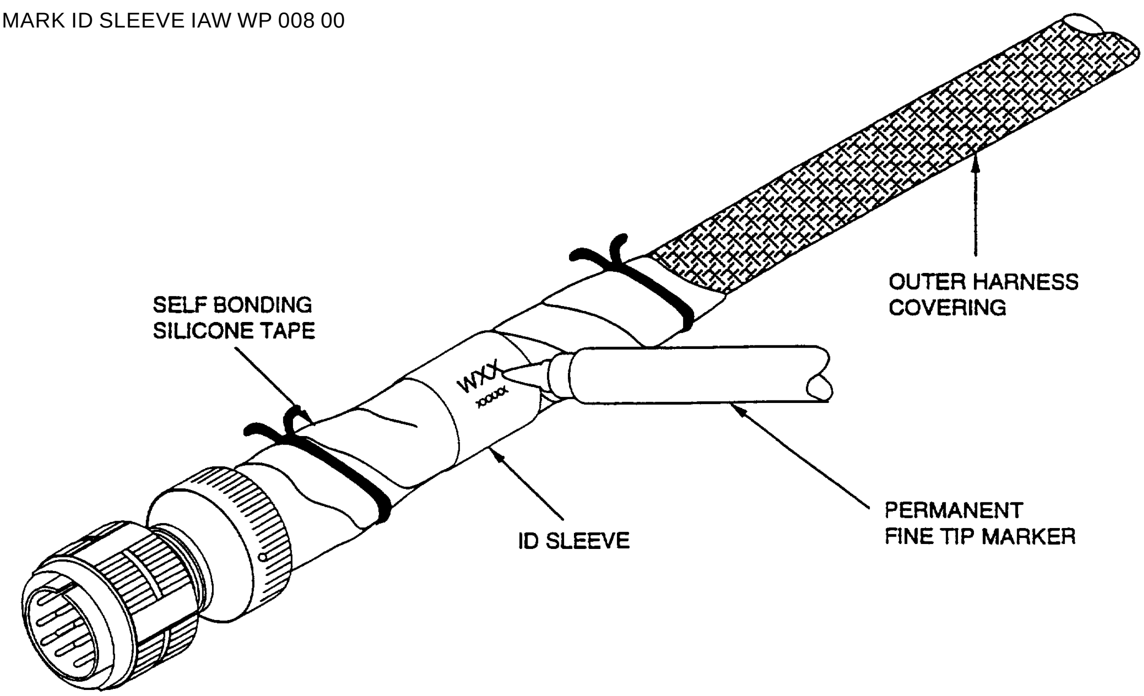


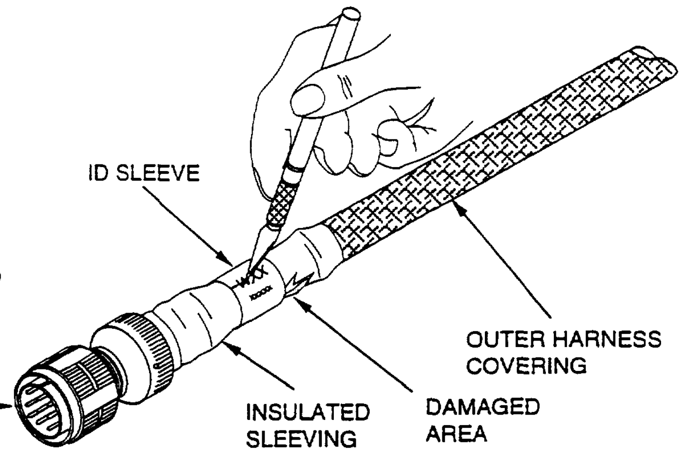
Figure 7. Copper Foil Shield Repair at Termination End (Sheet 12)

8. BRAID TAIL REPAIR.

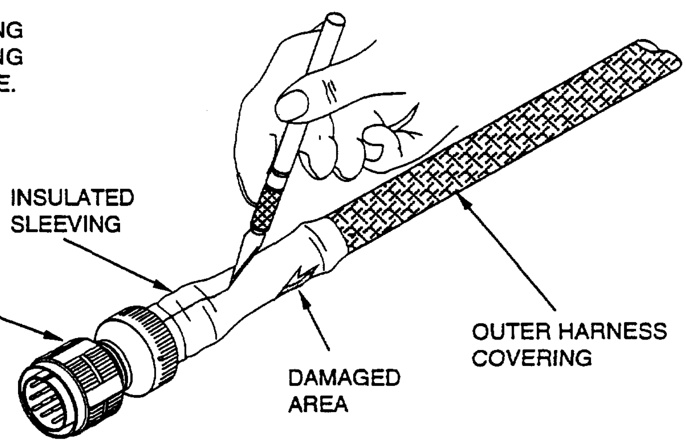
NOTE

MAJOR DAMAGE TO BRAID TAIL WILL REQUIRE REPLACING ENTIRE BRAID TAIL; MINOR DAMAGE WILL REQUIRE SPLICING.

A. REMOVE WHITE HARNESS ID SLEEVE AND RETAIN.



B. REMOVE BLACK SHRINK SLEEVING COVERING HARNESS BRANCH BY SCORING ALONG LENGTH OF SLEEVING WITH AN EXACTO KNIFE.



NOTE

FOR PREPARATION, USE AND OPERATION OF HEAT GUN. REFER TO WP 012 00

C. USING HEATING TOOL WITH SMALL NOZZLE AND NEEDLE NOSE PLIERS, APPLY HEAT AND WITH PLIERS PEEL OFF SLEEVING AND TUBING.

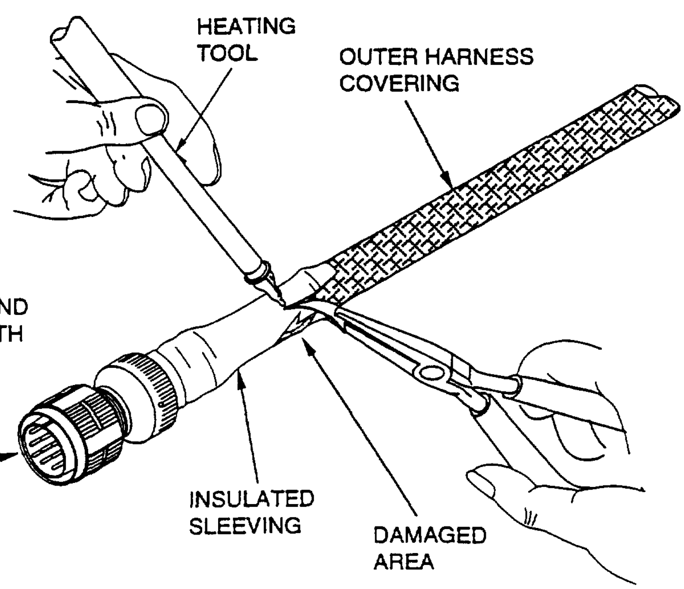
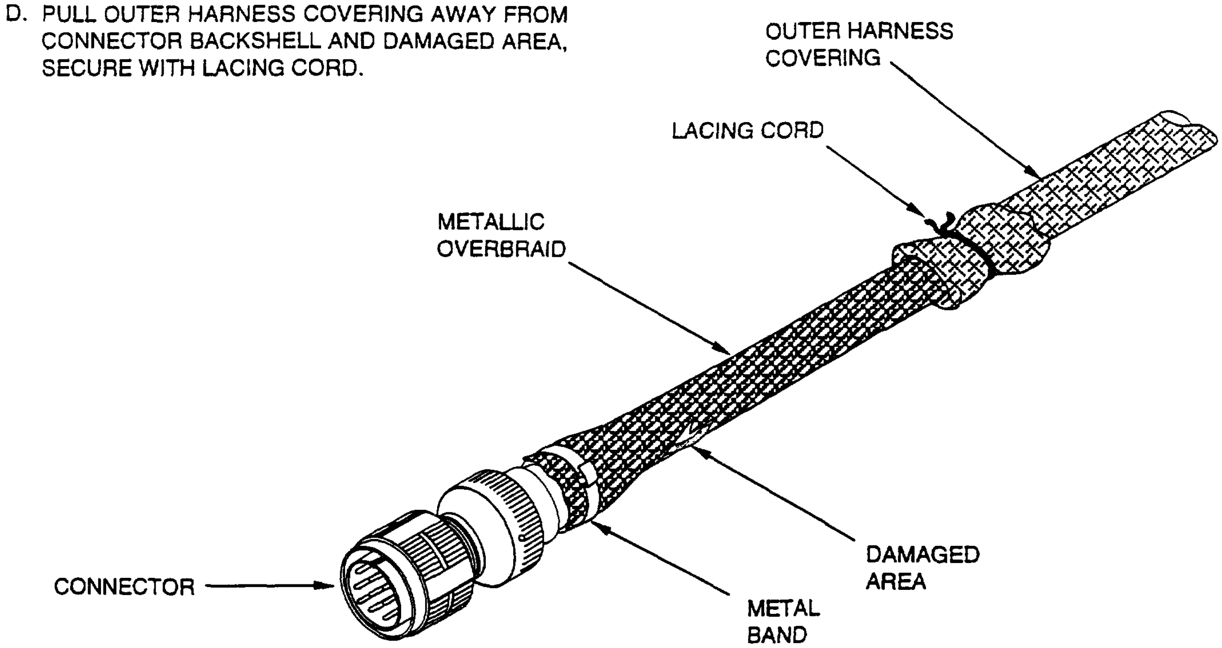


Figure 8. Braid Tail Repair (Sheet 1 of 10)



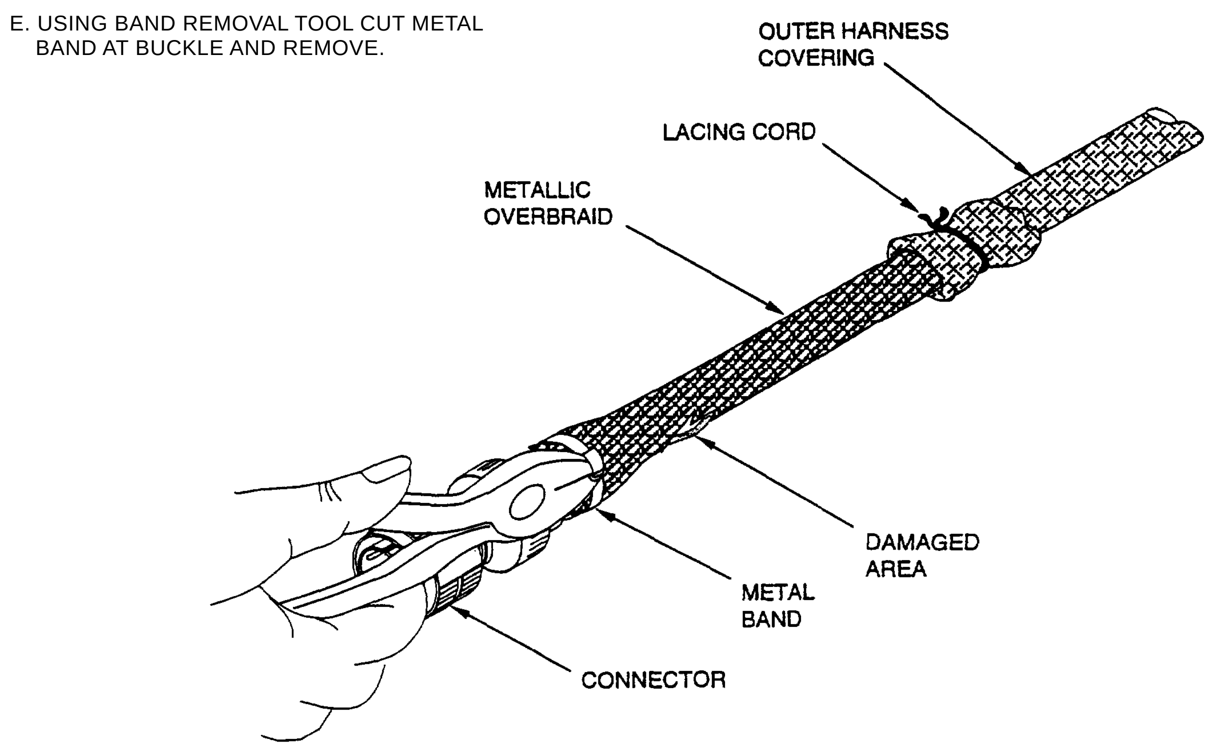
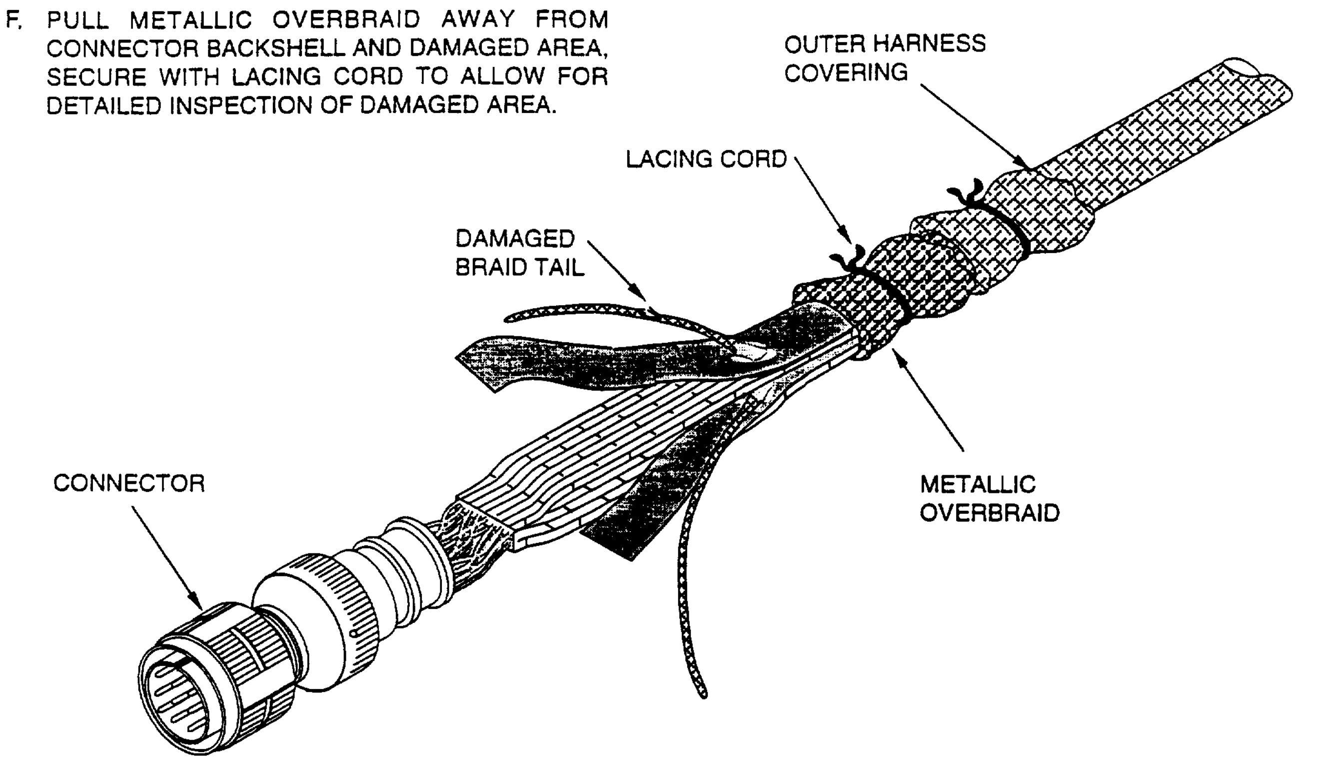


Figure 8. Braid Tail Repair (Sheet 2)



G. IF BRAID TAIL DAMAGED AREA IS NOT CUT THROUGH COMPLETELY. USE BAND REMOVAL TOOL AND CUT BRAID TAIL.

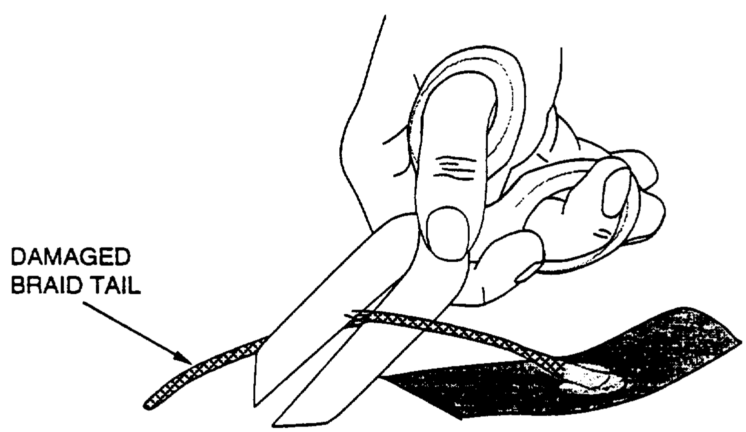
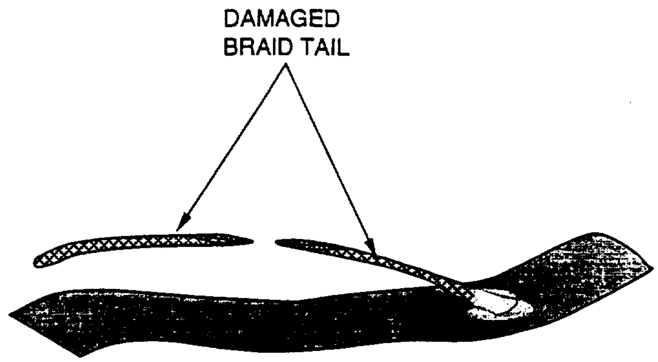


Figure 8. Braid Tail Repair (Sheet 3)

H. TWIST BOTH ENDS OF BRAID TAIL FOR SPLICING.



I. USING M81824/1-3 SPLICE, INSERT ENDS OF BRAID TAIL AND CRIMP (WP 015 00).

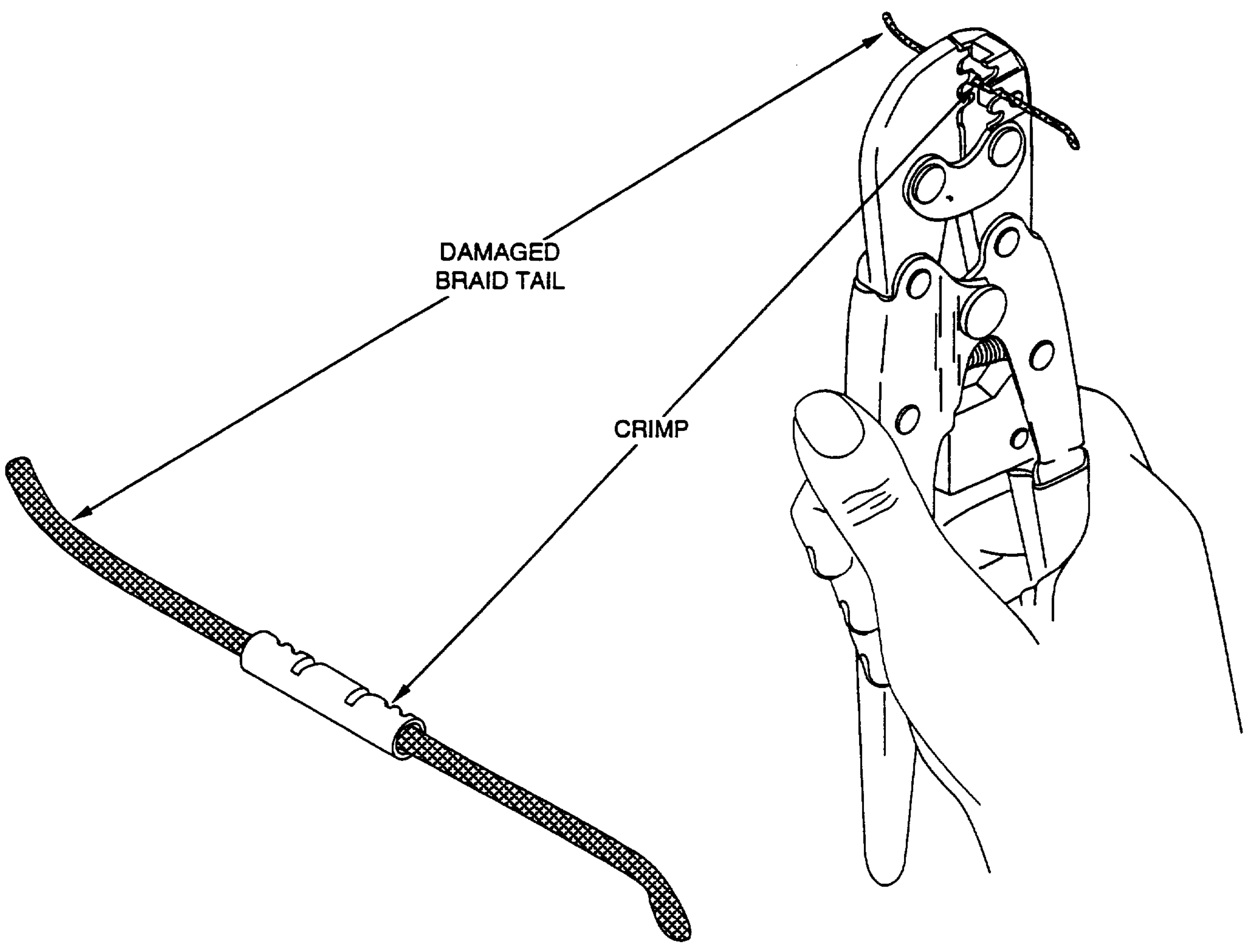
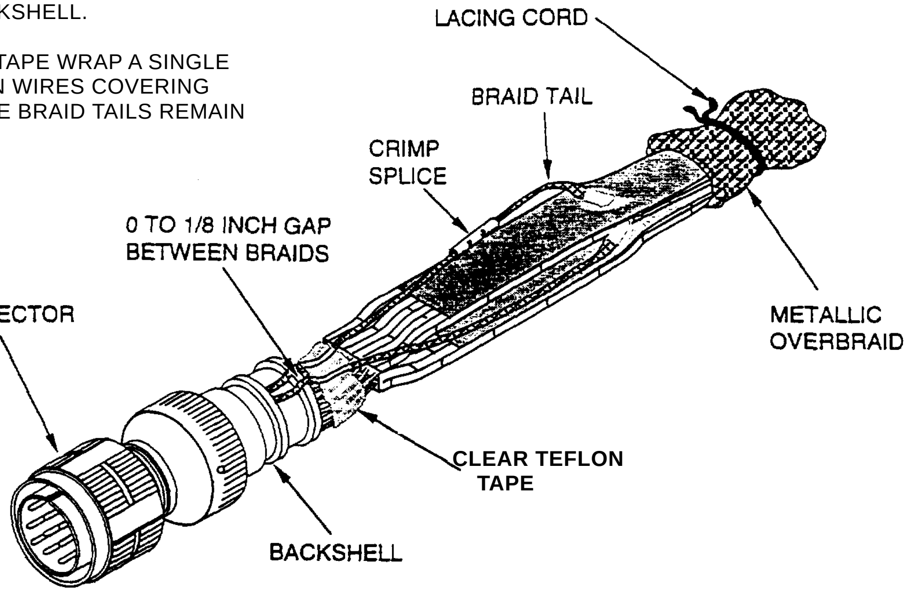


Figure 8. Braid Tail Repair (Sheet 4)

J. PLACE BRAID TAILS EVENLY ON ONE SIDE OF BANDING AREA OF BACKSHELL.

K. USING CLEAR TEFLON TAPE WRAP A SINGLE LAYER AROUND RIBBON WIRES COVERING BRAID TAILS TO ENSURE BRAID TAILS REMAIN IN POSITION.



L. CUT LACING CORD AND PULL METALLIC OVERBRAID BACK OVER BACKSHELL BANDING AREA.

NOTE

ENSURE METALLIC OVERBRAID IS AS TIGHT AS POSSIBLE PRIOR TO BANDING.

M. VISUALLY INSPECT BACKSHELL AREA TO ENSURE THAT BRAID TAILS MAINTAIN THEIR POSITIONS ON BACKSHELL.

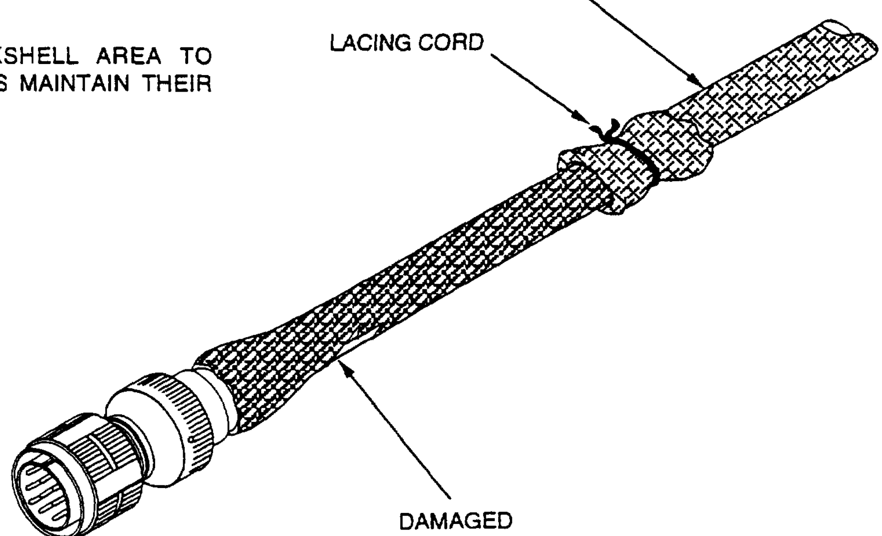
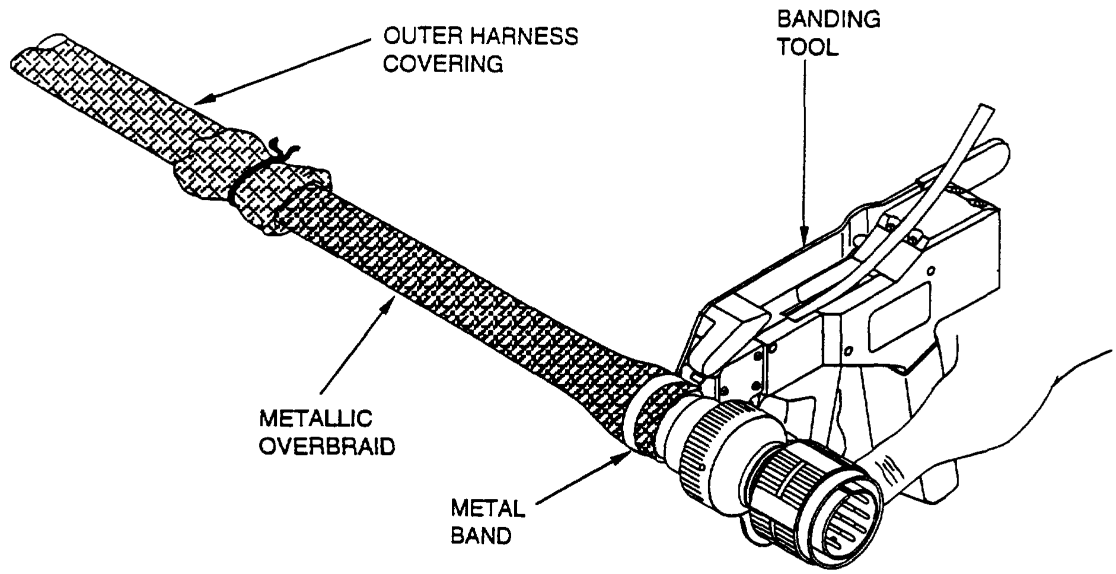


Figure 8. Braid Tail Repair (Sheet 5)

N. PLACE METAL BAND OVER BRAID TAILS AND METALLIC OVERBRAID. USING BANDING TOOL (WP 011 00) CRIMP METAL BAND TO CONNECTOR BACKSHELL BANDING AREA.



O. WITH WIRE CUTTERS OR SCISSORS CUT AWAY DAMAGED OVERBRAID IN DAMAGED AREA.

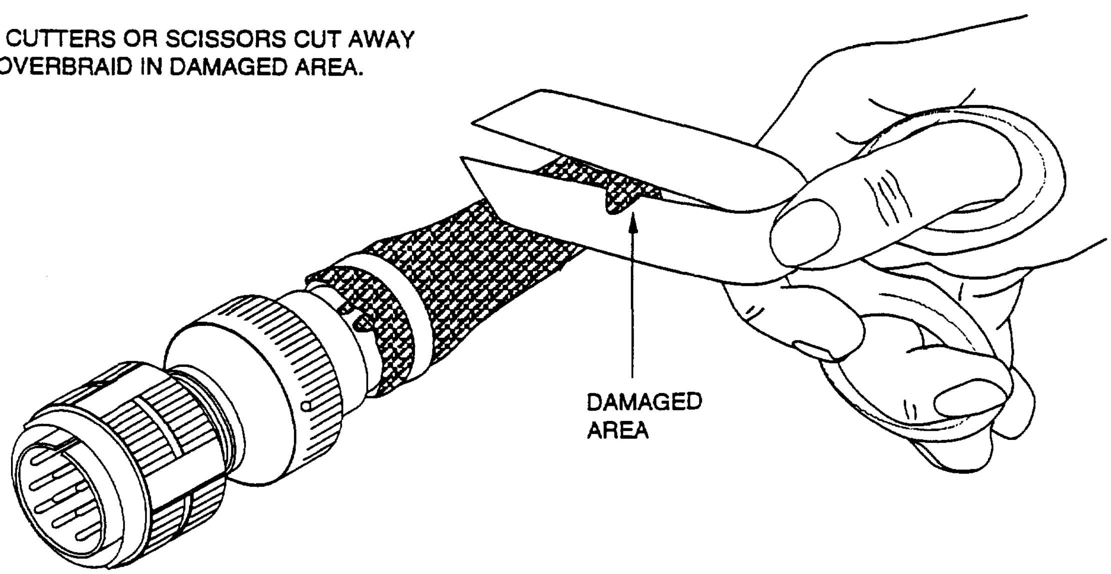


Figure 8. Braid Tail Repair (Sheet 6)

WARNING

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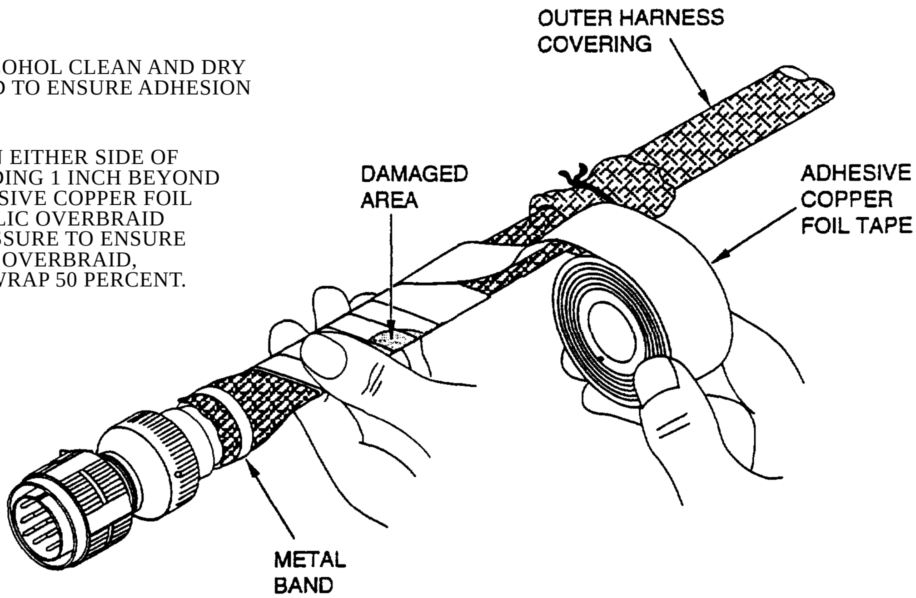
P. USING ISOPROPYL ALCOHOL CLEAN AND DRY METALLIC OVERBRAID TO ENSURE ADHESION OF COPPER FOIL TAPE.

Q. BEGINNING 1 INCH ON EITHER SIDE OF DAMAGE AND EXTENDING 1 INCH BEYOND DAMAGE, WRAP ADHESIVE COPPER FOIL TAPE AROUND METALLIC OVERBRAID WHILE APPLYING PRESSURE TO ENSURE ADHESION OF FOIL TO OVERBRAID, OVERLAPPING EACH WRAP 50 PERCENT.



R. CUT LACING CORD AND PULL OUTER HARNESS COVERING TOWARD CONNECTOR BACKSHELL.

S. USING CLEAR TEFLON TAPE WRAP A SINGLE LAYER AROUND METAL BAND AT BACKSHELL.

T. USING SCISSORS CUT AWAY DAMAGED OUTER HARNESS COVERING.

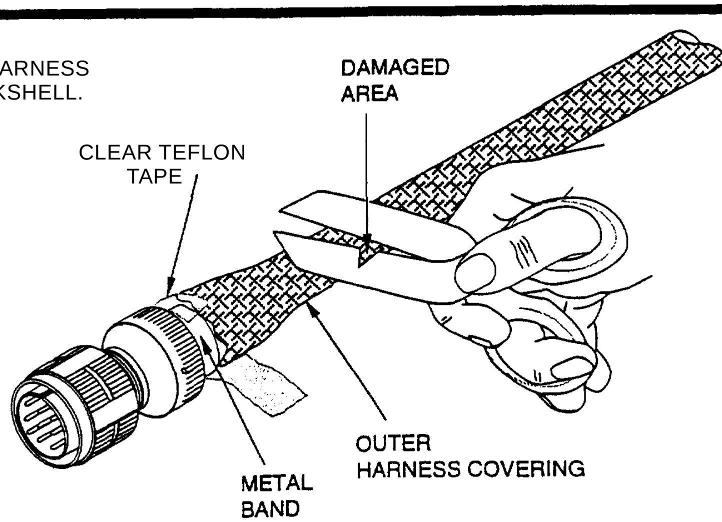


Figure 8. Braid Tail Repair (Sheet 7)

WARNING

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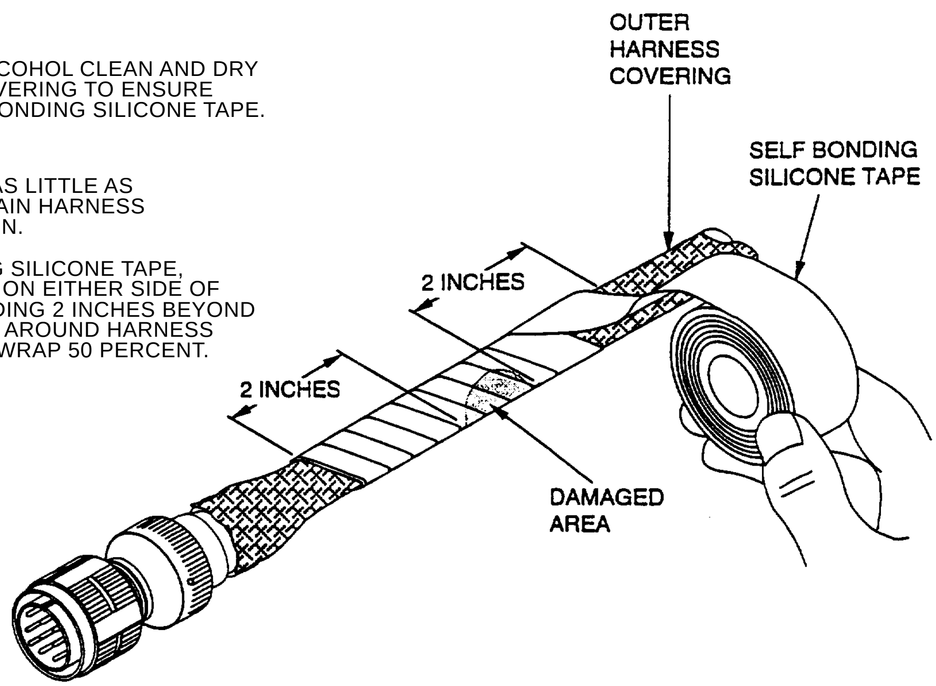
U. USING ISOPROPYL ALCOHOL CLEAN AND DRY OUTER HARNESS COVERING TO ENSURE ADHESION OF SELF BONDING SILICONE TAPE.

CAUTION

DISTORT HARNESS AS LITTLE AS POSSIBLE TO MAINTAIN HARNESS FLAT CONFIGURATION.

V. USING SELF BONDING SILICONE TAPE, BEGINNING 2 INCHES ON EITHER SIDE OF DAMAGE AND EXTENDING 2 INCHES BEYOND DAMAGE, WRAP TAPE AROUND HARNESS OVERLAPPING EACH WRAP 50 PERCENT.



W. SECURE ENDS OF TAPE WITH LACING CORD.

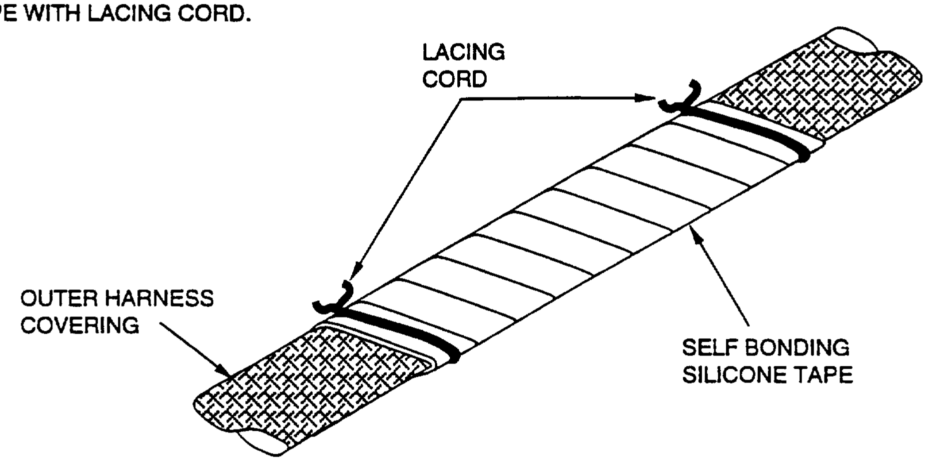
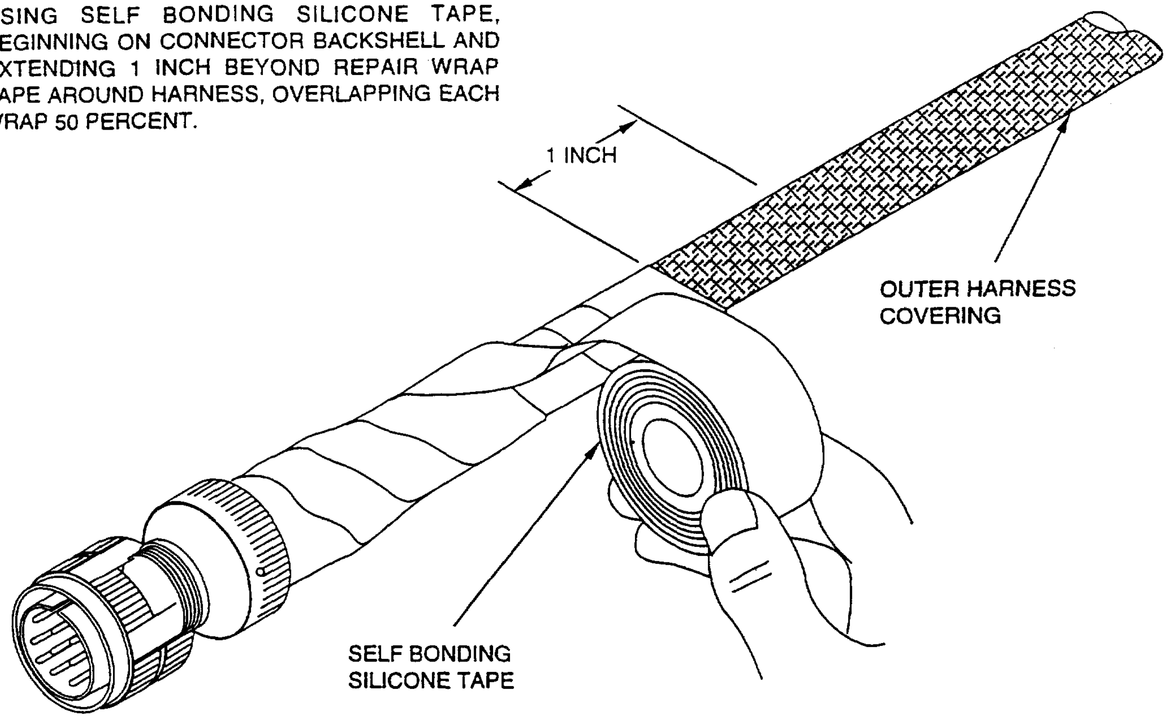


Figure 8. Braid Tail Repair (Sheet 8)

X. USING SELF BONDING SILICONE TAPE, BEGINNING ON CONNECTOR BACKSHELL AND EXTENDING 1 INCH BEYOND REPAIR WRAP TAPE AROUND HARNESS, OVERLAPPING EACH WRAP 50 PERCENT.



Y. MARK ID SLEEVE IAW WP 008 00

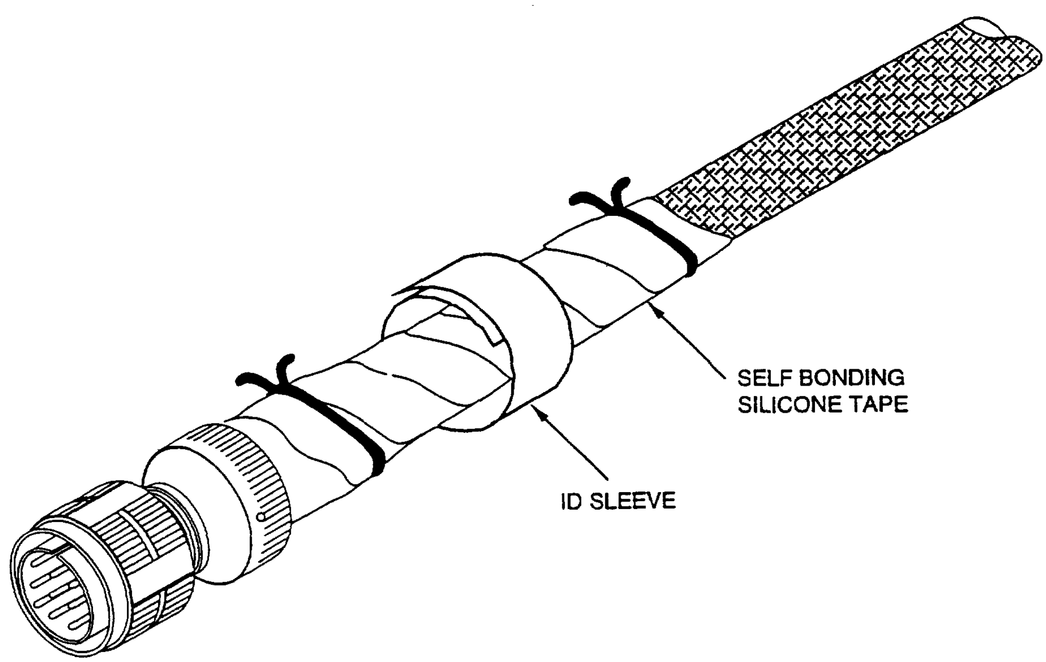


Figure 8. Braid Tail Repair (Sheet 9)

z. MARK ID SLEEVE IAW WP 008 00

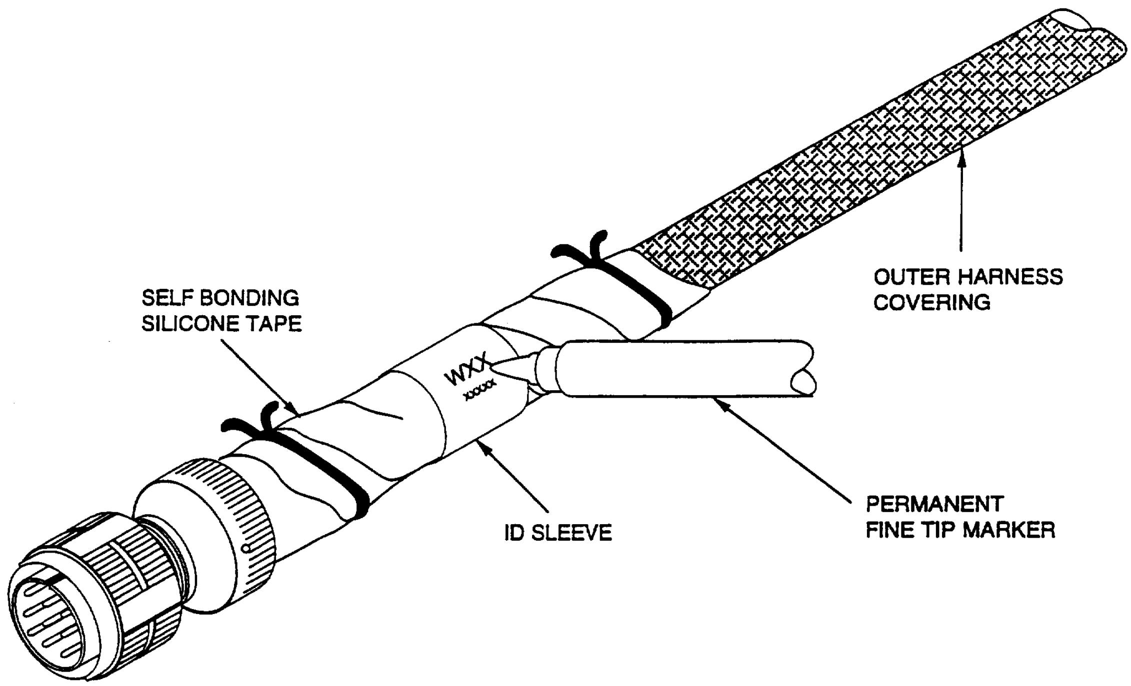


Figure 8. Braid Tail Repair (Sheet 10)

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HEATING TOOLS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Aircraft Fuel Cells And Tanks . . . . NAVAIR 01-1A-35
Environmental Test Methods for Aerospace and Ground Equipment MIL–STD–810

Alphabetical Index

Alphabetical Index

Record Of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Compressed Air/Nitrogen Heat Gun	HT–71002
Heat Gun, Compressed Air/Nitrogen	HT–900B
Heat Gun, Compressed Air/Nitrogen	HT–920B
Heat Gun, Battery Powered	MCH–100–A
Heating Tool, Radiant	IR-500
Heating Tool, Infrared	IR-550
Heating Tool, Infrared	IR-1759
Heating Tool, Thermogun	CV–5000
Mini–Gun Hot Air Tool	CV–5300
Mini–Gun Hot Air Tool	CV–5302
Nitrogen Bottle	—

Materials Required

Nomenclature	Part Number/Type Designation
Isopropyl Alcohol	TT-I-735
Nitrogen Bottle	

1 . **INTRODUCTION.**

2 . This work package (WP) provides information and operating procedures for heating tools used for build-up and repair of aircraft wiring system.

3 . **GENERAL.**

4 . Performing maintenance on an aircraft can be very hazardous to personnel and equipment. Extreme caution must be observed while using heating tools with electric motors on aircraft. The following paragraphs list the procedures that shall be adhered to while performing aircraft wiring maintenance.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

5 . **SAFETY PRECAUTIONS.** Prior to performing repair procedures on any aircraft wiring system using heating tools with brush type electric motors, refer to

NAVAIR 01-1A-35 for procedures concerning gas-free certifications. For definitions of confined spaces, refer to paragraph 7.

6. **MOTORIZED HEAT GUNS USAGE POLICY.** The policy for use of motorized heating tool on aircraft not strictly considered confined space is:

a. Do not perform any other maintenance during defueling, depuddling, purging, or inerting operations. See NAVAIR 01-1A-35.

b. Aviation Gas Free Environment (AVGFE) check spaces for Oxygen, (19.5% to 23.5%) and 0% flammables (0% Lower Explosive Limit [LEL]) whenever any of the following conditions exist:

(1) Any fuel cell is open.

(2) Any fuel line is open.

(3) Any fuel system component has been removed anywhere on the aircraft.

c. If there are no open fuel cells, no fuel lines have been broken, and no fuel system components have been removed, it is not necessary to check Oxygen, and LEL.

NOTE

This policy also applies to drop tanks and support equipment. For confined spaces, refer to NAVAIR 01-1A-35.

7. **CONFINED SPACE.** Confined space is defined as:

a. A space large enough and so confined maintenance personnel can bodily enter and perform assigned work.

b. A space having limited or restricted means for entry or exit.

c. A space not designed for continuous maintenance personnel occupancy.

8. **PERMIT REQUIRED CONFINED SPACE.** Permit required confined space means a confined space that has one or more of the following characteristics:

a. A space that contains, or has the potential to contain a hazardous atmosphere.

b. A space that contains a material that has the potential for engulfing an entrant.

c. A space that has an internal configuration such that an entrant could be trapped and asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a small cross section.

d. A space that contains any other recognized serious safety hazard.

9. **HT-900B/HT-920B COMPRESSED AIR/ NITROGEN HEATING TOOL.**

WARNING

Use of nitrogen with the HT-900B/HT-920B heat gun in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

10. Compressed air/nitrogen heating tool (Figure 1), is a portable source of heat for use with heat-shrinkable tubing, meltable solder fittings, and is qualified for use on fueled aircraft. With the exception of a source of compressed air/nitrogen, the is self-contained. Specifications are listed in Table 1. Tool contains several safety features as follows:

a. If the air/nitrogen pressure monitored at the heating tool falls below a preset minimum, a safety switch shuts off power to the heating element.

b. Cool air passes between the heating element and heating tool handle, keeping the handle cool.

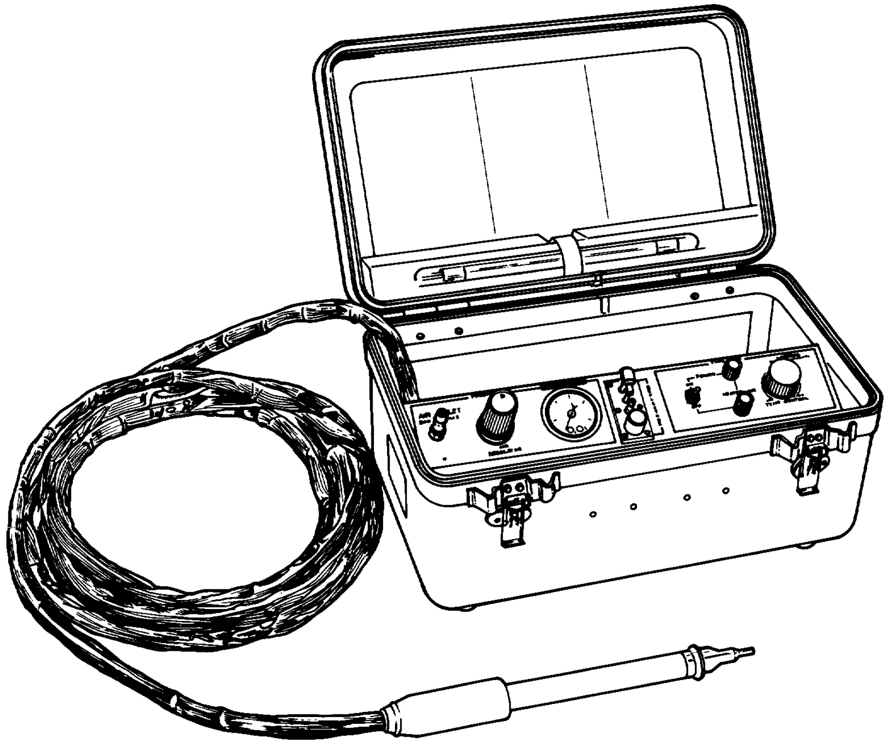


Figure 1. Compressed Air/Nitrogen Heating Tool With Case

c. If the heating tool is inadvertently connected to an air source in excess of 200 psi, an air safety valve protects both the equipment and the operator.

11 . **PRE-OPERATION.** Prior to using compressed air/nitrogen heating tool (Figure 1), proceed as follows:

CAUTION

Do not connect the heating tool to a compressed air/nitrogen source greater than 200 psig.

a. Push down and fully turn AIR REGULATOR ccw.

b. Remove dust cap from AIR INLET nipple. Connect nipple to pressurized air/nitrogen source.

c. Push down and turn AIR REGULATOR cw until pressure of 5 to 7 psig is registered on AIR PRESSURE GAGE.

12 . **REFLECTOR SELECTION.** The attachments for the air/nitrogen heater consist of five reflectors. These reflectors are attached to the tip of the heat gun and concentrate the heated air/nitrogen output around the material. The uses of the various reflectors are as follows:

13 . **Termination Sleeve Reflector.** Used for heating solder termination sleeves and shrinking small-diameter tubing (Figure 2).

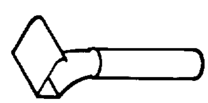


Figure 2. Termination Sleeve Reflector

14 . **Miniature Termination Sleeve Reflector.** Used for heating small solder termination sleeves and making terminations in a confined area (Figure 3).

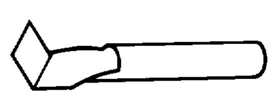


Figure 3. Miniature Termination Sleeve Reflector

15 . **Boot and Tubing Reflector.** Used for shrinking tubing and molded components such as strain-relief boots and potting caps (Figure 4).

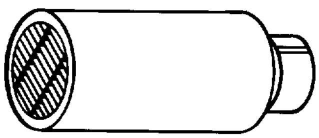


Figure 4. Boot and Tubing Reflector

16 . **Needle Point Reflector.** Used where a lower precise air-flow is required to terminate micro-miniature connectors, or to repair or modify low-temperature insulated wire termination (Figure 5).

Table 1. Specifications

Electrical Power, HT-900B	115 VAC, 50-400 Hz, single-phase, 7 Amps
Electrical Power, HT-920B	220 VAC, 50-400 Hz, single-phase, 3.5 Amps
Heat gun output temperature	550-920°F (290-495°C)
Compressed air/nitrogen	80-200 psig, 4 SCFM (Dry and oil-free)

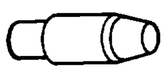


Figure 5. Needle Point Reflector

17 . **Large Boot and Tubing Reflector.** Used for installing large diameter tubing and molded parts (Figure 6).

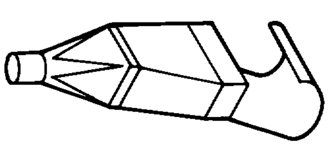


Figure 6. Large Boot and Tubing Reflector

18 . **OPERATION.** To operate compressed air/nitrogen heating tool (Figure 7), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, M–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Push reflector over gun tip.

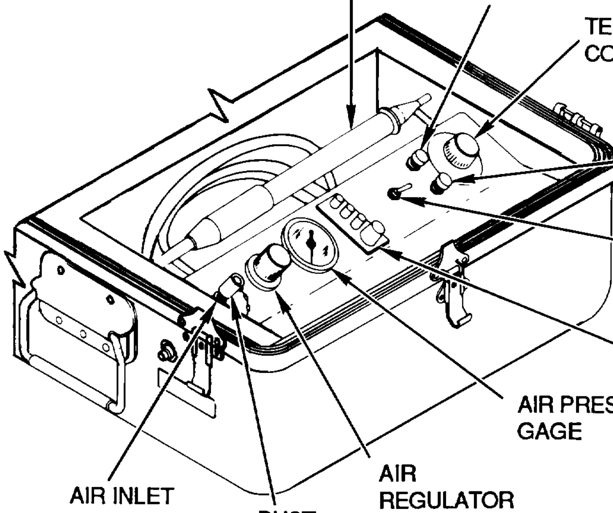


Figure 7. Compressed Air/Nitrogen Heating Tool

b. Plug in power cord to 115 VAC, 50-400 Hz, single-phase, 7 AMPs minimum power source, for the HT-900 tool, and to 220VAC, 50-400 Hz, single phase, 3.5 AMPs minimum power source for the HT-920B tool.

c. Set POWER switch to ON. POWER lamp and HEATED AIR ON lamp should light.

NOTE

The HEATED AIR ON lamp does not light unless the switch in the heat gun handle is in the forward position. Heated air can be removed from the heat gun at any time during operation, without powering down the control module, by positioning the switch to the rear of the handle.

d. Allow one minute warm–up. After warm–up, air pressure will be 10-15 psig.

e. Adjust TEMP CONTROL knob to desired setting.

19. **POST-OPERATION.** After using compressed air/nitrogen heating tool (Figure 7), proceed as follows:

a. Push down and fully turn AIR REGULATOR ccw. Observe that AIR PRESSURE GAGE registers 0 psig and HEATED AIR ON lamp goes out.

b. Position heat gun handle switch to rear of handle.

c. Position POWER switch to OFF. Observe that POWER lamp goes out.

CAUTION

Failure to cool the gun, as directed below, will shorten heating element life.

d. Cool heat gun, for a minimum of one minute, by allowing air/nitrogen to flow until cool.

e. Disconnect power connector from power source.

f. Disconnect compressed air/nitrogen source from AIR INLET nipple. Install dust cap.

Figure 8. HT–71002 Nitrogen/Compressed Air Hot Air Tool

g. Allow a few minutes for reflector to cool.

h. Remove reflector and store in case.

20 . **HT–71002 NITROGEN/COMPRESSED AIR HOT AIR TOOL.**

a. The HT–71002 hot air tool is designed to operate in a potentially hazardous/explosive environment as spelled out in MIL–STD–810, Method 511.3, Procedure 1. This device produces hot air at temperatures up to 950° F, utilizing compressed air/nitrogen passing through a high resistance electric heat element and is directed or diffused through various types of special purpose nozzle attachments. Some examples of application are: heat shrinkable tubing, solder sleeve electrical connectors, drying and curing applications.

b. This unit comes packaged in a fiberglass/aluminum carrying case and consists of two major parts: The control unit and heat pistol (Figure 8).

When operating the HT–71002 in a potentially explosive atmosphere, the following instructions must be followed explicitly.

21 . **Observe warning on power cable.**

WARNING

Failure to observe connection procedures as described in paragraphs a. and b. may result in explosion and or fire.

Before applying power to the HT–71002, the following procedures must be adhered to exactly.

a. Disconnect power at the source.

b. If using hangar or ships power, disengage the supply circuit at the circuit breaker panel, connect up the extension cord to the HT–71002 supply at the circuit breaker panel, activate the 115Vac (50 – 400 Hz) and observe the control unit panel indicator that AC is present.

22 . **CONNECTING AIR/NITROGEN SUPPLY.**

a. Air input Maximum 150 psi. Air input operating range: 60–150 psi.

23 . **COMPRESSED AIR.**

a. Air supply must be water and contaminant free. The HT–71002 employs a three (3) stage filtration system that purges water from the system automatically, however in order to minimize contamination of the extremely fine particulate and water filtration system of the HT–71002, the air supply (compressor) should be drained of water prior to connecting up the HT–71002 to the air supply.

b. Connect the air supply to connection nipple marked AIR INPUT. Observe the Air Pressure gauge and LOW AIR indicator. The minimum operational pressure for the HT–71002 is 3.5 psi. The LOW AIR lighted indicator will illuminate at approximately 2.0 psi, however steady state operation requires a pressure setting of 3.5 psi minimum.

c. If there is no pressure indicated on the control unit pressure gauge and the air supply to the unit is present at 60–150 psi, rotate the pneumatic control pressure regulator clockwise until pressure is indicated on the pressure gauge, to a setting of 3.5 psi. At approximately 2.0 psi, the LOW AIR lamp will illuminate, indicating that the low limit air protection circuitry has determined that air is insufficient and that the tool cannot be powered up.

24 . **NITROGEN GAS SUPPLY.**

WARNING

Bottled nitrogen is usually contained in high pressure cylinders with pressures in excess of 2000 psi. Be certain that the appropriate input line pressure to the HT–71002 is observed. Proper regulation of the high pressure nitrogen is mandatory.

a. Connect the Nitrogen supply to connection nipple marked AIR INPUT. Observe the air pressure gauge and LOW AIR indicator. The minimum operational pressure for the HT–71002 is 3.5 psi. The LOW AIR lighted indicator will illuminate at approximately 2.0 psi, however steady state operation requires a pressure setting of 3.5 psi minimum.

b. If there is no pressure indicated on the control unit pressure gauge and the Nitrogen supply to the unit is present at 60–150 psi, rotate the pneumatic control pressure regulator clockwise until pressure is indicated on gauge of 3.5 psi. At approximately 2.0 psi, the LOW AIR lamp will illuminate, indicating that the low limit Nitrogen protection circuitry has determined that Nitrogen is insufficient and that the tool may not be powered up.

25 . **OPERATION.**

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, M–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

26 . **POWERING UP THE HT–71002.**

a. Once the required electrical and air/nitrogen connections have been made, the HT–71002 is ready for operation.

(1) Set Air/nitrogen air pressure 3.5 psi minimum.

(2) Set Temperature control on heat tool at “0”.

(3) Observe that the LOW AIR lamp is extinguished.

(4) Depress POWER ON switch and indicator will illuminate.

27 . **AIR/TEMPERATURE SETTINGS.**

a. The working environment of the HT–71002 will affect the resultant temperature at the nozzle of the heat tool. Such conditions are:

(1) Wind and air turbulence.

(2) Ambient temperatures that are below freezing and above 70 degrees F.

(3) Air compressor supplied input where the compressor is subjected to ambient temperatures.

b. Normal operating air pressure range of the HT–71002 is between 3.5 and 9.0 psi. With a constant temperature setting and an increased airflow, the resultant nozzle temperature will decrease, therefore a higher temperature setting will be required to achieve the desired temperatures.

c. With an ambient temperature of 70 degrees F, a “0” setting on the heat tool equals ambient temperature at 3.5 psi and “10” setting on the heating tool at 3.5 psi equals approximately 975 degrees F.

28 . **SHRINKING/CURING.**

a. Set temperature control on tool between ”4” and “6” with air pressure set between 3.5 – 4.0 psi.

b. If shrinking or curing operation requires more heat, leave air pressure at initial setting and increase temperature.

29 . **SOLDER SLEEVE CONNECTORS.**

a. Install spoon reflector nozzle on heat tool.

b. Set temperature control between “5” and “8” on heat tool, with air pressure between 3.5 and 4.0 psi.

c. Depending on the connector and wire size, either a higher or lower setting will be required.

(1) Observe the solder ring in the connector for reflow. Do not leave heat on connector longer than is required to achieve a high integrity connection.

30 . **IR-550 MARK II, INFRARED HEATING TOOL.**

31 . Infrared heating tool, IR-550 Mark II (Figure 9), is a portable electric heating tool designed for fast reliable installation of solder devices and other heat-shrinkable products. It can be used as a hand tool or as a bench heater. As a hand tool, it is operated by a switch on the handle; as a bench heater, it is operated by a foot switch or the handle switch. This tool provides an unobstructed view of work in process and quiet, hands free operation. Instant on/off heat is generated by an optically filtered, commercially available tungsten-halogen lamp. Reflectors focus the heat from the lamp, concentrating heat energy within the work area of the front reflector. Optical filter between the lamp and the work area eliminates glare from the lamp, allowing the operator to observe the heating process. Tool is also equipped with a viewing window to ensure operator eye comfort. These features minimize operator errors and fatigue, significantly reducing installation time and costs. Specifications are listed in Table 2.

Table 2. Specifications

Electrical Power	115 VAC, 50-60 Hz, 4 1/2 Amps
Normal lamp life	Over 1000 hours of intermittent use
Duty Cycle	80%, 90 second heating times

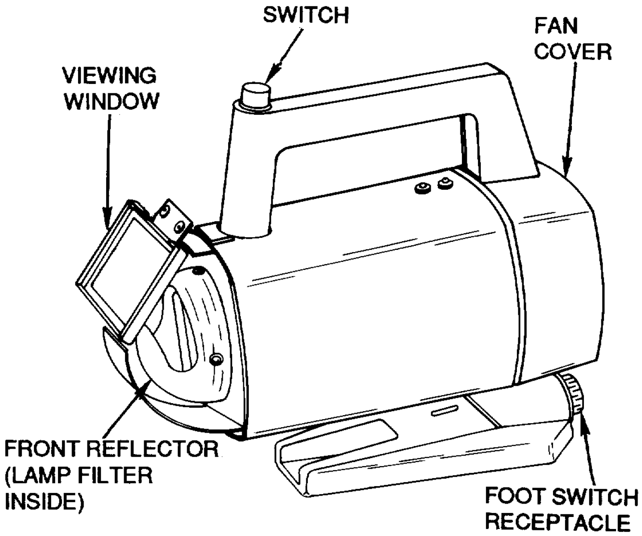


Figure 9. Infrared Heating Tool, IR-550 Mark II

32 . **PRE-OPERATION.** Prior to using infrared heating tool (Figure 9), proceed as follows:

a. Visually check front reflector and outer face of lamp filter for contamination.

b. If contamination is found, remove front reflector by lifting upper nose plunger from hole in reflector; tilt reflector away from housing, lift the reflector off lower plunger and slide it out of the housing.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean contaminated surfaces of front reflector and outer face of lamp filter with a soft cloth and isopropyl alcohol.

d. Install front reflector being careful not to contaminate inner reflective surface.

33 . **REFLECTOR SELECTION.** The attachments for the infrared heating tool consist of four reflectors. These reflectors are attached to the front end of the tool housing and concentrate the heated infrared output around the material. The uses of the various reflectors are as follows:

a. RG-2. Used for heating solder termination sleeves and shrinking large-diameter tubing. Has a 3/4 inch wide aperture and comes with heating tool when ordered.

b. RG-6. Used for heating solder termination sleeves and shrinking large-diameter tubing. Has a 3/4 inch wide aperture and has to be ordered separately (Figure 10).

c. RG-10. Used for heating solder termination sleeves and shrinking small-diameter tubing. Has a 3/8 inch wide aperture and has to be ordered separately (Figure 11).

d. RG-11. Used for heating solder termination sleeves and shrinking small-diameter tubing. Has a 1/2 inch wide aperture and has to be ordered separately (Figure 12).

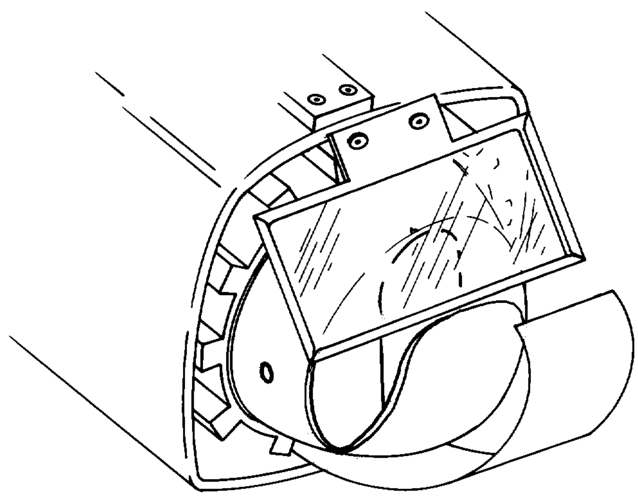


Figure 10. RG-6 Reflector

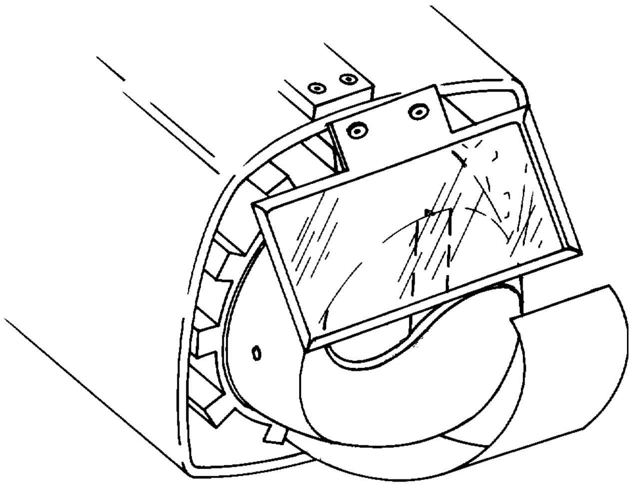


Figure 11. RG-10 Reflector

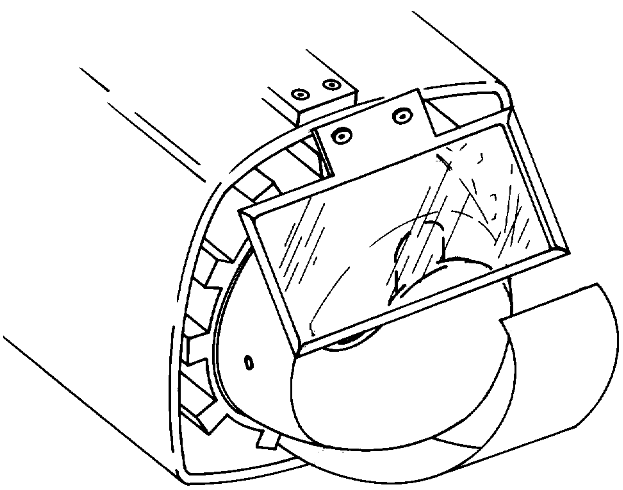


Figure 12. RG-11 Reflector

34 . **OPERATION.** To operate infrared heating tool (Figure 3), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Select the appropriate front reflector for the application.

b. Clip the front reflector onto the front end of the lamp housing by sliding the reflector between the upper and lower nose plungers until the bosses on the clips snap into the upper and lower holes in the reflector.

c. Plug in power cord to 115 VAC, 50-60 Hz, 4 1/2 Amps minimum power source. (For foot switch operation, foot switch must first be plugged into receptacle on rear of tool before plugging into power source.)

d. Prepare assembly to be heated.

e. Place the assembly to be terminated into slot of front reflector.

f. Turn heat lamp on by depressing switch on handle or by depressing foot switch.

WARNING

Since front reflector is outside the cooling air stream, it may get hot during the long heating cycles. Therefore, front reflector should not be touched when tool is in use.

g. Observe assembly during heating. After assembly has received proper amount of heat (or maximum of 90 seconds), stop heat cycle by releasing switch on handle or removing pressure from foot switch. Repeat if necessary if additional heating time is required.

h. Remove assembly from front reflector and inspect.

35 . **POST-OPERATION.** After using infrared heating tool (Figure 9), proceed as follows:

a. Disconnect power connector from power source.

b. Allow a few minutes for reflector to cool.

c. Visually check front reflector and outer face of lamp filter for contamination. If contamination is found, clean contamination using steps in paragraph 32.

d. Store reflector in proper place.

e. Periodically check the fan area to see if any dirt or lint has accumulated, when necessary clean with a soft brush. To facilitate cleaning, simply remove two mounting screws located on the rear of the fan cover.

36 . **IR-500, RADIANT HEATING TOOL.**

37 . Radiant heating tool, IR-500 (Figure 13), is a portable lightweight electric heating tool designed for fast and reliable installation of heat-shrinkable products. It can be used as a hand tool or as a bench tool and operated with a foot switch. The ellipsoidal reflector focuses the heat produced by halogen quartz lamp into the heating zone in front of the unit. Lamp is optically filtered to eliminate glare which allows the operator to observe the heating process, minimizing faulty installation and thereby assuring a quality finished product. Specifications are listed in Table 3.

38 . PRE-OPERATION. Prior to using radiant heating tool (Figure 13), proceed as follows:

a. Visually check reflector and outer face of lamp filter for foreign material accumulation.

b. If accumulation is found, remove reflector by lifting the reflector plunger, and tilting reflector away from housing and off reflector anchor pin.

Table 3. Specifications

Electrical Power	115 VAC, 50-60 Hz, 5 Amps
Duty Cycle	50%, 30 second heating times

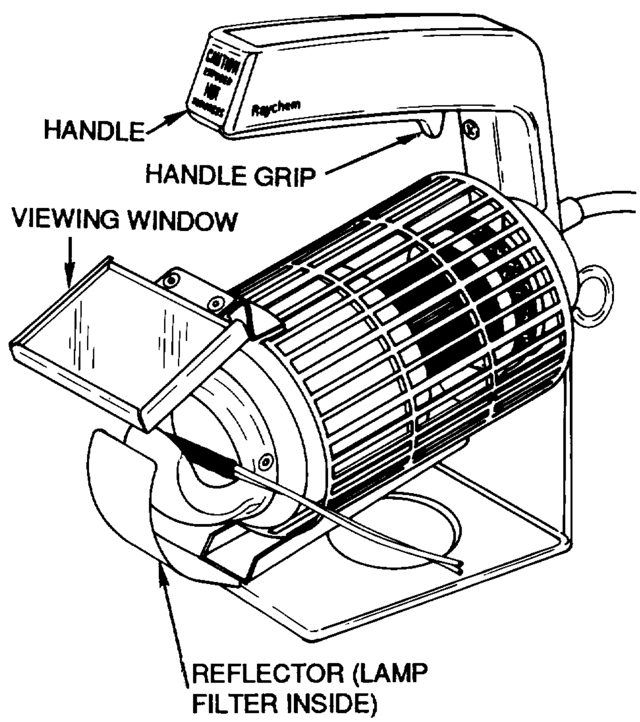


Figure 13. Radiant Heating Tool, IR-500

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean foreign material off surfaces of reflector and outer face of lamp filter with a lint free, soft cloth or paper dampened with isopropyl alcohol.

d. Install reflector, being careful not to touch inner reflective surface.

39 . **REFLECTOR SELECTION.** The attachments for the radiant heating tool consist of three reflectors. These reflectors are attached to front end of the tool housing and concentrate the heated radiant output around the material. The uses of the various reflectors are as follows:

a. RG-1. Used for installing solder termination sleeves on non-heat sensitive wires; has to be ordered separately.

b. RG-2. Used for installing solder termination sleeves on heat sensitive wires; comes with heating tool when ordered.

c. Tubing Reflector. Used for installing heat shrinkable tubing and molded parts; comes with heating tool when ordered.

40 . **OPERATION.** To operate radiant heating tool (Figure 13), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Select the appropriate reflector for the application.

b. Install the reflector onto the front end of the lamp housing by putting the bottom of the reflector on the reflector anchor pin and tilting reflector up until it snaps onto reflector plunger.

c. Plug in power cord to 115 VAC, 50-60 Hz minimum power source. (For foot switch operation, foot switch must first be plugged into heating tool power cord before being plugged into power source.)

d. Prepare the assembly to be heated.

e. Place the assembly into heating area.

f. Turn heat lamp on by squeezing handle grip. Handle grip trigger actuates the on-off switch.

WARNING

During use the reflector may become hot. Do not touch.

g. Observe assembly during heating. When heating operation is complete (or maximum of 30 seconds) turn lamp off by releasing the handle or removing pressure from foot switch. Repeat as necessary if additional heating time is required.

h. Remove assembly from heating area and inspect.

i. If using foot switch for operation, trigger must be moved forward to take it out of its locked position, then released to turn heating tool completely off.

41 . **POST-OPERATION.** After using radiant heating tool (Figure 13), proceed as follows:

a. Disconnect power connector from power source.

b. Allow a few minutes for reflector to cool.

c. Visually check reflector and outer face of lamp filter for foreign material accumulation. If material is found, clean using steps in paragraph 32.

d. Store reflector in proper place.

42 . **IR-1759, MINIRAY INFRARED HEATING TOOL.**

43 . MiniRay infrared heating tool, IR-1759 (Figure 14), is a small, lightweight, medium-duty hand heating tool designed for quiet, efficient operation. It can significantly reduce installation time on a variety of heat-shrinkable products. The low profile allows product installation where work space is restricted. Specifications are listed in Table 4.

44 . **PRE-OPERATION.** Prior to using infrared heating tool (Figure 14), proceed as follows:

a. Visually check aperture reflector for foreign material accumulation.

b. If accumulation is found, remove aperture reflector by removing screw, under reflector, and taking aperture reflector off heating tool.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean foreign material off reflector surface with soft cloth and isopropyl alcohol.

d. Install aperture reflector, being careful not to touch reflective surface.

45 . **REFLECTOR SELECTION.** The attachments for the infrared heating tool consist of two reflectors. These reflectors are attached to the front end of the tool housing and concentrate the heated infrared output around the material. The uses of the various reflectors are as follows:

46 . **Standard Aperture Reflector Assembly.** Used for heating solder termination sleeves and shrinking small-diameter tubing. Used on devices having a maximum outside diameter of l/4 inch and a maximum length of 1 inch and comes with heating tool when ordered (Figure 15).

Table 4. Specifications

Electronic Control Unit	
Electrical Power	115 VAC, 60 Hz, 11 Amps
Infrared Heating Tool	
Lamp Type	Tungsten-Halogen
Lamp Power	250 W, 24 VAC, 50-60 Hz
Lamp Life	Average time continuous use 50 hours

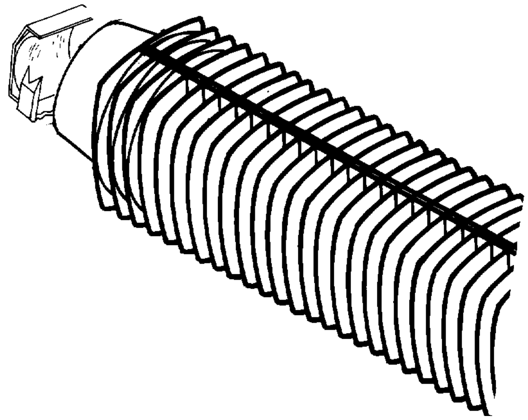


Figure 15. Standard Aperture Reflector Assembly

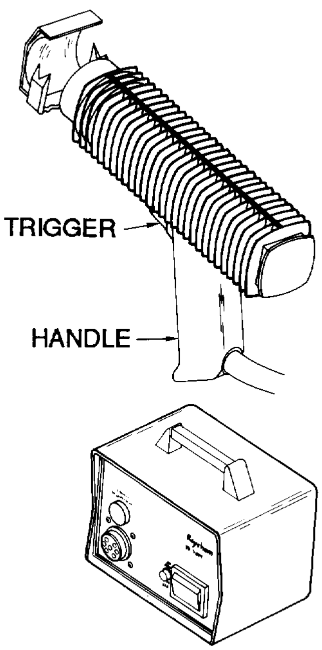


Figure 14. Infrared Heating Tool, IR-1759 with Standard Electronic Control ED-7-004

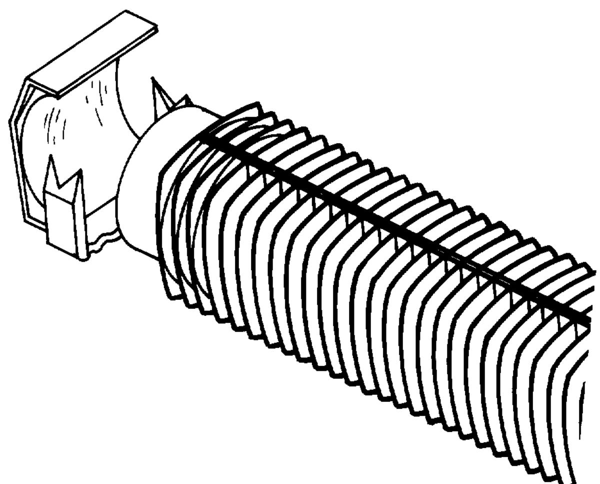


Figure 16. AE-897 Wide Aperture

47 . **AE-897 Wide Aperture.** Used for heating solder termination sleeves and shrinking small-diameter handle tubing. Used on devices having a maximum outside diameter of 3/8 inch and a maximum length of 2 inches and has to be ordered separately (Figure 16).

48 . **OPERATION.** To operate infrared heating tool (Figure 14), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B heating tool is authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Select the appropriate aperture for the application

b. Attach the aperture to heating tool by using screw under front tip of heating tool.

c. Plug in power cord to 115 VAC, 60 Hz, 11 Amps minimum power source.

d. Prepare the assembly to be heated.

e. Place the assembly into heating area.

f. Turn heat lamp on by squeezing trigger on handle.

WARNING

During use the aperture may become hot. Do not touch.

g. Observe assembly during heating. After assembly has received proper amount of heat, stop heat cycle by releasing trigger on handle.

h. Remove assembly from heating area and inspect.

49 . **POST-OPERATION.** After using infrared heating tool (Figure 14), proceed as follows:

a. Disconnect power connector from power source.

b. Allow a few minutes for aperture to cool.

c. Visually check aperture reflector for foreign material accumulation. If material is found, clean as follows:

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

(1) Clean contaminated surfaces of front reflector and outer face of lamp filter with a soft cloth and isopropyl alcohol.

(2) Install front reflector being careful not to contaminate inner reflective surface.

50 . **<u>CV-5000, THERMOGUN MARK II HEATING TOOL.</u>**

51 . ThermoGun Mark II heating tool, CV-5000 (Figure 17), is a rugged stand mounted or hand held hot-air tool engineered with a turbo fan driven blower and double jacketed element housing for heavy duty use. Combining features and options such as adjustable side vents, a wide variety of reflectors, and two temperature ranges (determined by model selected). ThermoGun provides precise control when terminating abroad range of heat shrinkable products, including boots and tubing up to 3 inches in diameter. Specifications are listed in Table 5.

Table 5. Specifications

Model 500B & 502B	
Electrical Power, Model 500B	115 VAC, 60 Hz, 14 Amps
Electrical Power, Model 502B	220 VAC, 50-60 Hz, 7 Amps
Output temperature	500° - 700°F (260° - 371°C)
Model 750B & 752B	
Electrical Power, Model 750B	115 VAC, 60 Hz, 18 Amps
Electrical Power, Model 752B	220 VAC, 50-60 Hz, 9 Amps
Output temperature	750° - 1000°F (399° - 538°C)

52 . **PRE-OPERATION.** Prior to using heating tool (Figure 17), Proceed as follows:

a. Visually check reflector for foreign material accumulation.

b. If accumulation is found, remove reflector by pulling it straight off ThermoGun nozzle.

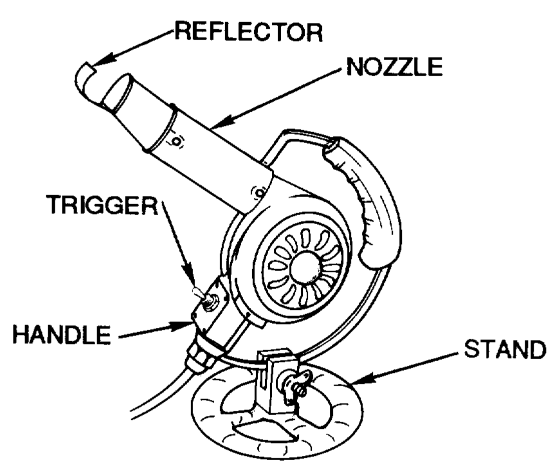


Figure 17. ThermoGun Mark II Heating Tool, CV-5000 with Stand

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean foreign material off surfaces of reflector with a soft cloth and isopropyl alcohol.

d. Install reflector, being careful not to touch reflective surface.

53 . **REFLECTOR SELECTION.** The attachments for the heating tool consist of six reflectors. These reflectors are attached to nozzle of heating tool and concentrate heated output around the material. The uses of the various reflectors are as follows:

a. TG-12. Used for heating solder termination sleeves and shrinking small-diameter tubing. Used for short lengths of tubing up to 3/4 inch diameter and comes with heating tool when ordered (Figure 18).

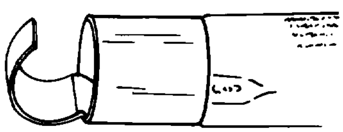


Figure 18. TG-12 Reflector

b. TG-13. Used for heating solder termination sleeves and shrinking large-diameter tubing. Used for short lengths of tubing from 3/4 inch to 2 inches in diameter and has to be ordered separately (Figure 19).

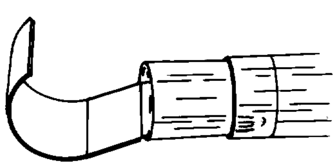


Figure 19. TG-13 Reflector

c. TG-13A. Used for heating solder termination sleeves and shrinking small-diameter tubing. Used for splice covers where wires must be shielded from heat and has to be ordered separately (Figure 20).

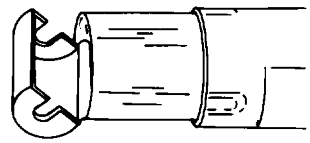


Figure 20. TG-13A Reflector

d. TG-23. Used for heating solder termination sleeves and shrinking medium-diameter tubing and boots. Used for boots up to 1 3/4 inches in diameter and has to be ordered separately (Figure 21).

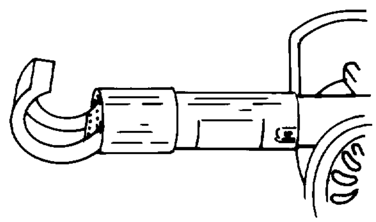


Figure 21. TG-23 Reflector

e. TG-24. Used for heating solder termination sleeves and shrinking large-diameter tubing and boots. Used for boots up to 3 inches in diameter and has to be ordered separately (Figure 22).

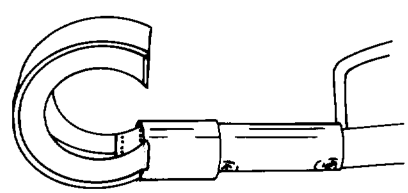


Figure 22. TG-24 Reflector

f. TG-135. Used for heating solder terminations sleeves and shrinking small-diameter tubing. Has to be ordered separately (Figure 23).

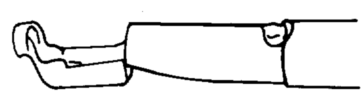


Figure 23. TG-135 Reflector

54 . **OPERATION.** To operate heating tool (Figure 17), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Select the appropriate reflector for the application.

b. Install the reflector on front of ThermoGun nozzle by pushing reflector straight on nozzle.

c. Plug in power cord to 115 VAC, 60 Hz, 14 or 18 Amps minimum power source, or 220 VAC, 60 Hz, 7 or 9 Amps minimum power source, depending on the model selected.

d. Prepare the assembly to be heated.

e. Place the assembly into heating area.

f. Turn the heat on by squeezing trigger on handle.

WARNING

During use the reflector may become hot. Do not touch.

g. Observe assembly during heating. After assembly has received proper amount of heat, stop heat cycle by releasing trigger on handle.

h. Remove assembly from heating area and inspect.

55 . **POST-OPERATION.** After using heating tool (Figure 17), proceed as follows:

a. Disconnect power connector from power source.

b. Allow a few minutes for reflector to cool.

c. Visually check reflector for foreign material accumulation. If material is found, clean using steps in paragraph 52.

d. Store reflector in proper place.

56 . **CV-5300/CV-5302, MINI-GUN HOT AIR TOOL.**

57 . Mini-Gun hot air tool, CV-5300/CV-5302 (Figure 24), is a lightweight hand-held tool used for applying a variety of heat-shrinkable products and solder termina-

tion products. It provides a continuous flow of heated air at temperatures of 450° - 700°F (232° - 371°C), depending on the hot-air reflector used. Specifications are listed in Table 6.

Table 6. Specifications

Electrical Power, CV-5300	115 VAC, 60 Hz, 7 Amps
Electrical Power,CV-5302	220 VAC, 50 Hz, 3.5 Amps
Output temperatures	
Without adapter	450°F (232°C)
With adapter only	550°F (288°C)
With MG-1 Reflector	700°F (371°C)
With MG-2 Reflector	450°F (232°C)

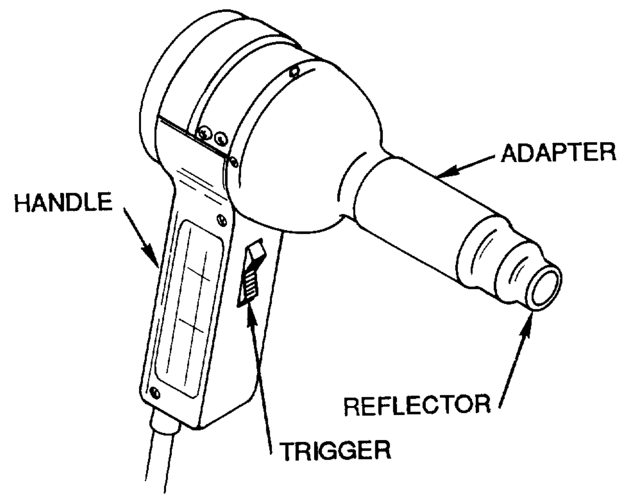


Figure 24. Mini-Gun Hot Air Tool, CV-5300/CV-5302

58 . **PRE-OPERATION.** Prior to using mini-gun heating tool (Figure 24), proceed as follows:

a. Visually check reflector for foreign material accumulation.

b. If accumulation is found, remove reflector by pulling it straight off mini-gun adapter.

WARNING

Isopropyl Alcohol, TT–I–735 is highly flammable and toxic. Do NOT use synthetic wipe cloths due to possible electrostatic discharge and ignition. Use in a well ventilated area. Keep away from open flames. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid any contact with eyes. Safety glasses and protective gloves are recommended. Wash hands after use.

c. Clean foreign material off surfaces of reflector with a soft cloth and isopropyl alcohol.

d. Install reflector, being careful not to touch reflective surface.

59 . **REFLECTOR SELECTION.** The attachments for the heating tool consist of two reflectors. These reflectors are attached to adapter on nozzle of heating tool and concentrate heated output around the material. The uses of the various reflectors are as follows:

a. MG-1. Used for heating solder termination sleeves and shrinking small-diameter tubing. Used for concentrated, high-temperature heating and tubing reflector and comes with heating tool when ordered (Figure 25).

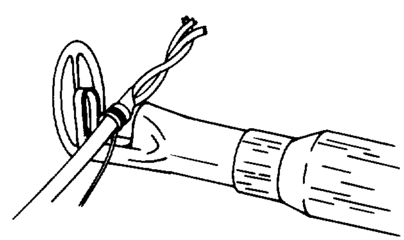


Figure 25. MG-1 Reflector

b. MG-2. Used for heating solder termination sleeves, molded parts, and shrinking large-diameter tubing. Used for surrounding heat-shrinkable tubing and molded parts with lower-temperature air, and has to be ordered separately (Figure 26).

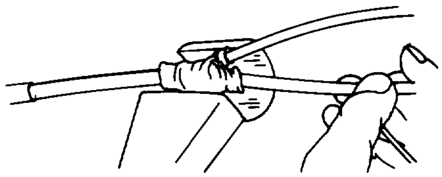


Figure 26. MG-2 Reflector

c. Barrel Adapter. Permits attachment of either reflector to the mini-gun.

60 . **OPERATION.** To operate heating tool (Figure 24), proceed as follows:

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

a. Mount the mini-gun on its stand or operate it as a hand held tool (Figure 27).

(1) Bench stand clips into back of the heat gun body and onto nozzle, providing for various operating positions.

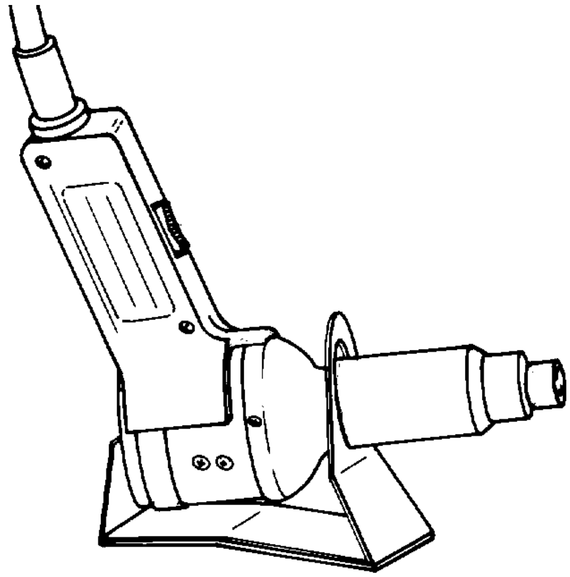


Figure 27. Mini-Gun Hot Air Tool, CV-5300/CV-5302 on Bench Stand

b. While the power is off and nozzle is cool, attach barrel adapter and appropriate reflector for the application to mini-gun.

(1) Reflector opening should face upward with mini-gun in its operating position.

c. Plug in power cord to 115 VAC, 60 Hz, 7 Amps minimum power source, or 220 VAC, 50 Hz, 3.5 Amps minimum power source.

d. Move switch to hot.

e. Allow heat gun to warm up for at least 30 seconds.

CAUTION

Nozzle, barrel adapter and reflector are hot. Do not adjust or remove them without first moving switch to cool and allowing blower to operate until reflector is cool (at least 90 seconds).

f. Prepare the assembly to be heated.

g. Place assembly into heating area.

h. Observe assembly during heating. After assembly has received proper amount of heat, stop heat cycle by removing assembly from heating area.

i. Inspect assembly.

61 . **POST-OPERATION.** After using heating tool (Figure 24), proceed as follows:

a. Move switch to cool position and allow blower to run until output air is cool. Then move switch to off:

b. Disconnect power connector from power source.

c. Allow a few minutes for reflector to cool.

d. Visually check reflector for foreign material accumulation. If material is found, clean using steps in paragraph 58.

e. Store reflector in proper place.

62 . **MCH–100–A BATTERY POWERED HEAT GUN.**

63 . **INTRODUCTION**.

64 . Portable battery powered hot air tool MCH–100–A is a lightweight portable unit designed for field deployment or shop usage. It is to be used for various applications such as contactless soldering and desoldering, shrink tubes, plastic welding, drying, and many more applications that would require hot air.

65 . The MCH–100–A consists of a heat gun, power cord, 16 mm spoon reflector, 10 mm sleeve reflector, carrying case, battery charger with adapter plate, and battery case with two batteries (Figure 28). The battery case and the two rechargeable batteries are displayed in (Figure 29).

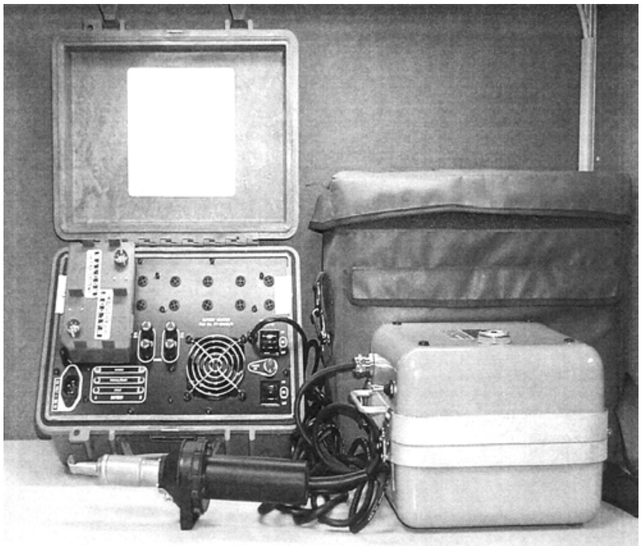


Figure 28. MCH–100–A.

66 . **UNPACKING TOOL.**

a. Inventory the MCH–100–A and check it against the contents chart to ensure all items are present.

b. Pressure release valves are installed on the power pack and charging case to equalize pressure where an imbalance may have occurred during transportation. The valve on the power pack is a push button type, simply push the red button to equalize the pressure. The valve on the charger is located on the bottom of the case and requires a flat head screwdriver to activate.

67 . **INSTALLATION OF BATTERIES INTO POWER PACK.** Batteries should be fully charged before they are placed into the power pack.

a. Install two batteries into the foam slots provided inside the power pack. The connector plug on both batteries must be on the top. Figure 33.

b. Push fit the battery connector onto the batteries. It fits only one way. Figures 34 and 35.

c. Close the power pack lid and secure the latches.

d. Place the power pack into its slot in the carry case.

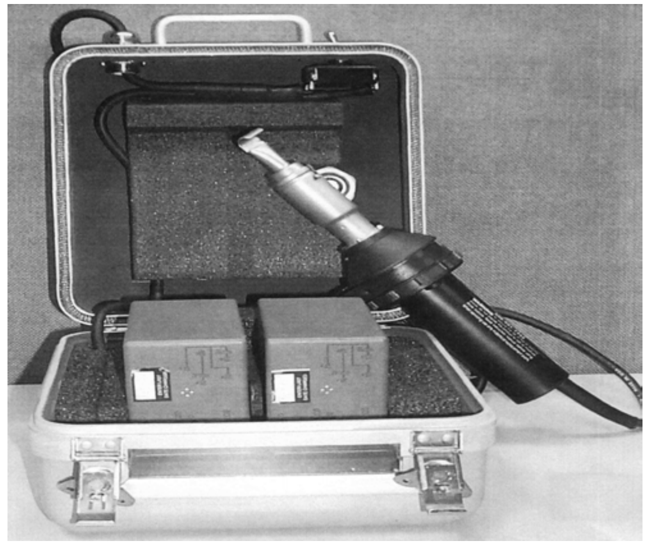


Figure 29. MCH–100–A and Batteries.

68 . **OPERATING PROCEDURES.**

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

WARNING

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

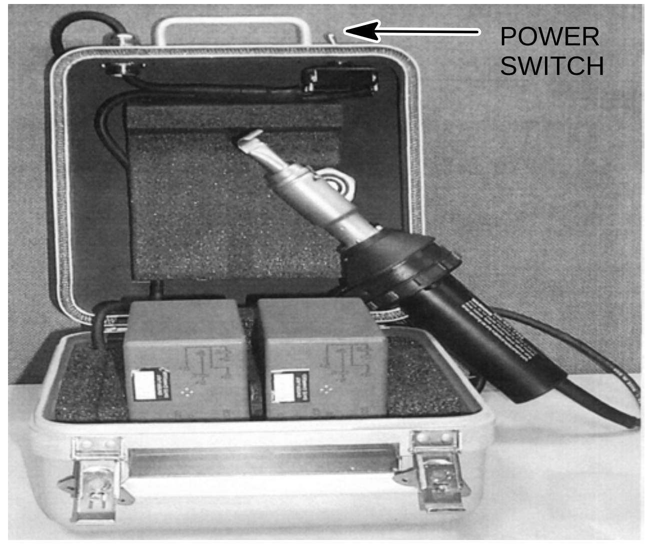
Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

69 . **HOT AIR TOOL CONTROLS**.

70 . The MCH–100–A hot air tool has two simple controls which are described below and shown in Figure 30 and Figure 31. Figure 30 shows the on/off switch located on the power pack that activates the power to the heat gun. When this switch is on, the fan in the hot air tool will be running. Figure 31 shows the on/off switch located on the handle of the hot air tool. This provides power to the heating element. Also shown in the figure is the air intake filter.



Item	Function
ON–OFF switch on battery box	Turns power on and off to the hot air tool. The fan starts up in the tool when the switch is on.

Figure 30. MCH–100 On/Off Switch Located on Power Pack

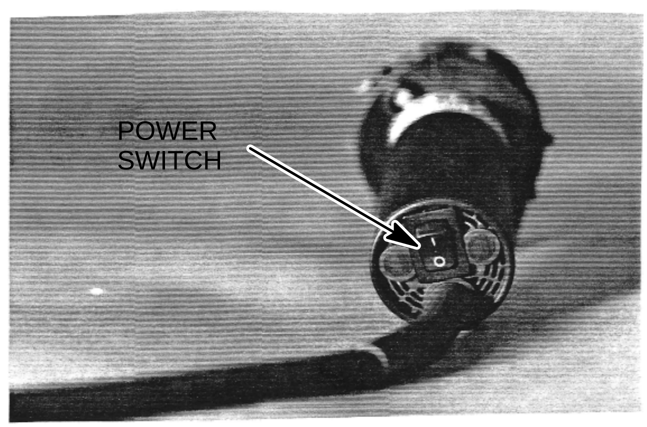
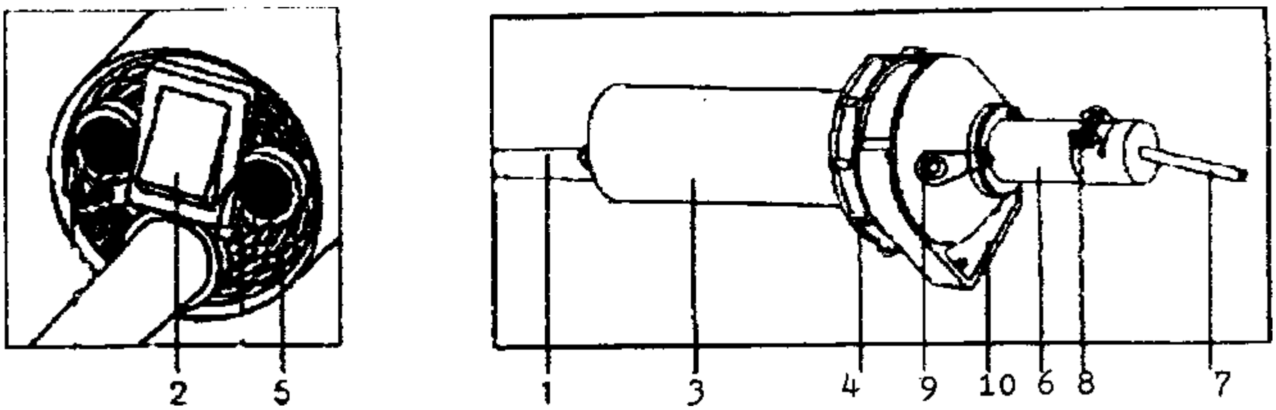


Figure 31. MCH–100 On/Off Switch Located on Handle of Tool



1. Cable to main DC power
2. On/off switch
3. Handle
4. Rubber stand
5. Air filter
6. Element housing
7. Nozzle
8. Push–fit nozzle with twist lock
9. ESD–lead connection
10. Tool stand (can be removed, rotated and fixed)

Figure 32. MCH–100 Controls

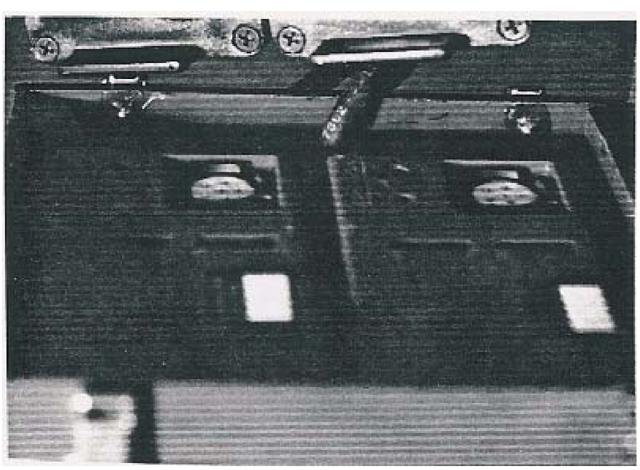


Figure 33. Battery Installation

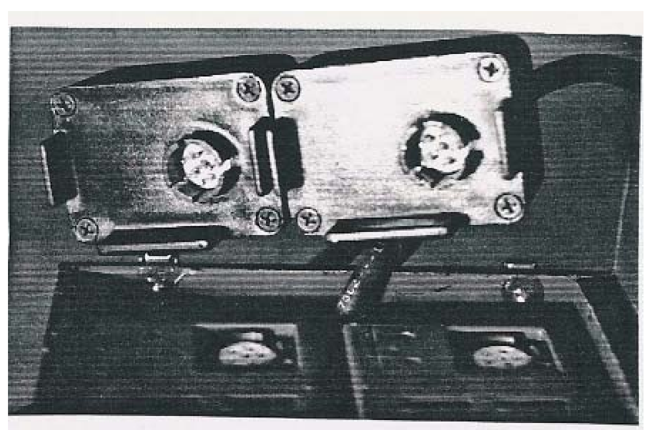


Figure 34. Battery Connection

WARNING

Use only MIL–STD–810 qualified heat guns (HT–900B/HT–920B, HT–71002, MCH–100–A) when working on aircraft that have not been defueled and purged. Only after defueling and purging of the aircraft can other motorized heat guns listed in this manual be used.

71 . **SETUP PROCEDURES**.

a. Select appropriate nozzle (Figure 32, Item 7) and install (push & twist) onto the hot air tool.

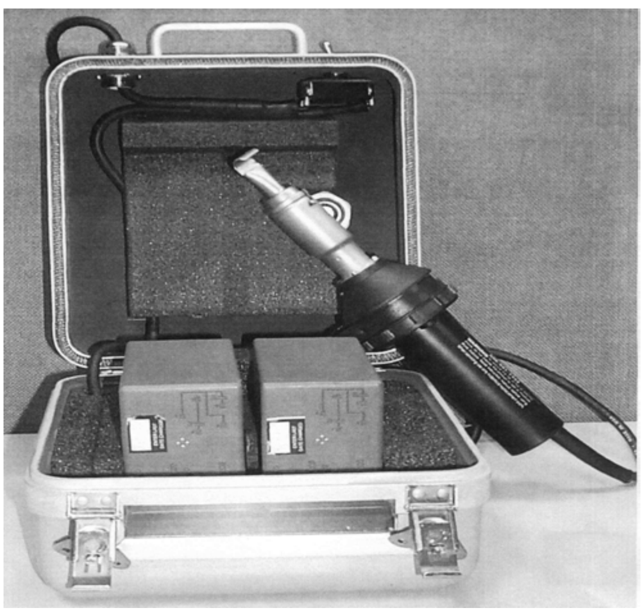


Figure 35. Battery Connection

b. A clip is provided on the tool for Electrostatic Discharge (ESD). If you are using the tool on printed circuit boards where static discharge may cause damage to the electronics, then you will need to ground the tool via the ESD lead connection located on the hot air tool (Figure 32, Item 9).

c. Switch on the power at the power pack (Figure 30).

d. Switch on the power at the hot air tool (Figure 32, Item 2). It should reach full operating temperature in less than one minute.

72 . **CHANGING HOT AIR NOZZLES**.

WARNING

HOT AIR TOOL CAN CAUSE BURNS.

Avoid contact with the hot air tool stainless steel heating element cover and attached nozzles during operation. This part of the tool becomes very hot and can cause burns. Do not point the hot air flow in the direction of personnel.

a. It is recommended that before changing nozzles the operator allow the tool to cool down by turning off the heat (Figure 32, Item 2) and let the fan cool the nozzle down, or turn off the power to the tool and use only combination pliers and or insulated gloves to remove the hot nozzle. When you install a nozzle it is recommended that the fan to the tool be turned off. Push the new nozzle onto the tool and turn it to lock into place (Figure 36).

WARNING

Do not touch hot nozzle with bare hands. Place the hot nozzle onto a heat resistant surface or drop it into the insulated pocket in the MCH–100–A carrying case.

b. Only nozzles specifically designed for this tool should be used.

73 . **CHARGING BATTERIES.**

a. Remove batteries from battery pack.

b. Place batteries onto the supplied charger adapter plate as outlined in Operating Manual AG–BOHGA–OPM–000.

c. Charge batteries using only the supplied battery charger (PP–8444A/U) IAW AG–BOHGA–OPM–000.

74 . **OPERATION IN UNUSUAL WEATHER CONDITIONS.** Observe these precautions when the hot air tool MCH–100–A heat gun is operated in area where severe climatic conditions may exist:

a. Operation in Arctic Climates. The hot air tool performance will be diminished at lower temperatures. The following precautions should be observed:

(1) Handle equipment carefully.

(2) Keep equipment clean and dry.

(3) Prevent ice from forming on the equipment. Ice formations may prevent proper electrical connections.

(4) Battery and hot air tool performance decreases as temperature drops.

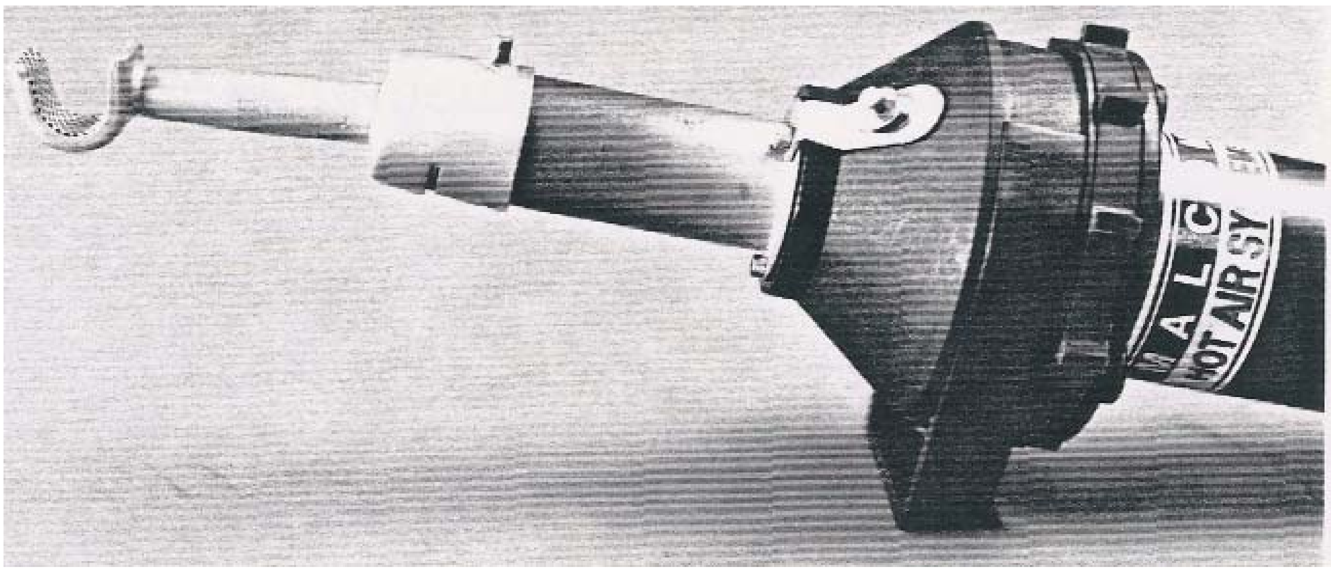


Figure 36. Nozzle Installation

b. Operation in Desert Climates. Temperature extremes of 122˚F(50˚C) and dryness associated with desert environment will not affect equipment usage. However, the built in thermal safety switch inside the batteries will automatically shut the power off if the interior battery temperatures reach 158˚F (70˚C). In order to prevent thermal shutdown, turn off the hot air tool once your work is complete. Try to avoid running the tool longer then 10 minutes at one time in the hot desert conditions. Dust storms associated with desert climates may cause poor electrical connections and prevent proper operation. When operating in these conditions, the filter on the back of the hot air tool should be kept clean by periodically brushing it off as it gets blocked.

c. Operation in Salt Spray. Keep equipment clean and dry at all times and immediately wipe salt spray from exposed surfaces, cables and connectors. When not in use, be sure that cover is fully latched, and the hot air tool is stored it the storage bag with the bag flaps in place.

75 . **PREPARATION FOR MOVEMENT AFTER USE.**

a. Set POWER switch to OFF on the hot air tool to let the tool cool down.

b. Set POWER switch to OFF on the battery box to stop the fan in the tool.

c. Remove any installed nozzles and place them into the appropriate storage pockets in the carrying bag (Figurer 37).

d. Coil DC power cable.

e. Insert hot air tool into appropriate pocket in carrying bag (Figure 37).

f. Insert coiled power cable into appropriate pocket in carrying bag.

g. Close cover to carrying bag and secure.

Figure 37. Hot Air Tool Installed in Carrying Bag

CONTACTS, TERMINALS, SPLICES AND CAPS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont)

Alphabetical Index (Cont)

Alphabetical Index (Cont)

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Crimp Tool	AD–1377 *
Inspection Gage	AD–1378 *
Holding Fixture	AT–1319–11
Holding Fixture	AT–1319–14
Holding Fixture	AT–1319–17
Holding Fixture	AT–1319–18
Holding Fixture	AT–1319–19
Inspection Gage	G125 *
Inspection Gage	G682 *
Inspection Gage	G683 *
Inspection Gage	G684 *
Inspection Gage	G726 *
Inspection Gage	G744 *
Inspection Gage	G745 *
Inspection Gage	G746 *

Support Equipment Required (Cont.)

Nomenclature	Part Number/Type Designation
Inspection Gage	G747 *
Inspection Gage	G801 *
Inspection Gage	G854 *
Inspection Gage	G855 *
Crimp Tool Frame	HD51 *
Die	HD51–105–1 *
Die	HD51–106–1 *
Die	HD51–107–1 *
Die	HD51–113–1 *
Die Set	HD51–128 *
Die Set	HD51–129 *
Die	HD51–130–1 *
Die	HD51–131–2 *
Die	HD51–132–2 *
Die	HD51–133–2 *
Die	HD51–133–2 *
Die	HD51–134–2 *
Die Set	HD51–154 *
Crimp Tool Frame	HH80C *
Heat Gun	HT–900B/HT–920
Crimp Tool Frame	M22520/10–01
Die Set	M22520/10–05
Die Set	M22520/10–06
Die Set	M22520/10–100
Die Set	M22520/10–101
Die Set	M22520/10–103
Die Set	M22520/10–104
Crimp Tool Frame	M22520/19–01
Positioner	M22520/19–02
Positioner	M22520/19–04
Crimp Tool Frame	M22520/20–01
Positioner	M22520/20–02
Positioner	M22520/20–03
Crimp Tool Frame	M22520/2–01
Crimp Tool Frame	M22520/21–01

Support Equipment Required (Cont.)

Nomenclature	Part Number/Type Designation
Positioner	M22520/21–02
Positioner	M22520/21–04
Positioner	M22520/2–24
Positioner	M22520/2–28
Positioner	M22520/2–29
Positioner	M22520/2–30
Pneumatic Crimper	M22520/23–01
Die	M22520/23–02
Die	M22520/23–03
Die	M22520/23–04
Die	M22520/23–05
Die	M22520/23–06
Die	M22520/23–07
Locator	M22520/23–09
Locator	M22520/23–10
Locator	M22520/23–11
Locator	M22520/23–12
Locator	M22520/23–13
Locator	M22520/23–14
Locator	M22520/23–15
Locator	M22520/23–16
Positioner	M22520/2–33
Pneumatic Crimper	M22520/28–01
Air Supply Hose	M22520/28–02
Pneumatic Crimper	M22520/29–01
Bench Mount	M22520/30–01
Foot Valve	M22520/30–02
Inspection Gage	M22520/3–09
Inspection Gage	M22520/3–10
Inspection Gage	M22520/3–12
Inspection Gage	M22520/3–13
Inspection Gage	M22520/3–14
Crimp Tool	M22520/37–01
Crimp Tool	M22520/38–01
Inspection Gage	M22520/39–01

Support Equipment Required (Cont.)

Nomenclature	Part Number/Type Designation
Inspection Gage	M22520/39–01
Crimp Tool Frame	M22520/5–01
Die Set	M22520/5–08
Die Set	M22520/5–10
Die Set	M22520/5–100
Die Set	M22520/5–102
Die Set	M22520/5–103
Crimp Tool Frame	M22520/7–01
Die Set	MS23002–01
Die Set	MS23002–02
Die Set	MS23002–03
Die Set	MS23002–04
Die Set	MS23002–1
Die Set	MS23002–2
Die Set	MS23002–4
Die Set	MS23002–6
Die Set	MS23002–8
Inspection Gage	MS23003–01
Inspection Gage	MS23003–02
Inspection Gage	MS23003–03
Inspection Gage	MS23003–04
Inspection Gage	MS23003–1
Inspection Gage	MS23003–2
Inspection Gage	MS23003–4
Inspection Gage	MS23003–6
Inspection Gage	MS23003–8
Head	MS25441–1
Hydraulic Hose	MS25441–3
Hydraulic Pedal Pump	MS25441–5
Die Set	MS25442–01A
Die Set	MS25442–02A
Die Set	MS25442–03A
Die Set	MS25442–04A
Die Set	MS25442–1A
Die Set	MS25442–2A

Support Equipment Required (Cont.)

Nomenclature	Part Number/Type Designation
Die Set	MS25442–4A
Die Set	MS25442–6A
Die Set	MS25442–8A
Die Set	MS90485–01
Die Set	MS90485–02
Die Set	MS90485–03
Die Set	MS90485–04
Die Set	MS90485–1
Die Set	MS90485–2
Die Set	MS90485–4
Die Set	MS90485–6
Die Set	MS90485–8
Inspection Gage	MS90486–01
Inspection Gage	MS90486–02
Inspection Gage	MS90486–03
Inspection Gage	MS90486–04
Inspection Gage	MS90486–1
Inspection Gage	MS90486–2
Inspection Gage	MS90486–4
Inspection Gage	MS90486–6
Inspection Gage	MS90486–8
Pneumatic Crimper	WA22 *
Pneumatic Crimper	WA27F *
* Tool or commercial equivalent	* Tool or commercial equivalent

Materials Required

Nomenclature	Part Number/Type Designation
Methyl Ethyl Ketone (MEK)	ASTM D740 or other approved solvent
Sleeving, Insulation, Heat Shrinkable	SAE AMS–DTL–23053

1 . **INTRODUCTION.**

2 . This work package (WP) provides information for crimping contacts, terminals, and splices with the required crimp tool. Preparation of the tool for crimping is also provided.

3 . **CRIMP CONTACT.**

4 . A contact is used in a connector to transfer electrical energy from one mating half of a connector to the other mating half of a connector pair (WP 003 00). A crimp contact is typically removable from the front or rear of a connector (01–1A–505). A contact can generally be

grouped into four categories: signal, power, thermocouple and high frequency.

5. **POWER/SIGNAL CONTACT.** A power contact and signal contact are usually grouped together for discussion purposes, because other than perhaps size, the contact configuration is basically the same for most applications. Typically a smaller size contacts are used for signal, and a larger contact is used for power. For future discussion in this WP, the term power contact will be used for both. A power contact is usually gold-plated copper alloy for sizes 28 through 12, and silver-plated copper alloy for sizes 12 through 04. Size 12 contacts are either silver-plated copper alloy or gold–plated copper alloy, depending on the application.

6. **THERMOCOUPLE CONTACT.** A thermocouple contact is unplated, although sometimes coated, and consists of the same material as the thermocouple conductor on which the contact is being crimped. The thermocouple contact has the same configuration as the power contact.

7. **HIGH FREQUENCY CONTACT.** A high frequency contact is more commonly known as a coaxial or triaxial contact. These contacts are usually gold-plated copper alloy. A high frequency contact has a variety of configurations depending on the manufacturer. Because of the variety, often times the assembly procedure for the contact must be in accordance with the manufacturer's assembly instruction. The assembly instructions provided herein may not be the only means of assembly.

8. **MIL-C-39029 SPECIFICATION AND PART NUMBER.** Most crimp contacts, power and thermocouple, used in military connectors are standardized in MIL-C-39029. The MIL-C-39029 contact is identified by a Basic Identification Number (BIN) which represent three color bands marked on the crimp barrel of the contact (Figure 1).

a. Example: M39029/33-463

b. M39029: Basic specification defining the contact performance requirement.

c. /33: Detail specification defining the contact configuration, the connector application, the crimp tool, and other detail characteristics.

d. -463: BIN Number (Figure 1).

9. **POWER AND THERMOCOUPLE CONTACT CRIMPING PROCEDURE.** Since a power contact and a thermocouple contact has the same configuration, the crimping procedure is the same and is as follows:

a. Select the correct crimp tool in accordance with the appropriate connector requirement (the appropriate NAVAIR 01-1A-505 Connector Volumes or MIL-C-39029.

b. Prepare the conductor in accordance with WP 009 00.

c. Prepare the crimp tool in accordance with paragraphs 71, 82, or 93.

d. Insert stripped wire into contact conductor barrel. Ensure all wire strands are inside contact conductor barrel and the conductor is completely visible in contact inspection hole (Figure 2).

e. If insulation gap is greater than 1/64, trim conductor as required. If insulation gap is too small, trim insulation as required.

f. Crimp contact to wire in accordance with paragraphs 81 or 92.

g. Remove contact from crimp tool and inspect for the following:

(1) Two series of four indents shall secure contact to wire (Figure 3).

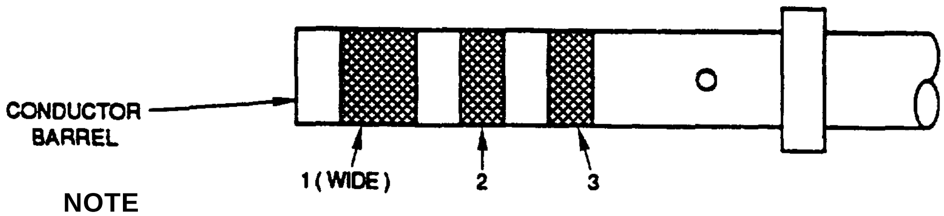
(2) Wire strands shall be visible in contact inspection hole, indicating that wire is crimped into contact at correct depth.

(3) Verify insulation gap is within limits specified in applicable work package.

(4) Wire strands shall not he nicked or loose.

(5) Contact shall not be nicked, bent, or distorted.

h. Refer to applicable connector work package or volume for contact insertion procedure.



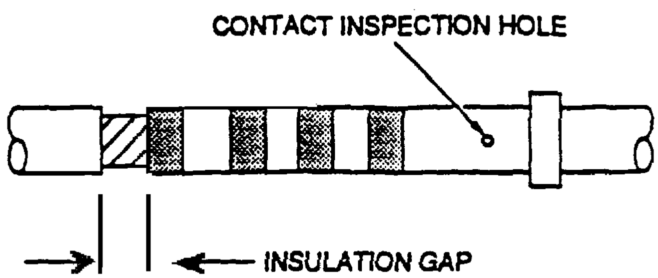
NOTE

FOR CONTACTS SIZE 16 AND LARGER, THE BIN MAY BE STAMPED ON THE CONTACT BARREL

BLACK	0	GREEN	5
BROWN	1	BLUE	6
RED	2	VIOLET	7
ORANGE	3	GRAY	8
YELLOW	4	WHITE	9

EXAMPLE BIN CODE: 463
YELLOW (WIDE BAND)/BLUE/ORANGE

Figure 1. Basic Identification Number and Color Bands



CONTACT SIZE	WIRE AWG	INSULATION GAP
22D	26	
22M		
22	24	1/64" MAX
	22	
20	20	
16	20	
	18	
	16	
12	14	
	12	1/32" MAX
8	10	
	8	1/32" MAX

Figure 2. Insulation Gap

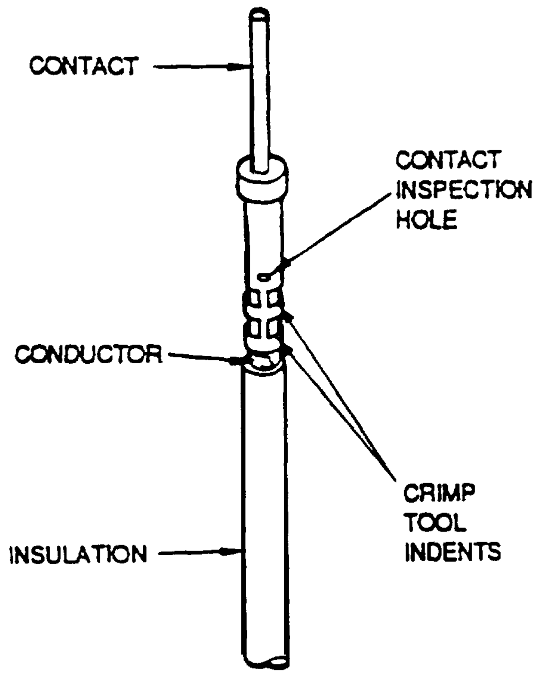


Figure 3. Crimp Joint Inspection

10. **COAXIAL CONTACT CRIMPING AND ASSEMBLY.** A coaxial contact may be crimped and assembled in numerous ways. The assembly procedures provided herein are for known standard assemblies. A typical example of a coaxial contact assembly is shown in Figure 4.

11. **MIL-C-39029/54 AND /55 COAXIAL CONTACTS.** MIL-C-39029/54 and /55 coaxial contacts are used in MIL–DTL–26518 connectors.

12. **M39029/54-342 AND -343 COAXIAL CONTACT CRIMPING PROCEDURE.** Crimp and assemble the size 12 contacts as follows:

a. Cut cable end square, leaving enough cable for adequate strain relief without excess slack.

b. Slide crimp sleeve over cable. Using coaxial cable stripper, strip jacket dimension A from end and trim shield to dimension B from jacket, as specified in Table 1 and Figure 5 .

c. Flare the shield back as shown in Figure 6 . Do not comb out individual shield strands. Using a sharp knife, strip dielectric to dimension C Table 1 .

d. Slide rear insulator, large diameter first, over center conductor, then seat rear insulator against dielectric as shown in Figure 7.

e. Insert center conductor into center contact and trim center conductor as required to seat center contact against rear insulator. Ensure center conductor remains visible in contact inspection hole (Figure 7).

f. Crimp center contact using the specified crimp tool frame, and positioner and selector knob setting required for the cable (Figure 8).

g. If front insulator is not captivated inside contact body, slide front insulator, large inside diameter first, over center contact (Figure 8).

h. Slide contact body over center contact assembly and under shield until fully seated (Figure 9).

i. Arrange shield as close to original lay as possible. Slide crimp sleeve over shield and obtain 1/4 to 9/32-inch dimension. Trim excess shield ahead of crimp sleeve (Figure 10).

j. After correctly locating crimp sleeve perform crimp using tooling, specified in Table 1 (Figure 11).

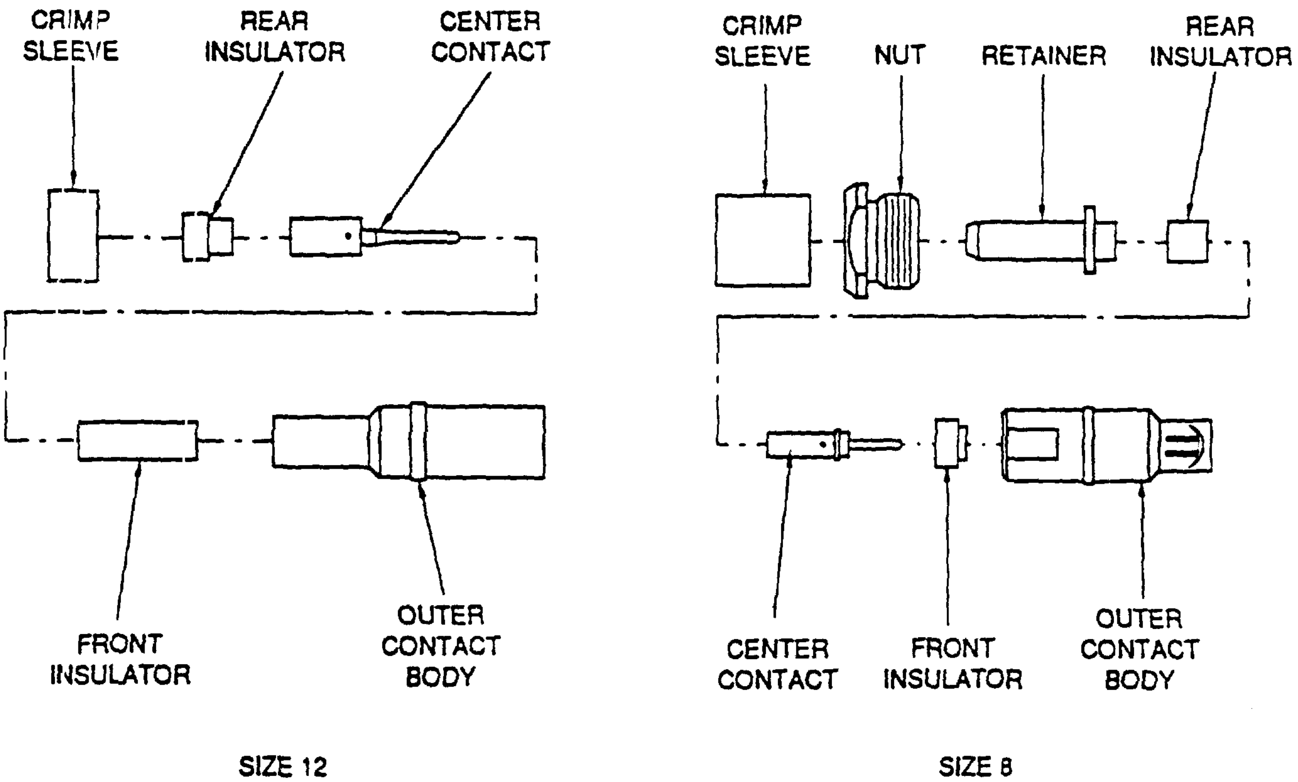


Figure 4. Typical Coaxial Shield Assembly

Table 1 . MIL-C-39029/54 AND /55 Coaxial Contact Tooling

Contact M39029/	Strip Dimension (Inch) A	B	C	Center Contact Crimp Tool Frame M22520/	Center Contact Positioner M22520/	Crimp Sleeve Crimp Tool Frame M22520/	Crimp Sleeve Die Set Positioner M22520/
54-342	7/32	5/64	7/64	2–01	2–33	5-01 or 10-01	5-08 or 10-05 (A)
54-343	7/32	7/64	9/64	2–01	2–24	5-01 or 10-01	5-10 or 10-06
55-344	7/32	5/64	7/64	2–01	2–33	5-01 or 10-01	5-08 or 10-05(A)
55-345	7/32	7/64	9/64	2–01	2–24	5-01 or 10-01	5-10 or 10-06

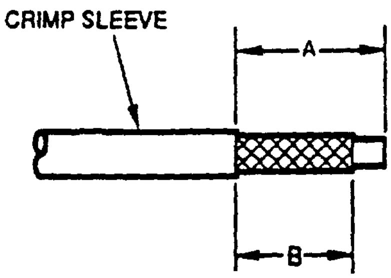


Figure 5. Cable Strip Length

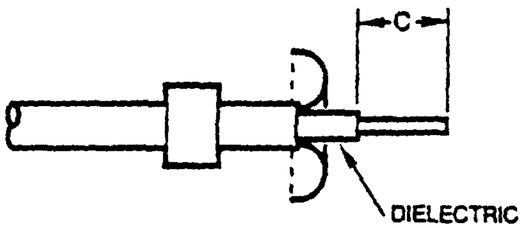


Figure 6. Braid Fold-Back

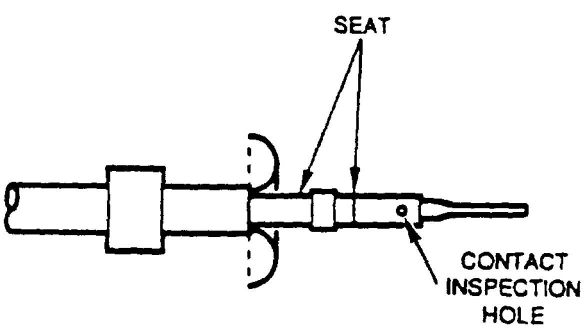


Figure 7. Contact Seating

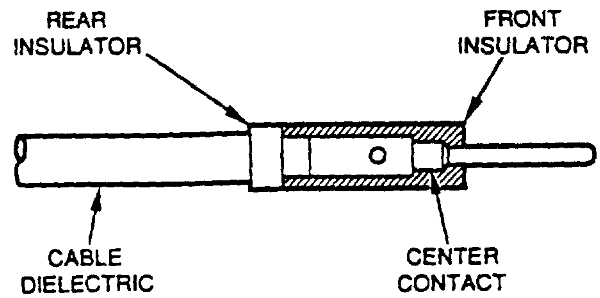


Figure 8. Contact Insulator

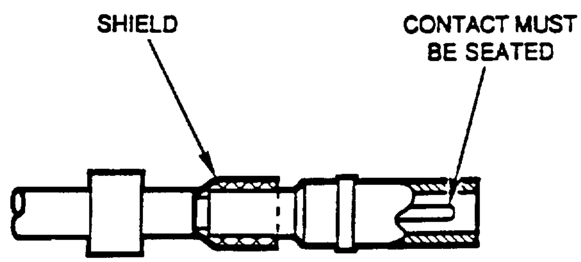


Figure 9. Shield Preparation

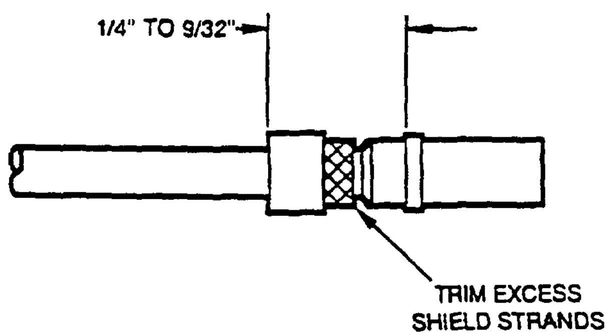


Figure 10. Trim Shield

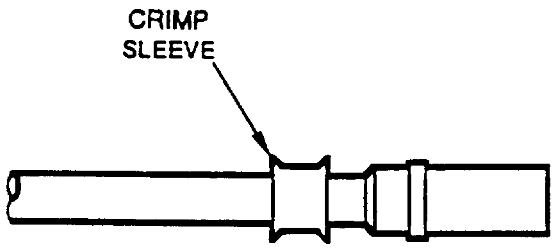


Figure 11. Crimp Sleeve

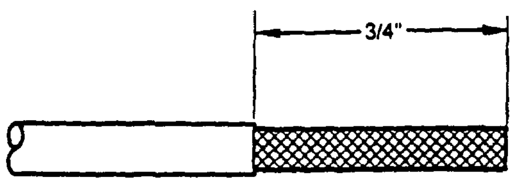


Figure 12 . Strip Length

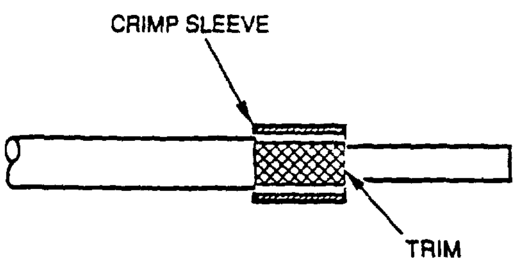


Figure 13. Shield Crimp

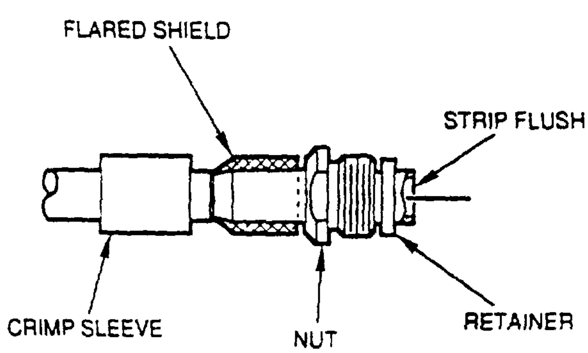


Figure 14. Flare Shield

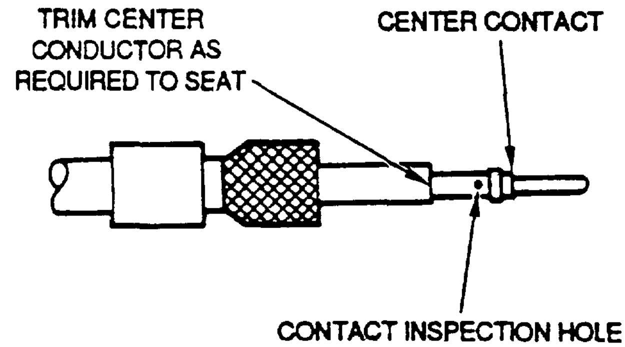


Figure 15. Contact Retainer

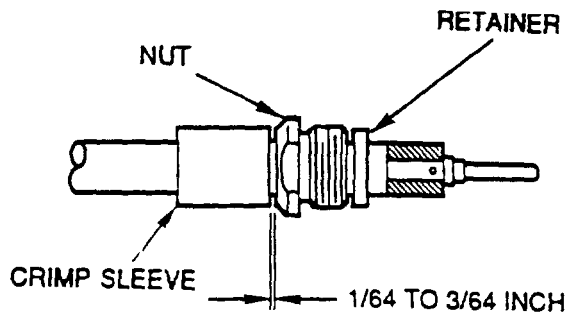


Figure 16. Mount Retainer

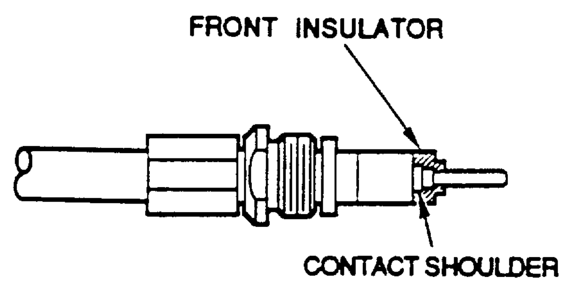


Figure 17. Mount Insulator

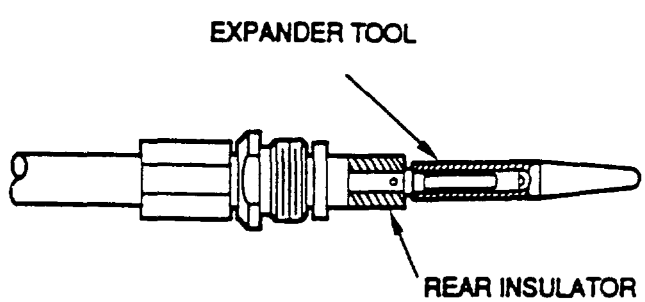


Figure 18. Crimp Contact

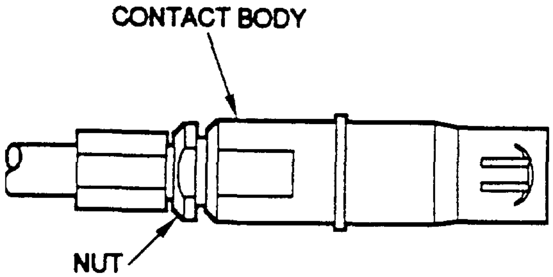


Figure 19. Mount Contact Body

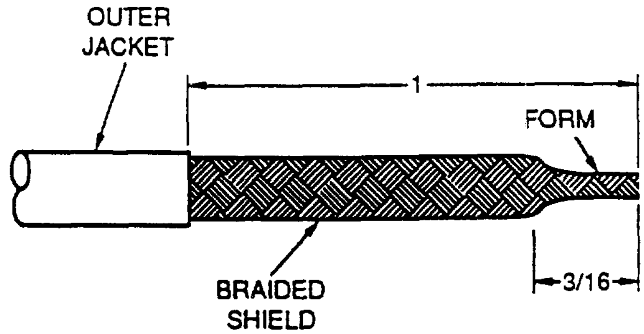


Figure 20. Strip Shield Cable

13. **MIL-C-39029/19 AND /20 COAXIAL CONTACTS.** MIL-C-39029/19 and /20 coaxial contacts are used in MIL-C-81511 connectors.

14. **M39029/19-181 COAXIAL CONTACT CRIMPING PROCEDURE.** Crimp the M39029/19-181 size 16 pin contact as follows:

CAUTION

When stripping cable, remove only amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

a. Cut cable end square with wire/cable cutters as shown in Figure 20. Remove 1-inch of outer jacket and push braided shield back to expose insulation of center conductor. Strip 3/16-inch of insulation from center conductor. Slide braided shield back in place and form end to aid in sleeve installation.

b. Slide outer sleeve over braided shield to butt cut end of outer jacket as shown in Figure 22.

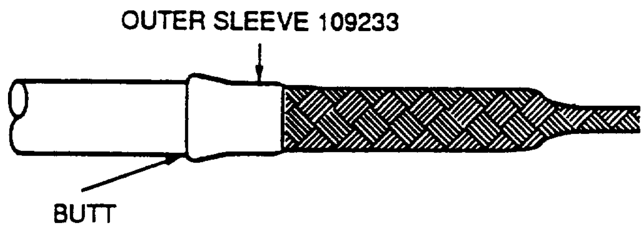


Figure 21. Mount Outer Sleeve

c. Slide contact body over center contact assembly as shown in Figure 19. Thread nut into contact body until retainer is seated in contact body.

d. Fold braided shield back tightly over outer sleeve and trim braid at fold line as shown in Figure 22.

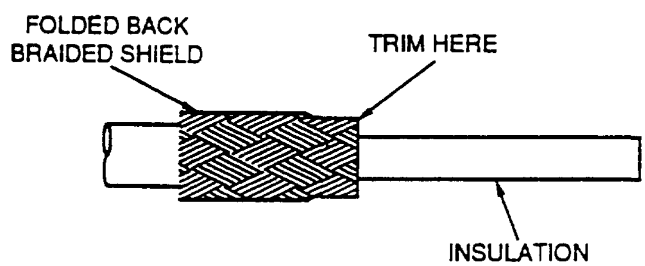


Figure 22. Fold Shield

e. As shown in Figure 23, strip 1/8-inch of insulation from center conductor, allowing 13/64-inch between edge of braided shield and end of center conductor. Twist center conductor to prevent splayed wire strands.

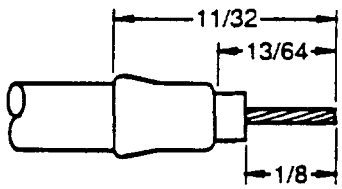


Figure 23. Strip Center Conductor

f. Install center contact onto center conductor to butt insulation as shown in Figure 24. Ensure that all wire strands enter the center contact wire barrel.

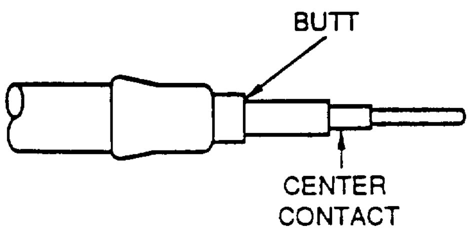


Figure 24. Install Contact

NOTE

When crimping center contact, push cable into spacer and contact and maintain slight pressure during crimp cycle.

g. As shown in Figure 25, crimp center contact to center conductor using crimp tool frame M22520/2-01 and positioner M22520/2-28.

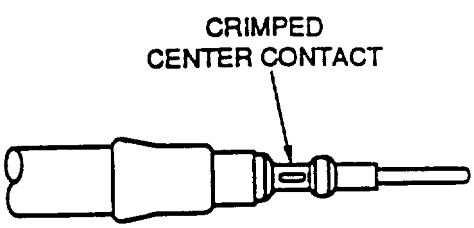


Figure 25. Crimp Center Contact

h. Install teflon insulator over contact until it bottoms. Slide outer sleeve to butt spacer and crimp in place using crimp tool frame M22520/20-01 and positioner M22520/20-02 (Figure 26).

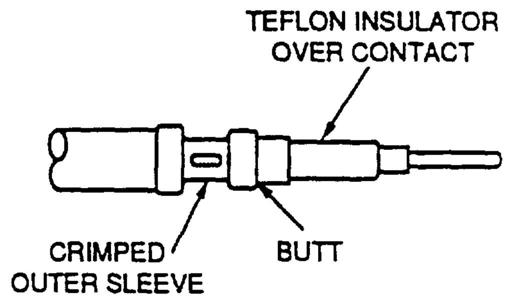


Figure 26. Mount Teflon Insulator

i. Install center contact and cable assembly into outer contact until it bottoms (Figure 27).

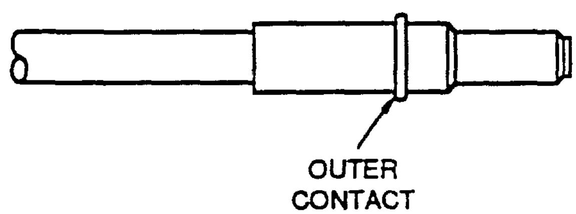


Figure 27. Install Outer Contact

NOTE

When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

j. As shown in Figure 28, crimp outer contact to cable assembly using crimp tool frame M22520/19-01 and positioner M22520/19-02.

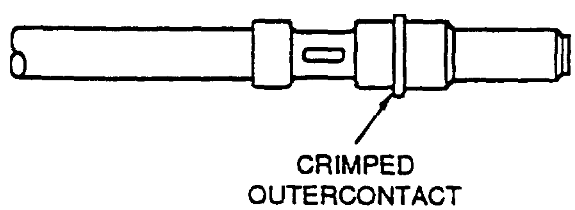


Figure 28. Crimp Outer Contact

k. Inspect completed assembly to ensure that center contact is not recessed more than 1/64-inch (Figure 29).

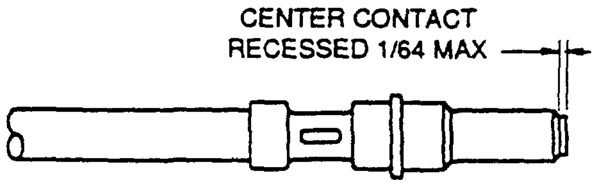


Figure 29. Inspect Contact

15. M39029/19-182 COAXIAL CONTACT CRIMPING PROCEDURE. Crimp the M39029/19-182, size 12 pin contact as follows:

CAUTION

When stripping cable, strip only the amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

a. As shown in Figure 30, cut cable end square with wire/cable cutters. Strip 3/8-inch of cable jacket, 3/16-inch of braided shield, and 1/8-inch of insulation from center conductor. Twist center conductor to prevent splayed wire strands.

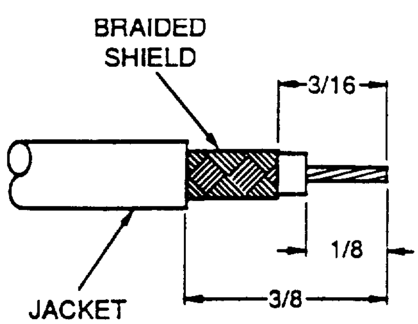


Figure 30. Prepare Cable

CAUTION

Center contact is one assembly composed of center contact and teflon insulator. Under no circumstances shall they be taken apart.

b. Install center contact (Figure 31) onto center conductor and butt against the insulation. Ensure that all wire strands enter the center contact wire barrel, and no braided shield strands enter center contact insulator (Figure 32).

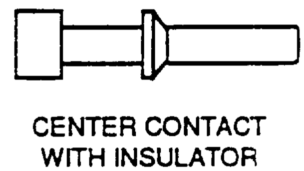


Figure 31. Center Contact Insulator

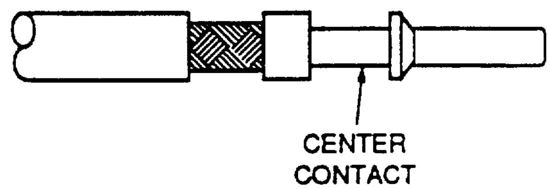


Figure 32. Install Center Contact

NOTE

When crimping center contact, push cable into contact and maintain slight pressure during crimp cycle.

c. As shown in Figure 33, crimp center contact (through teflon insulator) to center conductor, using crimp tool frame M22520/2-01 and positioner M22520/2-29.

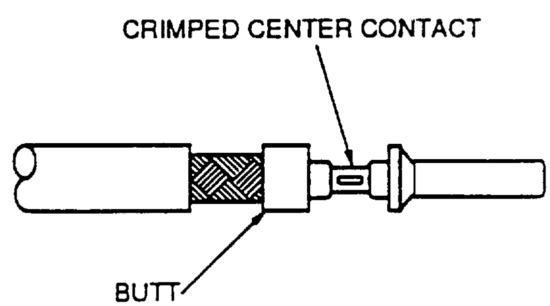


Figure 33. Crimping Center Contact

d. Install center contact and cable assembly into outer contact. Ensure that all braided shield strands enter inside outer contact (Figure 27).

e. Crimp outer contact to braided shield of cable, using crimp tool frame M22520/21-01 and positioner M22520/21-02 (Figure 28). When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

f. Inspect completed assembly to ensure that center contact insulator does not protrude more than 1/64-inch (Figure 29).

16. **M39029/19-183 COAXIAL CONTACT CRIMPING PROCEDURE.** Crimp the M39029/19-183, size 12 pin contact as follows:

CAUTION

When stripping cable, strip only amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

a. As shown in Figure 20, cut cable end square with wire/cable cutters. Remove 1-inch of outer jacket and push braided shield back to expose insulation of center conductor. Remove (strip) 3/16-inch of insulation and center conductor. Slide braided shield hack in place and form braided shield to aid in sleeve installation.

b. Slide inner sleeve, 109256 over braided shield to butt cut end of outer jacket as shown in Figure 21.

c. As shown in Figure 34, fold braided shield back tightly over inner, sleeve and trim braid flush with back end of sleeve.

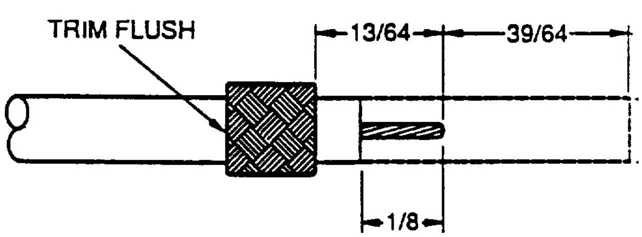


Figure 34. Trim Braid

CAUTION

Center contact is one assembly composed of center contact and teflon insulator. Under no circumstances shall they be taken apart (Figure 31).

d. Install center contact onto center conductor and butt against the insulation. Ensure that all wire stands enter center contact wire barrel (Figure 32).

NOTE

When crimping center contact, push cable into contact and maintain slight pressure during crimp cycle.

e. Crimp center contact (through teflon insulator) to center conductor using crimp tool frame M22520/2-01 and positioner M22520/2-29 (Figure 33).

f. Install center contact and cable assembly into outer contact until it bottoms (Figure 37).

NOTE

When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

g. Crimp outer contact to braided shield of cable using crimp tool frame M22520/21-01 and positioner M22520/21-02 (Figure 28).

h. Inspect completed assembly to ensure that center contact insulator does not protrude more than 1/64-inch (Figure 29).

17. **M39029/20-184 COAXIAL CONTACT CRIMPING PROCEDURE**. Crimp the M39029/20-184, size 16 socket contact as follows:

CAUTION

When stripping cable, remove only amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

a. Cut cable end square with wire/cable cutters. Remove 1 -inch of outer jacket and push braided shield back to expose insulation of center conductor. Remove 3/16-inch of insulation and center conductor. Slide braided shield back in place and form end to aid in sleeve installation (Figure 20).

b. Slide outer sleeve over braided shield to butt cut end of outer jacket (Figure 21).

c. Fold braided shield back tightly over outer sleeve and trim braid at fold line (Figure 22).

d. As shown in Figure 35, strip 7/16-inch of insulation from center conductor, allowing 33/64-inch between edge of braided shield and end of center conductor. Twist center conductor to prevent splayed wire strands.

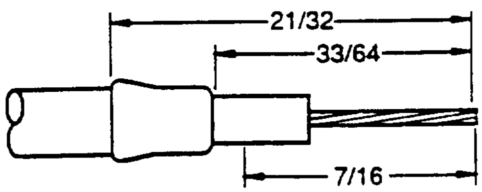


Figure 35. Strip Lengths

e. Install spacer and center contact onto center conductor to butt insulation. Ensure that all wire strands enter center contact wire barrel (Figure 36).

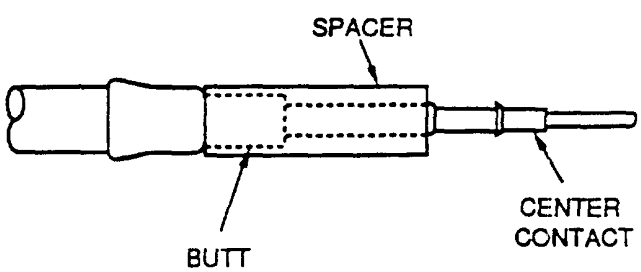


Figure 36. Install Space

NOTE

When crimping center contact, push cable into spacer and contact and maintain slight pressure during crimp cycle.

f. As shown in Figure 37, crimp center contact to center conductor using crimp tool frame M22520/2-01 and positioner M22520/2-28.

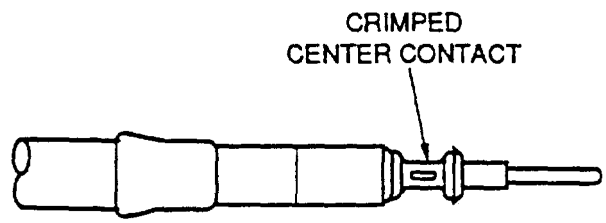


Figure 37. Center Contact Crimped

g. Install teflon insulator over contact until it bottoms. Slide outer sleeve to butt spacer and crimp in place using crimp tool frame M22520/20-01 and positioner M22520/20-03 (Figure 38).

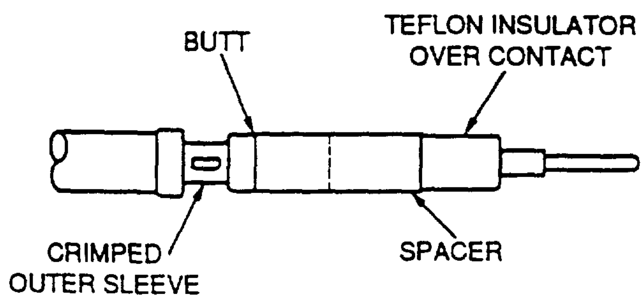


Figure 38. Teflon Insulator

h. As shown in Figure 39, install center contact and cable assembly into outer contact until it bottoms.

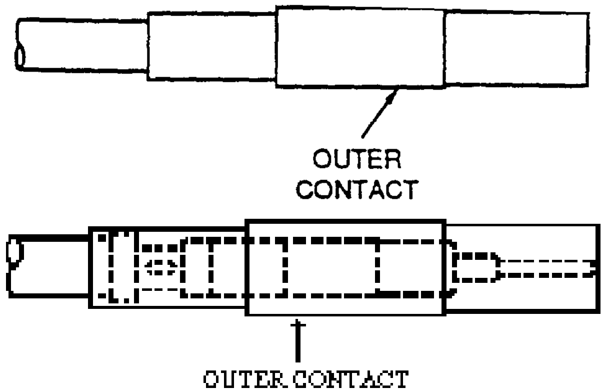


Figure 39. Outer Contact

NOTE

When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

i. Crimp outer contact to cable assembly using crimp tool frame M22520/19-01 and positioner M22520/19-04 (Figure 40).

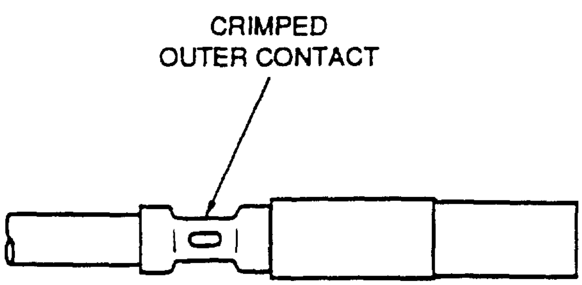


Figure 40. Crimp Outer Contact

j. As shown in Figure 41, inspect completed assembly to ensure that center contact is not recessed more than 1/64-inch.

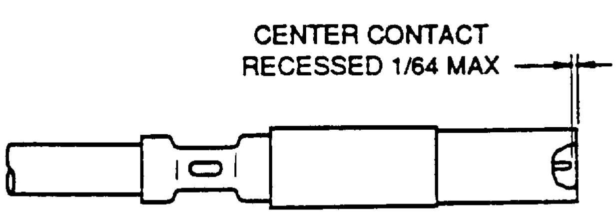


Figure 41. Recess Inspection

18. M39029/20-185 COAXIAL CONTACT CRIMPING PROCEDURE. Crimp the M39029/20-185, size 12 socket contact as follows:

CAUTION

When stripping cable, strip only amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

a. As shown in Figure 42, cut cable end square with wire/cable cutters. Strip 11/16-inch of cable jacket, 7/16-inch of braided shield, and 1/8-inch of insulation from center conductor. Twist center conductor to prevent splayed wire strands.

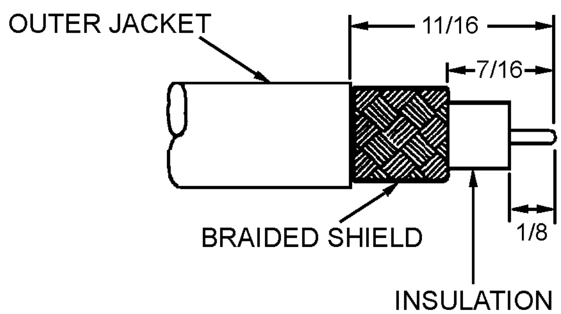


Figure 42. Strip Cable

CAUTION

Center contact is one assembly composed of center contact and teflon insulator. Under no circumstances shall they be taken apart (Figure 31).

b. Install center contact onto center conductor to butt insulation. Ensure that all wire strands enter center contact wire barrel (Figure 32).

NOTE

When crimping center contact, push cable into contact and maintain slight pressure during crimp cycle.

c. Crimp center contact (through teflon insulator) to center conductor. using crimp tool frame M22520/2-01 and positioner M22520/2-29 (Figure 33).

d. Install center contact and cable assembly into outer contact, until it bottoms (Figure 39).

NOTE

When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

e. Crimp outer contact to braided shield of cable using crimp tool frame M22520/21-01 and positioner M22520/21-04 (Figure 40).

f. Inspect completed assembly, to ensure that center contact is not recessed more than 1/64-l-inch (Figure 41).

19. **M39029/20-186 COAXIAL CONTACT CRIMPING PROCEDURE.** Crimp the M39029/20-186, size 12 socket contact as follows:

a. Cut cable end square with wire/end cutters. Remove 1-inch of outer jacket and push braided shield back to expose insulation of center conductor. Strip 3/16-inch of insulation and center conductor. Slide braided shield back in place and form end to aid in sleeve installation (Figure 21).

CAUTION

When stripping cable, strip only amount of material necessary. Do not cut too deep because the braided shield or insulation may be damaged. Strip dimensions shall be as accurate as possible. Incorrect strip dimensions are the greatest cause of contact failure.

b. Install spacer and center contact onto center conductor to butt insulation. Ensure that all wire strands enter center contact wire barrel (Figure 32).

c. Slide inner sleeve over braided shield to butt cut end of outer jacket as shown (Figure 21).

CAUTION

Center contact is one assembly composed of center contact and teflon insulator. Under no circumstances shall they be taken apart (Figure 31).

d. As shown in Figure 43, fold braided shield back tightly over inner sleeve and trim braid flush with back end of sleeve. Strip 29/64-inch of insulation from center conductor allowing 17/32-inch between edge of braid and end of center conductor. Twist center conductor to prevent splayed wire strands.

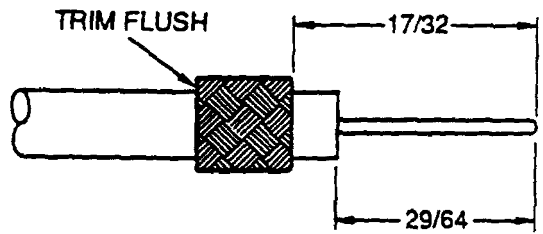


Figure 43. Length of Strip

NOTE

When crimping outer contact. push cable into spacer and contact and maintain slight pressure during crimp cycle.

e. Crimp center contact (through teflon insulator) to center conductor, using crimp tool frame M22520/2-01 and positioner MS22520/2-29 (Figure 33).

f. Install center contact and cable assembly into outer contact until it bottoms (Figure 39).

CAUTION

When crimping outer contact, push cable into contact and maintain slight pressure during crimp cycle.

g. Crimp outer contact to braided shield of cable using crimp tool frame M22520/21-01 and positioner M22520/21-04 (Figure 40).

h. Inspect completed assembly to ensure that center contact is not recessed more than 1/64-inch (Figure 41).

20 . **M39029/50 AND /51 COAXIAL CONTACTS.** MIL-C-39029/50 and /51 coaxial contacts are used in MIL–DTL–83723 connectors. Both the M 39029/51-340 coaxial pin contact and the M39029/51–341 socket contact are assembled as follows (Figure 44):

a. As shown in Figure 45, cut cable end square and remove outer jacket to 33/64-inch dimension. For cable stripping refer to WP 009 00.

b. Slide crimp sleeve onto the cable out of the way (Figure 46).

c. As shown in Figure 47, comb and fold out outer conductor. Strip dielectric and trim inner conductor to 5/64-inch diameter.

d. If applicable, slide metal cap, small bore first, over stripped center conductor and dielectric.

e. As shown in Figure 48, slide dielectric bushing on (large diameter first) until it butts combed our outer conductor.

f. Tin the center conductor and solder onto center contact (WP 017 00). Maintain a butt condition between contact and dielectric while soldering in place. If the center contact is designed to be crimped, use M22520/2-01 crimp tool with positioner M22520/2-30 (49).

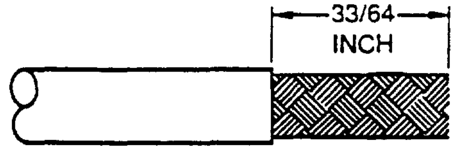


Figure 44. M39029/51 Strip Length

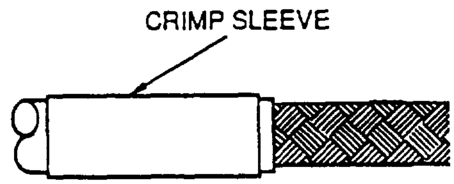


Figure 45. M39029/51 Crimp Sleeve

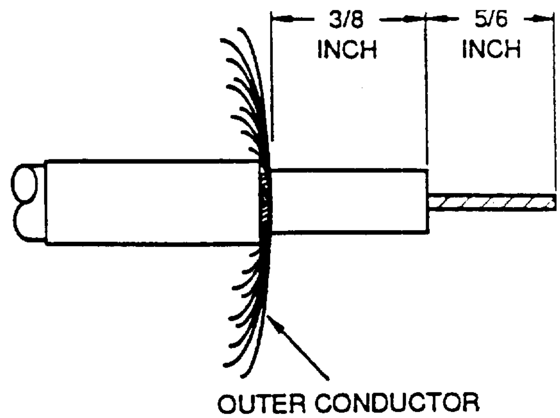


Figure 46. M39029/51 Shield Preparation

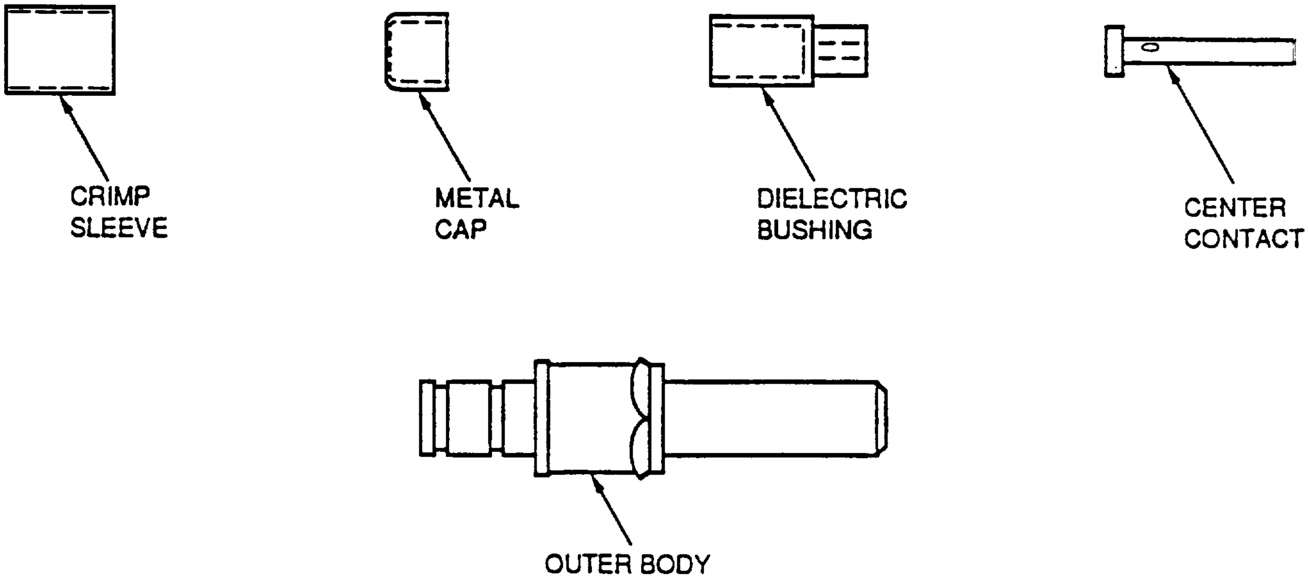


Figure 47. M39029/51 Shielded Contact Assembly

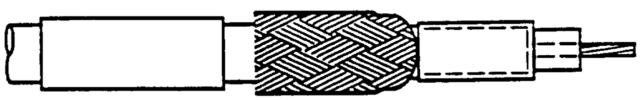


Figure 48. M39029/51 Bushing

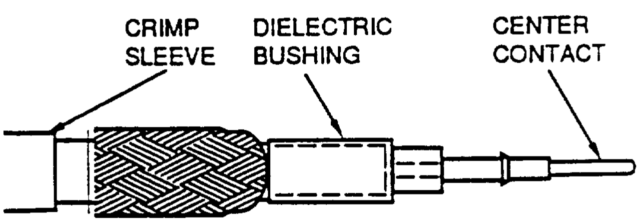


Figure 49. M39029/51 Center Contact

g. As Shown in Figure 50, insert center contact assembly into contact outer body until it bottoms. If previously installed, slide metal cap onto outer contact ferrule until it bottoms.

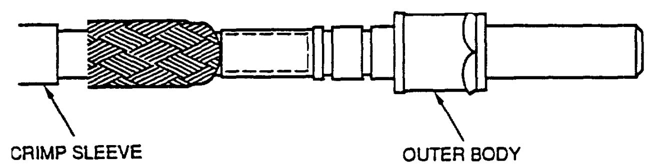


Figure 50. M39029/51 Outer Body

h. Fold outer conductor strands evenly over ferrule end of outer contact body and metal cap, if installed. and position crimp sleeve over them approximately 1/16-inch from contact shoulder (Figure 51).

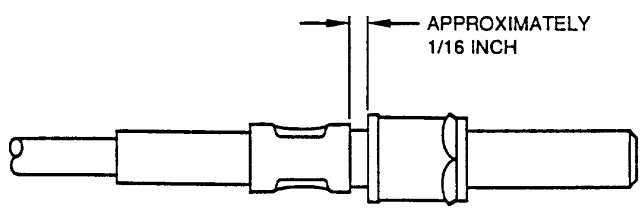


Figure 51. M39029/51 Outer Body Position

i. As shown in Figure 52, hold sleeve in place while crimping the contact end with a M22520/5-01 crimp tool and a M22520/5-08 positioner.

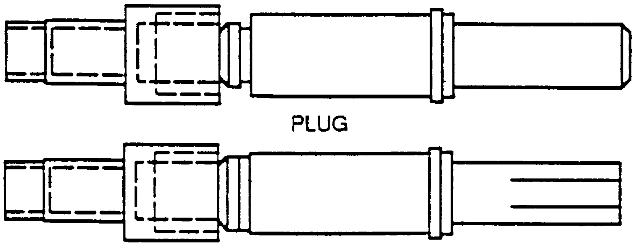


Figure 52. M39029/50 and /51 Contact

j. Assemble the M39029/50 contact in the same manner as the M39029/51 contact.

21 . **COAXIAL SOLDER CONTACT INSTALLATION.**

22 . Introduction To Solder Contacts. Removable solder-type contacts are used with connectors conforming to MIL-C-26482, MIL–DTL–83723, MIL-DTL–83733, MIL-DTL-26500, and, MIL-DTL–28748. These contacts contain prefluxed solder preforms and heat-shrinkable insulation material, which is available for twisted pair wire, coaxial cable (Figure 15), or single conductor shielded cable.

23 . When the contact is heated, the solder melts and the heat-shrinkable insulation shrinks, terminating the wire or cable to the contact, insulating and strain relieving the conductors.

24 . **CONTACT SELECTION.** To select the proper contact, use the following procedure:

a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 4).

c. Verify contact is compatible with size of cable to be terminated (Table 6).

25 . **CABLE PREPARATION.** To prepare the cable, use the following procedure:

a. Determine method of cable preparation (Table 5).

b. Determine cable stripping dimensions (Figure 16).

c. Strip cable in accordance with NAVAIR 01-lA-505, WP 009 00.

d. Straighten center conductor and smooth shield-braid tightly against cable.

e. If stranded or unplated copper, tin center conductor.

26 . **ASSEMBLY.** To assemble the solder contact to the coaxial cable perform the following procedure:

NOTE

For conventionally stripped cable, slightly rotate contact during cable insertion to prevent shield-braid strands from splaying.

a. Slip solder contact carefully over end of prepared cable and push contact onto cable until it stops.

b. Inspect assembly to see that shield-braid aid center conductor are both visible through the respective inspection windows (Figure 14).

c. If shield braid and center conductor are not visible, remove contact from cable and check for incorrect strip dimension, splayed shield braid, or bent center conductor.

27 . **HEATING.** To attach the solder contact to the cable, use the following procedure:

a. Select appropriate adapter (Table 5).

b. Set up holding fixture and adapter as shown (Figure 16).

c. Insert contact and cable assembly into holding fixture and adapter (Figure 17). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

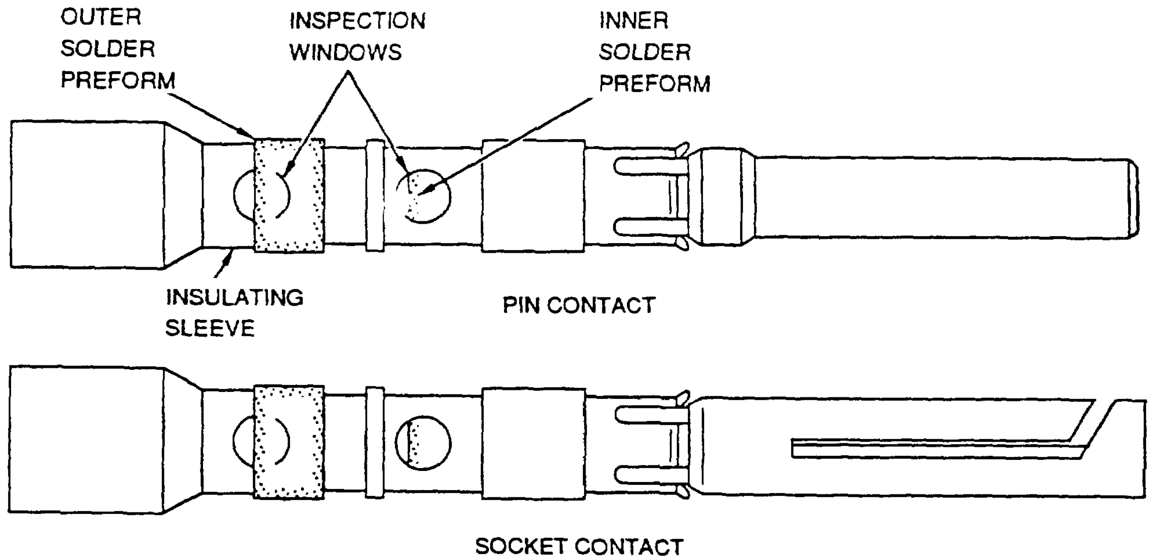


Figure 53. Typical Coaxial Solder Contact

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until large outer solder ring melts and flows and outer sleeving is shrunk over cable.

e. Inspect small inner solder ring. If it has not melted and flowed, continue heating until it flows.

f. Allow assembly to cool at least five seconds before removing from holding fixture.

28 . **INSPECTION.** Inspect solder flow through two inspection windows.

29 . **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into strands of shield-braid.

b. Inner solder preform must be completely melted and flowed between the cable center conductor and inner contact soldering surface.

c. Fillet of solder should be visible through each inspection window.

d. Insulation sleeve should be fully shrunk onto cable.

30 . **Underheated.**

a. Original form of one or both preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

Table 2 . Solder Contact Selection

Connector Specification	Contact Cavity Size	Wire or Cable Type	Contact Type	Raychem Solder Contact No.	Raychem Holding Fixture Adapter Number
MIL-C-26482 MIL-DTL–26500	12	Coaxial Cable	Pin	D-602-17	AT-1319-11
MIL-C-26482 MIL-DTL–26500	12	Coaxial Cable	Socket	D-602-16	
MIL-DTL–28748	16	Coaxial Cable	Pin	D-602-44	AT-1319-14
			Socket	D-602-45	
		Twisted Pair	Pin	D-602-54	
			Socket	D-602-55	
MIL-C-26482	16	Coaxial Cable	Pin Socket	D-602-46 D-602-47	AT-1319-17
MIL-DTL–26500		Twisted Pair	Pin Socket	D-602-56 D-602-57	
MIL–DTL–83723	12	Coaxial Cable	Pin	M39029/74–400 M39029/74–399	AT-1319-19
			Socket	M39029/73–397 M39029/73–396	
MIL–DTL–83733		Twisted Pair	Pin	M39029/74–401	
			Socket	M39029/73–398	
MIL-DTL-28748	16	Coaxial Cable	Pin	D-602-72	AT-1319-18
			Socket	D-602-73	

Table 3 . Coaxial Solder Contact Cable Accommodation Cable Dimensions

Solder Contact No.	Type of Cable Preparation	Cable Dimensions			
		NOTE 1 Center Conductor Diameter	Dielectric Diameter	NOTE 1 Shield Braid Diameter	Jacket Diameter
Raychem/Tyco P/N D-602-16, D-602-17	Conventional Strip	.011-.020	.033-.067	.074-.095	.131 MAX.
	Braid Foldback	.011-.020	.033-.067	.110 MAX. Over Folded Back Braid	—
Raychem/Tyco P/N D-602-72 D-602-73 D-602-44, D-602-45, D-602-46, D-602-47	Conventional Strip	.012-.026	.036-.066	.066-.082	.110 MAX.
	Braid Foldback	.012-.026	.036-.066	.086 MAX Over Folded Back Braid	—
M39029/74–400	Conventional Strip	.011-.026	.034-.081	.072-.098	.130 MAX.
M39029/73–397	Braid Foldback Note 2	.011-.026	.034-.081	.099 MAX Over Folded Back Braid	—
M39029/74–399	Conventional Strip	.012 NOM.	.102 .103 NOM.	.124 NOM.	.145 MAX.

NOTES:

1. Conductors must be silver-or tin-plated.
2. To achieve an environmental seal, install P/N CTA-0042 immediately adjacent to end of metallic body.

31 . **Overheated**

a. Insulation sleeve is darkened to an opaque brown.

b. There are no solder fillets seen through inspection windows.

c. Cable insulation is melted or charred.

32 . **REPAIR PROCEDURES.** An underheated contact can be reheated to flow solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit insulation lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (Paragraphs 40 and 41).

33 . **TWISTED PAIR SOLDER CONTACT INSTALLATION.**

34 . **CONTACT SELECTION.** To select the proper contact, use the following procedure:

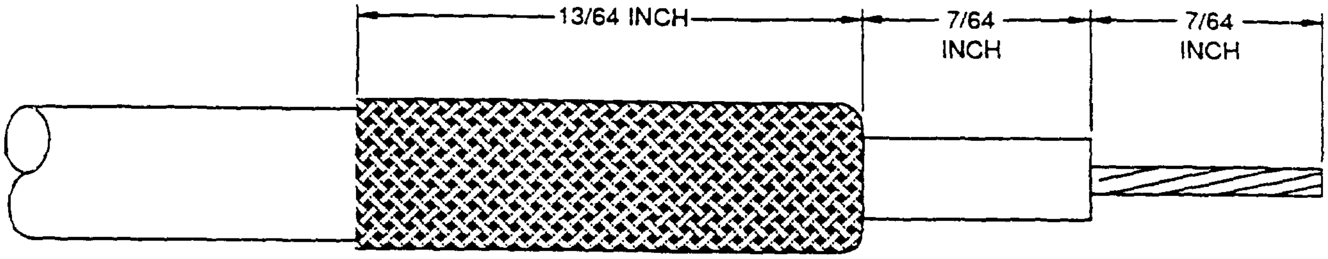
a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 1).

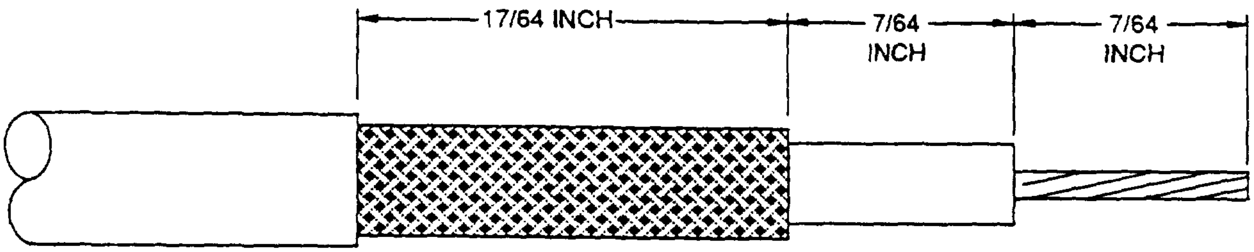
c. Verify contact is compatible with gage (AWG) size of twisted pair wire to be terminated (Table 7).

35 . **WIRE PREPARATION.** To prepare the twisted pair, use the following procedure:

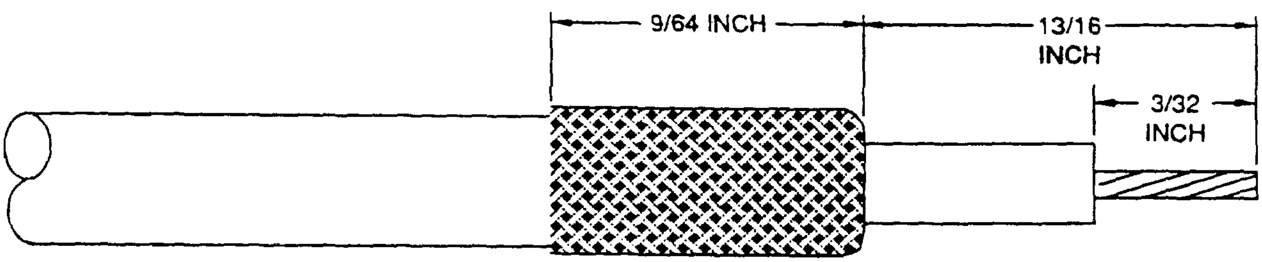
a. Strip wire in accordance with Figure 12.



FOR CONTACTS NO. D-602-16, D-602-17
BRAID FOLDED BACK



FOR CONTACTS NO. D-602-16, D-602-17
CONVENTIONAL STRIPPING



FOR CONTACTS NO. D–602–44, D–602–45, D–602–46, D–602–47, D–602–72, D–602–73,
M39029/74–400, M39029/73–397
BRAID FOLDED BACK

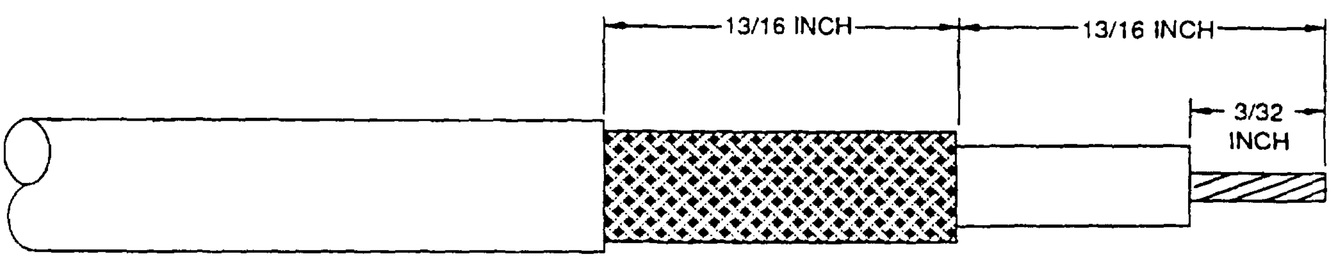
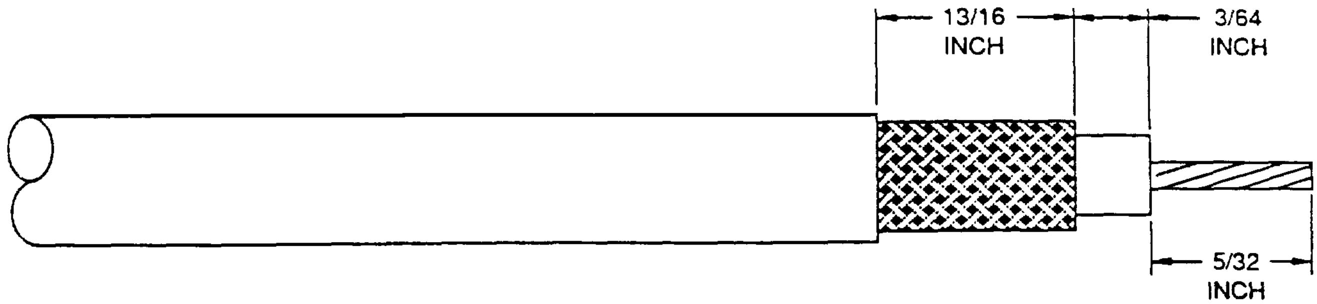


Figure 54. Strip Dimensions for Coaxial Solder Contacts (Sheet 1 of 2)



FOR CONTACTS NO. M39029/74–400, M39029/73–396
CONVENTIONAL STRIPPING

Figure 54. Strip Dimensions for Coaxial Solder Contacts (Sheet 2)

b. Twist conductors into normal lay and straighten.

c. Tin all stranded and non-plated solid wire.

d. After tinning, ensure wire ends are straight.

36 . **ASSEMBLY**. To assemble the solder contact to the twisted pair, use the following procedure:

a. Insert signal lead into center insulating sleeve and ground lead into outer insulating sleeve. Ensure wires bottom in contact (Figure 53).

b. Ensure signal lead is visible through forward inspection window inside inner solder preform.

c. Position ground lead so that it is not located directly in rear inspection windows.

37 . **HEATING.** To attach the solder contact to the twisted pair, use the following procedure:

a. Select appropriate adapter (Table 1).

b. Set up holding fixture and adapter as shown (Figure 55).

c. Insert contact and twisted pair assembly into holding fixture and adapter (Figure 56). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

WARNING

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation. Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until small inner solder ring melts and flows and sleeving is shrunk over wires.

e. Inspect large outer solder ring to see if it has melted and flowed. If it has not melted and flowed, continue heating until it flows.

f. Allow the contact and wire assembly to cool for at least five seconds before removing from holding fixture.

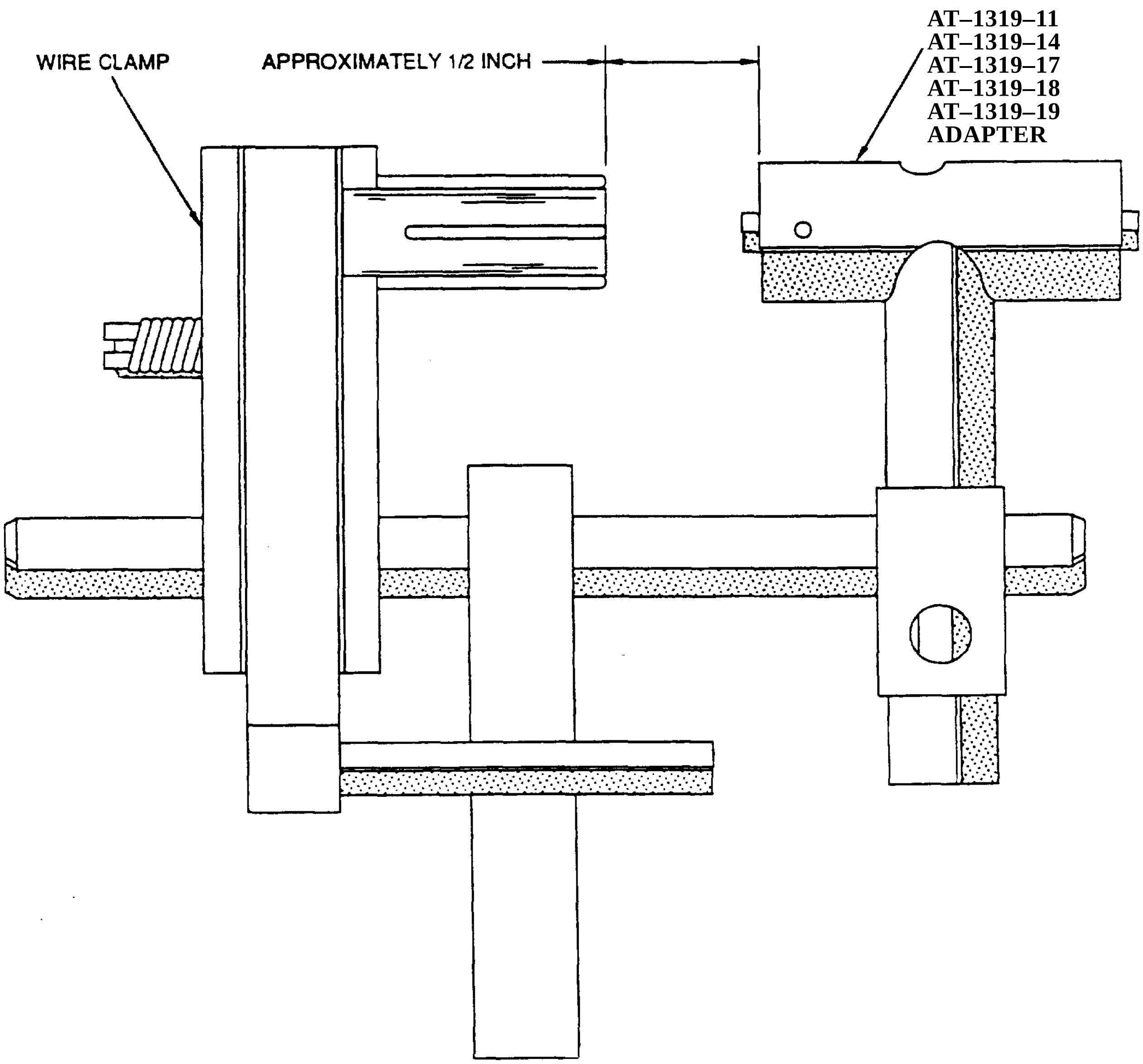


Figure 55. Holding Fixture and Adapter Setup

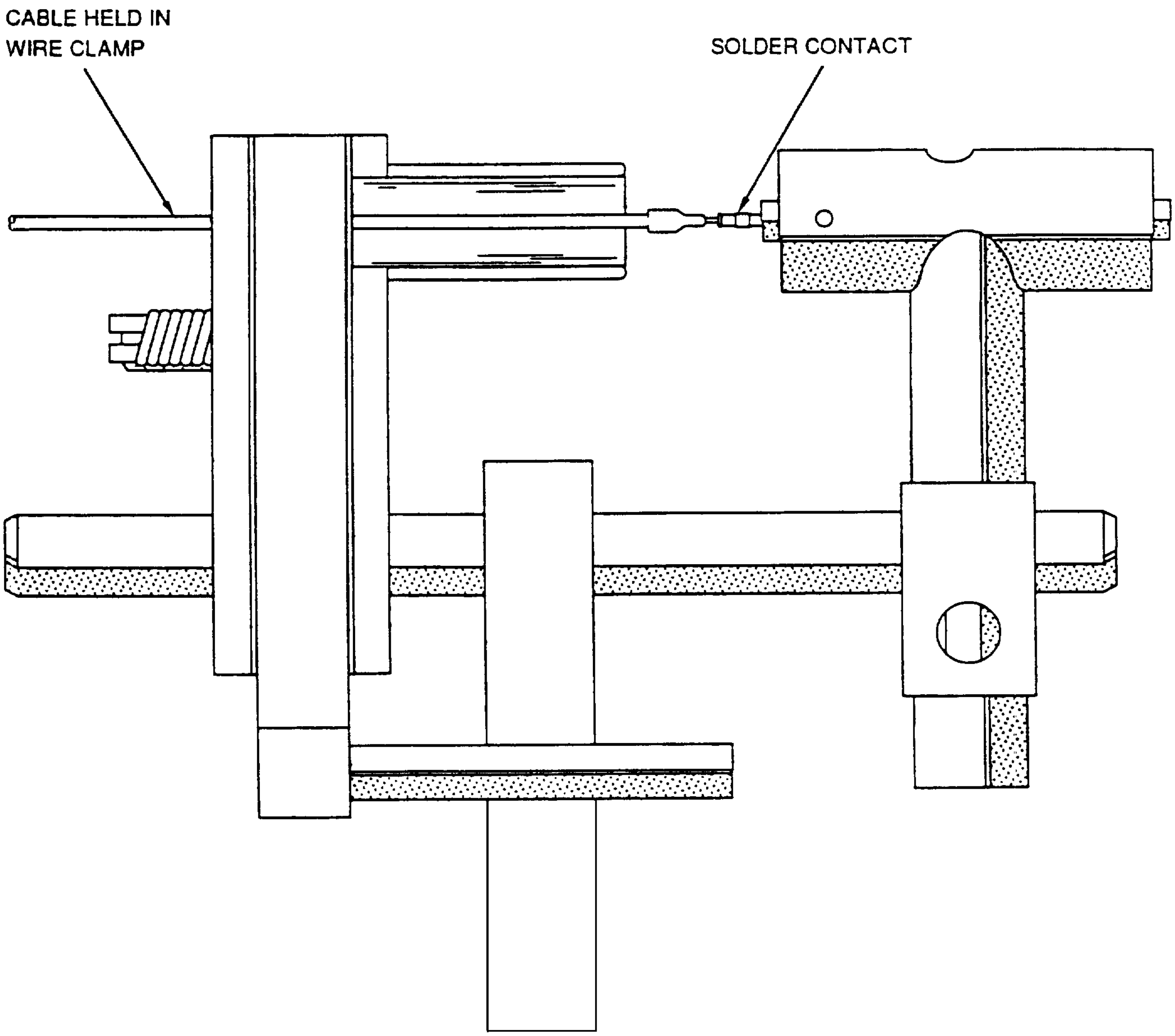


Figure 56. Solder Contact and Cable Prepared for Heating

38 . **INSPECTION.** Inspect solder flow through two inspection windows.

39 . **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into rear inspection window.

b. Inner solder preform must be completely melted and flowed, forming a fillet of solder between signal wire conductor and inner soldering surface.

c. Both insulation sleeves should be fully shrunk onto wire insulation.

40 . **Underheated.**

a. Original form of one or both solder preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

41 . **Overheated.**

a. Insulation sleeve is darkened to an opaque brown.

b. There are no solder fillets seen through inspection windows.

c. Wire insulation is melted or charred.

42 . **REPAIR PROCEDURES.** An underheated contact can be reheated to flow the solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit the insulating sleeve lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (Paragraphs 50 and 51).

Table 4 . Twisted Pair Solder Contact Accommodation

Solder Contact No.	Twisted Pair Wire Size	NOTE 1 Conductor Type
Raychem/Tyco P/N D-602-54 D-602-55 D-602-56 D-602-57	30 thru 24 AWG	Stranded Or Solid
NOTE 2 M39029/74–401 M39029/73–398	24 thru 26 AWG	Stranded Or Solid

NOTES:

1. Conductors must be silver- or tin-plated.
2. To achieve an environmental seal, install P/N CTA-0006 immediately adjacent to end of inner insulation sleeve.

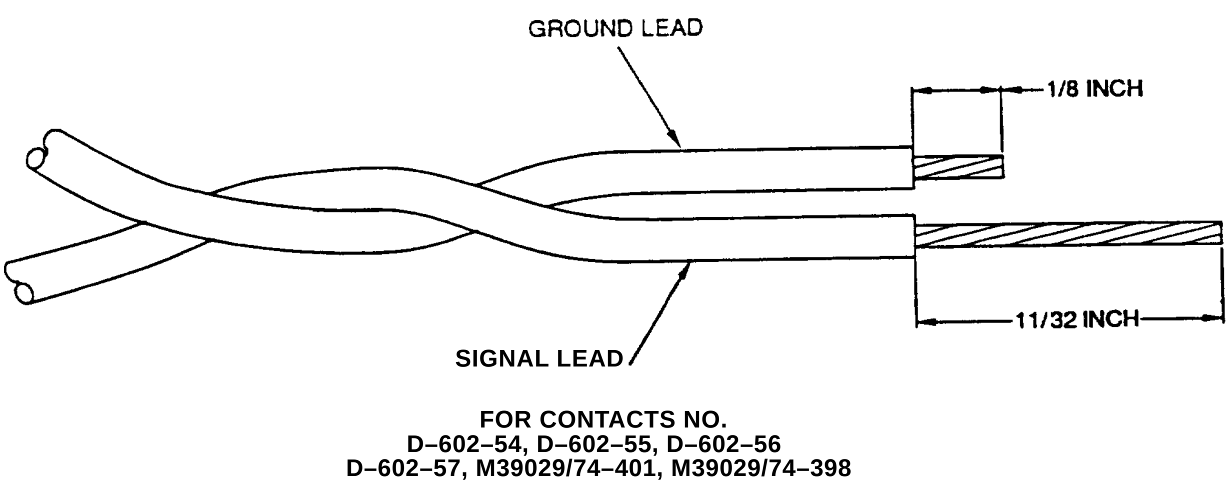


Figure 57. Strip Dimensions for Twisted Pair Solder Contacts

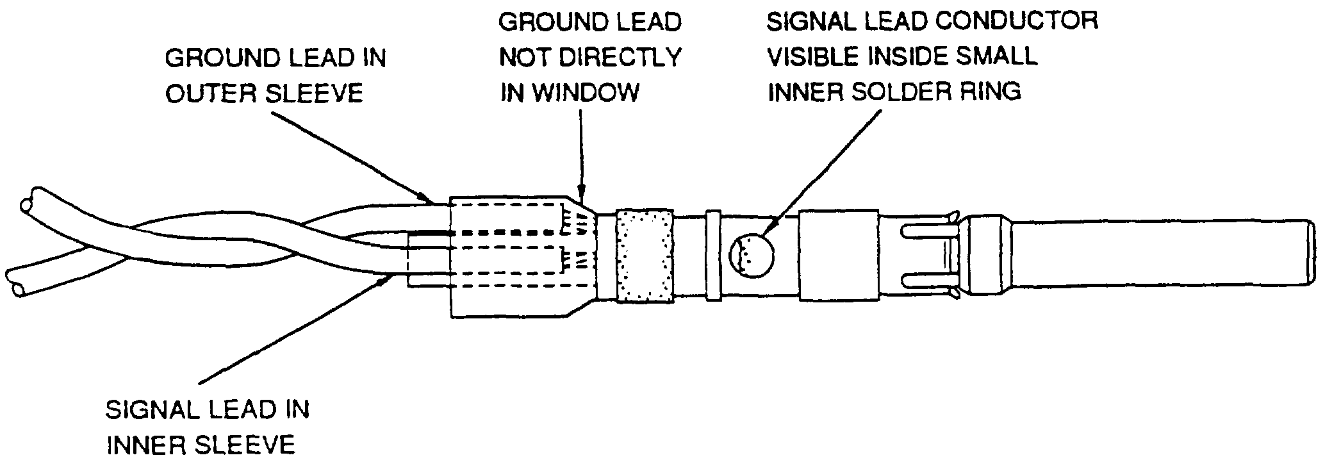


Figure 58. Inserting Twisted Pair into Solder Contact

Table 5 . Coaxial Cable with Air/Polyethylene Dielectric solder Sleeve Termination

Part Number	Primary Lead Color Code	Ground Lead Color Code	Dielectric O.D. (in) max	Jacket O.D. (in)	Lead Wire Gage
D-500-0089	White	Blue	.130	.145-.290	22AWG
D-500-0114	White	Blue	.080	.090-.215	24AWG
D-500-0120	Yellow	White	.130	.145-.290	22AWG
D-500-0121	Yellow	White	.130	.145-.290	24AWG
D-500-0122	Yellow	White	.130	.145-.290	26AWG
D-500-0134	White	White with Black Stripe	.157	.200-.290	22AWG

43 . <u>CRIMP TERMINAL LUGS</u>

44 . Wires terminated with solderless terminal lugs provide easy and efficient connections and disconnections from terminal boards, bus bars, and other electrical equipment. The solderless terminal lugs are either copper or aluminum, insulated or uninsulated, and in various styles and wire sizes.

45 . **SAE AS7928 TERMINALS: LUG AND SPLICES, CONDUCTORS CRIMP STYLE COPPER.** This specification covers insulated and uninsulated crimp style copper terminal lugs for stranded conductors (Table 6).

46 . **Standards.** The SAE AS7928 terminal specifications also list the Military Standards for the different types and styles as listed (Table 7).

47 . **SAE AS70991 TERMINALS: LUG AND SPLICE, CRIMP STYLE, ALUMINUM, FOR ALUMINUM AIRCRAFT WIRE.** This specification covers crimp style aluminum terminals for aluminum aircraft wire.

48 . Only aluminum terminal lugs conforming to SAE–AS70991 shall be crimped to aluminum wire. The tongue

of the aluminum terminal lugs or the total number of tongues of aluminum terminal lugs when stacked, shall be sandwiched between two MS25440 flat washers when terminated on terminal studs. Spacers or washers are not permitted between the tongues of terminal lugs. Terminals shall be of the types specified on the applicable standards specified in Table 8 .

CAUTION

Use copper terminations only on copper wire. Use aluminum terminations only on aluminum wire.

49 . **COPPER TERMINAL LUGS.** Terminals and conductor splices listed in this specification shall be of the following types and class.

Type I – Uninsulated

Type II – Insulated

Class 1 – Terminals and conductor splices which conform to all of the requirements of SAE AS7928/ when installed with the crimping tool or crimping dies shown on the applicable MS standard or specification sheet.

Copper terminal lugs are available in two styles for use under different space conditions and requirements: Straight (Figure 59) and Flag.

Table 6 . M7928/ Applicable Specifications

Part No. M7928/	Description
1	Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, for Thin Wall Wire, Type II, Class 1
2	Terminal, Lug, Crimp Style, Copper, Insulated, Rectangular Tongue, for Thin Wall Wire, Type II, Class 1
4	Terminal, Lug, Crimp Style, Copper. Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1 (For 302°F [150°C] Total Conductor Temperature)
7	Terminal, Lug and Splices, Conductor, Crimp Style, Copper Terminal, Lug Crimp Style Copper. Uninsulated, Ring Tongue, Type I. Class 1, (For 347°F [175°C] Total Conductor Temperature)

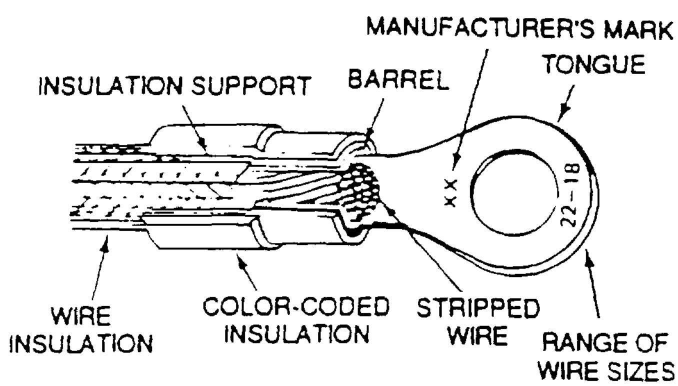


Figure 59. Typical Terminal Lug

Table 7 . M7928/ Military Standards

Part No.	Description
MS17143	Terminal, Lug, Crimp Style, Copper, Insulated, Rectangular Tongue, Type II, Class 1
MS20659	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I. Class 1
MS21004	Terminal, Lug, Uninsulated, Rectangular Tongue, Crimp Style, Copper, Type I. Class 1
MS25036	Terminal, Lug, Crimp Style, Copper, Insulated, Ring Tongue, Bell-Mouthed, Type II, Class 1
MS25189	Terminal, Lug, Flag Type, Crimp Style, Copper, Class 1
MS25274	Cap Electrical (Wire End, Crimp Style, Type II, Class 1)

Table 8 . Applicable Standards

Part No.	Description
MS25435	Terminal Lug, Crimp Style, Straight Type for Aluminum Aircraft Wire, Class 1
MS25436	Terminal Lug, Crimp Style, 90 Degree Upright Type for Aluminum Aircraft Wire, Class 1
MS25438	Terminal Lug, Crimp Style, Right Angle Type for Aluminum Aircraft Wire, Class 1
M81824/1	Splices, Electrical, Permanent, Crimp Style, Copper, Insulated, Environment Resistant, Class 1
MS25493	Splice, Permanent Crimp Style, 2 Way Type for Aluminum Aircraft Wire Class 18

50 . **Size.** Some pre-insulated terminals accommodate more than one wire size. The insulation is color-coded and the range of wire sizes is marked on the tongue to identify the wire sizes that can be terminated with each of the terminal lug sizes (Table 9).

Table 9 . Color Coding of Copper Terminal Lug Insulation

Terminal Lug Insulation Color	Wire Sizes (AWG) Used With
Yellow	#26 - #24
Red	#22 - #20, #18
Blue	#16-#14
Yellow	#12 - #10

51 . **Insulation.** Uninsulated type terminal lugs may be insulated (after assembly to wire) by heat-shrinkable tubing or by lengths of transparent tubing, called sleeves. These methods of insulation provide electrical and mechanical protection at the connection.

52 . **HIGH TEMPERATURE TERMINAL LUGS.** High temperature terminal lugs conform to SAE AS7928 and are available in two types. M7928/4 and M7928/7.

53 . **ALUMINUM TERMINAL LUGS.** Aluminum terminal lugs are used only to terminate aluminum wires. Aluminum terminal lugs are available in three types: straight, 90 degree upright, and angle (left or right). The barrels of aluminum terminal lugs may be filled with a petroleum-based abrasive compound. This compound, by a grinding process during the crimping

operation, removes the oxide film and prevents reforming in the completed connection. All aluminum terminals have an inspection hole to allow checking the depth of wire insertion. This inspection hole may be sealed with a removable plastic plug, which also serves to retain the oxide-inhibiting compound. Each aluminum terminal lug is marked with the letters AL indicating it is for use with aluminum wire. and also with the wire size it will accommodate (Figure 54).

54 . **Insulation.** Aluminum terminal lugs are not pre-insulated; therefore, they may be required to be insulated in the manner described in paragraphs 30 and 34.

WARNING

Methyl Ethyl Ketone is highly flammable. Avoid prolonged breathing of vapors and ensure there is adequate ventilation.

55 . Tight fitting sleeves are expanded in methyl ethyl ketone solvent before installation. When the solvent evaporates, the sleeve will shrink tightly over the terminal lug.

56 . **ELECTRICAL END CAPS.** End caps or stub splices are used to terminate a wire in itself or for dead ending a wire. There are numerous ways to provide an end cap or stub splice. A stub splice is also known as a parallel connector. End caps should be selected from WP 011 00 Table 1. There are four sizes of electrical end caps. Selecting the correct crimp tool is essential in the crimping process to ensure proper electrical contact. Table 16 is provided for proper selection of each crimping tool.

57 . **COPPER TERMINAL LUG/CAP TOOLS.** There are numerous types of lugs by size, style, and type. Proper tooling is essential in the crimp procedures to ensure proper contact. The tooling information is provided for each type terminal lug and electrical caps (Tables 10 through 18).

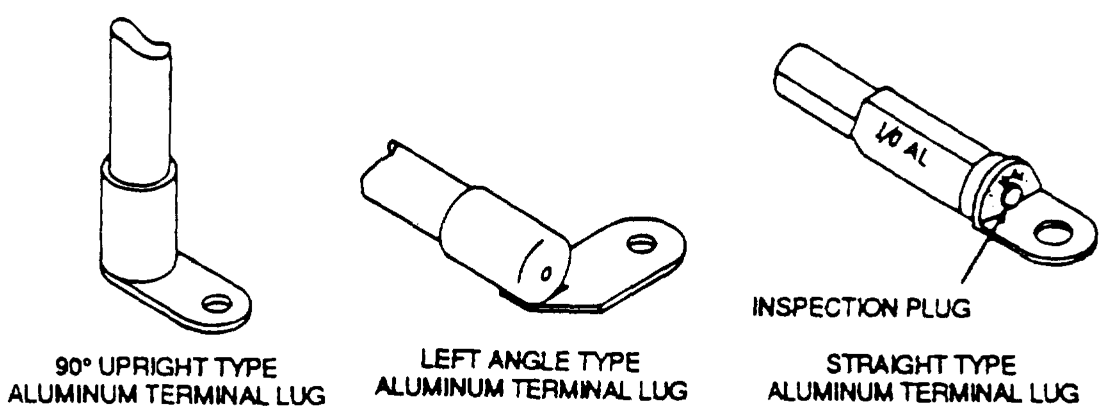


Figure 60. Solderless Aluminum Terminal Lugs

Table 10 . M7928/1 Preinsulated Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
M7928/1-					
-1 thru 5	26				
-6 thru 10	24				
-70,-29 thru 19	22		M22520/5–01	M22520/5–100	M22520/3–10
-71,-20 thru 28	20	26-14	M22520/10-01	M22520/10 01	M22520/3-10
-72,-29 thru 37	18				
-38 thru 46	16				
-47 thru 55	14				
-47thru 55	14				
-56 thru 62	l2				
-63 thru 69	10				
		12-10	M22520/5–01	M22520/5–100	M22520/3-9
			M22520/10-01	M22520/10-100	M22520/3–9

Table 11 . M7928/2 Preinsulated Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
M7928/2					
-1 thru 7	22	22-14	M22520/5-01	M22520/5-100	M22520/3-10
-8 thru 14	20				
-15 thru 21	18				
-22 thru 28	16		M22520/10-01	M22520/10-101	M22520/3-10
-29 thru 35	14				
-36 thru 42	12				
-43 thru 49	10	12-10	M22520/5-01	M22520/5-100	M22520/3–9
			M22520/10-01	M22520/10-100	M22510/3-9

Table 12 . M7928/4 Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
M7928/4-					
-101 thru 105	22-18	26-14	M22520/5-01	M22520/5-100	M22520/3-10
-106 thru 110	16-14				
-111 thru 114	12-10		M22520/10-01	M22520/10-101	M22520/3-10
-115 thru 118	8				
-119 thru 122	6				
-123thru 125	4				
-126 thru 128	2				
-129 thru 131	1				
-132 thru 134	0				
-135 thru 137	00				
-143 thru 147	26-10	12-10	M22520/5–01 M22520/10-01	M22520/5–100 M22520/10-100	M22520/3–9 M22520/3-9
-148 thru 151	22-18				
-152 thru 155	16-14				
-156 thru 158	12-10				
-159	22-18				
		8	HD51	HD51–105–1 & HD51–133–2	GS682
		6	HD51	HD51–106–1 & HD51–134–2	GS683
		4	HD51	HD51–107–1 & HD51–134–2	GS684
		2	HD51	HD51–113–1 & HD51–133–2	G801
		1	HD51	HD51–154	G726
		0	HD51	HD51–128	G854
		00	HD51	HD51–129	G855

Table 13 . M7928/7 Uninsulated Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
M7928/7-		22-14			
-1 thru 6	22-18		M22520/38-01		M22520/39-01
-7 thru 11	16-14				

Table 14 . MS17143 Preinsulated Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS17143-1, 4, 7, 10, 13, 16, 19, 22, 23, 24, 25, 28	22-10	22-10	M22520/5-01	M22520/5-100	M22520/3-10
MS17143-2, 5, 8, 11, 14, 17, 20	16-14	22-14	M22520/10-01	M22520/10-101	M22520/3-10
MS17143-3, 6. 9, 12, 15, 18, 21	12-10				
		12-10	M22520/10-01	M22520/10-100	M22520/3-9

Table 15 . MS20659 Uninsulated Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS20659-101, 102, 125, 161, 138, 162, 167	22-18	22-10	M22520/38-01, M22520/5-01	M22520/5-100	M22520/39-01, M22520/3-10
MS20659-103, 104, 126, 127, 139, 163, 164	16-14				
MS20659-105, 106, 128, 165, 166	12-10	8	HD51	HD51–130–1 & HD51–131–2	G744
		6	HD51	HD51–130–1 & HD51–132–2	G745
		4	HD51	HD51–130–1 & HD51–132–2	G746
		2	HD51	HD51–130–1 & HD51–131–2	G747
MS20659-107, 108, 129, 140, 141, 142	8	8 6 4	MS25441-1* + MS25441-3*	MS90485-8 -6 -4	MS90486-8 -6 -4
MS20659-109, 110, 130, 131, 143	6	2 0 00	+ MS25441-5*	-2 -01 -02	-2 -01 -02
MS20659-111, 1, 132, 144, 145	4	000 0000		-03 -04	-03 -04
MS20659-113, 114, 133, 146, 147, 148	2	8	HH80C	MS90485–8	MS90486–8
		6	HH80C	MS90485–6	MS90486–6
		4	HH80C	MS90485–4	MS90486–4
		2	HH80C	MS90485–2	MS90486–2
		1	HH80C	MS90485–1	MS90486–1
		0	HH80C	MS90485–01	MS90486–01
		00	HH80C	MS90485–03	MS90486–02
		000	HH80C	MS90485–03	MS90486–03
		0000	HH80C	MS90485–04	MS90486–04
MS20659-115, 116, 134, 149, 150	1				
MS20659-117, 118, 135, 151, 152	0				
MS20659-119, 120, 136, 153, 154	00				
MS20659-121, 122, 155, 156	000				
MS20659-123, 124, 137, 157,158, 159, 160	0000				

* Tool may be used until worn out. Do not replace or repair.

Table 16 . MS25247 Electrical End Cap and Crimp Tool.

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS25274–1	26–24	26–14	M22520/5–01	M22520/5–100	M22520/3–10
MS25274–2	22 – 18		M22520/10–01	M22520/10–101	M22520/3–10
MS25274–3	16 – 14				
MS25274–4	12 – 10				
		12 – 10	M22520/5–01	M22520/5–100	M22520/3–9
			M22520/10–01	M22520/10–100	M22520/3–9

Table 17 . MS25189 Uninsulated Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS25189- 101-106 107-111 112-116 117-122 123-127 128-132 133-137 138-141 142-147	 8 6 4 2 1 0 00 000 0000	8	HD51	HD51–130–1 & HD51–131–2	G744
		6	HD51	HD51–130–1 & HD51–132–2	G745
		4	HD51	HD51–130–1 & HD51–132–2	G746
		2	HD51	HD51–130–1 & HD51–131–2	G747
		8 6 4 2 1 0 00 000 0000	 MS25441–1* + MS25441-3* + MS25441-5* HH80C	MS90485–8 MS90485–6 MS90485–4 MS90485–2 MS90485–1 MS90485–01 MS90485–02 MS90485–03 MS90485–04	MS90486–8 MS90486–6 MS90486–4 MS90486–2 MS90486–1 MS90486–01 MS90486–02 MS90486–03 MS90486–04

* Tool may be used until worn out. Do not replace or repair.

Table 18 . MS25036 Uninsulated Terminal Lug and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS25036-101, 102, 103, 104, 105, 148, 149, 150, 151, 159	22-18	22-14	M22520/5-01 M22520/10-01	M22520/5-100 M22520/10-101	M22520/3-10 M22520/3-10
MS25036-106, 107, 108, 109, 110, 152, 153, 154, 155	16-14	22-10	M22520/5-01 M22520/10-01	M22520/5-100 M22520/10-101	M22520/3-9 M22520/3-9
MS25036-111, 112, 113, 114, 156, 157, 158	12-10				
MS25036-115-118	8				
MS25036-119-122	6	8 6 4 2	HD51 HD51 HD51 HD51	HD51–105–1 & HD51–133–2 HD51–106–1 & HD51–134–2 HD51–107–1 & HD51–134–2 HD51–113–1 & HD51–133–2	G682 G683 G684 G801
MS25036-123-125	4	8-0000	MS25441-1	MS23002-8	MS23003-8
MS25036-126-128	2		+ MS25441-3	-6 -4	-6 -4
MS25036-129-131	1		+ MS25441-5	-2 -1	-2 -1
MS25036-132-134	0		HH80CC	-01 -02	-01 -02
MS25036-136-137	00			–03 –04	–03 –04
MS25036-138-139	000				
MS25036-140-141	0000				

*Tool maybe used until worn out. Do not replace or repair.

58 . **COPPER LUG CRIMPING PROCEDURE**. The following crimp procedures are recommended.

a. Select terminal crimp tool, crimp die. and inspection gage (Table 10).

b. Strip wire to dimensions (Table 19) in accordance with WP009 00.

Table 19 . Wire Stripping Lengths for Small Copper Terminal Lugs

Wire Size (AWG)	Strip Lengths (In Inches)
#26 and #24	5/32
#22 and #20	3/16
#18-#14	1/4
#12 and #10	9/32

c. Check tool with proper gage (Tables 6 through 15) in accordance with tool paragraph listed herein.

d. Insert terminal lug, tongue first. into wire side of tool crimping jaws, until terminal lug barrel butts flush against tool stop on the locator.

e. Squeeze tool handles slowly until tool jaws hold terminal lug barrel firmly in place, but without denting it.

f. Insert stripped wire into terminal lug barrel until wire insulation butts flush against near end of wire barrel (Figure 55).

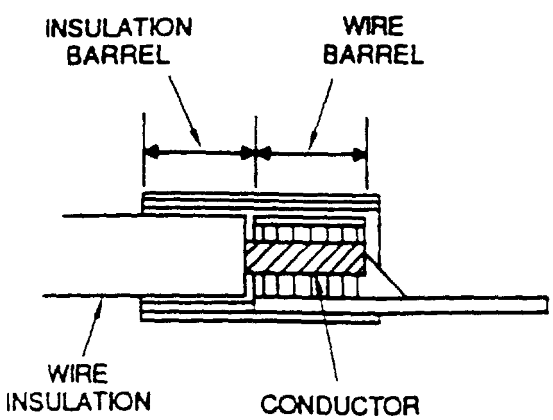


Figure 61. Insertion of Wire Into Insulated Terminal Lug

g. Squeeze tool handles until ratchet releases.

CAUTION

Do not use any connection which is found defective as a result of the visual inspection. Cut off defective connection and remake using a new terminal lug or splice.

h. Examine the crimped condition carefully for the following:

(1) Indent centered on terminal lug barrel.

(2) Indent in line with barrel: not cracked.

(3) Terminal lug barrel not cracked.

(4) Terminal lug insulation not cracked.

(5) Insulation grip crimped.

59 . **ALUMINUM LUG CRIMPING PROCEDURES.** Crimp aluminum terminal lugs as follows:

WARNING

Because of potential hotspots an aluminum terminal should be replaced with an identical terminal. See aircraft CFA for support if terminal is not a MS25435 through MS25438 terminal.

CAUTION

Use care when stripping wire insulation.

a. Using the tool specified in Table 16, select proper die for wire size required. Die is stamped with the wire size on both upper and lower faces and with the letters AL. Install die in tool head (paragraph 143).

b. Strip wire insulation carefully, using recommended stripping practices for aluminum wire described in WP 009 00. Stripping lengths in inches are listed in Table 17.

Table 20 . Stripping Lengths for Aluminum Wire

Wire Size	MS25435, 25436, 25437, & 25438
8	11/16
6	13/16
4	27/32
2	1-1/32
1	1-1/32
1/0	1-1/32
2/0	1-7/32
3/0	1-9/32
4/0	l-7/16

c. Install insulation sleeve over wire insulation, well back from crimping area.

d. Inspect to see that inner barrel is well coated with compound, if required.

e. Insert wire into terminal barrel.

f. Wipe off any excess compound squeezed out of terminal lug barrel with a clean soft cloth.

CAUTION

If present, do not remove the inspection plug as this keeps the compound in the barrel. When the wire is inserted to the full depth of the barrel, the compound is forced between and around the conductor strands.

g. Insert assembly into the die correctly positioned as shown in Figure 56.

h. Actuate handle for manual hydraulically operated tool. Do not release the button until the dies open automatically.

NOTE

Wire sizes No. 8 to No. 2/0 require only one crimp. Wire sizes No. 3/0 and No. 4/0 require two crimps. Locate the second crimp centrally on the portion of the barrel remaining after the first crimp (Figure 57).

i. Check visually to see that the correct wire size is imprinted on the barrel.

j. Remove the inspection plug and check visually or with the aid of a probe to see that wire is fully inserted. Replace the plug after inspection.

k. Slide insulating sleeve, if needed, over the terminal lug barrel and shrink it.

60 . **ELECTRICAL END CAP CRIMPING PROCEDURE**. The following crimp procedures are recommended.

a. Select end cap crimp tool, crimp die, and inspection gage (Tables 6 through 14).

b. Strip wire insulation carefully, using recommended stripping practices for wires described in WP 009 00.

c. Check tool with proper gage (Tables 6 through 12).

d. Insert end cap into wire side of tool crimping jaws, until barrel butts to tool stop on the locator.

e. Squeeze tool handles slowly until tool jaws hold barrel firmly in place, but without denting it.

f. Insert stripped wire into barrel until it bottoms out at back of cap.

g. Squeeze tool handles until ratchet releases.

h. Examine the crimped condition carefully for the following:

(1) Indent centered on barrel.

(2) Barrel not cracked.

(3) Insulation not cracked.

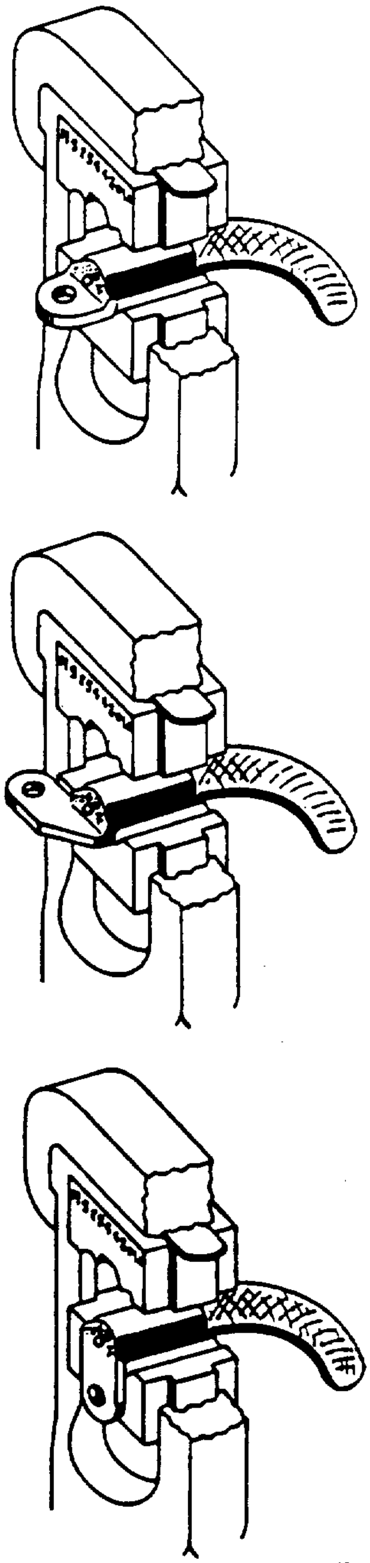


Figure 62. Positioning Aluminum Terminal Lugs in Die Nests

61 . **CRIMP SPLICE.**

62 . Crimp slices can typically be grouped as follows:

a. Environmental copper crimp splices.

b. Non-environmental aluminum crimp splices.

63 . **ENVIRONMENTAL COPPER CRIMP SPLICES.** Only environmentally scaled splices are authorized for Navy applications. The environmental sealed splice for wire sizes 12 through 26 are defined in AS81824 or MIL-S-81824. The splice is a two piece splice consisting of a special sealing sleeve and a butt splice. For wire size 10 and 8, an environmental seal splice is used. For wire size 6 a splice cover with shrink sleeving must be used. Splice part number details are provided in Table 8.

64 . **ENVIRONMENTAL COPPER SPLICE CRIMP PROCEDURE.** Crimp an environmental copper splice as follows:

a. Locate the damaged portion of the wire and prepare the wire for splicing in accordance with WP 015 00.

b. Select the splice in accordance with Table 21 .

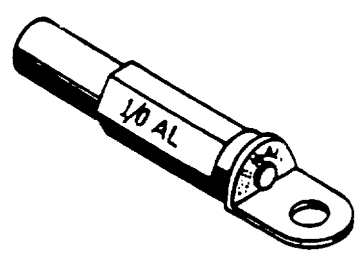


Figure 63. Single Crimp on Aluminum Terminal Lugs

Table 21 . Splice Tooling

Wire Gage	Splice Part No.	Color Band	Strip Dimension (+1/16,-0)	Crimp Tool	Die Set	Inspection Gage
20 thru 26	M81824/1-1	Red	1/4	M22520/37-01 M22520/5-01* M2520/10-01* AD-1377*	M22520/5-103* M22520/10-104*	M22520/39-01 M22520/3-14* M22520/3-14* AD-1378
16, 18	M81824/1-2	Blue	5/16	M22520/37-01 M22520/5-01* M22520/10-01* AD-1377*	M22520/5-103* M22520/10-104*	M22520/39-01 M22520/3-13* M22520/3-13* AD-1378*
12, 14	M81824/1-3	Yellow	5/16	M22520/37-01 M22520/5-01* M22520/10-01* AD-1377*	M22520/5-102* M22520/10-103*	M22520/39-01 M22520/3-12* M22520/3–12* AD-1378*
10	D-436-26		5/16	49900** M22520/5-01	M22520/5-100	M22520/3- 9 and 10
8	D-436-0081		7/16	69355** HD51	HD51–105–1 & HD51–133–2	G682
6	324660		7/16	HD51	HD51–106–1 & HD51–134–2	G683

*Use tool and Gage until worn out. Replace tool and gage with M22520/37-01 and M22520/39-01, respectively.
** Use tool until worn out.

c. Slide sealing sleeve over one end of stripped wire (Figure 62).

d. Select proper tool (Table 22) Buildup and adjust tool in accordance with paragraphs 81 and 104.

e. Insert crimp barrel into correct cavity of crimp tool. For wire gages 12 through 26, the cavity color code will match the color of the stripe on the crimp barrel. Ensure end of crimp barrel is against stop of tool and inspection hole is visible (Figure 60).

f. Lock crimp barrel in place by partially closing handles without denting crimp barrel.

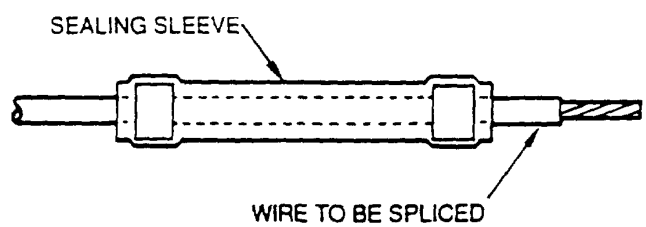


Figure 64. Sealing Sleeve Placed on Wire End

g. Insert end of wire into end of crimp barrel opposite stop. Wire must be visible through inspection hole. A gap 1/32 to 1/16-inch for wire gages 10 through 26, or 1/16 to 1/8-inch for wire gages 6 and 8, must exist between wire insulation and crimp barrel. Trim conductor or insulation as required.

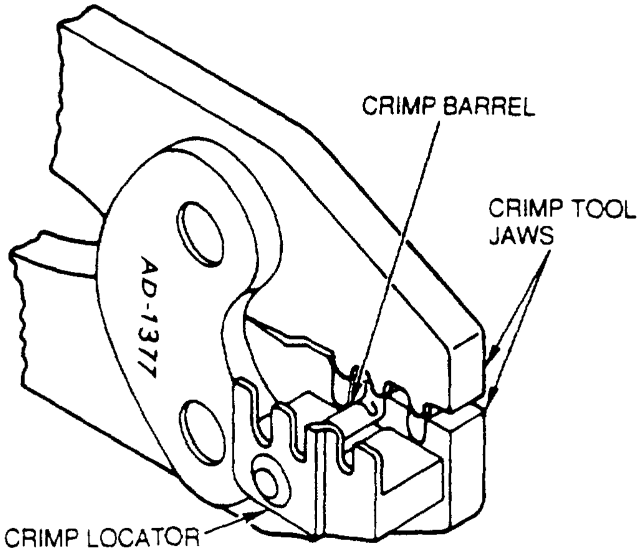


Figure 65. Inserting Crimp Barrel in Crimp Tool, MS22520/37

h. Squeeze handles of crimp tool through complete crimp cycle. Crimp tool will not release until crimp cycle has been completed.

i. Reverse crimp barrel in cavity. Attached wire will fit in slot of stop. Ensure end of crimp barrel is against stop of tool and inspection hole is visible. Repeat steps a through h.

j. Examine crimped connection for the following:

(1) Indent centered on splice barrel.

(2) Indent in line with barrel.

(3) Barrel not cracked.

(4) Wire cannot be pulled out of splice.

(5) Maximum gap of 1/64 for wire gages 10 through 25 (Figure 61).

k. Center sealing sleeve over crimp barrel (Figure 62).

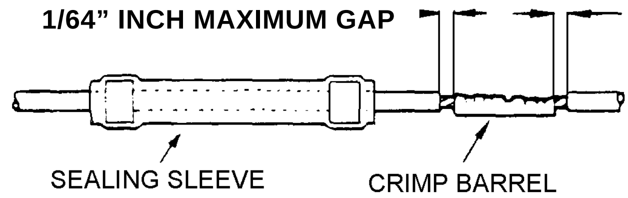


Figure 66. Correctly Installed Crimp Barrel

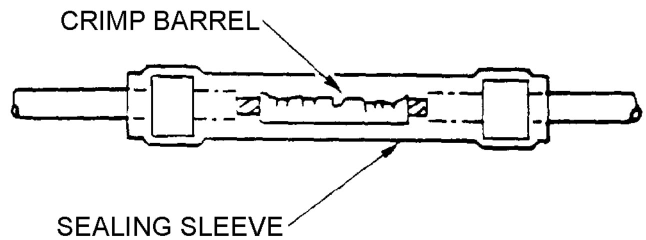


Figure 67. Sealing Sleeve Centered Over Crimp Barrel

WARNING

The HT–900B, HT–920B, HT–71002, and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT-900B/HT–71002 heat guns in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

l. Shrink sealing sleeve using heat gun with small termination sleeve reflector (WP 012 00). Shrink middle first and heat towards end until sealant melts and begins to flow out end. Repeat for other end. Allow to cool (Figure 63).

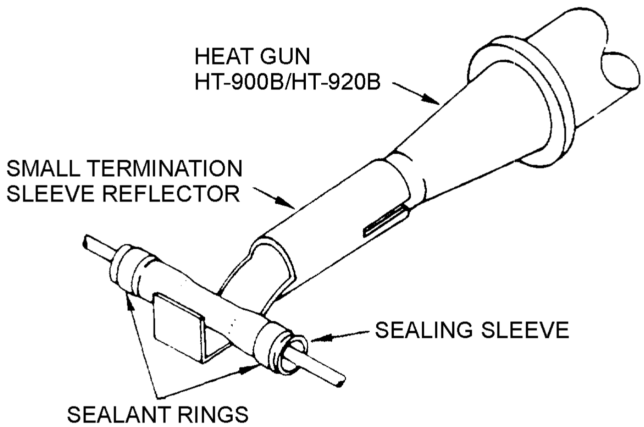


Figure 68. Splice Sealing

65 . **NON-ENVIRONMENTAL ALUMINUM CRIMP SPLICE.** Because aluminum wire diameters have been changing over time, splicing should be performed as a last resort. Whenever practical, replace the wire point-to-point.

NOTE

Contact Aircraft CFA for aluminum wire splice guidance.

66 . **NON-ENVIRONMENTAL, ALUMINUM CRIMP SPLICE PROCEDURE.** If the terminals on the ends of a damaged aluminum wire is the same as in Table 17, an MS25439 splice may be used as follows:

a. Locate the damaged portion of the wire and prepare wire for splicing in accordance with WP 015 00.

b. Pick the appropriate splice in accordance with Table 19.

c. Pick an appropriate size SAE AMS–DTL–23053 shrink sleeve.

d. Cut the sleeve to overlap the wire insulation by 1-inch on each side of the splice.

e. Slide shrink sleeve over one end of stripped wire (Figure 59).

f. Crimp the splice to the conductor using the same procedure as for aluminum terminals (paragraph 38).

g. Examine crimped connection for the following:

(1) Indent centered on splice barrel.

(2) Indent in line with barrel.

(3) Barrel not cracked.

(4) Wire can not be pulled out of splice.

(5) Wire gap is 1/64–inch max.

h. Slide sleeve over splice with approximately 1-inch overlapping the insulation on both sides of splice.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

WARNING

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

i. Shrink the sleeve in accordance with WP 012 00.

67 . **MIL-DTL-22520 CRIMPING TOOLS HAND OR POWER ACTUATED, WIRE TERMINATION AND TOOL KITS.**

68 . **PURPOSE.** This specification covers the general requirements for crimp tools, inspection gages and tool kits used for connecting the following:

a. Removable Contacts.

b. Coaxial Connectors.

c. Ferrules.

d. Terminals.

e. End Caps.

f. Splices.

69 . **CLASSIFICATION.** Crimp tools are of the following types:

a. Type 1. Type 1 crimp tools are those which produce an indent crimp.

b. Type 2. Type 2 crimp tools are those which produce a formed crimp.

70 . **CRIMP TOOL M22520/1-01.**

71 . **GENERAL DESCRIPTION.** This tool is considered to be the upper range adjustable crimp tool, with virtually limitless application within the 12 to 26 AWG wire range. The tool measures 9 3/4 inches X 2 1/2 inches X 1 1/4 inches and weighs 15 ounces (Figure 64).

72 . **Use.** The tool is used to crimp removable contacts with a wire barrel size of 12 thru 20. The crimp is the standard 8 impression which affords maximum tensile strength. The 8 impression indent crimp is illustrated (Figure 65).

73 . **Ratchet.** A precision ratchet controls the cycling of the tool in both directions of the handle. This ratchet mechanism ensures the same and accurate crimp for each operation.

74 . **Crimp Depth (Die Closure).** A positive crimp depth is controlled by an 8 position selector knob located on the tool frame. The operator dials in the desired step for the wire being used and locks the setting with a locking pin (Figure 66).

Table 22 . Aluminum Splice Part No. and Crimp Tool

Part No.	Wire Size Range	Crimp Tool Range	Crimp Tool	Crimp Die	Inspection Gage
MS25439		8	HD51	HD51–130–1 & HD51–131–2	G744
		6	HD51	HD51–130–1 & HD51–132–2	G745
		4	HD51	HD51–130–1 & HD51–132–2	G746
		2	HD51	HD51–130–1 & HD51–131–2	G747
-1	8	8	MS25441–1*	MS25442–8A	
-2	6	6	+	-6A	
-3	4	4	MS25441-1*	-4A	
-4	2	2	+	-2A	
-5	1	1	MS25441-5*	-1A	
-6	0	0		-01A	
-7	00	00	HH80C	-02A	
-8	000	000		-03A	
-9	0000	0000		-04A	

* Use tool until worn out.

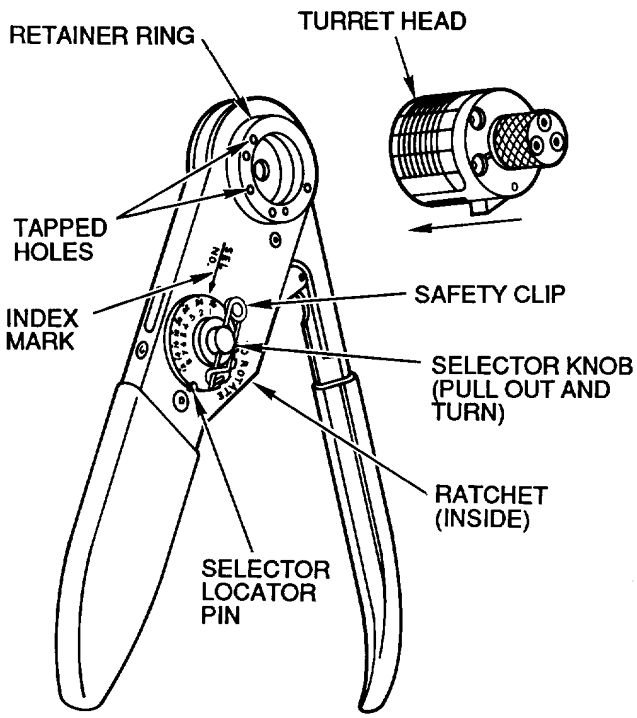


Figure 69. Crimp Tool M22520/1-01

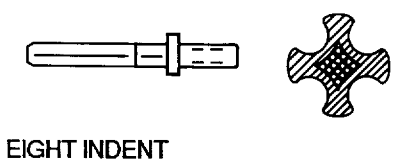


Figure 70. 8 Impression Crimp

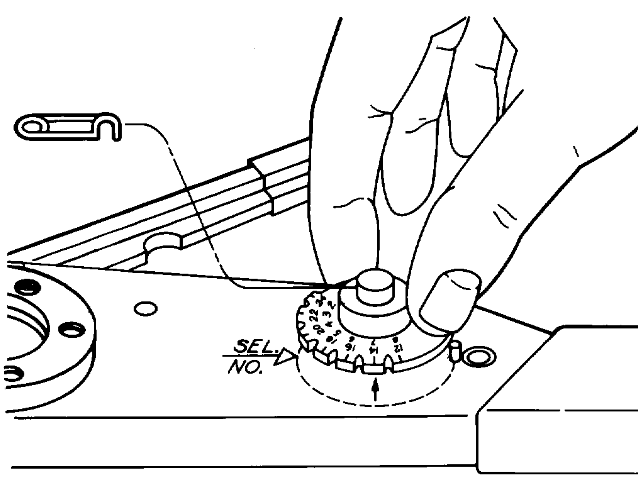


Figure 71. Crimp Depth (Die Closure)

75 . **Turret.** For proper operation the tool frame must be mated with a turret head (Figure 67) which has a 3 index positioner (Figure 69, Sheet 3).

a. Turret Head. The turret head is a device that contains more than one positioner which is indexed by rotating a circular barrel when attached to the tool frame.

b. Positioner. The positioner is a device that when attached to the tool frame locates or positions the contact in the correct position.

c. Locator Positioner. The locator on a turret is a 3 index positioner which rotates to accommodate 3 different size wire crimps (Figure 69).

76 . **Inspection Gage.** The inspection gage is a Go/No Go gage used to ensure accurate crimps. The gage ends are color coded green for Go, red for No Go (Figure 68).

77 . **Maintenance.** No operator maintenance is required other than proper storage and cleaning.

78 . **Data Plates.** A permanent data plate is affixed to all turret heads and positioners. The plate lists specific contact part numbers, corresponding position color code on 3 position turret heads, and suggested selector depth settings.

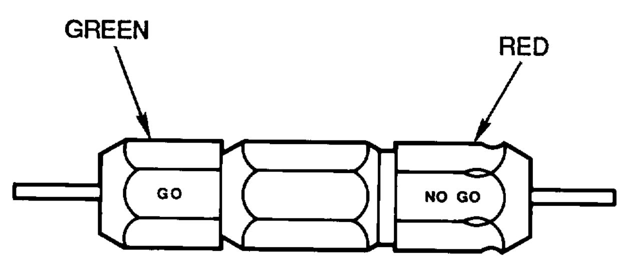


Figure 72. Inspection Gage

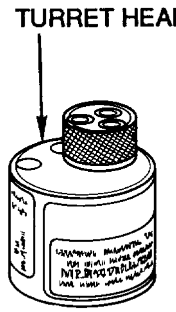


Figure 73. M22520/1-01 Turret Head

79 . **Tooling Gage (Calibration) Procedure.** Periodic gaging is recommended to ensure proper crimp dimensions and tool calibration, and is performed in the following manner (Figure 69):

a. Set tool selector knob to the appropriate position.

b. Activate tool to fully closed position.

c. Go gage should freely pass through indenters.

d. No Go gage may partially end, but should not pass through indenters.

e. When either gaging fails, reject tool to repair or calibration.

80 . M22520/1-01 Crimping Procedure. Correct crimp tool buildup and adjustment are necessary to perform mechanically and electrically sound crimps. Perform buildup and adjustment using the following steps:

a. Select proper turret.

b. Select proper inspection gage.

c. Buildup and adjust tool (Figure 69).

d. Operate (Figure 69).

81 . **CRIMP TOOL M22520/2-01.**

82 . **GENERAL DESCRIPTION.** This tool is considered to be the lower range adjustable crimp tool designed for most miniature and subminiature connector contacts accommodating wire size 20 thru 32 AWG. The tool measures 7.5 inches maximum and weighs 1 pound maximum. The crimp range of this tool overlaps the M22520/1-01 making these tools primary for all crimp contact applications (Figure 70). The tool body color is blue.

83 . **Use.** The tool is used to crimp removable contacts with a wire barrel size of 20 thru 32. The crimp is the standard 8 impression which affords maximum tensile strength as illustrated (Figure 26).

84 . **Ratchet.** A precision ratchet controls the cycling of the tool in both directions of the handle. This ratchet mechanism assures the same and accurate crimp for each operation.

85 . **Crimp Depth (Die Closure).** A positive crimp depth is controlled by an 8 position selector knob located on the tool frame. The operator dials in the desired step for the wire being used and locks the setting with a locking pin as illustrated (Figure 66).

86 . **Positioner.** For proper operation the tool frame must be mated with a positioner.

87 . **Inspection Gage.** The inspection gage is a Go/No Go gage used to ensure accurate crimps. The gage ends are color coded green for Go, red for No Go as illustrated (Figure 68).

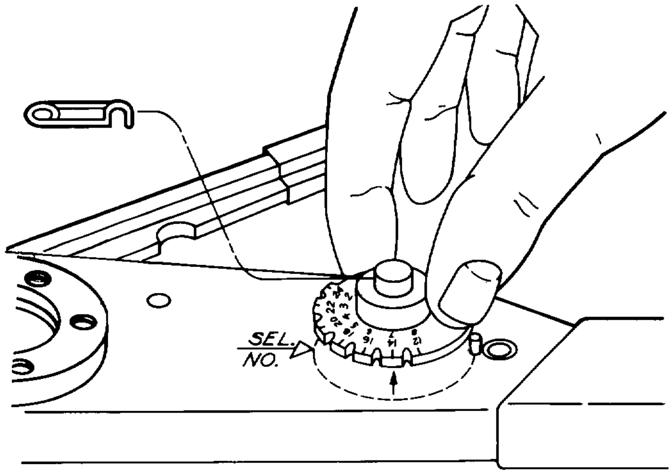
88 . **Periodic Gaging.** Periodic gaging is recommended to ensure accurate calibration as defined (paragraph 66).

89 . **Data Plates.** A permanent data plate is affixed to all positioners. The plate designates which contacts the positioner accommodates for its wire size and indicates selector position.

A. DIE CLOSURE CHECK.

1. REMOVE SAFETY PIN. RAISE WIRE SIZE SELECTOR KNOB AND ROTATE TO 4. REINSTALL SAFETY PIN.

2. CLOSE HANDLES COMPLETELY AND HOLD IN FULLY CLOSED POSITION.



CAUTION

DO NOT CRIMP THE GAGE PIN. THIS WILL PERMANENTLY DAMAGE THE TOOL AND THE GAGE.

3. AXIALLY ALIGN GO GAGE (GREEN) WITH INDENTER OPENING. SLIDE GO GAGE INTO INDENTER OPENING AND THROUGH INDENTERS. GAGE SHOULD PASS FREELY THROUGH INDENTERS. IF NOT, RETURN TOOL FOR REPAIR.

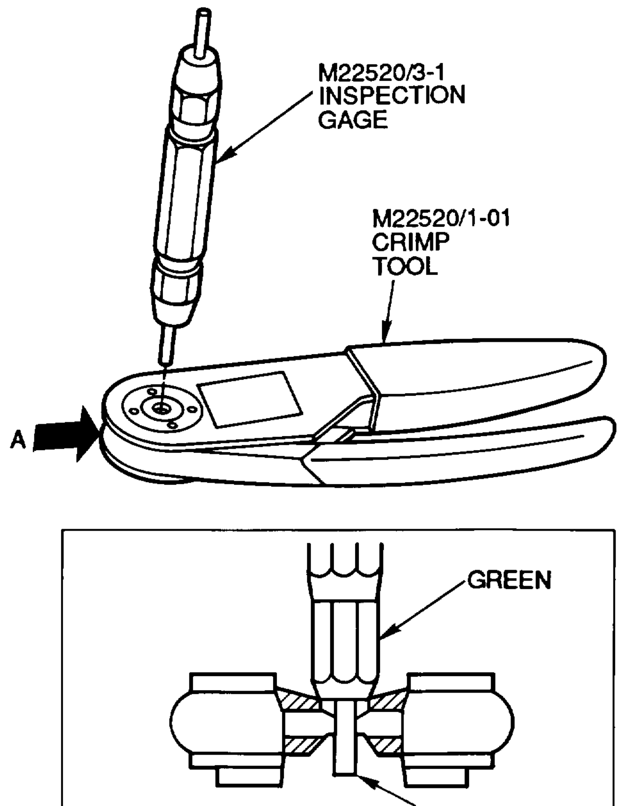
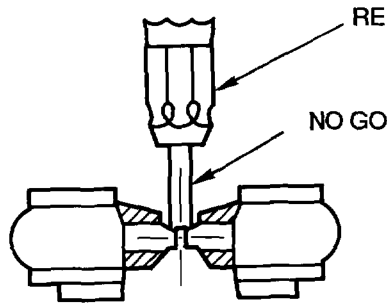
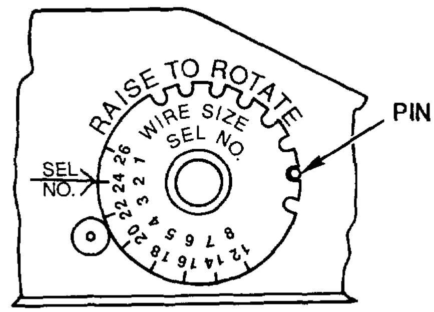


Figure 74. M22520/1-01 Setup, Adjustment, and Operation (Sheet 1 of 4)



4. INVERT INSPECTION GAGE WHILE CONTINUING TO HOLD HANDLES IN THE FULLY CLOSED POSITION. INSERT NO GO (RED) GAGE INTO INDENTER OPENING. GAGE MAY PARTIALLY ENTER, BUT SHOULD NOT PASS BETWEEN INDENTERS. IF NO GO (RED) GAGE PASSES THROUGH INDENTERS, RETURN TOOL FOR REPAIR.



WIRE SIZE SELECTOR KNOB

B. CRIMP TOOL SETUP AND ADJUSTMENT.

1. DETERMINE THE REQUIRED SELECTION SETTING (CRIMP DEPTH) FOR THE WIRE SIZE BY REFERRING TO THE DATA PLATE ON THE TURRET OR POSITIONER.

2. REMOVE SAFETY PIN FROM WIRE SIZE SELECTOR KNOB.

3. RAISE WIRE SELECTOR KNOB AND ROTATE TO SELECTOR SETTING NUMBER. SEE TABLE.

4. LOWER WIRE SIZE SELECTOR KNOB.

5. ENSURE THAT NOTCH ON WIRE SIZE SELECTOR KNOB ENGAGES WITH PIN ON CRIMPING TOOL HANDLE. REINSTALL SAFETY PIN.

CONTACT SIZE	WIRE SIZE	SELECTOR SETTING	TURRET BUSHING
20	24	2	RED
20	22	3	RED
20	20	4	RED
16	20	4	BLUE
16	18	5	BLUE
16	16	6	BLUE
12	14	7	YELLOW
12	12	8	YELLOW

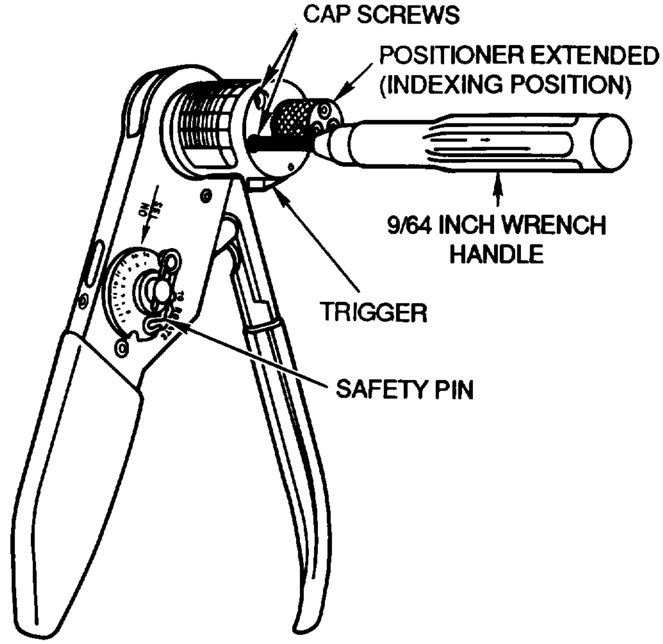
Figure 74. M22520/1-01 Setup, Adjustment, and Operation (Sheet 2)

6. PRESS TRIGGER ON TURRET HEAD RELEASING POSITIONER TO EXTENDED (INDEXING) POSITION.

7. SEAT TURRET HEAD ONTO RETAINER RING ON BACK OF TOOL WITH SCREWS LINED UP WITH TAPPED HOLES.

8. TIGHTEN CAP SCREWS WITH A 9/64 INCH ALLEN WRENCH.

9. TO REMOVE, LOOSEN CAP SCREWS UNTIL THREADS ARE DISENGAGED FROM TAPPED HOLES AND LIFT TURRET HEAD OFF CRIMP TOOL FRAME.



10. OPEN CRIMP TOOL HANDLES. DEPRESS TRIGGER TO UNLOCK AND EXTEND (RAISE) POSITIONER TO INDEXING POSITION.

11. WITH POSITIONER EXTENDED, ROTATE BUSHING OF APPLICABLE CONTACT SIZE AND COLOR TO INDEX MARK.

12. DEPRESS POSITIONER INTO LOCKED DOWN POSITION (FLUSH WITH TURRET).

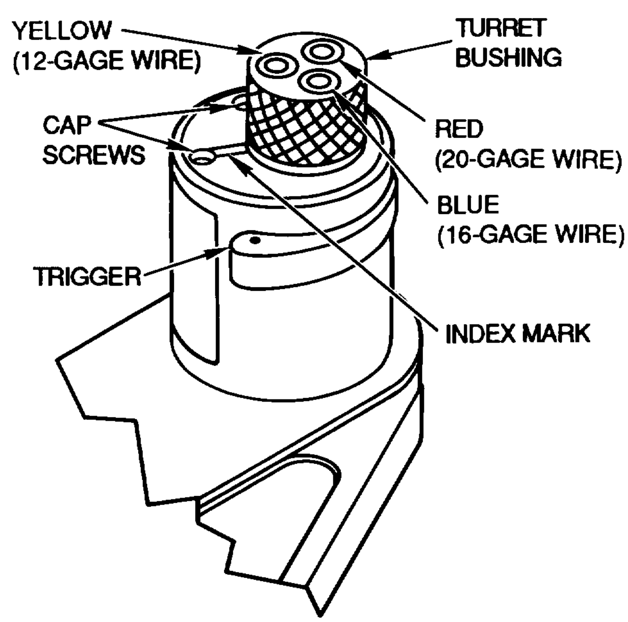
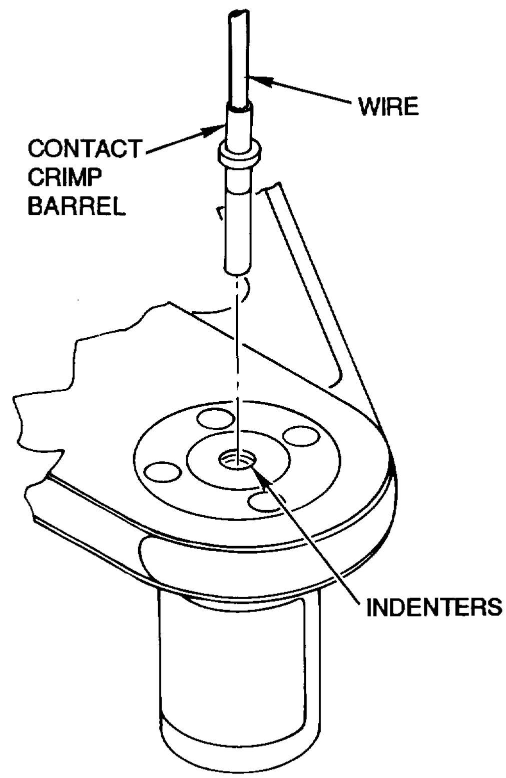


Figure 74. M22520/1-01 Setup, Adjustment, and Operation (Sheet 3)

13. INSERT CONTACT AND WIRE INTO CRIMP TOOL INDENTERS ON FRONT OF TOOL UNTIL CONTACT BOTTOMS IN TURRET HEAD. HOLDING WIRE AND CONTACT IN PLACE, SQUEEZE CRIMP TOOL HANDLES TOGETHER SMOOTHLY UNTIL RATCHET RELEASES AND TOOL OPENS.

NOTE

CRIMP TOOL WILL NOT RELEASE UNTIL CRIMPING CYCLE IS COMPLETED.



14. REMOVE CONTACT FROM CRIMP TOOL AND INSPECT CONTACT AS REQUIRED.

15. REFER TO APPLICABLE WORK PACKAGE FOR CONTACT INSERTION PROCEDURE.

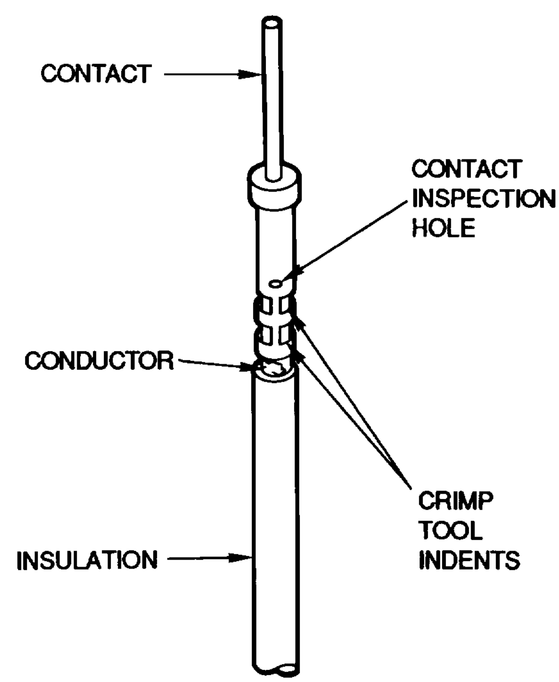


Figure 74. M22520/1-01 Setup, Adjustment, and Operation (Sheet 4)

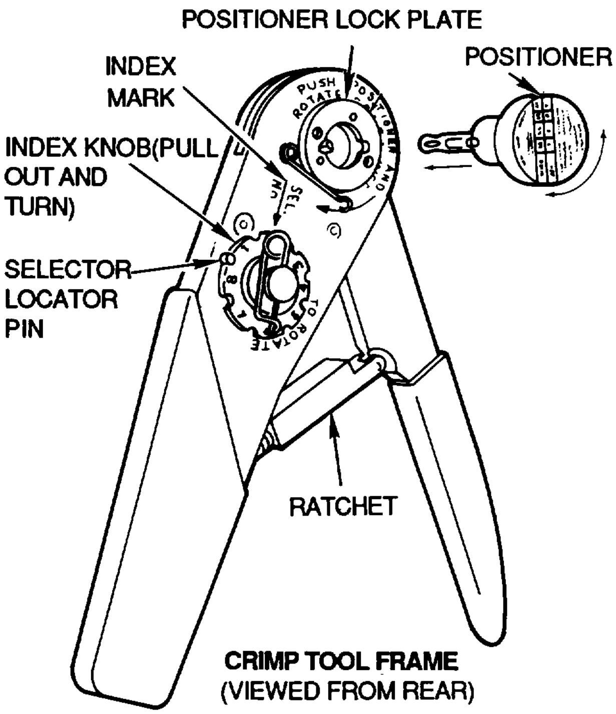


Figure 75. Crimp Tool M22520/2-01

90 . **Maintenance.** No operator maintenance is required other than proper storage and cleaning.

91 . **M22520/2-01 CRIMPING PROCEDURE.** Correct crimp tool setup and adjustment are necessary to perform mechanically and electrically sound crimps. Perform setup and adjustment using the following steps:

a. Select proper positioner.

b. Select proper inspection gage.

c. Setup and adjust tool (Figure 71).

d. Operate (Figure 71).

92 . **CRIMP TOOL M22520/7-01.**

93 . **GENERAL DESCRIPTION.** This tool is considered to be the middle range adjustable crimp tool designed for most miniature and subminiature connector contacts accommodating wire size 16 thru 28 AWG. The tool is the same size, weight, and appearance as the M22520/2-01 (Figure 70). The tool body color is green.

94 . **Use.** This tool is used to crimp removable contacts with a wire barrel size accommodating 16 thru 28 AWG wire. The crimp is the standard 8 impression which affords maximum tensile strength as illustrated (Figure 65).

95 . **Ratchet.** A precision ratchet controls the cycling of the tool in both directions of the handle. This ratchet mechanism ensures the same and accurate crimp for each operation.

96 . **Crimp Depth (Die Closure).** A positive crimp depth is controlled by an 8 position selector knob located on the tool frame. The operator dials in the desired step for the wire being used and locks the setting with a locking pin as illustrated (Figure 66).

97 . **Positioner.** For proper operation the tool frame must be mated with a positioner.

98 . **Inspection Gage.** The inspection gage is a Go/No Go gage used to ensure accurate crimps. The gage ends are color coded green for Go, red for No Go as illustrated (Figure 68).

99 . **Periodic Gaging.** Periodic gaging is recommended to ensure accurate calibration as defined (Paragraph 58).

100 . **Data Plates.** A permanent data plate is affixed to all positioners. The plate designates which contacts the positioner accommodates for its wire size and indicates selector position.

101 . **Maintenance.** No operator maintenance is required other than proper storage and cleaning.

102 . **SETUP, ADJUSTMENT, AND OPERATION.** Correct crimp tool setup and adjustment are necessary to perform mechanically and electrically sound crimps. Perform buildup and adjustment using the following steps:

a. Select proper positioner.

b. Select proper inspection gage.

c. Setup and adjust tool (Figure 71).

d. Operate (Figure 71).

103 .**Emergency Eye Sight Positioning.**

CAUTION

This procedure should be used only in emergency situations or when crimp performance can be properly evaluated. Crimp impressions that are too deep will cause the wire to break easily at the crimp joint while crimp impressions that are too shallow will allow the wire to pull out.

WARNING

Alternate tools (pliers, diagonal cutting pliers, etc.) are not acceptable crimp tools in any circumstances.

104 .If it becomes necessary to crimp contacts for which no positioning heads, positioners, or universal heads are available. the following procedures may he used:

a. Remove any positioning device installed in tool.

b. Determine and set an approximate selector setting for the contact/wire combination. Some tools have wire sizes on the selector for reference. A setting may be estimated by comparing the combination with other known contact/sizes and materials.

A. DIE CLOSURE CHECK.

1. REMOVE SAFETY PIN. RAISE WIRE SIZE SELECTOR KNOB AND ROTATE TO 8. REINSTALL SAFETY PIN.

2. CLOSE HANDLES COMPLETELY AND HOLD IN FULLY CLOSED POSITION.

CAUTION

DO NOT CRIMP THE GAGE PIN. THIS WILL PERMANENTLY DAMAGE THE TOOL AND THE GAGE.

3. AXIALLY ALIGN GO GAGE (GREEN) WITH INDENTER OPENING. SLIDE GO GAGE INTO INDENTER OPENING AND THROUGH INDENTERS. GAGE SHOULD PASS FREELY THROUGH INDENTERS. IF NOT, RETURN TOOL FOR REPAIR.

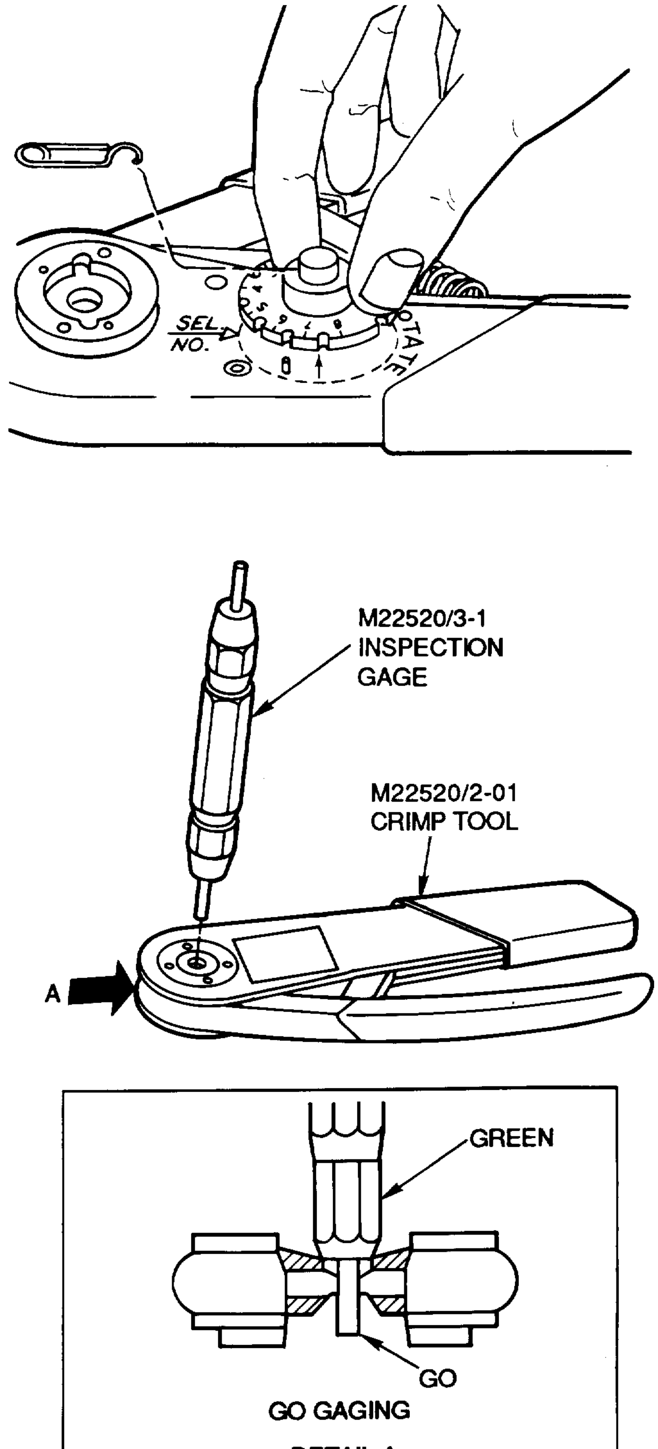
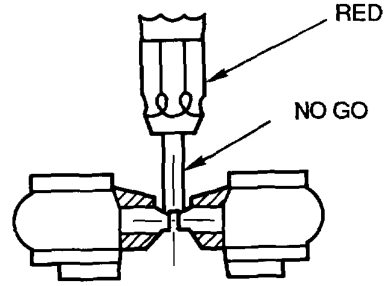


Figure 76. M22520/2-01 and M22520/7-01 Setup, Adjustment, and Operation (Sheet 1 of 4)

4. INVERT INSPECTION GAGE WHILE CONTINUING TO HOLD HANDLES IN THE FULLY CLOSED POSITION. INSERT NO GO (RED) GAGE INTO INDENTER OPENING. GAGE MAY PARTIALLY ENTER, BUT SHOULD NOT PASS BETWEEN INDENTERS. IF NO GO (RED) GAGE PASSES THROUGH INDENTERS, RETURN TOOL FOR REPAIR.



B. CRIMP TOOL SETUP AND ADJUSTMENT

1. REMOVE SAFETY PIN FROM WIRE SIZE SELECTOR KNOB.

2. RAISE WIRE SIZE SELECTOR KNOB AND ROTATE TO SELECTOR SETTING NUMBER. SEE TABLE.

3. LOWER WIRE SIZE SELETOR KNOB.

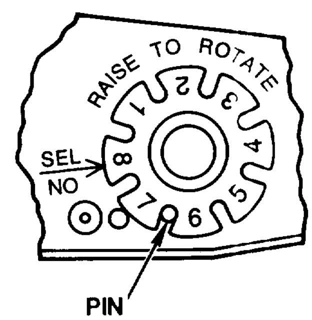
4. ENSURE THAT WIRE SIZE SELECTOR KNOB ENGAGES WITH PIN ON CRIMPING TOOL HANDLE REINSTALL SAFETY PIN.

5. OPEN CRIMPING TOOL HANDLES.

6. REMOVE SAFETY PIN.

7. INSERT POSITIONER SPECIFIED IN CONNECTOR FIGURE OF APPLICABLE WORK PACKAGE IN CRIMP TOOL AS SHOWN.

8. TURN POSITIONER 60 DEGREES CLOCKWISE TO LOCK POSITIONER IN CRIMP TOOL. INSERT SAFETY PIN THROUGH POSITIONER AND CRIMP TOOL.



CONTACT SIZE	WIRE SIZE	SELECTOR SETTING
22	26	3
22	24	4
22	22	5

TYPICAL DATA PLATE

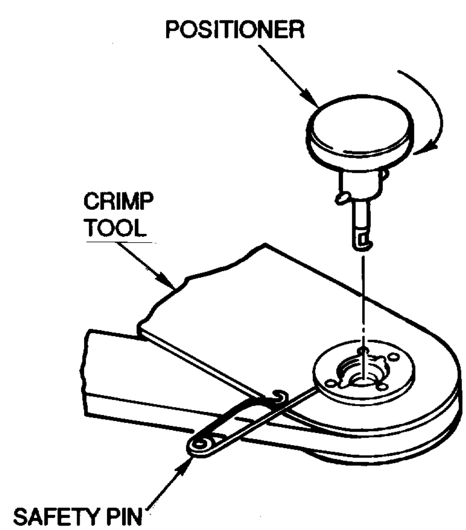
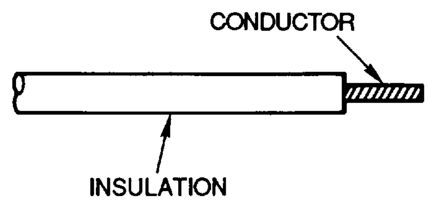


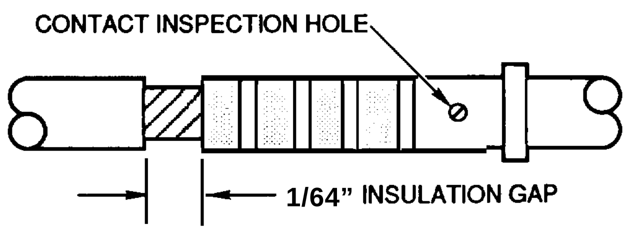
Figure 76. M22520/2-01 and M22520/7-01 Setup, Adjustment, and Operation (Sheet 2)

C. CRIMPING PROCEDURE

1. STRIP INSULATION FROM END OF WIRE (WP 009 00), SELECT SPECIFIED CONTACT.



2. INSERT STRIPPED WIRE INTO CONTACT CONDUCTOR BARREL (PARAGRAPH 9).



3. INSERT CONTACT AND WIRE INTO CRIMP TOOL INDENTERS ON FRONT OF TOOL UNTIL CONTACT BOTTOMS IN POSITIONER. HOLDING WIRE AND CONTACT IN PLACE, SQUEEZE CRIMP TOOL HANDLES TOGETHER SMOOTHLY UNTIL RATCHET RELEASES AND TOOL OPENS.

NOTE

CRIMP TOOL WILL NOT RELEASE UNTIL CRIMPING CYCLE IS COMPLETED.

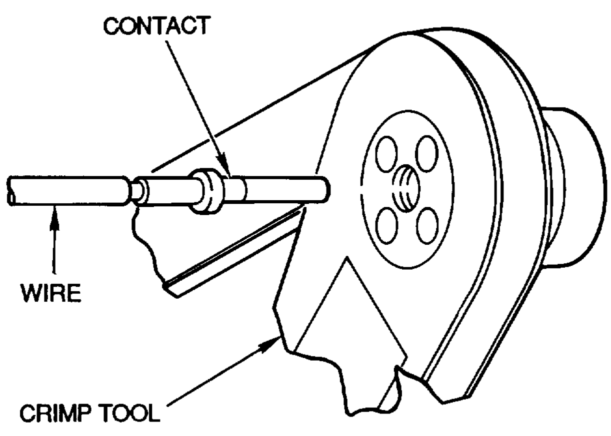


Figure 76. M22520/2-01 and M22520/7-01 Setup, Adjustment, and Operation (Sheet 3)

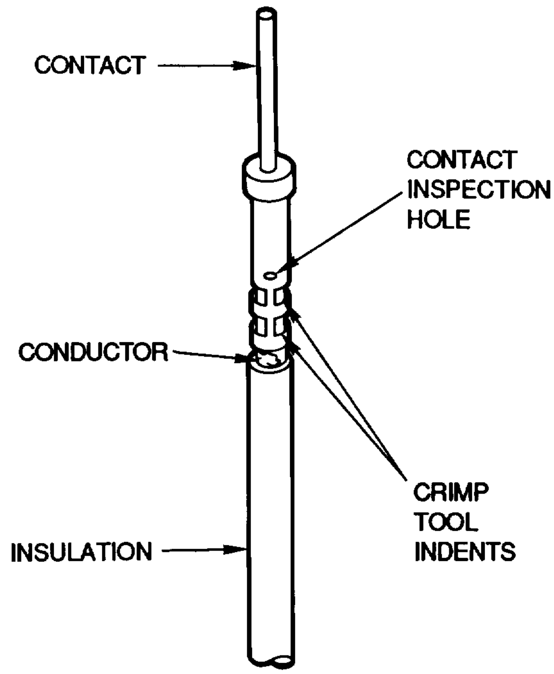


Figure 76. M22520/2-01 and M22520/7-01 Setup, Adjustment, and Operation (Sheet 4)

c. Insert the contact into the tool between the indenter tips. Slowly close the handles and grip the contact lightly with the indenters without crimping. At the same time, position the contact so the indenters are located midway between the inspection hole and the end of the contact (or bottom of insulation cup, if present).

d. While still holding the contact lightly with the indenter tips, insert the stripped wire into the contact. making sure wire is fully bottomed.

e. Close the handles to the ratchet release position and open.

f. Remove the contact and inspect for the following:

(1) Wire is visible through the inspection hole in wire barrel.

(2) Position of crimp impressions is midway on wire barrel.

(3) Contact is not bent or distorted.

(4) Contact wire barrel is not cracked and plating is intact.

105 . **CRIMP TOOL M22520/5-01 AND M22520/10-01.**

106 . **GENERAL DESCRIPTION.** These tools are discussed together due to their similarity. These are open frame crimp tools using interchangeable dies. The M22520/5-01 is 11 inches maximum and weighs 2 pounds maximum, and the M22520/10 is 9 inches maximum and weighs 1.5 pounds maximum.

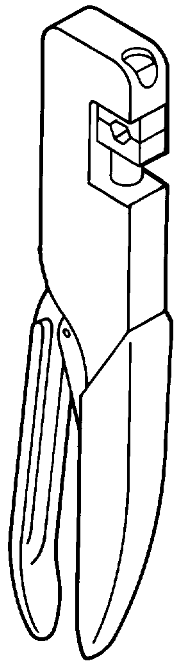


Figure 77. Crimp Tool M22520/5-01 and M22520/10-01

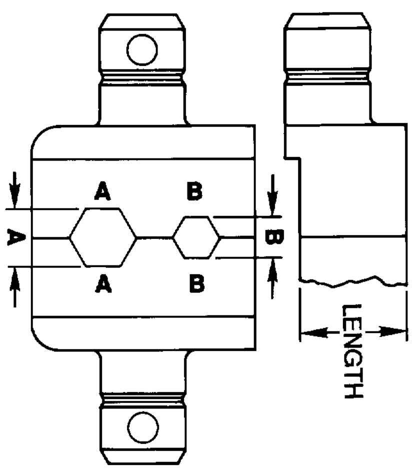


Figure 78. Die Dimensions

107 . **Use.** The tools are used, with hexagonal dies in a variety of configurations having single, double, and triple cavity design, to crimp most coaxial and triaxial connectors and contacts. Dies of various other crimp patterns are available for insulated and uninsulated terminal lugs, splices, and end caps.

108 . **Ratchet.** A positive precision ratchet controls the cycling of the tool in both directions of the handle. This ratchet mechanism ensures the same and accurate crimp for each operation.

109 . **Tool Die.** M22520/5 dies are illustrated in Figure 73. The available /5 and /10 dies are listed in Table 20.

110 . **Inspection Gage.** The inspection gage is a Go/No Go gage used to ensure accurate crimps. The gage ends are color coded green for Go and red for No Go as illustrated (Figure 68). Gages are to be selected by die used (Table 20).

111 . **Periodic Gaging.** Periodic gaging is recommended to ensure proper crimp dimensions and tool calibration, and is performed in the following manner (Figure 74):

a. Activate tool to fully mate die surfaces.

b. Go gage should freely pass through die.

c. No Go gage should not pass through die.

d. When either gage fails, reject tool and return for repair or calibration.

Table 23 . Inspection Gage Selection

Part No. Die M22520/	Inspection Gage Die Closure A M22520/	Inspection Gage Die Closure B M22520/
5-02	6-030	6-029
5-03	6-003	6-001
5-04	6-029	6-002
5-05	6-008	6-006
5-06	6-029	—
5-07	6-011	—
5-08	6-003	—
5-09	6-006	6-029
5-10	6-005	—
5-11	6-008	6-029
5-13	6-011	6-029
5-15	6-012	6-029
5-17	6-002	—
5-19	6-011	6-008
5-21	6-025	—
5-23	6-020	—
5-25	6-022	6-031
5-27	6-027	—
5-29	6-017	6-031
5-31	6-026	—
5-33	6-018	6-001
5-35	6-017	6-003
5-37	6-016	6-004
5-39	6-015	6-005
5-41	6-014	6-006
5-43	6-013	6-007
5-45	6-010	6-009
5-47	6-019	—
5-49	6-021	—
5-51	6-023	—
5-53	6-024	—
5-55	6-017	—
5-57	6-008	6-031
5-59	6-011	6-031
5-61	6-022	—
5-63	6-012	6-030
10-02	6-030	6-029
10-03	6-011	—
10-04	6-028	6-002

Table 23. Inspection Gage Selection (Cont.)

Part No. Die M22520/	Inspection Gage Die Closure A M22520/	Inspection Gage Die Closure B M22520/
10-05	6-003	6-001
10-06	6-005	—
10-07	6-008	6-006
10-08	6-003	—
10-09	6-002	—
10-10	6-003	—
10-11	6-001	—
10-13	6-003	—
10-15	6-004	—
10-17	6-006	—
10-19	6-007	—
10-21	6-008	—
10-23	6-009	—
10-25	6-010	—
10-27	6-011	—
10-100	3-9	—
10-101	3-10	—
10-102	3-11	—

A. REMOVAL OF DIES.

CAUTION

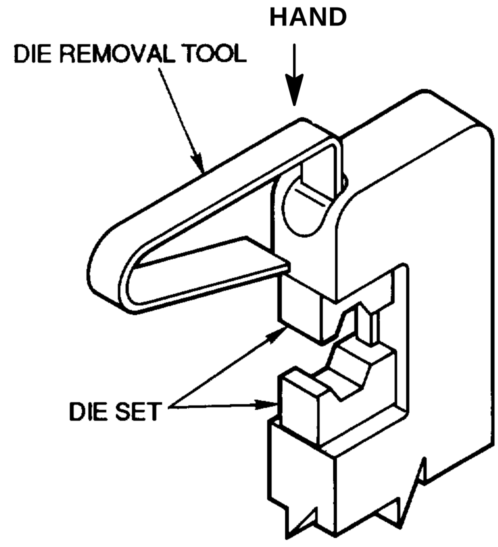
IF DIES HAVE BEEN PERMANENTLY INSTALLED, THE LOCK PINS MUST BE REMOVED FIRST TO PREVENT SERIOUS DAMAGE TO TOOLS.

1. WITH HANDLES IN THE OPEN POSITION, USE THE DIE REMOVAL TOOL AND YOUR HAND TO APPLY A DOWNWARD FORCE TO THE UPPER DIE HALF.

2. THE DIE WILL BE RELEASED FROM THE LOCK SPRING AND EJECTED APPROXIMATELY 1/16 INCH. COMPLETE THE REMOVAL BY HAND.

NOTE

IF DIE REMOVAL TOOL IS UNAVAILABLE, A STEEL ROD 3/16 INCH DIAMETER x 1 3/4 INCH LONG MAY BE USED.



3. CLOSE THE CRIMP TOOL HANDLES AND SLIDE THE REMOVAL TOOL BETWEEN THE LOWER DIE AND TOOL BODY AS SHOWN.

4. PULL THE HANDLES OPEN WITH A SNAP ACTION. THE DIE WILL BE RELEASED FROM THE LOCK SPRING AND CAN BE REMOVED BY HAND.

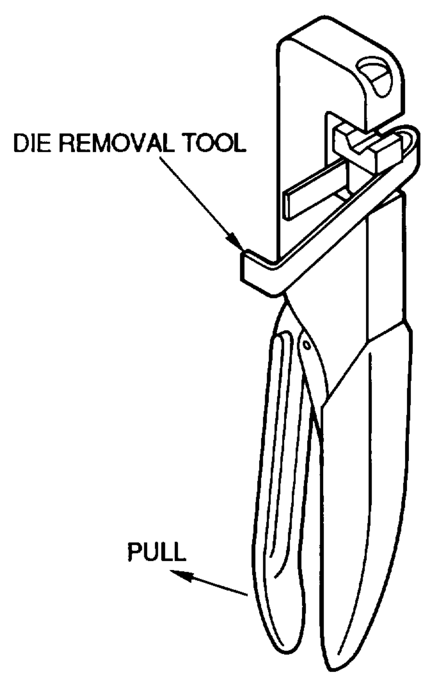


Figure 79. M22520/5-01 and M22520/10-01 Setup, Adjustment, and Operation (Sheet 1 of 4)

B. INSTALLATION OF DIES.

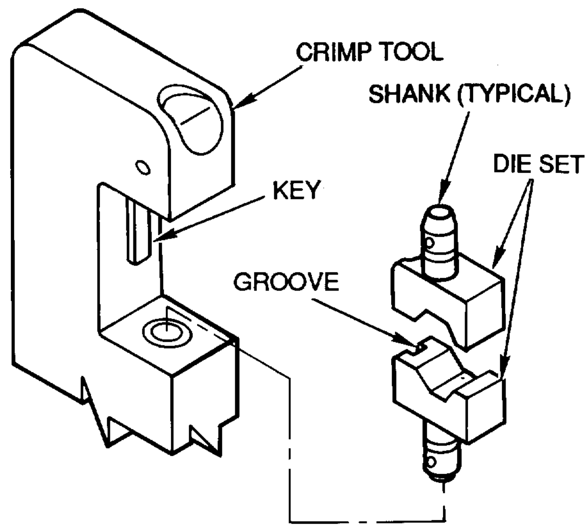
1. SELECT DIE SET SPECIFIED IN APPLICABLE WORK PACKAGE.

2. ALIGN GROOVE IN DIES WITH KEY IN CRIMP TOOL.

3. OPEN HANDLES FULLY.

4. INSTALL DIES BY INSERTING SHANKS INTO HOLES IN TOOL.

5. AFTER CLOSING HANDLES, VISUALLY CHECK TO SEE THAT DIES ARE PROPERLY SEATED, LOCKED IN PLACE, AND ALIGNED WITH EACH OTHER.



WARNING

SAFETY GLASSES SHALL BE WORN WHILE USING HAMMER. SERIOUS EYE INJURY CAN OCCUR.

6. IF A PERMANENT DIE ASSEMBLY IS REQUIRED, DRIVE A 1/8 INCH DIAMETER PIN THROUGH TOOL BODY HOLE AND ANOTHER PIN OF SAME DIAMETER THROUGH PUSH ROD HOLE.

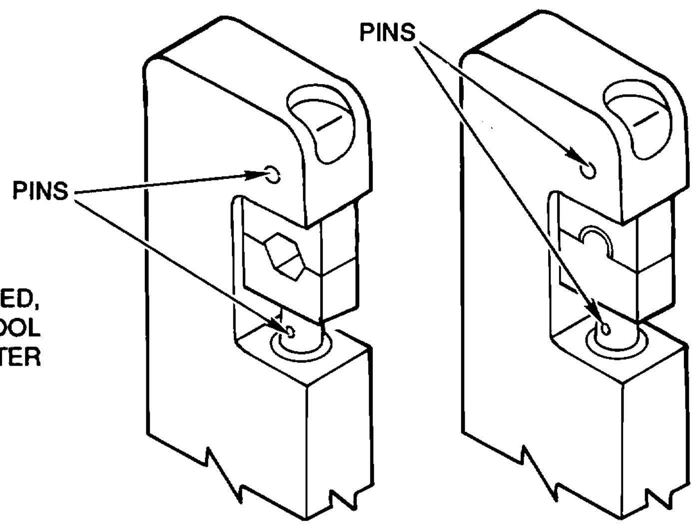


Figure 79. M22520/5-01 and M22520/10-01 Setup, Adjustment, and Operation (Sheet 2)

C. DIE CLOSURE CHECK.

1. CLOSE HANDLES COMPLETELY AND HOLD IN FULLY CLOSED POSITION.

2. AXIALLY ALIGN GO GAGE (GREEN) WITH INDENTER OPENING. SLIDE GO GAGE INTO INDENTER OPENING AND THROUGH INDENTERS. GAGE SHOULD PASS FREELY THROUGH INDENTERS. IF NOT, RETURN TOOL FOR REPAIR.

3. INVERT INSPECTION GAGE WHILE CONTINUING TO HOLD HANDLES IN THE FULLY CLOSED POSITION. INSERT NO GO (RED) GAGE INTO INDENTER OPENING. GAGE SHOULD NOT PASS BETWEEN INDENTERS. IF NO GO (RED) GAGE PASSES THROUGH INDENTERS, RETURN TOOL FOR REPAIR.

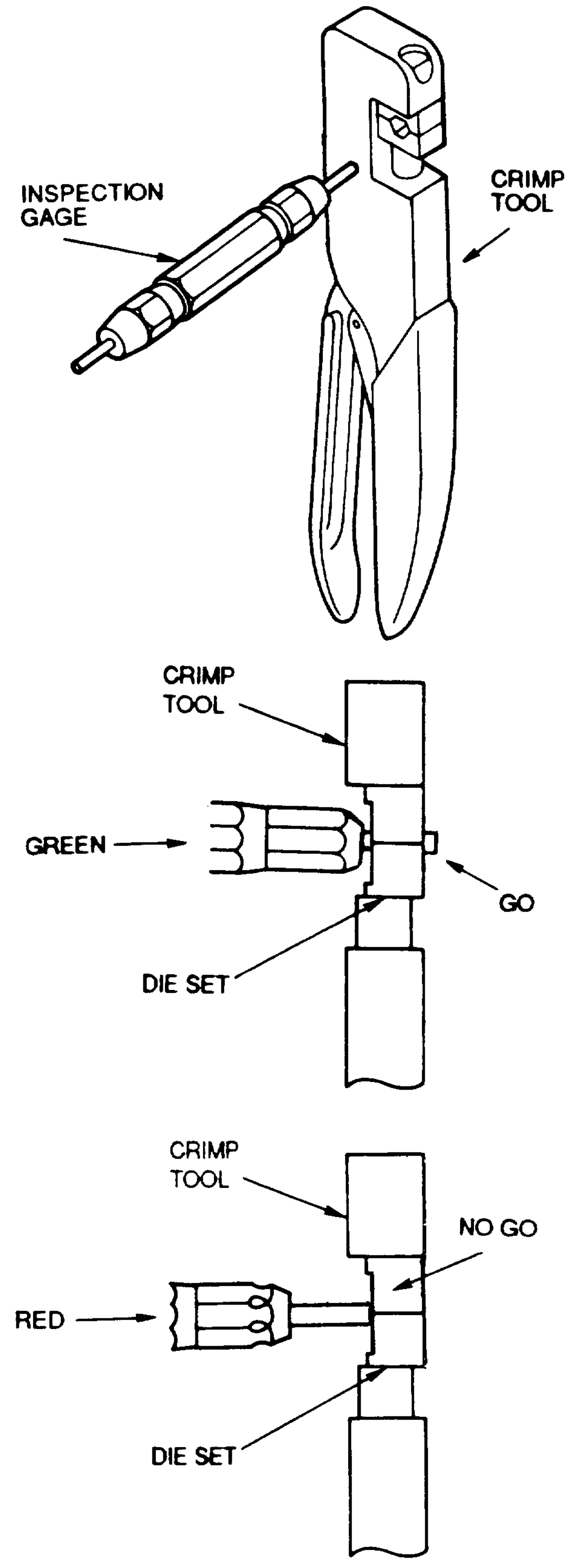
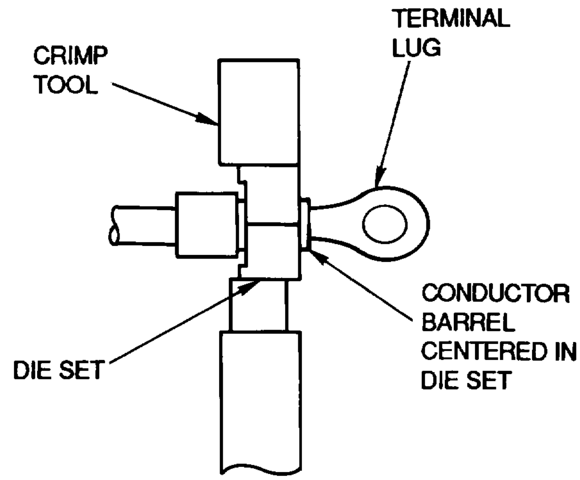


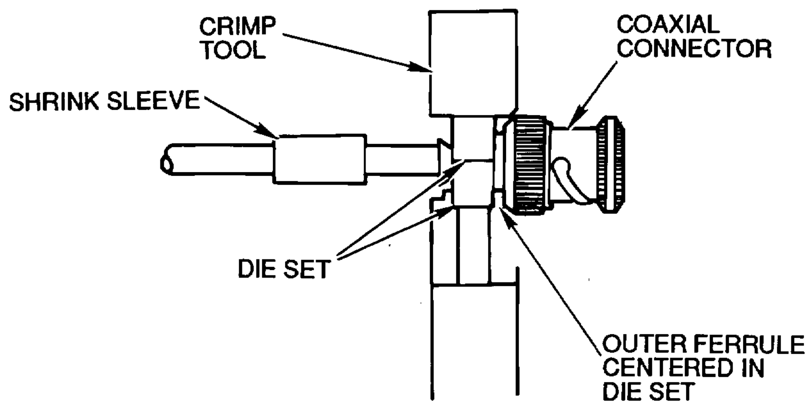
Figure 79. M22520/5-01 and M22520/10-01 Setup, Adjustment, and Operation (Sheet 3)

D. CRIMP TOOLS M22520/5-01 AND M22520/10-01 CRIMPING PROCEDURE.

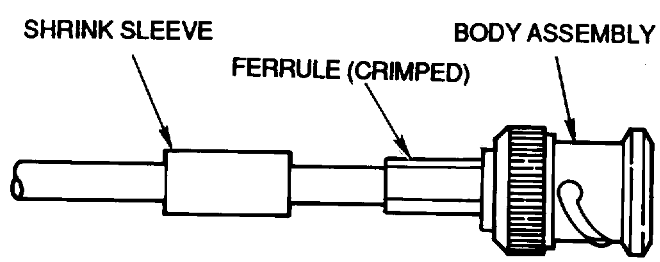
1. PREPARE WIRE/CABLE AND ASSEMBLE CONNECTOR, CONTACT, OR LUG IN ACCORDANCE WITH APPLICABLE WORK PACKAGE.

2. HOLD CRIMP BARREL CENTERED IN DIE SET. SQUEEZE TOOL HANDLES TOGETHER SMOOTHLY UNTIL RATCHET RELEASES.





3. REMOVE CRIMPED DEVICE FROM TOOL AND INSPECT AS REQUIRED BY THE APPLICABLE WORK PACKAGE.



4. REFER TO APPLICABLE WORK PACKAGE FOR INSTALLATION/INSERTION PROCEDURES.

Figure 79. M22520/5-01 and M22520/10-01 Setup, Adjustment, and Operation (Sheet 4)

112 . **<u>CRIMP TOOL M22520/23-1 PNEUMATIC.</u>**

113 . **GENERAL DESCRIPTION.** The tool uses use air pressure 90 to 120 PSI to crimp contacts in the range of 8 to 0000 (4/0). The tool measures 12.7 inches X 9.2 inches and weighs 17 pounds less dies and locators (Figure 80).

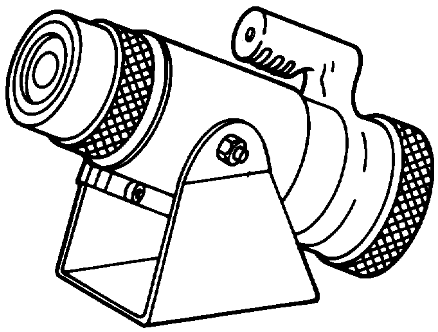


Figure 80. Pneumatic Crimp Tool M22520/23-1

114 . **<u>Use.</u>** The tool is used to crimp contacts with a wire barrel size of 8 thru 4/0 with the standard 8 impression crimp as illustrated (Figure 65).

115 . **<u>Full Cycle Control.</u>** Unlike the M22520/1-01, 2-01, 5-01, 7-01 and 10-01 there is no mechanical ratchet mechanism. A full cycle is controlled by internal valves. This full cycle control is tamper-proof and cannot be disengaged prior to or during crimp cycle.

116 . **<u>Crimp Depth.</u>** The crimp depth is controlled by the length of the individual indenters, which are changed as a unit for each cycle is controlled by internal valves.

117 . **<u>Accessories.</u>** For proper operation the tool must be mated with the proper dies and locator (Figure 81).

118 . **ACCESSORY TOOLING.** It is necessary to select the proper accessory to ensure accurate crimps. The proper die must be selected according to size (Table 24). The proper locator must be selected by size and contact part number (Table 25).

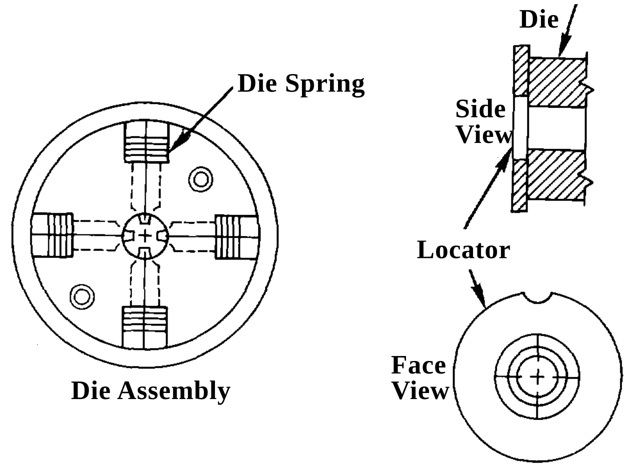


Figure 81. M22520/23-01 Accessories

Table 24 . Die Selection

Part No. M22520/	Contact Size
23-02	8
23-03	6
23-04	4
23-05	0
23-06	00
23-07	0000

Table 25 . Locator Selection

Part No. M22520/	Contact Size	MS Contact Number
23-09	8	M39029/29-8-8 M39029/30-8-8 MIL–C–39029/44 MIL–C–39029/45
23-10	6 6N 6G 6 6G	MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/49 MIL–C–39029/49
23-11	4	M39039/29-4-4 M39029/30-4-4 MIL–C–39029/44 MIL–C–39029/45
23-12	4 4N 4G 4 4G	MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/49 MIL–C–39029/49

Table 26 . Locator Selection cont

Part No. M22520/	Contact Size	MS Contact Number
23-13	1/0	MIL–C–39029/48 M39029/30-0-0 MIL–C–39029/44 MIL–C–39029/48
23-14	1/0 1/0N 1/0	MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/49
23-15	2/0 2/0N 2/0	MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/49
23-16	4/0 4/0N 4/0	MIL–C–39029/48 MIL–C–39029/48 MIL–C–39029/49

119 . **SETUP AND OPERATION.** Correct crimp tool buildup and operation are necessary to perform mechanically and electrically sound crimps. Perform buildup and operation using the following steps:

a. Select proper accessories.

b. Setup tool (Figure 81).

c. Operate (Figure 81).

120 . **HD51 CRIMPING TOOL.**

121 . **DESCRIPTION**. The hydraulic tool (Figure 82) is operated by pumping both handles . It can be operated with one hand by laying the stationary handle on a flat surface. It has a force of 5.5 tons and weighs 4.6 Lbs. The tool has an audible "Click" to prevent over–compression. It also has a 180° rotating head for easy accessibility in confined working areas. An example of tool in use is depicted in Figure 85.

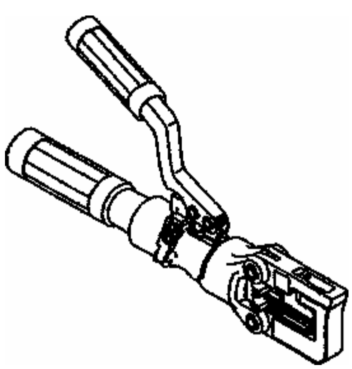


Figure 82. HD51 Crimping Tool

122 . **SELECTION OF CRIMPING DIE.** Determine proper crimping die set to be used for the crimp.

123 . **OPERATING PROCEDURES.**

a. Open head and insert crimping dies (Figure 83). The head assembly has two slots to slide the dies in and out easily.

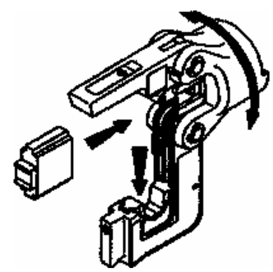


Figure 83. HD51 Crimping Tool Die Insertion

b. Lock the head over the connector and pump the handle until an audible click is heard.

c. Activate the pressure release trigger to retract the hydraulic ram (Figure 87).

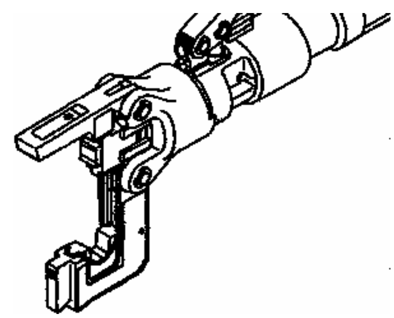


Figure 84. HD51 Open Head for Die Removal

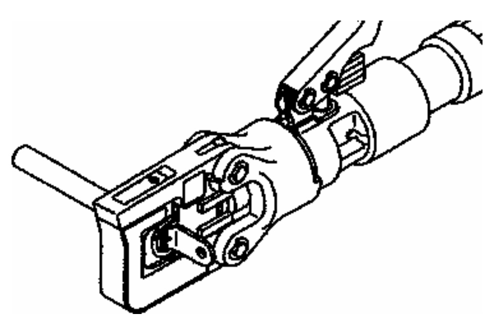


Figure 85. HD51 In Use Crimping Terminal

CAUTION

Do not press the pressure release trigger until click is heard and crimp is complete. Damage to tool will occur if mechanism is released before crimp is completed; Do not work the tool without dies.

d. To remove the dies, open head and remove dies by sliding along slot (Figure 84).

124 .**REFILLING THE RESERVOIR AND BLEEDING THE TOOL.**

a. Fit a set of dies, depress handle until dies are closed, or as far as dies will close.

b. Invert tool and allow air to rise to top of reservoir.

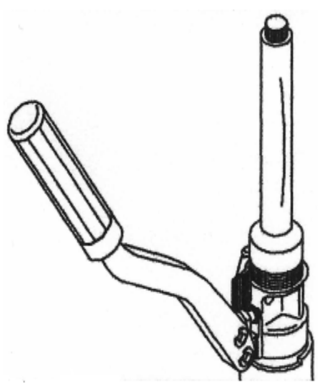


Figure 86. HD51 Oil Reservoir Filler Plug

c. Unscrew reservoir cover and remove filler plug, fill with oil (Figure 86).

d. Depress release trigger, excess oil will be ejected from reservoir as ram retracts.

e. Replace filler plug and reservoir cover.

f. Perform two full closures with the tool inverted.

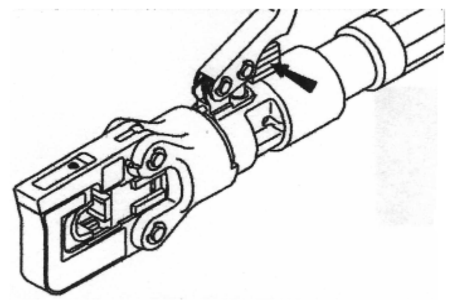


Figure 87. HD51 Pressure Release Trigger

125 .**HH80C HAND ACTUATED HYDRAULIC CRIMP TOOL.**

126 .**INTRODUCTION.** The HH80C is a hand actuated hydraulic crimp tool designed to use interchangeable MS23002–XX dies (for insulated lugs) and MS 90485–XX dies (for un–insulated lugs). It has a two–stage hydraulic system with an automatic relief valve to prevent over–compression.

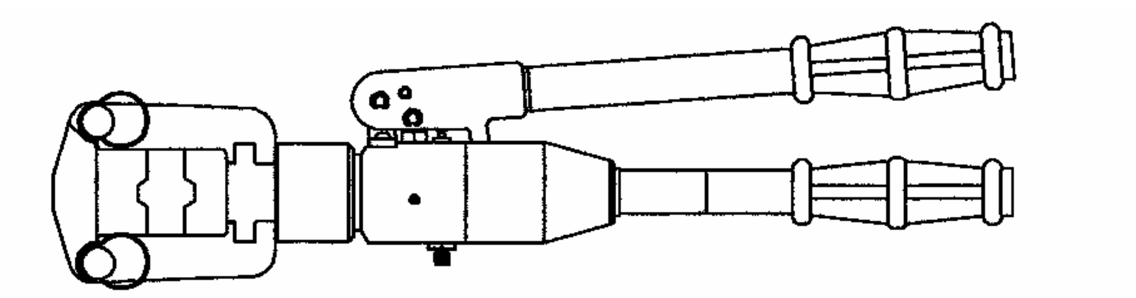


Figure 88. HH80C Hand Actuated Hydraulic Crimp Tool.

127 . **COLD WEATHER NOTE.** This tool is supplied with Drydene Paradene 46AW hydraulic oil. For operation below 20˚ F (–6.7˚ C), refill reservoir with Drydene 22AW Hydraulic oil or equivalent. In cold weather and after periods of non use, O–ring seal sticking may cause non–pumping. Rotate the advance handle clockwise to advance the dies and free any sticking O–rings.

128 . **STORAGE.** When tool is to be stored for any extended period of time, the tool should be pumped up approximately every three weeks to keep O–rings and seals lubricated. The tool should also be stored with the dies in the fully open position.

129 . **GENERAL MAINTENANCE.** The HH80C tool is a hydraulically actuated mechanism which requires well trained, experienced personnel having a clean work area equipped with adequate tools for major repairs, adjustments or maintenance.

a. KEEP THE TOOL CLEAN. Dirt and grit are the worst enemies of hydraulic equipment. Do not lay the tool on the ground. Wipe the entire tool thoroughly with a clean dry or slightly oily cloth after each day's use.

b. DO NOT MAKE ADJUSTMENT TO THE TOOL. There are no adjustments on this tool that can be made in the field.

CAUTION

DO NOT OPERATE THIS TOOL WITHOUT A DIE SET INSTALLED! Damage to the tool can result.

c. STORE THE TOOL PROPERLY. Before storing tools for any length of time, back the rapid advance handle to the fully open position and depress the pump release handle to fully retract the crimping die. This protects the operating ram from moisture condensation and will help assure correct operation at the next period of use.

130 . **OPERATING INSTRUCTIONS.**

a. Pull both pivot and bridge pins to remove bridge as shown in Figure 89.

b. Place the movable die half between the die rails. Carefully lower the die and mate the die snap retainer to the snap retainer located in the ram as shown in Figure 90.

c. Place the stationary die half between the rails and lower it so the flat spring fits into the spring recess of the die rail. Replace the bridge onto the die rails and snap the stationary die into the mating snap located in the bridges.

d. Replace both bridge and pivot pins.

WARNING

The fiberglass handles and neoprene grips are not designed to protect the operator in "HOT" line work.

CAUTION

The stationary die snap and bridge snap retainers must be fully engaged before the pins can be installed. Do not operate this tool without a die set installed! Damage to the tool can result.

131 . **CRIMPING A TERMINAL LUG.**

a. Place a lug in the movable die making sure the lug is positioned. Rotate the advance handle clockwise until the die loosely clamps the lug (see Figure 89).

b. Insert the conductor into the lug's socket making sure that the conductor is pushed fully into the lugs crimping area.

c. Actuate the pump handle and the movable die will start compressing the lug. A positive trip will occur when the crimp is completed. Stop pumping. Back off the rapid advance handle (rotate counterclockwise) approximately two to three turns depending on the size of the lug.

d. Release the movable die from the compressed lug by partially raising the pump handle. Then rotate the handle fully clockwise and push inward. The movable die will open sufficiently to allow the lug to be removed.

CAUTION

Do not overcompress the die set during the gaging operation.

132 .**GAGING.** The gaging of the MS23002–XX and the MS90485–XX dies is accomplished by installing the die set into the tool as described in the operating instructions. Rotate the advance handle clockwise until the die set is completely closed. The dies must be flush against each other with light force only.

133 .**“GO” GAGING** Insert the “GO” gage end as shown in Figure 90. The gage must pass freely through the cavity in the die set.

134 .**“NO–GO GAGING”.** Try to insert the NO–GO” gage end as shown in Figure 91. The gage may partially enter the cavity but must not pass completely through the opening.

135 .**CHECKING PUMP OIL LEVEL.** Check reservoir oil level of tool by screwing inward on the advance handle. Oil supply is adequate if the dies touch before the advance handle is completely advanced. Add oil if required (see ADDITION OF HYDRAULIC OIL).

136 .**LOSS OF HYDRAULIC OIL.** Hydraulically actuated tools will gradually lose their hydraulic oil over a period of time. This loss is caused by the adherence of small amounts of oil to the moving parts exposed to the outside, such as plungers, pistons, and rams, and from occasional leakage around mechanical seals. A small loss of hydraulic oil is normal and will not affect the operation of the HH80C tool. However, if the level drops too low, air can become trapped in the hydraulic system causing the tool to develop a “spongy” feel, preventing it from operating. Occasional hydraulic oil checks can be performed as follows:

CAUTION

Caution should be exercised to assure that oil of different types are not mixed when tool reservoirs are replenished. Do not use brake fluid.

137 .**ADDITION OF HYDRAULIC OIL.** For cold weather regions, an oil with a viscosity @ 100˚ F, SUS114 should be used.

a. Rotate the advance handle fully counterclockwise to retract the movable die and return the oil to the oil chamber.

b. Actuate the pump release handle and confirm that the die is in the fully open position (see Figure 89).

c. Hold the tool with the crimping head down on a clean surface and remove set screw, and unscrew cover along with the handle assembly.

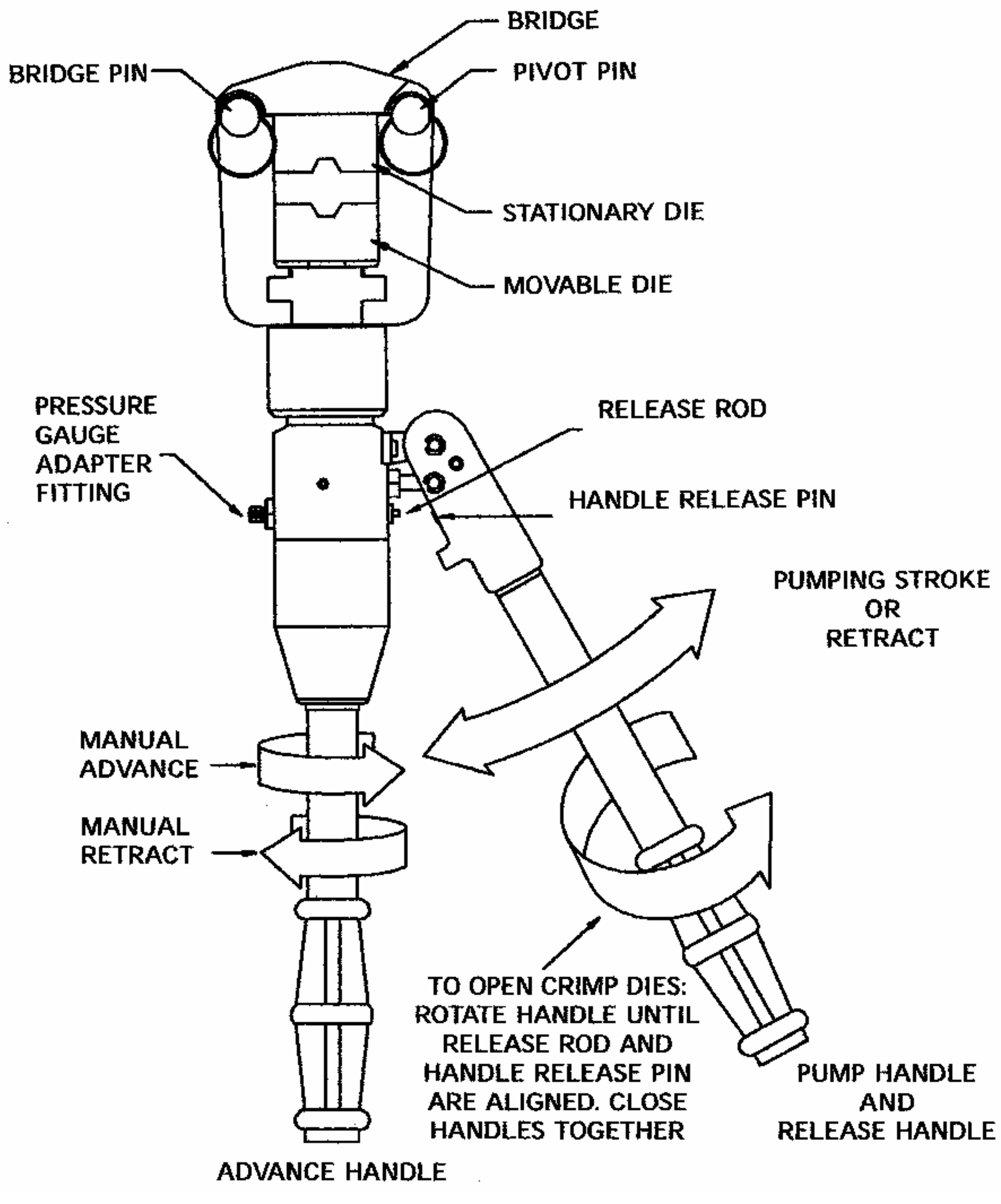


Figure 89. HH80C Hand Actuated Hydraulic Crimp Tool
(Sheet 1 of 3)

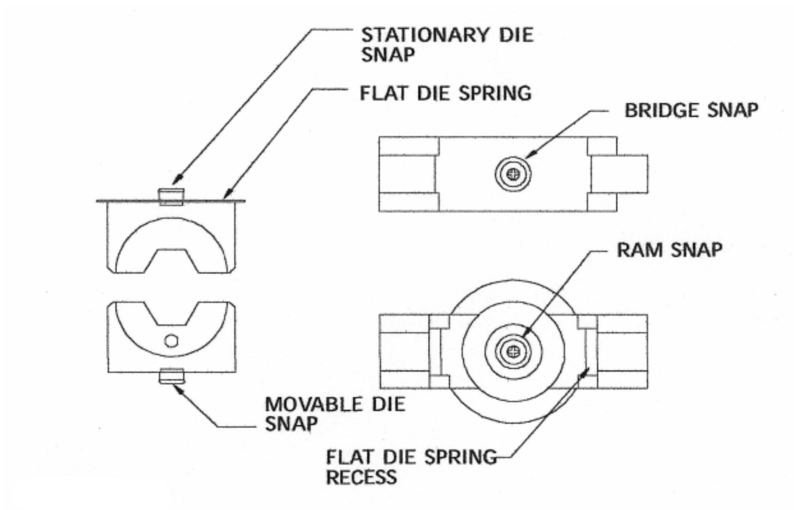


Figure 89. HH80C Hand Actuated Hydraulic Crimp Tool (Sheet 2)

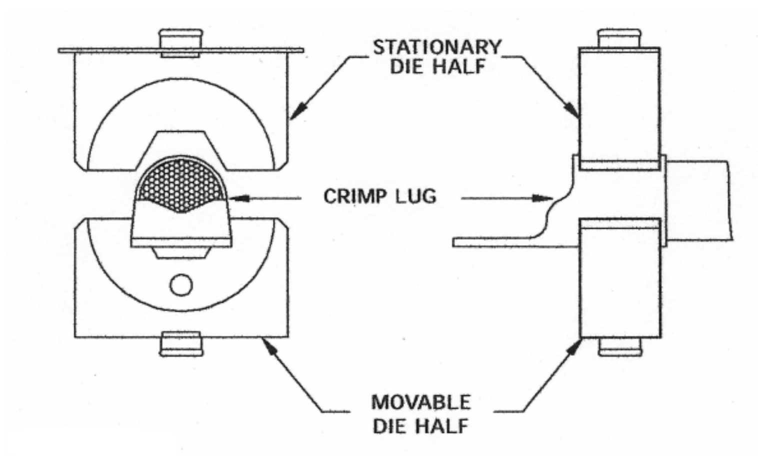


Figure 89. HH80C Hand Actuated Hydraulic Crimp Tool (Sheet 3)

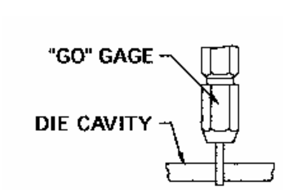


Figure 90. “GO” Gage

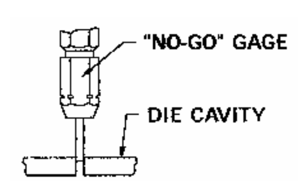


Figure 91. “NO–GO” Gage

d. Remove plunger spring and loosen oil fill screw. Do not remove screw at this time.

e. Grasp the stem of plunger and lift it so the plunger is no higher than the oil reservoir section of the body.

f. Remove filler screw, O–ring will also be removed with the filler screw.

g. Fill the reservoir with the proper hydraulic oil (see COLD WEATHER NOTE for choice of oils).

h. Apply slight pressure to the plunger to allow the oil to just reach the surface of the fill hole and replace the filler screw and O–ring.

i. Reassemble the tool by reversing the order of operations described above (steps 5 through 3).

CAUTION

Use hydraulic oil as shown below or one that meets the specifications listed below. Do not use brake fluid!

138 . **Hydraulic oil.** Tool supplied with Drydene Paradene 46AW hydraulic oil. Below 20˚ F (– 6.7˚ C), use Drydene 22AW hydraulic oil (or equivalent). Hydraulic oil manufacturer: Drydene Oil Company, 9300 Pulaski Highway, Baltimore, MD 21220 (USA).

139 . **WA22 PNEUMATIC CRIMP TOOL.**

140 . **GENERAL SPECIFICATIONS.** Pneumatic Tools are designed with up to 8 die closures, changeable by a selector knob. The tool also has a full cycle ratcheting control mechanism.

141 . Either the hand operated valve or the air foot valve may be used. The working pressure of the tool is 80 – 120 p.s.i. It is recommended that each tool be set up with a regulator and filter.

SIZE:

Length: 8” Width: 2.25” Weight: 2.2lbs.

CRIMPING RANGE:

Contacts:	Size 20 thru 28
Wire Size:	Size 20 AWG thru 32 AWG

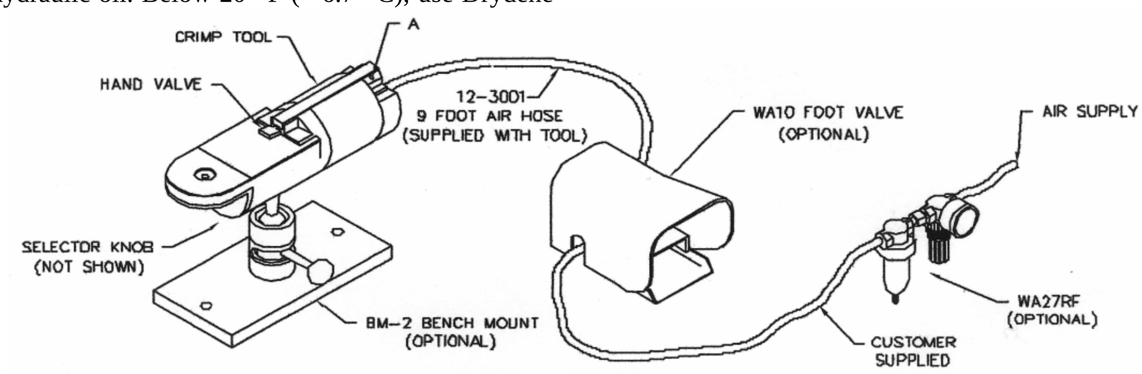
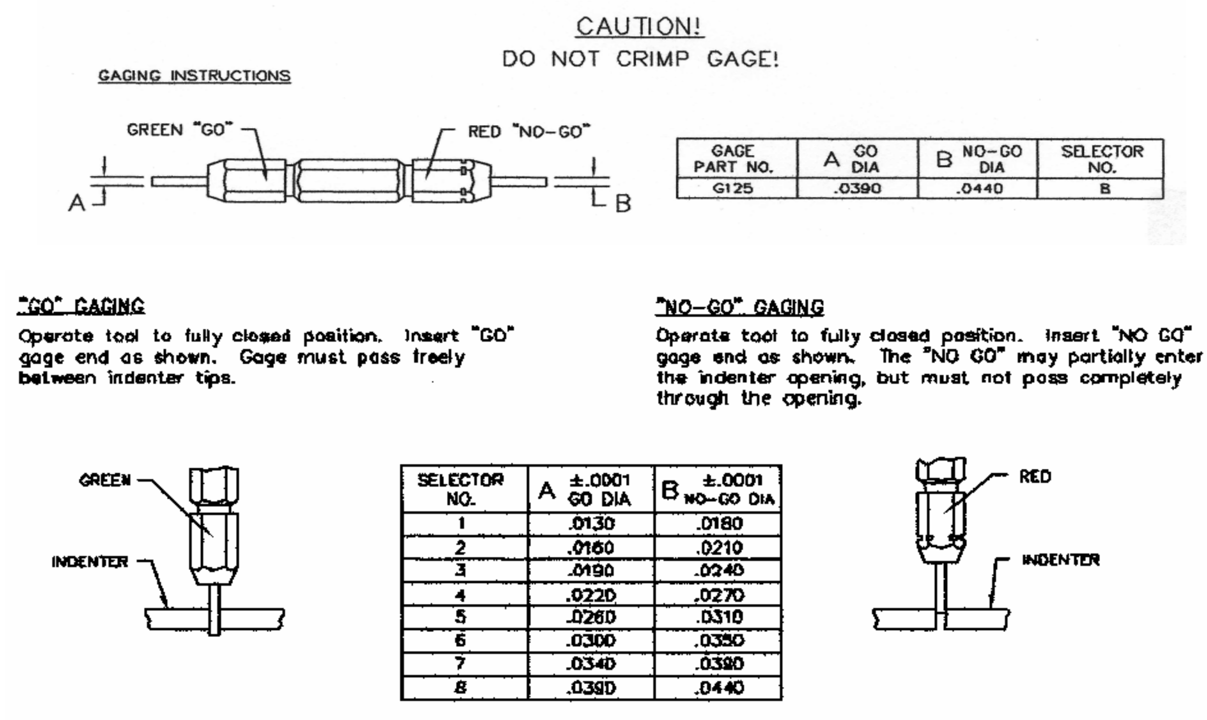


Figure 92. Pneumatic Crimping Tool



GAGE PART NO.	A GO DIA	B NO-GO DIA	SELECTOR NO.
G125	.0390	.0440	8

SELECTOR NO.	A ±.0001 GO DIA	B ±.0001 NO-GO DIA
1	.0130	.0180
2	.0160	.0210
3	.0190	.0240
4	.0220	.0270
5	.0260	.0310
6	.0300	.0350
7	.0340	.0390
8	.0390	.0440

Figure 93. GO/NO GO Gaging

142 .**ACCOMMODATIONS.** Tool will accommodate all MIL SPEC and "K" series Positioners relating to MIL SPEC hand tool part numbers M22520/2–01.

143 .**FOOT VALVE OPERATION.** Attach Foot Valve between air supply and tool air inlet. Depress hand valve and lock in down position with set screw (A) using 1/16 hex Allen wrench.

144 .**CHECKING THE FULL CYCLE RATCHETING MECHANISM.** The ratcheting mechanism can be checked for proper functioning by the following procedure.

a. Adjust the air line pressure to 15 p.s.i.

b. Using a size 20 contact with a size 20 AWG wire, operate the tool until the indenters stop. The indenters will not reach the fully closed position and the contact will be locked in if the ratcheting mechanism is functioning properly.

c. To release the partially crimped contact, increase the air line pressure to 80–120 p.s.i. and operate. The tool will then complete the crimp allowing the indenters to return to the fully open position.

145 .**RELEASING A PARTIALLY CRIMPED CONTACT.** To release a partially crimped contact, proceed as follows:

a. Increase the air pressure to 120 p.s.i. and operate the unit. (If increasing the air pressure does not release the contact, proceed as follows:)

b. Turn the selector knob clockwise to the highest lockable setting. (Selector knob must be in the locked position before proceeding.) Operate the unit.

146 .**CARE OF TOOL.** There is virtually no maintenance required. However, it is a good practice to keep indenter tips free of residual color band deposits and other debris. A small wire brush may be used for this purpose.

It is strongly recommended that you:

1. DO NOT immerse tools in cleaning solutions.
2. DO NOT spray oil into tool to lubricate.

3. DO NOT attempt to disassemble tool or make repairs.

147 . This is a precision crimping tool and should be handled as such.

148 . **WA27F PNEUMATIC CRIMP TOOL.**

149 . **GENERAL SPECIFICATIONS.** Pneumatic Tools are designed with up to 8 die closures, changeable by a selector knob. The tool also has a full cycle ratcheting control mechanism.

150 . Either the hand operated valve or the air foot valve may be used. The working pressure of the tool is 80 – 120 p.s.i. It is recommended that each tool be set up with a regulator and filter.

SIZE:

Length: 10”	Width: 2.75”	Weight: 3.1lbs.

CRIMPING RANGE:

Contacts:	Size 12 thru 20
Wire Size:	Size 12 AWG thru 26 AWG

151 . **ACCOMMODATIONS.** Tool will accommodate all MILSPEC and OEM Turret Heads and Single Position Heads relating to MILSPEC hand tool part number M22520/1–01.

152 . **FOOT VALVE OPERATION.** Attach Foot Valve between air supply and tool air inlet. Depress hand valve and lock in down position with set screw (A) using 1/16 hex Allen wrench.

153 . **CHECKING THE FULL CYCLE RATCHETING MECHANISM.** The ratcheting mechanism can be checked for proper functioning by the following procedure.

a. Adjust the air line pressure to 15 p.s.i.

b. Using a size 20 contact with a size 20 AWG wire, operate the tool until the indenters stop. The indenters will not reach the fully closed position and the contact will be locked in if the ratcheting mechanism is functioning properly.

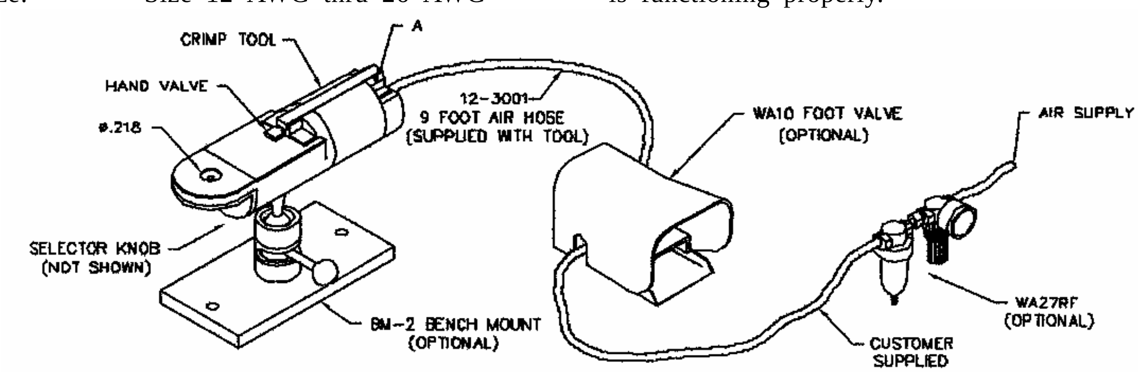
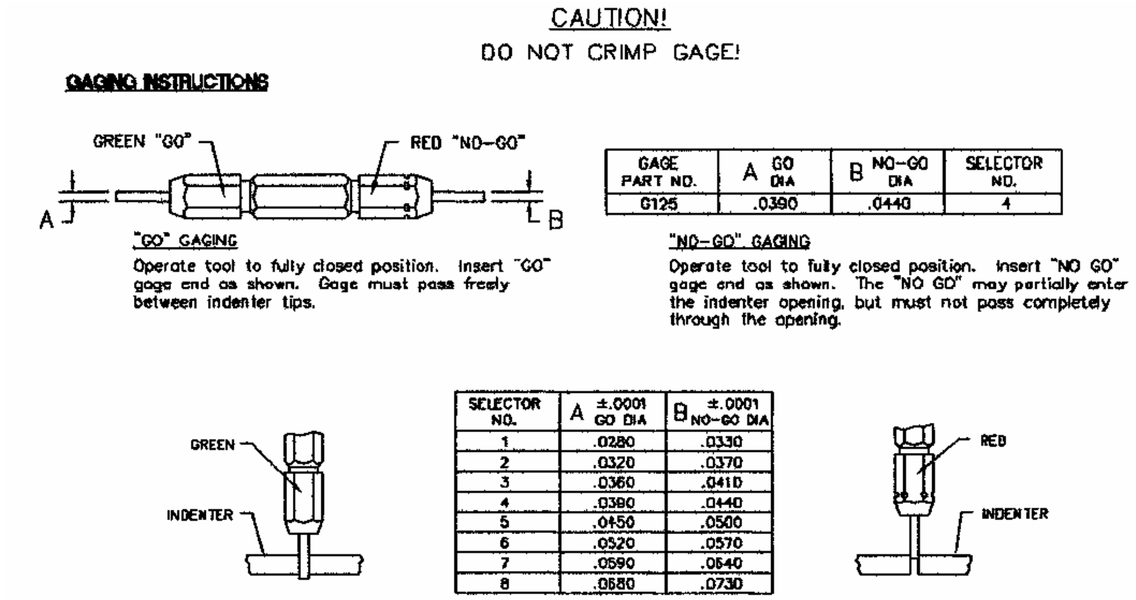


Figure 94. Pneumatic Crimp Tool



GAGE PART NO.	A GO DIA	B NO-GO DIA	SELECTOR NO.
G125	.0390	.0440	4

SELECTOR NO.	A ±.0001 GO DIA	B ±.0001 NO-GO DIA
1	.0280	.0330
2	.0320	.0370
3	.0360	.0410
4	.0390	.0440
5	.0450	.0500
6	.0520	.0570
7	.0590	.0640
8	.0680	.0730

Figure 95. GO/NO GO Gaging

c. To release the partially crimped contact, increase the air line pressure to 80–120 p.s.i. and operate. The tool will then complete the crimp allowing the indenters to return to the fully open position.

154 .**RELEASING A PARTIALLY CRIMPED CONTACT.** To release a partially crimped contact, proceed as follows:

a. Increase the air pressure to 120 p.s.i. and operate the unit. (If increasing the air pressure does not release the contact, proceed as follows:)

b. Turn the selector knob clockwise to the highest lockable setting. (Selector knob must be in the locked position before proceeding.) Operate the unit.

155 .**CARE OF TOOL.** There is virtually no maintenance required. However, it is a good practice to keep indenter tips free of residual color band deposits and other debris. A small wire brush may be used for this purpose.

It is strongly recommended that you:

1. DO NOT immerse tools in cleaning solutions.
2. DO NOT spray oil into tool to lubricate.
3. DO NOT attempt to disassemble tool or make repairs.

156 . This a precision crimping tool and should be handled a such.

157 .**CRIMP TOOL M22520/28-1 AND M22520/29-1 POWER.**

158 .**GENERAL DESCRIPTION.** These are pneumatic operated crimp tools that utilize the same accessories as the M22520/1-01 and 2-01. They may be operated either by hand or bench mounted with either hand control or foot control. The M22520/28-1 measures 8 inches X 2 1/4 inches and weighs 32 ounces, and the M22520/291 measures 11 inches X 2 3/4 inches and weighs 60 ounces (Figure 15).

159 .**M22520/28-1.** This tool uses the same accessories as the M22520/2-01. The gaging buildup and operation are the same (paragraph 70).

160 .**M22520/29-1.** This tool uses the same accessories as the M22520/1-01. The gaging buildup and operation are the same (paragraph 59).

161 .**Optional Accessories.** There are some accessories used only by M22520/28-1 and M22520/29-1 tools (Table 24).

Table 27 . Optional Accessories

Accessory Part Number	Used On M22520/ 28-01	Used On M22520/ 29-01
BENCH MOUNT M22520/30-01	YES	YES
FOOT VALVE M22520/30-02	YES	YES
AIR SUPPLY HOSE M22520/28-02	YES	YES

162 .**CRIMP TOOL M22520/37-01.**

163 .**GENERAL DESCRIPTION.** The M22520/37-01 is self-contained, with a full cycle control ratchet which will not release until the crimp is completed. The tool contains a permanently attached locator with three slots for crimping (Figure 79).

164 .**Use.** The crimp tool is used to crimp wire barrel type splices. The tool performs the same function as the M33630/5-102, /5-103, /10-103, and /10-104 dies.

165 .**Calibration Gage.** The tool shall be inspected and the crimp jaws shall be gaged with an M22520/39-01 Calibration Gage. The calibration gage is a 3 step gage as shown in Figure 80.

166 .**OPERATION.** This tool requires no buildup. Adjustment is limited to inspection. The operation is outlined (Figure 81).

A. CRIMP TOOL SETUP

1. SELECT LOCATOR AND CRIMPING HEAD SPECIFICIED IN CONNECTOR FIGURE WITH APPLICABLE WORK PACKAGE.

NOTE

NOTCH IN LOCATOR FLANGE MUST INDEX TO HALF–PIN IN TOOL HEAD.

2. INSTALL LOCATOR IN TOOL HEAD.

NOTE

LOCATING HOLE IN REAR OF CRIMP HEAD MUST INDEX TO LOCATING PIN IN TOOL HEAD.

3. INSTALL CRIMPING HEAD.

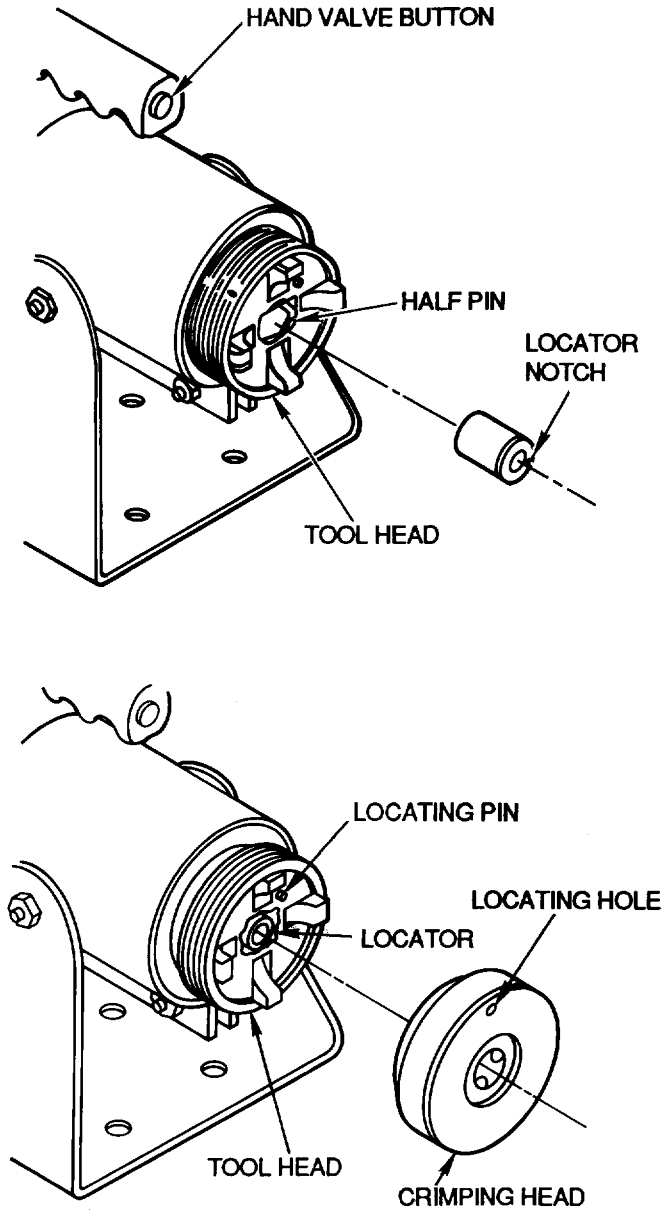


Figure 96. M22520/23-1 Setup and Operation (Sheet 1 of 3)

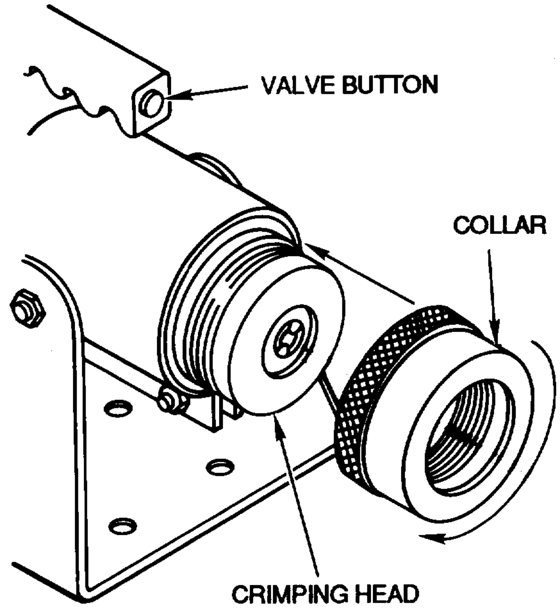
4. SCREW COLLAR ON HAND TIGHT. COLLAR IS COLORED RED FOR SAFETY PURPOSES.

5. CONNECT POWER CRIMPER TO AIR SUPPLY.

6. DEPRESS VALVE BUTTON TO CYCLE TOOL. REPEAT SEVERAL TIMES.

NOTE

THE CRIMPER WILL CYCLE AUTOMATICALLY.



B. CONTACT CRIMPING.

1. PREPARE WIRE AS INSTRUCTED IN WIRE STRIPPING SECTION OF APPLICABLE WORK PACKAGE.

2. INSERT WIRE INTO CONTACT CONDUCTOR BARREL. ENSURE INSULATION GAP IS WITHIN LIMITS SPECIFIED IN CONNECTOR FIGURE WITHIN APPLICABLE WORK PACKAGE.

3. ENSURE WIRE IS VISIBLE IN CONTACT INSPECTION HOLE.

4. RETIGHTEN CRIMP TOOL COLLAR BEFORE PROCEEDING.

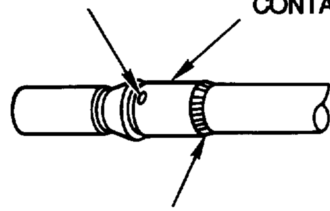
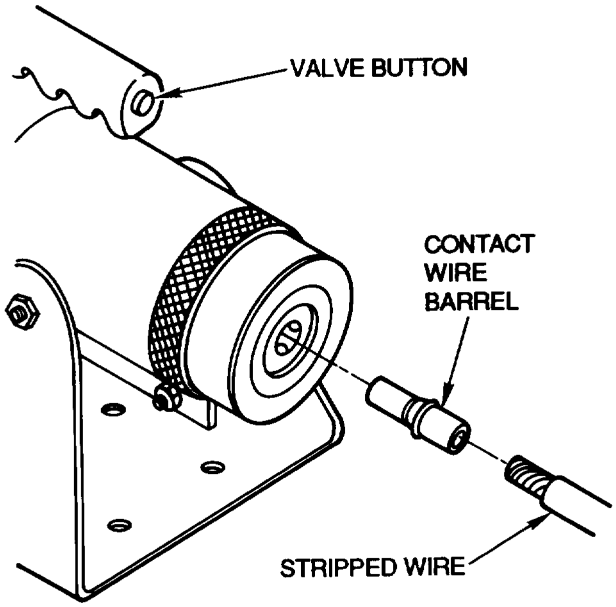


Figure 96. M22520/23-1 Setup and Operation (Sheet 2)



5. INSERT CONTACT INTO LOCATOR.

6. INSERT STRIPPED WIRE INTO CONTACT WIRE BARREL AND HOLD IN PLACE.

7. DEPRESS VALVE BUTTON TO CRIMP CONTACT.

8. REMOVE CRIMPED CONTACT ASSEMBLY FROM POWER CRIMPER AND INSPECT AS REQUIRED.

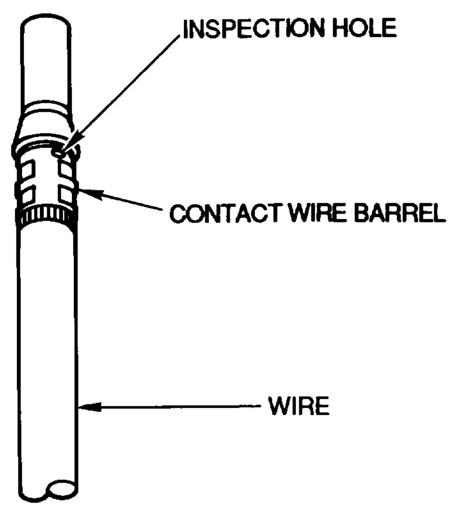


Figure 96. M22520/23-1 Setup and Operation (Sheet 3)

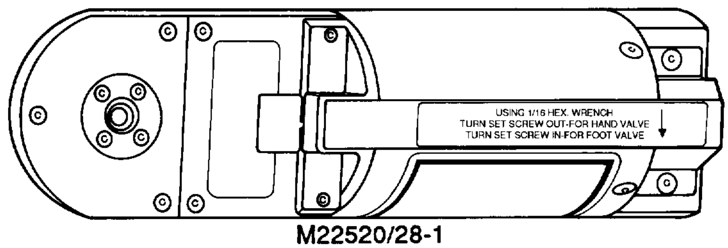


Figure 97. Crimp Tools M22520/28-1 And M22520/29-1

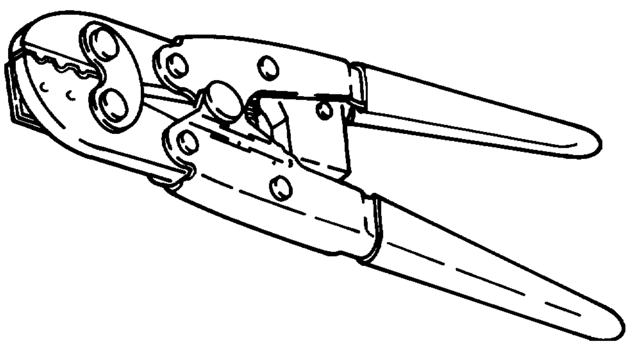


Figure 98. Crimp Tool M22520/37

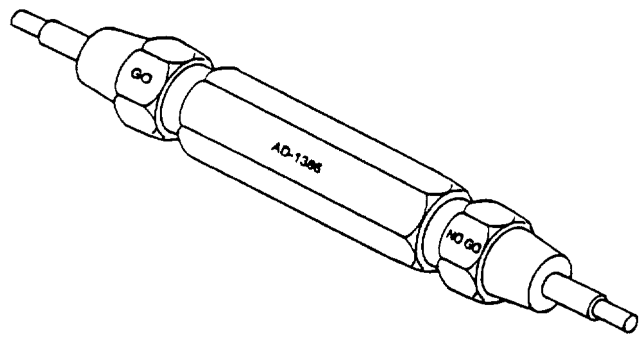


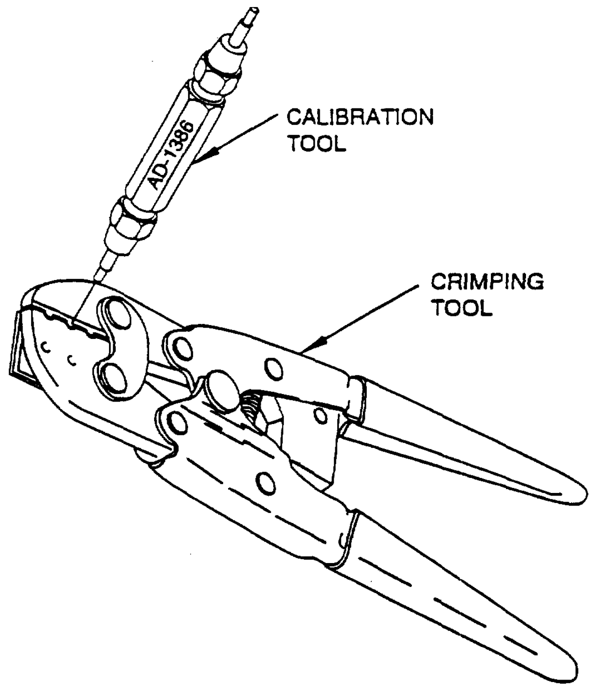
Figure 99. M22520/39-01 Calibration Gage

A. FULLY CLOSE TOOL JAWS.

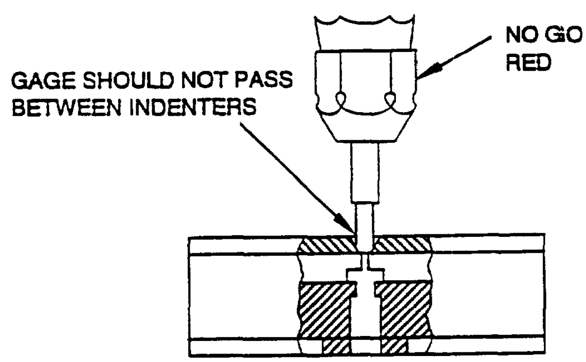
CAUTION

DO NOT CRIMP DOWN ON GAGE PIN AS THIS WILL PREVENT TOOL FROM CYCLING TO RATCHET RELEASE POSITION.

B. AXIALLY ALIGN GO GAGE (GREEN) WITH INDENTER OPENING. SLIDE GO GAGE INTO INDENTER OPENING AND THROUGH INDENTERS. GAGE SHOULD PASS FREELY THROUGH INDENTERS. IF NOT, RETURN TOOL FOR REPAIR.



C. INVERT INSPECTION GAGE WHILE CONTINUING TO HOLD HANDLES IN THE FULLY CLOSED POSTION. INSERT NO GO (RED) GAGE INTO INDENTER OPENING. GAGE SHOULD NOT PASS BETWEEN INDENTERS. IF NO GO (RED) GAGE PASSES THROUGH INDENTERS, RETURN TOOL FOR REPAIR.



NO GO GAGING

D. PREPARE ENDS OF WIRE(S) TO BE SPLICED TOGETHER IN ACCORDANCE WITH INSTRUCTIONS IN APPLICABLE WP.

E. OPEN CRIMPING TOOL JAWS. INSERT CRIMP BARREL IN SLOT CORRESPONDING TO SIZE OF CRIMP BARREL.

NOTE

SLOTS ON CRIMPING TOOL ARE LABELED WITH SIZE OF APPLICABLE CRIMP BARREL.

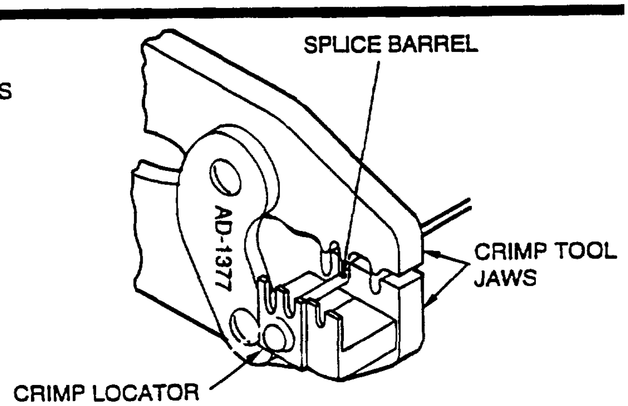
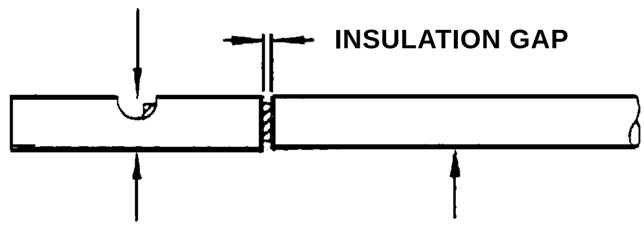


Figure 100. M22520/37-01 Crimping Tool Operation (Sheet 1 of 2)

F. INSERT STRIPPED WIRE IN CRIMP BARREL UNTIL LEAD REACHES MIDDLE OF BARREL AND IS VISIBLE IN CONTACT INSPECTION HOLE. ASSURE INSULATION GAP EXISTS AND IS LESS THAN 1/64 INCH.



G. SQUEEZE HANDLES TOGETHER SMOOTHLY UNTIL HANDLES RELEASE.

H. REMOVE CRIMPED SPLICE ASSEMBLY FROM CRIMPING TOOL.

REVERSE CRIMP BARREL IN TOOL AND REPEAT STEPS F AND G.

J. REFER TO APPLICABLE WP TO COMPLETE SPLICE.

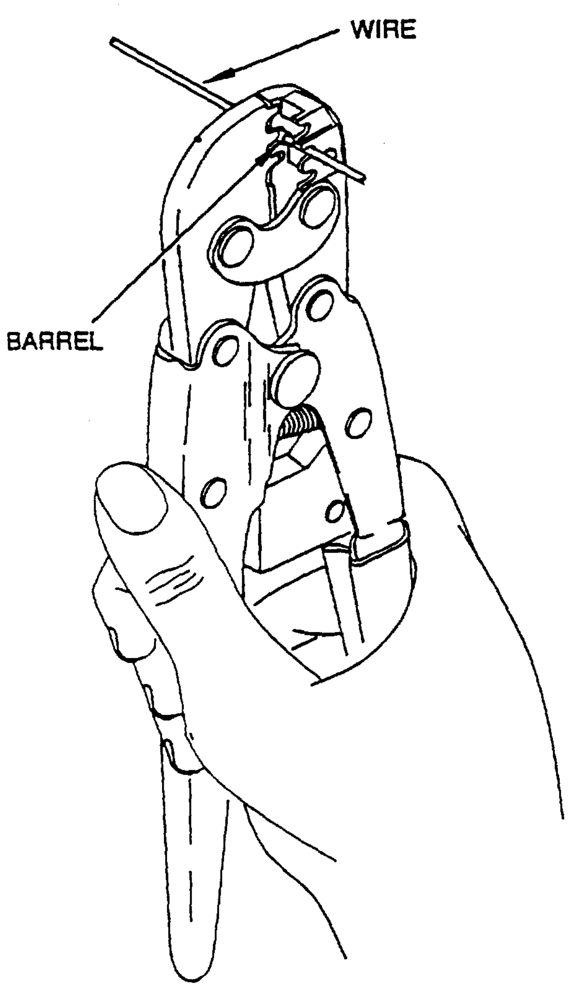


Figure 100. M22520/37-01 Crimping Tool Operation (Sheet 2)

167 .**CRIMP TOOL, MS25441.**

168 .**Use.** The tool is used to crimp pre-insulated. uninsulated, and aluminum terminal lugs and splices (Tables 6 through 15, 17, and 20).

169 .**Periodic Gauging.** Periodic gaging (Tables 6. through 15, 17. and 20) is required before each crimp to ensure proper crimp dimensions and tool calibration and is performed in the following manner.

a. Activate tool to fully mate die surfaces.

b. Go gage should freely pass through die (Figure 69 Step A3).

c. No Go -gage should not pass through die (Figure 69, Step A4).

d. When either caging fails reject tool to repair or calibration.

170 .**SETUP, ADJUSTMENT, AND OPERATION.** Correct tool buildup and adjustment are necessary to perform mechanically and electrically sound crimps. Perform build up and adjustment using the following steps:

a. Select proper tool (Figure 85).

b. Select proper die.

c. Select proper inspection gage (Table 6 through 15, 17, and 20).

d. Setup and adjust tool.

e. Operate.

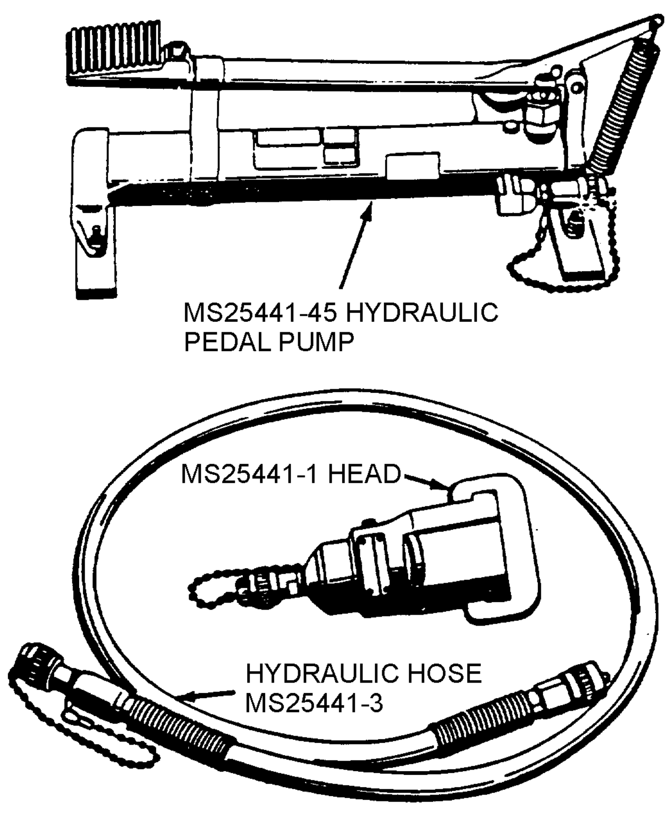


Figure 101. MS25441 Terminal Crimp Tool

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WIRE AND CABLE SPLICING AND REPAIR

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Support Equipment Required

Nomenclature	Part. No./Type Designation
Bristle Brush	–
Cable Stripper	45–162
Cable Stripper	45–163
Cable Stripper	45–164
Cable Stripper	45–165
Coaxial Cable Splice Kit	D–150–02
Coaxial Cable Splice Kit	D–150–12
Coaxial Cable Splice Kit	D–150–15
Coaxial Cable Splice Kit	D–150–16
Coaxial Cable Splice Kit	D–150–28
Coaxial Cable Splice Kit	D–150–29
Crimping Die	HD51–130–1
Crimping Die	HD51–131–2
Crimping Die	HD51–132–2
Crimping Tool	MIL–DTL–22520/37
Crimping Tool	HD–51
Diagonal Pliers	–
Heat Guns	Refer to WP 012 00
Inspection Gage	MIL–DTL–22520/39
Knife	–
Notched Copper Sheet Shield	–
Resistance Heating Pliers	–
Safety Glasses	–

Support Equipment Required (Cont.)

Nomenclature	Part Number/Type Designation
Scissors	–
Solder Pot	–
Soldering Iron, 140 Watt	–
Soldering Iron, 200–250 Watt	–
Thermocouple Connector	AN 5537

Materials Required

Nomenclature	Part Number/Type Designation
Alcohol, Denatured	O–M–232
Alcohol, Isopropyl 150	TT–I–735
Alcohol, Isopropyl, Grade A, Technical	TT–I–735 Grade A
Bonding Paste	—
Borax	—
Brushing Compound, Zinc Chromate	—
Dichloromethane	ASTM D4701 or other approved solvent
Flux, Hard Solder	O-F-499
Flux, Lactic Acid	—
Flux, or Equivalent	A–A–51145
Rosin	A–A–59142
Sleeving, Heat-Shrinkable	—
Solder Hard	—
Solder, Soft	—
Solvent, Stoddard’s	MIL–PRF–680 TYPE II
Tape, Teflon	—
Tubing, Wire Braid	2194
Wire, 30 AWG Bare	—

WARNING

Soldering may result in the emission of hazardous metallic fumes and vapors from fluxes used. Workers should position themselves so as to not directly inhale the fumes/vapors. Local conditions may require evaluation.

CAUTION

Use copper terminations only on copper wire. Use aluminum terminations only on aluminum wire.

1. . **INTRODUCTION.**

2. This work package (WP) includes the repair of wire and various types of cable such as the following:

a. Single Conductor Wire (WP 004 00).

b. Jacket/shielded Cable (WP 005 00).

c. Radio Frequency Cable (WP 006 00).

d. Thermocouple Cable (WP 005 00).

e. Ribbon cable (WP 005 00).

3. **SINGLE CONDUCTOR WIRE REPAIR.**

4. **ENVIRONMENTAL RESISTANT SPLICES.** The environmental resistant splice conforming to AS 81824 or MIL–S–81824 shall be used to splice single conductor wires, single conductor wires within a multiconductor cable, and single conductor wires in ribbon cable size 12 to 26 AWG. These splices may be used in all cases where the total temperature does not exceed 302˚F (150˚C).

NOTE

When splices are used for in–line connections of two or more wires, where disconnect is required, disconnect splices in accordance with AS81714/11 and AS81714/12 shall be used. Sealing plugs in accordance with MS27488 shall be installed in unused grommet holes. Use WP 028 00 for installation instructions.

5. **SPLICES FOR ALUMINUM – WIRES.** Aluminum wires shall be repaired using permanent crimp splices MS25439 only.

6. **SPLICES FOR LARGE WIRES NOT COVERED BY AS81824 OR MIL–S–81824.** Large wires size 6 to 10 AWG, should be spliced using environment resisting splices such as D–436 series commercial splices or other commercial environmental splices. Wire sizes 4 AWG and larger, are spliced using terminal lugs.

7. **SPLICE RESTRICTIONS.** All splices are subject to the following restrictions:

a. Splices in bundles shall be staggered and shall not increase the size of the bundle so as to adversely, affect maintenance.

b. Splices shall not be used to salvage scrap lengths of wire.

c. There shall be no more than one splice in any one wire segment except as follows:

(1) When attaching to a spare lead or pigtail.

(2) To splice multiple wires to single wires.

(3) To adjust wire size to be compatible with contact crimp barrel

(4) When a repair action requires a jumper wire.

8. **REPAIR PROCEDURES.**

9. **Wire Damaged at Single Point.** A wire damaged at a single point can normally be repaired with a single splice. To repair single point wire damage, proceed as follows:

a. Locate damaged portion of wire and ensure there is enough slack in wire to make a single splice.

b. Remove damaged portion of wire.

c. Clean last two inches of ends of wire to be spliced to remove any oil or grease.

d. Refer to Table 1 for splice selection, strip dimensions, and crimping tool selection.

e. Strip wire insulation in accordance with WP 009 00 to dimension specified in Table 1 for appropriate splice.

f. FOR AIR FORCE USE: Splices shall not be used within 12 inches of a termination device, except as follows:

(1) Splices may be used within 12 inches of a termination device when attaching to the pigtail spare lead, adding a wire or segment to a potted termination device, splicing multiple wires to a single wire and adjusting the wire sizes so that they are compatible with the contact crimp barrel sizes.

Table 1. Splice Tooling.

Wire Gage	Splice Part No.	Color Band	Strip Dimension (+1/16–0)	Crimp Tool	Die Set	Inspection Gage
20 thru 26	M81824/1–1	Red	1/4	MIL–DTL–22520/37		MIL–DTL–22520/39
16,18	M81824/1–2	Blue	5/16	MIL–DTL–22520/37		MIL–DTL–22520/39
12,14	M81824/1–3	Yellow	5/16	MIL–DTL–22520/37		MIL–DTL–22520/39
10	D–436–26	–	5/16	M22520/5–01	M22520/5–100	M22520/39 and 10
8	D–436–0081	–	7/16	HD–51	HD51–131–2 & HD51–130–1	G744
6	AMP324660	–	7/16	HD–51	HD51–132–2 & HD51–130–1	G745

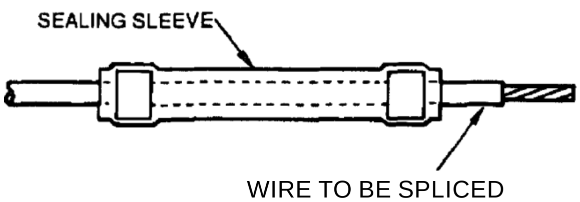

Figure 1. Sealing Sleeve Placed on Wire End.

g. Slide sealing sleeve over one end of stripped wire (Figure 1).

h. Select proper tool (Table 1). Buildup and adjust in accordance with WP 013 00.

i. Insert crimp barrel into correct cavity of crimp tool. For wire gages 12 thru 26, the cavity color code will match the color of the stripe on the crimp barrel. Ensure end of crimp barrel is against stop of tool and inspection hole is visible (Figure 2).

j. Lock crimp barrel in place by partially closing handles without denting crimp barrel.

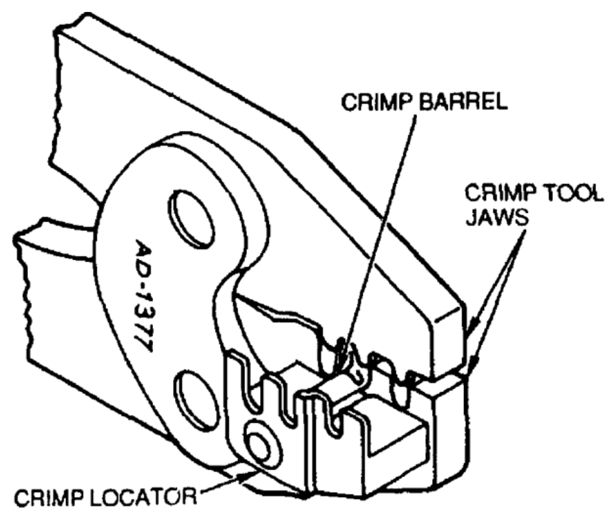

Figure 2. Inserting Crimp Barrel in Crimp Tool, MIL–DTL–22520/37.

k. Insert end of wire into end of crimp barrel opposite stop. Wire must be visible through inspection hole. A gap 1/32 to 1/16–inch for wire gages 10 thru 26, or 1/16 to 1/8–inch for wire gages 6 and 8, must exist between wire insulation and crimp barrel. Trim conductor or insulation as required.

l. Squeeze handles of crimp tool through complete crimp cycle. Crimp tool will not release until crimp cycle has been completed.

m. Reverse crimp barrel in cavity. Attached wire will fit in slot of stop. Ensure end of crimp barrel is against stop of tool and inspection hole is visible. Repeat steps h thru k.

n. Examine crimped connection for the following:

(1) Indent centered on splice barrel.

(2) Indent in line with barrel.

(3) Barrel not cracked.

(4) Wire cannot be pulled out of splice.

(5) Gap of 1/32 to 1/16–inch for wire gages 10 thru 26, or 1/16 to 1/8–inch for wire gages 6 and 8 exists between crimp barrel and wire insulation (Figure 3).

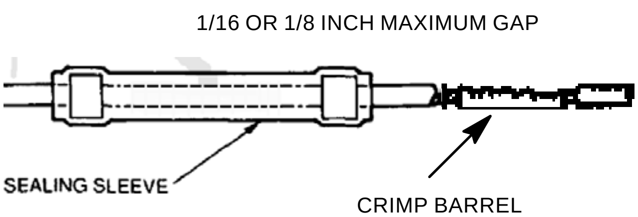

Figure 3. Correctly Installed Crimp Barrel.

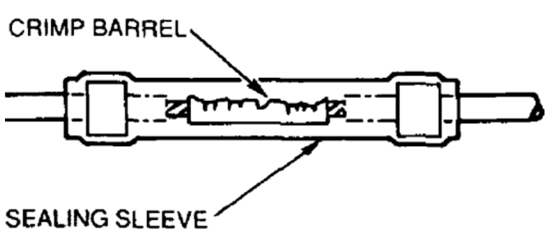

Figure 4. Sealing Sleeve Centered.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

o. Center sealing sleeve over crimp barrel (Figure 4).

p. Shrink sealing sleeve using heat gun with small termination sleeve reflector (WP 012 00). Shrink middle first and heat towards end, until sealant melts and begins to flow out end. Repeat far other end. Allow to cool (Figure 5).

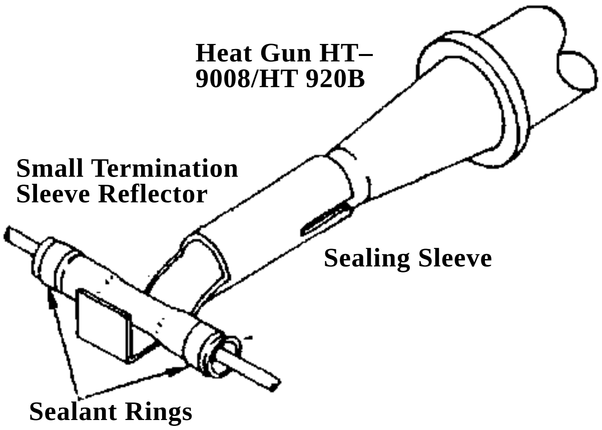

Figure 5. Splice Sealing.

10. **Wire Damaged Along Its Length.** When damage exists along the length of a wire, the damaged portion shall be removed and a jumper installed using two splices. To repair a single conductor wire along it length, proceed as follows:

a. Locate damaged portion of wire.

b. Cut a minimum of 6 inches from damaged wire (Figure 6).

c. The jumper wire shall be the same as the wire being repaired, except for MIL–DTL–81381 Kapton wire shall be replaced with wire in accordance with WP 004 00. Always ensure jumper wire is the same size (AWG).

d. Cut jumper wire 1/2 inch longer than removed damage portion.

e. Install jumper wire in accordance with Paragraph 9, steps c thru o for each end of jumper wire.

f. If wire identification is no longer within 3 inches of termination, mark wire in accordance with WP 008 00.

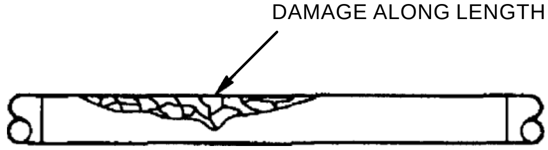

Figure 6. Wire Damage

11. **MULTI-CONDUCTOR WIRE REPAIR.** Multiconductor cable consists of two or more conductors contained within a common jacket. Splice requirements and restrictions are the same as single conductor wire repair. When more than one wire needs repaired in the same location in a harness the wires shall be repaired as follows:

a. When splices are used for in–line connections of two or more wires, where disconnect is required, disconnect splices in accordance with AS81714/11 and AS81714/12 shall be used. sealing plugs in accordance with MS27488 shall be installed in unused grommet holes. Use WP 028 00 for installation instructions

b. If the damaged wire area is close to a termination point and re–termination is possible using a new contact or terminal, a new wire section and contact or terminal should be installed to avoid using two splices.

c. Flex cable at score marks until jacket separates. If necessary, use a sharp knife to complete the cut along the cable.

d. Fold jacket back to gain access damaged area.

e. Remove damaged portion of wire.

f. Clean last two inches of wire ends to be spliced to remove any oil or grease).

g. Refer to Table 1 for splice selection, strip dimensions, and crimping tool selection.

h. Strip wire insulation in accordance with WP 009 00 to dimensions specified in Table 1 for appropriate splice.

i. Slide sealing sleeve over one end of stripped wire (Figure 2).

j. Select proper tool (Table 1). Buildup and adjust in accordance with WP 013 00.

k. Insert crimp barrel into correct cavity of crimp tool. For wire gages 12 thru 26, the cavity color code will match the color stripe on the crimp barrel. Ensure end of crimp barrel is against stop of tool and inspection hole is visible (Figure 3).

l. Insert end of wire into end of crimp barrel opposite stop. Wire must be visible through inspection hole. A gap 1/32 to 1/16–inch for wire gages 10 thru 26, or 1/16 to 1/8–inch for wire gages 6 and 8, must exist between wire insulation and crimp barrel. Trim conductor or insulation as required.

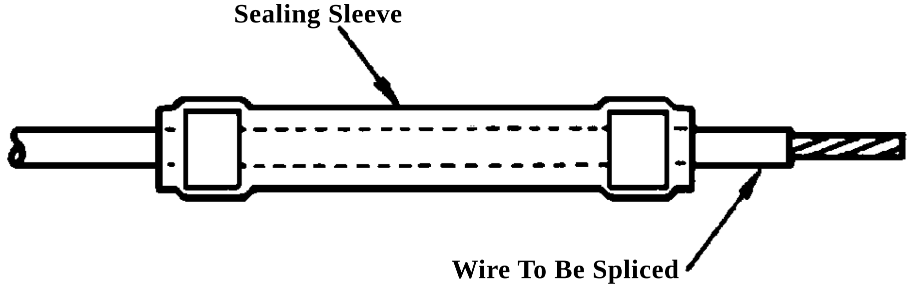

Figure 7. Sealing Sleeve Placed on Wire End.

m. Lock crimp barrel in place by partially closing handles without denting crimp barrel.

n. Squeeze handles of crimp tool through complete crimp cycle. Crimp tool will not release until crimp cycle has been completed.

o. Reverse crimp barrel in cavity. Attached wire will fit in slot of stop. Ensure end of crimp barrel is against stop of tool and inspection hole is visible. Repeat steps k thru n.

p. Examine crimped connection for the following:

(1) Indent centered on splice barrel.

(2) Indent in line with barrel.

(3) Barrel not cracked.

(4) Wire cannot be pulled out of splice.

(5) Gap of 1/32 to 1/16–inch for wire gages 10 thru 26, or 1/16 to 1/8–inch for wire gages 6 and 8 exists between crimp barrel and wire insulation (Figure 3).

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Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

q. Center sealing sleeve over crimp barrel (Figure 4).

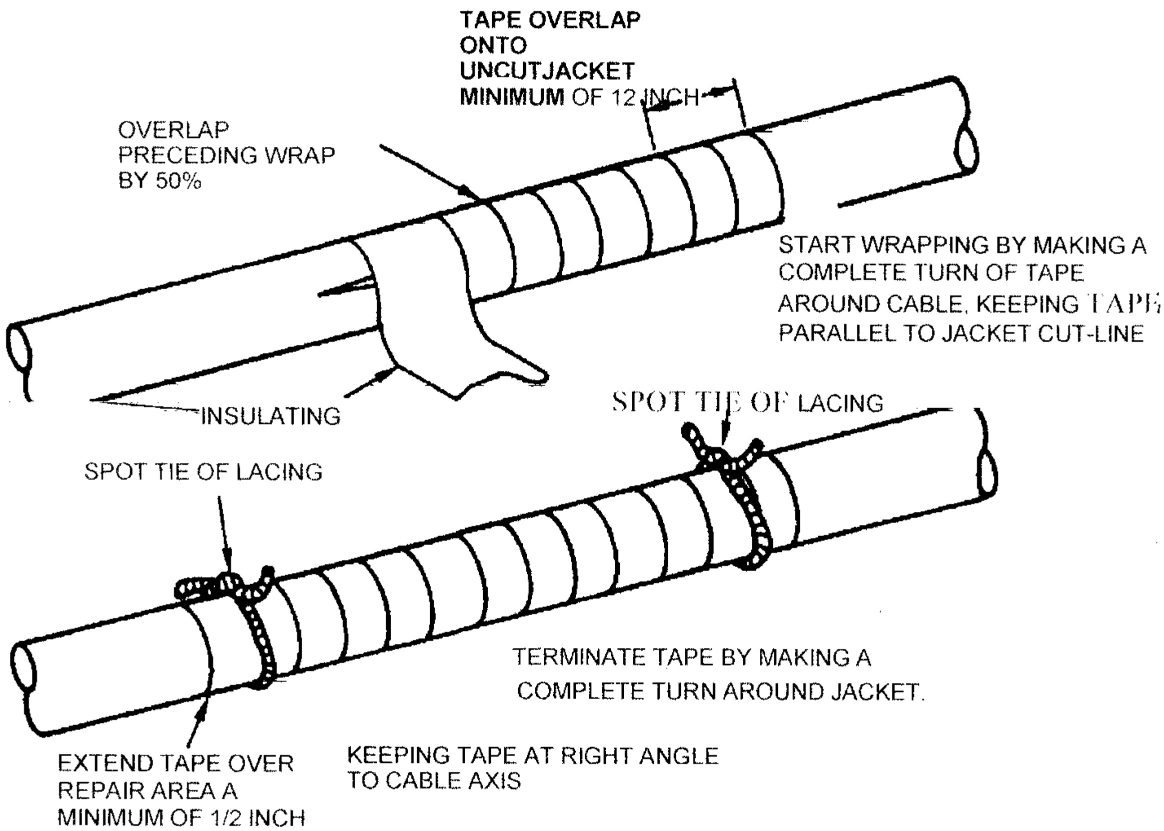

Figure 8. Taping Cable Jacket

r. Shrink sealing sleeve using heat gun with small termination sleeve reflector (WP 012 00). Shrink middle first and heat towards end, until sealant melts and begins to flow out end. Repeat for other end. Allow to cool (Figure 5).

NOTE

When applying insulating tape, hands should be free of dirt and oil.

(1) Spot tie both ends of insulating tape using lacing tape.

s. Replace cable clamps and ties.

12. **Multi–Conductor Shielded Cable.** Shielded cables containing one to five primary conductors can be repaired using a shield repair kit and the following procedures. The below procedure calls for cutting all the conductors in the cable to allow for the installation of the repair braid and insulation tubing.

a. Cut ties and remove clamps to gain access to, and isolate damaged area.

b. Select shield repair kit according to length of damaged area and diameter of shield braid in damaged cable (Table 2).

Table 2. Shield Repair Selection.

Wire Gage (AWG)	Maximum Jacket O.D.	Shield Repair Kit Part Number
Two Conductor Cables		
20–26	5/32	D–150–0231
16–18	3/16	D–150–0232
14	15/64	D–150–0233
12	23/64	D–150–0234
Three or Four Conductor Cables		
24–26	5/32	D–150–0235
20–22	3/16	D–150–0236
16–18	15/64	D–150–0237
12–14	23/64	D–150–0238

c. Score jacket carefully around cable and along area to be removed using a sharp blade. Do not cut shield (Figure 10).

d. Flex cable at score marks until jacket separates. Use knife blade, if necessary, to complete jacket removal. Do not cut through shield.

e. Remove separated jacket.

f. Use small scissors or diagonal cutter to remove shield. Do not damage wires (Figure 9).

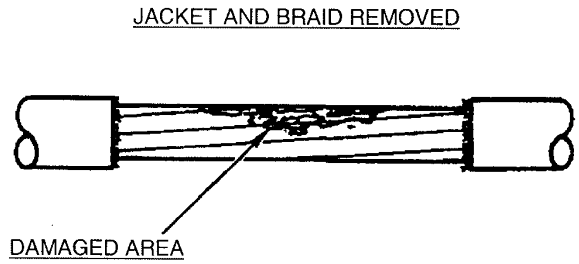

Figure 9. Damaged Multiconductor Wire.

g. If wires are not color coded, or otherwise identified, tag all wires for identification before proceeding.

h. Cut damaged wire or wires to remove any damaged portions. If damaged wire must be cut out, remove at least 2 inches total length. If damage is at a single point, damaged wire can be cut at the point of damage (Figure 10).

i. Cut undamaged wires at staggered locations (Figure 10).

j. Slide tubing and braid from shield repair kit, over either cable end. Tape tubing and braid to bundle to hold in place (Figure 11).

k. Repair damaged wires and cut wires in accordance with paragraph 8, steps e. thru r. to regain cable integrity.

l. Carefully score around jacket and along length to be stripped. Do not cut through jacket (Figure 13).

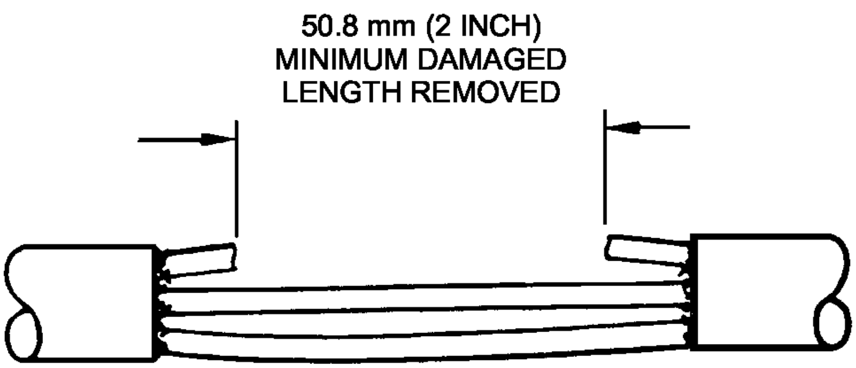

Figure 10. Wire with Damaged Portion Removed.

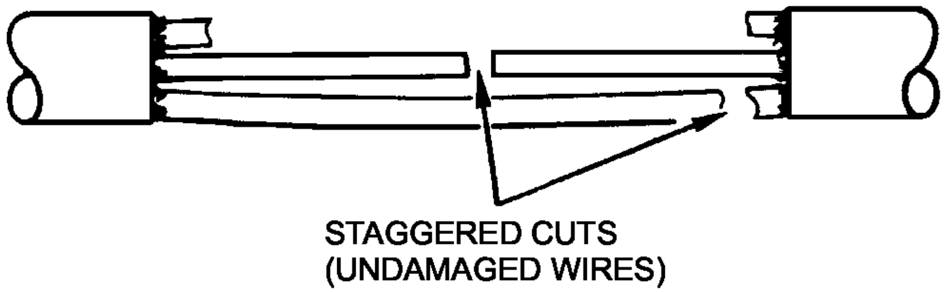

Figure 11. Undamaged Wires Cut at Staggered Locations.

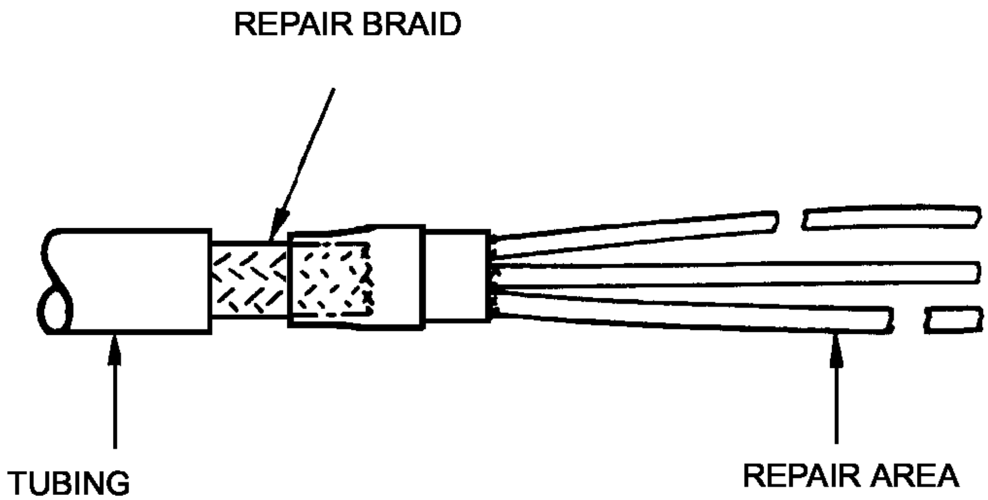

Figure 12. Tubing and Braid Placed on Cable End.

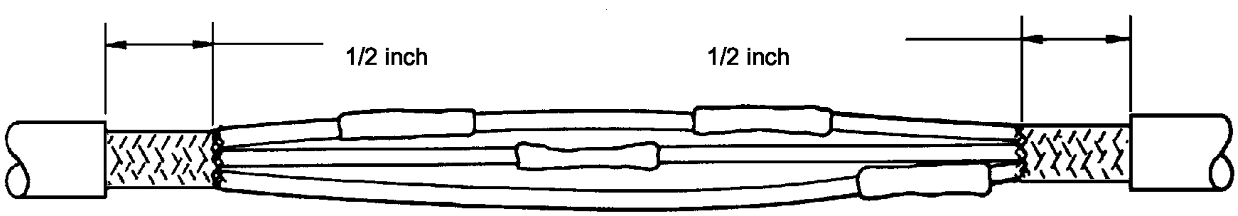

Figure 13. Jacket Scored 1/2 Inch.

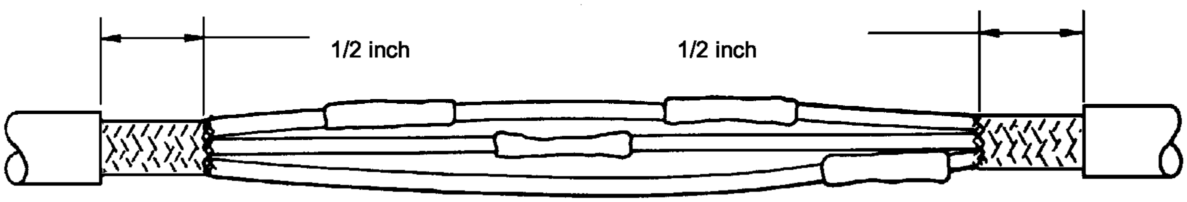

Figure 14. Jacket Peeled Away 1/2 Inch.

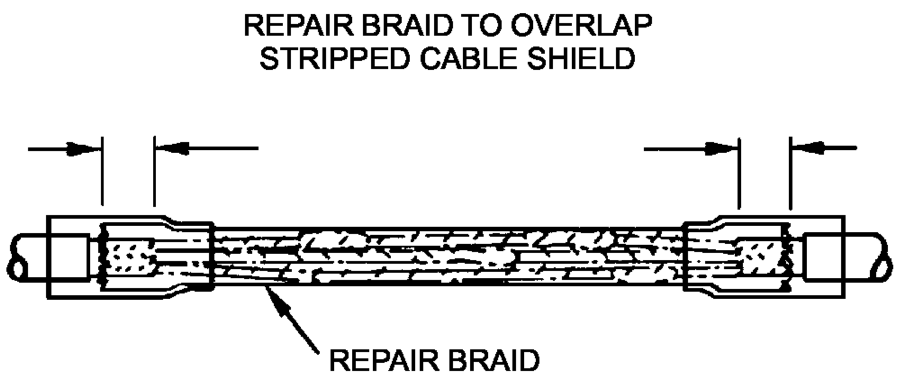

Figure 15. Repair Braid Centered Over Repair Area.

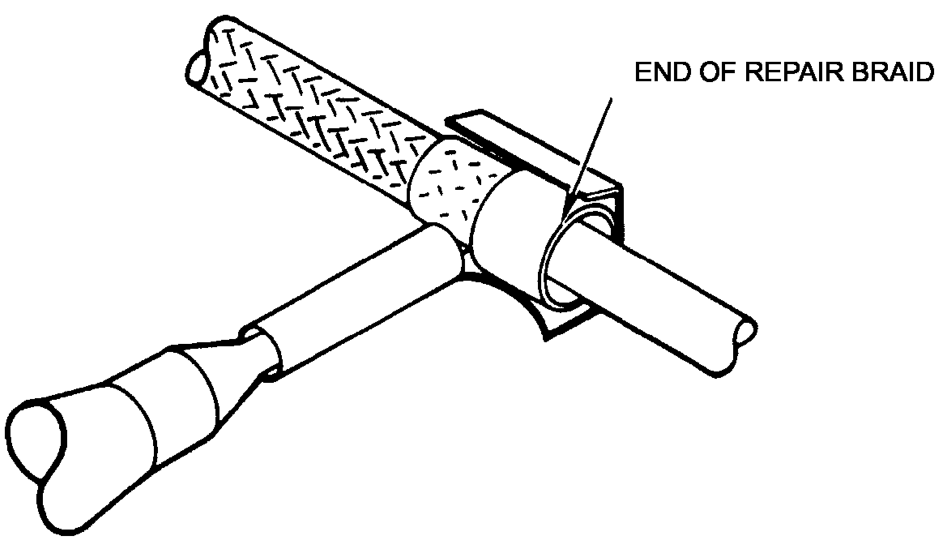

Figure 16. Heating Repair Braid.

m. Flex cable at score marks until jacket separates.

n. Peel insulation away from cable (Figure 14).

o. Slide repair braid along cable and center over repaired area (Figure 15).

WARNING

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Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

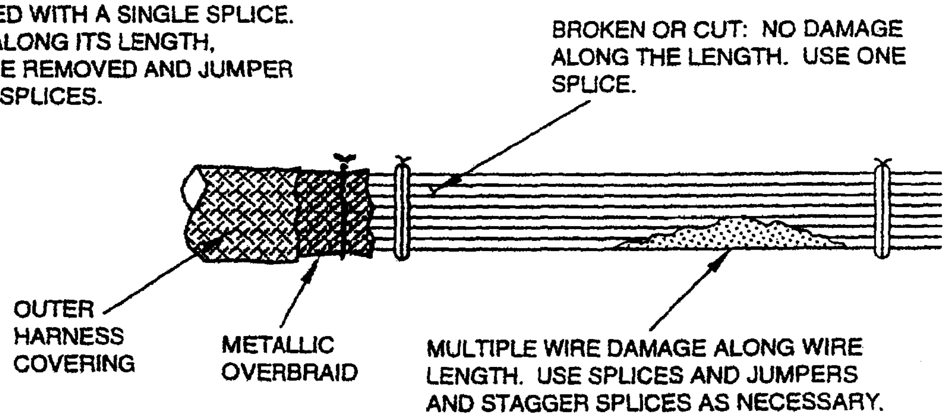
When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

p. Heat one end of repair braid using HT900B/HT–920B/HT71002/MCH–100–A heat gun with terminal sleeve reflector. Apply heat to overlapping shield area until solder melts and sleeve shrinks down onto cable. Continue heating until solder flows into braid strands. Allow to cool undisturbed until solder solidifies (Figure 16).

WIRE PREPARATION.

A. GAIN ACCESS TO DAMAGED WIRE BY PULLING BACK OUTER HARNESS COVERING AND METALLIC OVERBRAID.

B. IF A WIRE IS DAMAGED AT A SINGLE POINT AND THERE IS SUFFICIENT SLACK IN WIRE, DAMAGED WIRE SHALL BE REPAIRED WITH A SINGLE SPLICE. IF A WIRE IS DAMAGED ALONG ITS LENGTH, DAMAGED AREA MUST BE REMOVED AND JUMPER INSTALLED, USING TWO SPLICES.



C. CUT TIES AND REMOVE CABLE CLAMPS AS REQUIRED TO ACCESS WIRE DAMAGE.

D. WORK DAMAGED WIRES TO OUTSIDE OF WIRE BUNDLE. PULL SLACK IN WIRE TOWARD DAMAGED AREA TO PREVENT STRAIN ON SPLICE.

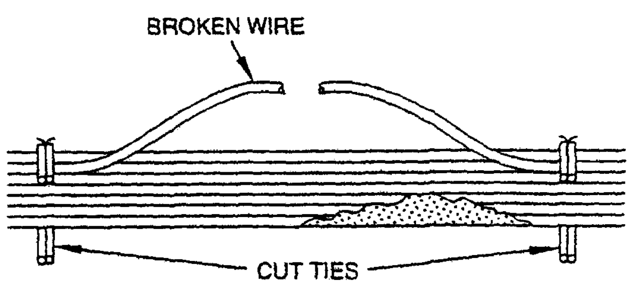


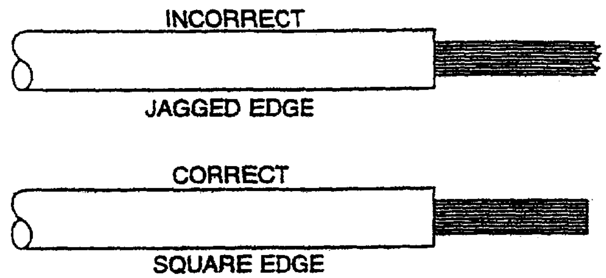
Figure 17. Wire Preparation (Sheet 1 of 2)

WARNING

SAFETY GLASSES WILL BE WORN DURING ALL STRIPPING AND CUTTING OPERATIONS.

CAUTION

ASSURE BLADES OF CUTTING TOOLS ARE SHARP AND FREE FROM NICKS. A DULL BLADE WILL DEFORM AND EXTRUDE WIRE ENDS.



E. CUT WIRE SO CUT IS CLEAN AND SQUARE, AND WIRE IS NOT DEFORMED. IF DEFORMED, RESHAPE LARGE DIAMETER WIRES WITH PLIERS AFTER CUTTING.

F. USE DIAGONAL PLIERS TO CUT A SMALL NUMBER OF LIGHT GAGE WIRES. DO NOT ATTEMPT TO CUT WIRES LARGER THAN 8-AWG WITH DIAGONAL PLIERS.

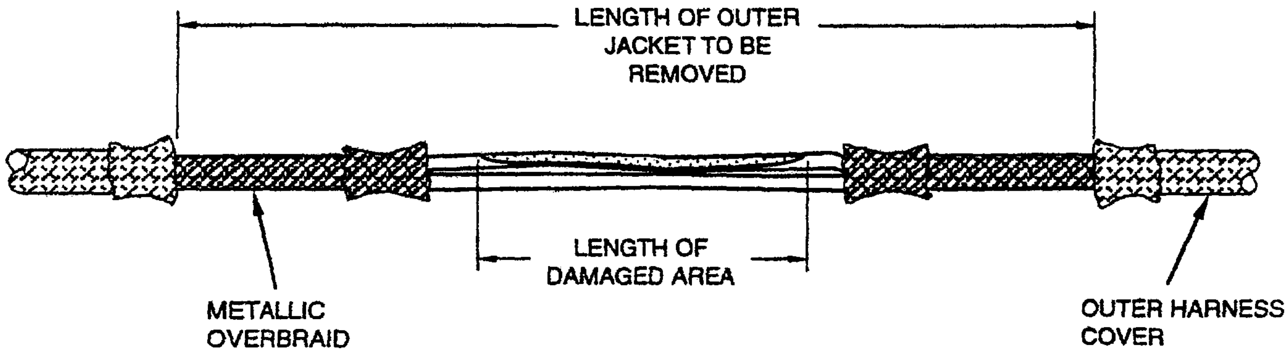
Figure 17. Wire Preparation (Sheet 2)

CABLE PREPARATION.

A. GAIN ACCESS TO DAMAGED CABLE BY PULLING BACK OUTER HARNESS COVERING AND METALLIC OVERBRAID.

B. CUT TIES AND REMOVE CLAMPS AS REQUIRED TO GAIN ACCESS TO DAMAGED CABLE.

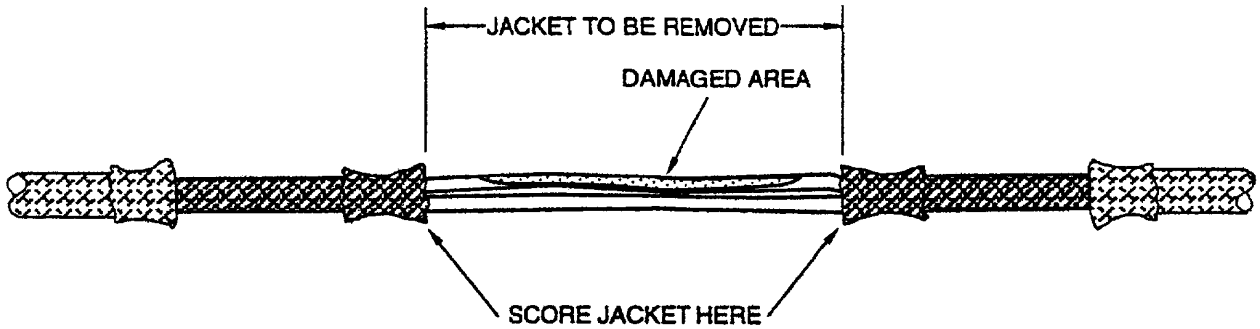
C. DETERMINE EXTENT OF DAMAGE TO CABLE.



LENGTH OF DAMAGED AREA (INCHES)	LENGTH OF OUTER JACKET TO BE REMOVED (INCHES)
LESS THAN 2	5
2 TO 5	8
5 TO 8	11

Figure 18. Multi-Conductor Preparation (Sheet 1 of 3)

D. USING SHARP KNIFE, CAREFULLY SCORE CABLE JACKET AROUND CABLE DIAMETER AND ALONG AREA TO BE REMOVED.



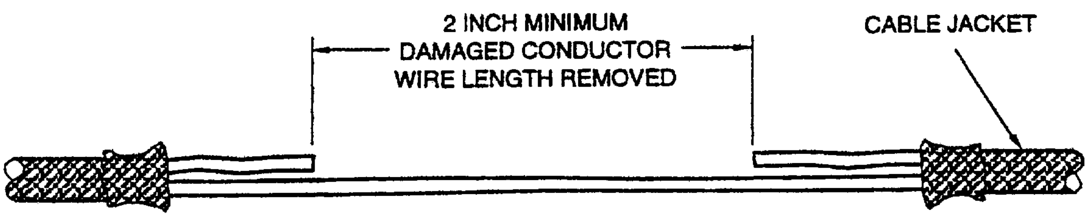
E. FLEX WIRE UNTIL JACKET SEPARATES, AND REMOVE JACKET.

NOTE

IF WIRE IS DAMAGED AT A SINGLE POINT, AND THERE IS SOME SLACK IN THE WIRE,THE EXISTING WIRE CAN USUALLY BE REPAIRED WITH A SEALED SPLICE. IF A WIRE HAS DAMAGE ALONG ITS LENGTH, THE DAMAGED SEGMENT MUST BE CUT OUT AND REPLACED BY A JUMPER WIRE INSTALLED USING TWO SPLICES.

Figure 18. Multi-Conductor Preparation (Sheet 2)

F. CUT DAMAGED WIRE AND REMOVE DAMAGED AREA. REMOVE AT LEAST TWO INCHES. IF DAMAGED AT A SINGLE POINT, DAMAGED WIRE CAN BE CUT AS IN NEXT STEP.



G. DETERMINE WIRE TYPE AND JUMPER WIRE SIZE IF REQUIRED. CUT JUMPER WIRE SO THAT IT IS SAME LENGTH AS WIRE THAT WAS REMOVED.

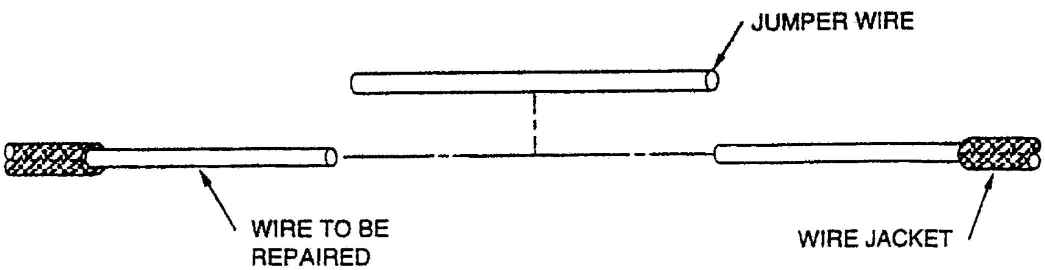


Figure 18. Multi-Conductor Preparation (Sheet 3)

13. . **RADIO FREQUENCY REPAIR.**

14. **RADIO FREQUENCY CABLE REPAIR.** A radio frequency cable can be a simple single conductor shielded cable or a complex multi-conductor, multi-shield cable (WP 006 00). The repair procedure provided covers the popular cable types found in Navy Aircraft. The aircraft manual should be used or the CFA contacted for the repair of unique radio frequency types.

NOTE

Damaged RF cables may be repaired or replaced at Organizational and Intermediate level maintenance. Damaged RF cables are to be replaced at Depot level maintenance.

15. **SINGLE CONDUCTOR/SHIELDED JACKET RADIO FREQUENCY (RF) CABLE REPAIR.** The repair of a RF cable should be viewed as a temporary emergency repair. System degradation is possible whenever RF cable repairs are attempted. Whenever possible the cable should be totally replaced.

16. **RADIO FREQUENCY CABLE STRIPPING.** The RF cable stripping procedure is shown in Figure 19 (WP 009 00).

17. **RADIO FREQUENCY CABLE SOLDER METHOD REPAIR.** The RF cable may be repaired by soldering the conductor and shield followed by heat shrink sleeving as shown in Figure 20.

18. **RADIO FREQUENCY CABLE SLEEVE METHOD REPAIR.** The RF cable may be repaired using solder sleeve kits as shown in Figure 21.

19. **TRIAXIAL RADIO FREQUENCY CABLE REPAIR.**

20. **TRIAXIAL CABLE SOLDER METHOD REPAIR.** A triaxial RF cable must be repaired with the solder method only. Strip the cable as shown in Figure 19 and, steps a and b. Repair the cable as shown in Figure 22.

21. **DATA BUS TWIN AXIAL CABLE REPAIR.** Strip the cable as shown in Figure 19 and WP 009 00.)

22. . **CABLE SPLICING.**

23. **SINGLE SHIELD CABLE WITH SOLDER SLEEVE PRIMARY SPLICE.** For single shield cable with solder sleeve primary splice repair procedures see Figure 23.

24. **DOUBLE SHIELD CABLE WITH SOLDER SLEEVE PRIMARY SPLICE.** For double shield cable with solder sleeve primary splice repair procedures see Figure 24.

25. **SINGLE SHIELD CABLE WITH MINI-SEAL CRIMP PRIMARY SPLICE.** For single shield cable with mini-seal crimp primary splice repair procedures, see Figure 25.

26. **DOUBLE SHIELD CABLE WITH MINI-SEAL CRIMP PRIMARY SPLICE.** For double shielded cable with mini-seal crimp splice repair procedures, see Figure 26.

27. **SOLDER SLEEVE SPLICES INSPECTION.** Solder sleeve splices must be inspected for the following:

a. Conductors must be overlapped a minimum 3/8 inch.

b. Fillet length must be a minimum 1/4 inch.

c. Sealing rings must have flowed along the wire.

d. Sleeve must not have discolored to the degree that joint cannot be inspected.

e. Sleeve must not be cut or split.

f. Strands of conductor must not be sticking through the sleeve.

28. **MINI-SEAL SPLICES INSPECTION.** Mini-Seal splices must be inspected for the following:

a. Conductors must be visible at point where they enter crimp barrel.

b. Both indentations of crimp must be on crimp barrel.

c. Sealing sleeve inserts must have flowed along wire insulation.

d. Sleeve must not have discolored to the degree that crimp barrel cannot be inspected.

e. Sleeve must not be cut or split.

A. DETERMINE THE DAMAGE LOCATION BY VISUAL INSPECTION.

B. CUT CABLE, AS REQUIRED, TO ELIMINATE DAMAGED SECTION. USE CAUTION TO BE SURE THAT LENGTH TOLERANCES ARE MAINTAINED.

C. SELECT CORRECT CABLE STRIPPERS.

Stripper Part No.	Cable Size Outside Diameter (INCH)
45-162	UP TO 1/8
45-163	1/8 TO 7/32
45-164	1/4 TO 9/16
45-165	3/16 TO 5/16

D. STRIP CABLE TO BE REPAIRED. CHECK FOR BROKEN CONDUCTOR AND STRIP LENGTHS. ANY DAMAGED PORTION SHALL BE CUT OUT AND CABLE RESTRIPPED.

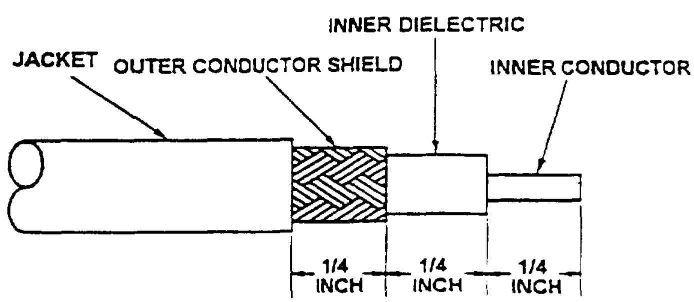


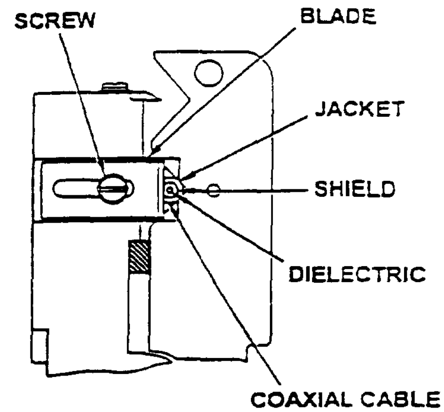
Figure 19. RF Cable Stripping (Sheet 1 of 3)

E. MEASURE DISTANCE BETWEEN BLADES. ADDING OR SUBTRACTING TWO SPARE BLADES WILL CHANGE DISTANCE BETWEEN BLADES BY 3/64 INCH.

F. REMOVE SCREWS AND ADD OR SUBTRACT SPARE BLADES AS REQUIRED TO OBTAIN CORRECT SPACING.

G. INSTALL SCREWS AND LOOSELY TIGHTEN.

H. ADJUST CUTTING DEPTH OF BLADES SO THAT JACKET WILL BE SCORED WITHOUT DAMAGE TO SHIELD. TIGHTEN SCREWS.



I. POSITION TOOL ON CABLE SO THAT EXCESS LENGTH OF CABLE WILL BE LEFT WHEN STRIPPING OPERATIONS ARE COMPLETE.

J. SPIN TOOL AROUND CABLE UNTIL MAXIMUM DEPTH IS OBTAINED.

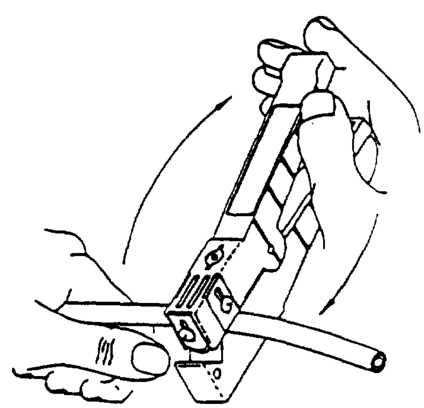
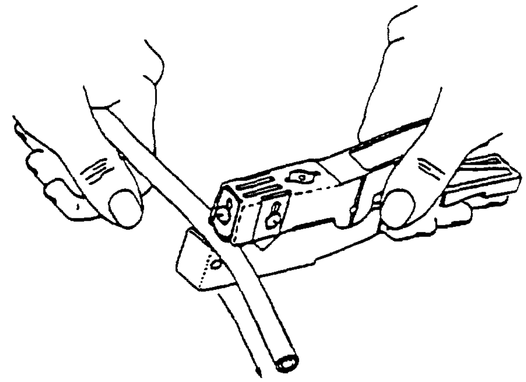


Figure 19. RF Cable Stripping (Sheet 2)

K. WITH ROUNDED BLADE INSTALLED IN FRONT OF TOOL. PLACE CABLE IN NOTCH AND PULL THROUGH.

L. PEEL OFF JACKET.



M. ADJUST BLADES TO DIMENSIONS OF DIELECTRIC REQUIRED. DO NOT TIGHTEN BLADES.

N. ADJUST CUTTING DEPTH SO THAT SHIELD WILL BE SCORED WITHOUT DAMAGE TO DIELECTRIC. TIGHTEN SCREWS.

O. POSITION TOOL ON CABLE AT PROPER STRIP DIMENSION.

P. SPIN TOOL AROUND CABLE UNTIL MAXIMUM CUTTING DEPTH IS OBTAINED.

Q. PULL OFF SHIELD.

R. STRIP DIELECTRIC BY REVERSING TOOL AND REPEATING STEP J.

S. PULL DIELECTRIC FROM CENTER CONDUCTOR.

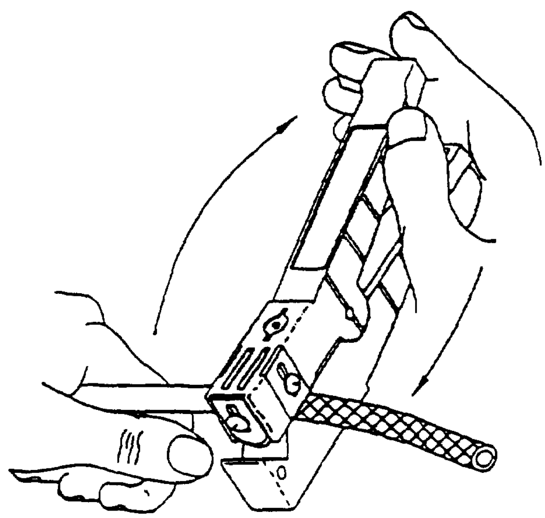
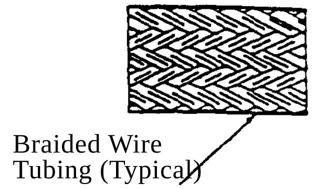


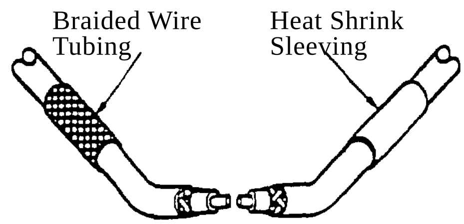
Figure 19. RF Cable Stripping (Sheet 3)

CABLE REPAIR

A. Slip A 4 1/2–Inch Long Piece of Heat–Shrinkable Sleeving On One Cable Half and Temporarily Tape It, To Preven Loss.

B. Slip A Piece Of Braided Wire Tubing Over Other Cable Half and Temporarily Secure As Above.





C. Tin Two Center Conductors. Overlap, And Wrap With A Single Continuous Turn of Bare (Stripped) 30 AWG Wire.

WARNING

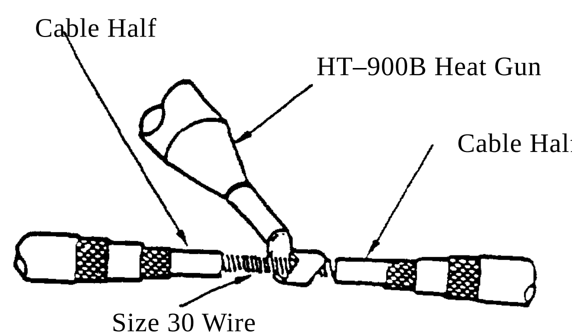
Do not perform hot work without specific authoriz–ation of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnet inter–ference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35) and there are no EMI restrictions.



Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

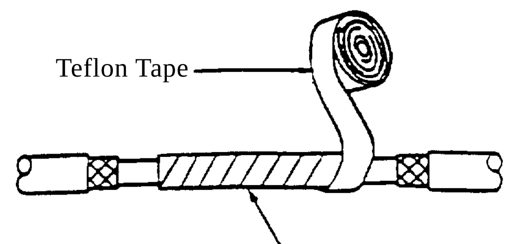
Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tools to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

Figure 20. RF Cable Solder Method Repair (Sheet 1 of 3)

E. Wrap Spliced Center Cnductors With Teflon Tape Built Up to Dielectric Diameter. Overlap Dielectric With One Tape Layer on Each End To Prevent Any Gap.



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Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

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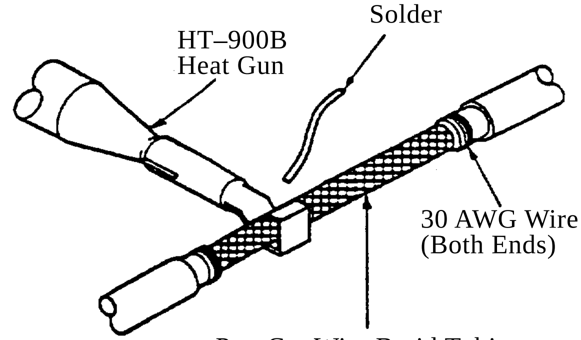


Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tools to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

F. Slide Precut Wire Braid Tubing Over Taped Center Conductor Splice and Conductor Shield. Use 30 AWG Wire to Secure Splice at Each End. Apply Solder Lightly to Assure Contact.

G. Wrap Spliced Conductor Shield with Teflon Tape. Built Up to Jacket Diameter. Overlap Jacket on Each End But Not More Than One or Two Layers Above Jacket OD.

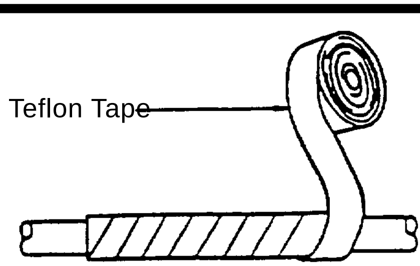


Figure 20. RF Cable Solder Method Repair (Sheet 2)

H. SLIDE HEAT-SHRINKABLE SLEEVING OVER REPAIR AND CENTER. HEAT UNTIL SLEEVE SHRINKS TIGHTLY.

I. RETIE WIRE BUNDLE.

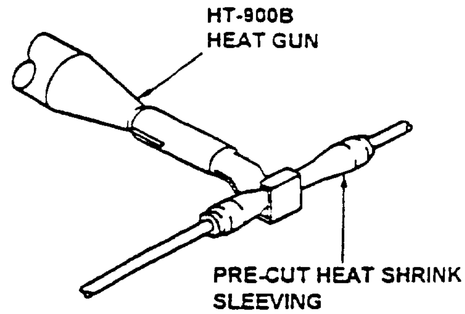


Figure 20. RF Cable Solder Method Repair (Sheet 3)

A. Determine the Damage Location by Visiual Inspection.

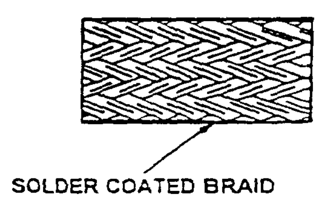
B. Strip Cable in Accordance with Figure 19.

C. Select Coaxial Cable Splice Kit from Table.

Jacket O.D.	Center Conductor		Splice Kit Part No. for Braid Type		
	Dielectric O.D. Max	Gage	Tin	Silver	Nickel
.070 - .110	.85	20-26	D-150-02		D-150-28
.070 - .110	.100	20-26		D-150-16	
.110 - .155	.110	20-26	D-150-02		D-150-29
.110 - .155	.150	20-26		D-150-12	
.150 - .210	200	20-26		D-150-15	

D. SLIP A 4 1/2-INCH-LONG PIECE OF HEAT-SHRINKABLE SLEEVING ON ONE CABLE HALF AND TEMPORARILY TAPE IT, TO PREVENT LOSS.

E. SLIP A 1 1/4-INCH PIECE OF SOLDER COATED BRAID OVER OTHER CABLE HALF, AND TEMPORARILY SECURE AS ABOVE.



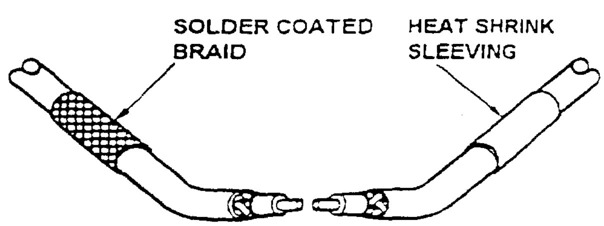
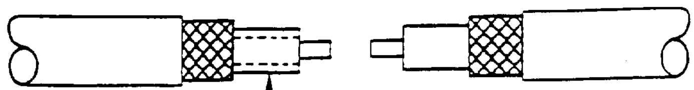
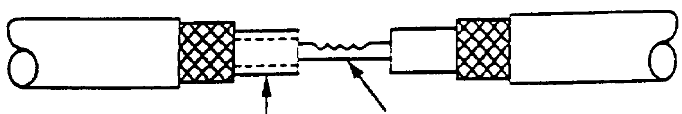


Figure 21. RF Cable Sleeve Method Repair (Sheet 1 of 3)

F. SLIDE INSULATING SLEEVE OVER ONE END OF CABLE.



G. USING SPLICE SELECTED FROM SOLDER SHIELD KIT, SLIDE ONE END OF CENTER CONDUCTOR INTO SPLICE. USING AD-1377 CRIMP SPLICE TO CENTER CONDUCTOR. REPEAT STEP FOR OTHER HALF OF CABLE.



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

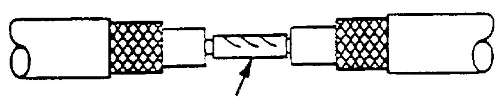
The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.



Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

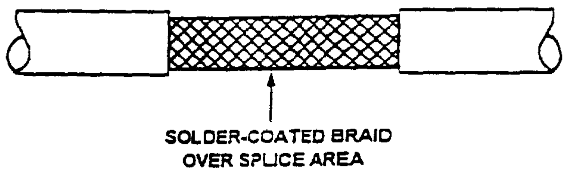
Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tools to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

H. Slide Insulation Sleeve Over Crimped Splice and Shrink

Figure 21. RF Cable Sleeve Method Repair (Sheet 2)

I. SLIDE SOLDER COATED BRAID OVER INSULATING SLEEVE. ENSURE EACH END OVERLAPS CABLE SHIELD. APPLY HEAT UNTIL SOLDER MELTS.

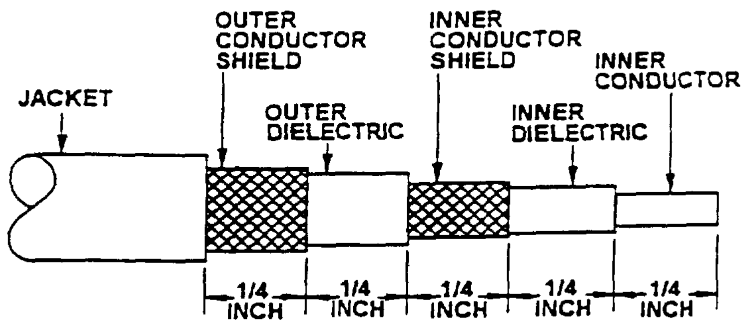


J. SLIDE HEAT SHRINKABLE SLEEVE OVER REPAIRED AREA AND SHRINK.

Figure 21. RF Cable Sleeve Method Repair (Sheet 3)

A. CUT CABLE TO ELIMINATE DAMAGED AREA.

B. STRIP ENDS OF BOTH CABLES TO BE SPLICED TO DIMENSIONS SHOWN.



C. SLIP A 4 1/2 INCH LONG PIECE OF SHRINKABLE SLEEVE ON ONE HALF OF CABLE.

D. SLIP A 2 1/2 INCH LONG PIECE OF WIRE BRAID, 2196, AND A 1 1/4 INCH LONG PIECE OF WIRE BRAID, 2194, OVER OTHER HALF OF CABLE.

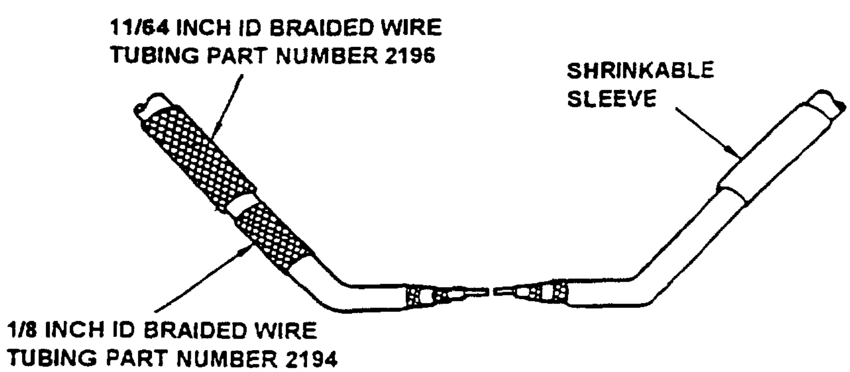


Figure 22. Triax Cable Solder Repair (Sheet 1 of 5)

E. Tin Center Conductors of Both Cable Halves. Overlap Conductors and Wrap with Single Continuous Turn of Bare Size 30 Braided Wire.

WARNING

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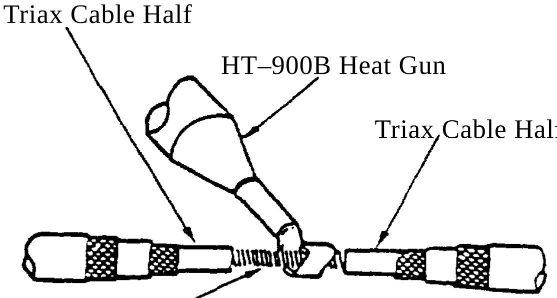
Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.



Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

F. Apply a Thin Coat of Solder Using HT–900B Heat Gun to Secure Wire. Avoid Excessive Solder Build Up on WIre

G. Wrap Spliced Center Conductors with Teflon Tape and Overlap Inner Dielectric at Both Ends.

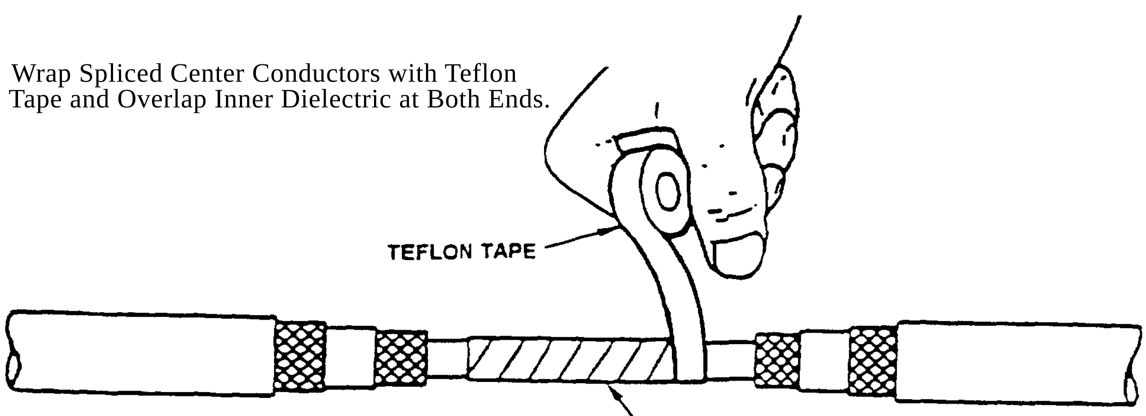


Figure 22. Triax Cable Solder Repair (Sheet 2)

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Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

H. SLIDE WIRE BRAID TUBING, 2194, OVER TAPED CENTER CONDUCTOR SPLICE AND INNER CONDUCTOR SHIELDS. WRAP BOTH ENDS OF WIRE BRAID WITH SIZE 30 WIRE BRAID AND APPLY LIGHT COAT OF SOLDER, USING HT-900B HEAT GUN.

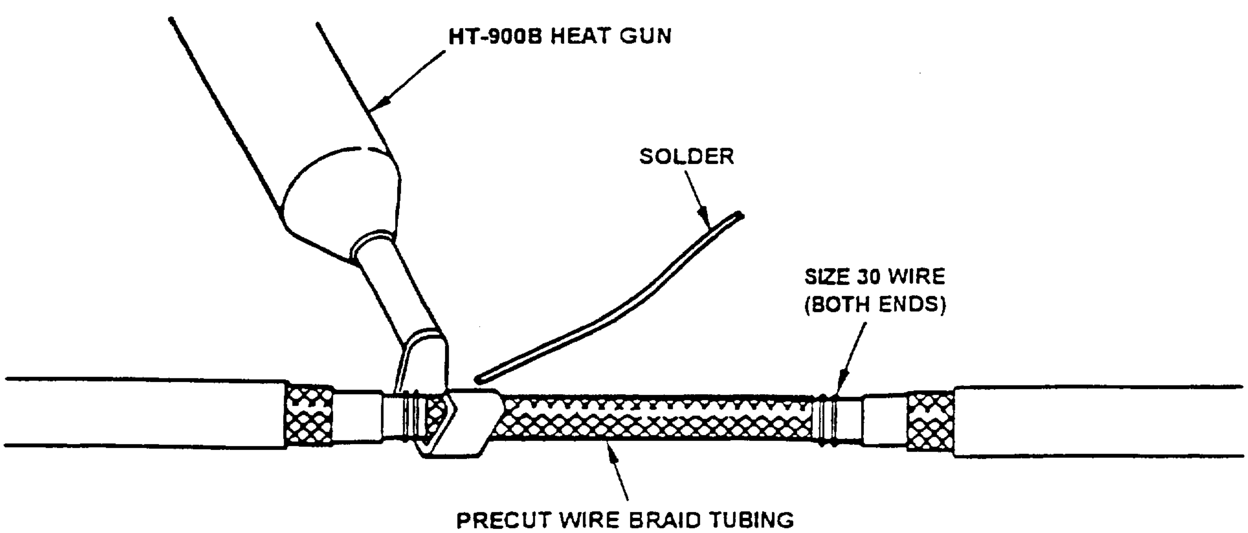
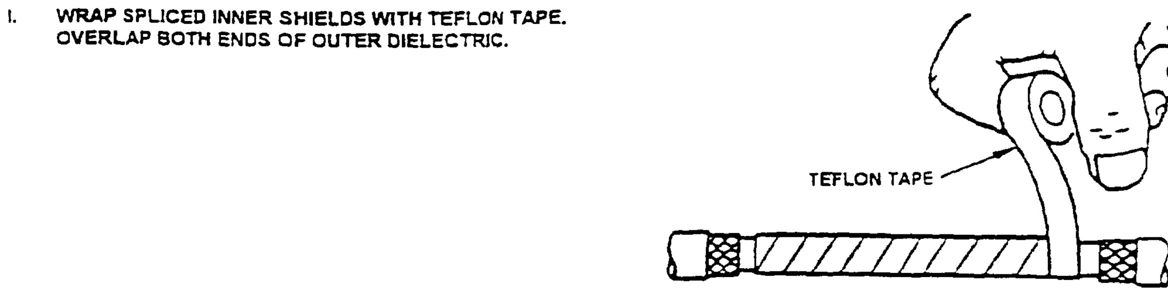


Figure 22. Triax Cable Solder Repair (Sheet 3)



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

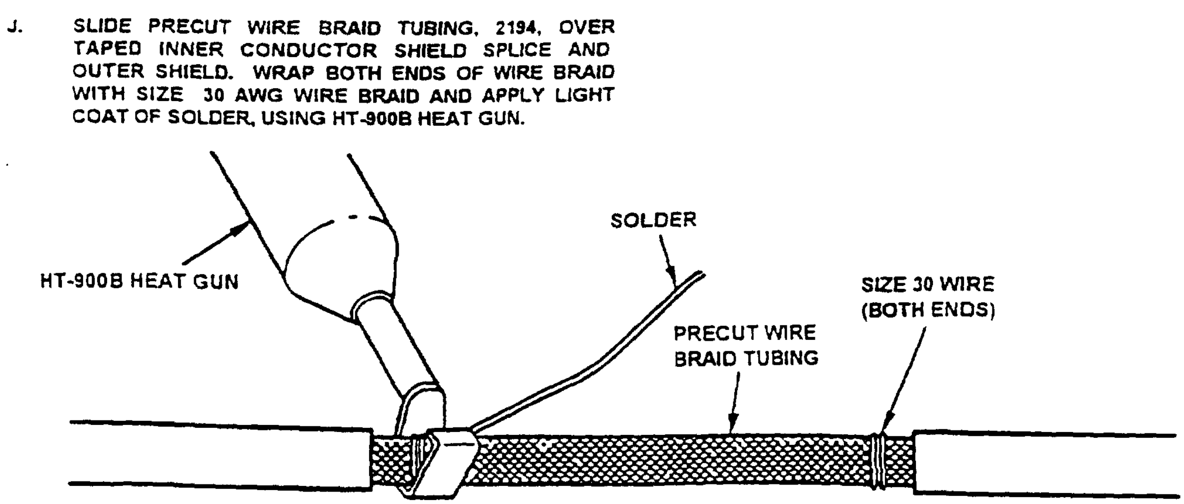
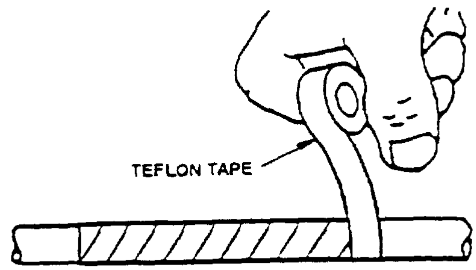


Figure 22. Triax Cable Solder Repair (Sheet 4)

K. WRAP SPLICED OUTER CONDUCTOR SHIELD WITH TEFLON TAPE. OVERLAP JACKET ON EACH END.



L. SLIDE SHRINKABLE SLEEVE OVER REPAIRED AREA. SHRINK SLEEVE, USING HT-900B HEAT GUN.

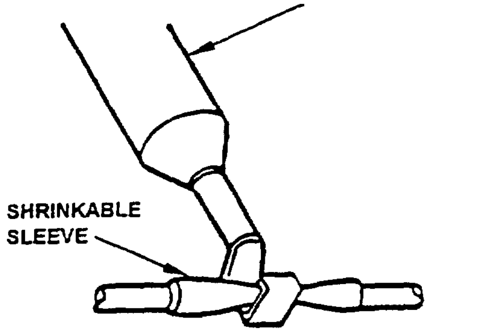
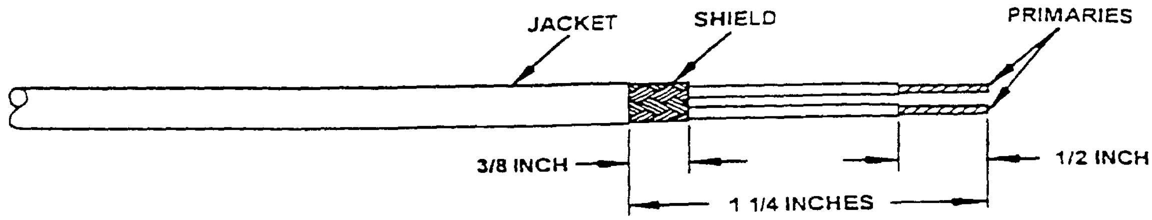


Figure 22 Triax Cable Solder Repair (Sheet 5)

CABLE PREPARATION.

A. STRIP 1 1/4 INCHES OF CABLE JACKET AND TRIM SHIELD TO 3/8 INCH FROM CABLE JACKET.

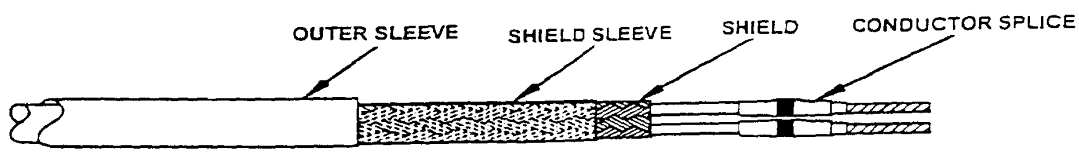


B. STRIP PRIMARY CONDUCTORS 1/2 INCH AND TIN CONDUCTORS.

CABLE REPAIR.

A. SLIDE OUTER SLEEVE, D-150-0124-01, AND SHIELD SPLICE, D-150-0124-02, SMALL END FIRST ONTO ONE HALF OF CABLE.

B. INSERT EACH PRIMARY CONDUCTOR INTO PRIMARY SPLICES, D-150-0124-03.



C. OVERLAP PRIMARY CONDUCTORS UNDER SOLDER PREFORMS. PLACE IN HOLDING FIXTURE TO HOLD WIRES IN ALIGNMENT.

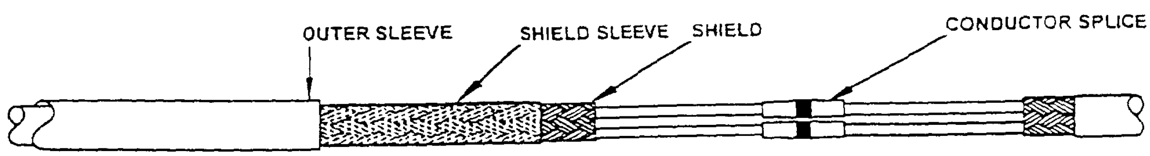


Figure 23. Single Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 1 of 3)

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

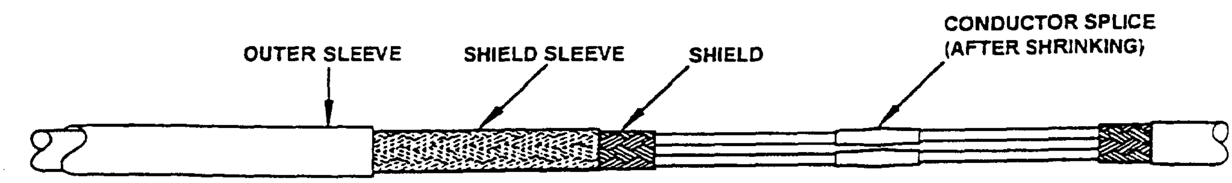
Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

D. USING HEAT GUN, HT-900B, HEAT SOLDER PERFORMS UNTIL MELTED AND FORM A FILLET ALONG THE WIRES.



E. CENTER SHIELD SPLICE, D-150-0124-02, OVER SPLICE AREA AND EXPOSED CABLE SHIELDS.

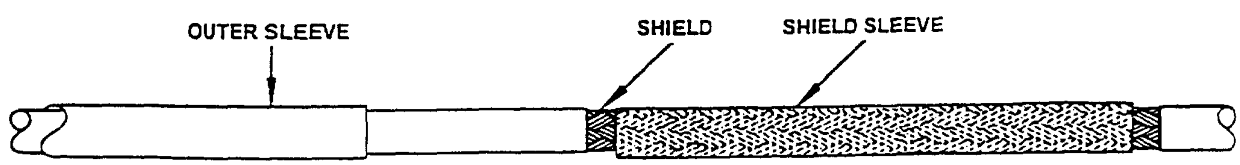


Figure 23. Single Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 2)

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

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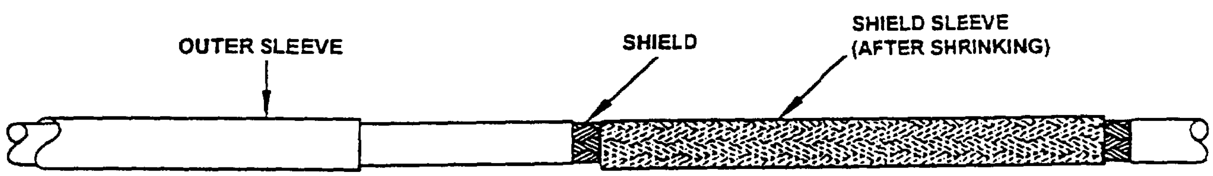
Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

F. USING HEAT GUN, HT-900B, HEAT CENTER OF SLEEVE UNTIL SOLDER MELTS AND SHIELD AND TUBE RECOVER. APPLY ADDITIONAL HEAT FOR 5 TO 10 SECONDS TO FINAL 1/2 INCH OF SLEEVE SHIELD TO ASSURE SUFFICIENT HEAT TRANSFER TO CABLE TO MAKE GOOD SEAL.



G. REPEAT STEP F FOR OTHER END OF SLEEVE.

H. CENTER STRAIN RELIEF SLEEVE OVER COMPLETED SPLICE AND SHRINK.

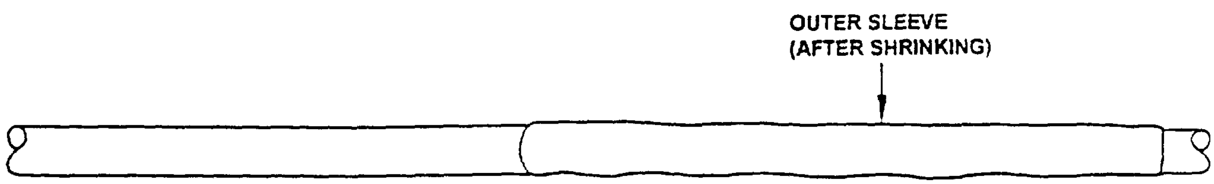
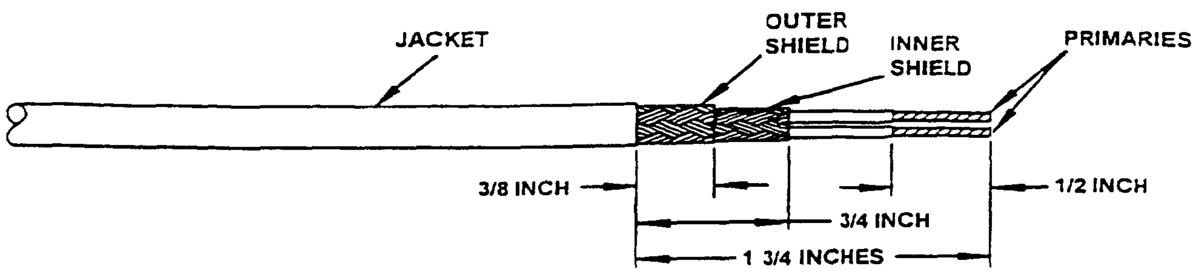


Figure 23. Single Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 3)

CABLE PREPARATION.

A. STRIP 1 3/4 INCHES OF CABLE JACKET AND TRIM SHIELD TO 3/4 INCH FROM CABLE JACKET. THEN TRIM OUTER SHIELD 3/8 INCH FROM CABLE JACKET.

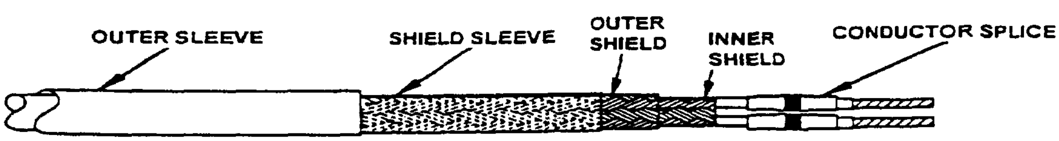


B. STRIP PRIMARY CONDUCTORS 1/2 INCH AND TIN CONDUCTORS.

CABLE REPAIR.

A. SLIDE OUTER SLEEVE, D-150-0134-01, AND SHIELD SPLICE, D-150-0134-02, SMALL END FIRST ONTO ONE HALF OF CABLE.

B. INSERT EACH PRIMARY CONDUCTOR INTO PRIMARY SPLICES, D-150-0134-03.



C. OVERLAP PRIMARY CONDUCTORS UNDER SOLDER PREFORMS. PLACE IN HOLDING FIXTURE TO HOLD WIRES IN ALIGNMENT.

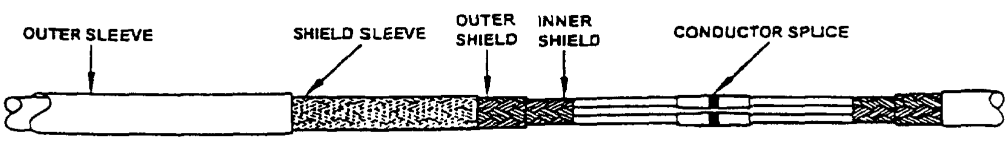


Figure 24. Double Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 1 of 3)

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

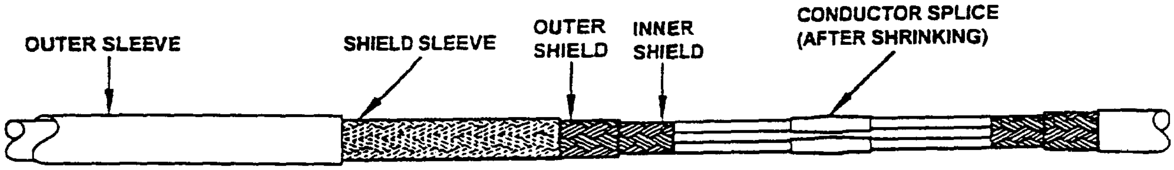
Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

D. USING HEAT GUN, HT-900B, HEAT SOLDER PERFORMS UNTIL MELTED AND FORM A FILLET ALONG THE WIRES.



E. CENTER SHIELD SPLICE, D-150-0134-02, OVER SPLICE AREA AND EXPOSED CABLE SHIELDS.

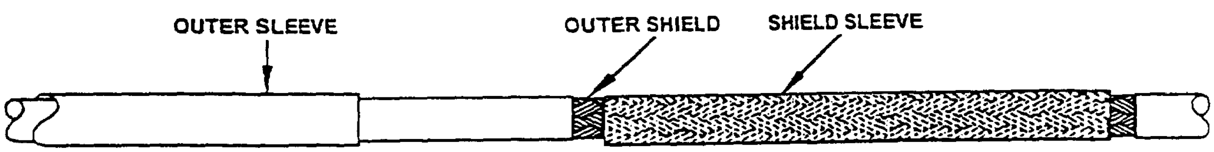


Figure 24. Double Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 2)

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

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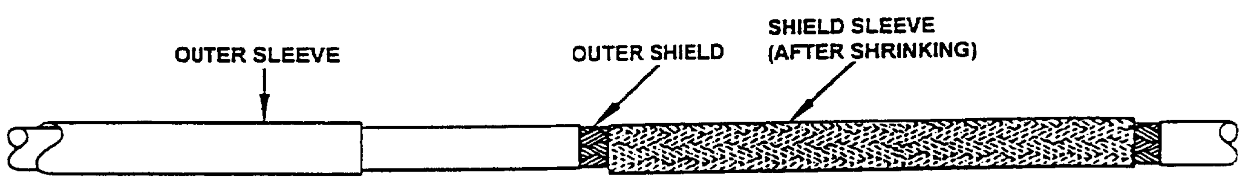
Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

F. USING HEAT GUN, HT-900B, HEAT CENTER OF SLEEVE UNTIL SOLDER MELTS AND SHIELD AND TUBE RECOVER. APPLY ADDITIONAL HEAT FOR 5 TO 10 SECONDS TO FINAL 1/2 INCH OF SLEEVE SHIELD TO ASSURE SUFFICIENT HEAT TRANSFER TO CABLE TO MAKE GOOD SEAL.



G. REPEAT STEP F FOR OTHER END OF SLEEVE.

H. CENTER STRAIN RELIEF SLEEVE OVER COMPLETED SPLICE AND SHRINK.

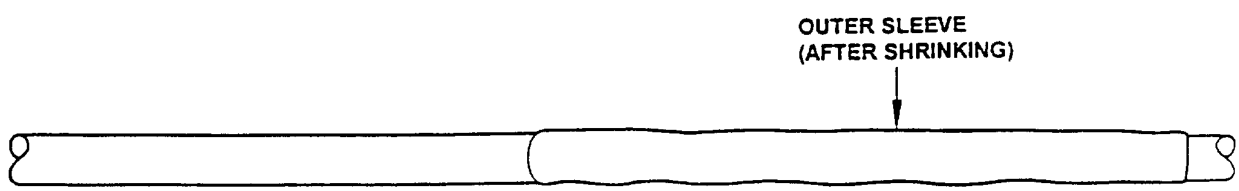
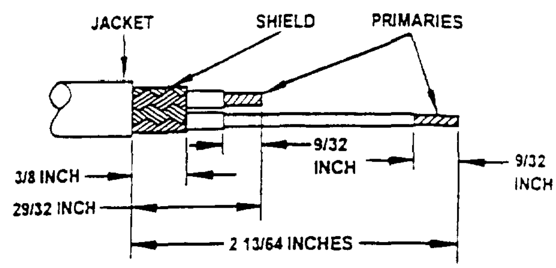


Figure 24. Double Shield Cable Repair with Solder Sleeve Primary Splice (Sheet 3)

CABLE PREPARATION.

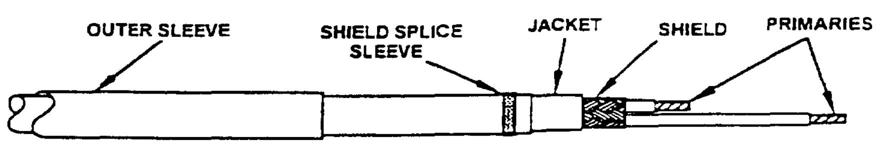
A. STRIP 2 13/64 INCHES OF CABLE JACKET AND TRIM SHIELD TO 3/8 INCH FROM CABLE JACKET.

B. CUT ONE PRIMARY CONDUCTOR 29/32 INCH FROM CABLE JACKET. THEN STRIP BOTH PRIMARIES 9/32 INCH.



CABLE REPAIR.

A. SLIDE OUTER SLEEVE, D-150-0167-01, AND SHIELD SPLICE, D-150-0167-02, SMALL END FIRST ONTO ONE HALF OF CABLE.



B. SLIDE SEALING SLEEVE, D-150-0167-03, ONTO LONGER PRIMARY LEAD OF EACH CABLE HALF.

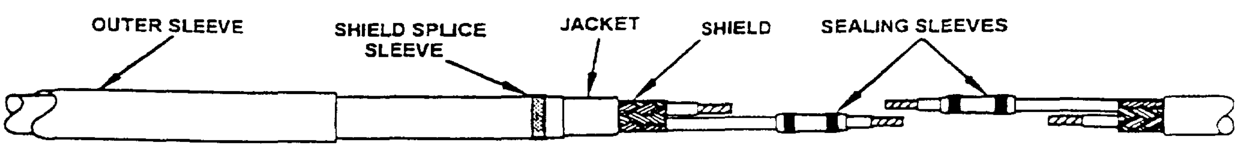
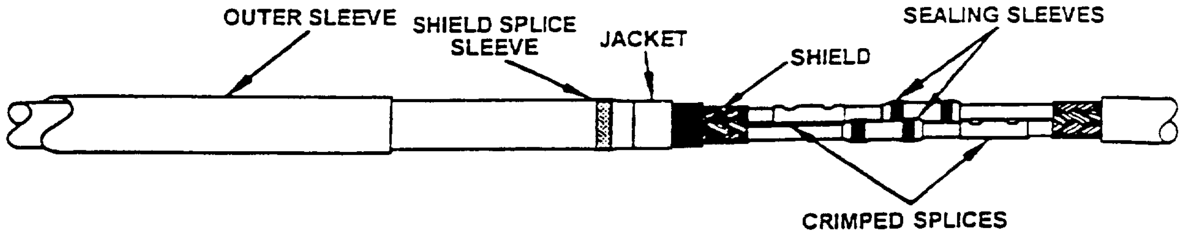


Figure 25. Single Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 1 of 3)

C. INSERT MATCHING PRIMARIES INTO OPPOSITE ENDS OF CRIMP SPLICE AND CRIMP, USING AD-1377.



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

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When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

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Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

D. CENTER SEALING SLEEVES OVER SPLICES AND SHRINK USING HEAT GUN, HT-900B.

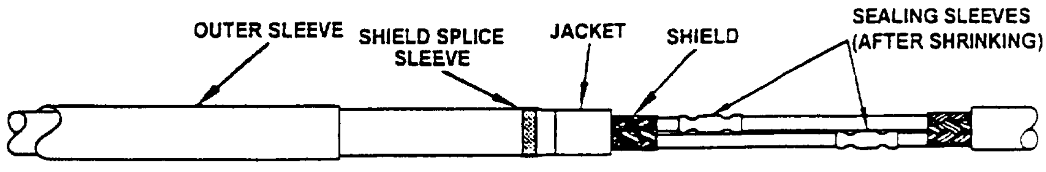
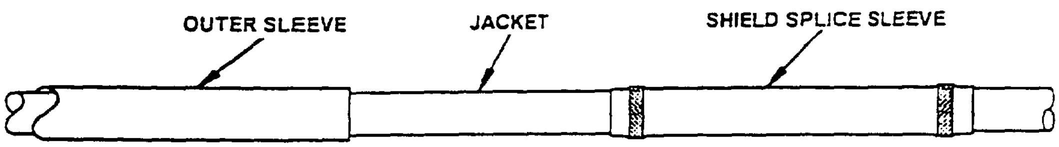


Figure 25. Single Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 2)

E. CENTER SHIELD SPLICE SLEEVE OVER SPLICE AREA AND EXPOSED SHIELD. THEN HEAT CENTER OF SLEEVE UNTIL SOLDER MELTS AND SHIELD AND TUBE RECOVER.



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F. CENTER OUTER SLEEVE OVER SPLICE AREA AND SHRINK USING HEAT GUN, HT-900B.

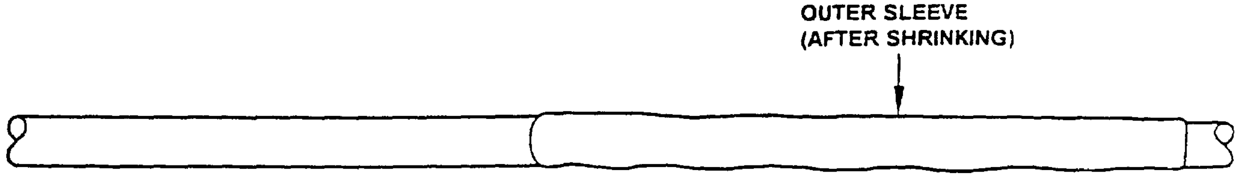
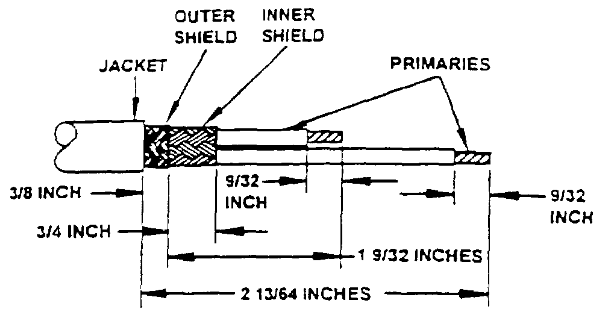


Figure 25. Single Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 3)

CABLE PREPARATION.

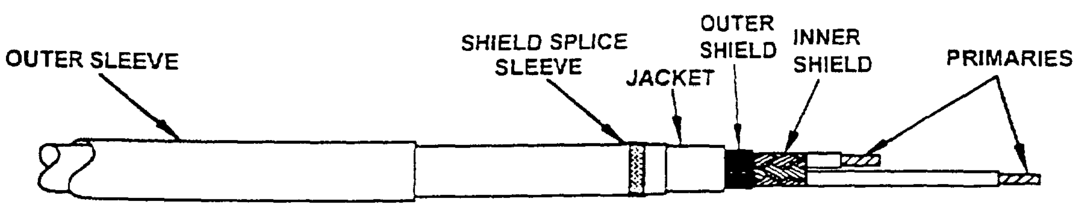
A. STRIP 2 13/16 INCHES OF CABLE JACKET AND TRIM SHIELD TO 3/4 INCH FROM CABLE JACKET. THEN TRIM OUTER SHIELD 3/8 INCH FROM CABLE JACKET.

B. CUT ONE PRIMARY CONDUCTOR 1 9/32 INCHES FROM CABLE JACKET. THEN STRIP BOTH PRIMARIES 9/32 INCH.



CABLE REPAIR.

A. SLIDE OUTER SLEEVE, D-150-0134-01, AND SHIELD SPLICE, D-150-0134-02, SMALL END FIRST ONTO ONE HALF OF CABLE.



B. SLIDE SEALING SLEEVE, D-150-0134-03, ONTO LONGER PRIMARY LEAD OF EACH CABLE HALF.

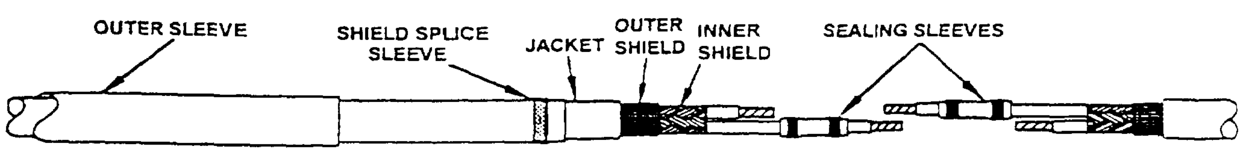
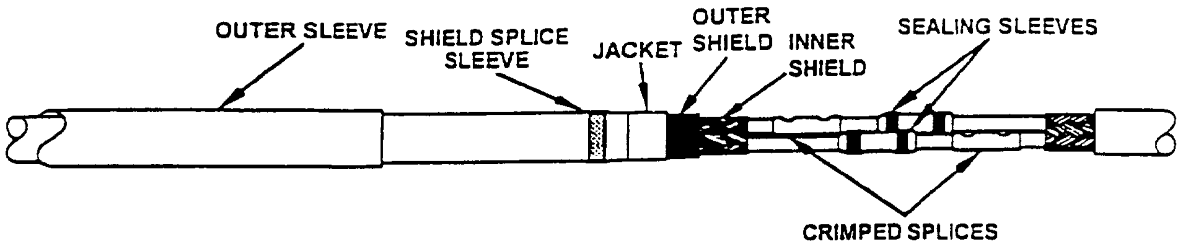


Figure 26. Double Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 1 of 3)

C. INSERT MATCHING PRIMARIES INTO OPPOSITE ENDS OF CRIMP SPLICE AND CRIMP, USING AD-1377.



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

D. CENTER SEALING SLEEVES OVER SPLICES AND SHRINK USING HEAT GUN, HT-900B.

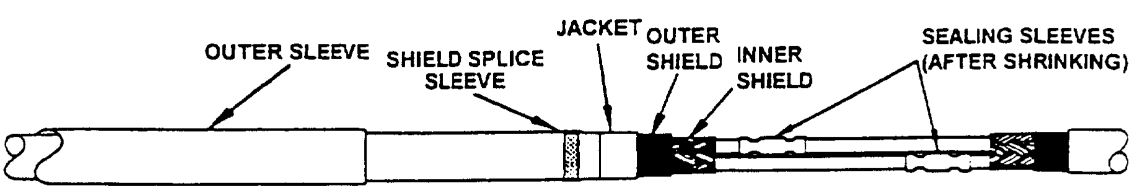
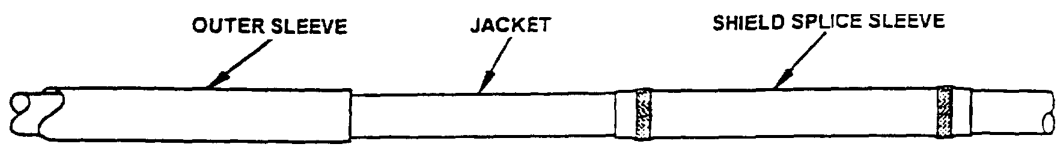


Figure 26. Double Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 2)

E. CENTER SHIELD SPLICE SLEEVE OVER SPLICE AREA AND EXPOSED SHIELD. THEN HEAT CENTER OF SLEEVE UNTIL SOLDER MELTS AND SHIELD AND TUBE RECOVER.



WARNING

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Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/ paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

F. CENTER OUTER SLEEVE OVER SPLICE AREA AND SHRINK USING HEAT GUN, HT-900B.

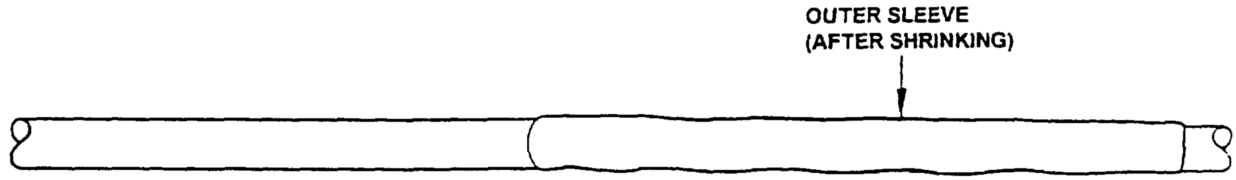


Figure 26. Double Shield Cable Repair with Mini-Seal Crimp Primary Splice (Sheet 3)

29. **SHIELD SPLICE INSPECTION.** Shield splices must be inspected for the following:

a. Sleeve/shield must be recovered along its entire length.

b. Sleeve must be recovered tightly around cable jacket.

c. Sealing rings must have flowed along cable jacket.

d. Sleeve must not have discolored to the degree that the joint cannot be inspected.

e. Sleeve must not be cut or split.

f. Strands must not be sticking through sleeve.

30. **OUTER SLEEVE INSPECTION.** Outer sleeves must be inspected for the following:

a. Sleeves must be recovered tightly onto assembly along its full length.

b. An adhesive bead should be visible at ends of sleeve.

c. Sleeve must not be cut or split.

31. . **THERMOCOUPLE CABLE REPAIR.**

32. Thermocouples are used throughout the aircraft to detect and measure temperature changes. Thermocouples are prefabricated into spark plug gaskets, bayonets for insertion into oil sumps, and probes for use in exhaust stacks. Thermocouples are supplied with short leads, usually 12 inches long, and end in terminals such as AN5548 or AN5539. The components of a thermocouple system are designed to have a high degree of accuracy.

33. **THERMOCOUPLE WIRE LEADS.** Thermocouple extension wires (Figure 26) are paired in a braided jacket and color-marked as listed in Table 3. The material for extension leads is the same as the thermocouple material. Iron-Constantan extensions are used for Iron-Constantan thermocouples, Chromel-Alumel extensions for Chromel-Alumel thermocouples, and Copper-Constantan extensions for Copper-Constantan thermocouples.

34. **THERMOCOUPLE TERMINALS AND CONNECTOR.** Selection of terminals for thermocouple wiring is based on location within the airframe, and on temperature conditions (Figure 28). Hot areas are those subject to high temperature, such as engine section, exhaust pipe, etc. Cool areas are those on the side of the firewall away from the engine or other heat producing elements. Where the temperature does not exceed 250°F, use terminals listed in Table 4. Dash letters after basic numbers indicate whether terminal is plain or lock type, except for AN 5538, where dash number indicates change in size only.

35. Thermocouple connector AN 5537 (Figure 29) is used to carry thermocouple connections through firewalls. This is a plug and jack connection, supplied with an insulating plate for attachment to the firewall. Plugs and jacks are supplied in chromel-alumel or iron-constantan combinations. The jack part of the connector is installed on the cool side of the firewall. The pin plug part of the connector is installed on the hot side of the firewall.

36. **THERMOCOUPLE CONTACTS IN MS CONNECTORS.** MS type connectors may be supplied with iron constantan or chromel-alumel contacts in sizes #12, #16, or #20 in some insert arrangements for thermocouple connections. These contacts are coded to identify the material (Table 5).

37. **DEFINITIONS.** The following definitions are needed to repair thermocouples:

a. Soft solder. A mixture of 60% tin and 40% lead, as specified in QQ-B-654. It may be in bar form to be melted for tinning, or in the form of rosin core solder wire for use with soldering iron.

b. Hard solder. Silver alloy with flow point at approximately 635 °C (1175 °F), as specified in QQ-B-654.

c. Hard solder flux. For use with hard solder, flux is borax or other similar material O-F-499, mixed to a paste-like consistency with water.

d. Soldering and brazing. For purposes of this section, the term “soldering” includes soft soldering, silver (hard) soldering, and brazing.

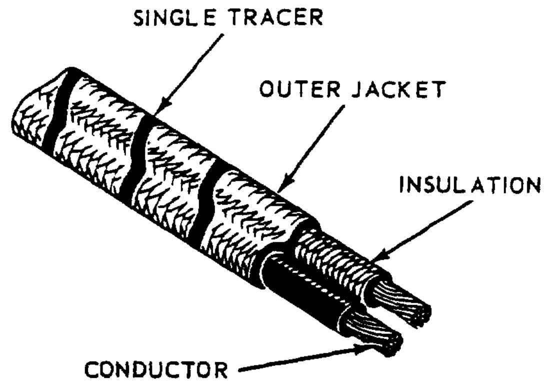


Figure 27. Thermocouple Wire

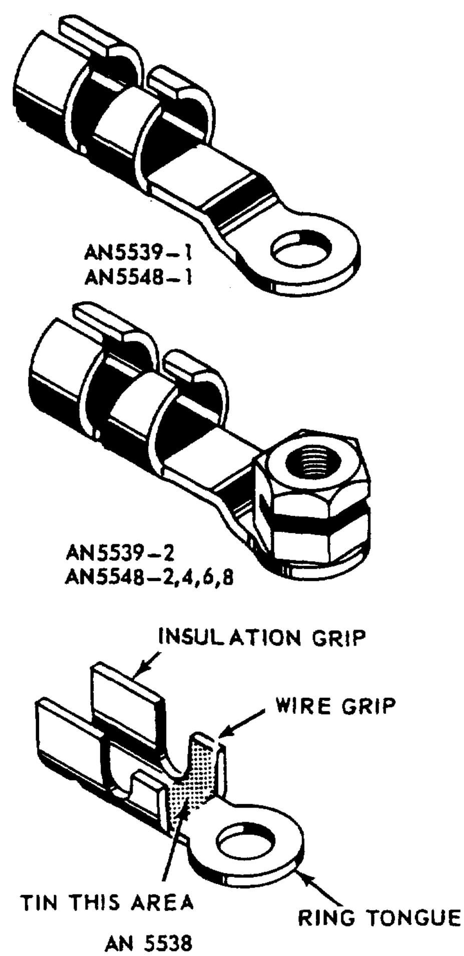


Figure 28. Thermocouple Terminals

Table 3. Thermocouple System

a. Iron Constantan Systems

	Conductor	Insulation Color	Polarity	
	Iron	Black	Positive (+)	
	Constantan	Yellow	Negative (–)	
	Type II - 8 ohms per 100 ft.		Type III - 8 ohms per 200 ft.	
	Class A	Class B	Class A	Class B
Outer jacket base color:	Light blue	Light blue	Light blue	Light blue
Tracer color:	None	One red	Two Black	Two red
Temperature limit of insulation:	120°C (248°F)	230°C (446°F)	120°C (248°F)	230°C (446°F)

b. Chromel-Alumel System

	Conductor	Insulation Color	Polarity
	Chromel	White	Positive (+)
	Alumel	Green	Negative (-)
	Type II, Class A 7 ohms per 25 ft.	Type III, Class A 7 ohms per 50 ft.	Type IV, Class A 7 ohms per 100 ft.
Outer jacket base color:	White	White	White
Tracer color:	One green	Two green	Three green
Temperature limit of insulation:	315°C (600°F)	315°C (600°F)	315°C (600°F)

c. Copper-Constantan System

	Conductor	Insulation Color	Polarity
	Copper	Red	Positive (+)
	Constantan	Yellow	Negative (-)

Type II - 7 ohms per 200 feet

	Class A	Class B
Outer jacket base color:	Black	Black
Tracer color:	One White	Two White
Temperature limit of insulation:	120°C (248°F)	230°C (446°F)

Table 4. TEMPERATURE for Thermocouple terminals

TBP

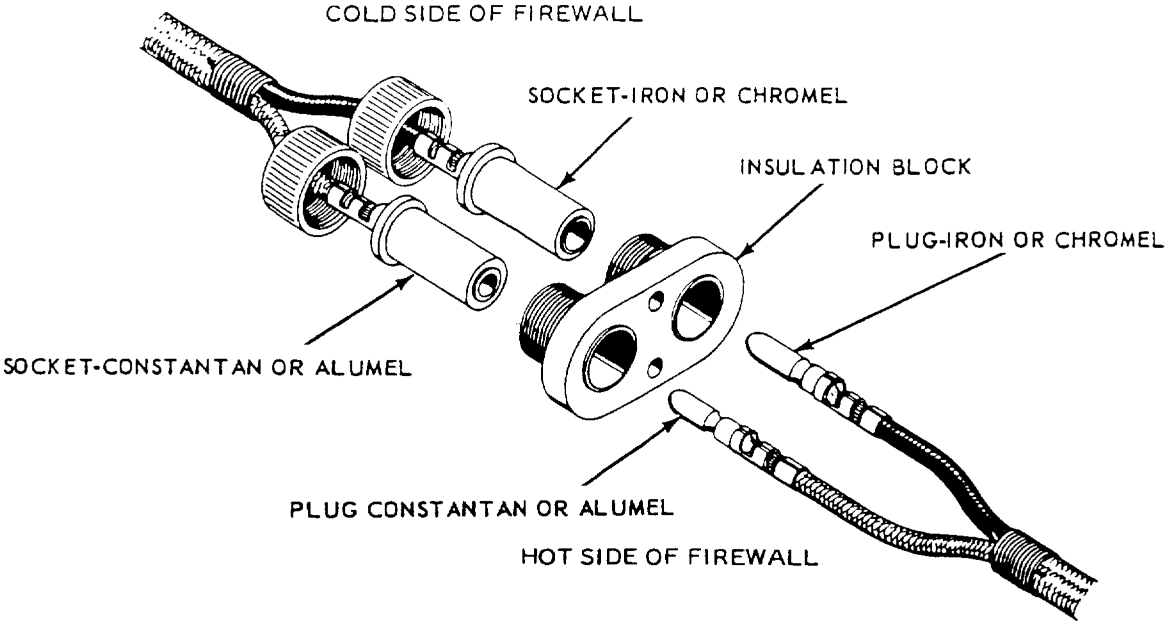


Figure 29. Thermocouple Connector Assembly (AN5537)

Table 5. Coding for Thermocouple Contacts in MS Connectors

Manufacturer	Method of Coding	Code			
		Iron	Constantan	Chromel	Alumel
Amphenol	Color	White	Red	Green	Orange
Bendix	Letters	Ir.	Con.	Ch.	Al.
Cannon	Letters	IR	CO	CH	AL

38. **CUTTING AND IDENTIFYING THERMOCOUPLE WIRE.** Cut thermocouple wire with diagonal pliers to length specified in drawing. Cut so that end is clean and square. Identify wire as described in WP 008 00.

CAUTION

Do not cut or nick strands of the conductor.

39. **STRIPPING THERMOCOUPLE WIRE.** Remove outer covering of thermocouple wire with a knife by slitting between parallel conductors and trimming the fabric braid with scissors of diagonal pliers. The stripping dimensions for each use are shown in 30 through 32. Note that longer stripped lengths are required if the wires are to be resistance tinned. Use a hand stripper, as illustrated in WP 009 00, for removing the primary insulation from each conductor.

CAUTION

Do not use extra heat and special fluxes as a substitute for clean soldering surfaces.

40. **CLEANING WIRE PRIOR TO SOLDERING.** Clean stripped conductor, if necessary, as follows: Remove grease and dirt by washing with Stoddard’s

solvent. Rinse in Dichiloromethane ASTM D4701 or other approved solvent for no longer than five seconds.

41. **DIP–TINNING WIRE WITH SILVER SOLDER.**. Thermocouple wires can be dip–tinned in molten silver solder if a solder pot capable of maintaining the required 635˚C (1175˚F) heat is available. The process is similar to that used in a dip tinning copper wire in soft solder (WP 017 00). The procedure for the dip tinning with silver solder is as follows.

a. Dip half of exposed, clean conductor into hard solder flux.

b. Dip fluxed conductor into solder pot. Do not dip conductor deeper than one half of exposed area.

NOTE

Powdered borax sprinkled over to of molten solder will retard oxidation of solder and aid alloying of silver solder to the wire. decompose flux and prevent alloying of silver solder to the wire.

c. After solder has flowed between strands, remove the wire and allow it to cool in air.

42. **RESISTANCE TINNING WIRE WITH SILVER SOLDER.** Electrical resistance heat is a good method for silver soldering thermocouple wires. Use a unit which has a capacity of 1000 watts. (Figure 33.) Wire which is to be tinned by means of electrical resistance should be stripped 1/2 inch longer than wire which is to be dip tinned or torch-tinned. The extra 1/2 inch provides a holding area which is removed after tinning is complete. See Figure 30 through Figure 32 for stripping dimensions. The procedure for resistance tinning is as follows:

a. Apply hard solder flux to area to be tinned. This is an area about 1/8 inch long, as shown in Figure 33.

b. Grasp end of wire in resistance heating pliers. Grasp wire only as shown.

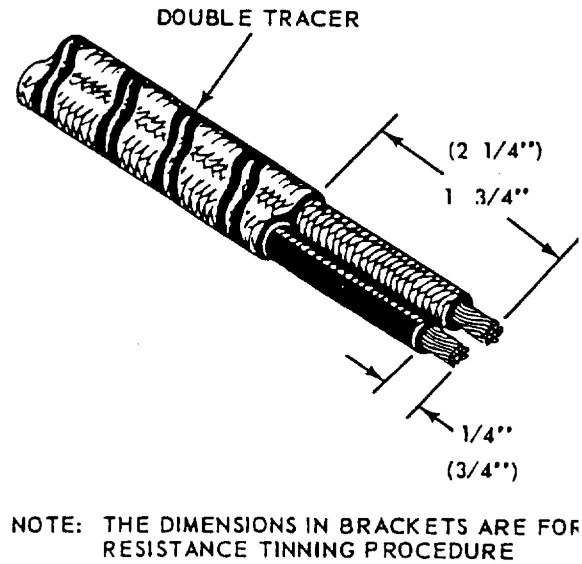


Figure 30. Stripping Thermocouple Wire for Terminal and for AN5537 Connector Installation

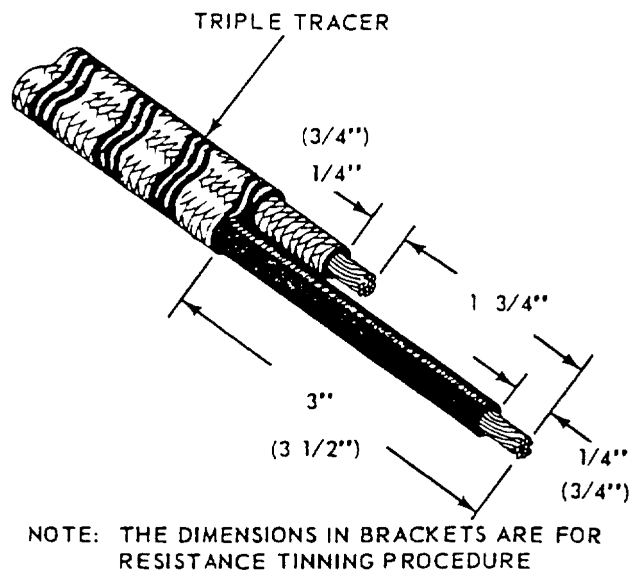


Figure 31. Stripping Thermocouple Wire for Splice Installation

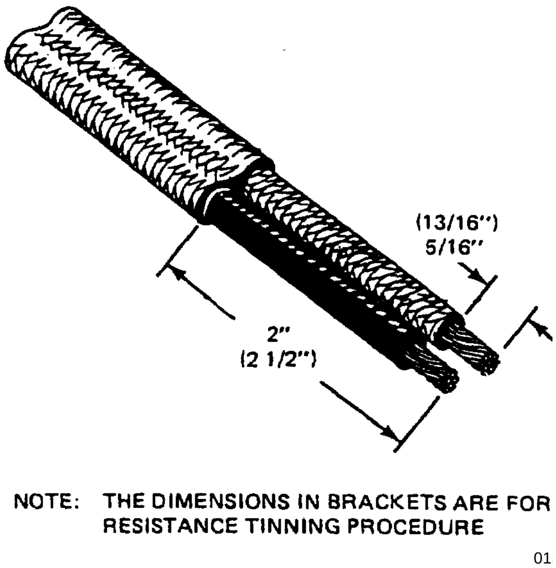


Figure 32. Stripping Thermocouple Wire for MS Connector Installation

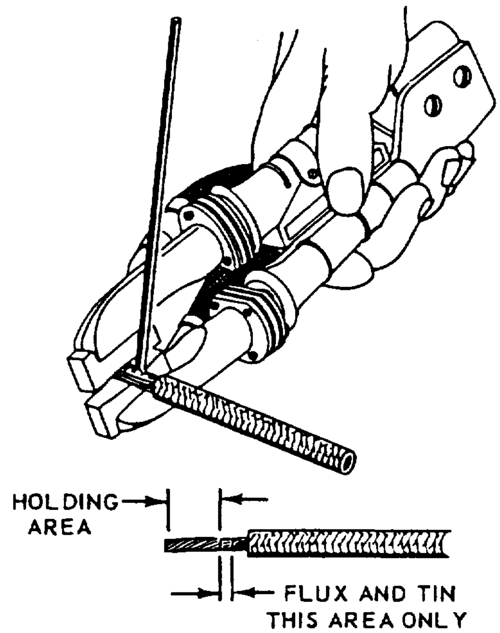


Figure 33. Resistance Heating to Tin Wire

CAUTION

Do not overheat the wire by allowing the current to remain on longer than necessary to flow the silver solder.

c. Apply current for approximately five seconds and then touch silver solder wire to area previously fluxed.

d. After solder has flowed between strands, shut off the current and allow the wire to cool in air.

e. Trim off the holding area of the exposed conductor. The conductor should be trimmed with diagonal pliers to the point of tinning.

43. **TINNING TERMINALS WITH SILVER SOLDER.** Tin only section of thermocouple terminals inside wire grip as shown in Figure 28. Terminals for silver soldering should not be plated.

CAUTION

Do not allow any flux or solder to get on the insulation grip or on the ring tongue.

a. With a brush, apply a small amount of hard solder flux to the area to be tinned.

b. Using a torch or the resistance heating pliers, melt a thin coat of silver solder onto inside of wire grip. See figure 34 for use of resistance heating pliers in this operation.

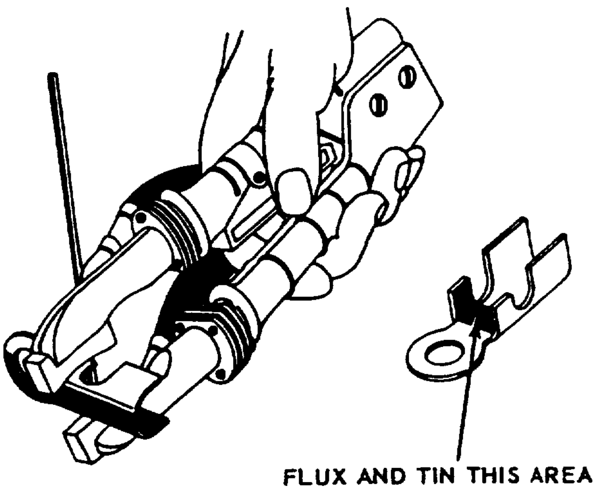


Figure 34. Resistance Tinning of Terminal

c. Allow terminal to cool in air.

44. **PROCEDURE FOR ATTACHING TERMINALS TO THERMOCOUPLE WIRE.** Secure terminal to thermocouple wire as follows:

a. Flux previously tinned areas of terminal and wire.

b. Install terminal on wire so that insulation is flush with or protrudes slightly beyond insulation grip. The tinned portion of the conductor should then be inside the wire grip (Figure 35).

c. Crimp wire grip over conductor using modified crimping tool illustrated in Figure 36.

NOTE

Do not crimp insulation grip until after soldering operation. The heat of soldering may damage insulation if insulation grip is tight during soldering.

45. **TORCH SOLDERING TERMINALS TO THERMOCOUPLE WIRE.** Torch solder terminal as follows: (Figure 35):

a. Use copper shield to protect insulation.

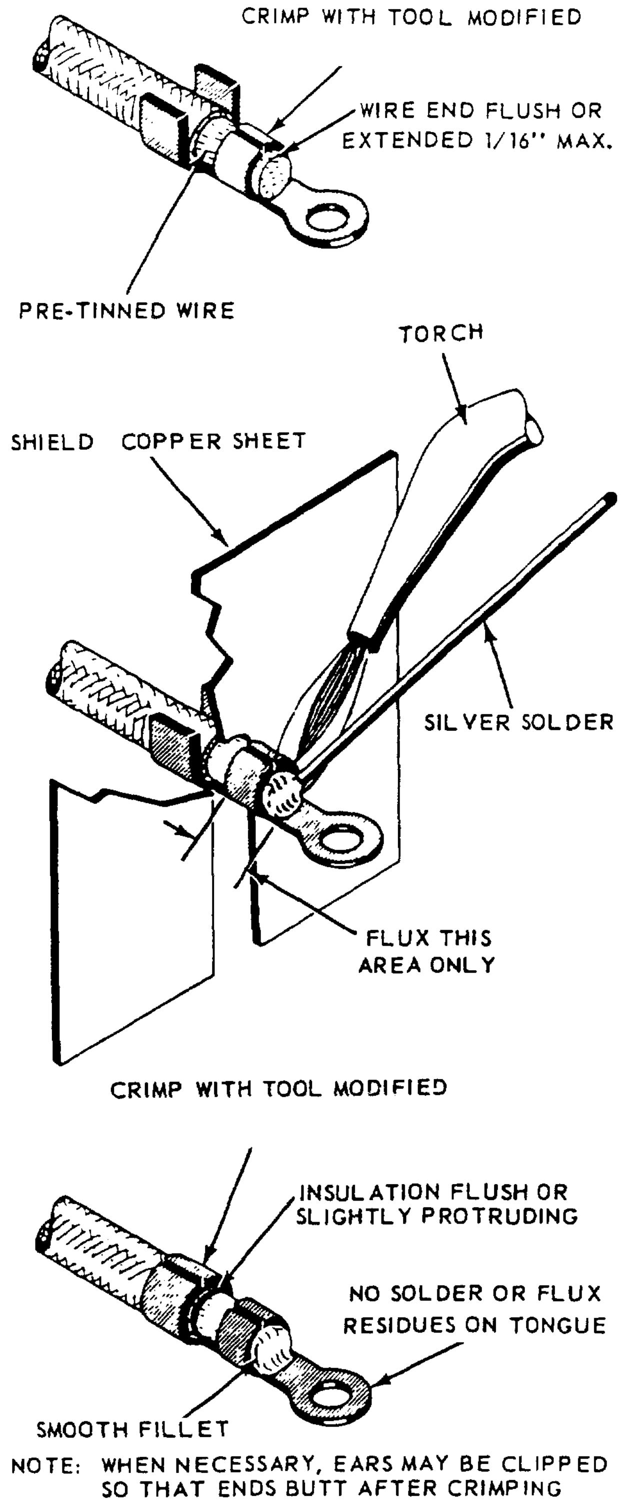


Figure 35. Silver Soldering Thermocouple Wire to Terminal

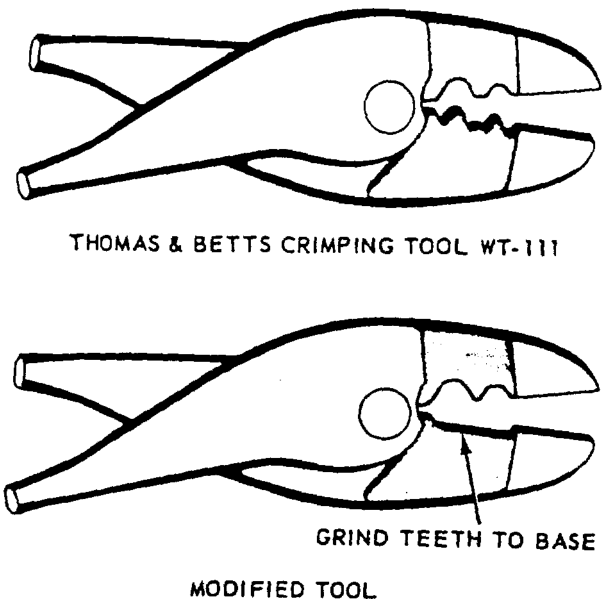


Figure 36. Modified Crimping Tool for Thermocouple Terminals

CAUTION

Do not allow solder to flow into ring tongue as this will prevent proper assembly into system.

b. Heat joint until flux bubbles and then apply silver solder wire to joint as shown. Keep flame in motion to assure uniform heating.

c. When solder has flowed down into wire grip, remove flame and allow joint to cool without disturbing it. Note that AN 5539 terminals require reinforcement with silver solder at indicated areas (figure 37).

46. **RESISTANCE SOLDERING TERMINALS TO THERMOCOUPLE WIRE.** Resistance solder terminals as follows:

a. Grasp terminal and wire assembly, prepared in accordance with paragraph 33, at wire grip area. The resistance heating pliers are to be in the position shown in Figure 34.

b. Apply current until flux bubbles; then apply silver solder wire to connection from conductor end of assembly.

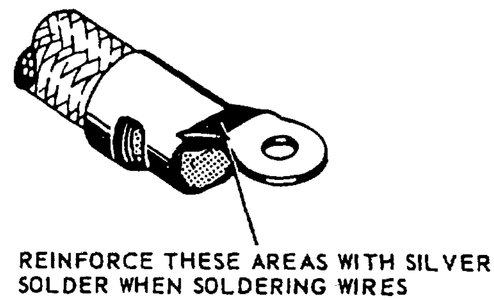


Figure 37. Reinforcing Solder on AN5539 Terminals

c. Continue to apply heat and watch for flow of solder inside wire grip. When solder is visible at opposite end of wire grip from where it was applied, turn off current.

d. Allow assembly to solidify before removing from pliers.

47. **CLEANING AND COMPLETING SILVER SOLDERED TERMINAL CONNECTIONS.** After the silver solder has solidified and cooled, the junction must be completed as follows:

a. Remove flux residues with warm water and a bristle brush, then dry thoroughly.

b. Secure insulation grip on insulation using modified crimping tool shown in Figure 36. The final result is shown in.

NOTE

Insulation grip ears may be trimmed so they butt.

c. Examine junction to be sure that the silver solder has alloyed to wire and terminal. Examine also to be sure that insulation has not been scorched. Rework any connection that is defective.

d. Coat areas indicated in Figure 38 with zinc chromate brushing compound.

e. Serve the completed extension lead at branching point as described in paragraph 41, and shown in Figure 38.

48. **SERVICE THERMOCOUPLE WIRE.** After soldering operation has been completed, and solder has cooled, service thermocouples at the branching point as shown in Figure 38. Use the cord as specified in WP 011 00. Coat the serving with clear lacquer, when available, otherwise tie as shown in WP 011 00. The serving will prevent unraveling of the outer jacket.

49. **TINNING WIRE FOR SOFT SOLDERING.** Tin thermocouple wire for soft soldering in the same manner as copper wire as described in WP 017 00. Either dip

tinning or soldering iron tinning is satisfactory. Occasionally, if wires are oxidized, rosin alcohol flux may not do satisfactory job of tinning. If this happens, use flux, Federal Specification A–A–51145 or equivalent. After tinning, the flux and flux residue on the tinned surface will be removed by using a cleaning solution of 50 percent water and 50 percent isopropyl alcohol, grade A, technical. An additional alcohol rinse will be accomplished to remove the water.

NOTE

When soldering iron method is used, use a soldering iron of 200 to 250 watts capacity for tinning thermocouple wires.

50. **TINNING TERMINALS FOR SOFT SOLDERING.** Tin terminal section inside wire grip, using a 200 to 250 watt soldering iron and rosin core solder. Do not allow flux or solder to get on the insulation grip or on the ring part of the tongue.

51. **PROCEDURE FOR SOFT SOLDERING WIRE TO TERMINALS.** Soft solder the wire as follows:

a. Install terminals on thermocouple wires as described in WP 013 00, and illustrated in Figure 35.

CAUTION

For soft-soldering, do not use any flux other than rosin-alcohol, regardless of flux used for tinning.

b. Soft solder, using 200 to 250 watt iron and rosin core solder. Make sure that solder flows inside wire grip and forms a smooth fillet.

c. Remove excess flux by scrubbing with brush and denatured alcohol.

d. Bend insulation grip ears around insulation using modified crimping tool shown in Figure 40. Trim ears so they butt flush around small wires. (Figure 36.)

e. Coat areas indicated in Figure 38 with zinc chromate brushing compound.

52. **PROCEDURE FOR CRIMPING WIRE IN MS CONNECTORS.** Thermocouples may be crimped to special thermocouple contacts in the same manner as gold plated copper contacts. Refer to the aircraft Manual for the correct contact and Crimp tool Setting. Crimp the contact in accordance with WP 013 00.

53. **PROCEDURE FOR SOLDERING WIRE TO MS CONNECTORS.** Thermocouple contacts in MS series, connectors are not tinned by the manufacturer. Therefore, it is necessary to properly tin these contacts with soft solder before ,thermocouple wire is soft soldered into place. MS connector contacts must be removed from inserts for soldering because of the extra heat needed to raise thermocouple wire to solder temperature. Best results are obtained when electrical resistance heating pliers are used to tin the contact and also for soldering wire into contact. The procedure for tinning and soldering is as follows:

a. Tin contact by use of resistance heating pliers or torch. Use rosin alcohol flux and 60/40 tin-lead solder.

b. Remove flux residues. Rosin residues are removed by brushing vigorously with Stoddard's solvent or with denatured alcohol. Lactic acid flux is removed by brushing in warm water. Dry each tinned contact thoroughly before proceeding with next step.

CAUTION

It is important that thermocouple materials match. Make sure that the thermocouple wire is soldered to a contact of the same material.

c. Check contact coding and wire coding carefully to avoid mismatch of materials (Table 3 and 5).

d. Insert properly pretinned wire into contact and solder using pliers or torch. Use only rosin core solder for this operation (Figure 40).

e. After solder has flowed and alloyed, allow connection to cool without motion. Then remove flux residues with Stoddard's solvent or denatured alcohol.

f. Examine joint to be sure solder has flowed to form smooth fillet, and that no solder is left on outside of solder cup.

g. Reassemble contacts into MS connector. Be careful to reassemble each contact into the hole from which it was removed.

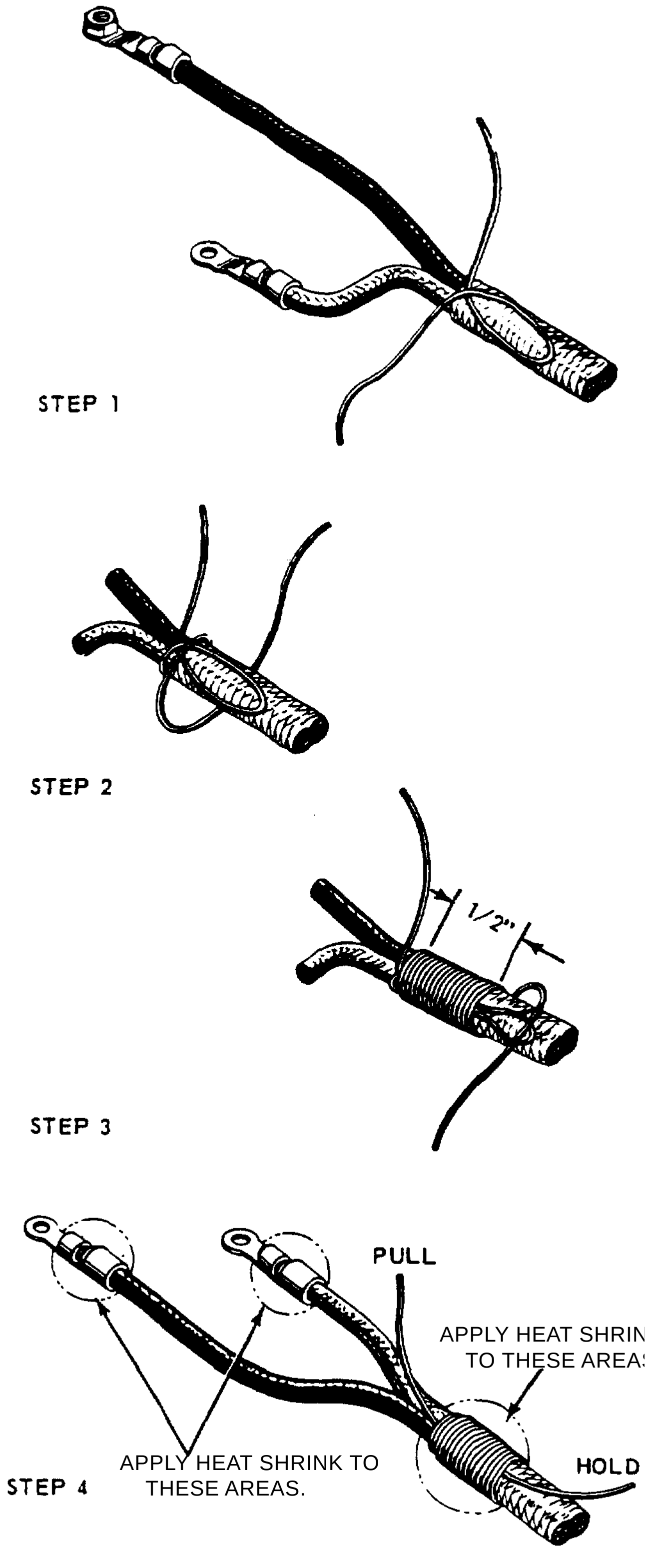


Figure 38. Serving Thermocouple Wire

NOTE

For chromel and alumel contacts (in addition to visual inspection of the contact stamping), further material further separation of contacts during connector assembly, and inspection verification after assembly can be made with the aid of a magnet, if desired, since a magnet will attract the alumel contact but not the chromel contact.

54. **SOFT SOLDERING WITH SILVER SOLDER BONDING PASTE.** In areas where temperatures do not exceed 250 °F and a high tensile strength or high electrical conductivity is required, silver solder bonding paste may be used as an alternative to the procedures described above (paragraphs 42, 43, 44, and 46, steps a through g as follows:

a. For attaching terminals, clean terminals and wire with 150 isopropyl alcohol. Next, install terminal, apply bonding paste to wire, and heat with a 140 watt soldering iron. Wipe clean with isopropyl alcohol.

b. For soldering MS and AN connectors, clean wire and socket contacts of connector with isopropyl alcohol. Apply bonding paste to wire and insert into socket. Heat with a 140 watt soldering iron, then clean with isopropyl alcohol. inspect joint to ensure smooth fillet and that no excess solder is outside of solder cup or socket. Assemble the connector.

55. **PROCEDURE FOR SOLDERING WIRE TO AN5537 FIREWALL CONNECTOR.** Thermocouple wires may be brought through firewalls by means of AN5537 firewall connectors. To preserve the integrity of the system, it is necessary to hard solder wires to the connector on the hot side of the firewall. The cool side of the firewall may be either hard or soft soldered. The procedure for attaching wires is as follows (Figure 29):

CAUTION

Be careful to connect wire leads to mating materials of connector. Connector plugs and sockets are coded with letters to indicate materials. Sizes are also different to aid in quick identification. (Table 6 for code.)

a. Disassemble connector as shown. Slide nuts over the pretinned leads which will be installed on the hot side of the firewall.

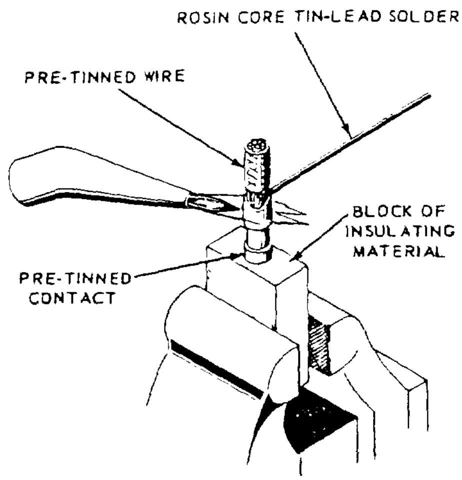


Figure 39. Torch Soldering Thermocouple Wire to MS Connector Contact

b. Tin the wire grips of the socket assemblies using hard solder as described in paragraph 36.

c. Assemble and hard-solder wires to socket assemblies as described in paragraphs 37 through 39.

d. Complete assembly of hot side wires by cleaning, crimping insulation grips, and coating with Zinc chromate brushing compound as described in paragraph 40.

e. Attach plugs to wires on cold side of firewall by using hard or soft solder as required on applicable drawing for the specific installation. The method of attachment, soldering, cleaning, etc., is the same as that previously described.

56. **CHROMEL/ALUMEL SIZE 20 CABLE SPLICE REPAIR.** When damage extends along the length of the conductors, the damaged area must be removed and replaced with a thermocouple jumper wire. Assure jumper wires are installed chrome(to chromel and alumel to alumel. For thermocouple wire repair, refer to Figure 41.

Table 6. Code for Markings on AN5537

Material	Code	Size
Iron	FE	Large
Constantan	CON	Small
Chromel	CR	Large
Alumel	AL	Small

57. **RIBBON CABLE REPAIR.** Ribbon cable should be repaired in the same manner as single or multi wire (paragraph 4, 5, WP 004 00 and WP 005 00).

58. . **FLAT CABLE REPAIR.**

59. Flat cable should be repaired in accordance with the aircraft maintenance manual. If no information is available, contact the CFA for support.

60. CONNECTING THERMOCOUPLE SPLICES.

61. Connect thermocouple splices as follows (refer to 42):

a. Slide sleeve over one lead.

b. Bend locknut of lock terminal slightly before assembly to assure tightness.

c. Bring contact areas of two terminals together; pass screw through plain terminal first, then through lock–nut of lock terminal.

d. Tighten screw securely.

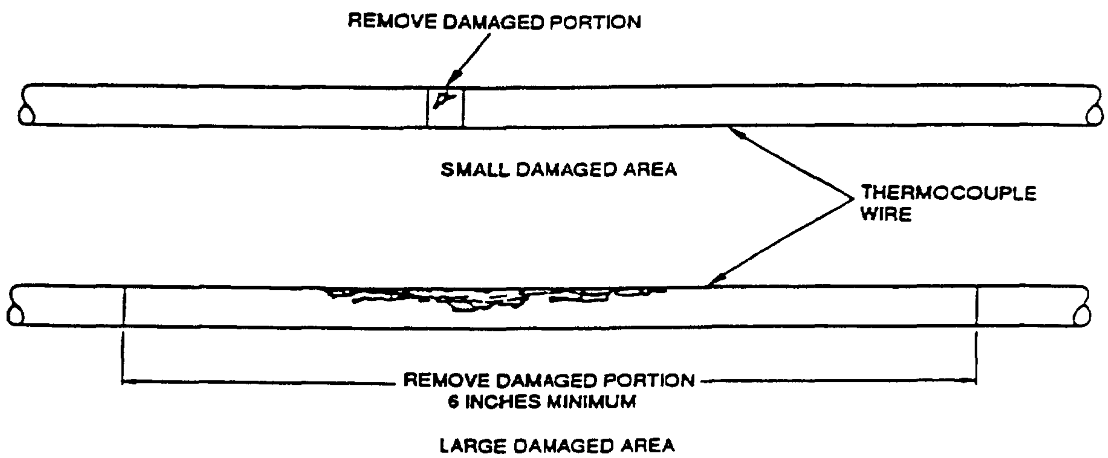
e. Slide sleeve over terminal and tie securely

f. Slide sleeve over terminal and tie securely.

THERMOCOUPLE WIRE REPAIR.

A. CUT SPOT TIES AND REMOVE CLAMPS AS REQUIRED TO GAIN ACCESS TO DAMAGED THERMOCOUPLE WIRE.

B. CUT THERMOCOUPLE WIRE TO REMOVE ANY DAMAGED PORTION. IF DAMAGED AREA IS SMALL AND WIRE HAS ENOUGH SLACK, WIRES CAN BE SPLICED DIRECTLY TOGETHER. IF THERE IS A LARGE DAMAGED AREA OR NOT ENOUGH SLACK, A LENGTH OF THERMOCOUPLE WIRE MUST BE SPLICED IN. CUT OUT A 6 INCH MINIMUM LENGTH OF DAMAGED WIRE.



C. CUT A JUMPER WIRE OF THE SAME GAGE, TEMPERATURE RATING AND EQUAL TO LENGTH OF DAMAGED THERMOCOUPLE WIRE REMOVED.

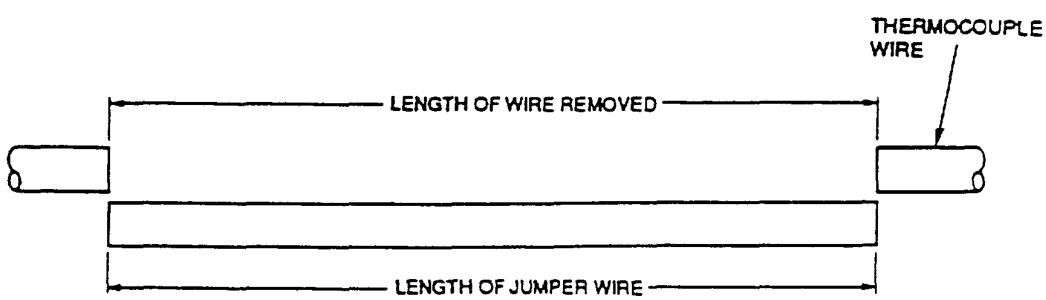
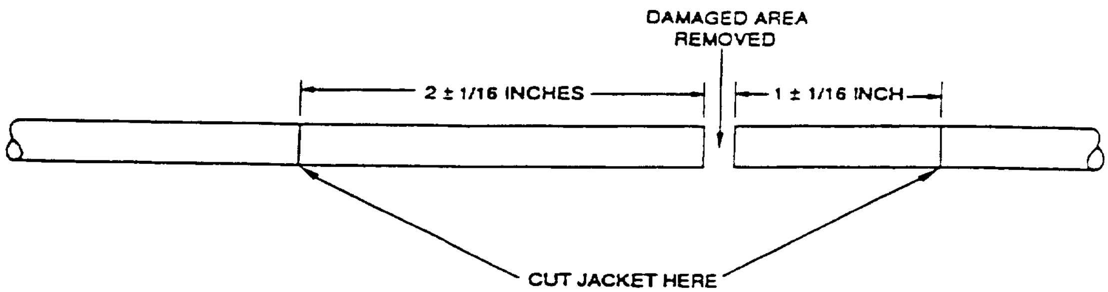
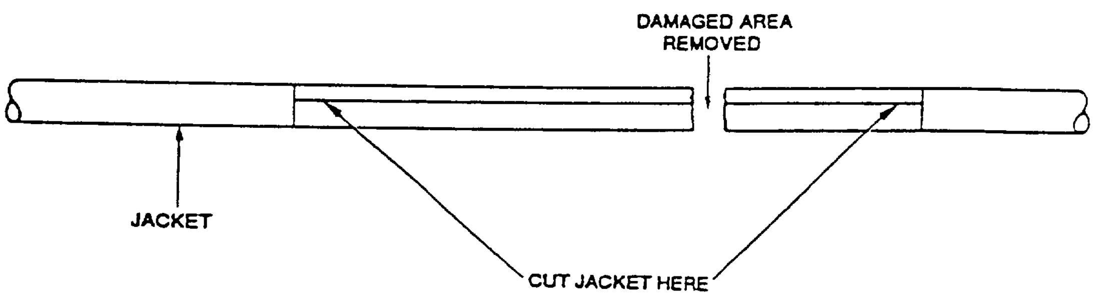


Figure 40. Chromel/Alumel Thermocouple Wire Splice Repair (Sheet 1 of 6)

D. CUT JACKET CAREFULLY AROUND WIRE, 2 ± 1/16 INCH FROM ONE END, AND 1 ± 1/16 INCH FROM OTHER END OF WIRES TO BE SPLICED. USE A SHARP BLADE AND DO NOT CUT INTO BRAID. IF A LENGTH OF WIRE IS BEING ADDED, REPEAT FOR JUMPER WIRE(S).



E. AT EACH END BEING SPLICED, CUT JACKET LENGTHWISE ALONG AREA TO BE REMOVED.



F. REMOVE JACKET AT PREPARED ENDS.

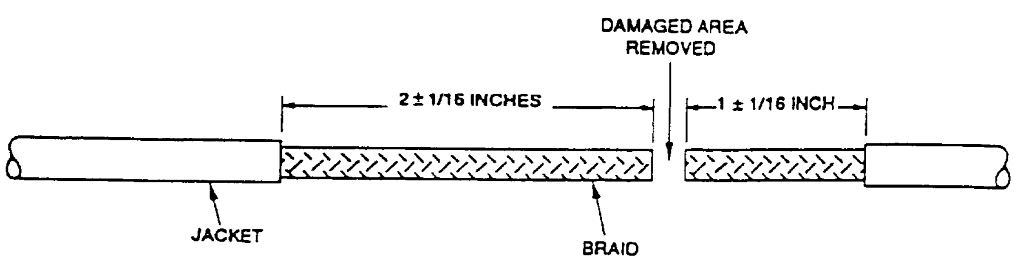
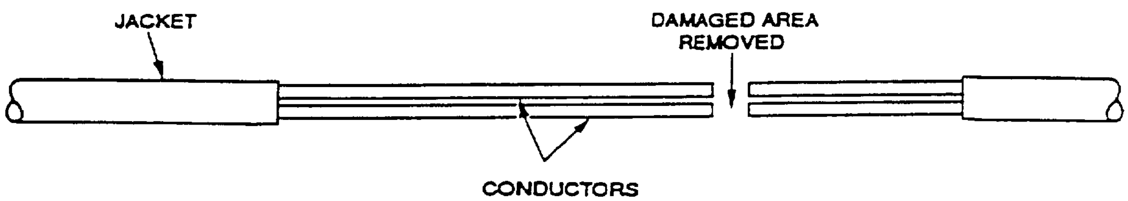


Figure 40. Chromel/Alumel Thermocouple Wire Splice Repair (Sheet 2)

CAUTION

DO NOT NICK OR DAMAGE INSULATION WHEN REMOVING BRAID.

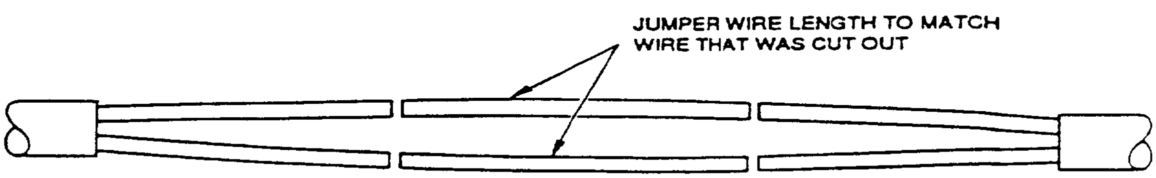
G. CAREFULLY REMOVE BRAID BACK TO JACKET. USE SMALL SCISSORS OR DIAGONAL CUTTER, AND TAKE CARE NOT TO DAMAGE WIRE INSULATION.



H. MATCH JUMPER WIRE LENGTHS TO WIRES THAT WERE CUT OUT.

NOTE

JUMPER WIRES SHALL BE ADDED AS MATCHED PAIRS ONLY.



I. SELECT APPLICABLE WIRE STRIPPER 45-1654.

J. STRIP WIRES, AND JUMPER WIRES

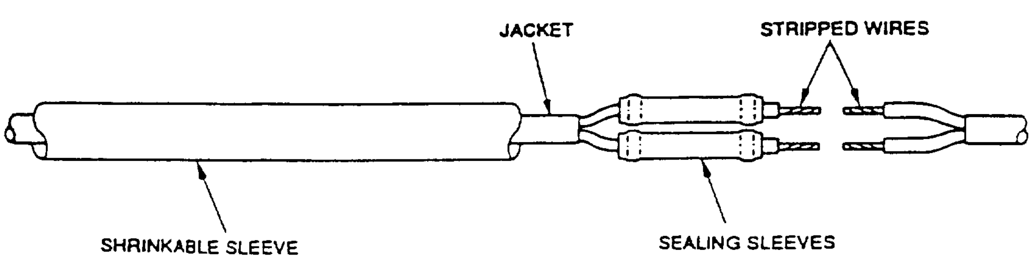


Figure 40. Chromel/Alumel Thermocouple Wire Splice Repair (Sheet 3)

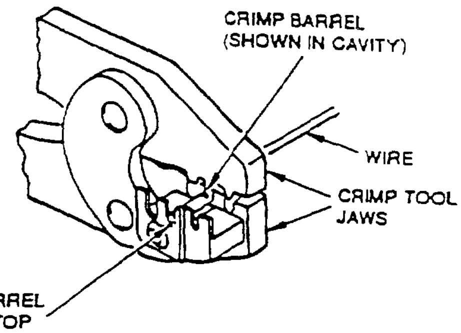
CAUTION

CHROMEL WIRE (WHITE INSULATION) MUST BE SPLICED TO CHROMEL WIRE USING THE GREY-CODED CRIMP BARREL. ALUMEL WIRE (GREEN INSULATION) MUST BE SPLICED TO ALUMEL WIRE USING THE GREEN-CODED CRIMP BARREL (D-436-0133).

L. INSERT CRIMP BARREL INTO CORRECT CRIMPING CAVITY OF CRIMP TOOL. COLOR CODE OF CRIMPING CAVITY MUST MATCH COLOR STRIPE ON CRIMP BARREL (NO. 8 AND NO. 10 WIRE CRIMPS EXCEPTED). ASSURE THAT CRIMP BARREL IS LOCATED CORRECTLY IN ITS CRIMPING CAVITY.

M. INSERT WIRE END INTO CRIMP BARREL (INTO THE END BETWEEN THE JAWS). WIRE MUST REACH MIDDLE OF CRIMP BARREL AND BE VISIBLE THROUGH INSPECTION HOLE.

N. SQUEEZE HANDLES TOGETHER TO FORM CRIMP. HANDLES WILL NOT RELEASE UNTIL CRIMP IS COMPLETED. (SEE WP 013 00.)



M22520/37-01 CRIMP TOOL

O. REVERSE CRIMP BARREL IN SAME CAVITY. CRIMPED END MUST NOW FIT AGAINST STOP.

P. INSERT JUMPER WIRE. IF APPLICABLE, INTO CRIMP BARREL AND CRIMP.

Q. INSPECT CRIMP BARREL AND WIRES AS SHOWN. WIRE INSULATION MUST BE WITH 1/16 INCH OF CRIMP BARREL (1/8 INCH FOR NO. 8 AWG WIRE). AND THERE MUST BE A SMALL GAP.

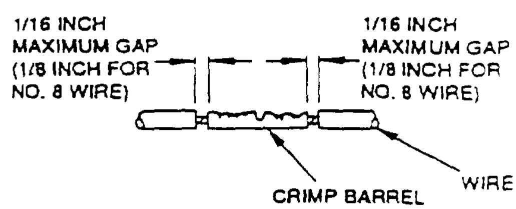
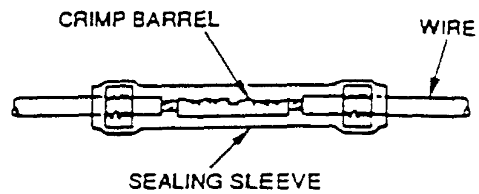


Figure 40. Chromel/Alumel Thermocouple Wire Splice Repair (Sheet 4)

R. CENTER SEALING SLEEVE OVER CRIMP BARREL



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

S. USING HT-900B/HT-920B HEAT GUN WITH SMALL REFLECTOR, SHRINK SEALING SLEEVE. START IN MIDDLE AND HEAT TOWARD ONE END UNTIL SEALANT MELTS AND BEGINS TO FLOW OUT. REPEAT FOR OTHER END. ALLOW TO COOL BEFORE HANDLING.

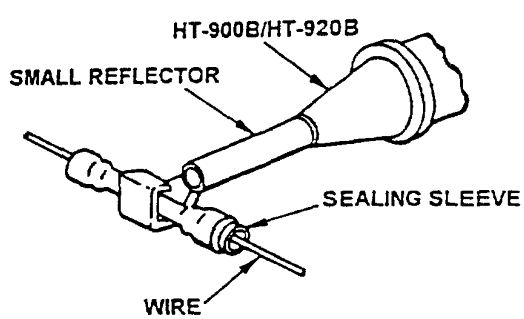


Figure 40. Chrome/Alumel Thermocouple Wire Splice Repair (Sheet 5)

T. After all wires are spliced and sealed, center shrinkable sleeve over repaired area.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat gun listed in this manual.

Aircraft with open fuel cells, broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01–1A–35. Only the HT–900B/HT–920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP–4 or the presence of fuel is imposing an immediate danger.

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The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environement, provided the aircraft meets the gas–free environment criteria (NAVAIR 01–1A–35), and there are no EMI restrictions.

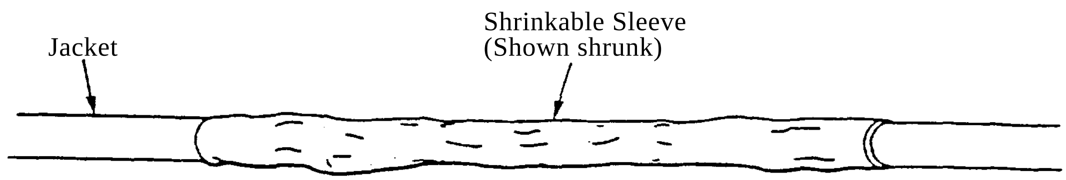
Use of nitrogen with the HT–900B/HT–920B heating tool in an enclosed area can be hazardous. Discharge of nitro–gen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

U. Using HT–900B/HT–920B Heat Gun with large Reflector, shrink shrinkable sleeve. Start in middle and shrink towards end.



V. If wiring identification is no longer within three inches of termination, remark wire.

W. Replace spot ties and clamps as required to secure repaired thermocouple.

Figure 40. Chromel/Alumel Thermocouple Wire Splice Repair (Sheet 6)

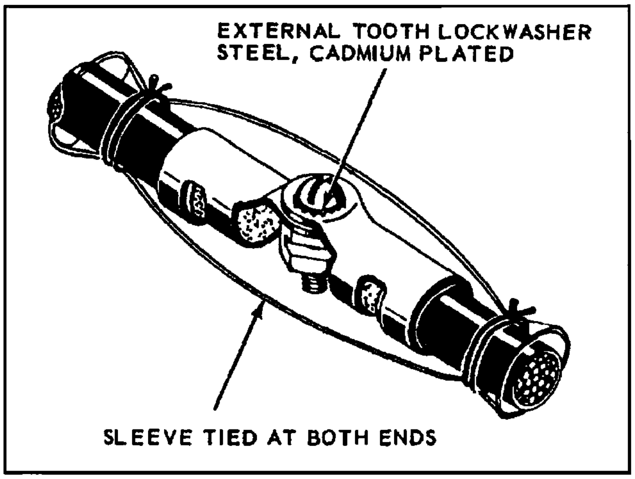


Figure 41. Connecting Thermocouple Splices

62. ALTERNATE METHOD FOR SPLICING AND CONNECTING MIL–2–5846, TYPE 1, STRANDED CONDUCTOR, AWG 20 ALUMEL–CHROMEL THERMOCOUPLE CABLE.

63. Similar metal terminations are required to connect the connections from the thermocouple probe to the circuitry cable at any point where temperature changes may be expected. Termination of thermocouple cables in areas where all components would be at the same ambient temperature normally would not require similar metal terminations. Splicing and connections of Alumel–Chromel thermocouple cables in engine nacelles, individual cable runs and wire bundles will be made using Alumel–Chromel Butt Splice with Insulation Support. These splices are uninsulated and separate insulation must be provided over the splice at the time of installation. A separate outer jacket must also be provided for cable protection and mechanical support purposes.

64. ALUMEL–CHROMEL THERMOCOUPLE BUTT (IN–LINE) SPLICE AND SEALING SYSTEM.

a. Tools and Equipment:

(1) Heat Gun: Raychem Part Nos. AA–400, CV5700, HT 900, or M83507/14–01 Heat Gun Kit.

(2) Crimp Tool: Amp Part No. 46673.

b. Materials:

(1) Materials Installation Kit: Raychem Part No. D–436–0133.

(2) MIL–W–5846 (M584611E2120–(AC)) Alumel Chromel Thermocouple Cable (as required).

(3) 112 inch wide fiberglass tape with thermosetting adhesive (optional).

NOTE

The following materials are contained in the Raychem Part No. D–436–0133 Materials Installation Kit:

1 ea. D–436–133–01 Chromel Splice, Color Coded Gray

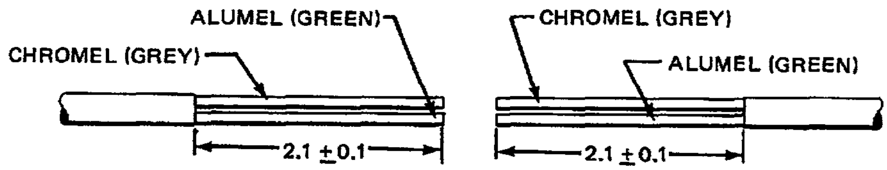
1 ea. D–436–133–02 Alumel Splice, Color Coded Green

2 ea. D–436–133–03 Splice Sealing Sleeves

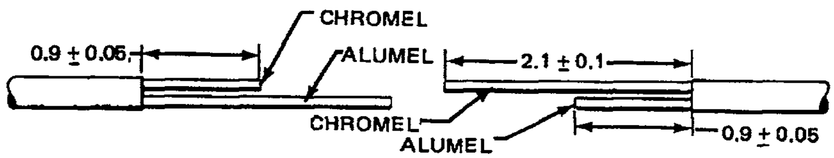
1 ea. D–436–133–04 Overall Insulation Sleeve

65. See Figure 43 for Butt Splicing Procedure and Figure 44 for Stub Splicing Procedure.

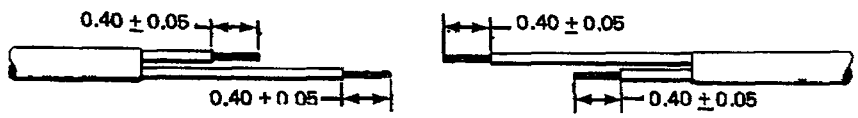
66. Step #1 – Remove 2.1 ± inches of jacket from cables to be spliced.



67. Step #2 – Cut the chromel lead of one cable and the alumel lead of the other cable to 0.9 ± 0.05 inch.

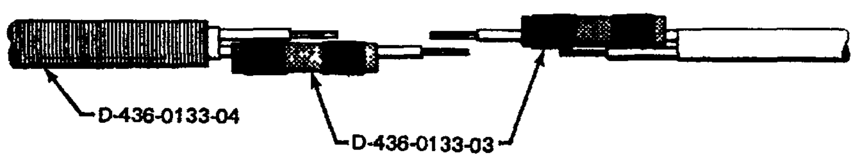


68. Step #3 – Strip 0.40 ± 0.05 inch from end of each wire.



69. Step #4 – a. Place a D–436–0133–04 (large sleeve) onto one of the cables.

70. b. Place a D–436–0133–03 on the longer lead of each cable.



71. Step #5– a. Crimp chromel leads (grey insulation) into opposite ends of the D–436–0133–01 (grey) crimp barrel.

72. b. Crimp alumel leads (green insulation) into opposite ends of the D–436–0133–02 (green) crimp barrel.

73. Note: Make crimp using amp tool #46673

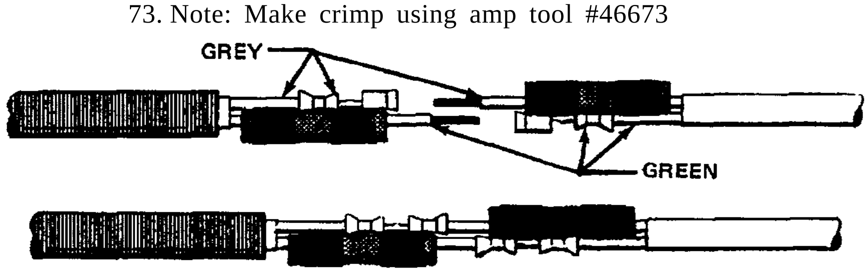
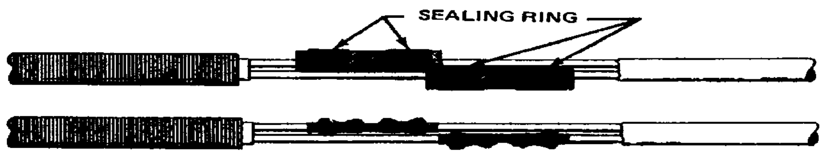
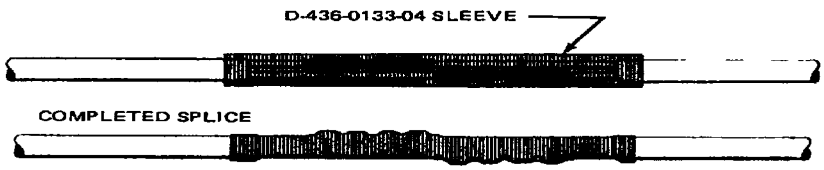


Figure 42. Butt Splicing Procedure (Sheet 1 of 2)

Step #6 – Center the D436–0133–03 sealing sleeves over the splices, and heat to shirnk, using a hot–air heater, until the sleeve recovers and the sealing inserts melt and flow along wire. Heat must be applied to individual sealing rings until they melt and flow.



Step #7 – Center D436–0133–04 outer cover over the completed splice assembly and heat until it recovers tightly onto the assembly. Sleeve should overlap cable jackets approximately 1/2 inch.



Step #8 – Wrap splice area with fiberglass tape if additional protection or support is needed.

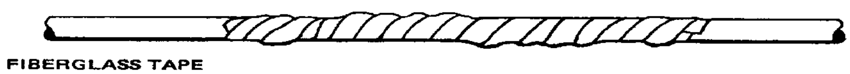
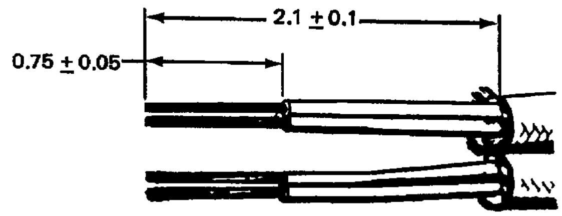


Figure 42. Butt Splicing Procedure (Sheet 2 of 2)

a.



Step #1 – End strip outer jacket off Alumel–Chromel thermocouple wire 2.10 inch ±0.1 inch.

Step #2 – End strip both conductors 0.75 inch ±0.05 inch.

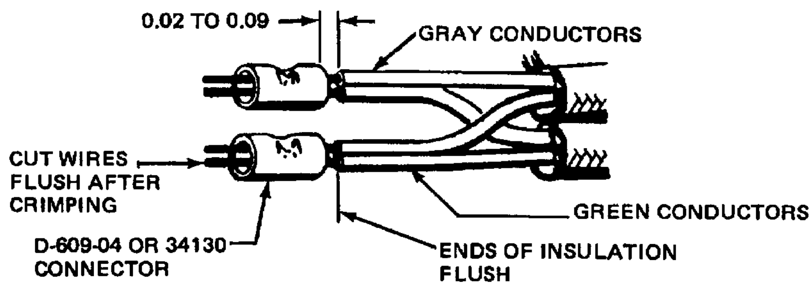
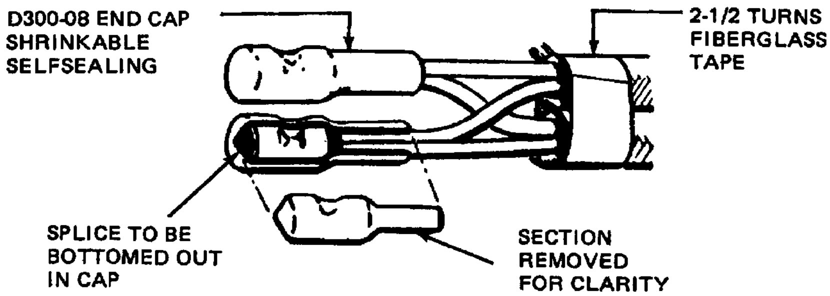


Figure 43. Stub Splicing Procedure (Sheet 1 of 2)

Step #3 – Keeping the ends of insulation flush, twist stripped wire ends as necessary to permit their insertion into connectors.



NOTE

Twist ends of the same color coded wires together

Alumel – Green   Chromel – Gray

Step #4 – Position wires in parallel connector so that after crimping with crimp tool 49936 and connector 34130 or crimp tool AD1377 and D–609–04 connector there will be a maximum of 0.03 to 0.09 inch between connector and wire insulation.

NOTE

- Use crimp tool AD1377 with D–609–04 connector. Use crimp tool 49935 with 34130 connector
- If connector has a welded seam, the seam must be in nest section of crimping tool

Step #5 – Crimp connector.

Step #6 – Cut protruding wire flush with end of connector.

Figure 43. Stud Splicing Procedure (Sheet 2 of 2).

74. QUALITY ASSURANCE SUMMARY

a. Ensure like color–coded wires have been spliced together.

b. Ensure individual stub splices have been completely insulated.

75. MOUNTING AN5537 CONNECTOR ASSEMBLY.

76. AN5537 firewall connector assemblies are mounted as shown in Figure 45.

a. Attach insulating block to firewall on hot side. Bosses on block should fit into holes in firewall so that block face is flush against wall.

b. Push socket assemblies through holes and lock into place with coupling nuts.

c. Push plugs into socket assemblies from cold side of firewall.

77. ROUTING THERMOCOUPLE WIRING.

78. Route thermocouple wiring as described generally in T.O. 01–1A–14, Chapter 14. In addition, observe the following special pre–cautions:

a. Support thermocouple wiring so it will not come into contact with heat producing surfaces, such as exhaust pipe or combustion chamber, at any point.

b. Do not bend thermocouple leads sharply.

c. Do not splice thermocouple leads except where specifically indicated, and then only with approved splices such as shown in Figure 42.

d. Protect adjacent wiring against abrasion from thermocouple splices as described in paragraph 65.

e. Route thermocouple wiring away from hot spots.

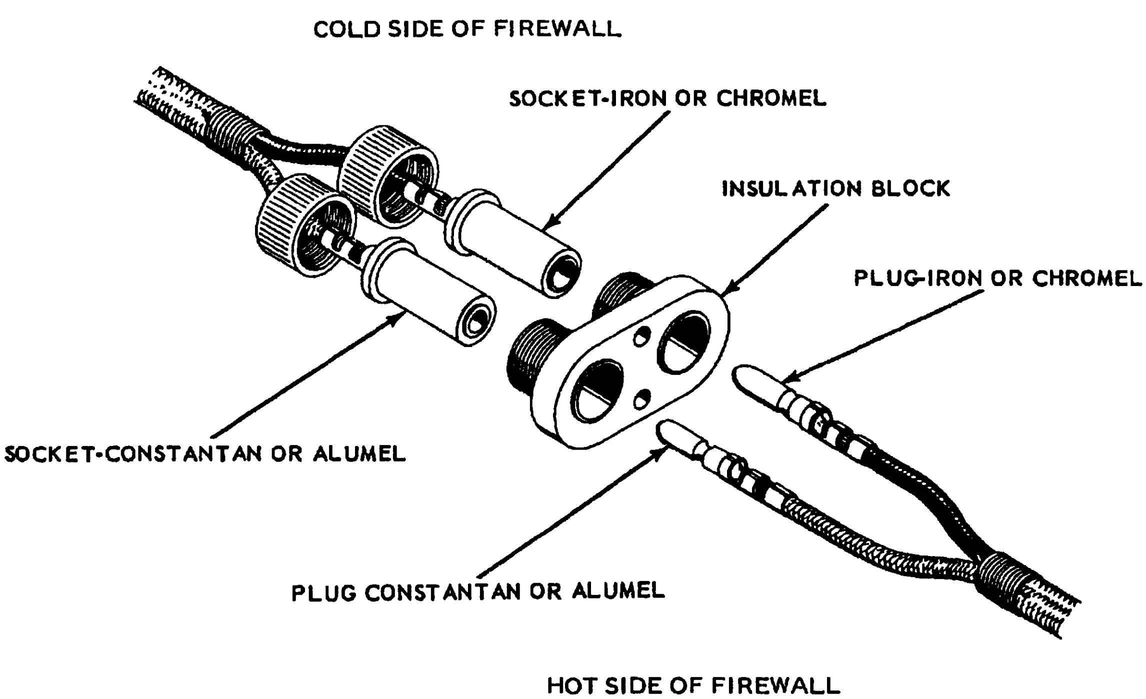


Figure 44. Thermocouple Connector Assembly (AN5537)

79. PROTECTION.

CAUTION

Do not use sleeving as a substitute for safe routing.

80. Insulate thermocouple spliced terminal connections with sleeves to protect the insulation of adjacent wires from abrasion. Use plastic sleeving in cool areas and silicon impregnated rubber or glass sleeving in hot areas. Tie sleeving securely at both ends.

81. SLACK IN THERMOCOUPLE WIRING.

CAUTION

Do not bend thermocouple leads to less than a two–inch radius. When calibration resistors are used in the circuit to adjust for short lengths, do not allow any excess slack, except for approximately three inches at each end for maintenance.

82. Thermocouple wire installations require the use of fixed wire lengths to maintain a specified resistance (see Figure 46). The slack that results should be distributed by one of the following methods:

a. Distribute excess slack evenly between wire supports, as shown in Figure 46, view A.

b. If sufficient slack is available, take it up at a support, in the form of a loop of which the diameter is at least 20 times the thickness of the thermocouple wire, as shown in Figure 46, view B.

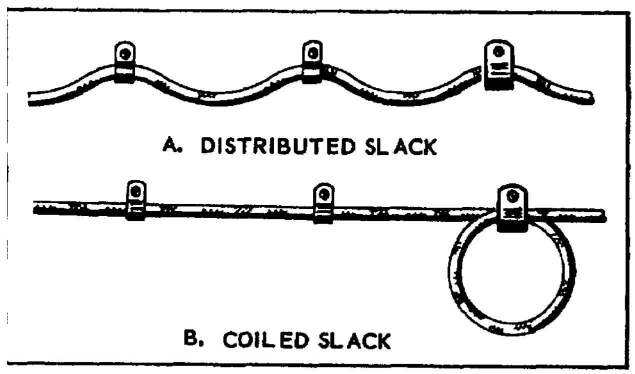


Figure 45. Distributing Slack in Thermocouple Wire

**EMERGENCY REPAIRS
(U.S. AIR FORCE and ARMY ONLY)**

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Abrasive Mats, Nonwoven, Nonmetallic MIL–A–9962
Chemical Conversion Material for Coating Aluminum and Aluminum Alloys MIL–C–81706
Clamp, Cushioned, Support, Loop–type, Aircraft MS21919
Cloth, Osnaburg Cotton CCC–C–429
Coated Abrasive, Cloth, Aluminum Oxide or Silicon Carbide P–C–451
Corrosion Preventive Compound, Solvent Cutback, Cold–Application MIL–C–16173
Corrosion Preventive Compound, Water Displacing Ultra Thin Film . . . . MIL–C_85054
Isopropyl Alcohol TT–I–735
Molding and Potting Compound, Chemically Cured Polyurethane (Polyether Based) MIL–M–24041
Plastic Sheet and Strip, Thin Gauge, Polyolefin L–P–378
Scaling Compound, Electrical SIlicone Rubber, Accelerator Required MIL–S–23586
Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems,
Chemically Cured MIL–S–8516
Waste, Matted Yarns DDD–W–101
Wiring, Aerospace Vehicle MIL–W–5088
Wire, Electric, Fluoropolymer Insulated, Copper or Copper Alloy MIL-C-85485

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

Alodine . . . . MIL–C–81706, Class 3
Tape wire markers . . . . Brady PMW–PK–8
Corrosion Preventing Compound (CPC) . . . . MIL–C–16173, Grade 4
Isopropyl Alcohol TT-I-735
Stoddard’s Solvent . . . . MIL–PRF–680 Type II

1 . INTRODUCTION.

2 . It is sometimes necessary to make emergency repairs to the aircraft electrical system at advanced fields, where a minimum of tools and equipment is available.

3 . SCOPE

4 . This chapter describes and illustrates some recommended procedures for emergency repairs to broken or damaged copper wires, shielded and coaxial cable, and electric connectors, and for replacing terminal board covers.

CAUTION

Emergency repairs not meeting the requirements of the previous chapters of this technical order should be replaced as soon as possible. Also, Air Force activities must comply with the inspection requirement of T.O. 8–1–1 (Aircraft Electrical System Inspection Procedures).

Do not repair wires with damaged shielding braid by covering with potting compound or sleeves. As it is not possible to seal off severed ends, and these may puncture the wire insulation. For coaxial cable repair, see T.O. 01–1A–14 Chapter 12.

Do not use solder to splice broken wires except under emergency conditions and then repair wires with correction solderless splices as soon as possible.

5 . **METHODS OF REPAIRING WIRE**

6 . Repair of small broken wires is accomplished by means of crimped permanent splices. Breaks in large wire (AWG size No. 8 and larger) are repaired by means of terminal lugs bolted together.

7 . **SPLICING SMALL COPPER WIRES (SIZES NO. 26 THROUGH NO. 10)**

8 . **Insulated Splices**

9 . Insulated permanent copper splices conforming to MIL–T–7928, MIL–T–7928/3, MIL–T–7928/5 and MIL–S–81824 are used to join small copper wire sizes No. 26 through No. 10. Typical splices are shown in T.O. 01–1A–14, Chapter 5, Figure 1. Note that splice insulation extends over the wire insulation. Each splice size can be used for more than one wire size. Splices are color coded in the same manner as insulated small copper terminal lugs.

10 . Terminating small copper wires (sizes No. 26 through No. 10) with preinsulated terminal lugs.

a. Small copper wires (sizes No. 26 through No. 10) are terminated with solderless, preinsulated straight copper terminal lugs conforming to MIL–T–7928 (see part of the terminal lug and extends beyond its barrel, this makes the use of an insulation sleeve unnecessary. In addition, preinsulated terminal lugs have an insulation–support (a metal reinforcing sleeve) beneath the insulation for extra supporting strength on the wire insulation.

b. Some preinsulated terminals accommodate more than one size of wire. The insulation is color–coded and the range of wire sizes is marked on the tongue, (T.O. 01–1A–14, Chapter 5, Table 1) to identify the wire sizes that can be terminated with each of the terminal lug sizes.

11 . **Crimping tools for sizes 26 through 10 splices**

12 . The M22520/5 and M22520/10 crimp tools with appropriate dies are the preferred tools for crimping sizes 26 through 10 splices. MS3316 and MS90413 crimp tools may be used if M22520/5 and M22520/10 tools are not available. When new and/or additional crimp tools are needed M232520/5 and/or M22520/10 crimp tools and dies should be procured for replace of MS3316 and MS90413 tools. The crimp tools listed above will crimp M7928/3 splices. For crimping M7928/5 and M81824 splices only the M22520/5 and M22520/10 crimp tools with appropriate dies can be used. See T.O. 01–1A–14, Chapter 5, Table 2 for splice and crimp tool information.

13 . **Crimping procedure for M22520/5 and M22520/10, MS3316 and MS90413 standard hand crimping tools.**

14 . Crimp small preinsulated copper splices in the 26 to 10 wire size range with M22520/5, M22520/10 and MS90413 or the MS3316 tool, as follows:

a. Select the appropriate crimp tool(s) and die(s) from TO 1–1A–14.1, Chapter 5, Table 2 for crimping the splice(s) to be used.

b. Check tool for correct adjustment. Tools out of adjustment must be returned to the manufacturer for repairs (see TO 1–1A–14.1, Chapter 5, paragraph 10).

c. Strip wire to length given in TO 1–1A–14.1, Chapter 5, Table 7, following on of the procedures described in Chapter 2, paragraphs 2.37 through 2.44.

d. For the M22520/5 and M22520/10 tools, see Figure 2 for crimping instructions.

e. For the MS90413 tool, with the tool handles fully open (see TO 1–1A–14.1, Chapter 5, Figure 4), set the wire size selector knob (see TO 1–1A–14.1, Chapter 5, Figure 6) to the proper position for the wire size being crimped. Slide the terminal lug locator down below the die surface into the fully retracted position (see TO 1–1A–14.1, Chapter 5, Figure 14), and insert the splice into the stationary die so that the MS90413–2 location “finger” fits into the locator groove in the splice, and the insulation barrel protrudes from the “wire side” of the tool.

f. For the MS3316 tool, one locator is used for both terminal lugs and 7928/3 splices (see TO 1–1A–14.1, Chapter 5, Figure 8). For the M7928/3 splice, insert the splice into the movable dies so that the locator on the tool fits into the groove in the splice, and the insulation barrel on the side of the splice to be crimped protrudes from the “wire side” of the tool.

g. Squeeze tool handles slowly until tool jaws hold splice barrel firmly in place, but without denting the barrel.

h. Insert stripped wire into splice barrel which protrudes from “wire side” of splice until stripped end of wire butts against the stop in the center of the splice. This can be seen through the splice inspection window.

i. Crimp by closing tool handles. Tool will not open until full crimping cycle has been completed.

j. After crimping, check that wire end is still visible through the inspection window.

k. Reverse position of splice in crimping tool (or location of crimping tool on splice) and repeat steps b through h to crimp wire into other side of splice.

15 . **Splicing procedure for M81824 environmental splices.**

a. M22520/5 or /10 crimp tool for wear in accordance with TO 1–1A–14.1, Chapter 5, paragraph 5.10. If the tool is worn out of tolerance, it must be replaced.

b. Select the correct size sealed splice using Table 3. Choose a size crimp barrel from TO 1–1A–14.1, Chapter 5, Table 3 that will accommodate the wire(s) to be crimped in each separate end.

c. Strip 5/16 to 11/32 inch of insulation from wires, following one of the procedures in T.O. 1–1A–14 Chapter 2.

d. Position the crimp barrel in the appropriate die of the M22520/5 or /10 crimp tool, so that one end of the crimp barrel butts against the crimp locator (see TO 1–1A–14.1, Chapter 5, Figure 15). Lock in place by partially closing the handles without denting the crimp barrel.

e. Insert the wire fully into the crimp barrel, and crimp by closing the handles until the ratchet releases.

f. Before completing the splice, slide the sealing sleeve, which will be shrunk later, back over one of the wires (M81824/1 splice only).

g. Reverse the position of the crimp barrel in the crimp tool die. The attached wire will extend through the slot in the crimp locator.

h. Lock the crimp barrel in place by partially closing the handles, insert the other wire(s), and crimp as before.

WARNING

Do not use heat guns with electric motors when working on aircraft that have been defueled and purged for extensive maintenance, Mod/PDM, or major modifications, because motor brushes produce sparks, and because air from the immediate work area is passed over the heating element which could cause an explosion or fire. Compressed air/nitrogen heat guns M83521/5–01, M83507/14–01, and M22520/13–20 are the only heat tools approved for use on fueled aircraft.

i. Slide the sealing sleeve over the crimp barrel, center it (M81824/1 splice only), and heat with hot air to shrink the sleeve. Heat the middle first to lock the sleeve in place; then heat the ends until the sealing rings melt and ooze out around the wire. To ensure a good seal, allow to cool before handling.

16 . **Splicing high–temperature wires.**

17 . Splices for high temperature applications are available in the same wire size ranges as terminal lugs. The tools and crimping procedures are the same for splices as for terminal lugs. Crimp splice at both ends.

18 . SPLICING BROKEN WIRES WITH PERMANENT SPLICE

19 . When splicing wires by means of permanent splices, observe the following procedures (see Figure 1):

NOTE

Make sure that only aluminum splices are used when splicing aluminum wire

a. Cut ties and work the broken wire to the outside of the bundle.

b. Pull sufficient slack from the wire run toward the break so that there will be no strain on the splice.

c. Trim the wire as close to the break as possible so that all strands will be of equal length.

d. Clean the wire for a distance of at least one inch from the break with Stoddard's solvent. This will ensure the removal of foreign particles and debris to provide a good insulating surface.

NOTE

If an additional piece of wire has to be spliced in to make the repair, the added wire should be of the appropriate type selected from MIL–W–5088 (TO 1–1A–14.1, Appendix A, Table A–1 or A–II). The replacement wire should be equal to or better than the original wire in tensile strength, temperature rating, etc.

e. Select a crimp splice from (TO 1–1A–14.1, Chapter 5, Table 3). If a uninsulated splice is used, slide a piece of shrinkable tubing slightly larger in diameter than the OD of the splice being used over one end of the severed wire (see TO 1–1A–14.1, Chapter 11, Table 11). If shrinkable tubing is not available, a piece of flexible transparent tubing can be substituted.

NOTE

Environment resistant sealed splices shall be used in areas of severe wind or moisture problems or both (swamp), such as wheel wells, rear wing flaps, wing folds, and other areas specified in the detail specification.

f. Install the splice as described below:

NOTE

The inability to obtain a good tinned surface indicates the wire is not clean.

(1) Dip half of exposed clean conductor into hard solder flux.

(2) Protect wire insulation with notched copper sheet shield, to prevent scorching.

(3) Apply flame to wire until flux bubbles. Then feed small amount of silver solder in wire form to fluxed area while flame is kept there. After the silver solder has flowed, remove the flame, and allow the wire to cool in the air.

g. Re–tie spliced wire into bundle.

20 . **SPLICING LARGE WIRE WITH TERMINAL LUGS.**

21 . Trim the broken ends of the wire and install an insulating sleeve over one end of the wire. Strip wire and crimp an insulated terminal lug of the proper size to each wire end, following the procedures described in TO 1–1A–14.1, Chapter 5. Bolt the terminal lugs together as shown in Figure 2. SLide the insulating sleeve over the connection and tie securely to the wire at both ends.

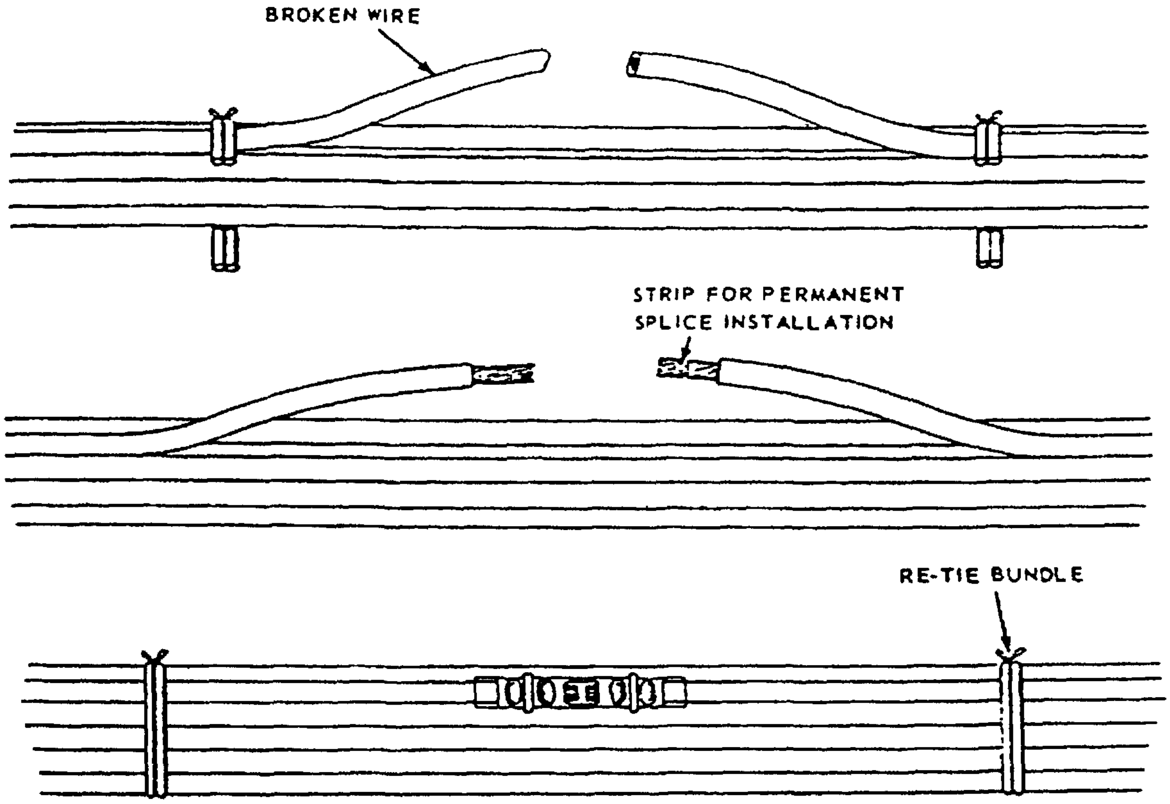


Figure 1. Permanent Splice Repair of Wire

22 . **REPAIRING DAMAGED WIRE INSULATION**

23 . If the wire insulation is damaged but the wire itself is not damaged, repair the insulation in either of the following ways:

a. Dip the damaged portion of the wire insulation into a container of potting compound. Instructions for mixing potting compound are given in Chapter 10. Allow potting compound to dry in air (70° – 75F°) for 4 hours before touching. Full cure and electrical characteristics are achieved in 24 hours.

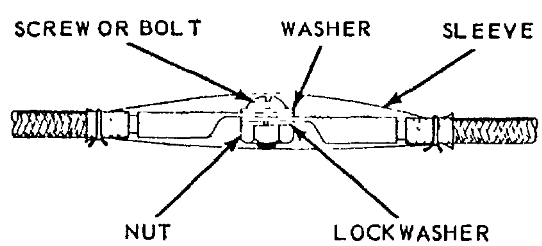


Figure 2. Bolted Terminal Lug Repair of Large Wire

b. If potting compound is not available, repair damaged wire insulation by using a transparent sleeve of flexible tubing 1–1/2 times the outside diameter of the wire and 2 inches longer than the damaged portion of the insulation. This sleeving is split lengthwise and wrapped 1–1/2 times around the wire at the damaged section. Tic with nylon braid at each end and at one inch intervals over the entire length (see Figure 3).

c. Heat shrink tubing may be used in lieu of transparent sleeve if feasible.

24 . **REPAIRING SHIELDED CABLE**.

25 . When the shielding braid of shielded cable has been damaged or the cable severed, it can be repaired in the following manner (see Figure 4).

CAUTION

Do not attempt to repair damaged shielding braid by covering with tape, as it is not possible to seal off severed ends, and these may puncture the wire insulation.

a. Select a grounding sheath according to instructions in TO 1–1A–14.1, Chapter 2.

b. Prepare the severed ends of the cable for application of a grounding sheath connector as described in section it.

c. Slide over the splice two insulating sleeves, either shrinkable or flexible transparent tubing, the inner one just large enough to pass over the grounding sheath connector and the outer one large enough to accommodate the inner insulating sleeve and the grounding lead. The inner insulating sleeve should be just long enough to completely cover the permanent splice. The outer sleeve must be long enough to extend beyond the two grounding sheath connectors as shown in Figure 4.

d. Attach a grounding sheath connector to one end of the severed wire as described in TO 1–1A–14.1, Chapter 2. The grounding wire should be long enough to span the repair.

e. Install a grounding sheath connector on the other side of the break. Do not crimp this yet.

f. Use a permanent splice to join the severed inner conductor (see Figure 4).

g. Slide inner insulating sleeve into position as shown in Figure 4. If shrinkable tubing is used apply heat as described in TO 1–1A–14.1, Chapter 11.

h. Push the free end of the grounding wire, from step c above, into the uncrimped grounding sheath connector. Crimp securely.

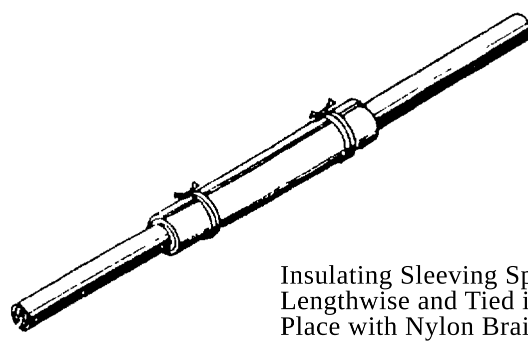


Figure 3. Insulation Repair with Sleeving

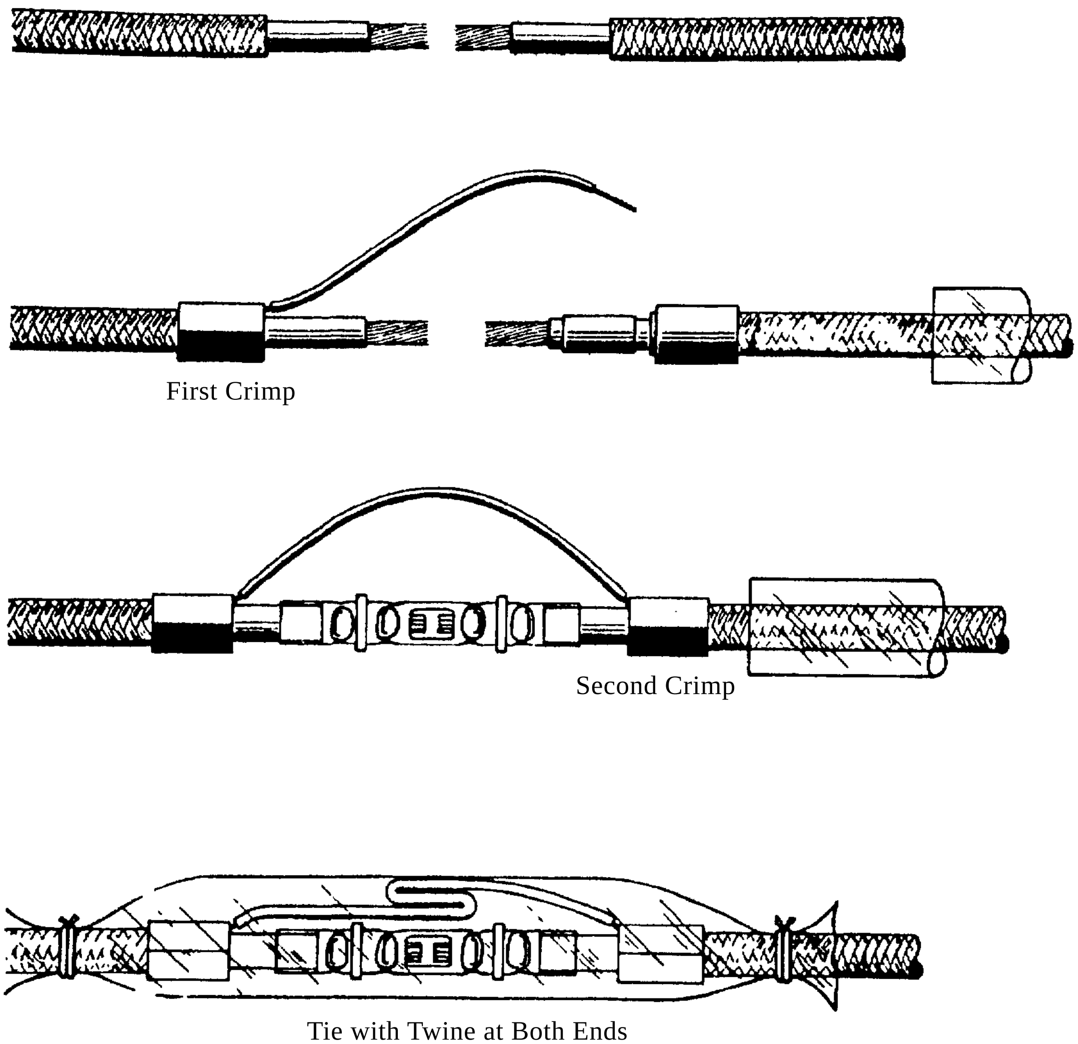


Figure 4. Repair of Shielded Wire

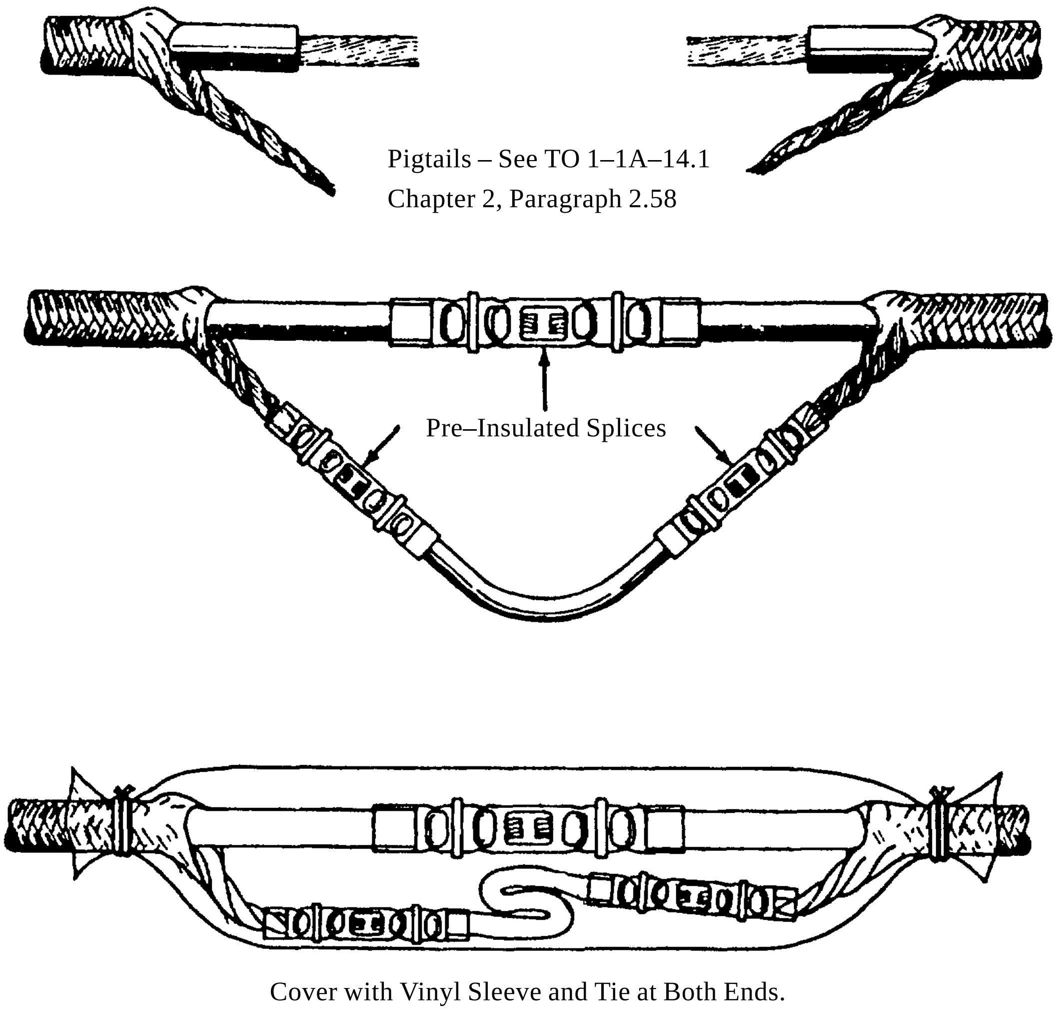


Figure 5. Alternative Method for Repair of Shield Wire

i. Slide outer insulating sleeve into place. If shrinkable tubing is used, proceed as in step g above. If flexible tubing is used, tie both ends with nylon braid as shown.

26 . An alternative method of repairing shielded cable is to be used, if grounding sheath connector as described in paragraph 25 is not available. The alternative method (shown in Figure 5) is as follows:

a. Prepare the severed ends of the cable for pigtail method of shield termination as described in TO 1–1A–14.1, Chapter 2.

b. Use pre–insulated splice connector to join inner conductors as described in TO 1–1A–14.1, Chapter 5.

c. Use two splice connectors to add short length of insulated wire as extension to complete shield connection.

27 . REPAIRING UNPOTTED CONNECTORS

28 . Defective MS connectors which have broken pins can be temporarily repaired in the following manner:

a. Where it is possible to get at both halves of the connector, one of the spare wires provided may be used by splicing the wire from the damaged or broken pin to the spare wire, following the procedures of paragraphs 13 – 17. This procedure must be followed for the wire leading to both halves of the connector. The unit must then be marked that this repair has been done.

CAUTION

Tag both connector halves with complete information of the modification. Replace both connector halves at the next PAR cycle.

b. Repairing or straightening of a bent pin should be accomplished with a mating socket of the same size. Bent pins should not be straightened with needle nose pliers.

29 . REPAIRING POTTED CONNECTORS

30 . Potted connectors are equipped with spare wires on all spare pins. If a pin becomes defective, the repair is made by cutting the wire leading to the defective pin and using a permanent splice (as previously described) to join the wire to a spare wire. The mating connector must also be so modified.

CAUTION

Tag both connector halves with complete information on the modification. Replace both connector halves at the earliest opportunity.

a. Cut away the potting compound (sealant) with a thin knife blade or scalpel. Use long nose pliers to pull the sealant while cutting. Be careful not to cut into wire insulation.

b. Carefully scrape away sealant from defective pin.

c. Use small (pencil) soldering iron to unsolder the wire lead from pin.

d. Use long nose pliers to pull pin out of resilient insert.

e. Solder wire to new pin and push pin into insert from rear.

f. Pour new potting compound into area of repair and air cure at room temperature for 24 hours. The new compound will seal satisfactorily to the old compound remaining in connector.

31 . FAILED WIRE

32 . Occasionally, a wire will fail inside the potted area of a connector. When the connector has a back shell, slide a thin knife blade around the outside edge of the sealant and unscrew the shell. This may take considerable force, depending on how tightly the sealant adheres to the shell. Follow the same steps as described above to reach the soldered connection. Do not remove the pin, but solder a new wire to the contact and repot the connector.

33. CLEANING CORROSION FROM CONNECTORS

34. If the corrosion has not entered the electrical portion of the connector and if they are electrically functional, the following procedure should be carefully followed:

a. If water is present, apply a light coat of water displacing preservative MIL–C–85054, Grade B, then dry thoroughly. Remove built–up corrosion products by using a soft–bristled brush, a fine abrasive mat, (M1L–A–9962), an aluminum oxide cloth P–C–451, Type 1, 320 grit), or a scraper or picker for hard–to–remove deposits. Avoid damage to the nonmetallic parts of the connector or adjacent nonmetal parts during the cleaning process.

b. After the major portion of corrosion products have been removed, if the connector will not disengage. small amounts of a 10 or 20 weight general purpose lubricating oil or a substance such as, or similar to WD–40 can be applied to the working surfaces of the connector. After the lubricant has worked itself in, it should be possible (by using alternate loosening and tightening motions) to free the working surfaces and disengage the connector halves. (The use of pliers or other configuration–defacing tools should be avoided).

c. With the connector halves apart, immediately remove any excess lubricant from the mating surfaces of the connector shell to keep it from entering the electrical portion of the connector. Also, remove any lubricant which has gotten into the nonmetallic or pin areas of the connector. Using the same tools as in step a, thoroughly clean any remaining corrosion products from the outside of the connector shell. Exercise care so as to prevent corrosion products from entering the electrical portion of the connector. This may be accomplished by holding the connector face against a flat surface which is covered with a clean shop cloth and then brushing the shell. Inspect the connector shells for integrity and function, and replace if required.

d. If the connector shells are satisfactory, they can be cleaned with a suitable cleaning solvent, such as Isopropyl Alcohol, TT–I–735, to remove any remaining corrosion products and lubricant residue. The entire connector should be inspected, repaired, and cleaned as required at this time.

WARNING

Alodine is moderately toxic to skin, eyes, and respiratory tract. Skin and eye protection is required.

Solvent should only be used in well ventilated areas and eye protection is required.

e. Apply a brush costing of Alodine (MIL–C–81706, Class 3) to the outer surfaces of the connector shell and coupling nut and dry according to the manufacturers' recommendations. Rinse the residue from the connector shell with a spray bottle of deionized water. Use potable water if deionized water is not available. Exercise care to keep the alodine solution and the rinse water from entering the electrical portion of the connector. Dry thoroughly using low–pressure, clean, dry air.

f. Brush a coating of MIL–C–16173, Grade 4, Corrosion Preventing Compound (CPC) on the outer surface of the shell and on the coupling nut. Allow to dry.

g. Mate connectors and touch up any damaged CPC with a light coating of fresh CPC. If the corrosion has entered the electrical portion of the connector and the contacts are corroded or damaged, replace the contacts as required. If this is not feasible, replace the connector.

35. REPLACEMENT OF CONNECTORS

36. Occasionally, a connector will be damaged to such a degree that the entire connector will require replacement. This usually requires installing a new connector to existing wires. However, if existing wires are too short, splices and wire pigtails must be used to install new connector. The following method is preferred:

NOTE

If wire identifying numbers are not visible use tape wire markers, Brady PMW–PK–8 or equivalent, to identify pin's socket position.

a. Select wire pigtails so that splices can be staggered. Shortest wire should be a minimum of six inches long.

b. Solder or crimp wires to pins/sockets required, then insert pins or sockets into the connector in a shop environment when possible. One end of the splice should be installed in this area also. The pigtailed connector then is spliced into the aircraft wire bundle. If connector is attached to shock–mounted equipment, wires should be of sufficient length to ensure free movement of the equipment on its shock mounts.

37 . REPAIR TO A WIRE BUNDLE

38 . Repair to a complete wire bundle should be accomplished using the same crimping techniques previously described. Care should be exercised to stagger splices. Where possible, splices in adjacent wires in a bundle should be separated by at least one splice–length. This may require the use of added jumper wires spliced into the existing wiring. The following rules apply:

a. Always use the proper size splice for the size wire being repaired,

b. Select the correct tool and ensure splice is located in the tool properly before crimping.

c. After repairs are made, ensure all MS21919 cable clamps and wire bundle ties are replaced. NEVER use string or plastic ties for primary wire bundle support.

39 . REPLACING TERMINAL BOARD COVERS.

40 . When a terminal board cover is lost or damaged so as to be unusable, cover the board with a piece of large insulating tubing, split lengthwise, and tied securely around the terminal board. This procedure is described in TO 1–1A–14.1, Chapter 13.

WARNING

If it is necessary to clean aircraft electric components, use only approved Military Standard cleaning compounds and approved procedures. The use of ordinary cleaning compounds or the failure to follow proper procedures may cause fires or explosions.

CAUTION

Emergency repairs not meeting the requirements of 01–1A–14 should be replaced as soon as possible. Air Force activities must comply with the inspection requirements of T.O. 8–1–1 (Aircraft Electrical Inspection Procedures).

41 . REMOVAL OF REVERTED POTTING COMPOUNDS

42 . The following instructions on the removal of reverted potting compounds are general in nature and require specific instruction before they are implemented. Due to peculiarities in the different aircraft systems the use of these instructions in the aircraft shall be directed by the specific aircraft System Manager (SM). The SM shall ensure that all safety and precautionary measures are accomplished (or can be accomplished) before directing the implementation.

WARNING

Deviations from these instructions can be dangerous to both the aircraft and personnel.

43 . REPLACEMENT WITH ENVIRONMENTAL TYPE ELECTRICAL CONNECTORS.

44 . The preferred method for repair of potted electrical connectors is replacement with environmental type electrical connectors. If environmental connectors are not obtainable then the next preferred method for repair is replacement with identical connectors and potting with an approved potting compound. If replacement is impossible and depotting becomes necessary, the following procedures are applicable.

45 . TOOLS AND EQUIPMENT.

a. Soldering iron with modified tip for cutting potting compound (not authorized for use on aircraft other than those defueled and purged for extensive maintenance, IRAN or major modification).

b. Tweezers.

c. Needle nose pliers.

d. Plastic/wood probes.

e. Electrician’s pocketknife.

f. Heat Applicator (heat⁄gun) Raychem HT900 (MS3507/14–01) (see paragraph 11.21) or explosion proof equivalent.

g. Respirators (organic vapor type).

h. Small stiff bristle brush.

i. Protective Clothing

(1) Rubber gloves.

(2) Eye protection (safety goggles).

(3) Rubber Apron.

j. Polyethylene Bags.

(1) 4–inch by 4–inch.

(2) 6–inch by 6–inch.

(3) 8–inch by 8–inch.

(4) 10–inch by 10–inch.

(5) 12–inch by 12–inch.

k. Polyethylene sheet, Federal Specifications L–P–378.

l. Absorbent material, Specifications CCC–C–429, DDD–W–101

m. Degasser: vacuum pump and accessories capable of maintaining a vacuum of 25 to 29 mm of mercury.

n. Balance, Harvard trip type, double beam, capable of weighing to 2000 grams and sensitive to 0.1 gram; or equivalent.

o. Sealant gun such as Semco Model 250–6 with retainer.

p. Potting compound cartridges to correspond to potting gun used, such as Semco Number 250–C12, 250–C6, 250–C2 1/2.

q. Cartridge nozzles to correspond to potting gun used, such as Semco Number 420, 440, etc.

r. Timing device, sweep second hand.

s. Stirring paddles, wood or plastic (wide tongue depressors are satisfactory).

t. Spray bottle, Polyethylene 16 oz.

u. Shore Durometer

v. Nylon Cord.

w. Wire (for typing around bags).

x. Portable ventilation equipment for use in confined locations to remove solvent vapors (such ventilation equipment must be explosion proof).

46 . **MATERIALS**

Potting Compound	Specification MIL–S–8516 (for low–temp areas)
Potting Compound	Specification MIL–S–23586 (for hi–temp areas)
Primer A4094	For Dow Corning compounds Silastic 69210 and 69220
Primer SS4004	For General Electric compound RTV 8111

NOTE

Use primer A4094 only with Dow Corning potting compounds and SS4004 only with General Electric potting compounds.

Examine all connectors potted with Pro Seal 777 or EC 2273 for evidence of material deterioration. Connectors shall be replaced or repotted in each instance in which the potted compound has deteriorated to any of the following stages: less than 20 SHore A, soft, spongy, doughy, viscous, or flowing A Shore A hardness of 60 or greater should ensure a 3–year service left before replacement.

Under no circumstances shall Pro Seal 777 or EC 2273 be covered over with another potting compound. It must be removed before repotting.

47 . **REMOVAL OF HI–TEMP (300°F) PRO SEAL 77A/B (GREEN) AND EC2273 (BLACK) POTTING COMPOUNDS AND INSTALLATION OF APPROVED POTTING COMPOUNDS.**

48 . Procedures for removing PRO SEAL 777 or EC 2273 potting compounds.

a. Prior to cleaning operation, rope off area involved and provide suitable signs indicating unauthorized personnel stay clear of area.

WARNING

Isopropyl Alcohol (TT–I–735) is toxic and flammable. Avoid eye and skin contact or breathing of vapors. Protective equipment is required. Personnel injury could result.

b. Prepare the area below all items subject to solvent for solvent spillage.

CAUTION

Isopropyl Alcohol, TT–I–735 will damage most paint films.

(1) Lay down a sheet of polyethylene covered with compounds absorbent material.

(2) Should any solvent be spilled on the absorbent materials, this material should be removed and disposed of or laundered.

c. Prepare aircraft taking all outlined safety precautions.

d. Remove plastic mold from potting on connector or relay (if installed), using soldering iron to cut plastic (see paragraph 45 step a).

e. Trim excess potting from component using soldering iron (see paragraph 45 step a) with modified tip.

CAUTION

Use extreme care to prevent damage to wire insulation or to the component body.

NOTE

Soldering iron tip should be modified to resemble a small spoon with no sharp or blunt edges. New tips may be fabricated from brass welding rod (see paragraph 45 step a).

f. Fill the polyethylene bag with enough Isopropyl Alcohol, TT–I–735 to completely immerse the potting compound, and check the bag for leakage. If the bag is leaking, transfer the solvent to a new bag and discard the leaky bag. Label the starting time on the bag with a marking pen to keep an accurate count of the soaking time.

g. Insert the connector or relay in the polyethylene bag. Tie the top of the bag in place with a nylon cord or a wire to prevent evaporation of the solvent.

NOTE

An alternate method is to place the connector in below the connector a large can or bucket, filling the container with enough Isopropyl Alcohol, TT–I–735 to completely immerse the potting compound. Then add about one inch of water to it. The water will stay on top of the Isopropyl Alcohol keeping the vapors from getting into the air. This will also prevent evaporation of the solvent.

Also the use of ZIP–LOCK polyethylene bags in lieu of the tie type bags is permitted.

CAUTION

Be sure the bags are tightly sealed. The laminate procedure must be accomplished in a ventilated booth area approved the by the resident Bio–environmental Engineer.

h. While the compound is soaking, inspect the bags for leaks every 10 to 20 minutes. Leaking bags found during this period shall have a second bag tied around them. This soak period shall be restricted to a maximum of one hour. Connectors which have the potting compound swelled or dissolved in less than one hour should be removed as soon as possible from the solvent to minimize soak time.

i. After the old potting compound has been dissolved, swelled, or one hour soaking time has been obtained, remove the bag of solvent. Contaminated solvent must be disposed of in an environmentally safe manner. Contact the Bio–environmental Engineer to establish an approved procedure.

j. Using tweezers, needle nose pliers, or picks, remove swollen potting compound.

k. Repeat swelling and picking operation until all potion compound is removed.

CAUTION

Never allow the soaking time to be extended over 2 hours. Prolonged immersion can swell and damage neoprene inserts in connectors. Tie the top of the bag in place with a nylon cord or a wire to prevent evaporation of the solvent.

l. Brush the connector briskly to remove all residues; rinse while brushing with small quantities of Isopropyl Alcohol, TT–I–735. Allow the solvent to run over the connector and collect in a container or polyethylene bag below the connector.

m. Allow the component to dry for 30 minutes minimum, then apply heat with Raychem HT900 (M83507/14–01) (see TO 1–1A–14.1 Chapter 11) or an explosion proof heat gun starting 6 to 8 inches above the component and work down. Five minutes heating time is sufficient. The applied temperature should not exceed 250°F

n. Let stand for 24 hours. Inspect for cleanliness and check all wires for insulation damage.

49. INSTALLATION OF NEW POTTING COMPOUND.

NOTE

Specification MIL–S–8516 potting compound is authorized for use in all compartments of the aircraft where ambient temperature normally does not exceed 185°F (200°F for naval weapon systems). Specification MIL–S–8516 compound will not be used to pot components in the engine bays, keel area, or areas adjacent to bleed air ducts (Boundary Layer Control and air conditioning).

a. a. Perform necessary rework, making sure that fluorocarbon insulated wires to be installed in the connector pin(s) are treated with a fluorocarbon etching compound to obtain a bondable surface (see T.O. 1–1A–14 Chapter 10).

NOTE

Wires and connectors previously potted will not be treated with the fluorocarbon etching compound. Only newly installed wires are to be treated.

CAUTION

Fluorocarbon etchant must not come in contact with a connector assembly or pin.

b. Prior to repotting, thoroughly inspect each component as follows:

(1) Inspect for any potting compound between the connector pins or embedded in any pin holes.

(2) Ensure that all depotting solution has been removed, insert has reduced to normal size, and the component is dry.

(3) Inspect for corrosion products on component hardware.

(4) Inspect the component for any liquid bleed out.

(5) Reprocess the component according applicable instructions if any one of the above deficiencies is detected.

(6) Inspect rubber insert in connectors. If insert is lose replace connector.

(7) Inspect for any broken, damaged or shorted wiring on the part. If the wiring is damaged, repair as necessary.

(8) Ensure that all wires and components are clean and free of contamination, that is , metal chips, grease, dirt, etc.

(9) Repotting procedure may be instituted if processed part is found to be satisfactory.

c. Potting should be accomplished as follows:

(1) If new wires have been added, clean the complete connector assembly by scraping off rosin and brush vigorously in new dry cleaning solvent or acetone followed by a second rinse of acetone.

WARNING

Isopropyl Alcohol (TT–1–735) is toxic and flammable. Avoid eye and skin contact or breathing of vapors. Protective equipment is required. Personnel injury could result.

(2) Rinse area to be potted with Isopropyl Alcohol (see paragraph 47) applied from hand operated spray bottle or similar device. Prevent skin contact with the Isopropyl Alcohol and use only with adequate ventilation. Eye protection is required.

NOTE

Complete potting within 2 hours after cleaning.

(3) Place proper size potting mold around the connector; make sure that it fits squarely on the should of the connector. If the proper size mold is not available, take two molds and overlap one over the other. Do not use anything except a commercial manufactured mold.

NOTE

Do not use masking tape as a mold for MIL–S–23586 potting compound.

(4) When the potting mold is placed squarely on the connector, make one wrap around the base on the mold using one inch masking tape to securely fasten the mold to the connector. Mask–off the connector from the top of the mold to the bottom of the connector, making sure to cover the pin sockets to prevent overflowed potting compound from entering.

(5) Thoroughly dry the connector with a heat gun.

NOTE

This drying operation is absolutely necessary to ensure that the connectors are bone dry prior to priming or potting.

(6) Carefully apply RTV primer using a brush or aerosol can to coat all surfaces of the connectors, wires, potting mold, etc., that will come in contact with MIL–S–23586 potting compound. In most cases a thin film of primer will give the best adhesion. If cracks appear in the chalked film, the primer coat is too heavy.

NOTE

MIL–S–8516 potting compound does not require the use of a primer.

(7) Mixing:

(a) The potting compound is stored in paired cans of base compound and accelerator. Use only the accelerator supplied with the base compound. Substitution may produce a sealant with sub–standard electrical properties. To avoid errors, store the base and accelerator together in a carton. Store material in not less than 40°F nor greater than 80°F.

(b) Weigh the desire amount of base compound into a quarter container.

NOTE

Any residue in the bottom of the base compound can should not be used. Do not scrape the can clean.

(c) Mix the catalyst thoroughly before using.

(d) Weigh the correct amount of catalyst into the preweighed base and mix thoroughly to achieve a uniform color. Scrape the mixing paddle, the sides, and the bottom of the container sufficiently to obtain a complete mix. Do not mix compound violently or excessive air bubbles will be entrapped. Refer to Table 1 for the correct mix ratio.

NOTE

A side reaction takes place in MIL–S–23586 potting between the catalyst and the base shortly after mixing. Due to this reaction, there may be a small evolution of gas. This gas must be removed by vacuum de–aeration. Gas evolution will not continue after vacuum de–aeration.

A container three to four times larger than the amount of compound mixed is required due to occluded air expansion in the vacuum chamber.

(e) Place container in vacuum chamber and vacuum deaerate at 25 mm (1 inch) or less of mercury, until the bubbling mass collapses. Continue vacuum for 3 to 5 minutes. Cautiously refill the vacuum chamber with air. Remove container from vacuum chamber.

(f) Immediately place the material in cartridges by pouring the material into the inside wall of the cartridge, while holding the cartridge at an angle. Exercise care to prevent folding in air. When the nozzle portion has filled, hold a finger over the end to prevent the material from running through. The cartridge is then assembled for use.

(8) Potting:

(a) Pot the connector immediately.

NOTE

Potting compound should fill mold and flow between pins, wires, and leave no voids.

(b) Do not attempt to pot any connector without the use of a potting gun. Insert the potting gun nozzle into the center of the wires at the bottom of the mold and inject material slowly, so as to force the material outward and upward to fill the mold from the bottom up. On many connectors it will be necessary to remove the nozzle from the circumference of the bottom edges. When the potting is done properly, the wires and bottom are coated first with the material rising and displacing air. Remove the nozzle slowly, adding a small amount of material to fill the cavity caused from the removal of the nozzle. If the wires are tightly grouped, they may be moved slightly to aid in the elimination of air cells and to aid in the flow of the material about the wires.

(c) Immediately, after filling each connector, tie the wires together loosely about 6 inches back from the connector. Make sure that the wires are centrally located in the connector so that each wire is completely surrounded by potting compound. The potted connectors must be secured in a vertical position so that the new potting material will not run out.

(d) Do not disturb connector until potting is cured. Refer to Table 1. Heat may be used to accelerate cure, but do not exceed 120°F. Vulcanization will not be accelerated at the center of the piece until the entire mass has reached the elevated temperature.

(9) After the potting has cured, remove the masking tape, replace the grounding band if necessary, and reidentify the connector.

WARNING

Epoxy Polyamide Primer Coating (MIL–P–23377 and MIL–PRF–85582) are highly toxic to eyes, skin, and respiratory tract. Avoid all contact. Skin and eye protection required. Use only with adequate ventilation.

(10) Where metal surfaces of components have been affected, clean surface affected with a wire brush and paint with Epoxy Polyamide Primer Coating MIL–P–23377 or MIL–PRF–85582. Apply Epoxy Polyamide Primer Coating MIL–P–23377 or MIL–PRF–85582 with brush or aerosol can. Use care not to paint mating surfaces of connector.

Table 1. Mix Ratio for Potting Compound

Potting Compound	Mix Ratio by Weight	Pot Life at 77° F	Tack Free at 77° F	Cure Time at 77° F
MIL–S–23586				
Type I (RTV8111)	100/3	1/2 hr	8 hrs.	24 hrs.
Type II (69210)	100/10	1 1/2hrs.	16 hrs.	48 hrs.
MIL–S_8516				
Class I	100/10	1/2 hr.	5 hrs.	24 hrs.
Class II	100/10	1 hr.	8 hrs.	48 hrs.
Class III	100/10	2 hrs.	16 hrs.	72 hrs.

d. Failure of potting compound to harden could be caused by any one or a combination of the following conditions:

(1) Improper ratio of potting compound to catalyst.

(2) Poor mixing of potting compound and catalyst. Through mixing is essential for proper hardening. Uniform coloring is an indication of proper mix.

(3) Low temperature. If temperature is lower than room temperature (70°F), a proportionately longer

cure time will be required. See Table 2 for effect of temperature on cure time.

Table 2. Effect of Temperature on Cure TIme

TEMP	TACK FREE	FULL CURE
77° F	8 hrs.	24 hrs.
50° F	24 hrs.	48 hrs.

NOTE

The cure times in Table 2 will also very depending on quantity of catalyst used. Low temperature cures should be avoided whenever possible. The 77°F cure will give optimum cure properties.

(4) Fault catalyst or base compound. It is wise to make a 25 gram test sample of each lot of both base and catalyst prior to starting the potting operation.

(5) Organic impurities such as zinc chromatic putty, cleaning solvents or traces of old potting will inhibit cure of MIL–S–23586 potting compounds. Through cleaning will prevent this problem.

50. QUALITY ASSURANCE SUMMARY

a. Potting adheres firmly to wires and existing potting.

b. No holes or soft spots that would indicate air entrapment in the potting.

c. Potting completely covers all connector contacts.

51. REMOVAL AND INSTALLATION OF POTTING COMPOUNDS. SPECIFICATION MIL–S–23586 AND MIL–S–8516 ACCESS TO CONTACT ONLY.

a. Using a soldering iron (see para 19) with a modified tip as shown in Figure 6, cut away the potting to gain access to the desire contact(s).

CAUTION

Use extreme care not to damage adjacent connector contacts or wire.

b. Using a dull knife, scrape away the remaining potting in the contact area.

WARNING

Isopropyl Alcohol (TT–I–735) is toxic and flammable. Avoid eye and skin contact or breathing of vapors. Protective equipment is required. Personnel injury could result.

c. Wash area thoroughly with Isopropyl Alcohol (TT–I–735) (paragraph 21)

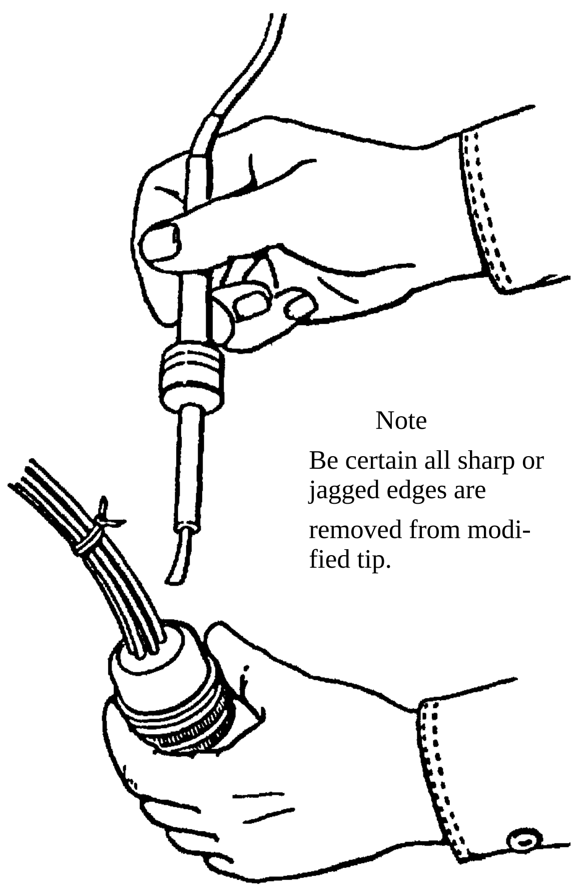


Figure 6. Potting Removal

d. Before potting connector, inspect for the following:

(1) Wire satisfactorily solder to contact, or, crimp pins correctly installed.

(2) Adjacent wiring or contacts have not been damaged during rework.

52. COMPLETE REMOVAL OF POTTING COMPOUND.

a. MIL–S–23586 must all be removed using a soldering iron (paragraph 19) and a dull tool.

b. MIL–S–8516 potting may be removed manually or with Isopropyl Alcohol, TT–I–735 (see paragraph 21).

53. INSTALLATION.

a. Construct a potting mold so potting will be at least 1/4 inch above connector contacts.

b. Prime all areas to which potting must adhere when using MIL–S–23586. Use A4094 primer with Dow Coming potting compounds, and SS4004 primer with General Electric RTV8111 potting compound. No primer is required for MIL–S–8516.

c. Mix potting compound, Specification MIL–S–23686, according to manufacturer's instructions (see paragraph 22 step c (7)).

d. Pot connector with potting compound (see paragraph 22).

e. Do not disturb connector for 24 hours after potting.

f. After curing is completed, the potting mold will be retained to provide additional mechanical strength.

g. MIL–S–8516 potting compound may be used to replace old MIL–S–8516 by following the instructions in paragraph 22.

54. QUALITY ASSURANCE SUMMARY.

a. Potting adheres firmly to wires and existing potting.

b. No holes or soft spots that would indicate air entrapment in the potting.

c. Potting completely covers all connector contacts.

55. REMOVAL OF HI–TEMP (500 °F) 3M COMPANY EC 1663 A/B POTTING AND INSTALLATION OF APPROVED POTTING COMPOUNDS.

56. This procedure provides information for correct removal and installation of hi–temp potting, which is used on electrical connectors of compact wire bundles.

57. REMOVAL.

58. Refer to paragraph 21.

NOTE

When a connector, relay, etc., containing potting compound Specification MIL–M–24041 is to be repaired, MIL–M–24041 must be removed completely and replaced with potting compound, Specification MIL–S–23586.

59. ALTERNATE PROCEDURE ONLY FOR PYLE NATIONAL THREADED CONNECTORS.

60. Remove all potting external to the shell per paragraph 21 step 3. Place the connector in a vise, cable end up, holding the wrench flats at the pin end of the connector. Heat the cable support metal shell using a propane torch. Heat the shell until a thin film of potting adjacent to the interior shell liquidifies. Remove heat and unscrew the threaded cable support shell, using a pipe wrench at the cable shell wrench flats. Do not exceed the temperature rating of the various connector components.

WARNING

Do the connector heating only in a well ventilated area.

61. INSTALLATION.

62. Refer to paragraph 22 for procedures and paragraph 23 for quality assurance.

63. POTTING SPLICING.

64. Temporary splicing when no environmental splices are available or splicing is required in a fuel vapor area will be accomplished as follows:

a. Install a piece of sleeving (selected from TO 1–1A–14.1, Table 11–11) about four inches long and of the proper diameter to fit loosely over the insulation, on one piece of broken wire.

b. Strip appropriate length from each end of the broken wire.

c. Splice both wires with M7928/5 splice.

d. Draw sleeve over wires and tie at one end. Fill sleeve with potting MIL–S–23586 and tie securely.

e. Allow potting compound to set without touching for four hours. Full cure and electrical characteristics are achieved in 24 hours.

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SHIELD TERMINATIONS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature		Part. No./Type Designation
Fixture, Holding		AD-156
Heat Gun		HT-900B
Heat Gun		HT-920B
Heating Tool, Infrared		IR-500
Heating Tool, Infrared		IR-550
Heater, Two Station		IR-1044
Contact		M39029/74–400
Contact		M39029/73–397
Contact		M39029/74–401
Contact		M39029/73–398
Contact		M39029/74–399
Contact		M39029/73–396
Shield Terminations		SAE–AS83519 Series
Shielding Jumper Wire		M22759/11-22-5
Shielding Termination Ferrule	1	3280XX
Shielding Termination Ferrule	1	5M608-XX
Sleeve, Filling		CTA-0006
Sleeve, Filling		CTA-0042
Sleeve, Protective		RNF-100
Sleeving, Insulation	1	M23053/12-XX-0
Tape, Insulation, Electrical, High Temperature, Polytetrafluoroethylene, Pressure Sensitive		A–A–52080 thru A–A–52084
Wire		MIL-W-22759

Note

1 Size required to be determined by technician.

1 . **INTRODUCTION.**

2 . This work package (WP) covers the types of shield terminations used for shielded/coaxial cables, their selection and the authorized shield termination installation procedures for terminating shields and shielded cable on aircraft.

3 . **SHIELD TERMINATIONS FOR SHIELDED/ COAXIAL CABLE.**

4 . **DESCRIPTION.** Shield terminators are used to terminate shielded single cable, multi–conductor cable and coaxial cable to a wire pair PC board, connector terminals, wire-wrap posts, or match impedance between cable and PC boards.

5 . The types of shield terminations are solder sleeves, paddle card, pinpak, and matched impedance terminations.

6 . **HEATING.** Proper heat is essential to all types of shield terminations to ensure proper solder connection and sealing. These shield terminations are designed to be installed using a heat gun or infrared heating tool.

7 . **SOLDER SLEEVE TERMINATIONS.** A solder sleeve termination consist of heat-shrinkable insulation sleeve with an integral solder preform with flux and thermal indicator, Class I termination only, and two integral rings of sealing material. When specified, these terminations contain a preinstalled ground lead. Environment resistant. heat-shrinkable solder type terminations may be used on data bus, shield, and coaxial cables where temperatures does not exceed 302°F (150°C).

8 . **FUNCTION.** When the solder sleeve is placed over a cable and heated, the solder melts and flows connecting the ground lead to the shield. The outer sleeve shrinks and the thermoplastic insert melts encapsulating the termination. The result is a soldered, strain relieved, and environmentally protected termination.

9 . **VERSATILITY.** Solder sleeve terminations can be utilized at any location along a cable providing excellent protection from electromagnetic interference.

10 . **CLASSIFICATION.** Solder sleeve terminations are divided into two classes, Class I and Class II.

11 . **Class I.** These terminations are intended for use by the military and the only class authorized for use by their activities.

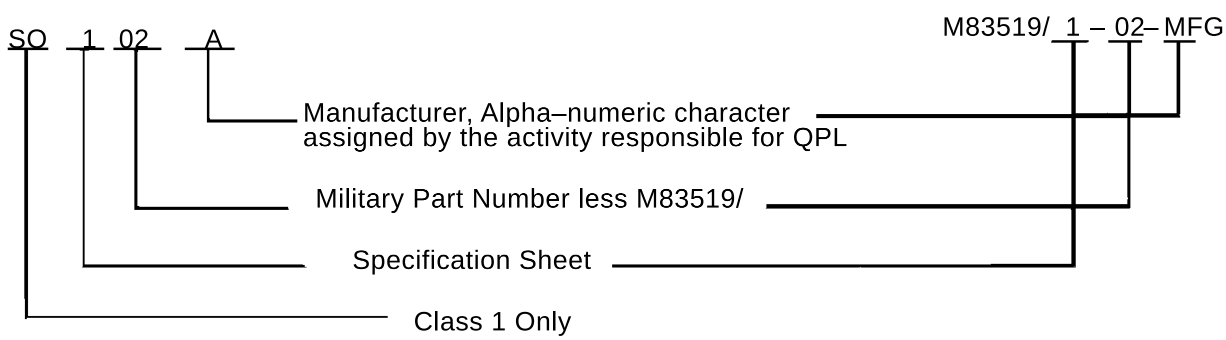
12 . **Class II.** These terminations are authorized for original equipment manufacturers and are not to be used for replacement purposes.

13 . **MARKING CODE.** Class I terminations are permanently marked with six alpha-numeric characters in contrasting ink (Figure 1) Class II terminations are marked with four alpha-numeric characters consisting of specification sheet number, a two digit part number, and an alpha character manufacturer code.

14 . **IMMERSION RESISTANT SOLDER SLEEVES (PREFERRED).** Immersion resistant solder sleeve shield grounding terminations provide a strong, environmentally sealed, soldered connection which is both completely insulated and encapsulated. They are can be procured with a pre-installed ground lead to provide: a single pre-assembled part. The preinstalled ground lead combined with the solder sleeve termination method means part positioning and installation are exceptionally fast, easy, and convenient (Figure 2).

15 . Advantages of immersion resistant solder sleeves are as follows:

a. Higher operating temperatures.



Example: S0102X – Standard configuration without ground lead – .145 I.D.
S0215X – Standard configuration with preinstalled ground lead – .300 I.D.

Figure 1 . Marking Code

b. Altitude immersion resistant.

c. Meets sealing requirements of AS50881.

16 . **M83519/1 or Series SO1.** These solder sleeves are supplied without a ground lead; and if required, ground lead must be installed. (Figure 3).

17 . **M83519/2 or Series SO2.** These solder sleeves are supplied with a pre-tinned ground lead (Figure 4).

18 . **IMMERSION RESISTANT SOLDER SLEEVE SELECTION.** To provide proper sealing and connection, the solder sleeve must be selected by size and cable dimensions (Figure 5).

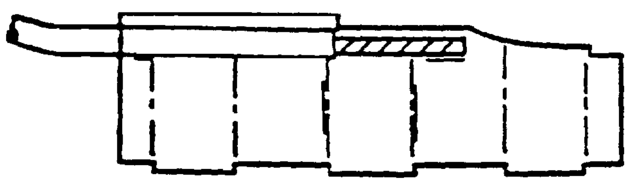


Figure 2 . Immersion Resistant Solder Sleeve

NOTE

For center stripped applications on cables rated above 257°F (125°C) only, the cable jacket diameter shall not exceed E maximum.

When using an M83519/2 the E diameter is of the cable only.

The G dimension is the minimum the sleeve will seal. Additional sealing material may be required for certain multi conductor cables.

19 . **STANDARD SOLDER SLEEVES.** Standard solder sleeve shield grounding terminations provide a strong, soldered connection that is completely insulated and encapsulated. They are not normally supplied with a pre-installed ground lead to provide a single pre-assembled part (Figure 6). The pre-installed ground lead combine with the solder sleeve termination method means part positioning and installation are exceptionally fast, easy, and convenient.

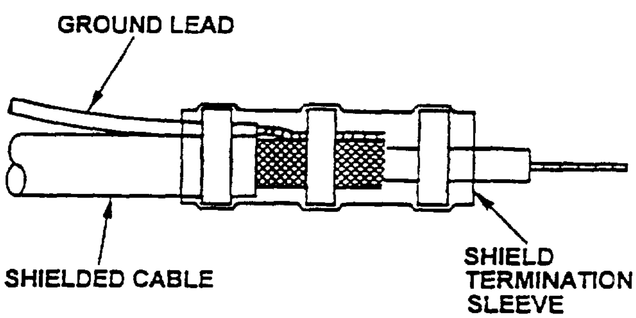


Figure 3 . M83519/1 Termination

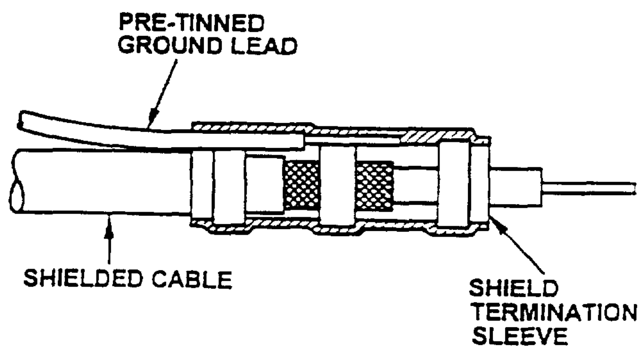
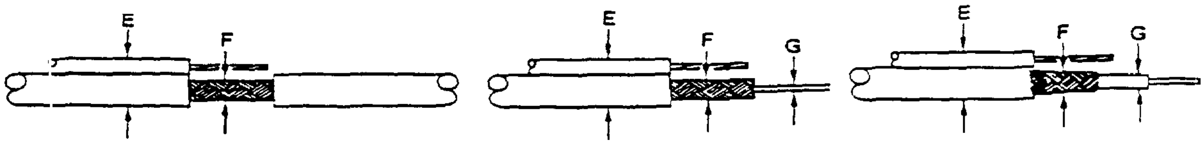


Figure 4 . M83519/2 Termination



CENTER STRIP | END STRIP | END STRIP BRAIDED FOLDED BACK

NOTE:
FOR CENTER–STRIPPED APPLICATIONS ON CABLES RATED ABOVE 257° F (125° C) ONLY THE CABLE JACKET DIAMETER SHALL NOT EXCEED E MAX.

WHEN USING A SLEEVE WITH A PRE–INSTALLED LEAD. THE E DIAMETER IS THE DIAMETER OF THE CABLE ONLY.

G DIAMETER IS THE MINIMUM DIAMETER ON WHICH THE SLEEVE WILL SEAL.

USE FOLD BACK METHOD FOR CABLES RATED BELOW 257° F (125°C).

Part Number	Marking Code	Gage of Ground Lead	E Max.	F Min.	G Min.
M83519/1-1	S0101X	—	.105	.035	.020
M83519/1-2	S0102X	—	.145	.055	.030
M83519/1-3	S0103X	—	.200	.085	.050
M83519/1-4	S0104X	—	.255	.130	.070
M83519/1-5	S0105X	—	.300	.170	.100
M83519/2-1	S0201X	20	.105	.035	.020
M83519/2-2	S0202X	20	.145	.055	.030
M83519/2-3	S0203X	20	.200	.085	.050
M83519/2-4	S0204X	20	.255	.130	.070
M83519/2-5	S0205X	20	.300	.170	.100
M83519/2-6	S0206X	22	.105	.035	.020
M83519/2-7	S0207X	22	.145	.055	.030
M83519/2-8	S0208X	22	.200	.085	.050
M83519/2-9	S0209X	22	.255	.130	.070
M83519/2-10	S0210X	22	.300	.170	.100
M83519/2-11	S0211X	24	.105	.035	.020
M83519/2-12	S0212X	24	.145	.055	.030
M83519/2-13	S0213X	24	.200	.085	.050
M83519/2-14	S0214X	24	.255	.130	.070
M83519/2-15	S0215X	24	.300	.170	.100
M83519/2-16	S0216X	26	.105	.035	.020
M83519/2-17	S0217X	26	.145	.055	.030
M83519/2-18	S0218X	26	.200	.085	.050
M83519/2-19	S0219X	26	.255	.130	.070
M83519/2-20	S022OX	26	.300	170	.100
X = The Manufacturer’s Alpha Numeric Character assigned by the Qualifying Activity					

Figure 5 . Immersion Resistant Solder Sleeve Selection

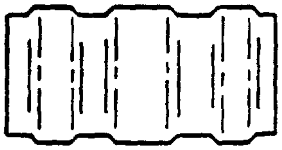


Figure 6 . Standard Solder Sleeve

20 . The heat-shrinkable thermoplastic sleeve contains a fluxed solder preform which provides exactly the amount of solder and flux required to terminate the ground lead to the cable shield. Thermoplastic sealing rings, one at each end of the sleeve, melt when the sleeve, is heated, providing strain relief and forming an environmental seal to protect the termination from dirt and moisture. The termination contains a thermochromic temperature indicator (Class 1 only) to assist in termination and inspection. In addition, a permanent identification number is marked on the sleeve.

21 . **COAXIAL CABLE SOLDER SLEEVE TERMINATIONS.** Coaxial cable solder sleeve terminations (Figure 7) are used to terminate coaxial cables to PC boards, solderless wrap terminals, and crimp solder connections. These solder sleeves consist of two heat-shrinkable thermoplastic sleeves, each containing a ground or signal lead, fluxed solder preform and thermoplastic sealing inserts. The thermoplastic sealing inserts melt when the sleeve is heated to form an environmentally protected termination and eliminates the possibility of a solder bridge between the center conductor and the shield. Two types of coaxial terminators are available for use with low temperature, -67°F (-55°C) to -257°F (+125°C) and high temperature, -67°F (-55°C) to +302°F (+150°C).

22 . **Low Temperature Part Number Breakdown.** (Figure 8) provides the part number breakdown for the Series D–131 low temperature coaxial cable solder sleeve terminations.

23 . **Low Temperature Selection.** The dielectric O.D. (Table 1) determines low temperature coaxial cable solder sleeve size.

24 . **High Temperature Part Number Breakdown.** (Figure 9) provides the part number breakdown for the Series D-181 high temperature coaxial cable solder sleeve terminations (Table 2).

25 . **COAXIAL CABLE WITH AIR/POLYETHYLENE DIELECTRIC SOLDER SLEEVE TERMINATIONS.** Coaxial cable with air/polyethylene dielectric solder sleeve terminations (Figure 10) is used to terminate cables to a wire pair, PC board, connector terminals, or wire-wrap posts. These solder sleeves consist of two separate assemblies. The center conductor termination consists of a dielectric barrier and a heat-shrinkable sleeve containing a fluxed solder preform, a meltable insert, and a pre-installed ground lead. These solder sleeves are used on low temperature cables with a temperature rating of -67°F (-55°C) to +257°F (+125°C).

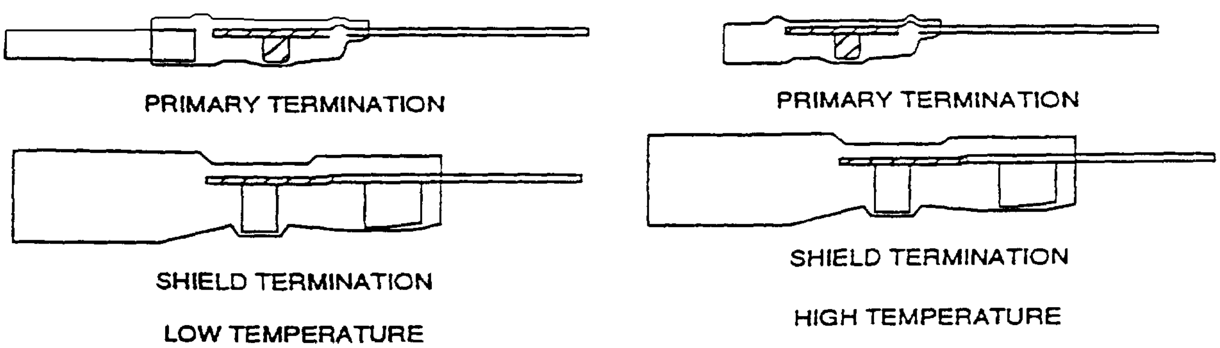


Figure 7 . Coaxial Cable Solder Sleeves

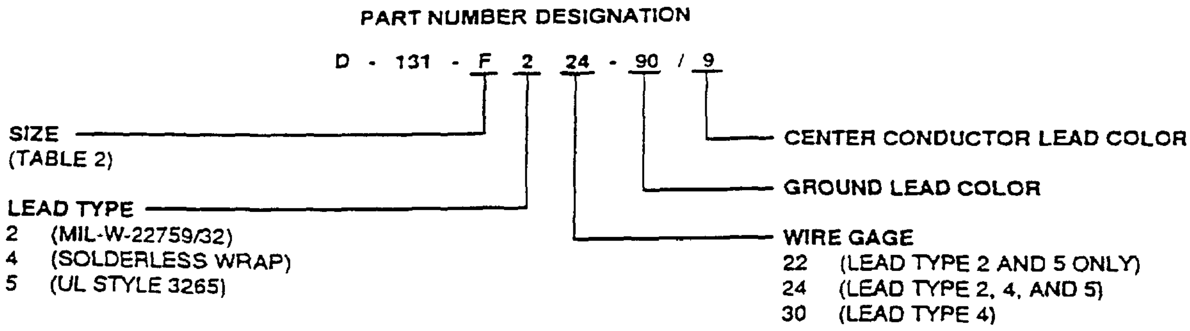


Figure 8 . Low Temperature Coaxial Cable Termination Part Number Breakdown

Table 1 . Low Temperature Coaxial Cable Solder Sleeve Selection

Termination Size	Dielectric O.D (in)	Cable Type	Termination Size	Dielectric O.D (in)	Cable Type
A	.050	—	G	.110	—
B	.060	—	H	.120	—
C	.070	174	J	.130	58
D	.080	—	K	.140	—
E	.090	—	L	.150	—
F	.100	122	M	.160	59, 62, 100

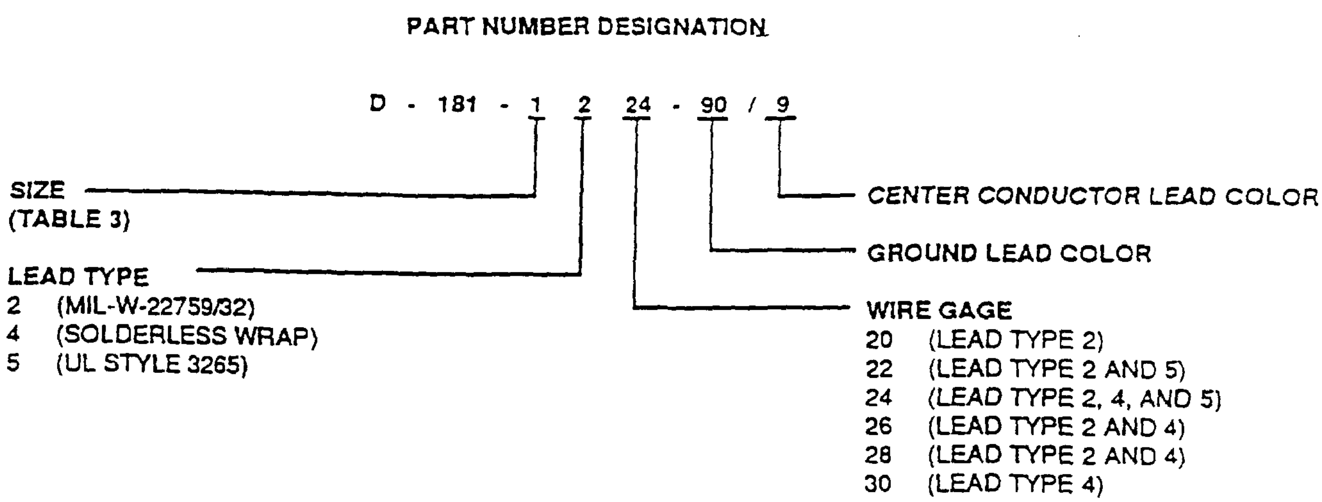


Figure 9 . High Temperature Coaxial Cable Solder Sleeve Selection

Table 2 . High Temperature Coaxial Cable Solder Sleeve Selection

Termination Size	Dielectric O.D. (in)	Shield O.D. (in)	Jacket O.D. (in)	Cable Type
D-181-1XXX	.025-.090	.045-.125	.060-.140	178, 179, 188, 316, 404
D-181-2XXX	.035-.118	.060-.140	.075-.170	180, 279
D-181-3XXX	.055-.153	.085-.180	.100-.205	141, 195, 302, 303, 400

Table 3 . Coaxial Cable with Air/Polyethylene Dielectric Solder Sleeve Termination

Part Number	Primary Lead Color Code	Ground Lead Color Code	Dielectric O.D. (in) max	Jacket O.D. (in)	Lead Wire Gage
D-500-0089	White	Blue	.130	.145-.290	22AWG
D-500-0114	White	Blue	.080	.090-.215	24AWG
D-500-0120	Yellow	White	.130	.145-.290	22AWG
D-500-0121	Yellow	White	.130	.145-.290	24AWG
D-500-0122	Yellow	White	.130	.145-.290	26AWG
D-500-0134	White	White with Black Stripe	.157	.200-.290	22AWG

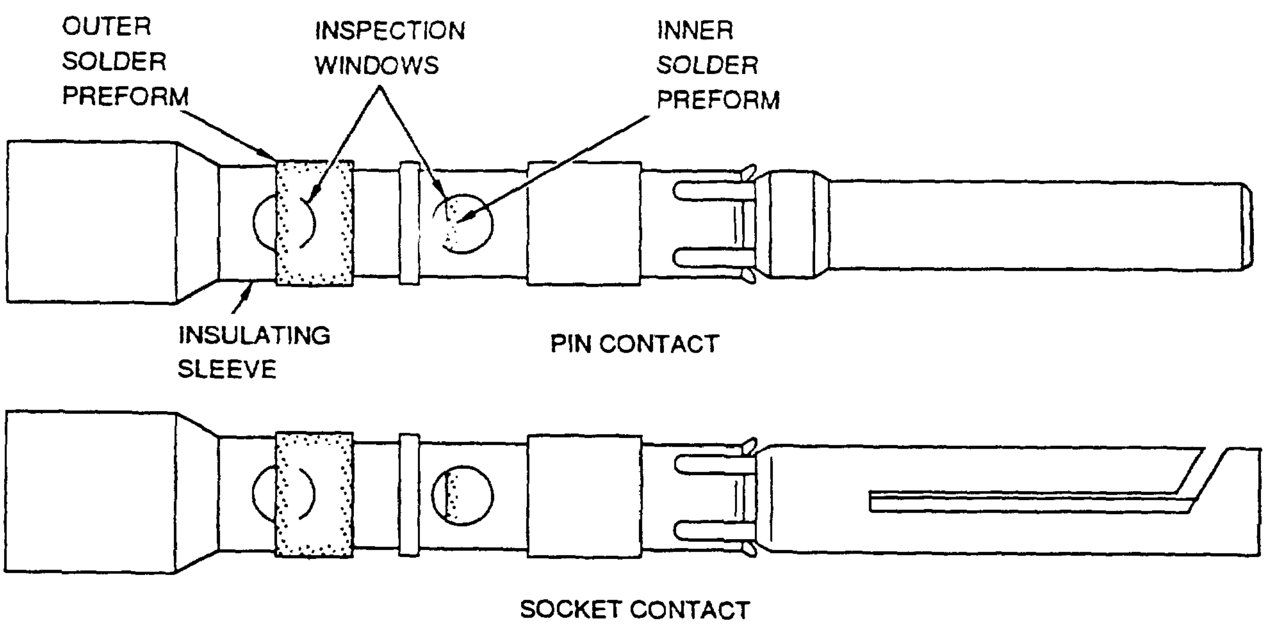


Figure 10 . Typical Coaxial Solder Contact

26 . **COAXIAL CABLE WITH AIR/ POLYETHYLENE DIELECTRIC SOLDER SLEEVE TERMINATION SELECTION.** Selection of these solder sleeves is determined by the O.D. of the dielectric and jacket and the lead wire gage (Table 3).

27 . **PADDLE CARD TERMINATIONS.**

28 . Paddle card terminations (Figure 11) are used to terminate coaxial cables to paddle card or PC boards. These terminations consist of a heat-shrinkable sleeve containing a pre-installed ground bus and a solder preform. When the paddle card termination is installed on a coaxial cable, the ground bus is soldered to the shield and the heat-shrinkable sleeve (Figure 12).

29 . **PADDLE CARD TERMINATION SELECTION.** Selection of paddle card terminations is determined by the O.D. of the cable jacket. For cables with a temperature rating below 257°F (125°C), select the dielectric barrier by dielectric O.D. of the cable and paddle card termination to be installed (Table 4).

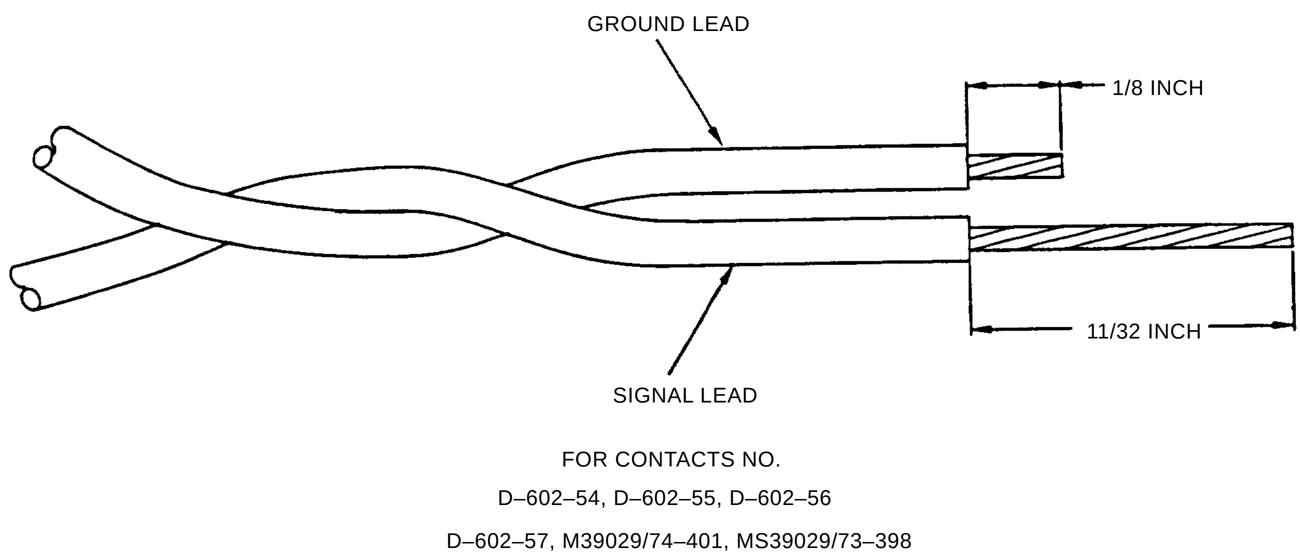


Figure 11 . Strip Dimensions for Twisted Pair Solder Contacts

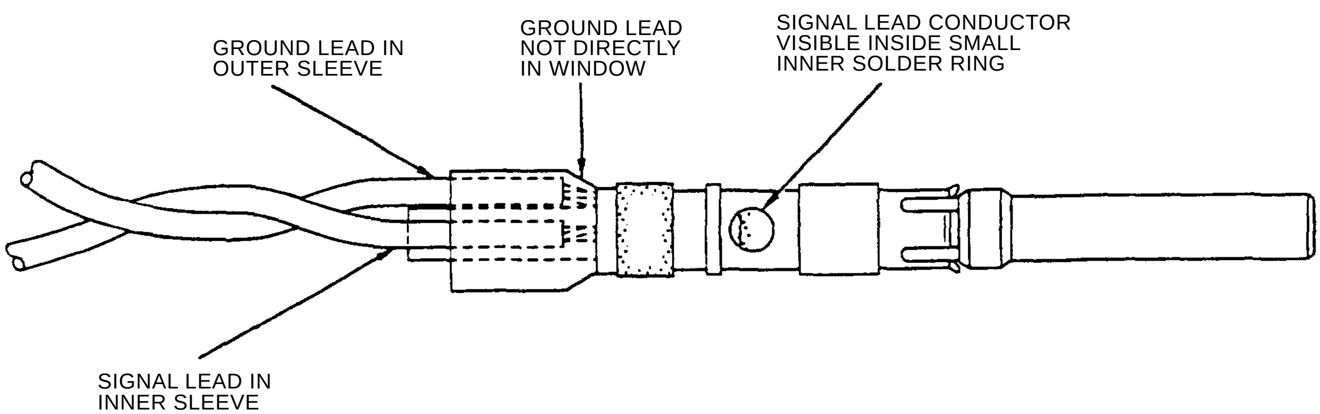


Figure 12 . Inserting Twisted Pair into Solder Contact

Table 4 . Paddle card Termination and Dielectric Barrier Selection

Termination Part Number	Cable Jacket O.D. (in)	Color Code	Barrier Part Number	Cable Dielectric O.D. (in)	Color Code
D-134-03	.070-.130	Black	D-513-03	.020-.030	Yellow
D-134-04	.090-.215	Blue	D-513-04	.030-.040	Blue
			D-513-05	.040-.050	White
			D 513-06	.050-.060	Yellow
			D 513-07	.060-.070	Blue
			D-513-08	.070-.080	White
			D-513-09	.080-.090	Yellow
D-134-05	.130-.240	Yellow	D-513-09	.080-.090	Yellow
			D-513-10	.090-.100	Blue
			D-513-11	.100-.110	White
			D-513-12	.110-.120	Yellow
D-134-06	.145-.270	Red	D-513-10	.090-.100	Blue
			D-513-11	.100-.110	White
			D-513-12	.110-.120	Yellow
			D-513-13	.120-.130	Blue
			D-513-14	.130-.140	White
D-134-07	.165-.315	Green	D-513-12	.110-.120	Yellow
			D-513-13	.120-.130	Blue
			D-513-14	.130-.140	White
			D-513-15	.140-.150	Yellow
			D-513-16	.150-.160	Blue
			D-513-17	.160-.170	White
D-134-08	.190-.365	Violet	D-513-15	.140-.150	Yellow
			D-513-16	.150-.160	Blue
			D-513-17	.160-.170	White
			D-513-18	.170-.180	Yellow
			D-513-19	.180-.190	Blue
			D-513-20	.190-.200	White
			D-513-21	.200-.210	Yellow
			D-513-22	.210-.221	Blue

30 . PINPAK COAXIAL TERMINATIONS.

31 . PinPak coaxial terminations (Figure 13) are used to terminate coaxial cables to PC boards. These terminations consist of a heat-shrinkable sleeve containing a pre-shaped lead member, solder preforms, and meltable insert. The lead member consists of a ground lead portion and a signal lead portion, which are on a fixed spacing to match the holes in the PC board. The other end of the lead member fits the coaxial cable so that the ground lead aligns with the braid and the signal leads aligns with the cable center conductor. When the termination is installed, the shield and the center conductor are simultaneously soldered to the lead member and the sleeve shrinks to form an insulated and strain relieved termination.

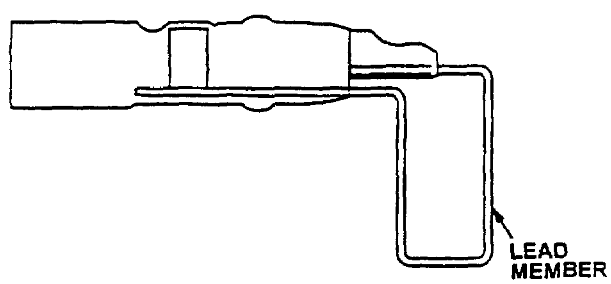


Figure 13 . PinPak Coaxial Termination

32 . **PINPAK COAXIAL TERMINATION SELECTION.** Selection of these terminations is determined by cable O.D., shield type, lead diameter, and row spacing (Table 5).

33 . **MATCHED IMPEDANCE TERMINATIONS.**

34 . Matched impedance terminations (Figure 14) provide a fully shielded, low voltage standing wave ratio (VSWR), matched impedance termination of 50 and 75 ohm coaxial cables to PC boards. These terminations consist of a tin plated copper body, heat-shrinkable sleeve, and a fluxed solder preform. When installed and soldered to the PC board, all conducting and insulating components are securely fixed to maintain consistent impedance.

35 . **MATCHED IMPEDANCE TERMINATION SELECTION.** These terminations are supplied in one size, which fit cables with a jacket diameter of .075 to .110 inch and a dielectric diameter of /034 to .060 inch. Selection is determined by requirement for a straight or right angle matched impedance termination. The D-607-09 is the straight termination and D-607-10 is the right angle termination.

36 . **SHIELD TERMINATION INSTALLATION.**

NOTE

Thermal indicator is the red color around the solder band and is used as an inspection aid. The final inspection criteria for a proper termination is as called out in MIL-HDBK-454 Requirement 5 and Figure 15 .

37 . **HEATING.** Proper heat is essential to ensure proper solder connection and sealing. The sleeves are designed to be installed using the HT-900B/HT-920B Heat Gun

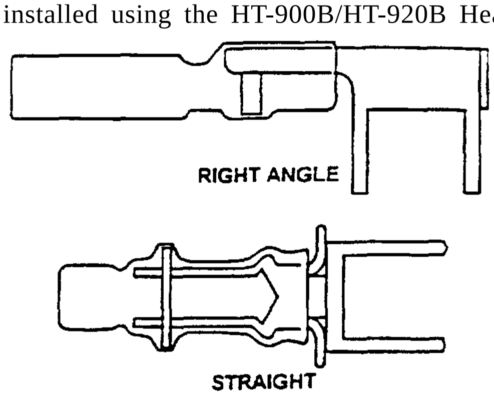


Figure 14 . Matched Impedance Termination

or IR-500/550 infrared heating tool. The sleeve contains a colored thermochromic temperature indicator that changes to clear when the surfaces have reached wetting temperature, which also aids in the inspection of the completed transmission (Figure 15).

38 . The following paragraphs and Figures provide installation procedures for all shield terminations presented in this manual.

39 . **IMMERSION RESISTANT AND STANDARD SOLDER SLEEVE INSTALLATION.** Figures provides installation procedures for the M83519/1, M83519/2, and Series SO immersion resistant solder sleeves.

40 . **COAXIAL CABLE SOLDER SLEEVE TERMINATION INSTALLATION.** Figure 17 and Figure 18 provide installation procedures for low temperature Series D-131 and high temperature Series D-181 coaxial cable solder sleeve installation, respectively.

41 . **PADDLE CARD TERMINATION INSTALLATION.** (Figure 19) provides installation procedures for paddle card terminations.

42 . **INFRARED.** Infrared heat may be used when available. Solder sleeves may be affixed with these tools which offer faster shrinking and solder flow and a1so less complication in setup and portability. There are two types of Infrared Heating tools.

43 . **IR-550.** This tool is a self contained portable unit that requires 115 volts AC for operation. The tool consists of a main body with a stand and handle attached (Figure 16).

44 . **IR-500B.** This tool is a self contained portable unit that requires 115 volts AC for operation. The tool differs slightly in that the IR-500 has a screen covered main body with a stand and handle that contains a trigger switch where as the IR-500B has a pressure push switch.

45 . **INFRARED PROCEDURE.** The procedure for shrinking solder sleeves is as follow:

a. Prepare cable as in Figure 17 depending upon the application required.

b. Assemble cable, ground lead when required, and solder sleeve. Ensure no strands protrude to puncture sleeve. Ground lead entry can be either front or rear (Figure 18).

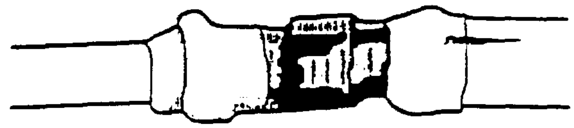
UNACCEPTABLE TERMINATION (INSUFFICIENT HEAT)

DULL RED COLOR (THERMAL INDICATOR) IS CLEARLY VISIBLE.

ORIGINAL SHAPE OF SOLDER PREFORM IS CLEARLY VISIBLE.

MELTABLE SEALING INSERTS HAVE NOT FLOWED.

CONTOUR OF BRAID AND/OR LEAD IS BLOCKED BY SOLDER.



ACCEPTABLE TERMINATION (MINIMUM SOLDER FLOW)

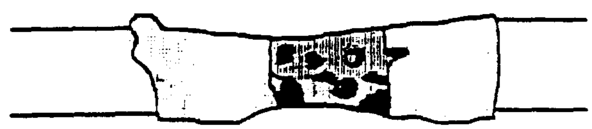
SLIGHT TRACES OF DULL RED COLOR SHALL BE PRESENT.

SOLDER HAS LOST ALL ORIGINAL SHAPE.

SEALANT INSERTS HAVE MELTED AND FLOWED ALONG WIRES.

SHIELD AND LEAD CONTOURS ARE VISIBLE.

A DEFINITE FILLET IS VISIBLE BETWEEN LEAD AND SHIELD.



ACCEPTABLE TERMINATION (MAXIMUM SOLDER FLOW)

DULL RED COLOR HAS DISAPPEARED.

NO TRACES OF DULL RED COLOR REMAIN IN THE SEALANT INSERT AREA. SLIGHT TRACES OF DULL RED COLOR IN SEALANT INSERT AREA ARE ACCEPTABLE.

A DEFINITE FILLET IS CLEARLY VISIBLE BETWEEN LEAD AND SHIELD.

JOINT AREA IS VISIBLE DESPITE BROWNING OF SLEEVE.

UNACCEPTABLE TERMINATION (OVERHEATED)

JOINT AREA IS NOT VISIBLE BECAUSE OF SEVERE DARKENING OF THE OUTER SLEEVE.

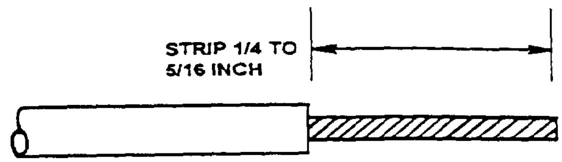
SOLDER FILLET IS NOT VISIBLE ALONG LEAD AND SHIELD INTERFACE.

WIRE INSULATION DAMAGED OUTSIDE OF SLEEVE.

Figure 15 . Termination Inspection

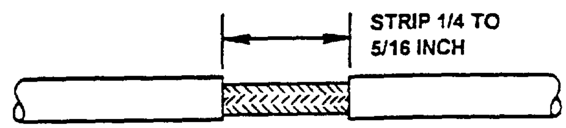
A. GROUND LEAD PREPARATION.

1. IF GROUND WIRE IS NOT PRE–INSTALLED, SELECT WIRE FROM MIL–W–22759

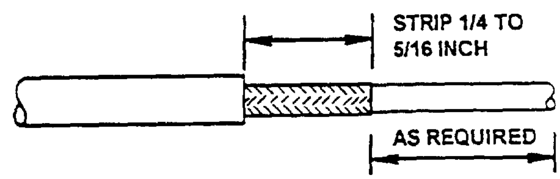


B. SHIELD PREPARATION

1. STRIP 1/4 TO 5/16 INCH OF JACKET FROM CABLE.

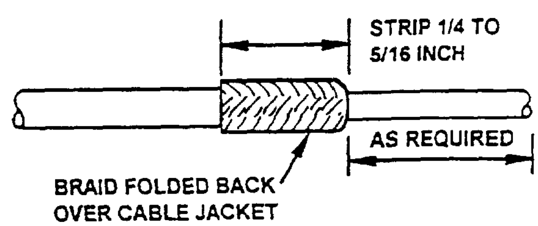


CENTER STRIPPED FOR CABLES RATED ABOVE 257°F (125°C)



END STRIPPED FOR CABLES RATED ABOVE 257°F (125°C)

2. AFTER STRIPPING, BUILD UP DIAMETER OF SMALL CABLE BY FOLDING BRAID OVER JACKET.



BRAID FOLDED BACK FOR SMALL CABLE RATED BETWEEN 221°F (105 C) AND 257°F (125°C)

Figure 16 . Immersion Resistant and Standard Solder Sleeve Installation (Sheet 1 of 3)

C. ASSEMBLY.

1. Assemble Cable, Ground Lead, and Solder Sleeve Ensuring No Strands Protrude to Puncture Sleeve. Ground Lead Entry May Be From Front or Rear.

WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

2. Using Heat Gun, Apply Heat Directly to Solder Perform Until Solder Melts, Flows and Wets Shield Braid and Ground Lead.

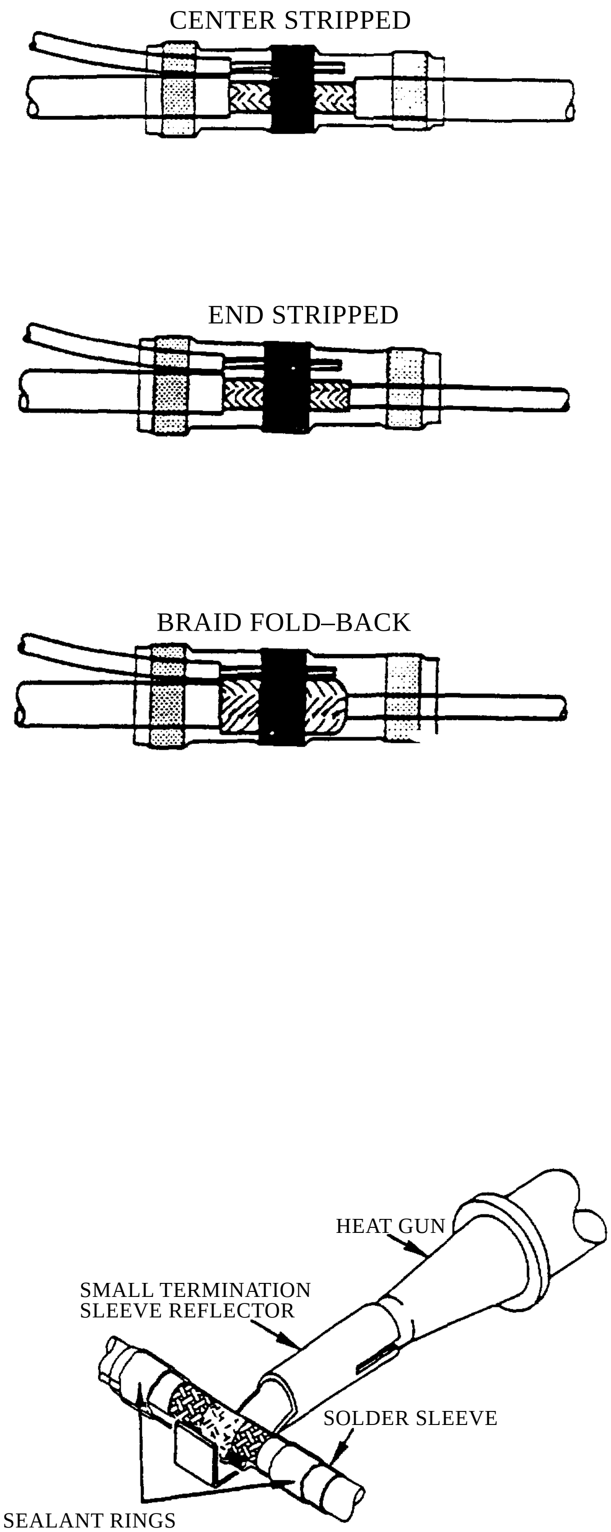


Figure 16. Immersion Resistant and Standard Solder Sleeve Installation (Sheet 2)

NOTE

The Collapse of Solder Preform Does Not Indicate Solder Flow. Continue to Apply Heat Until Solder Flows and Forms Fillet Between Shield and Ground Lead

3. If Necessary, Heat Ends of Sleeve to Complete Shrinkage of Sleeve and Inserts.
4. Inspect Termination for Acceptable Conditions.
5. Reshrink, If Necessary, Until Acceptable Condition Exists.

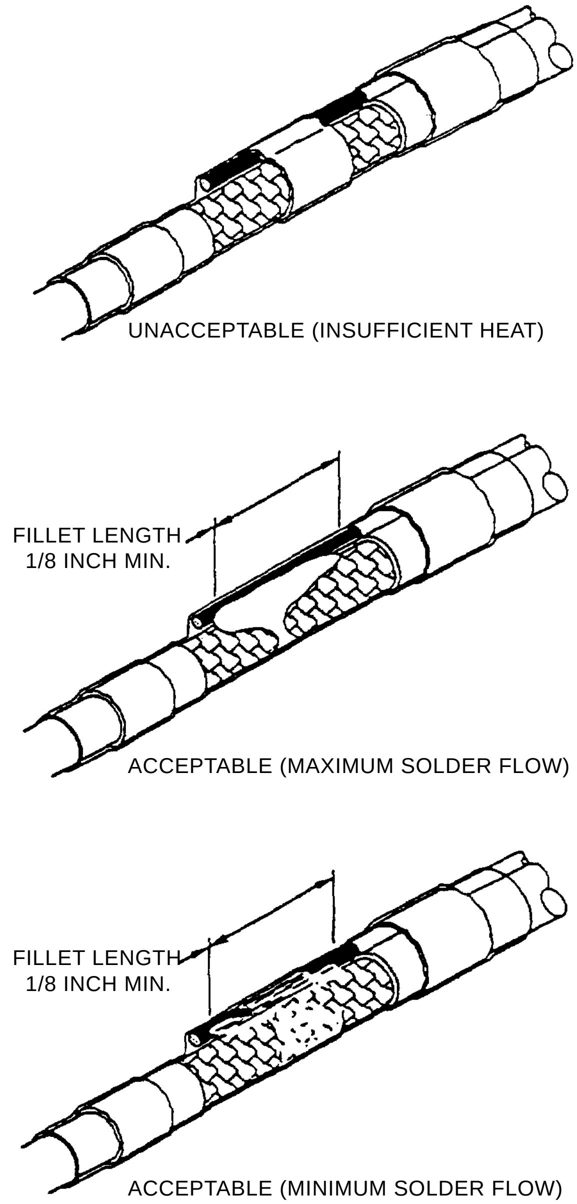
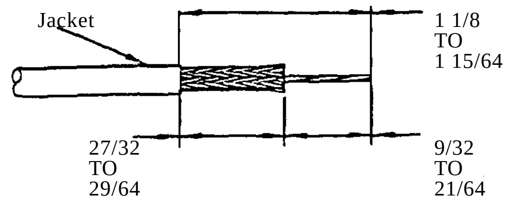


Figure 16. Immersion Resistant and Standard Solder Sleeve Installation (Sheet 3)

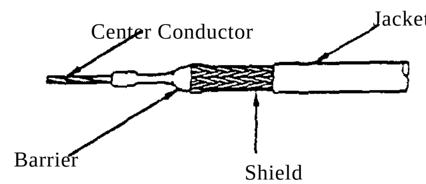
A. CABLE PREPARATION.

1. Strip Cable Jacket Exposing 1 1/8 to 1 15/64 Shield (WP 009 00)
2. Trim Shield from 27/32 to 29/64.
3. Strip Dielectric Exposing 9/32 to 21/64 Center Conductor.



B. ASSEMBLY

1. Slide Primary Termination with Barrier over Center Conductor and Dielectric. Ensure Barrier is Between Dielectric and Shield.



WARNING

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When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

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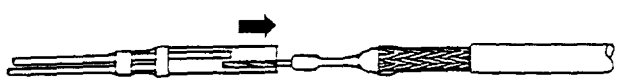
Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

2. APPLY HEAT TO SOLDER PREFORM UNTIL A FILLET IS FORMED BETWEEN PRE–INSTALLED LEAD AND CENTER CONDUCTOR.



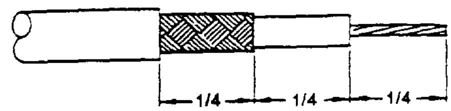
3. POSITION SHIELD TERMINATION SO THAT SOLDER PREFORM IS ALIGNED WITH END OF SHIELD

4. APPLY HEAT TO SOLDER PREFORM UNTIL A FILLET IS FORMED BETWEEN GROUND LEAD AND SHIELD. ENSURE INSERT IS COMPLETELY MELTED.

Figure 17 . Low Temperature Coaxial Cable Solder Sleeve Installation

A. CABLE PREPARATION

1. Strip Cable Jacket Exposing 3/4 Inch of Shield.
2. Trim Shield from 1/2 Inch Dielectric.
3. Strip Dielectric Exposing 1/4 Inch Center Conductor.

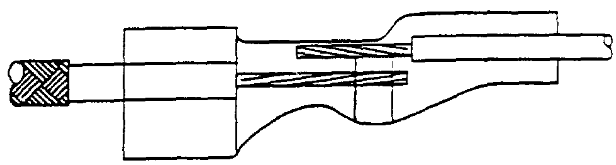


B. ASSEMBLY

NOTE

D–181 Termination May Be Installed Separately or Snap Together.

1. Insert Cable into Primary Sleeve Until Dielectric Stops at Shoulder in Sleeve and Center Conductor Extends Through Solder Preform.



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

Aircraft with open fuel cells or broken or open fuel lines shall be certified gas free in accordance with NAVAIR 01-1A-35. Only the HT-900B/HT-920B, HT–71002, MCH–100–A heating tools are authorized for use on any aircraft whenever AVGAS, JP-4 or the presence of fuel is imposing an immediate danger.

When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

Figure 18 . High Temperature Coaxial Cable Solder Sleeve Installation (Sheet 1 of 2)

WARNING

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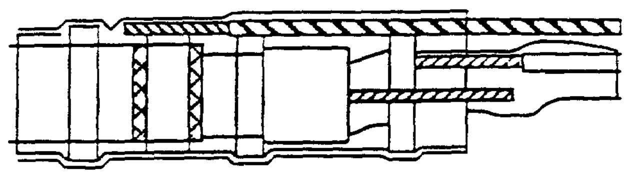
Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.



2. Apply Heat to Solder Preform until a Fillet is Formed Between Pre–Installed Lead and Center Conductor.

3. Position Shield Termination Over Primary Termination so that Solder Preform is Aligned with Shield.

4. Apply Heat to Solder Preform Until a Fillet is Formed between Pre–Installed Lead and Shield. Ensure Insert is Completely Melted.

Figure 18. High Temperature Coaxial Cable Solder Sleeve Installation (Sheet 2)

Table 5 . PinPak Coaxial Termination Selection

Termination Part Number	Cable O.D. (in) max	Shield O.D. (in) min	Shield Description	Lead Diameter (in)	Row Spacing (in)
D-148-0201	.090	.025	Single or double with tin or silver plating	.025	7/64
D-148-0202	.090	.025	Single or double with tin or silver plating	.025	13/64
D-148-0203	.090	.025	Single or double with tin or silver plating	.025	1/4
D-148-0204	.090	.025	Single or double with tin or silver plating	.032	13/64
D-148-0205	.090	.025	Single or double with tin or silver plating	.032	1/4
D-148-0206	.175	.080	Single with tin plating	.025	7/64
D-148-0207	.175	.080	Single with tin plating	.025	13/64
D-148-0208	.175	.080	Single with tin plating	.025	l/4
D-148-0209	.175	.080	Single with tin plating	.032	13/64
D-148-0210	.175	.080	Single with tin plating	.032	1/4
D-148-0211	.175	.080	Double or silver plated	.025	7/64
D-148-0012	.175	.080	Double or silver plated	.025	13/64
D-148-0213	.175	.080	Double or silver plated	.025	1/4
D-148-0214	.175	.080	Double or silver plated	.032	13/64
D-148-0215	.175	.080	Double or silver plated	.032	1/4

46 . **PINPAK COAXIAL TERMINATION INSTALLATION.** The installation procedures for PinPak terminations are the same as paddle card terminations (Figure 19), except the leads must be cut to proper length before attachment to PC board.

47 . **MATCHED IMPEDANCE TERMINATIONS.** Figure 20 provides installation procedures for match impedance terminations.

a. Place assembled cable in fixture of tool.

b. Ensure eye protection is in place.

c. Ensure hands and fingers are clear from work area.

WARNING

Infrared heating tools reach operating temperature extremely fast and can inflict serious painful burns instantaneously. Do not operate without eye shield in place. Refer to manufacturer's operating instructions.

Allow solder sleeve to cool before handling for inspection as serious burns can result.

CAUTION

Do not hold power switch on for extended periods as damage to product and unit will result. Cycle switch, do not hold.

d. Cycle switch, do not hold to shrink sleeve.

e. Allow solder sleeve to cool and inspect termination.

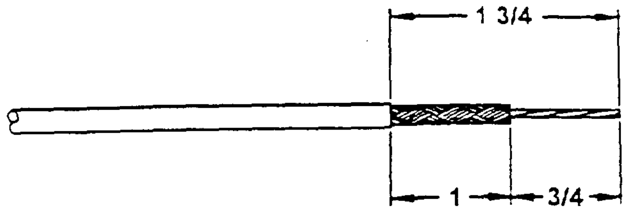
f. Reshrink if necessary until acceptable condition exists.

g. If over heated cut out bad termination and start procedure again.

A. CABLE PREPARATION.

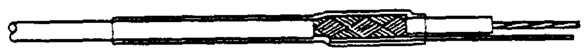
1. STRIP CABLE JACKET EXPOSING 1 3/4 INCH BRAID.

2. TRIM BOTH SHIELD AND DIELECTRIC EXPOSING 3/4 INCH CENTER CONDUCTOR.



B. ASSEMBLY.

1. SLIDE BARRIER UNDER BRAID.
2. SLIDE TERMINATION OVER STRIPPED END OF CABLE UNTIL IT STOPS.



WARNING

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The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

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When using heat guns with electric motors, recertification may be required as work progresses, as directed by the Aviation Gas Free Engineering Technician (AVGFET).

The MCH–100–A heat gun has been electromagnetic interference (EMI) qualified for flight line or flight deck use. All other electric motor type heat guns are not authorized for flight line or flight deck use due to electromagnetic interference (EMI). The electric motor type heating tools are safe for use by Navy/Marine Corps personnel at the organizational maintenance level to repair aircraft wiring in a hangar or hangar deck environment, provided the aircraft meets the gas-free environment criteria (NAVAIR 01-1A-35), and there are no EMI restrictions.

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

3. APPLY HEAT UNTIL SOLDER MELTS AND FLOWS.

4. BEND CENTER CONDUCTOR AND GROUND LEAD AND INSERT LEADS THROUGH PC BOARD. CUT LEADS TO APPROPRIATE LENGTH AND SOLDER (WP 017 00)

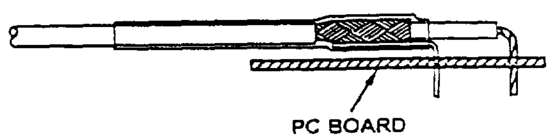


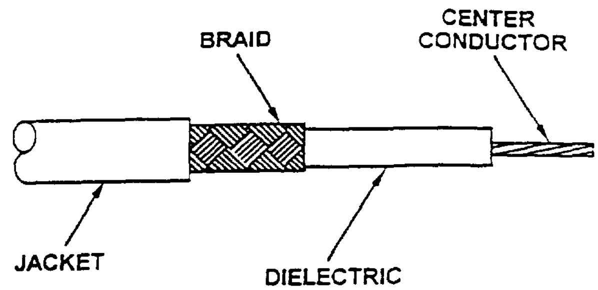
Figure 19 . Paddle card Termination Installation

A. CABLE PREPARATION.

1. STRIP CABLE JACKET EXPOSING APPROPRIATE LENGTH OF BRAID.

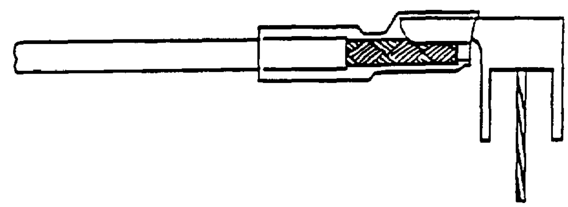
2. TRIM BRAID EXPOSING APPROPRIATE LENGTH OF DIELECTRIC.

3. STRIP DIELCTRIC EXPOSING APPROPRIATE LENGTH OF CENTER CONDUCTOR FOR STRAIGHT OR RIGHT ANGLE TERMINATION.



B. ASSEMBLY

1. PRE–TIN CENTER CONDUCTOR.
2. INSERT STRIPPED END OF CABLE INTO TERMINATION.



WARNING

Do not perform hot work without specific authorization of activity Aviation Gas Free Engineer (AVGFE) or Gas Free Engineer (GFE).

The HT–900B, HT–920B, HT–71002 and MCH–100–A heat guns are the only authorized heat guns to be used when working on aircraft that have not been defueled and purged. The aircraft must be defueled and purged before using any other heat guns listed in this manual.

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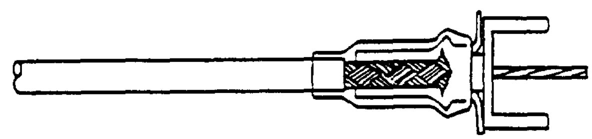

Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

Figure 20 . Matched Impedance Termination Installation (Sheet 1 of 2)

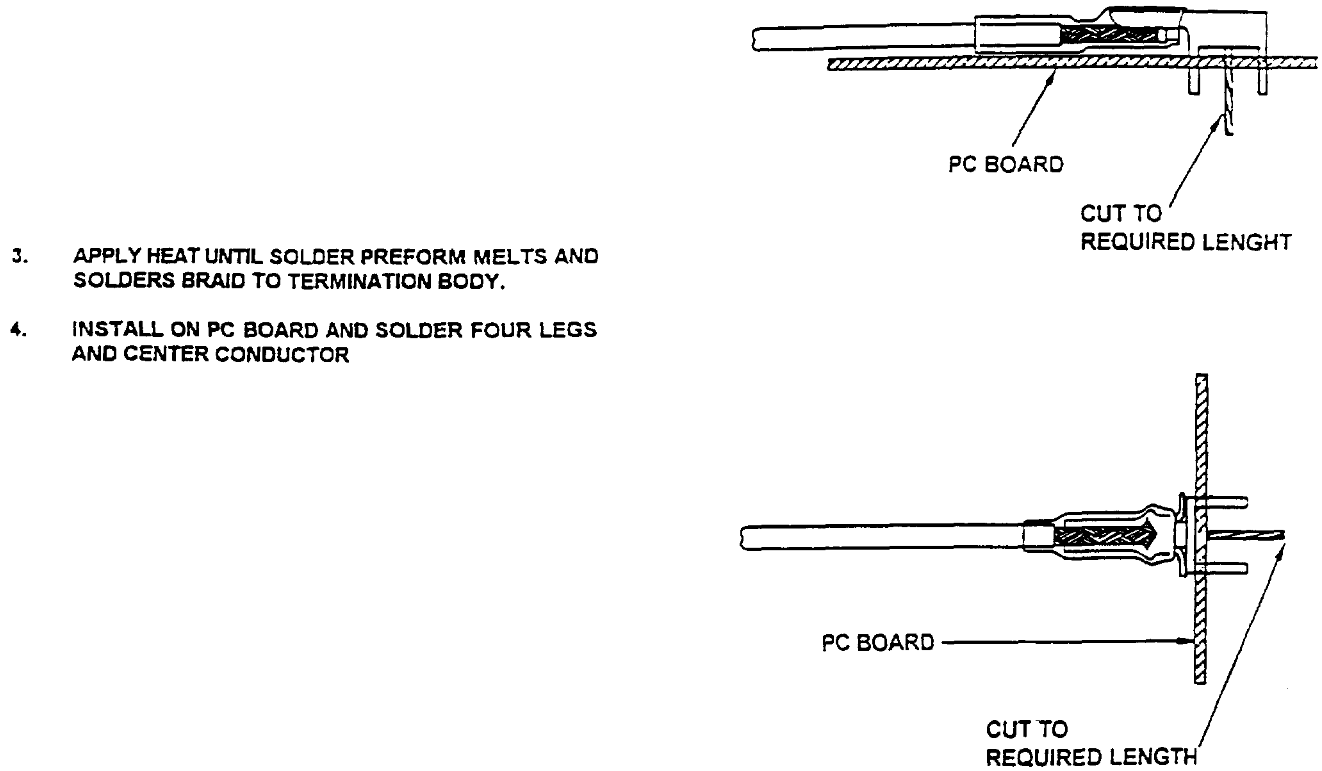

Figure 20. Matched Impedance Termination Installation (Sheet 2)

48 . **SERIES D-106 SOLDER SLEEVE SELECTION.** The selection of the appropriate solder sleeve is determined by the braid diameter.

49 . **SERIES D-153 SOLDER SLEEVES.** The Series D-153 solder sleeves are used for termination of gross shielded harnesses (Figure 21).

50 . **SERIES D-153 SOLDER SLEEVE SELECTION.** The selection of the appropriate solder sleeve is determined by the gross shield diameter, minimum, and the back shell assembly braid, braid straps-and gross shield, maximum.

51 . **TERMINATION OF GROSS-SHIELD HARNESS WITH PRIMARY WIRES ONLY.** To terminate gross-shield harnesses with primary wires only, perform procedure (Figure 22)

52 . **TERMINATION OF GROSS-SHIELD HARNESS.** To termination of gross-shielded harnesses containing shielded and jacketed cables with or without primary wires, perform procedures (Figure 23).

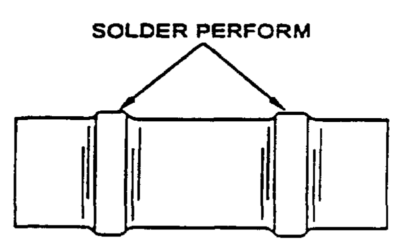

Figure 21 . Series D-153 Solder Sleeve

WARNING

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Use of nitrogen with the HT-900B/HT-920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not perform wire repair while using explosive solvent/paint products on the aircraft.

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tool to avoid serious burns.

When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

1. INSTALL PROTECTIVE SLEEVE AND SHRINK WITH HOT AIR.

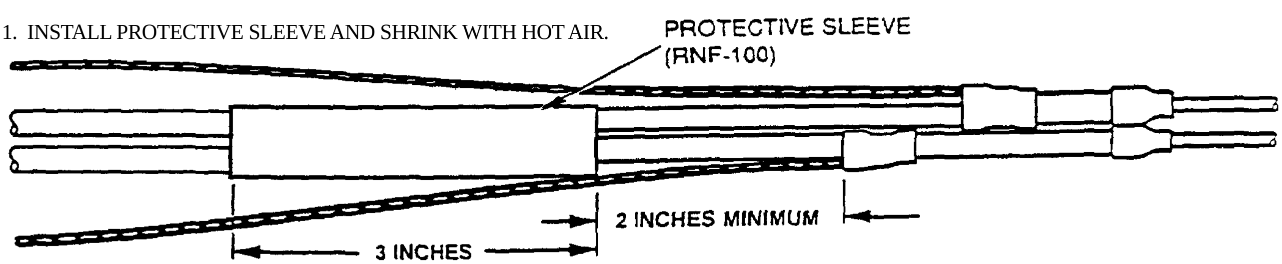
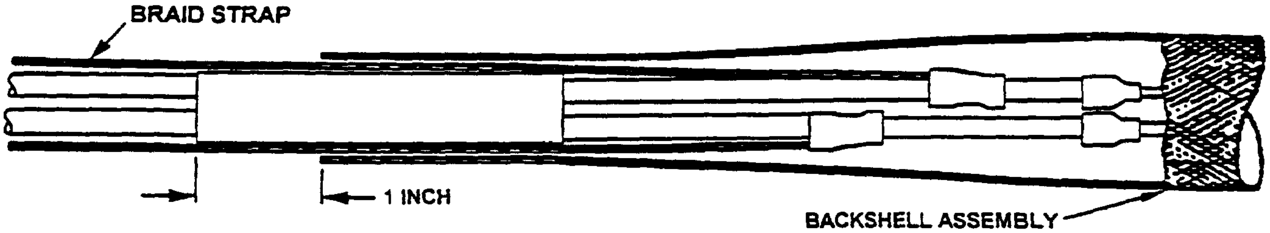


Figure 22 . Termination of Bundled Shielded and Jacketed Cable (Sheet 1 of 2)

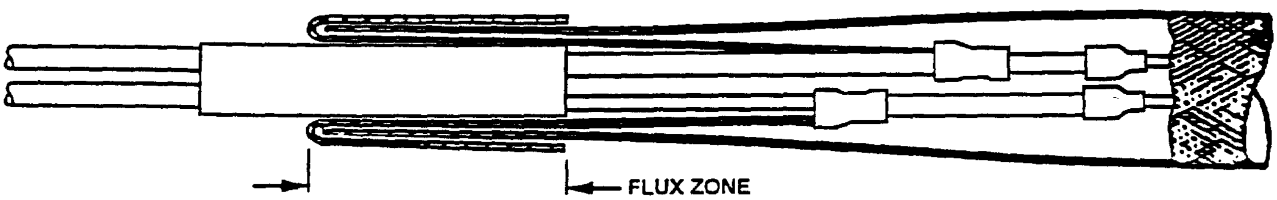


2. SLIDE SOLDER SLEEVE TERMINATOR ON BUNDLE BEYOND PROTECTIVE SLEEVE AND BRAID STRAPS.

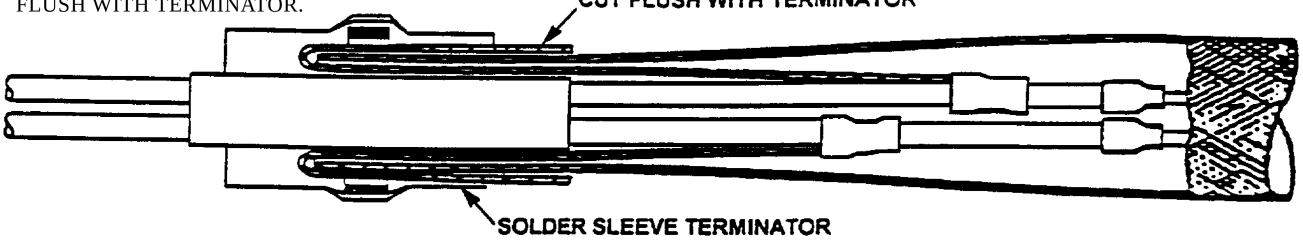
3. POSITION BRAID STRAPS AND BRAID OF BACKSHELL ASSEMBLY OVER PROTECTIVE SLEEVE.

4. FOLD BRAID STRAPS BACK TO FULLY EXTENDED LENGTH ONTO OUTSIDE SURFACE OF BACK SHELL ASSEMBLY BRAID.

5. COAT BRAID IN FLUX ZONE WITH LIQUID FLUX.



6. POSITION SOLDER SLEEVE TERMINATOR AND HEAT WITH HOT AIR. CUT OFF EXCESS LENGTH OF BRAID STRAPS FLUSH WITH TERMINATOR.



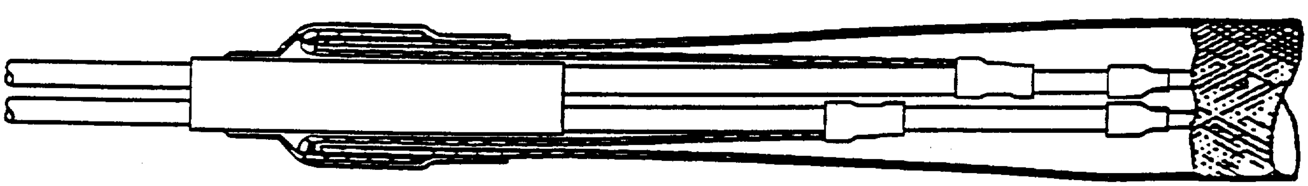


Figure 22. Termination of Bundled Shielded and Jacketed Cable (Sheet 2)

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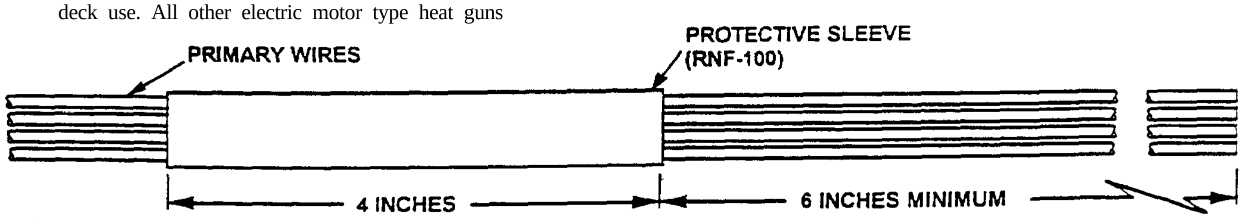


1. INSTALL PROTECTIVE SLEEVE AND SHRINK WITH HOT AIR.

2. INSTALL GROSS SHIELD.

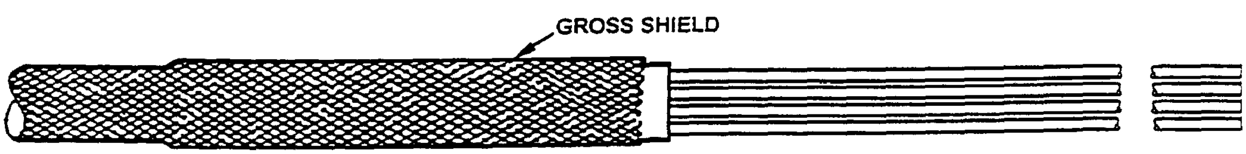
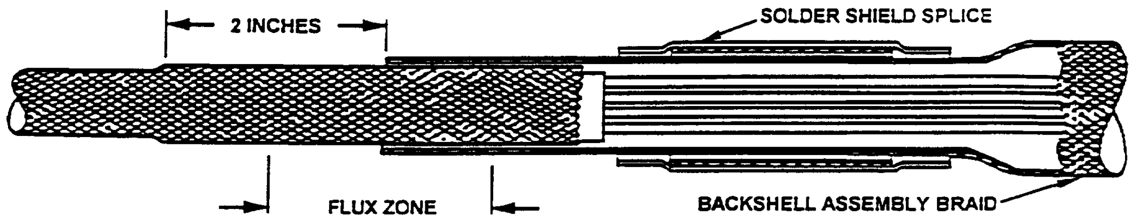


Figure 23 . Termination of Gross-Shielded Harnesses with Primary Wires Only (Sheet l of 2)

3. INSTALL SOLDER SHIELD SPLICE ON BACKSHELL ASSEMBLY BRAID AND POSITION BRAID OF BACKSHELL ASSEMBLY OVER GROSS SHIELD.

4. COAT BRAID IN FLUX ZONE WITH LIQUID FLUX.



5. POSITION SOLDER SHIELD SPLICE OVER FLUX ZONE AND HEAT WITH HOT AIR STARTING AT BACKSHELL ASSEMBLY.

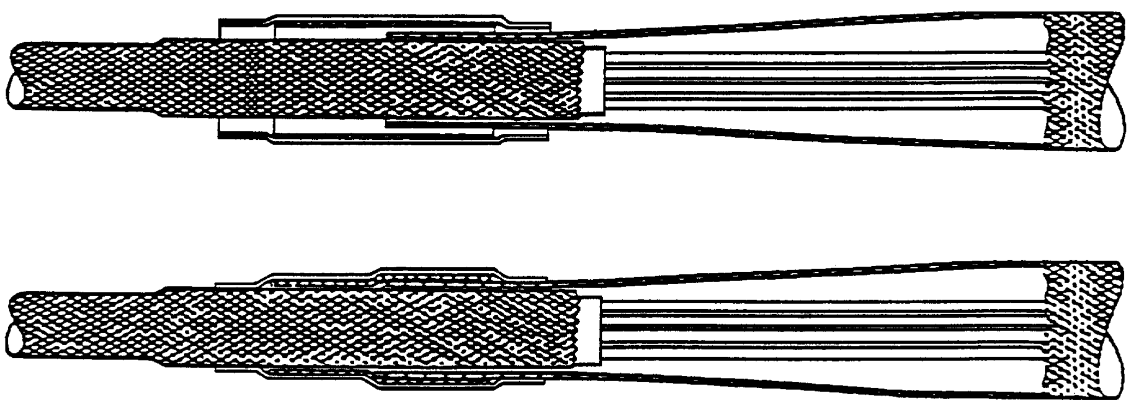


Figure 23. Termination of Gross-Shielded Harnesses with Primary Wires Only (Sheet 2)

WARNING

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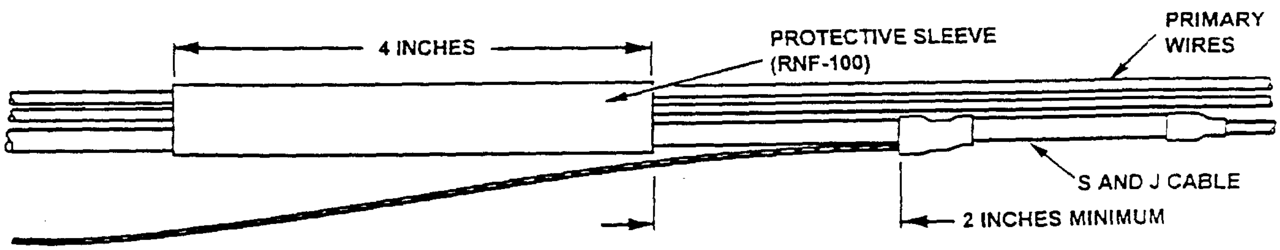
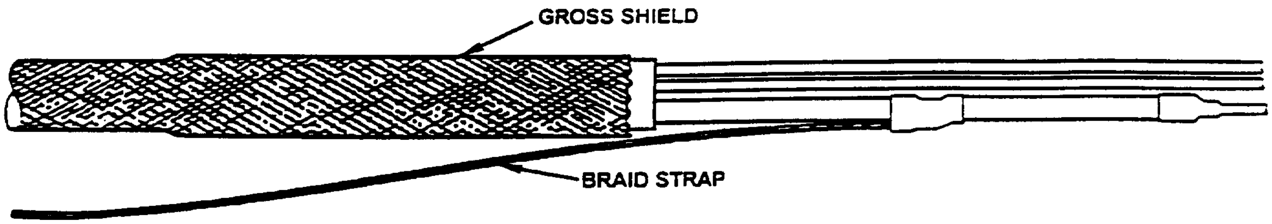


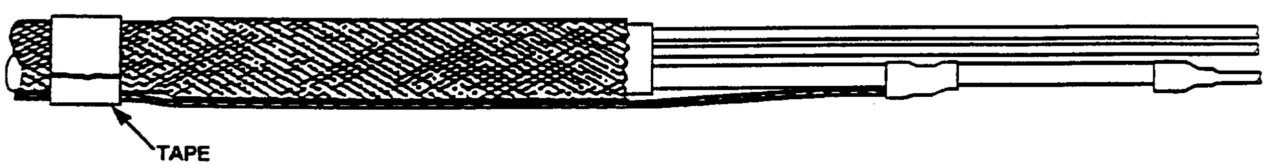
1. INSTALL PROTECTIVE SLEEVE AND SHRINK WITH HOT AIR.

Figure 24 . Termination of Gross-Shielded Harness (Sheet 1 of 3)

2. INSTALL GROSS SHIELD.



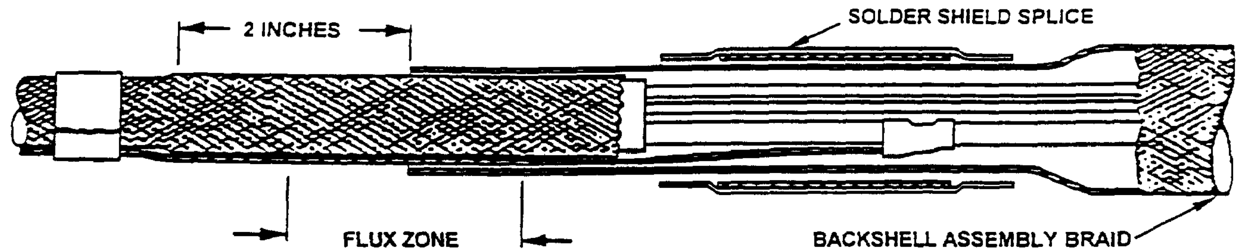
3. POSITION BRAID STRAP OVER GROSS SHIELD AND HOLD WITH TAPE.



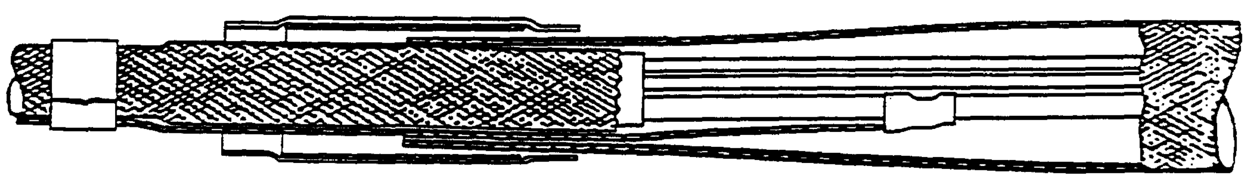
4. INSTALL SOLDER SLEEVE SPLICE ON BACKSHELL ASSEMBLY BRAID AND POSITION BRAID OF BACKSHELL ASSEMBLY OVER GROSS SHIELD.

Figure 24. Termination of Gross-Shielded Harness (Sheet 2)

5. COAT BRAID IN FLUX ZONE WITH LIQUID FLUX.



6. POSITION SOLDER SHIELD SPLICE OVER FLUX ZONE AND HEAT WITH HOT AIR STARTING AT THE BACK- SHELL END.



7. REMOVE TAPE AND TRIM BRAID STRAP FLUSH WITH END OF SOLDER SLEEVE SPLICE.

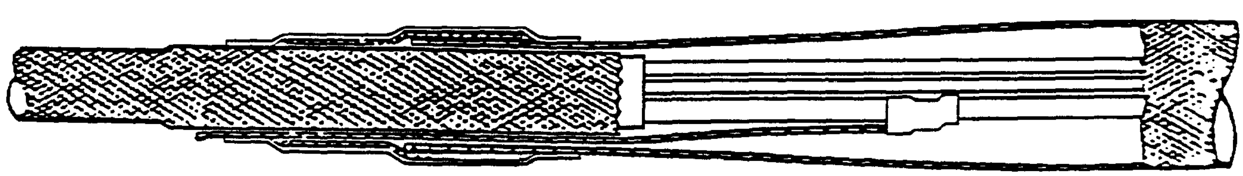


Figure 24. Termination of Gross-Shielded Harness (Sheet 3)

53 . **SHIELDING TERMINAL FERRULES.**

54 . **PROCEDURE.**

CAUTION

To prevent damage to aircraft wiring or equipment, disconnect both the utility battery and the emergency battery. When electrical power is off, 24vdc battery voltage exists in some wiring. Refer to appropriate aircraft repair manual for correct procedures.

NOTE

Identify applicable cable/wiring assembly then refer to Wire Type List (WP 004 00) for correct wire strippers.

a. Using wire strippers identified in WP 009 00, strip cable and shielding jumper wire as shown below in Figure 25 .

b. Determine ferrule and die set required. Refer to Table 6 .

c. Install shielding termination ferrule on cable and shielding.

d. Insert shielding jumper wire into shielding termination ferrule so that end of jumper wire is visible through inspection hole of ferrule. See Figure 26 .

WARNING

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When using a heat tool, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

e. Shrink insulation sleeving using heat tool. See Figure 25 .

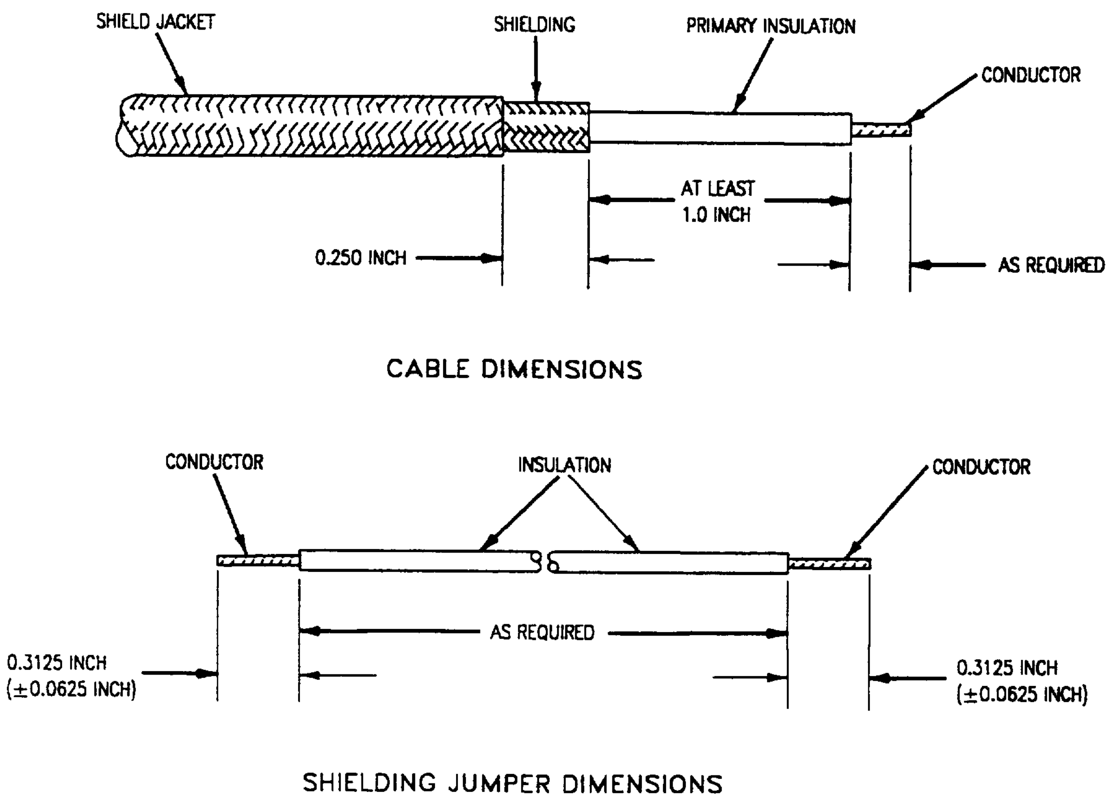


Figure 25 . Strip Cable and Shielding Jumper Wire

Table 6 . Ferrule and Die Set Combinations

Ferrule Part Number	Insulation Diameter (Inch)	Die Set Part Number	Die Set Color Code
5M608-12 or 328051	0.025 thru 0.045	45061-2	White
5M608-13 or 328052	0.045 thru 0.065	45062-2	Violet
5M608-14 or 328053	0.065 thru 0.085	45063-2	Blue
5M608-15 or 328054	0.085 thru 0.105	45064-2	Brown
5M608-16 or 328055	0.105 thru 0.125	45065-2	Orange
5M608-17 or 328056	0.125 thru 0.145	45066-2	Green
5M608-18 or 328057	0.145 thru 0.170	45238-2	Violet
5M608-19 or 328058	0.170 thru 0.195	45239-2	Blue
5M608-20 or 328059	0.195 thru 0.220	45240-2	Brown
5M608-21 or 328060	0.220 thru 0.245	45241-2	Orange
5M608-22 or 328061	0.245 thru 0.270	45158-2	Green

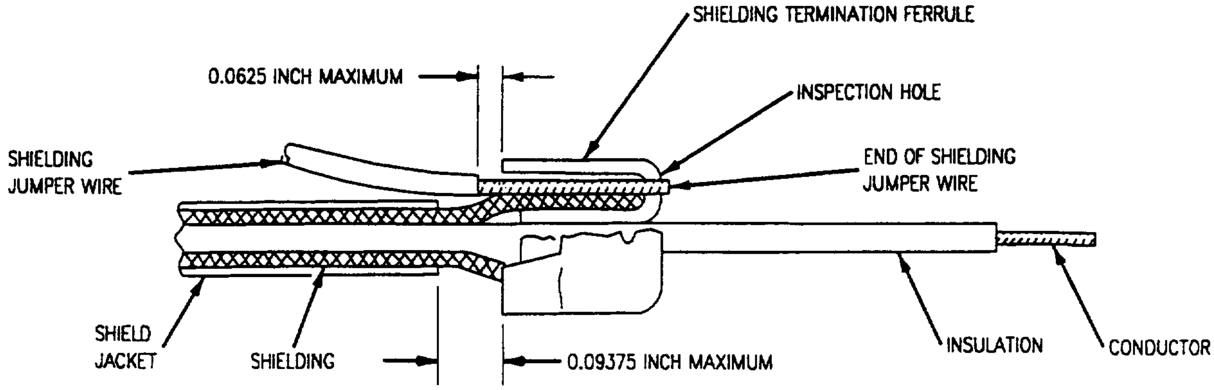


Figure 26 . Installing Shielding Termination Ferrule

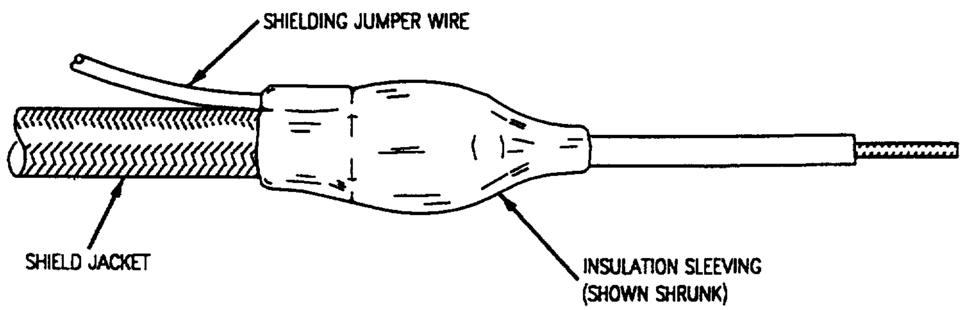


Figure 27 . Shrink Insulation Sleeving

SOLDERING

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont.)

Support Equipment Required

None

Materials Required

Nomenclature	Specification/ Part Number
Alcohol, Isopropyl (Isopropanol)	TT-I-735
Brush, Acid Swabbing	–
Flux, Silver Brazing	AMS3411–1S
Flux, Brazing, Silver Alloy, Low Melting Point	O-F-499
Methyl Isobutyl Ketone	ASTM D1153 or other approved solvent
Requirements for Soldering Fluxes	ANSI J-STD-004
Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications	ANSI J-STD-006
Sheet, Copper Alloy 110, Soft Annealed, .020 in. Thick (Nominal)	Copper Alloy 110
Solder, Hard	QQ-B-654
Solder, Hard	46S657

1 . **INTRODUCTION.**

2 . This work package (WP) is concerned with solder connections. This WP will describe general terms, materials, equipment and processes used in soldering, as well as the general inspection criteria. For specific soldering requirements refer to 01–1A–23.

3 . **GENERAL.**

4 . **SOLDERING.** Soldering is the joining of metal parts with a metal alloy that has a lower melting point than the parts being joined. Soldering offers an economical and reliable method to assemble and repair wires and their terminations. Soldering shall not be used to terminate crimp style contacts.

5 . **SOLDER**. Solder is fusible metal alloy used to join two or more metals using heat.

6 . **SOLDERABILITY.** Solderability is the property that permits good bonding of a specified solder in the presence of a specified flux at a specified temperature.

7 . **SOLDER PREFORM.** A solder preform is a part that has been formed into a specific shape for a specific purpose.

8 . **SOLDER TYPES.** There are two types of solder and distinctions are made between, hard solder or brazing and soft solder. Alloys used in hard solder normally reach the melting point at temperatures above 1700°F (371°C), while those used in soft solder normally reach the melting point at temperatures below 700°F (371°C).

9 . **Hard Solder.** Hard solder often called brazing solder, is a silver alloy which conforms to QQ-B-654 with a melting point 700°F to 1600°F (371°C to 871°C). Hard solder has advantages as well as disadvantages.

a. Used where greater mechanical strength is required.

b. Used where higher temperatures are encountered.

c. Commonly used to solder thermocouple connections.

d. Not to be used on standard contacts, connectors, terminals, or circuit boards.

10 . **Soft Solder.** Soft solder is an alloy, consisting mainly of tin and lead along with silver and other additives, which conforms to ANSI J-STD-006 and has a melting point below 700°F (371°C). Soft solder is more widely used in aircraft wire repair and termination.

11 . **SOLDER FORMS.** Solder is available in many styles and forms designed for a specific task.

12 . **Pig.** A pig is a large block of solder 20 to 100 pounds used to replenish large solder baths.

13 . **Cakes or Ingots.** Cakes or ingots, either rectangular or circular in 3, 5 and 10 pound units, also used to replenish solder baths.

14 . **Bars.** Bars weigh 1/2 pound to 2 pounds and are used to replenish solder pots or small baths.

15 . **Segment or Drops.** Segments or drops are solder wire or bars precut to the length desired for application as desired.

16 . **Foil.** Solder as foil, also in sheets and ribbons, are used mainly in light solder applications.

17 . **Cream.** Solder cream is a suspension of solder and flux and is able to be placed where needed. Solder cream was brought about by the ever changing production requirements and electronic advances.

18 . **Wire.** Wire solder, available in different diameters and on spools, is one of the most common in use for hand soldering.

19 . **Wire Flux Core.** Wire solder with a flux core is the most common in use. Available in different diameters and on spools for use in hand soldering which conform to ANSI J-STD-006.

20 . **Preforms.** Solder preforms are parts that have been formed into a specific shape for a specific purpose.

21 . **HARD SOLDER USE.** Hard solder used in aircraft wiring and termination using hand soldering techniques is commonly solid wire solder.

WARNING

Silver solder brazing alloy 46S657 per QQ-B-654 contains cadium. The use of this material is preferred because of its low brazing temperature range and satisfactory service performance, however, poisonous fumes are produced upon heating. It will be deleted from QQ-B-654 when substitute brazing alloys have been evaluated for satisfactory service performance. Become familiar with the Materials Safety Data sheets (MSDS) for all materials used and use proper personal protection equipment. (PPE).

22 . **SOFT SOLDER USE.** Soft solder used in aircraft wiring and termination using hand soldering techniques, most commonly will be solid wire solder, or flux core solder.

WARNING

Solder contains lead and other hazardous materials. Avoid oral contact with hands during soldering operations and always wash hands immediately after soldering. Become familiar with Material Safety Data sheets (MSDS) for all materials used and use proper personal protection equipment (PPE).

23 . **Solid Wire Solder.** When solid wire solder is used, a rosin based flux must also be used. A list of preferred wire type solders follows:

a. Sn60Pb40. This type of solid solder is for use in general electrical and electronic applications.

b. Sn62Pb36Ag02. This type of solid solder is used for silver plated applications.

c. Sn63Pb37. This type of solid solder is used for applications on printed circuit boards and semi-conductor devices.

d. Flux Core Solder. Flux core solder, also referred to as rosin core, may or may not require external flux. Preferred solders used in flux core solder are the same as the solid solders shown in steps a through c, with the fluxes described in paragraph 26.

24 . **FLUX.** Flux is a chemical material which cleans and prepares the metal to be soldered by promoting good wetting of the surface. The result can be corroded connections, leading to failure of the connection.

WARNING

Under no circumstances will either acid flux or inorganic chloride flux, whether as liquids or as flux-core solders be used for securing connections on electrical or electronic equipment.

25 . **FLUX USE.** Flux is used to prepare the surface, as proper soldering requires unrestricted intermetallic contact between the solder and the metal being joined. Any barrier between the two in the form of oxide, grease, or other contaminants will prevent proper union. Flux removes these films without attacking the surfaces to be joined. The additional benefits include:

a. Sealing. Flux seals the surface to be joined.

b. Heating. As the surface is sealed heating time is decreased.

c. Oxidation. Oxidation is halted.

d. Solder Flow. The flux reduces surface tension and allows the solder to flow.

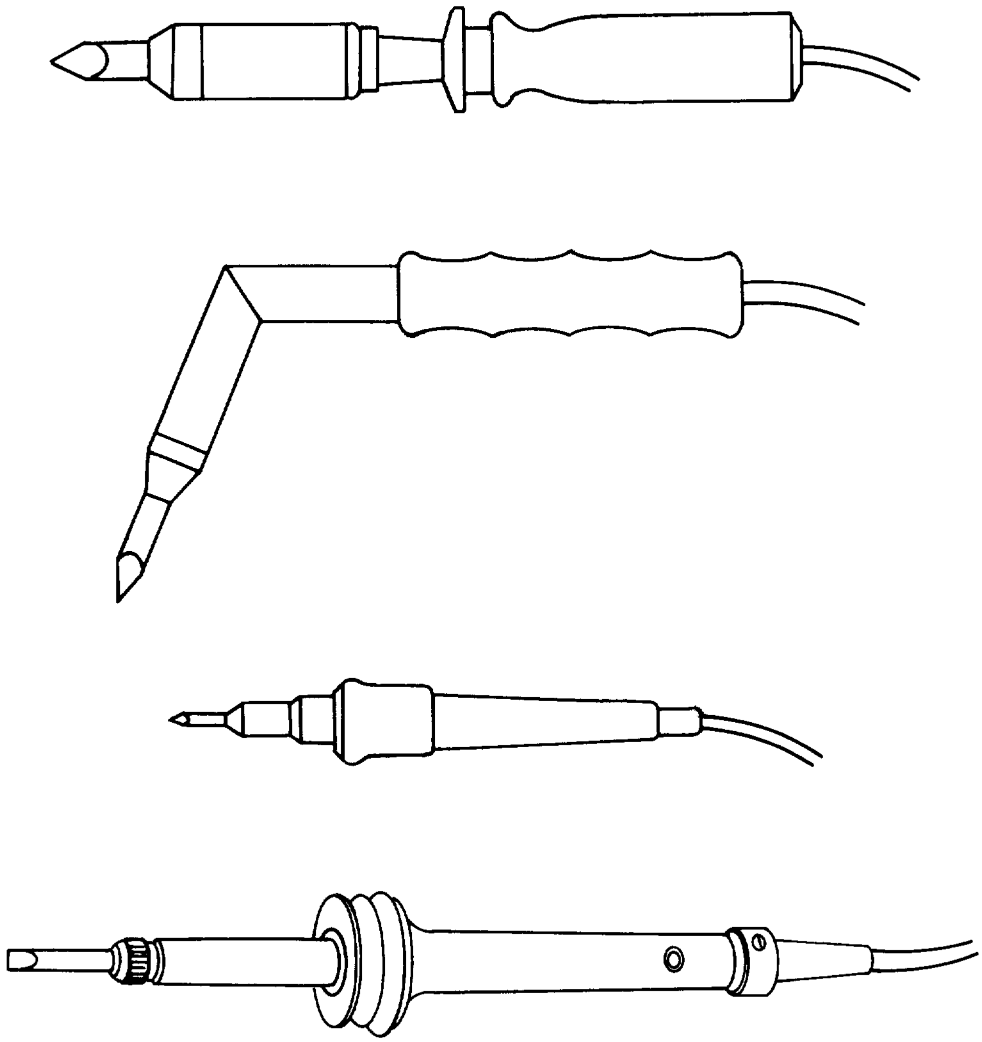


Figure 1. Types of Hand Soldering Irons (Typical)

WARNING

Isopropyl alcohol is flammable - do not use near open flames, welding areas, or on hot surfaces. Do not smoke when using it, and do not use where others are smoking. Inhalation of vapors can cause drowsiness, dizziness and headaches. Contact of liquid with skin may cause dermatitis and irritation. If any liquid contacts skin or eyes, immediately flush affected area thoroughly with water. Remove solvent-saturated clothing. Consult MSDS.

26 . **FLUX TYPE FOR SOFT SOLDER.** The flux used shall conform to ANSI J-STD-004 and are of the organic rosin type. Acid or inorganic flux shall not be used as they are highly corrosive. The residual action of even rosin flux will cause corrosion therefore the work area shall be cleaned with isopropyl alcohol when soldering is complete. Preferred fluxes as liquids and as cored solders follows:

a. ROL0. This type of flux is rosin based with low activity and no halide content. It is recommended for use on electronic applications and on printed circuit boards and on semiconductor devices.

b. ROM0. This type of flux is rosin based with moderate activity and no halide content. It may be used on electronic applications where greater flux activity is desired, but greater care must be taken to properly clean all residue after soldering.

27 . **FLUX TYPE FOR HARD SOLDER.** The flux used for brazing hard solder is not to be used with soft solder. Use flux which meets AMS3411–1S or equivalent.

28 . **HEAT APPLICATION.** There are methods by which heat is applied to the work and these will be covered in detail within this workpackage. These methods are as follows:

29 . **Soldering Iron.** Hand held, electrically heated soldering irons are the most commonly used tools to accomplish solder joining on aircraft or components. Soldering irons are available in different sizes, wattage, shape, angles, and tip selection. It is necessary to use the correct tool and soldering irons must be matched to perform the job correctly. Soldering irons must be selected to do the task assigned as quickly and efficiently as possible. Examples of typical soldering irons are illustrated (Figure 1).

30 . **Resistance Soldering.** Resistance soldering is utilized in areas of large volume and when heat is needed only at the point of contact. A low voltage transformer is used and the metal to be soldered is heated by resistance by this low voltage. A carbon pencil is used in another type of resistance soldering as one electrode and is desired for use in congested areas and heat restricted areas (Figure 2).

31 . **Torch Soldering.** Torch soldering is used where high heat is required, in soldering with hard solder, as in thermocouple soldering. Soft solder applications may be used providing the area of work is large enough. Torch soldering is not recommended for small parts.

32 . **Dip Solder.** Dip soldering is accomplished by using a solder pot or solder bath. By this method one or more connections can be accomplished in a single operation and is normally used on printed circuit boards. The dip method can also be used for wire tinning.

33 . **SOLDERING IRON PREPARATION AND MAINTENANCE.**

34 . **PREPARATION.** The soldering iron tip must be tinned to provide a completely metallic surface through which the heat may flow readily from the iron to the metal being soldered. If no tinning is present, the iron will oxidize and the heat cannot flow. Copper has a very high rate of heat conductivity, but copper tips oxidize quickly and must be frequently cleaned and re-tinned. If a tip has become badly burned and pitted as a result of overheating, replace it. Some copper soldering iron tips used in production soldering are coated with pure iron to help prevent oxidation. Follow manufacturer's instructions for cleaning such irons. A clean damp cloth may be used to wipe the iron. A clean damp cloth or sponge followed by a dry cloth wipe down may be used to remove excess solder. Do not file soldering iron tips coated with pure iron. Filing will ruin the protective coating. If the tip is pitted, replace it.

a. With the iron unplugged, file each working surface of the tip with a double-cut mill file until it is smooth and a bright copper color (Figure 3).

b. Remove copper filings from dressed edges with a file card.

c. Plug in the iron.

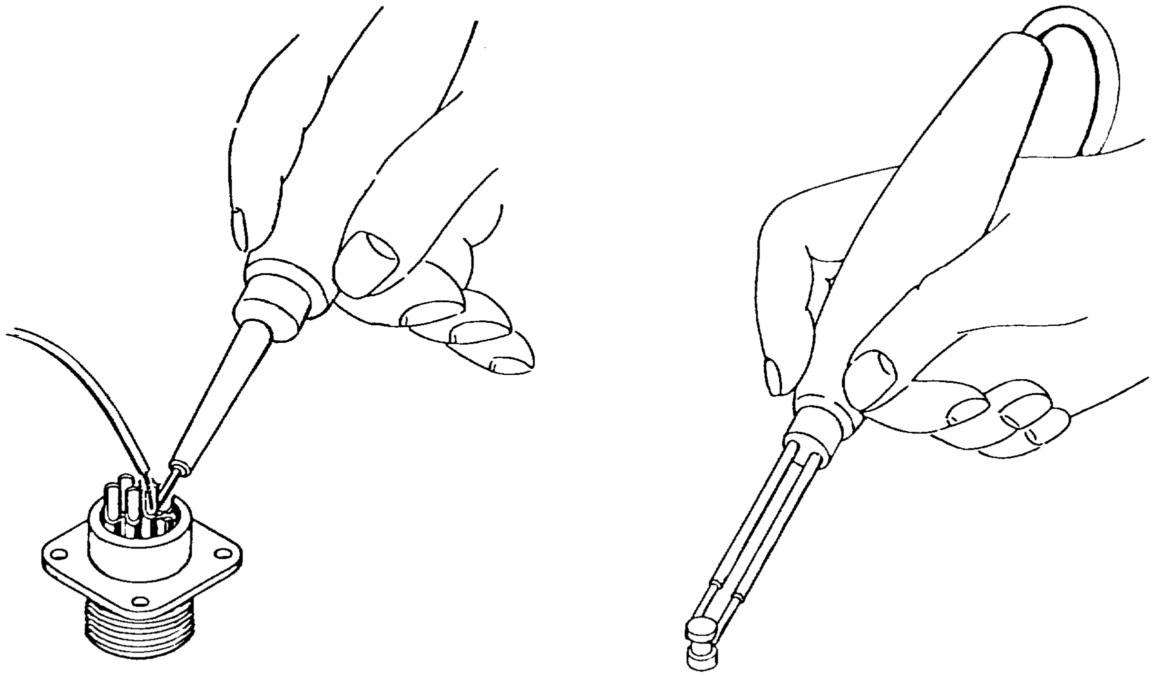


Figure 2. Resistance Soldering

WARNING

Avoid oral contact with hands during soldering operations and wash hands immediately after soldering operation. The lead contained in solder can be a source of lead oxide. Lead oxide, when absorbed in the body over the years, can cause serious health problems. Touching solder followed by smoking or eating is a potential means of ingesting trace amounts of lead oxide.

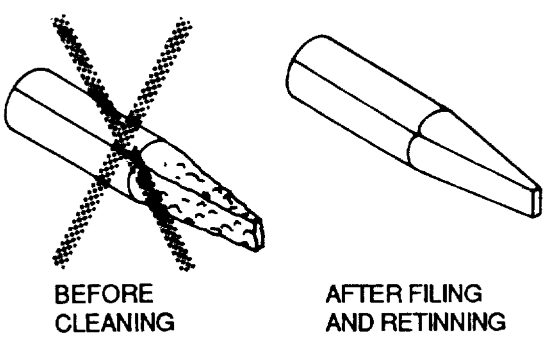


Figure 3. Soldering Iron Tip Before and After Cleaning

NOTE

Do not allow the iron to come up to full temperature before starting the tinning operation.

d. Apply cored solder just as the dressed copper is turning to a pigeon-blue, bronze, oxide color. This will allow the flux to wet and clean the tip before the solder melts to form an even bright coating (Figure 4).

CAUTION

Never shake or whip an iron to get rid of dross or excess solder droplets.

e. Wipe off excess solder with a damp sponge or cloth.

35 . **MAINTENANCE.** During use and just before each application, pass the soldering iron tip (with a rotary

motion) through the folds of a damp cleaning sponge. This will remove the surface dross and excess solder from the working surface.

36 . **DAILY MAINTENANCE.** Once a day, remove the tip and clean the black scale from the inside of iron and from the tip with fine steel wool. When the iron or tip is new, coat the inside of shank with dry flake graphite or anti-seize material to prevent freezing, and ensure maximum heat transfer. When replacing tip, ensure it is inserted the full depth of the casing and seated firmly against the heating element.

37 . **GENERAL SOLDERING PROCEDURES.**

38 . **AREA PREPARATION.** Cleanliness is of the utmost importance in the soldering operation. If possible, soldering should be done in an area that is reasonably clean and free from excessive dust. Drafty areas should be avoided so that the soldering iron will not cool.

WARNING

Isopropyl alcohol is flammable - do not use near open flames, welding areas, or on hot surfaces. Do not smoke when using it, and do not used where others are smoking. Inhalation of vapors can cause drowsiness, dizziness and headaches. Contact of liquid wit skin may cause dermatitis and irritation. If any liquid contacts skin or eyes, immediately flush affected area thoroughly with water. Remove solvent-saturated clothing. If vapors cause drowsiness, go to fresh air. Consult MSDS.

39 . **DECONTAMINATION.** Parts contaminated with dirt, oil, grime, grease, etc., cannot be successfully soldered. Make sure all parts are mechanically bright-clean before soldering. Clean the parts with a cloth or brush dipped in isopropyl alcohol, or other approved solvent. Badly corroded parts may be cleaned carefully by mechanical means, such as fine abrasive paper, a wire brush, or by careful scraping with a knife blade.

40 . **WIRE STRIPPING.** Insulated conductors should be stripped a distance longer than required for the solder connection. This allows for easier tinning of the conductor; the excess conductor will be trimmed off prior to soldering. The outer circumference of the end of the insulation shall have a smooth edge. The inner circumference shall have no insulation protrusions around the wire's surface. The insulation shall not show evidence of nicks or cuts. For specific wire stripping procedures, refer to WP 009 00.

WARNING

Avoid oral contact with hands during soldering operations and wash hands immediately after soldering operation. The lead contained in solder can be a source of lead oxide. Lead oxide, when absorbed in the body over the years, can cause serious health problems. Touching solder followed by smoking or eating is a potential means of ingesting trace amounts of lead oxide.

41 . **PRE-TINNING.**

42 . Before wires are soldered to connectors, the ends exposed by stripping are tinned to hold the strands solidly together. The tinning operation is considered satisfactory when the ends and sides of the wire strands are fused together with a coat of solder. Wires are usually tinned by dipping into flux and then into a solder bath.

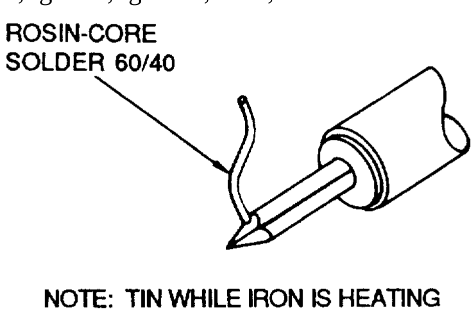


Figure 4. Tinning Soldering Iron Tip

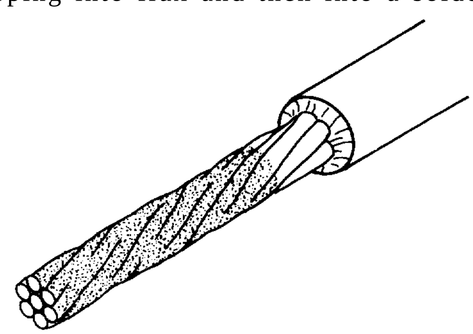


Figure 5. Properly Tinned Wire

Unacceptable tinning may leave stray conductor strands, may have too little or excessive solder, or the insulation may be damaged by overheating. In the field, wires can be tinned with a soldering iron and rosin core solder (Figures 5 and 6).

43 . **WIRES TO BE CRIMPED.** Do not tin wires which are to be crimped to Class K (fireproof) connectors, wires which are to be attached to solderless terminals or splices, or wires which are to be crimped to removable crimp-style connector contacts.

44 . **SOFT SOLDER AND FLUX PREPARATION**. The flux used to tin wire is a mixture of alcohol and rosin in a non-activated solution. During use, the alcohol will evaporate and should be replaced. Keep container closed when not in use to minimize evaporation. The solder used is a mixture of tin and lead. Maintain temperature of the solder pot between 450°F and 500°F (232°C and 260°C); this will keep solder in a liquid state. Skim surface of solder pot as necessary with a metal spoon or blade to keep solder clean and free from oxides, dirt, etc.

45 . **HARD SOLDER AND FLUX PREPARATION.** The flux used for hard solder is water based, and may evaporate over time. Keep container closed when not in use. Dilute with water or warm to proper consistency before use. The temperatures required for hard solder are higher than that of soft solder. Maintain the solder pot in the proper range for the solder composition being used. Silver alloy will flow at approximately 635°C (1175°F).

CAUTION

Do not use extra heat and special fluxes as a substitute for properly cleaned soldering surfaces.

Do not use any other flux or solder for tinning copper wires for use in aircraft electrical systems.

During tinning operation, take care not to melt, scorch, or burn the insulation.

46 . **DIP-TINNING.** Dip-Tin wires individually, regardless of size (Figure 7). The procedure for dip-tinning is as follows:

a. Prepare flux and solder as described in paragraphs 44 or 45, as appropriate.

b. Ensure that exposed end of wire is clean and free from oil, grease, and dirt. Strands should be straight and parallel. Dirty wire should be restripped.

c. Grasp wire firmly and dip into dish of prepared flux to a depth of about 1/8 inch.

d. Remove wire.

e. Immediately dip into molten solder. Dip only half of stripped conductor length into solder.

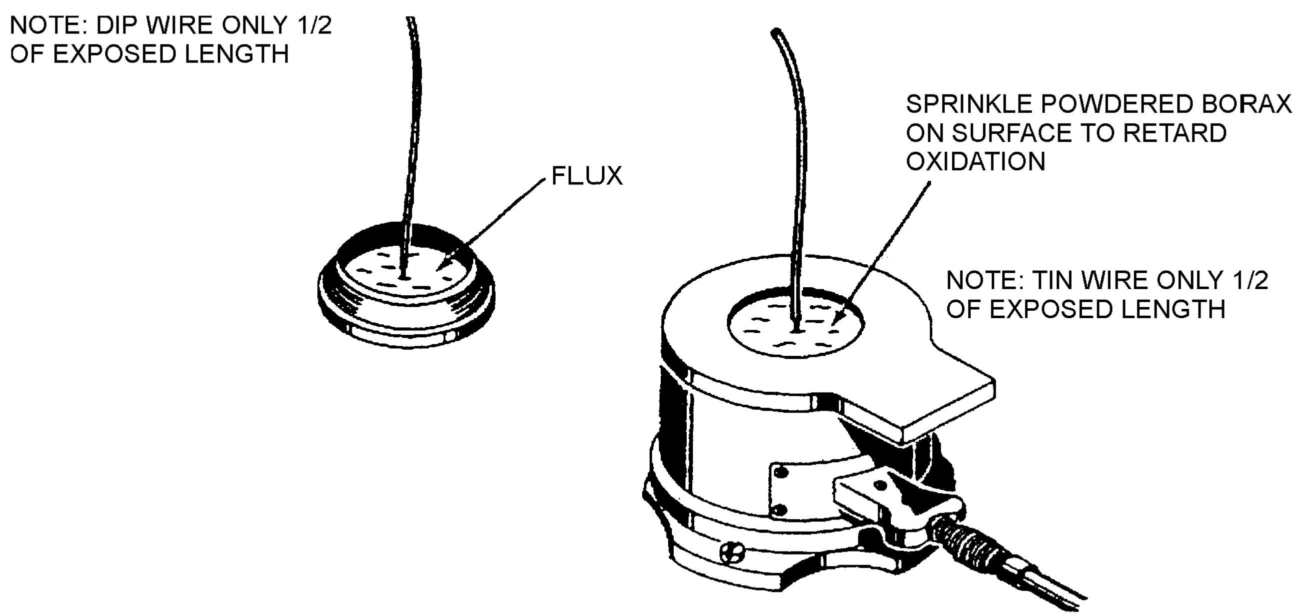


Figure 6. Dip-Tinning in Solder Pot

NOTE

The thickness of the solder coat depends on the speed with which the wires are handled and shaken, and the temperature of the solder bath.

f. Manipulate wire slowly in solder bath until it is thoroughly tinned. Watch the solder fuse to wire. Do not keep wire in bath longer than necessary.

g. Remove wire.

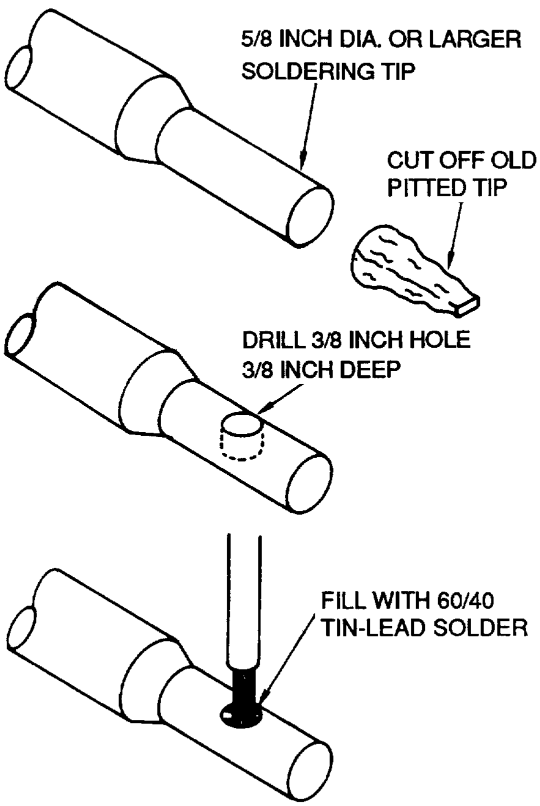


Figure 7. Alternate Dip-Tinning Method

47 . **TINNING WITH A SOLDERING IRON.** In the field, wires smaller than size 10 AWG may be tinned with a soldering iron and rosin-core solder as follows (Figure 8):

a. Select a soldering iron having suitable heat capacity for wire size from Table 1. Ensure that iron is clean and well tinned.

b. Prime by holding iron tip and solder together on wire until solder begins to flow.

c. Move soldering iron to opposite side of wire and tin half of the exposed length of conductor.

Table 1. Approximate Soldering Iron Sizes for Tinning

Wire Size (AWG)	Soldering Iron Size (Heat Capacity)
#20 - #16	60 Watts
#14 & #12	100 Watts
#10 & #8	200 Watts

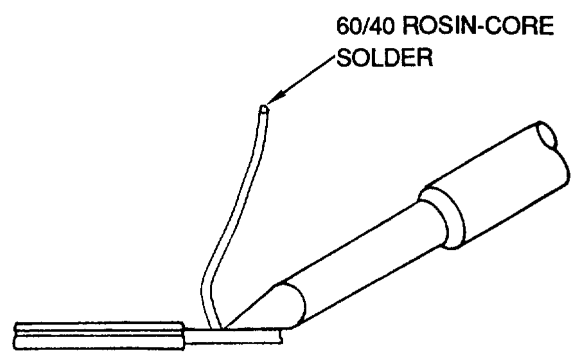
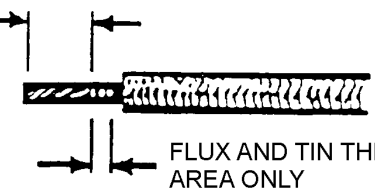


Figure 8. Tinning Wire With a Soldering Iron

A. TINNING

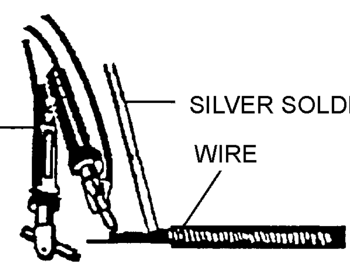
WARNING

SILVER SOLDER BRAZING ALLOY, QQ-B-654 GRADESIV, V, VII, AND VIII, ARE OF THE CADIUM-CONTAINING SILVER ALLOY TYPE. THEIR USE WAS PREVIOUSLY PREFERRED BECAUSE OF THEIR LOW BRAZING TEMPERATURE RANGE AND SATISFACTORY SERVICE PERFORMANCE. HOWEVER, POISONOUS FUMES ARE PRODUCED ON HEATING WHICH MAKES THEIR THEIR USE OBJECTIONAL FOR BRAZING OPERATIONS. THEY WILL BE DELETED FROM QQ-B-645 WHEN SUBSTITUTED BRAZING ALLOYS HAVE BEEN EVALUATED FOR SERVICE USE.



CAUTION

SILVER SOLDER WILL FLOW AND ADHERE TO CONDUCTOR AT APPROXIMATELY 1175°F. (635°C) AVOID HEAT GREATER THEN NECESSARY. EXCESS HEAT WILL DECOMPOSE FLUX AND PREVENT ALLOYING OF SILVER SOLDER TO WIRE.



1. RESISTANCE TINNING.

(A) STRIP 1/2 INCH LONGER THEN AREA WHICH IS TO BE TINNED. REFER TO PARAGRAPH 40.

(B) THE EXTRA LENGTH IS TO BE USED AS A GRIP AREA DURING TINNING AND IS TO BE REMOVED AFTER TINNING IS COMPLETE.

CAUTION

DO NOT OVERHEAT THE WIRE BY ALLOWING THE CURRENT TO REMAIN ON LONGER THAN NECESSARY TO FLOW THE SILVER SOLDER.

(C) WITH BRUSH, APPLY A SMALL AMOUNT OF HARD SOLDER FLUX TO AREA TO BE TINNED.

Figure 9. Tinning with Silver Solder (Sheet 1 of 3)

(D) USING HEAT RESISTANCE PLIERS, APPLY HEAT DIRECTLY TO WIRE AND MELT A THIN COAT OF SILVER ONTO WIRE.

(E) AFTER SOLDER HAS FLOWED BETWEEN STRANDS, SHUT OFF CURRENT AND ALLOW WIRE TO COOL.

(F) TRIM OFF HOLDING AREA OF EXPOSED CONDUCTOR TO POINT OF TINNING.

2. TORCH TINNING.

(A) STRIP WIRE AS NEEDED. REFER TO PARAGRAPH 40.

(B) DIP HALF OF EXPOSED, CLEAN CONDUCTOR INTO HARD FLUX.

(C) PROTECT WIRE INSULATION WITH NOTCHED COPPER SHEET SHIELD, TO PREVENT SCORCHING.

CAUTION

SILVER SOLDER WILL FLOW AND ADHERE TO CONDUCTOR AT APPROXIMATELY 1175°F (635°C). AVOID GREATER HEAT THAN NECESSARY. EXCESS HEAT WILL DECOMPOSE FLUX AND PREVENT ALLOYING OF SILVER TO WIRE.

(D) USING TORCH, APPLY FLAME TO WIRE UNTIL FLUX BUBBLES. THEN FEED SMALL AMOUNT OF SILVER SOLDER IN WIRE TO FLUXED AREA WHILE FLAME IS KEPT THERE. AFTER SOLDER HAS FLOWED, REMOVE FLAME AND ALLOW WIRE TO COOL.

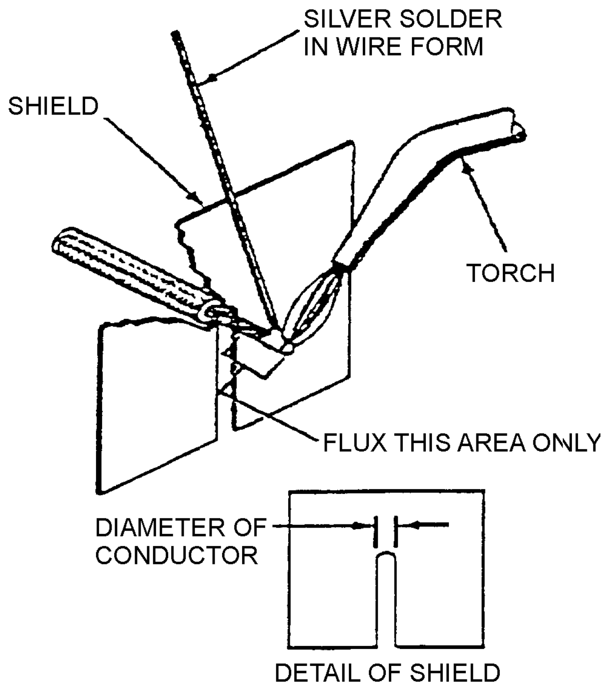
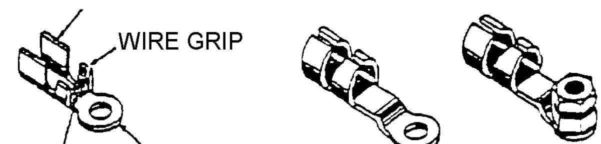


Figure 9. Tinning with Silver Solder (Sheet 2)

B. ATTACHING THERMOCOUPLE WIRE TO TERMINALS.

NOTE
TINNING OF THERMOCOUPLE TERMINALS IS REQUIRED TO THERMOCOUPLE WIRE.

1. TYPES OF THERMOCOUPLE TERMINALS.

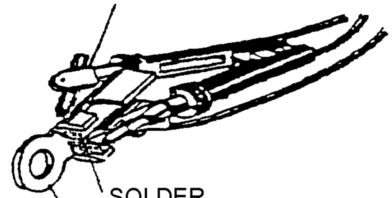


NOTE
TINNING OF THERMOCOUPLE TERMINALS IS REQUIRED TO THERMOCOUPLE WIRE.

2. WITH BRUSH, APPLY A SMALL AMOUNT OF HARD SOLDER FLUX TO AREA TO BE TINNED.

3. TINNING TERMINALS CAN BE ACCOMPLISHED BY USING RESISTANCE OR TORCH METHODS.

(A) RESISTANCE TINNING USE A UNIT WITH 2500 WATTS POWER. APPLY HEAT TO TERMINAL AT WIRE GRIP AND MELT A THIN COAT OF SOLDER ONTO INNER SURFACE.



(B) TORCH TINNING. USING A TORCH, APPLY HEAT TO BACK SIDE OF TERMINAL AT WIRE GRIP AREA AND MELT A COAT OF SOLDER ONTO TERMINAL.

4. ALLOW TERMINAL TO COOL.

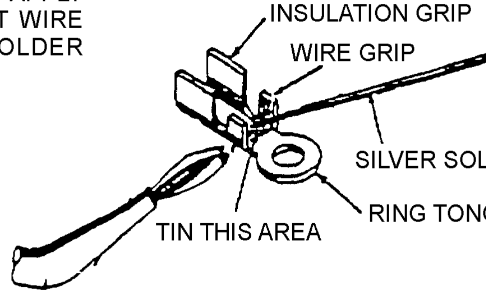


Figure 9. Tinning with Silver Solder (Sheet 3)

48 . **TINNING WITH SILVER (HARD) SOLDER.** Before wires are soldered to terminals or other connections, they are tinned. The inability to obtain a good tinned surface indicates that the wire was not clean. The procedure for tinning wire and terminals is shown in Figure 9.

49 . **SOLDERING IRONS.**

50 . **SOLDERING IRON SELECTION.** Select a soldering iron with a thermal capacity high enough so that the heat transfer is fast and effective. An iron with excessive heat capacity will burn or melt wire insulation; an iron with too little heat capacity will make a cold joint in which the solder does not alloy with the work. A soldering iron should also be suited to the production rate. Do not select a small pencil iron where a high steady heat flow is required.

51 . **SELECTION BY WATTAGE.** Soldering irons are available in wattage ranges from 20 to 500 watts. Irons with wattage ratings of 60, 100, and 200 watts are recommended for general use in aircraft electrical wiring. Pencil irons with a rating of 20 to 60 watts are recommended for soldering small parts. The soldering iron recommended for printed circuit soldering is a lightweight 55 watt iron with a 600°F (316°C) Curie point tip control. This iron has a three-wire cord to eliminate leakage currents which could damage the printed circuits.

52 . **TIP SELECTION.** Select the tip best suited for the size and shape of the work being soldered. Soldering iron tips are available in sizes from 1/16 inch to 2 inches in diameter. For general use, a tip of 1/4 inch to 3/8 inch diameter is recommended. For printed circuit soldering, use a long shank tip of 1/16, 1/8, 3/32, or 3/16 inch diameter. Screwdriver, chisel, and pyramid shapes are recommended (Figure 10).

WARNING

Avoid oral contact with hands during soldering operations and wash hands immediately after soldering operation. The lead contained in solder can be a source of lead oxide. Lead oxide, when absorbed in the body over the years, can cause serious health problems. Touching solder followed by smoking or eating is a potential means of ingesting trace amounts of lead oxide.

53 . **APPLICATION OF HEAT AND SOLDER.** Apply flux-core solder at the exact point between the metal and the soldering iron holding iron directly against the assembly. Melt the solder on the joint, not to the iron. Place the soldering iron firmly against the junction. If heavy rocking pressure is necessary, either the iron does not have sufficient heat capacity for the job, or it has not been properly prepared, or both. Do not apply heat to the work any longer than necessary to melt the solder on all parts of the joint. Do not use any more solder than necessary. Do not pile up solder around the joint; this is wasteful and results in joints difficult to inspect. Care should be exercised with silver coated wire to prevent wicking during solder application (Figure 11).

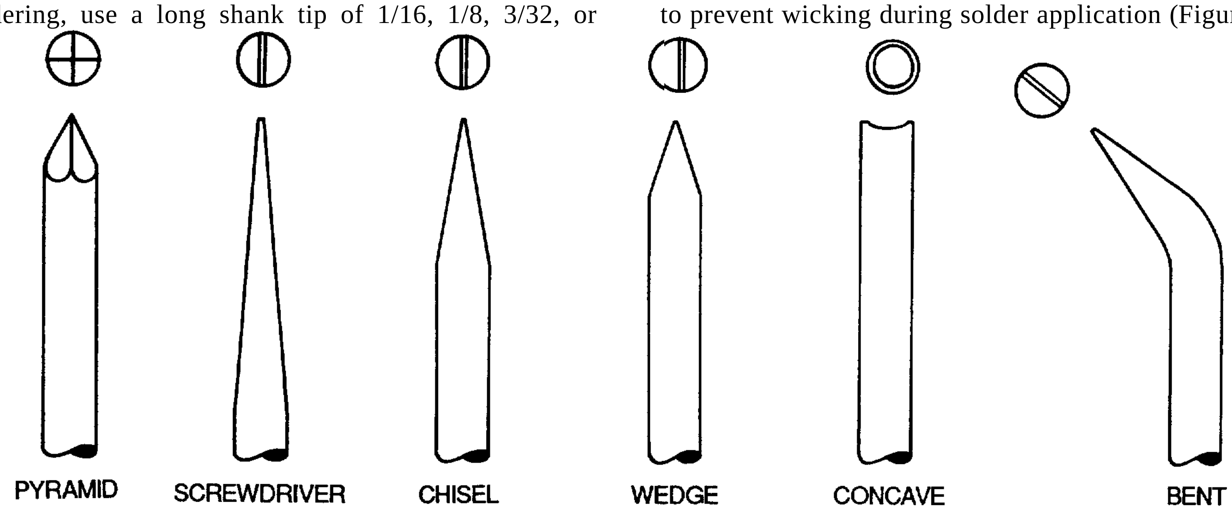


Figure 10. Soldering Iron Tip Shapes (Typical)

54 . **OVERHEAT PROTECTION.** Do not allow the iron to overheat. Disconnect the iron when it is not in use (between operations), or use a heat dissipating stand which will keep the iron at a constant temperature. When the soldering iron is not in actual use during operations, keep it in a holder. This will protect the operator against burns and the iron against damage (Figure 12).

55 . **COOLING.** When the solder joint has been made, hold the work firmly in place until the joint has set. Disturbing the finished work will result in a mechanically weak joint with high electrical resistance. Allow solder joints to cool naturally. Do not use liquids or air blasts.

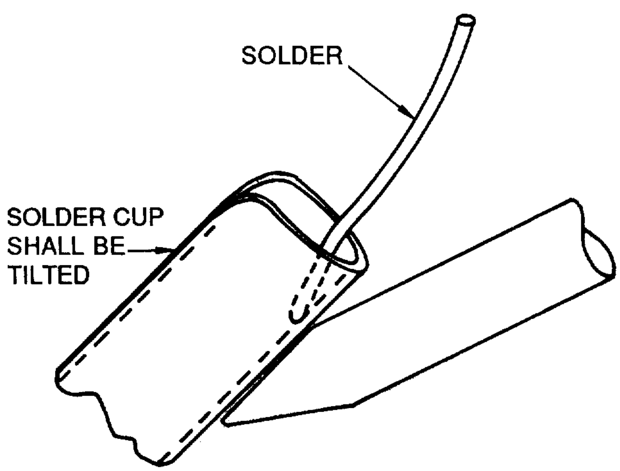


Figure 11. Correct Solder Application

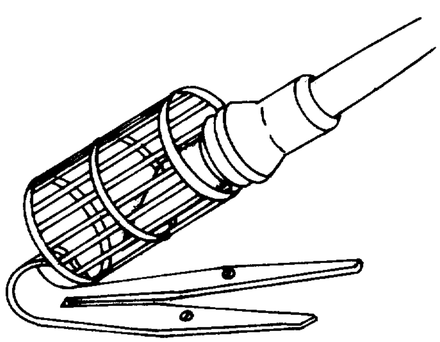


Figure 12. Soldering Iron Holder

WARNING

Isopropyl alcohol is flammable - do not use near open flames, welding areas, or on hot surfaces. Do not smoke when using it, and do not use where others are smoking. Inhalation of vapors can cause drowsiness, dizziness and headaches. Contact of liquid witH skin may cause dermatitis and irritation. If any liquid contacts skin or eyes, immediately flush affected area thoroughly with water. Remove solvent-saturated clothing. Consult MSDS.

56 . **CLEANING.** If the correct amount of solder is used and procedure instructions followed carefully, there should be little or no excess flux remaining on the finished joint. Remove excess flux by brushing the joint with a stiff brush dipped in methyl isobutyl ketone (ASTM D1153) or other approved solvent. Use alcohol sparingly and avoid contact between alcohol and wire insulation. For cleaning printed circuit connections, use a cotton swab-stick for small areas and a lint-free clean cloth for large areas and board edges.

57 . **SOLDER TERMINATION PROCEDURE.**

58 . Solder termination procedures shall be followed to ensure good electrical contact, mechanical adhesion, and clean solder joints. Each type of termination must be inspected and cleaned in accordance with the general procedures.

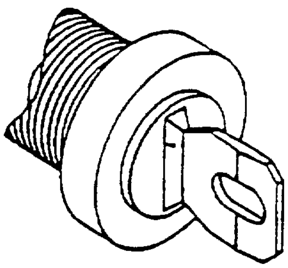
59 . **SPADE TERMINALS.** Spade terminals, also called eyelet terminals, shall be terminated in the manner described (Figure 13).

60 . **HOOK TERMINALS.** Hook terminals are manufactured in the shape of a hook and are terminated using a hook shape in the wire to be terminated (Figure 14).

61 . **TURRET TERMINALS.** Turret terminals are those that stand upright in a post position and are terminated using a hook shape in the wire to be terminated (Figure 15).

62 . **BIFURCATED TERMINALS.** Bifurcated terminals are those that stand upright but are divided into two parts and are terminated using three types of terminal fill (Figure 16).

A. SPADE TERMINAL TERMINATIONS.

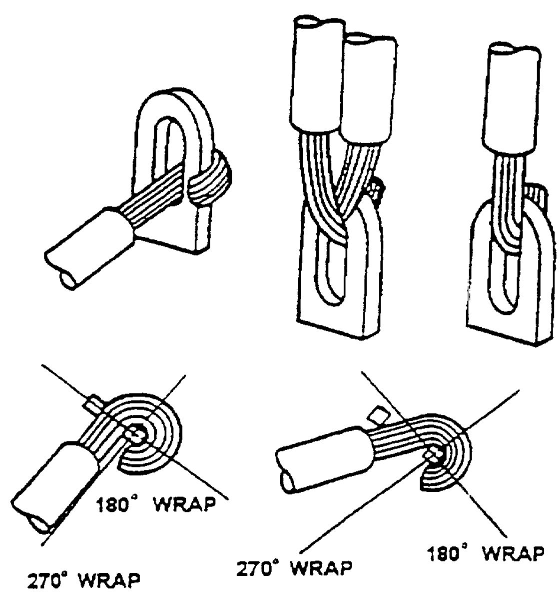


1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. INSERT AND CENTER WIRE ON THE TERMINAL.

4. WRAP THE WIRE EITHER 90° OR 180° FROM THE POINT OF ENTRY AROUND THE TERMINAL.



5. APPLY FLUX, SOLDER, AND HEAT IN ACCORDANCE WITH PARAGRAPH 54.

6. INSPECT SOLDER CONNECTION FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.

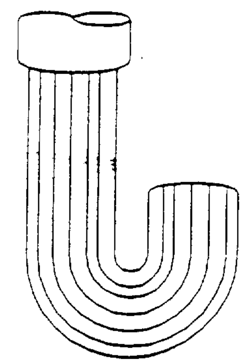
Figure 13. Spade Terminal Terminations

A. HOOK TERMINAL TERMINATIONS.

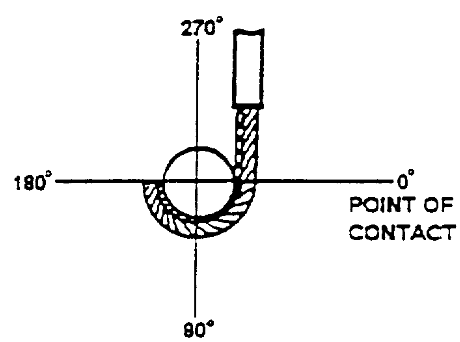
1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. FORM THE WIRE TO BE TERMINATED IN SHAPE OF HOOK 180° .



4. POSITION HOOK ON TERMINAL. ENSURE CONTACT WITH TERMINAL. ENSURE WIRE DOES NOT EXTEND BEYOND HOOK TERMINAL.



5. APPLY FLUX, SOLDER, AND HEAT IN ACCORDANCE WITH PARAGRAPH 54.

6. INSPECT SOLDER CONNECTIONS FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.

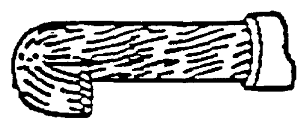
Figure 14. Hook Terminal Terminations

A. TURRET TERMINAL TERMINATIONS.

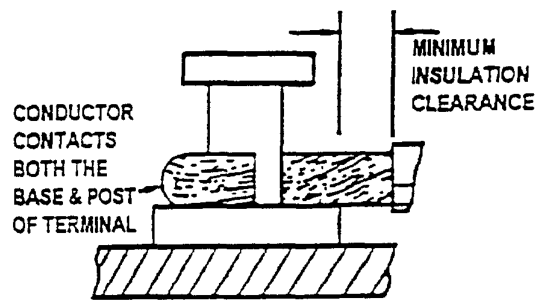
1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. FORM THE WIRE TO BE TERMINATED IN SHAPE OF HOOK 180°.



4. POSITION HOOK ON TERMINAL. ENSURE CONTACT WITH TERMINAL. ENSURE WIRE DOES NOT EXTEND BEYOND HOOK TERMINAL.



5. APPLY FLUX, SOLDER, AND HEAT IN ACCORDANCE WITH PARAGRAPH 53.

6. INSPECT SOLDER CONNECTIONS FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 69.

Figure 15. Hook Terminal Placement

A. TOP-ROUTE WIRES. METHOD OF CONNECTING THE WIRE BY COMING THROUGH THE TOP OF BIFURCATION GAP.

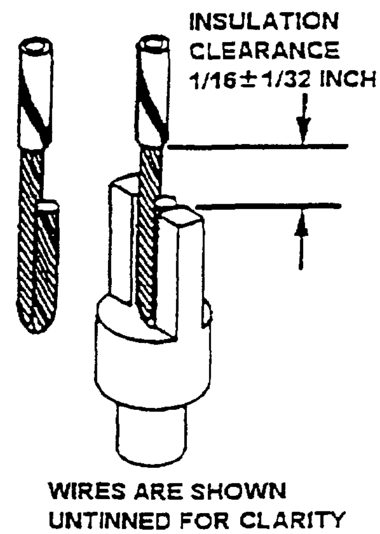
1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. FORM THE WIRE TO BE TERMINATED. DEPENDING ON THE BIFURCATION GAP, IN ONE OF THE FOLLOWING:

(A) A LARGE-DIAMETER WIRE WHICH FILLS THE GAP SHALL BE INSERTED WITH NO BEND AND SHALL REQUIRE ONLY FILLETS FOR RETENTION.

(B) A SMALL-DIAMETER WIRE WHICH DOES NOT FILL THE GAP SHALL BE BENT INTO A U-SHAPE AND INSERTED, PROVIDED THAT THE COMBINED DIAMETER IS SUFFICIENT TO FILL THE GAP.



4. POSITION WIRE IN GAP, ENSURE CONTACT WITH TERMINAL.

5. APPLY FLUX, SOLDER AND HEAT IN ACCORDANCE WITH PARAGRAPH 54.

6. INSPECT SOLDER CONNECTION FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.

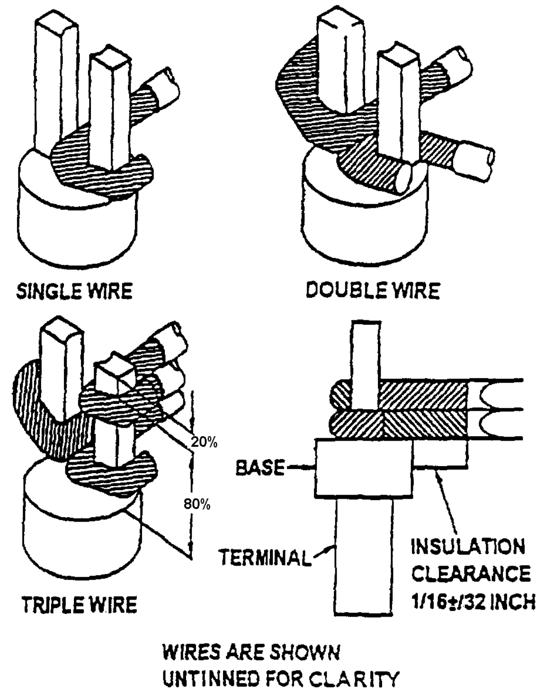
Figure 16. Bifurcated Terminal Terminations (Sheet 1 of 3)

B. SIDE-ROUTE WIRES. METHOD OF CONNECTING THE WIRE BY ENTERING THE MOUNTING SLOT FROM THE SIDE.

1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. FORM THE WIRE TO BE TERMINATED INTO THE SHAPE OF TWO 90° BENDS. WHEN MORE THAN ONE WIRE IS TO BE CONNECTED TO TERMINAL, DIRECTION OF THE 90° BENDS SHALL ALTERNATE. FIRST WIRE SHALL BE ATTACHED TO THE BASE AND THE VERTICAL POST. ADDITIONAL WIRES SHALL BE ATTACHED AS CLOSE AS POSSIBLE TO THE PRECEDING WIRE. A MAXIMUM OF THREE WIRES WILL BE PERMITTED. ALL WIRES SHALL BE CONFINED WITHIN LOWER 80 PERCENT OF THE TERMINAL.



4. POSITION WIRE IN GAP, ENSURE CONTACT WITH TERMINAL.

5. APPLY FLUX, SOLDER AND HEAT IN ACCORDANCE WITH PARAGRAPH 54.

6. INSPECT SOLDER CONNECTIONS FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.

Figure 16. Bifurcated Terminal Terminations (Sheet 2)

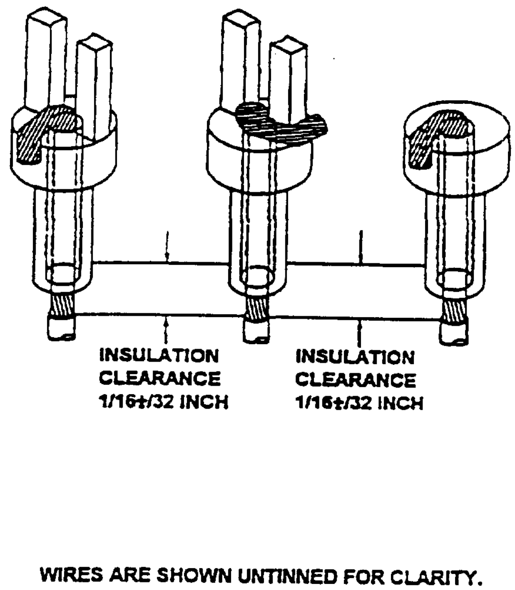
C. BOTTOM-ROUTED WIRES. ALSO KNOWN AS HOLLOW FEED-THROUGH. METHOD OF CONNECTING THE WIRE BY PASSING THROUGH THE FEED THROUGH TERMINAL.

1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. AFTER PASSING THROUGH THE FEED-THROUGH TERMINAL, FORM THE WIRE TO BE TERMINATED WITH A DOUBLE 90° BEND.

4. POSITION WIRE ON THE TERMINAL TOP SURFACE, ENSURE CONTACT WITH TERMINAL.



5. APPLY FLUX, SOLDER AND HEAT IN ACCORDANCE WITH PARAGRAPH 54.

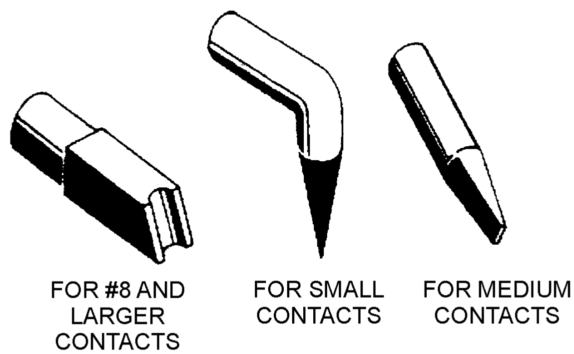
6. INSPECT SOLDER CONNECTION FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.

Figure 16. Bifurcated Terminal Terminations (Sheet 3)

A. SOLDER CUP PREPARATION.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE - DO NOT USE NEAR OPEN FLAME, WELDING AREAS, OR ON HOT SURFACES. DO NOT SMOKE WHEN USING IT, AND DO NOT USE IT WHERE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS AND HEADACHE. CONTACT OF LIQUID WITH SKIN MAY CAUSE DERMATITIS AND IRRITATION. IF ANY LIQUID CONTACTS SKIN OR EYES, IMMEDIATELY FLUSH AFFECTED AREA WITH WATER. REMOVE SOLVENT-SATURATED CLOTHING.



1. CLEAN THE SOLDER CUP PRIOR TO SOLDERING. NEW SOLDER CUPS CAN BE CLEANED WITH ISOPROPYL ALCOHOL AND AN ACID BRUSH. USED SOLDER CUPS THAT ARE TO BE REWORKED CAN BE CLEANED BY TINNING. VERY DIRTY OR OXIDIZED SOLDER CUPS MAY REQUIRE ABRASIVE METHODS TO REMOVE NON-METALLIC OXIDES.

2. IMPROVE TINNING AND SOLDERING OF CONTACTS IS ACHIEVED BY PROPER HEATING OF THE CONTACT. CHOOSE THE SOLDERING IRON TIP SHAPE WILL PROVIDE THE BEST HEATING OF THE CONTACT. LARGE CONTACTS CAN BE REMOVED FROM THE INSERT AND HELD IN A NONMETALLIC BLOCK TO MINIMIZE HEAT LOSS (FIGURE 21).

3. PREFILL THE SOLDER CUP WITH ENOUGH SOLDER TO FILL THE CUP WITHOUT OVERFLOW WHEN THE TINNED CONDUCTOR IS INSERTED. THE AMOUNT OF PREFILLING NEEDED WILL DEPEND UPON THE CONDUCTORS BEING USED. AS A RULE OF THUMB, FILL THE CUP WITH SOLDER TO THE LOWER LIP OF THE CUTOUT SECTION.

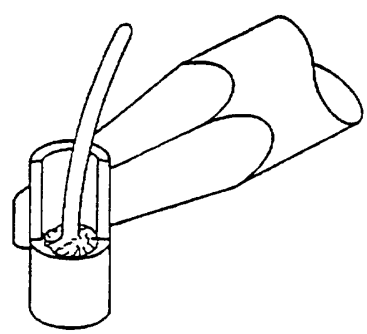


Figure 17. Solder Cup Termination (Sheet 1 of 2)

4. ALL EXCESS SOLDER SHOULD BE REMOVED, LEAVING THE TERMINAL INTERIOR BRIGHT AND SHINY. AVOID SPILLING SOLDER INTO AREAS NOT REQUIRING SOLDER. CLEAN THE SOLDER CUP WITH ISOPROPYL ALCOHOL AND AN ACID BRUSH AFTER THE TINNED SOLDER CUP HAS COOLED.

B. SOLDER CUP TERMINATION.

1. STRIP WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 40.

2. TIN WIRE TO BE TERMINATED IN ACCORDANCE WITH PARAGRAPH 41.

3. CUT A SUFFICIENT LENGTH OF INSULATION SLEEVING/TUBING AND SLIDE INTO WIRE.

4. HEAT THE SOLDER AND INSERT THE CONDUCTOR WHEN WHEN THE SOLDER IS MOLTEN (ALLOW GASES AND FLUXES TO ESCAPE). FULLY BOTTOM THE CONDUCTOR.

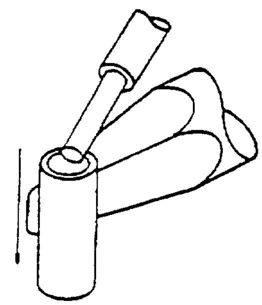


Figure 17. Solder Cup Termination (Sheet 2)

63 . **SOLDER CUP.** A solder cup is a hollow cylinder at the tubular end of a terminal or solder contact in which a conductor is inserted and soldered in place (Figure 17).

CAUTION

Use only rosin based non-active flux when soldering to contacts, and clean thoroughly following soldering to minimize potential corrosion.

64 . **ELECTRICAL RESISTANCE SOLDERING.** Resistance soldering will yield excellent results for both very large and very small contacts.

a. Small contacts are soldered by the use of a pencil type resistance soldering tool (Figure 18). The two electrodes of the tool are placed in contact with the side of the solder cup so that the heating current will pass through the wall of the cup. When the solder flows, insert the tinned wire. Continue to apply heating current to the connection until the solder flows to form a smooth fillet, remove heating current and allow the joint to cool and harden without movement.

NOTE

When soldering to connectors with a large number of contacts, a cooling off period should be allowed after each series of twenty contacts in order to prevent heat build-up.

65 . **SOLDERING SEQUENCE.** When soldering wires to connector, follow a rigid sequence to help avoid errors in wiring and prevent burning or scorching the insulation of wires already soldered. Two suggested sequences are shown (Figure 19) but are not mandatory. It is important that a fixed sequence is developed and used.

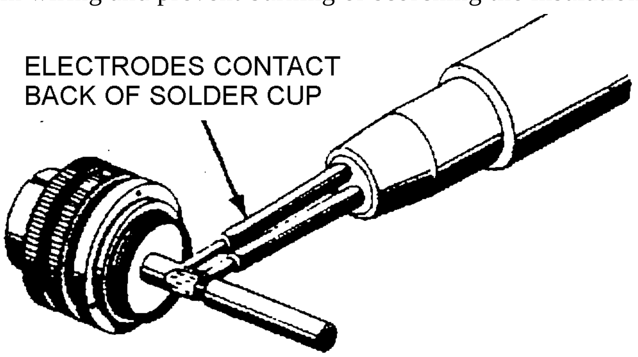


Figure 18. Resistance Soldering to Small Contacts

66 . **SOLDERING TERMINALS WITH SILVER (HARD) SOLDER.** Solder high temperature wire to terminals (see Figure 20). For more detailed information on soldering thermocouple wire, see WP 015 00.

67 . **QUALITY STANDARDS.** Quality is the most important standard. When quality is maintained, good electrical and mechanical joints will follow. Solder joints or connections are either acceptable or unacceptable.

a. Solder Joint. A good solder joint will have a bright silvery appearance, with smooth fillets and feathered, not sharp, edges. The entire joint will be covered with a smooth even coat of solder, and the contour of the joint will be visible. Any of the following indicate a poor solder joint and are cause for rejection:

(1) Dull gray, chalky, or granular appearance (evidence of a cold joint).

(2) Hair cracks or irregular surface (evidence of a disturbed joint).

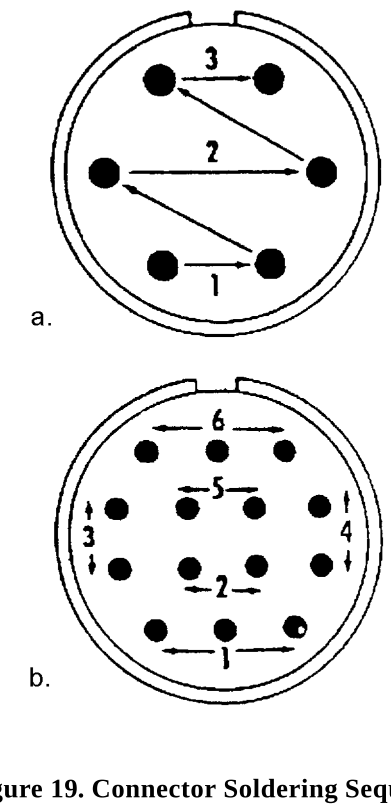
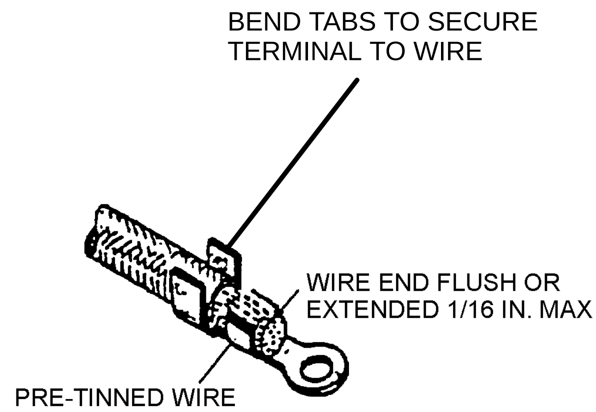


Figure 19. Connector Soldering Sequence

NOTE
TINNING OF THERMOCOUPLE TERMINALS IS REQUIRED TO THERMOCOUPLE WIRE.

1. SECURE TERMINAL TO THERMO-COUPLE WIRE.



(A) RESISTANCE SOLDERING.

(1) PLACE COPPER SHIELD BETWEEN INSULATION AND AREA TO BE SOLDERED.

(2) HEAT JOINT UNTIL FLUX BUBBLES.

(3) APPLY SILVER SOLDER TO JOINT. WHEN SOLDER HAS FLOWED INTO WIRE GRIP REMOVE PLIERS AND ALLOW JOINT TO COOL.

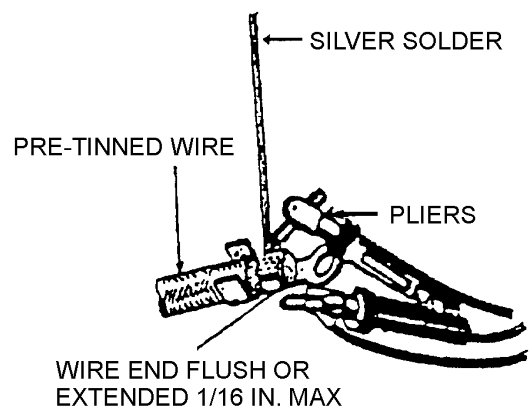


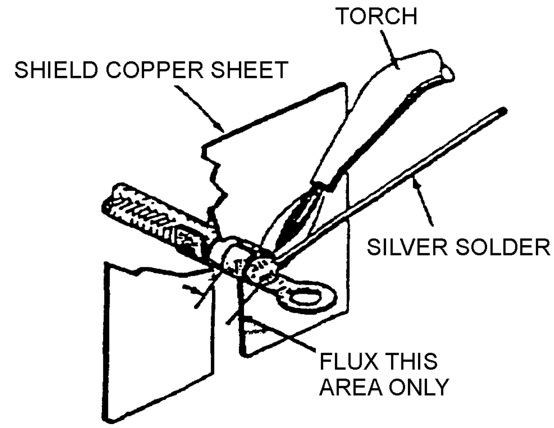
Figure 20. Silver Soldering Terminals (Sheet 1 of 3)

B. TORCH SOLDERING.

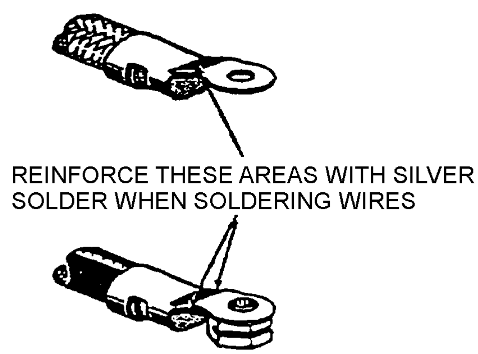
(1) PLACE COPPER SHIELD BETWEEN INSULATION AND AREA TO BE SOLDERED.

(2) HEAT JOINT UNTIL FLUX BUBBLES.

(3) APPLY SILVER SOLDER TO JOINT. WHEN SOLDER HAS FLOWED INTO WIRE GRIP, REMOVE FLAME AND ALLOW JOINT TO COOL.



NOTE
IF AN5539 TERMINALS ARE USED, PLACE ADDITIONAL SOLDER IN AREAS INDICATED.



2. COMPLETING TERMINAL CONNECTION.

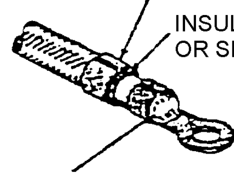
(A) REMOVE FLUX RESIDUES WITH WARM WATER AND A BRISTLE BRUSH. DRY THOROUGHLY.

(B) EXAMINE CONNECTION TO ENSURE SILVER SOLDER HAS ALLOYED TO WIRE AND TERMINAL, AND IS NOT SCORCHED.

Figure 20. Silver Soldering Terminals (Sheet 2)

3. SECURE INSULATION GRIP ON INSULATION USING INSULATION MODIFIED CRIMPING TOOL WT-111. INSULATION GRIP TABS SHALL BE IN FULL CONTACT AND SHOW EVIDENCE OF BITING INTO BUT NOT THROUGH INSULATION.

4. INSPECT SOLDER CONNECTION FOR QUALITY STANDARDS AS DEFINED IN PARAGRAPH 70.



WHEN NECESSARY, EARS MAY BE CLIPPED SO THAT ENDS BUTT AFTER CRIMPING

WARNING

ZINC CHROMATE PRIMER IS FLAMMABLE - DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. DO NOT SMOKE WHEN USING IT, AND DO NOT USE WHERE OTHERS ARE SMOKING. CONTACT WITH LIQUID OR VAPOR CAN CAUSE SKIN OR EYE IRRITATION, DIZZINESS AND HEADACHE. PROLONGED INHALATION CAN RESULT IN KIDNEY AND LIVER DAMAGE. AFTER PROLONGED SKIN CONTACT, WASH CONTACTED AREA WITH SOAP AND WATER. IF VAPORS CAUSE DIZZINESS, GO GET FRESH AIR. IF IRRITATION PERSISTS, GET MEDICAL ATTENTION.

5. COAT WIRE AND INSULATION GRIP AREAS OF TERMINAL WITH ZINC CHROMATE, DO NOT COAT RING TONGUE.

Figure 20. Silver Soldering Terminals (Sheet 3)

(3) Grayish, wrinkled appearance (evidence of excessive heat).

(4) Partially exposed joint (evidence of insufficient solder).

(5) Scorched wire insulation or burned connector inserts.

(6) Globules, drips, or tails of solder.

b. Insulation Damage. When a good solder joint is accomplished, the insulation will be properly cut and shall not show any of the following, which will be cause for rejection:

(1) Charred, burned or blistered (evidence of overheating).

(2) Frayed or uneven appearance.

(3) Solder on insulation.

68 . **TERMINAL STANDARDS.** Poor workmanship which relates to poor quality as illustrated. This type of workmanship applies to spade, hook, and turret terminals. This work is unacceptable and is cause for rejection (Figure 21).

69 . **SOLDER CUP STANDARDS.** Standards illustrated are acceptable and unacceptable work. Unlike terminal standards there is a maximum solder and minimum solder quantity. When these are exceeded the work is unacceptable and is cause for rejection (Figure 22).

70 . **REWORK.** If any of the above are present, the joint shall be taken apart, parts cleaned, and the entire soldering operation repeated, using fresh solder and flux.

71 . **UNSOLDERING.** There are times that it will be necessary to remove a wire from a soldered connection. Solder should be removed from terminals and solder cups either by mechanical means or by wicking.

a. Mechanical Means. The mechanical means is by using a mechanical vacuum device. As the soldering iron heats the solder the mechanical vacuum removes the solder from the work. A solder sucker, which is a hand operated bulb with a tip, may also be used.

b. Wicking. In wicking use a stranded conductor or braided conductor and flux. Place the wire on the solder connection and the tip of the hot iron on the wire, the solder will wick to the wire. When the solder has wicked remove the wire and the iron together.

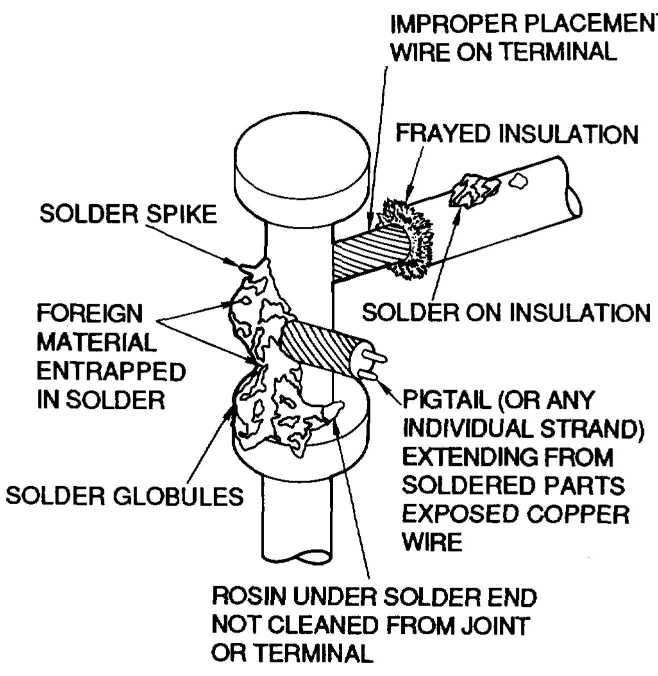


Figure 21. Unacceptable Conditions

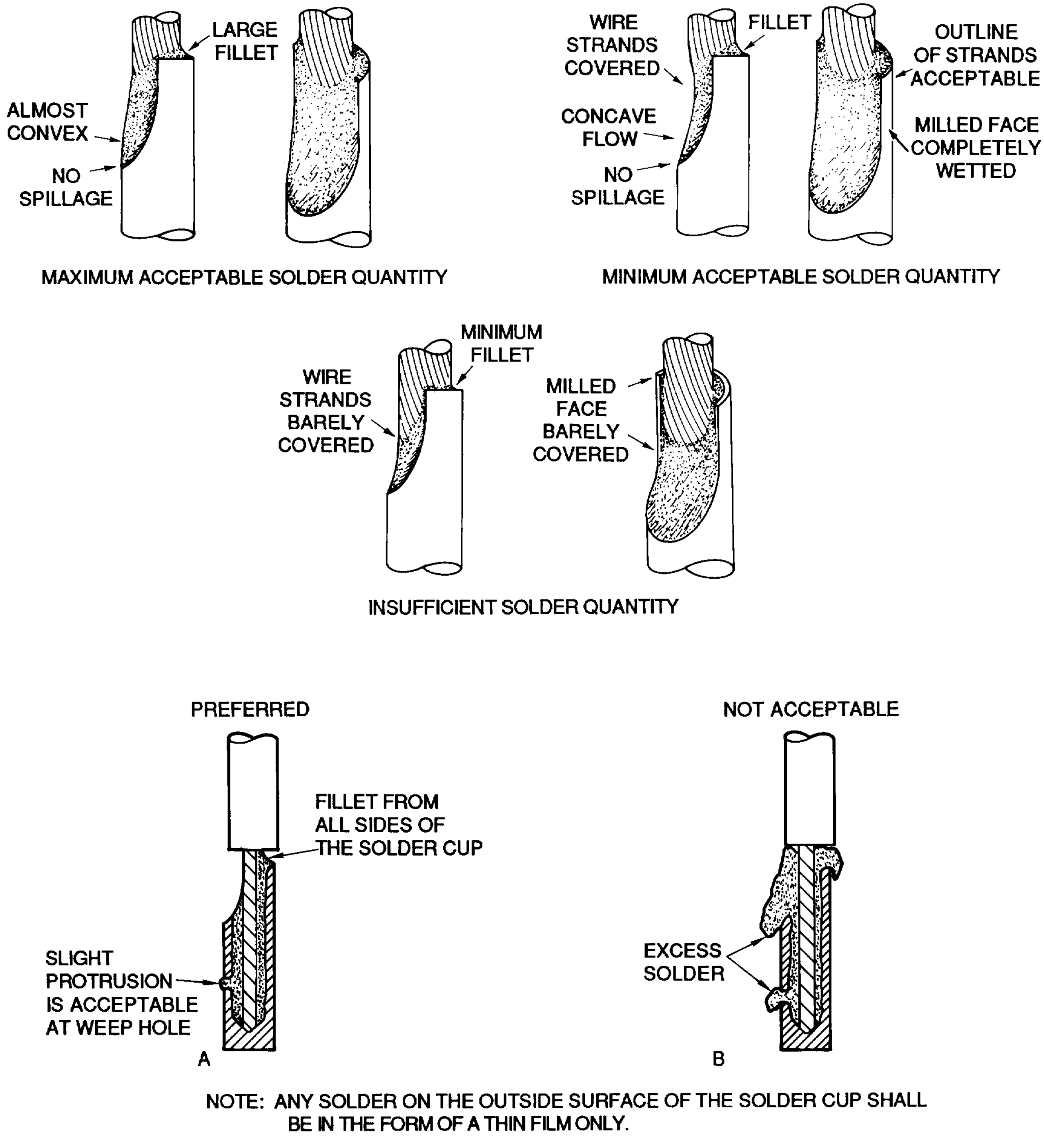


Figure 22. Acceptable and Unacceptable Conditions

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BONDING AND GROUNDING

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Chemical Conversion Material . . . . . . MIL–C–5541 CLASS 3
Connectors and Assemblies, Electrical, Aircraft Grounding:
Type IV Jumper Cable Assembly, Lead, Electrical MIL-C-83413/8
Electromagnetic Environmental Effects Requirements for Systems MIL-STD-464

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directive

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Low Range Ohmmeter	AN/USM–21A
Ohmmeter	R1L–E or R1L–E–1, 247000, T477W
Crimp Tool	M22520/5
Crimp Tool	M22520/24
Die, Crimp	MS23002
Crimp Tool, Hydraulic	MS25441
Die, Crimp	MS90485

Materials Required

Nomenclature	Part Number/Type Designation
Abrasive Mats	A–A–58054
Chemical Conversion Material	MIL–DTL–81706
Clamp, Bonding	AN735
Cloth, Abrasive Coated	ANSI B74.18
Conductor, Copper	ASTM-B172
Lockwasher	MS35338
Lockwasher	MS35340
Magnesium Alloy. Pretreatment	SAE–AMS–M–3171, Type VI
Methanol	O-M-232
Primer Coating, Epoxy	MIL–PRF–23377
Remover, Paint, Epoxy	TT–R–2918
Sleeving, Insulation, Heat Shrinkable	SAE AMS–DTL–23053/5, Class I
Mineral Spirits, Dry Cleaning	MIL–PRF–680 TYPE II
Splice Set, Quick Disconnect	M6852-3
Terminal Lug, Crimp Copper Insulated	MS25036 (Series)
Terminal Lug, Crimp Copper Uninsulated	MS20659 (Series)
Thinner, Dope and Lacquer	TT–R–2918
Washer	NAS1149
Screw	NAS1801
Screw	NAS1802
Lock nut	NASM21042
Lock nut	NASM21043

1. **INTRODUCTION.**

2. This work package (WP) describes bonding and grounding procedures, tools and the necessary associated hardware used in the installation and interconnection of electronic and electrical equipment to provide for proper grounding, bonding, and lightning protection.

3. **USE.** The intended use of bonding requirements is to ensure that the structures of aerospace systems are electrically stable and are made for the following:

a. To protect aircraft and personnel against hazards from lightning discharges.

b. To provide power current paths.

c. To prevent development of EMI potentials.

d. To protect personnel from shock hazard.

e. To provide stability and uniformity of radio transmission and reception.

f. To prevent accumulation of static charges.

g. To provide fault current return paths.

4. **DEFINITIONS.** For the purpose of this work package the following definitions apply:

a. Bond. A bond is a fixed union existing between two objects that results in electrical continuity between them. The bond is formed by either physical contact or from the addition of an electrical connection.

b. Bonding. Bonding, or to bond, is the process of obtaining, the electrical continuity which forms the bond.

c. Bonding Jumpers. A bonding jumper is a wire, braided wire, or metal strap that provides the necessary continuity to form the bond.

d. Conducting Surface. A conducting surface includes all objects having a resistance of less than one megohm per centimeter.

e. Isolated Surface. An isolated surface is one that is physically separated by insulation from the structure or other conductors, which are bonded.

f. Grounding. The electrical connecting of conducting objects to primary structure for return of current.

5 . **REQUIREMENTS.**

6 . **STANDARD PARTS**. Standard parts shall be used wherever suitable and shall be identified on drawings or documents by their part number. Commercial parts such as screws, bolts, washers, nuts and other hardware may be used providing they do not degrade the equipment or the bond. Standard parts will be preceded by MS, AN, NAS or JAN.

7 . **JUMPERS.** Jumpers used in bonding shall meet the requirements as set forth in MIL-C-83413/8 and as outlined below:

a. Bond or ground parts to the primary aircraft structure where practical.

Table 1. Bonding Classes

Class	Application
A	Antenna installation
C	Current path return
H	Shock hazard
L	Lightning protection
R	RF potentials
S	Static charge

b. Bond parts individually wherever possible.

c. Make bonding or grounding connections against smooth, clean surfaces.

d. Install bonding or grounding connections so that vibration, expansion or contraction, or relative movement incident to normal service use will not break or loosen the connection.

e. Locate bonding and grounding connections in protected areas whenever possible. Locate connections near hand holes, inspection doors, or other accessible areas to permit easy inspection and replacement whenever possible.

f. No more than four ground wires shall be connected to a common stud (per SAE-AS-50881).

g. Each ground for electric power sources (primary, secondary, conversion, emergency) shall be connected to separate ground points.

h. Equipment that has power supplied from the same source may be connected to a common ground point provided these equipment do not perform duplicate or overlapping functions.

i. Jumpers shall be kept as short and direct as possible.

j. The number of jumpers shall be kept to a minimum by careful design.

k. Jumpers are not to be used in series.

8 . **CLAMPS.** Clamps shall be of the plain type conforming to AN735.

9 . **BONDING CLASSES.**

10 . Electrical bonding falls into six classes of application as specified (Table 1). Refer to weapon system/ platform technical manuals for specific applications and associated values. In the absence of specific data, use the information provided in the paragraphs below.

11 . **CLASS A.** Class A bonding relates to the installation of antenna radiating elements exclusive of radar and other similar types. Antennas are installed and provided with a suitable ground plane of adequate dimensions so as not to detract from the desired radiation patterns.

a. Make bonding or grounding connections in such a way as not to weaken any part of the aircraft structure.

12 . **CLASS C.** Class C bonding relates to current path returns and shall be adequate to carry the power current return. The total impedance shall be such that the voltage drop does not exceed the limits of operation. Magnesium alloy structures shall not be used as a current path return.

13 . **CLASS H.** Class H bonding is to protect against shock hazard. Bonding of 0.1 ohm or less is required for conduits carrying electrical wiring. and may be accomplished through the equipment at which the conduit terminates. Exposed conducting frames or electronic parts and equipment shall be bonded to the structure with a resistance of 0.1 ohm or less.

a. Do not compression-fasten bonding or rounding connections through any nonmetallic material.

14 . **CLASS L.** Class L bonding relates to lightning protection, which shall be provided at all possible points of entry of lightning. Entry points include, but are not limited to the following:

a. Navigation lights.

b. Fuel Filler Caps.

c. Fuel Gage Covers.

d. Refueling Booms.

e. Fuel Vents.

f. Radomes.

g. Canopies.

15 . **CLASS R.** Class R bonding relates to EMI protection. All electrical and electronic units or components, which produce electromagnetic energy. shall be installed to provide a continuous low impedance path (25 milliohms or less) from the equipment to the structure per MIL-STD-464.

16 . **CLASS S.** Class S bonding relates to static charges. All isolated conducting items except antennas greater than 3 inches, which are external to the vehicle, carrying fluids in motion, are subject to frictional charging and shall be bonded to discharge static or frictional charging. Bonding for static charge shall be 1.0 ohm or less, in accordance with MIL-STD-464.

17 . **FUEL SYSTEM BONDING.**

WARNING

No work shall be performed in open fuel cell unless fuel cell has been defueled, purged and certified gas–free IAW NAVAIR 01–1A–35.

18 . All metallic components in fuel systems can be sources of electrical discharges and are potentially hazardous when they are electrically isolated. Grounding and bonding shall eliminate this component hazard.

19 . **BONDING JUMPER INSTALLATIONS.**

20 . The jumper should not interfere with the operation of movable aircraft elements, such as surface controls, nor should normal movement of these elements result in damage to the bonding jumper.

a. Bonding Connections. To ensure a low–resistance connection, non conducting finishes such as paint and anodizing films should be removed from the attachment surface to be contacted by the bonding terminal. Refer to paragraph 45 for surface preparation procedure

b. Corrosion Protection. One of the more frequent causes of failures in electrical system bonding and grounding is corrosion. Aircraft operating near salt water are particularly vulnerable to this failure mode. Because bonding and grounding connections may involve a variety of materials and finishes, it is important to protect completely against dissimilar metal corrosion. The areas around completed connections should be post–finished in accordance with paragraph 45.

c. Corrosion Prevention. Electrolytic action may rapidly corrode a bonding connection if suitable precautions are not taken. Aluminum alloy jumpers are recommended for most cases; however, copper jumpers should be used to bond together parts made of stainless steel, cadmium plated steel, copper, brass, or bronze. Where contact between dissimilar metals cannot be avoided, the choice of jumper and hardware should be such that corrosion is minimized, and the part likely to corrode would be the jumper or associated hardware. Figures

3 through 5 and figures 7 through 10 show the proper hardware combinations for making a bond connection.

d. Bonding Jumper Attachment. Tubular members should be bonded by means of clamps to which the jumper is attached. Proper choice of clamp material should minimize the probability of corrosion, Figures 5–7 through 5–9 show the proper clamp material

e. Test the bonding installation in accordance with paragraph 46.

21 . **HARDWARE SELECTION.**

22 . SMALL METALLIC COMPONENTS. Small metallic components within fuel systems such as name tags, coupling shells, brackets and clamps are all potentially hazardous and their use avoided whenever possible. When the use of such components are essential they shall be properly bonded with an electromechanical connection to the structure with one ohm or less resistance.

23 . **EXCEPTION.** When small metallic components cannot be feasibly bonded, as in paragraph 25, the component shall have a bonding connection that measures 10 megohms or less and shall be proven safe by tests performed in a laboratory by the procuring activity.

24 . **FAULT CURRENT.** Fault current is the maximum current delivered when an internal power to ground short occurs. Since bonding itself cannot eliminate all possible sources of ignition, the equipment itself must be so designed to minimize or eliminate all possible sources of ignition. The resistance between the equipment case and the structure shall not exceed those shown (Figure 1).

25 . **PIPE AND HOSE BONDING.** All metallic pipes, tubes, and hoses that carry petroleum products, or other fluids, shall have a mechanically secure bond that measures one ohm or less.

26 . **SELECTION.** The selection of hardware to be used in bonding and grounding shall be selected to meet the requirements established in accordance with MIL-STD-464.

27 . **SELECTION OF BOLTS, NUTS, AND SCREWS.** The selection of bolts, nuts, and screws shall be of the following:

28 . **Cadmium Plated Steel.** Cadmium plates, steel bolts, nuts. and screws shall be selected when weight is not critical and temperatures do not exceed 550°F (288°C).

29 . **Corrosion Resistant Steel.** Corrosion resistant steel shall he selected for use in high temperature applications.

30 . **Titanium.** Titanium shall be selected for use in high temperature applications and a saving of weight is desired. Bolts that carry current shall not be coated with tetrafluoroethylene.

31 . **Aluminum.** Aluminum shall be selected for general applications where temperatures do not exceed 300°F (149°C).

32 . **Prohibited.** Bolts. nuts, and screws that are zinc plated and all self-tapping screws are not to be used in any situation.

33 . **SELECTION OF WASHERS**. The selection of washers shall be of the following:

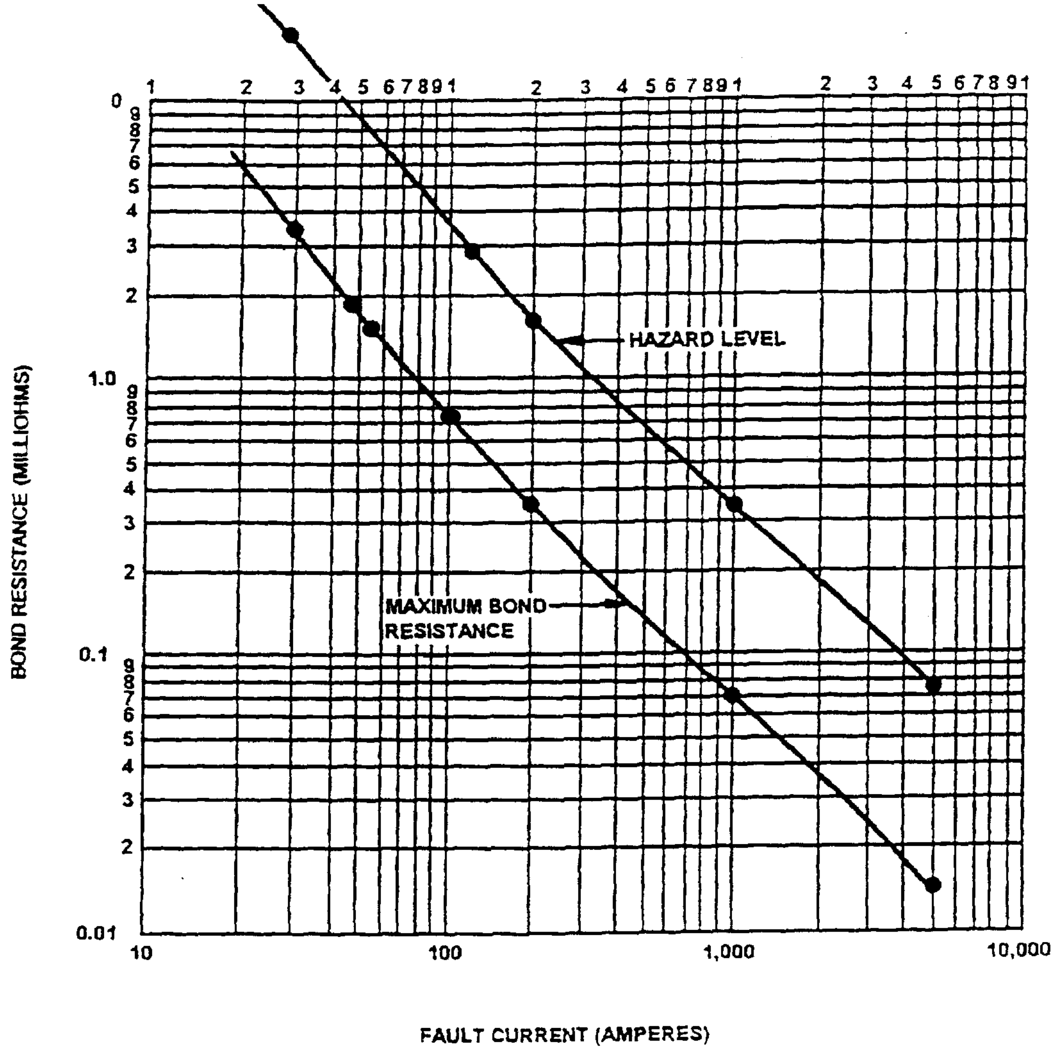
34 . **Plain.** NAS1149 washers are plain washers in various size, composition. and series. They are used in all bonding applications. Refer to applicable diagrams and drawings for selection. Aluminum alloy washers are to be finish code J. Corrosion resistant steel washers are to be finish code R.

35 . **Locking.** Lockwashers shall be one of two types and are used in connection with plain or self locking nuts. Refer to applicable diagrams and drawing for selection.

a. MS35338. This series is used where temperatures do not exceed 400°F (204°C).

b. MS35340. This series is interchangeable with MS35338 Series.

36 . **Prohibited.** Washers that are anodized, zinc plated, unplated, as well as any star washers are not to be used in any situation.



DATA POINTS

AMPS	HAZARD RESISTANCE (MILLIOHMS)	MAX RESISTANCE (MILLIOHMS)
5000	0.074	0.0148
1000	0.37	0.074
200	1.85	0.37
120	2.83	----
100	3.7	0.74
58	7.7	1.54
49	9.3	1.96
30	18	3.6

Figure 1. Fault Current

37 . **SELECTION OF CLAMPS.** Clamps shall be of the plain type conforming to AN735 and used as follows:

38 . **AN735 Cadmium Plate.** This series clamp shall he used on corrosion resistant steel where the temperature does not exceed 300°F (149°C).

39 . **AN735 Non–plated.** This series is for use on aluminum only.

40 . **SURFACE PREPARATION.**

41 . **ALUMINUM SURFACE CLEANING.**

WARNING

Mineral spirits dry cleaning solvent MIL–PRF–680 TYPE II is flammable. Avoid eye and skin contact or breathing of vapors. Protective equipment consisting of goggles and gloves is required.

CAUTION

Do not use abrasives such as emery cloth, crocus cloth, steel wool, or steel wire brushes, etc. These may leave particles imbedded in the surface or scattered in the area which may cause corrosive action.

a. Remove grease, oil. or other gross contaminants from the surface with mineral spirits dry cleaning solvent (ASTM-D235).

b. Remove paint, lacquer and/or primer from surface with epoxy paint remover (MIL-R-81294).

c. Remove anodic film from surface with aluminum oxide cloth. 320 grit (ANSI B74.18) or aluminum oxide abrasive webbing (A–A–58054) around mounting holes.

d. After cleaning, but before grounding hardware installation, cleaned surfaces shall be protected with a corrosion resistant conductive protective film in accordance with MIL–C–5541 Class III.

e. After hardware assembly, the mating surfaces around the ground hardware shall be restored to the original finish.

42 . **MAGNESIUM ALLOY SURFACE CLEANING.**

WARNING

Solvents, paint remover, methanol and chemical conversion coatings are flammable, do not use near open flames, welding areas or on hot surfaces. Contact with liquid or vapor can cause skin and eye irritation, dermatitis and drowsiness. If there is any prolonged skin contact. wash contacted area with soap and water. Remove solvent-saturated clothing. Ground returns shall not be connected to magnesium.

CAUTION

Do not use abrasives such as emery cloth, crocus cloth, steel wool or steel wire brushes, etc. These may leave particles imbedded in the surface or scattered in the area, which may cause corrosive action.

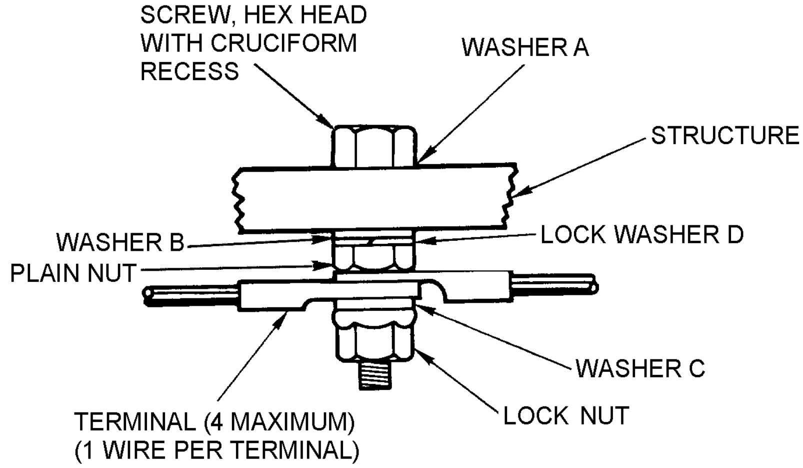
a. Remove grease, oil, or other gross contaminants from the surface with dry cleaning solvent.

b. Remove paint, lacquer and/or primer from surface with epoxy paint remover.

c. Apply chemical conversion coating in accordance with the manufacturer's recommended procedures, diluted one part to nine parts clean, fresh water, to slow down reaction speed normally used for aluminum.

d. After cleaning, but before grounding hardware installation, cleaned surfaces shall be protected with a corrosion resistant conductive protective film (MIL–DTL–81706) in accordance with MIL–C–5541 Class 3.

e. After hardware assembly, the mating surfaces around the ground hardware shall be restored to the original finish.



NOTE: SEE BELOW FOR MATERIALS

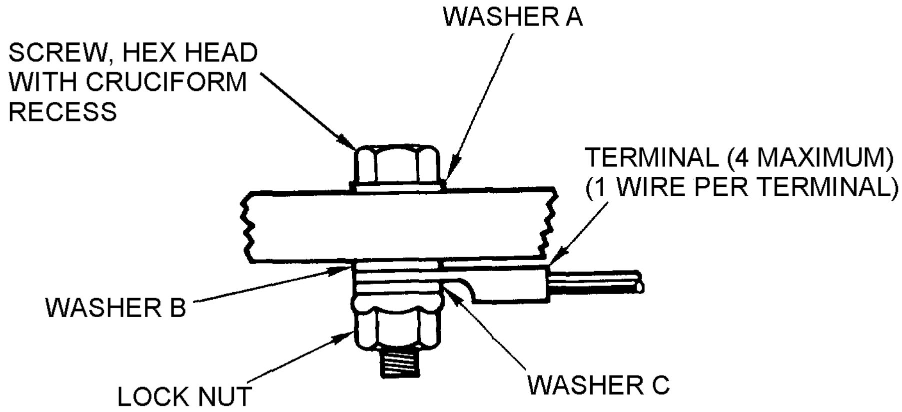
ALUMINUM TERMINAL AND JUMPER

STRUCTURE	SCREW, HEX HEAD	PLAIN NUT[3]	WASHER A	WASHER B	WASHER C	LOCK WASHER D	LOCK NUT [4]
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	TIN PLATED BRASS	ALUMINUM ALLOY[1]	ALUMINUM ALLOY[1]	ALLOY[1]	CAD. PLATED STEEL	NASM21042 CAD. PLATED STEEL
MAGNESIUM ALLOYS	NAS1801 CAD. PLATED STEEL	CAD. PLATED STEEL	MAGNESIUM ALLOY	MAGNESIUM ALLOY	ALLOY[1]	CAD. PLATED STEEL	NASM21042 CAD. PLATED STEEL
STEEL, CAD. PLATED	NAS1801 CAD. PLATED STEEL	CAD. PLATED STEEL	NONE	NONE	ALLOY[1]	CAD. PLATED STEEL	NASM21042 CAD PLATED STEEL
STEEL, COR. RESIST.	NAS1802 COR. RESIST STEEL	CAD. PLATED STEEL	NONE	NONE	ALLOY[1]	COR. RESIST. STEEL	NASM21043 CAD. PLATED STEEL
TINNED COPPER TERMINAL AND JUMPER							
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	CAD. PLATED STEEL	ALUMINUM ALLOY[1]	ALUMINUM ALLOY[1]	COR. RESIST[2]	CAD. PLATED STEEL	NASM21042 CAD. PLATED STEEL
MAGNESIUM ALLOYS	AVOID CONNECTING COPPER TO MAGNESIUM						
STEEL, CAD. PLATED	NAS1801 CAD. PLATED STEEL	CAD. PLATED STEEL	NONE	NONE	COR. RESIST[2]	CAD. PLATED STEEL	NASM21042 CAD. PLATED STEEL
STEEL, COR. RESIST.	NAS1802 COR. RESIST. STEEL	COR. RESIST. STEEL	NONE	NONE	COR. RESIST[2]	COR. RESIST. STEEL	NASM21043 COR. RESIST. STEEL

NOTES:

1. Finish Code J.
2. Finish Code R.
3. For #10 nuts, torque to 40 inch-pounds. For #8 nuts, torque to 20 inch-pounds.
4. For #10 lock nuts, torque to 35 inch-pounds. For #8 lock nuts, torque to 17 inch-pounds.

Figure 2. Hardware for Stud Bonding or Grounding to Flat Surface



NOTE: SEE BELOW FOR MATERIALS

ALUMINUM TERMINAL AND JUMPER

STRUCTURE	SCREW, HEX HEAD	WASHER A	WASHER B	WASHER C	LOCK NUT[3]
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	ALLOY[1]	ALUMINUM ALLOY[1]	ALLOY[1]	NASM21042 CAD. PLATED STEEL
MAGNESIUM ALLOYS	NAS1801 CAD. PLATED STEEL	MAGNESIUM ALLOY	MAGNESIUM ALLOY	ALLOY[1]	NASM21042 CAD. PLATED STEEL
STEEL, CAD. PLATED	NAS1801 CAD. PLATED STEEL	NONE	NONE	ALLOY[1]	NASM21042 CAD. PLATED STEEL
TINNED COPPER TERMINAL AND JUMPER					
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	ALUMINUM ALLOY[1]	ALUMINUM ALLOY[1]	COR. RESIST STEEL[2]	NASM21042 CAD. PLATED STEEL
MAGNESIUM ALLOYS	AVOID CONNECTING COPPER TO MAGNESIUM				
STEEL, CAD. PLATED	NAS1801 CAD. PLATED STEEL	NONE	NONE	COR. RESIST STEEL[2]	NASM21042 CAD. PLATED STEEL
STEEL, COR. RESIST.	NAS1802 COR. RESIST. STEEL	NONE	NONE	COR. RESIST STEEL[2]	NASM21043 CAD. PLATED STEEL

NOTES:

1. Finish Code J.
2. Finish Code R.
3. For #10 lock nuts, torque to 33 inch-pounds. For #8 lock nuts, torque to 17 inch-pounds.

Figure 3. Hardware for Bolt and Nut Bonding or Grounding to Flat Surface

43 . **STEEL SURFACE CLEANING.** When the surface is corrosion resisting, or plated steel, clean bonding or grounding surfaces as follows:

WARNING

Solvents, paint remover, methanol and chemical conversion coatings are flammable, do not use near open flames, welding areas or on hot surfaces. Contact with liquid or vapor can cause skin and eye irritation, dermatitis and drowsiness. If there is any prolonged skin contact, wash contacted area with soap and water. Remove solvent-saturated clothing.

CAUTION

Do not remove zinc or cadmium plate from steel surfaces.

a. Remove grease and oil from surface with methanol.

b. Remove paint or lacquer, if present, from surface with lacquer thinner.

44 . **BONDING AND GROUNDING METHODS.**

45 . **FLAT SURFACE CONNECTION.** Bonding and grounding connections are made to flat surfaces by means of through bolts or screws where installation has easy access. There are three types of bolted connection, as follows:

46 . **Stud Connection.** In this type of connection, a bolt or screw is locked securely to structure, thus becoming, in effect a stud. Grounding or bonding jumpers can be removed or added to the shank or stud without removing stud from structure (Figure 2).

CAUTION

When terminal is under head of screw or bolt, it is preferable not to install more than one terminal. Otherwise, the screw may loosen and cause improper operation of equipment.

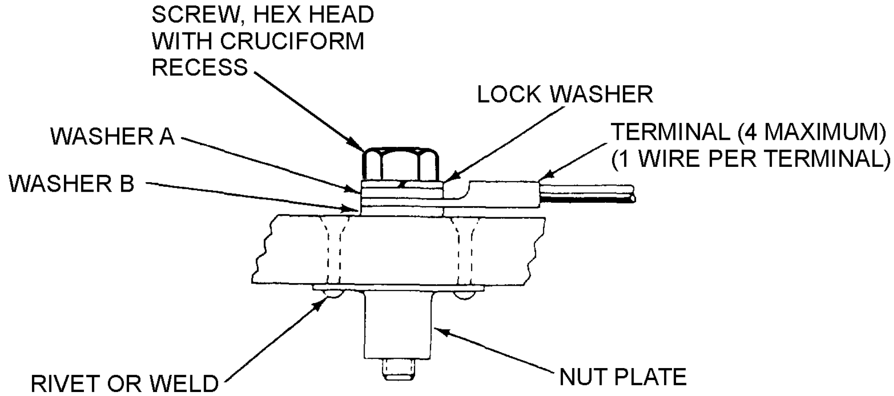
Ground attachment shall not be used as attachment points for any other equipment.

47 . **Nut and Bolt Connection.** In this connection the bolt or screw is not attached permanently to structure. When jumpers are to be added or removed, the entire connection is remade (Figure 3).

48 . **Nut Plate and Bolt Connection.** Nut plates are used where access to the nut for repair may be difficult. Nut plates are riveted or welded to a clean area of the structure (Figure 4).

49 . **RIVETED TAB CONNECTION.** For bonding leads carrying high current size AN-4 or larger, do not make connection directly to the structure. These connections shall be made to a tab of suitable size riveted to the aircraft structure. When a connection is made to a tab, clean the bonding or grounding surface and make the connection exactly as though the connection were being made to flat structure surface. If it is necessary to remove the tab for any reason, replace rivets with one size larger. Make sure surfaces of structure and tab are prepared in accordance with the applicable paragraph (Figure 5).

50 . **CYLINDRICAL SURFACE CONNECTION.** Make bonding or grounding connections to aluminum alloy, magnesium alloy, or corrosion resisting steel tubular structure as shown in Figures 6 and 7. Figure 6 shows the arrangement of hardware for bonding with an aluminum jumper. Because of the ease with which aluminum is deformed, it is necessary to distribute screw and nut pressure by means of plain washers as shown. Figure 7 shows the arrangement of hardware for bonding with a copper jumper. No extra washers are used. If installation conditions require, use AN742 clamp (uncushioned) instead of AN735. Do not change any other hardware if this substitution is made.



NOTE: SEE BELOW FOR MATERIALS

ALUMINUM TERMINAL AND JUMPER

STRUCTURE	SCREW, HEX HEAD	RIVET	LOCK WASHER	WASHER A	WASHER B	NUT PLATE
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	ALUMINUM ALLOY[1]	CAD. PLATED STEEL	ALUMINUM ALLOY[1]	NONE	CAD. PLATED STEEL
MAGNESIUM ALLOYS	NAS1801 CAD. PLATED STEEL	ALUMINUM ALLOY[1]	CAD. PLATED STEEL	ALUMINUM ALLOY[1]	NONE OR MAG. ALLOY	CAD. PLATED STEEL
CAD. PLATED STEEL	NAS1801 CAD. PLATED STEEL	COR. RESIST. STEEL	CAD. PLATED STEEL	ALUMINUM ALLOY[1]	NONE	CAD. PLATED STEEL
COR. RESIST. STEEL	NAS1802 COR. RESIST. STEEL	COR. RESIST. STEEL	CAD. PLATED STEEL	ALUMINUM ALLOY[1]	CAD. PLATED STEEL	CAD. PLATED STEEL
TINNED COPPER TERMINAL AND JUMPER						
ALUMINUM ALLOYS	NAS1801 CAD. PLATED STEEL	ALUMINUM ALLOY[1]	CAD. PLATED STEEL	COR. RESIST. STEEL[2]	ALUMINUM ALLOY[1]	CAD. PLATED STEEL
MAGNESIUM ALLOYS	AVOID CONNECTING COPPER TO MAGNESIUM					
CAD. PLATED STEEL	NAS1801 CAD. PLATED STEEL	COR. RESIST. STEEL	CAD. PLATED STEEL	COR. RESIST. STEEL[2]	NONE	CAD. PLATED STEEL
COR. RESIST. STEEL	NAS1802 COR. RESIST. STEEL	COR. RESIST. STEEL	CAD. PLATED STEEL	COR. RESIST. STEEL[2]	NONE	CAD. PLATED STEEL

NOTES:

1. Finish Code J.
2. Finish Code R.

Figure 4. Hardware for Nut Plate Bonding or Grounding to Flat Surface

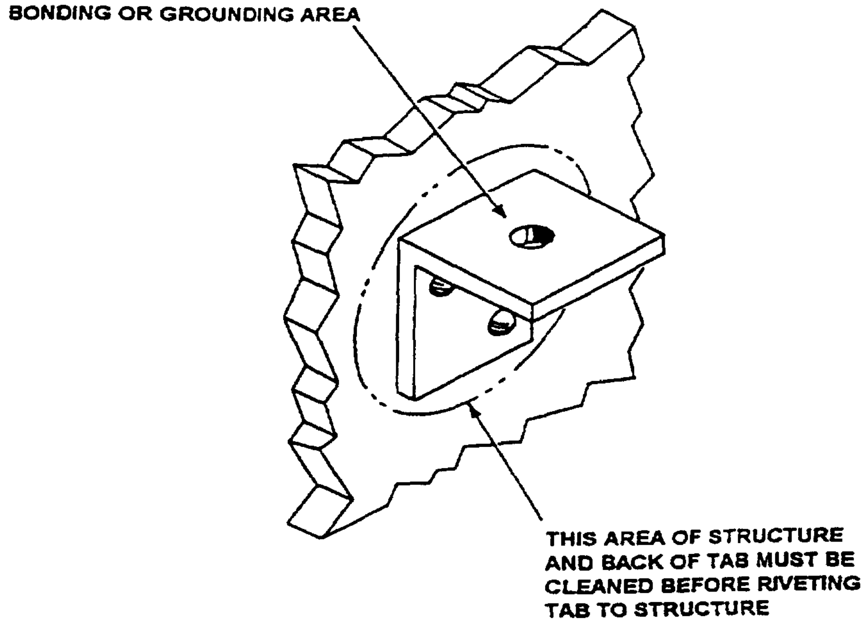


Figure 5. Bonding Tab Riveted to Structure

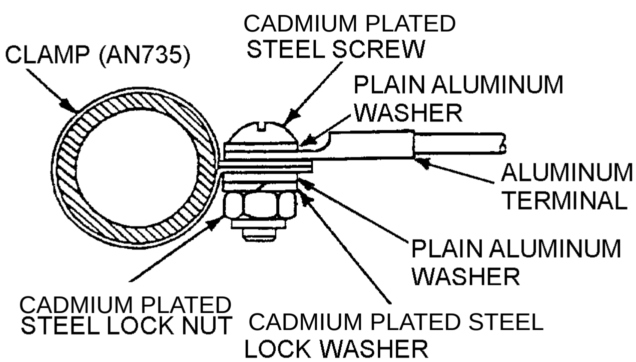


Figure 6. Aluminum Jumper Connector to Tubular Structure

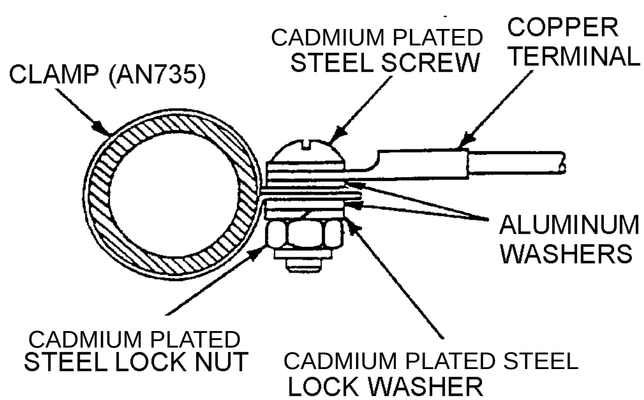


Figure 7. Copper Jumper Connection to Tubular Structure

Table 2. Bonding Jumper Selection

M83413/8 Jumper Type	Purpose	Material Size (AWG)	Available Lug Size (Table 3)	Method of Attaching Terminals	Marking Band Color
-A	Bonding	Copper 12	A, B, C, D, E,	Crimp	None
-B	Current Return	Copper 8	D,E	Crimp	None
-C	Bonding	Aluminum 10	A, B, C, D, E Aluminum	Brazed	Clear
-D	Quick Disconnect (QD)	Copper 12	A, B	Crimp	None
-E	Short end QD	Copper 12	A, B	Crimp	None
-F	Long end QD	Cooper 12	A, B	Crimp	None
-G	Bonding	Copper 12	A, B, C, D, E	Crimp	Yellow
-H	Current Return	Copper 8	D, E	Crimp	Yellow

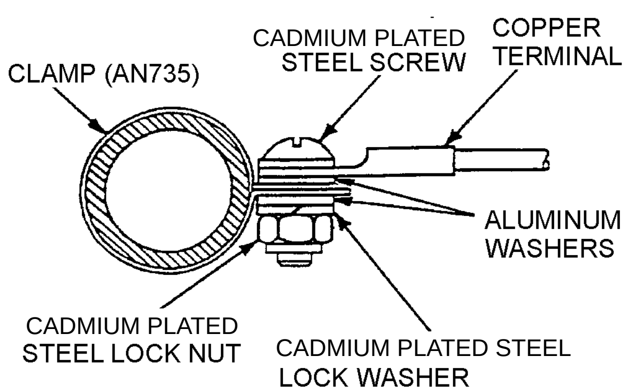


Figure 8. Bonding Conduit to Structure

51 . **BONDING CONDUIT TO STRUCTURE.** Bond aluminum alloy or corrosion resisting steel conduit to structure as shown in Figure 8. If installation conditions require, AN742 clamp (uncushioned) may be used instead of AN735 using the same hardware.

NOTE

This application is not recommended for Aerospace use, if required contact CFA for guidance.

52 . **BONDING AND GROUNDING JUMPERS.**

53 . Bonding and grounding, jumpers are used to provide a conductive path where direct electrical contact does not exist. In aircraft, jumpers are used in such applications as between moving parts, between shock-mounted equipment and structure, and between electrically conducting objects and structure. Keep jumpers as short as possible; if practical. under three inches. The use of two or more bonding jumpers in series is not recommended for Aerospace use, if required contact CFA for guidance.

54 . **SELECTION.** Bonding jumpers shall conform to M83413/8. Aluminum and copper jumpers are available through supply channels, but copper jumpers may also be fabricated (Table 2).

55 . **FUEL COMPATIBILITY.** Copper jumpers are not compatible with fuel. Only M83413/8-C aluminum jumpers are to be used in fuel cells and shall not be interchanged with other jumpers, or used external to fuel cells.

56 . **PROCUREMENT.** Jumpers may be obtained through normal supply channels using the part number (Figure 9)

57 . **FABRICATION.** Fabrication of jumpers consisting of copper is accomplished by the maintenance activity. The procedure will vary depending upon the series jumper required. M83413/8-D jumpers are illustrated in Figure 10. M83413/8-A, B. C, G, H are illustrated in Figure 11.

58 . **M83413/8-A Fabrication.** The M83413/8-A jumper can be fabricated by the maintenance activity. Table

4 shows the terminals and crimp tools to be used in fabrication and the procedure follows:

a. Cut tinned wire to desired length.

b. Crimp terminals to wire with applicable crimp tool (Table 4).

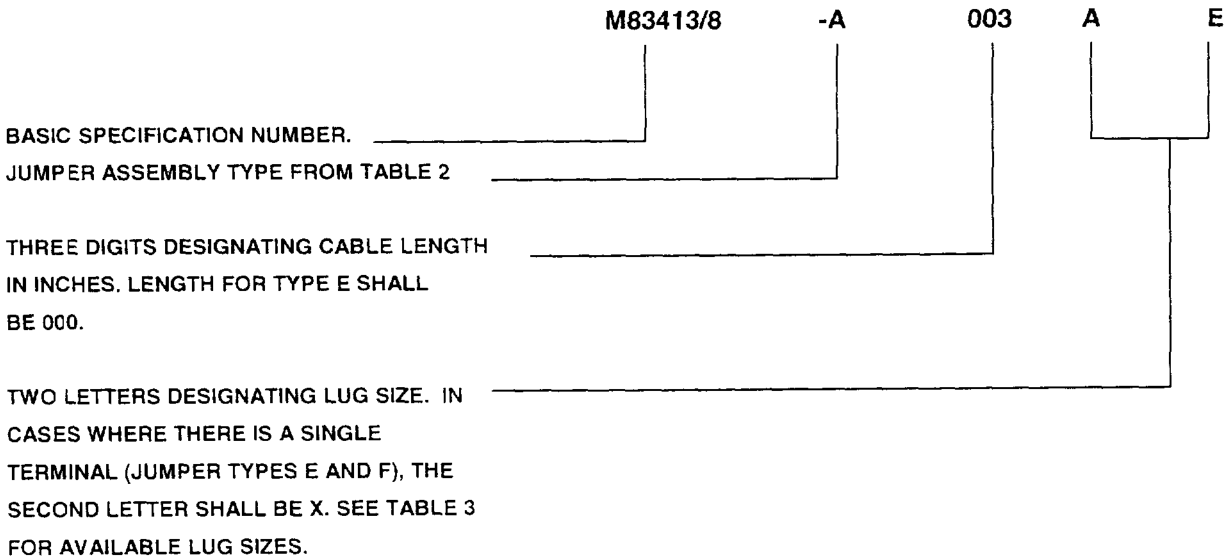


Figure 9. Part Number Breakdown

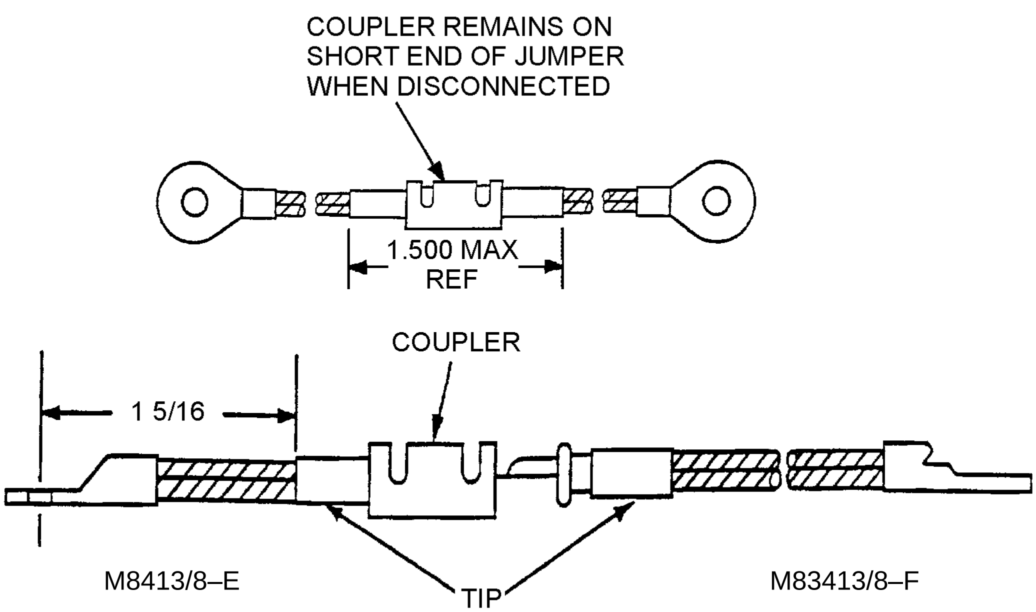


Figure 10. M83413/8-D (Jumper)

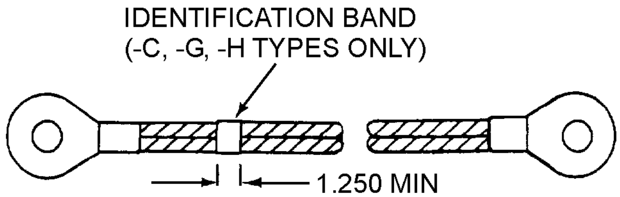


Figure 11. M83413/8-A, B, C, G, H

Table 3. Available Lug Size

Code Letter Lug Size Designation	For Stud Size (inches)
A	.112 or .134
B	.164 or .190
C	.24
D	.3125
E	.375

59 . **M83413/8-B Fabrication.** The M83413/8-B jumper can be fabricated by the maintenance activity. Table 5 shows the terminals and crimp tools used in the fabrication and the procedure follows:

a. Cut tinned wire to desired length.

b. Crimp terminals to wire with applicable crimp tool (Table 5).

60 . **M83413/8-C Fabrication.** The M83413/8-C is made of aluminum and is not to be fabricated. Order through normal supply channels.

61 . **M83413/8-D Fabrication.** The M83413/8-D is a quick disconnect jumper and can be fabricated by the maintenance activity. Table 6 shows the terminals and crimp tools used in fabrication, and the procedure follows:

a. Cut tinned wire to desired length.

b. Crimp terminals to wire with applicable crimp tool (Table 6).

c. Select quick disconnect coupler M6852-3 measure length of quick disconnect coupler tip, add 15/16 inches.

d. Cut wire the length obtained (step c) measured from center of terminal stud hole.

e. Crimp quick disconnect coupler assembly to ends of jumper, using M22520/24.

f. Coupler shall be attached to the short jumper.

62 . **M83413/8-G Fabrication.** The M83413/8-G can be fabricated by the maintenance activity. Table 4 shows the terminals and crimp tools used in fabrication, and the procedure follows:

a. Cut tined wire to the desired length.

b. Cut 1 1/4 minimum length of heat shrinkable sleeving of Polyolefin Class 2, SAE AMS–DTL-23053/5.

c. Mark sleeving with part number and install on jumper wire with approved heat source.

d. Crimp terminals to wire with applicable crimp tool (Table 4).

Table 4. Terminals and Tools for M83413/8-A and G Jumpers

Stud Hole Designation	Stud Size	Terminal* MS25036	Terminal* MS20659 (Optional)	Crimp Tool*
A	No. 4 or No.6	-111	-165	M22520/5
B	No. 8 or No. 10	-112	-105	
C	0.250	-157	None	
D	0.3125	-113	-106	
E	0.375	-114	-128	
*See WP 01300				

Table 5. Terminals and Tools for M83413/8-B and H Jumpers

Stud Hole Designation	Stud Size	Terminal* MS25036	Terminal* MS20659 (Optional)	Crimp Tool	Terminal* MS25036	Terminal* MS20659 (Optional)
D	0.3124	-117	-108	HD51	HD51–133–2 Die	HD51–133–2 Die
E	0.375	-118	-129		HD51–133–2	HD51–133–2
* See WP 013 00						

Table 6. Terminals and Tools for M83413/8-D Jumpers

Stud Hole Designation	Stud Size	Terminal* MS25036	Terminal* MS20659 (Optional)	Crimp Tool
A	No. 4 or No. 6	-111	-165	M22520/5
B	No. 8 or No. 10	-112	-105	
* See WP 013 00				

63 . **M83413/8-H Fabrication.** The M83413/8-H can be fabricated by the maintenance activity. Table 5 shows the terminals and crimp tool used in fabrication. Proceed with fabrication using the steps in paragraph 57 .

64 . **BONDING INSPECTIONS.**

65 . Inspect for the following:

a. If there is evidence of electrical arcing, check for intermittent electrical contact between conducting surfaces, that may become a part of a ground plane or a current path.

b. Bond connections should be secure and free from corrosion.

c. Bonding jumpers should be installed in such a manner as not to interfere in any way with the operation of movable components of the aircraft.

d. Inspect bonding jumper condition, they should not be frayed, kinked.

e. Self–tapping screws should not be used for bonding purposes. Only standard threaded screws or bolts of appropriate size should be used.

f. Bonds should be attached directly to the basic aircraft structure rather than through other bonded parts.

g. Use appropriate washers when bonding aluminum or copper to dissimilar metallic structures so that any corrosion that may occur will be on the washer.

66 . **TESTING BONDS AND GROUNDS.**

67 . The resistance across a bonding or grounding, jumper is required to be 0.1 ohm or less. Test is made after the mechanical connection is completed, and consists of a milliohm-meter reading, of the resistance between the cleaned areas of the object and the structure. Measurements of the specified resistance value are made with a special calibrated low-range ohmmeter such as the R1L–E or R1L–E–1. The Avtron T477W or functional equivalent, meeting UL–913 meeting explosion proof test criteria may be used in enclosed areas where hazards exist, such as explosive vapors from fuel systems. Test IAW ohmmeter instruction manual.

a. If the specified resistance value has been obtained the cleaned areas are now ready for refinishing.

68 . **REFINISHING.**

69 . Within 24 hours after an area has been cleaned and connection made, refinish surfaces IAW 01–1A–509 or TMS structures manual.

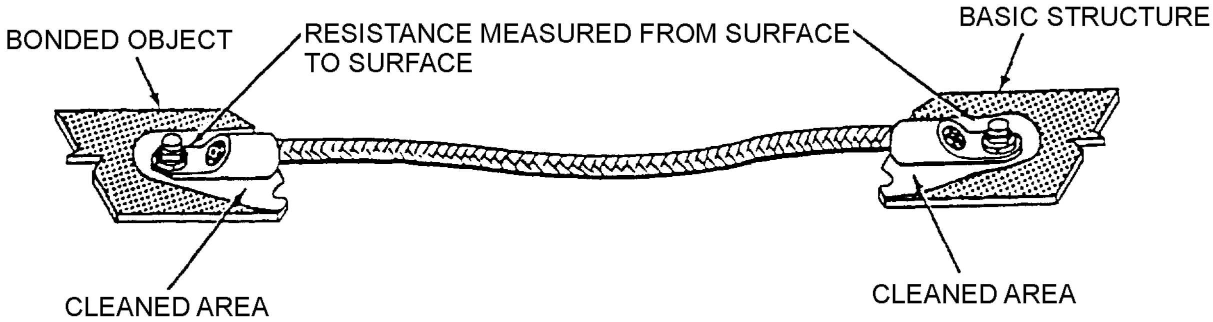


Figure 12. Resistance Testing of Bonds and Grounds

LOCKWIRING, SHEARWIRING AND SAFETY CABLES

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Safety Cable Kit Procurement Specification and Requirements for Use . . . . SAE AS4536

Alphabetical Index

Alphabetical Index (Cont.)

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
1/4” Bands	4–1380
1/4” Band Hand Tool	DBS–1100
Adjusting Tool	DBS–1100–32
Band Removal Tool	DBS–BR1
Calibration Fixture	DBS–CG2
Drill Bit	#56 (.046)
Rollover Tool	DBS–RO3
Wire Twister Plier with Side Cutter	–

Materials Required

Nomenclature	Part. Number./Type Designation
Cable, Safety, Self-Looping	AS3621 Series
Ferrule, Elongated	AS3619 Series
Kit, Safety Cable	AS3617 Series
Lockwire, Aluminum Alloy, Anodized, Blue, 0.020 Diameter	NASM20995-AB20
Lockwire, Aluminum Alloy, Anodized, Blue, 0.032 Diameter	NASM20995-AB32
Lockwire, Nickel-Chromium-Iron Alloy, 0.032 Diameter	NASM20995-N32
Lockwire, Nickel-Chromium-Iron Alloy, 0.020 Diameter	NASM20995-N20
Lockwire, Nickel-Copper Alloy, 0.020 Diameter	NASM20995-NC20
Lockwire, Nickel-Copper Alloy, 0.032 Diameter	NASM20995-NC32
Shearwire, Copper, Cadmium Plated, Yellow, 0.020 Diameter	NASM20995-CU20

1. **INTRODUCTION.**

CAUTION

Under no circumstance shall lockwire and shearwire procedures be mixed or shall the materials be mixed or interchanged.

2. This work package (WP) describes that lockwiring and shearwiring serve two complete and distinctly different purposes. The use of lockwire is for physical security against loosening due to vibration. The use of shearwire is for emergency device protection against accidental actuation. Lockwire is also referred to as safety wire and pre-twist lock wire is referred to as safety cable. This work package will cover procedures, materials, tools, and standards used in lockwiring and shearwiring.

3. **GENERAL WARNINGS AND CAUTIONS.**

WARNING

Loss of life may occur when lockwire is used instead of shearwire.

When using wire twister pliers and wire extends 3 inches or more beyond jaws of pliers loosely wrap wire around pliers to prevent whipping and personal injury.

CAUTION

When cutting wire ensure all cut pieces are recovered and disposed of to prevent foreign object damage and personal injury.

On connectors and accessories use 0.020 lockwire to avoid breakout or damage to lockwire hole.

4. **GENERAL.**

5. **LOCKWIRE.** Lockwire is uninsulated wire used to secure electrical equipment and connectors in aircraft

to prevent accidental loosening caused by vibration. Lockwire is often referred to as safety wire. Lockwiring or safety wiring is the process of application of lockwire to prevent accidental loosening. Safety cable is a lockwire process where the lockwire is pre-twisted prior to installation then crimped to hold the components (paragraph 31).

6 . **SHEARWIRE.** Shearwire is uninsulated copper wire with a low tensile strength or breaking point used to secure emergency devices to prevent accidental actuation. Shearwiring is the process of application to prevent accidental actuation.

7 . **ELECTRICAL CONNECTORS.** Threaded coupled connectors located in engine compartments or other areas of high vibration, and in areas which are normally inaccessible to periodic maintenance, shall have the coupling nut lockwired to prevent loosening of the connector caused by vibration. When lockwire is used on connectors, threaded coupling rings, screws, or rings used in fastening the connector, 0.020 diameter lockwire shall be used to prevent breaking out of the lockwire hole.

WARNING

Loss of life may occur when lockwire is used in place of shearwire.

8 . **LOCKWIRE AND SHEARWIRE APPLICATION.** Lockwire and shearwire are not to be interchanged or substituted. Their purpose is distinct. The table below lists the types of lockwire and shearwire, part number, size, material, and identification to be used (Table 1):

9 . **LOCKWIRE PROCEDURES.**

10 . There are two lockwiring procedures. The double twist method which is used in high vibration areas and inaccessible areas, and the single wire method used in close, hard to reach areas.

WARNING

The strength of a connector lockwire hole is marginal. Cut the wire close to the hole. Never twist the wire off when removing (paragraph 12, step a, Caution).

11 . **DOUBLE TWIST METHOD.** The double twist method is used for all equipment in areas of high vibration and in areas that are not accessible for periodic maintenance inspections. The lockwiring procedure is as follows (Figure 1):

a. When cutting lockwire for installation, use the shortest length needed to accomplish the task.

b. Lockwire shall be new upon each application, and shall be free of nicks or kinks.

c. Electrical connectors shall be properly mated and tightened prior to lockwiring.

d. Electrical connector hardware shall not be over-tightened or loosened to align the lockwire holes.

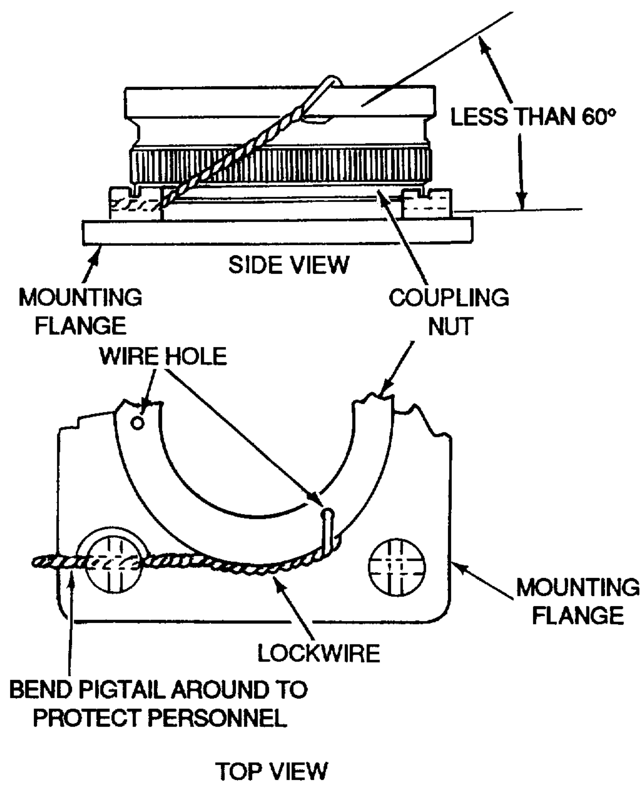


Figure 1. Double Twist Method

Table 1. Lock/Shearwire Types and Applications for Connectors

Wire	Material (Note 1)	Color	Size	Part Number (Note 2)
Lockwire	Monel (Below 700°F)	Natural	0.020	NASM20995-NC20 (0.020)
	Inconel (700 to 1500°F)			NASM20995-N32 (0.032) NASM20995-N20 (0.020)
	Aluminum Alloy (Alclad) Use on (magnesium parts)	Blue	0.020	NASM20995-AB20 (0.020)
Shearwire	Copper (Cadmium Plated)	Yellow (Copper)	0.020	NASM20995-CU20

NOTES:

1. Inconel may be used in all temperature applications.

2. Size 0.032 (NASM20995-NC32 or -N32, as applicable) should be used when the single wire method is required (paragraph 12, step a).

e. Parts shall be lockwired in such a manner that the lockwire shall be put in tension if the part begins to loosen (Figure 2).

f. When lockwiring screw or bolts, the lockwire shall be installed so that the loop around the head stays down and does not tend to come up over the head and leave a slack loop.

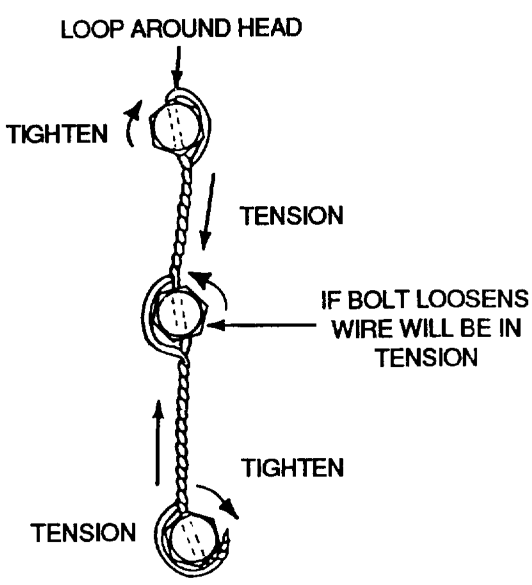


Figure 2. Proper Installation of Double Twisted Lockwire

g. Lockwire shall be twisted in a clockwise direction, with approximately 8 to 10 twists per inch (Figure 3).

h. When twisting wire by hand, the two ends of the wire shall be held straight and taut. Use pliers for the final twist to apply tension and to secure ends of wire. Lockwire must not be nicked, kinked, or mutilated. Never twist the wire ends off with pliers. Always cut the end leaving 4 to 6 complete turns (1/4 to 1/2 inches long), which is then bent under or back to prevent injury to personnel (Figure 5).

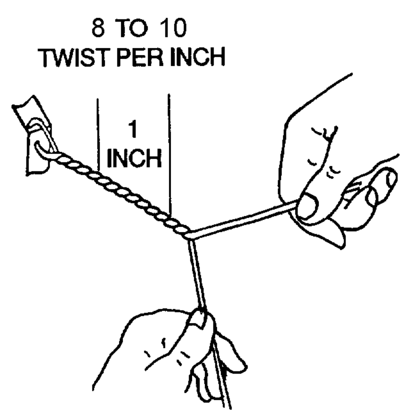


Figure 3. Wire Twisting by Hand

WARNING

When wire extends 3 inches beyond the pliers' jaw, loosely wrap the wire ends around the pliers to prevent whipping and possible personnel injury.

i. When using wire twister pliers, secure wire in jaws of pliers by sliding the outer sleeve down to lock handles (Figure 4). To prevent mutilation of the twisted section of the wire, grasp the wire with pliers at the end of the wire and not in the middle.

j. Pull knob to twist wire.

k. Lockwire shall be twisted tight but not overstressed to avoid breakage under strain or vibration.

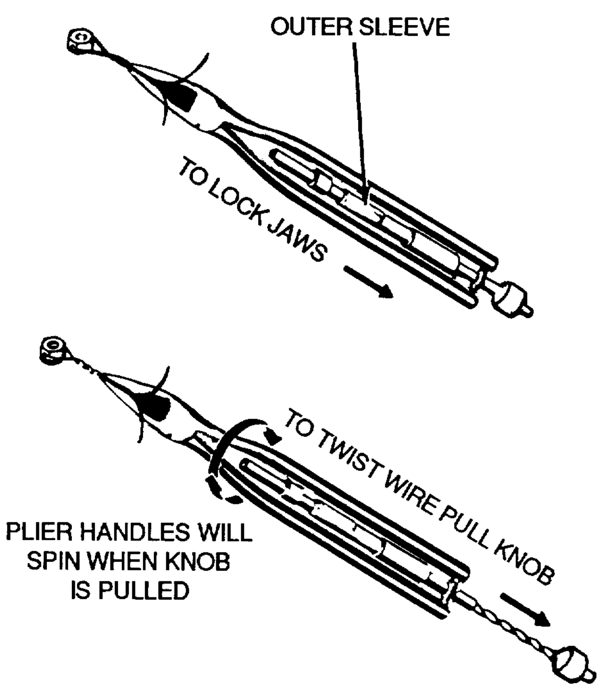


Figure 4. Twisting with Wire Twister Pliers

l. Lockwire shall not be used to secure hardware which is spaced more than 6 inches apart unless tie points are provided on adjacent parts to shorten the span of the lockwire to less than 6 inches.

m. Terminated lockwire shall have a 1/4 to 1/2 inch (3 to 6 twists) pigtail. The cut end shall be bent under the twisted wire (Figure 5) to prevent injury to personnel.

n. It is preferred to lockwire all electrical connectors individually (except jam nut receptacles). Do not lockwire one connector to another unless it is necessary to do so.

12. **SINGLE WIRE METHOD.** This method may be used to lockwire equipment in areas hard to reach or for small screws that are 2 inches or less between centers (Figure 5).

a. When using single wire method use size 0.032 inch wire (Table 1).

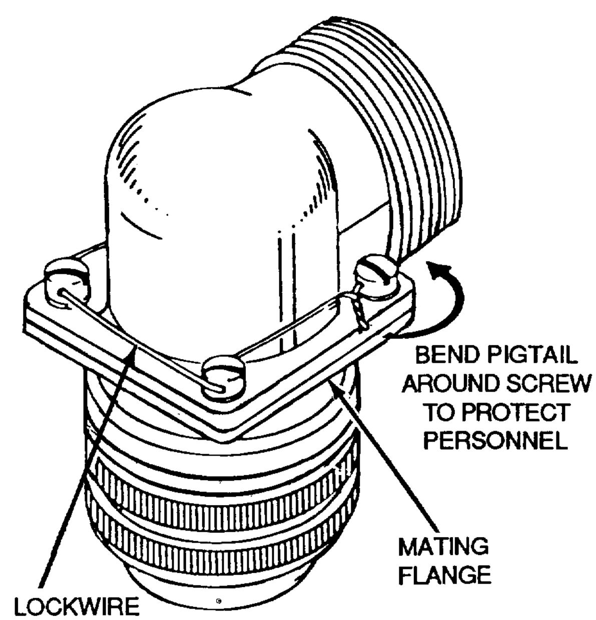


Figure 5. Single Wiring Method (Typical)

CAUTION

When cutting wire ensure all cut pieces are recovered and disposed of to prevent foreign object damage and personal injury.

On connectors and accessories use 0.020 lockwire to avoid breakout or damage to lockwire hole.

b. When cutting lockwire for installation use shortest length needed to accomplish task.

c. Ends of wire shall be pulled taut but not overstressed.

d. Terminated lockwire shall have 1/4 to 1/2 inch (3 to 6 twists) pigtail. The cut end shall be bent to prevent injury.

13 . **CONNECTOR LOCKWIRE APPLICATIONS.**

CAUTION

Most connectors are designed not to require lockwire. Lockwire should only be used when required by the aircraft maintenance manual.

14 . **CONNECTOR PREPARATION.** Threaded coupling connectors shall be lockwired using the double twist method. When holes are not present in the coupling ring lockwire holes must be drilled (Figure 6).

a. Select #56 (0.046 inch) drill bit.

b. Mark three locations 120° apart.

c. Drill diagonally through edge of coupling nut.

d. Upon completion preserve in accordance with NAVAIR 01–1A–540.

15 . **CONNECTORS WITH THREADED COUPLINGS.** Threaded couplings shall be lockwired using the double twist method.

16 . **Flanged Receptacle.** Connectors mated to a flanged receptacle shall be lockwired to one of the thru holes in fillister head mounting screws (Figure 1).

17 . **Jam Nut Receptacle.** Connectors mated to a jam nut receptacle shall be lockwired to one of the thru holes on the jam nut (paragraph 19).

18 . **No Provision.** Connectors mated to a receptacle with no lockwire provision shall be lockwired to a hole. If no provisions are made, contact CFA for guidance. (Figure 7).

19 . **JAM NUT RECEPTACLES.** Jam nut receptacles shall be lockwired using the double twist method using the thru holes in the jam nut to another jam nut. Up to three jam nuts may be lockwired together (Figure 8) When only one jam nut receptacle is used, the nut must be safety wired to structure (Figure 7). If no provisions are made, refer to paragraph 18.

20 . **BACKSHELLS.** Backshells are held in place by assembly nuts or by a mating flange.

21 . **Mating Flange.** Typical mating flange types are of two pieces held together and in place by four fillister

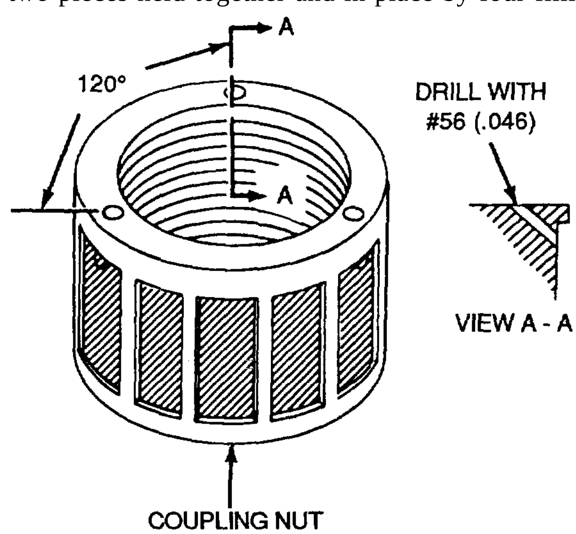


Figure 6. Lockwire Hole Locations

head screws which are lockwired using the single wire method (Figure 5).

22 . **Assembly Nuts.** When assembly nuts are used, lockwire using double twist method from assembly nut through hole to lockwire lug on backshell (Figure 9).

23 . **SPLIT BACKSHELLS.** Split backshells or two-piece backshells are held together by two fillister head screws, which are lockwired using the single wire method (Figure 10).

24 . **FLANGE TYPE RECEPTACLES.** Flange type receptacles are mounted with fillister head screws which are lockwired by the single wire method when mounting screws are less than 2 inches apart. When the mounting screws are greater than 2 inches use the double twist method (Figure 11).

25 . **QUALITY STANDARDS.** Inspect all lockwire applications for the following:

a. Electrical connectors which use threaded couplings, or employ screws or nuts to fasten the individual parts of the connector together have been lockwired using only size 0.020 wire of the applicable material (Table 1).

b. Connectors are lockwired individually, not to one another, if possible.

c. Lockwire is twisted 8 to 10 twists per inch (Figure 3).

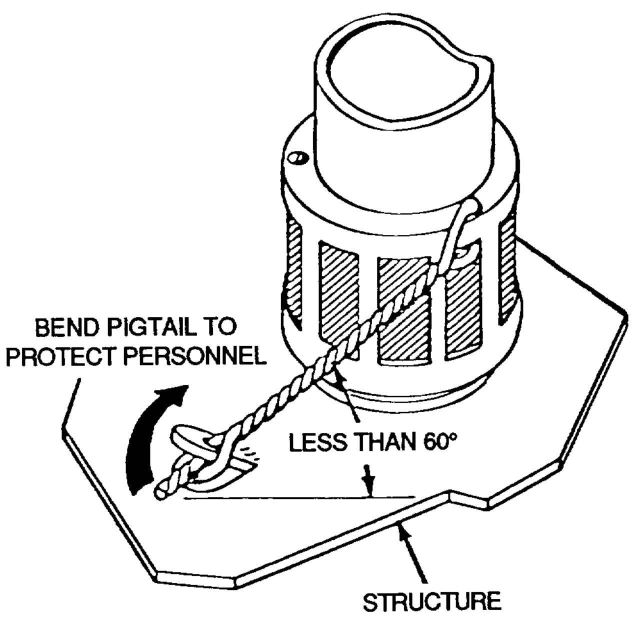


Figure 7. Lockwiring Connector to Structure

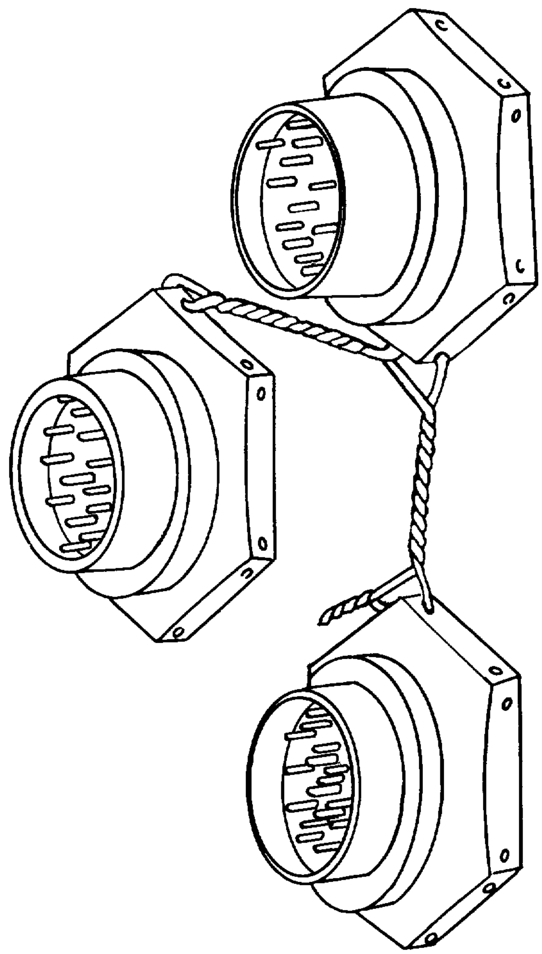


Figure 8. Lockwiring Jam Nut Receptacles

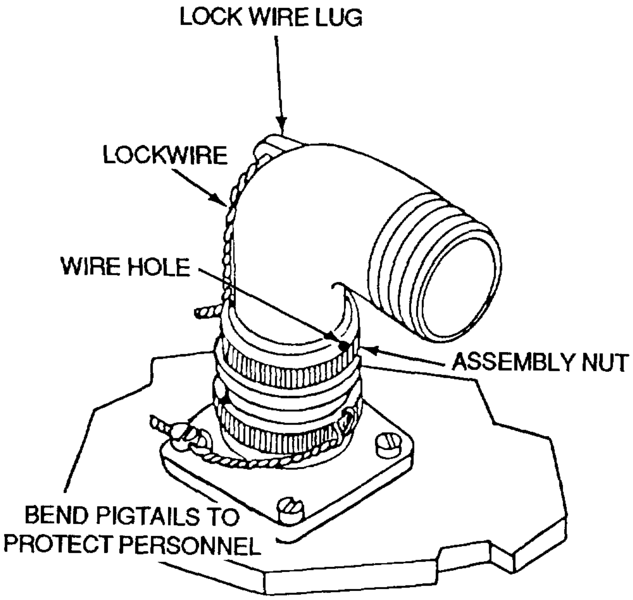


Figure 9. Lockwiring Assembly Nut Type Connectors (Typical)

d. Lockwire is not kinked or nicked.

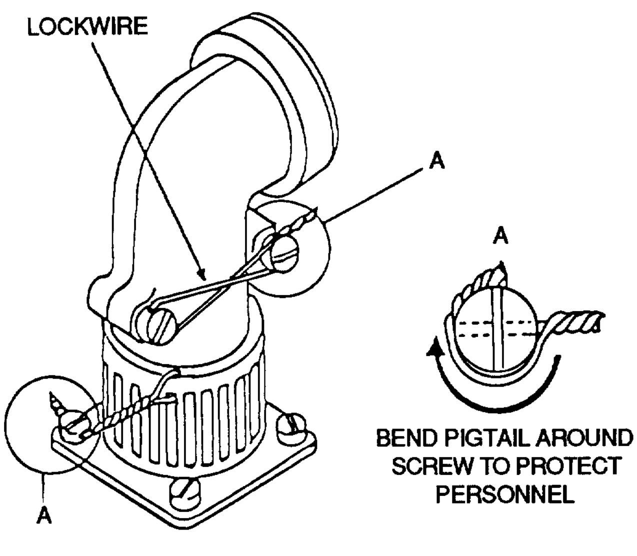


Figure 10. Lockwiring Split Shell Connectors (Typical)

e. Lockwire installed with a wire angle of 60° or less.

f. Pigtails have been bent toward the connector, around the screw, or under the wire to protect personnel.

g. Lockwire is installed so that the wire will be in tension if the part loosens.

26 . **SHEARWIRE APPLICATIONS.**

WARNING

Loss of life may occur when lockwire is used instead of shearwire.

27 . Shearwiring is used to prevent accidental actuation of emergency devices. Shearwire is installed so that a deliberate effort is required to actuate these emergency devices.

28 . **EMERGENCY DEVICES.** Emergency devices are color coded yellow with black stripes for visual recognition to include switches, switch guards, and handles which operate egress systems; emergency ordnance releases are color coded red. These emergency devices are shearwired with copper wire part number NASM20995-CU20 only.

29 . **SHEARWIRING.** All application of shearwire will use the single wire method. Under no circumstances will the double wire method be used. All applications of shear wire will use copper wire part number NASM20995-CU20 only and shall be wired as illustrated (Figure 12).

30 . **QUALITY STANDARDS.** All shearwire applications shall be inspected to comply with the following:

a. Only copper wire part number NASM20995-CU20 is used.

b. All applications are single wire method.

c. Installed so that shearwire may be easily broken in an emergency.

d. Wire ends are out of the way to protect against injury.

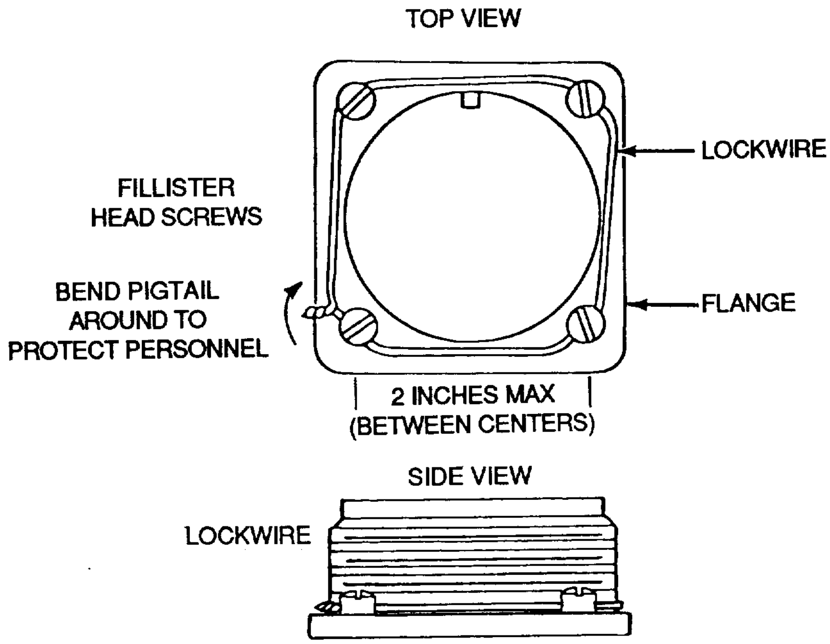


Figure 11. Single Wire Method of Locking Flanged Type Receptacles

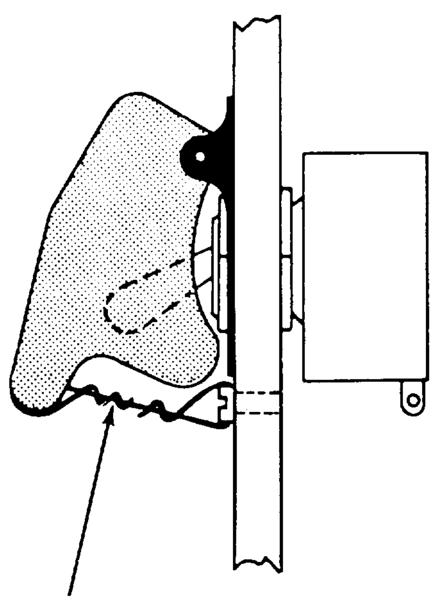


Figure 12. Shearwiring Emergency Devices

31 . **SAFETY CABLE PROCEDURE.**

32 . The selection of materials shall be in accordance with AS4536 and shall be in accordance with the service limitations outlined herein.

NOTE

Minimize mixing of safety wire and safety cable.

a. AS3617 series Safety Cable Kit (UNS N6600 Nickel Alloy) shall be selected for all standard safety cable applications on electrical connectors and accessories.

b. AS3619 series Ferrule, Elongated (UNS N6600 Nickel Alloy) for low profile and limited access applications is approved for use on electrical connectors and accessories.

c. AS3621 series Safety Cable, Self-Looping (UNS N6600 Nickel Alloy) for application of safety cable where safety device hole is not provided is approved for use on electrical connectors and accessories.

d. Only safety cables and ferrules supplied by a manufacturer that meets all the requirements of AS4536 shall be allowed.

e. Safety cable shall not be used for any shear or breakaway applications.

f. Safety cable shall be installed with a calibrated tool which is supplied by the safety cable manufacturer for the purpose of applying tension to the cable, crimping the ferrule, and cutting the excess cable without allowing tension to be lost.

33 . Safety Cable Diameter. The size of safety cable shall be in accordance with the following requirements:

a. 0.020 inch diameter safety cable is intended for use on parts having a nominal hole diameter of 0.045 inch (1.14 mm) or smaller.

b. 0.032-inch diameter safety cable is intended for use on parts having a nominal hole diameter of 0.075 inch. (1.91 mm) of smaller.

c. 0.040 inch diameter safety cable is intended for use on parts having a nominal hole diameter of 0.095 inch (2.41 mm) or smaller.

d. The specified length of the cable shall be selected to accommodate the span between fasteners/connectors added to the length of cable required to correctly engage the application tool.

34 . **SAFETY CABLE APPLICATIONS.**

CAUTION

Do not loosen or tighten properly tightened components to align safety wire holes.

35 . **GENERAL.** The following examples are typical of acceptable safety cable applications. The examples are typical of the application of safety cable on electrical connectors and accessories. All possible applications are not shown.

36 . **CONNECTORS WITH THREADED COUPLINGS.** Select the appropriate diameter safety cable using the guidelines in this manual, and install

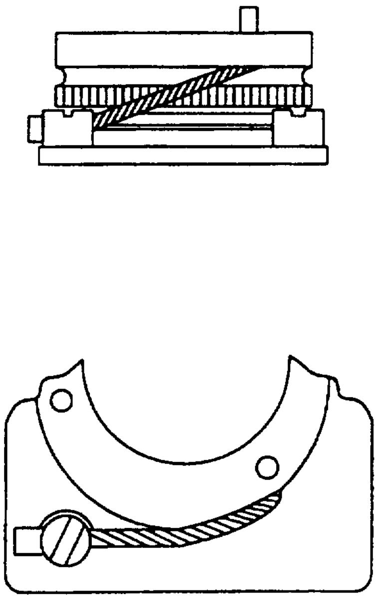


Figure 13. Threaded Coupling and Assembly Nut Safety Cable Installation Detail

safety cable on threaded couplings as shown in Figure 13.

37 . **FLANGED RECEPTACLE.** Select the appropriate diameter safety cable using the guidelines in this manual, and install safety cable on flanged receptacles as shown in Figure 14.

38 . **JAM NUT RECEPTACLE.** Select the appropriate diameter safety cable using the guidelines in this manual. When installing safety cable on adjacent jam nut receptacles use the method shown in Figure 15. When installing safety cable on a single jam nut receptacle, safety cable may be installed from a fastener as shown in Figure 16, or it may require the use of a self looping safety cable as shown Figure 17.

39 . Backshells and Strain Relief. Backshells are held in place by assembly nuts or by a mating flange.

40 . **Mating Flange.** Typical mating flange types are of two pieces, held together and in place by three or four screws. The screws can be secured with safety cable by installing safety cable through two or three screws in a positive or neutral direction.

41 . **Assembly Nuts.** When assembly nuts are used, safety cable may be installed between a strain relief

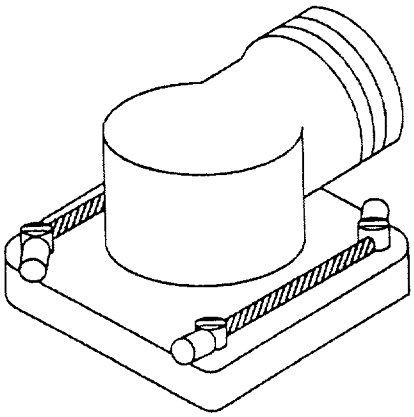


Figure 14. Flanged Receptacle Safety Cable Installation

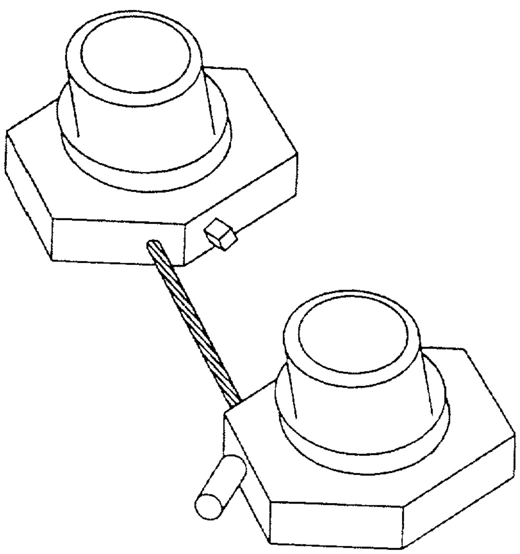


Figure 15. Multiple Jam Nut Receptacle Safety Cable Installation.

screw, or other backshell screw (Figure 18), to a fastener such as the receptacle flange screw (Figure 13), or it may require a self-looping safety cable (Figure 19).

42 . **Strain Relief Components.** The screws, which secure saddle clamps and other strain relief components, shall be secured with safety cable by installing the safety cable between the heads of two screws (Figure 20).

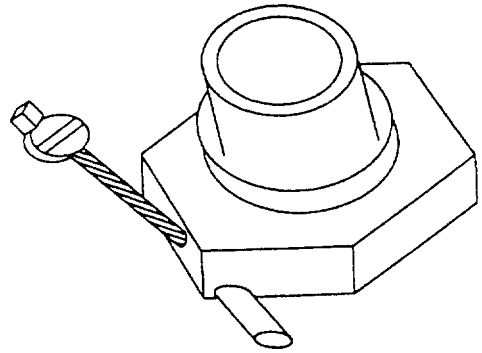


Figure 16. Single Jam Nut Receptacle Safety Cable Installation

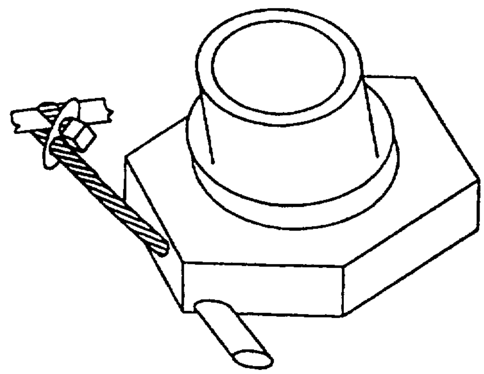


Figure 17. Single Jam Nut Receptacle Self-Looping Safety Cable Installation

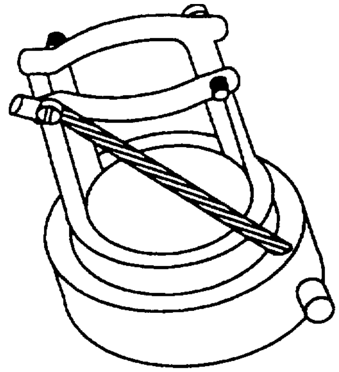


Figure 18. Assembly Nut to a Backshell or Strain Relief Screw Safety Cable Installation.

NOTE

If safety cable on a strain relief wraps across metal corners as shown in Figure 20, and the application is for high vibration areas, it is a recommended practice to install protective tubing over the safety cable.

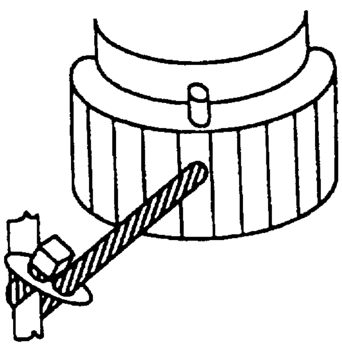


Figure 19. Assembly Nut Self-Looping Safety Cable Installation.

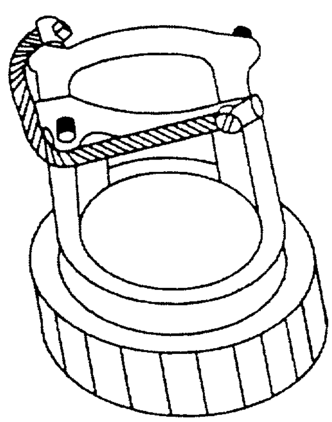


Figure 20. Strain Relief Safety Cable Installation.

43 . **SAFETY CABLE INSTALLATION**

CAUTION

Do not allow safety cable to touch the electrical wires that are installed in the connector.

44 . Safety cable may be used as a substitute for lockwire on electrical equipment and connectors in aircraft to prevent accidental loosening caused by vibration. Threaded parts, such as connector coupling mechanisms, backshells, strain relief components, relays, other electrical components, and equipment covers/panels. The following rules shall apply when using safety cable.

NOTE

Routing of safety cable may vary from that of lockwire in order to achieve a proper installation.

a. When safety cable is being substituted for lockwire in an existing installation (maintenance, rework, etc.), equivalent diameter safety cable to that of the lockwire shall be selected for use. Use the selection guidelines defined in paragraph 31 unless otherwise specified.

b. Adjacent Units. Safety cable shall be installed in such a manner that any tendency for a threaded part to loosen will be counteracted by an additional tension on the cable. Safety cable shall be threaded through fasteners in such a way as to produce installed safety cable with either positive or neutral pull.

c. Maximum Span. The maximum span of the safety cable between two termination points shall be six inches (152.4 mm) unless otherwise specified.

d. Installing Defects. Any cable defect (nick, fray, kink, or any other mutilation of the safety cable) found prior to, during, or subsequent to installation is not acceptable.

NOTE

Avoid kinks or sharp bends while handling and threading safety cable.

e. Applications where safety cable is to be installed through a hole having a nominal diameter of greater than 0.095 inch (2.41 mm), but less than 0.200 inch (5.08 mm) shall require a flat washer (same material composition as the safety cable) which is supplied by the safety cable manufacture for this purpose, and shall be used as shown in Figure 21.

f. Safety cable shall be installed with an application tool which has been calibrated to meet the performance requirements of AS4536 (SAE) and this manual.

g. Installing Holes. Safety cable must be installed through the holes intended for this purpose in the part being secured, or through the holes provided in a self-looping device secured to the safety cable by the safety. cable manufacturer (Figure 22). In applications where holes are not provided for safety cable in the component to which it is attached, the self looping safety cable may be used in a manner like, or similar, Figures 22 and 23.

h. Safety Cable/Ferrule Reuse. Safety cable and ferrule shall be new upon each application. Reuse is not allowed.

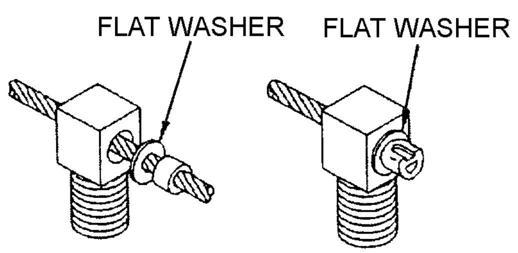


Figure 21. Flat Washer Safety Cable Installation

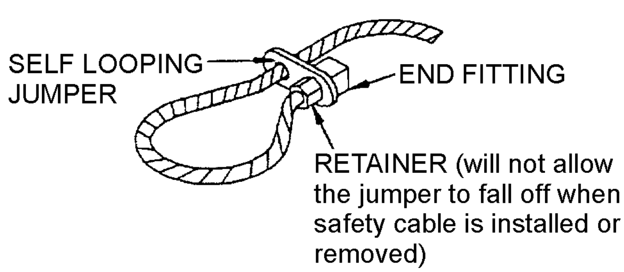


Figure 22. Self Looping Safety Cable

Table 2. Safety Cable Minimum Crimp Requirements (Pull-Off Load)

Nominal Cable Diameter inch (mm)	Safety Cable Construction	Minimum Pull-Off Load lb.-ft. (N)
0.020 (0.51)	1 x 7	30 (133.4)
0.032 (0.81)	3 x 7	70 (311.4)
0.040 (1.02)	7 x 7	1 10 (489.3)

i. Excess Cable. After installing safety cable, excess cable from the crimped ferrule shall be cut by the installation tool. The maximum allowable length of cable extending beyond the ferrule shall be 0.031 inch (0.79 mm).

45 . C**RIMPING REQUIREMENTS.** Safety cable shall be installed with the safety cable manufacturer's recommended tool, which has been tested and calibrated, and meets the requirements of Table 2.

WARNING

The maximum bend exit limit of safety cable, when applied to the head of a threaded fastener (such as a screw or bolt) shall be 135°. This does not apply to electrical connector coupling mechanisms and backshells where the safety cable is constrained by the shape of the component being secured.

a. Hole Alignment. Under torquing or over torquing to obtain proper alignment of the holes is not permitted. Apply recommended torque values to parts to be secured, and alignment of holes shall be evaluated before attempting to proceed with safety cable installation.

WARNING

This method should only be used in applications where the safety cable can not "flip"

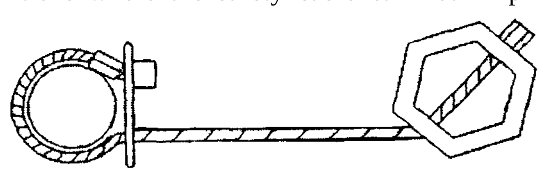


Figure 23. Self-Looping Safety Cable Anchored to a Pin Assembly

over the corner or over the head of the fastener being secured.

b. In applications where safety cable shall be required to exceed the 135° maximum bend on a threaded fastener head, a self looping device which is secured to the safety cable by the safety cable manufacturer may be used to obtain a secured installation as shown (Figure 24).

c. Cable Flex Limits. After installing safety cable, the maximum flex between termination points shall be no greater than specified in Table 3 (Figure 25).

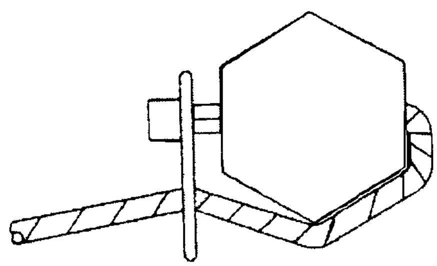


Figure 24. Self-Looping Safety Cable in High Bend Exit Applications.

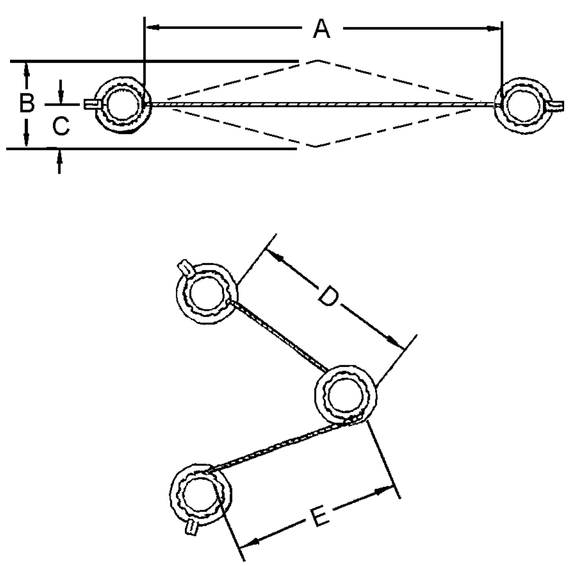


Figure 25. Safety Cable Flex Limits

Table 3. Flex Limits for Safety Cable

Flex Limits; Inch (mm)		
A	B	C
0.5 (12.7)	0.125 (3.18)	0.062 (1.59)
1.0 (25.4)	0.250 (6.35)	0.125 (3.18)
2.0 (50.8)	0.375 (9.52)	0.188 (4.76)
3.0 (76.2)	0.375 (9.52)	0.188 (4.76)
4.0 (101.6)	0.500 (12.70)	0.250 (6.35)
5.0 (127.0)	0.500 (12.70)	0.250 (6.35)
6.0 (152.4)	0.625 (15.88)	0.312 (7.94)

NOTE

Light finger pressure of approximately 2 pounds shall be applied at mid-span when inspecting the total flex limit of installed safety cable.

It is important to hold the tool as steady and perpendicular to the fastener as possible during the crimp/cut cycle in order to maintain consistent tensioning of the cable after the tool is removed.

46 . **ELONGATED FERRULES.** Ferrules of extra length, having a radius at one end and a straight surface at the other end, may be used in applications that restrict the clearance for the installation tool nose to be placed in correct alignment with the fastener (such as low profile fastener heads, recess locations, or obstructions, by structures or installed components); (Figure 26).

NOTE

Always install elongated ferrules with the radius end toward the fastener, and the straight end in the tool crimp cavity. Double check cable tension between fasteners after removal of application tool.

Radius required on 0.032inch diameter and larger elongated ferrules. Radius optional on 0.020inch diameter elongated ferrules.

47 . **SAFETY CABLE IDENTIFICATION STAMP.** In applications where the user requires a logo or ID code to be a permanent part of the safety cable installation (for warranty or trace-ability), it shall be

applied by the safety cable manufacturer to one or more surfaces of the square end fitting of the safety cable. Only impression stamping is permitted, no paint, ink, or labels are acceptable (Figure 27).

48. **SAFETY CABLE JACKETING FOR PROTECTION.** It is recommended to use a tubular jacket over safety cable when it is installed in a location where it is in contact with (or may contact) surfaces which may damage the safety cable or may be damaged by the safety cable. A tubular jacket material shall be capable of meeting the temperature range of the application, and shall be resistant to oil and chemical environments (Figure 28).

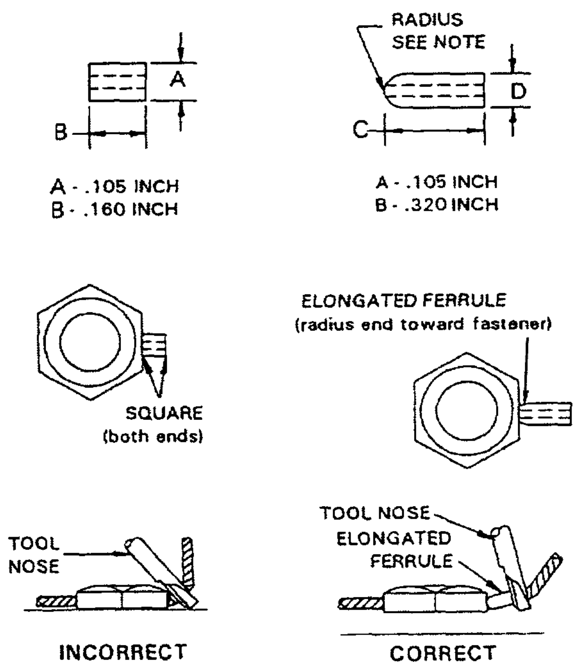


Figure 26. Low Profile Application for .032 and .040 Diameter Safety Cable

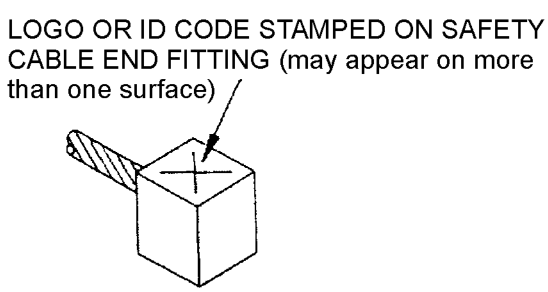


Figure 27. Safety Cable Identification Stamp

49. **SAFETY CABLE APPLICATION TOOLS.** When safety cable is used, the following basics apply for the application tools and calibration equipment.

a. Minimize mixing of safety wire and safety cable.

b. Install the ferrule cartridge into the tool body under the handle grip.

NOTE

When loading and using the safety cable application tools, be certain that the correct size safety cable and ferrules are being used with the tools.

c. Install the safety cable through the components to be secured.

d. The nose can rotate to any desired position (Figure 29).

e. Insert the free end of the cable through the ferrule in the cartridge, and remove the ferrule by pulling the cable away from the end of the cartridge (Figure 29).

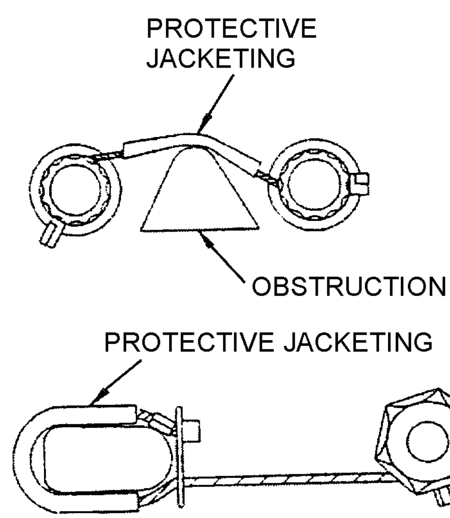


Figure 28. Safety Cable Jacketing for Protection

NOTE

Do not release the free end of the cable until it has been inserted through the tool nose (Figure 29).

f. Insert the free end of the cable through the tool nose and slide the tool along the cable to the component being secured (Figure 30).

50 . **TYPES OF SAFETY CABLE TOOLS.**

51 . The Pre-Set Tension Tool (Figure 30). Insert the free end of the cable into the cable entrance and continue to push the cable into the cavity. When the free end of the cable appears at the bottom of the tool, grip the cable and pull the slack from the cable by repeatedly

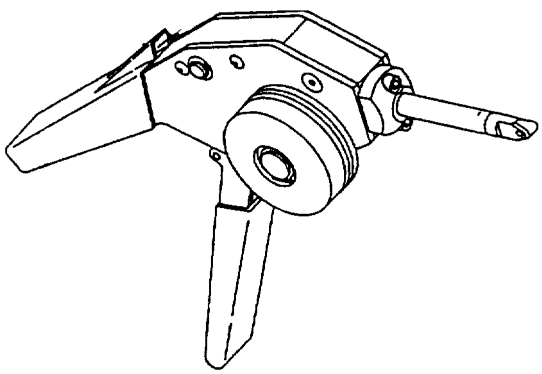


Figure 29. Safety Cable Application Tools

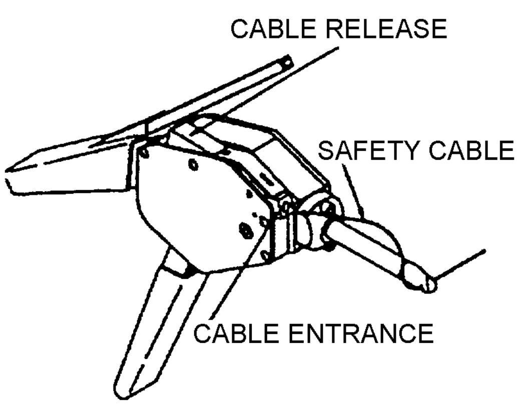


Figure 30. Pre-Set Tension Safety Cable Application Tool

closing the tool handle allowing the handle to open fully before closing again. When all slack is removed, from the cable, snug the tool against the fastener by using several short strokes of the handle. Release the handle to the full open position and fully close the handle to crimp securely and cut flush.

WARNING

Do not overtighten safety cable. It is a good practice to find a tension setting which removes the slack from the cable, (in order to meet the flex limit requirement) without overstressing the safety cable components.

NOTE

It is important on this final stroke to hold the tool as steady and perpendicular to the cable as possible while completing a full stroke. This assures consistent tensioning of the cable (Figure 31).

52 . **ADJUSTABLE TENSION TOOL** (Figure 32). Thread the safety cable through the fastener, ferrule, and tool nose in the same way as with other models. Wrap the cable one full revolution (clockwise) around the tension wheel, and with slight pressure applied by pulling the cable, secure the cable into the slot. Rotate the tension knob until several clicks are heard and felt. If additional tension is required, adjustment can be made with the tension adjuster on the opposite side of the tool.

a. Completely close the handles to crimp and cut the cable. Hold the tool steady and perpendicular to

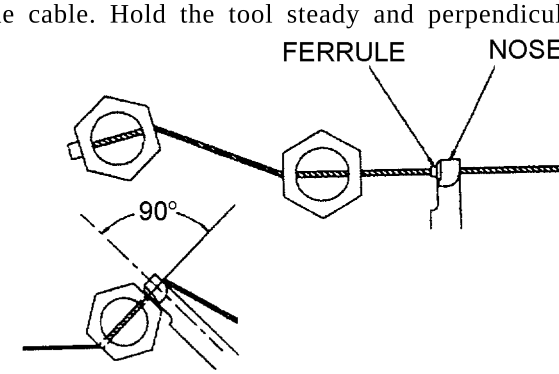


Figure 31. Correct Alignment of Safety Cable Tool Nose

the cable to maintain constant cable tension (Figure 31). Release the handle and remove the tool from the crimped ferrule. Remove the excess cable segment from the tool prior to the next application.

b. If it is more convenient to use the adjustable tension tool with the tension wheel on the opposite side, you may remove the retaining ring located on the opposite side from the tension wheel, slide the tension wheel assembly out of the tool body, reinsert it from the opposite direction, and replace the retaining ring. The tension wheel is now located on the opposite side of the tool.

NOTE

When using a hand tool, the tool handles are to remain fully open during the cable entry process (in both tool models).

53 . **PNEUMATIC SAFETY CABLE TOOL** (Figure 33). Confirm that the tool is set-up correctly and calibrated. Connect the pneumatic safety cable application tool to a clean dry air supply of 80 to 100 psi.

a. Install the safety cable through the components that are to be secured.

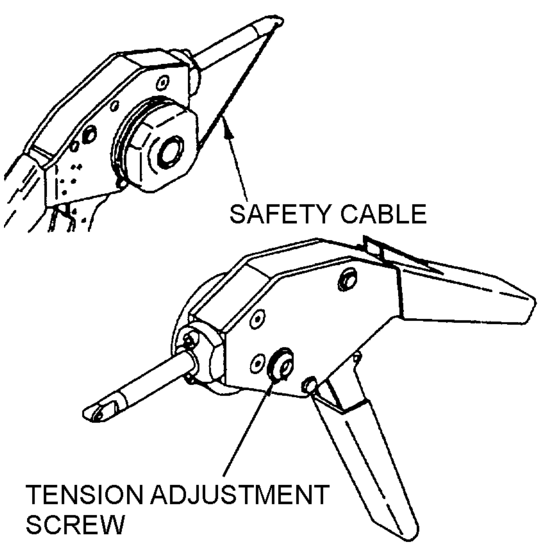


Figure 32. Adjustable Tension Safety Cable Tool.

b. The tool nose can be rotated to any convenient position.

c. Insert the free end of the cable through the ferrule in the cartridge, and remove the ferrule by pulling the cable away from the end of the cartridge. Insert the free end of the cable through the nose of the tool, and slide the tool along the cable to the desired position.

d. Rotate the cable tension wheel clockwise if necessary to move the cable entry slot to an assessable position. Align the nose such that the ferrule is pressed square against the component being secured. Make certain the ferrule is fully seated in the tool nose. Insert the free end of the cable into the cable entry slot of the cable-tensioning wheel. When the end of the cable exits the wheel, grip the slack from the cable. Do not leave more than 1 1/2 inch of total slack in the cable.

e. Press the trigger and hold. The tool will apply tension to the cable, crimp and cut. When the trigger is released, the crimp mechanism will retract (after the cycle is completed). The tool nose can then be removed from the ferrule, and the excess cable discarded.

f. The tension is adjustable by inserting the adjustment key (supplied by the manufacturer) into the adjustment port located on the tool handle. Clockwise rotation increases tension, and counter clockwise rotation decreases tension.

54 . <u>**SAFETY CABLE APPLICATION TOOL MAINTENANCE AND CALIBRATION.**</u>

55 . The safety cable tools should be stored in a dry place when not in use. Clean any debris (especially in

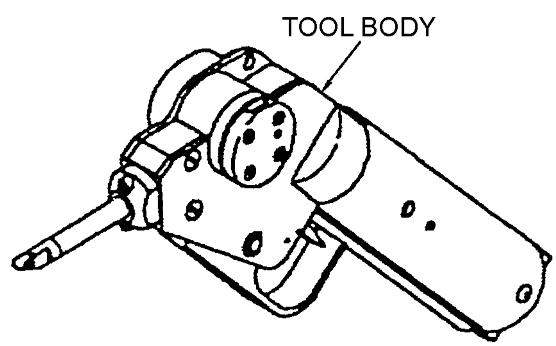


Figure 33. Pneumatic Safety Cable Application Tool

the crimp cavity in the tool nose) from the tool with a small brush and solvent if necessary. Lubricate the tool nose (into the crimp cavity) with a drop of oil on a regular basis.

56 . **TOOL CALIBRATION.** Verify tool calibration with the torque verification fixture, or the electronic pull tester.

NOTE

Indent calibration must be checked frequently, and must be checked each time the nose assembly has been removed or changed.

57 . **TORQUE FIXTURE.** Use the torque verification fixture and a calibrated torque wrench (0-155 inch-pound scale) to verify the. safety cable tool indenter adjustment. Thread a new piece of safety cable into the torque verification fixture (Figure 34), and crimp a ferrule onto the cable with the safety cable application tool that is being tested. This process is the same for all hand and pneumatic tool models.

58 . **PRETEST AREA.** Apply approximately 2 pounds force to the cable with your finger at the point marked “test area”. The cable should not touch the side of bottom wall of the fixture.

59 . **TORQUE WRENCH.** Place a calibrated 3/8 inch drive torque wrench (capable of indicating 30 inch-pounds for .020 cable, 70 inch-pounds for .032 cable, and 110 inch-pounds for .040 cable) into the square drive hole. Orient the verification fixture and the torque wrench on a stable surface, slowly and steadily apply the-force until the required torque is indicated. Do not apply additional pressure after the required force is indicated. Release and remove the torque wrench.

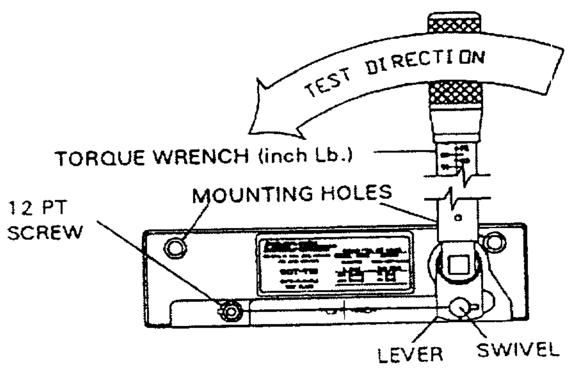


Figure 34. Torque Verification Fixture and Torque Wrench

60 . **POST TEST AREA.** Repeat the application of a 2-pound force to the area marked “test area”. The safety cable should not touch the wall of the verification fixture. Upon the successful completion of this test, the tool can be used to apply safety cable.

61 . **TOOL DISPOSITION.** If the safety cable does touch the wall of the fixture, the tool should not be returned to service, and must be adjusted or serviced by the manufacturer.

62 . **TOOL CALIBRATION VERIFICATION WITH AN ELECTRONIC TESTER.** It may be required in some applications to use an electronic pull tester to test safety cable to destruction. If this is required, the tester (Figure 35) should have digital readout capability, and a two (2) inch/minute pull rate.

63 . **SAFETY CABLE TOOL INDENTER ADJUSTMENT/CALIBRATION.** Remove the nose assembly by removing the two 8-32 socket head cap screws with a 9/64-inch hex wrench (Figure 36).

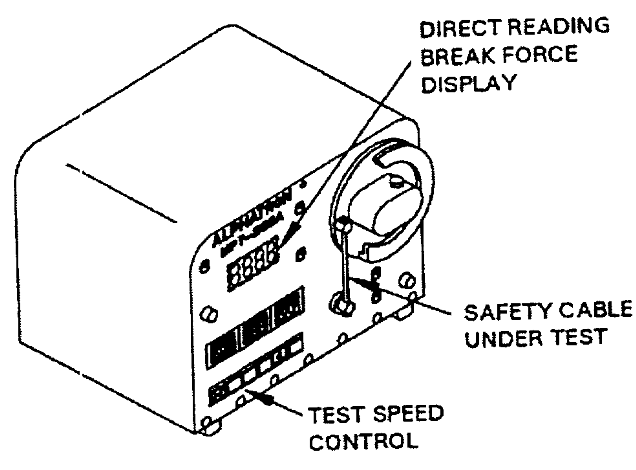


Figure 35. Electronic Safety Cable Pull Tester

CAUTION

Do not adjust the pushrod adjustment screw more than one-quarter turn at a time. Radical adjustments may cause damage to the tool.

64 . **SCT32080 TOOL.** Unlock the jamnut using the SCT32084 tool (supplied by the manufacturer). Adjust the pushrod adjustment screw using a 1/4-inch straight edge screwdriver (Figure 37). Turn the screw clockwise to loosen the crimp (enlarge the gaging dimension), or counterclockwise to tighten the crimp (reduce the gaging dimension). After each adjustment, securely tighten the jam nut using the SCT32084 tool (while holding the adjustment screw tight with the screwdriver). Reinstall the tool nose being sure to tighten the 8-32 socket cap screws securely.

65 . **TOOL CHECK.** Retest the tool using the procedures previously defined. Accept or reject the tool on the basis of the pass/fail criteria stated above, and repeat adjustment process if necessary to achieve passing results.

66 . **REPLACING THE TOOL NOSE.** If satisfactory results cannot be achieved by adjusting the tool as defined above, it may be necessary to replace the tool nose with a new assembly. Should this be necessary, obtain the new nose assembly, and follow steps as defined in paragraphs 63 through 65.

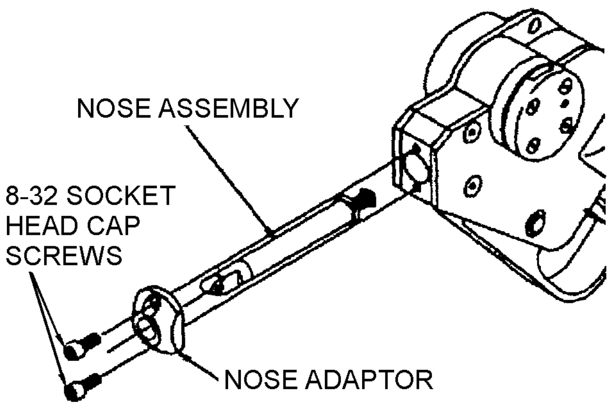


Figure 36. Removal of Safety Cable Tool Nose Assembly.

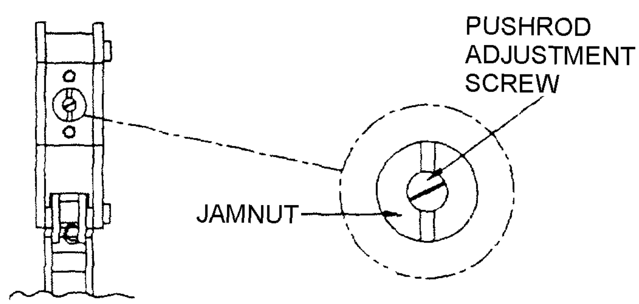


Figure 37. Adjustment of Safety Cable Indenter (Same for Hand and Pneumatic Tool Models)

BUS BAR AND TERMINAL BOARD

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Bonding and Grounding	017 00
Contacts, Terminals, Splices and Caps	013 00
Connector Cleaning and Preservation	026 00
Terminal Junction Block	027 00
Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured	MIL–PRF–8516
Terminal Board Assembly, Molded-In Stud, Electric	SAE–AS27212

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part Number/Type Designation
Soft Bristled Brush	—
Spatula	—

Materials Required

Nomenclature	Part Number/Type Designation
Bolt	NASM3 thru 20
Cloth	A–A–59323
Compound, Sealing	MIL–PRF–8516
Insulator	MS3373
Lockwasher	AN–935
Lockwasher	AN-936B
Lockwasher	MS35338
Methanol	O-M-232
Nut	AN-345
Nut	MS-25682
Nut, Plain	AN-340
Nut, Self locking	NASM21042
Nut, Self locking	NASM21044
Nut, Steel	NASM35649
Nut, Steel	NASM35650
Petrolatum,-Zinc Dust Compound	—
Polyethlene Sheeting	—
Polyurethane Coating	PR-1532
Screw	MS51957
Tape, Pressure Sensitive	—
Terminal Board	MS27212
Terminal Board Cover	MS18029
Terminal Lug, Aluminum	M7099
Terminal Lug, Aluminum	MS25435
Terminal Lug, Copper	M7928
Terminal Lug, Copper	MS20659
Terminal Lug, Copper	MS25036
Tubing or Vinyl Sheet	—
Washer, Plain	AN-960
Washer, Flat Plated	NASM25440
Wrench, Torque	0 – 200 in. lb.

1. INTRODUCTION.

This work package (WP) describes bus bars, protective devices, terminal boards, and terminal junctions, their use, protection, preparation, and the recommended procedures for installation.

2. BUS BARS.

Bus bars are used in aircraft for power distribution. The most commonly used materials for bus bars is bare aluminum, plated aluminum, or plated copper.

3. **UNPLATED ALUMINUM ALLOY BUS BAR PREPARATION.**

WARNING

Methanol, is highly flammable. Do not use near heat, open flame, or any source of ignition. Avoid prolonged breathing of vapors. Use only with adequate ventilation.

Clean bus bar by immersing in methanol, or by wiping with a clean soft cloth saturated with methanol solvent.

4. Keep enclosed areas well ventilated to prevent concentration of vapors

5. Non–soluble films may be removed by using a fine rotary stainless steel wire brush with pilot (Figure 1). They may also be removed by sanding or polishing with very fine garnet paper (silicon carbide or aluminum oxide, 320 grit or finer) or fiberglass eraser, using caution so as to not remove excessive metal.

NOTE

No emery or iron oxide paper or cloth is permitted. Stainless steel wire brushes should be used on only one type of metal in order to reduce the risk of galvanic reaction due to dissimilar metals

6. Apply a chemical conversion coating (ref. MIL–S–5002 and MIL–C–5541) to the area with clean scotch–brite (abrasive impregnated non–woven nylon), sponge, or equivalent. Keep area wet 3 to 5 minutes or until yellow color develops.

7. Remove most of the compound from bus bar by wiping lightly with a clean, soft cloth.

8. Examine bus bar to make sure that there are no steel brush bristles lodged in the aluminum.

NOTE

Allow the final coat of Petrolatum-Zinc Dust compound to remain on bus bar when installed. Excess will be squeezed out of connections and removed later.

9. Apply a thin coating of chemical conversion compound to contact surfaces.

10. **PLATED ALUMINUM AND COPPER BUS BAR PREPARATION.**

WARNING

Methanol, is highly flammable. Do not use near heat, open flame, or any source of ignition. Avoid prolonged breathing of vapors. Use only with adequate ventilation.

11. Clean bus bar by immersing in methanol or by wiping with a clean, soft cloth saturated with methanol solvent.

12. Wipe dry with a clean, soft cloth.

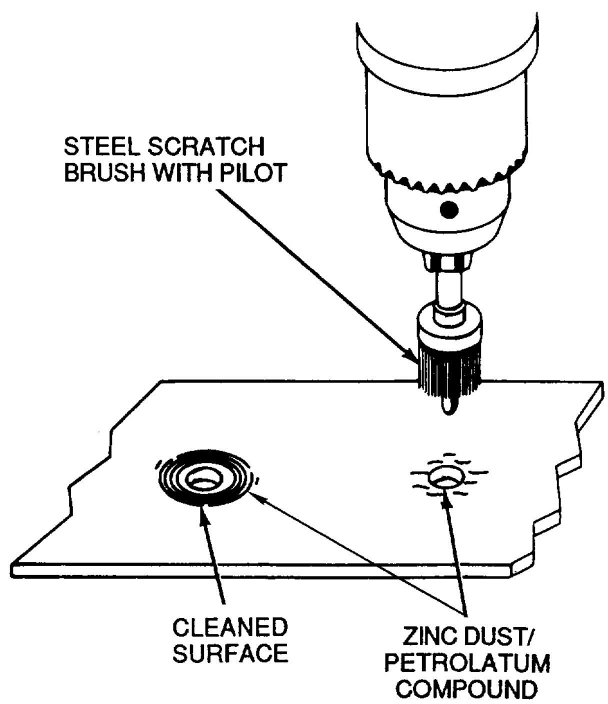


Figure 1. Unplated Aluminum Alloy Bus Bar Preparation

13. **PLATING REPAIR.**

CAUTION

Do not attempt to repair plating on aluminum.

14. Inspect contact surfaces of plated aluminum or copper bus bars for damage to plating. Reject damaged aluminum bus bars and return for rework. Repair slight damage to plated copper bus bars by tinning with a soldering iron or by brush plating. Thoroughly wash and dry brush plated areas.

15. **BUS BAR INSTALLATION.** Install bus bars inside panels, junction boxes, or in protected areas when possible. If this cannot be done, the bus bar shall be insulated.

16. . **Mounting.** When installing a copper bus bar, always use a plain cadmium plated steel washer between the bus bar and the lockwasher or self-locking nut. When installing on aluminum alloy bus bar, use a plain aluminum alloy washer between the bus bar and the lockwasher or self-locking nut (Figure 2).

17. . **Isolation.** Isolate the bus bar from structure, junction box, or support with a fiberglass, phenolic, or other rigid insulating stand-off. Do not use any moisture-absorbing material. Isolate to prevent fault to ground or phase to phase fault which would disrupt the electrical power system.

18. . **Insulation.** When conditions require, bus bars must be protected against accidental shorting. Bus bars may be insulated by applying a protective coating to the bus bar.

NOTE

Use a protective coating such as MIL–PRF–8516 sealing compound (WP 027 00).

19. Using pressure sensitive tape, mask all areas where connections will be made.

20. Apply a thick coat of compound using a spatula or soft bristled brush.

21. After compound has cured, remove tape with a razor blade by cutting into compound next to tape then peeling tape from masked area.

22. In conjunction with the previous steps, bus bars can also be protected by slitting a piece of vinyl tubing or suitable substitute with comparable dielectric characteristics, and wrapping it around the bus bar after all connections are made and coatings applied. Select tubing which has large enough diameter to permit a generous overlap when tying it in place (Figure 3).

23. CONNECTIONS TO BUS BAR.

24. HARDWARE FOR CONNECTION TO BUS BARS. Cadmium plated steel hardware (except as noted below) is used to secure terminals to bus bars. Use split lockwashers under hex nuts and under self-locking nuts.

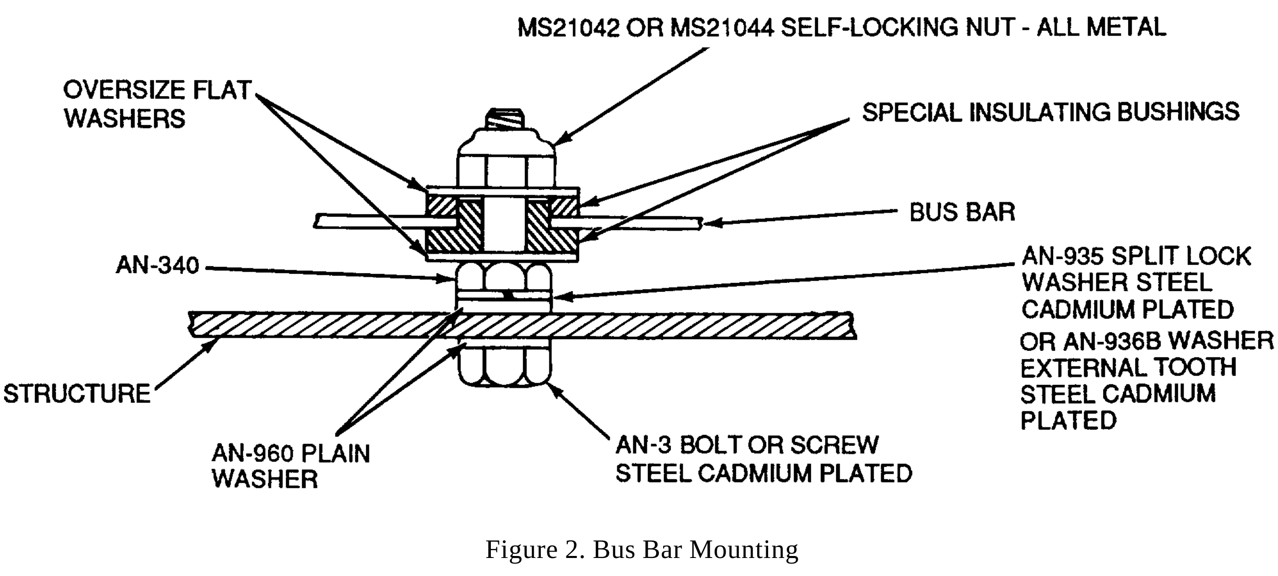


Figure 2. Bus Bar Mounting

Use plated steel plain washer AN-960 between lockwashers and copper terminals. Use plated brass flat washer NASM25440 between lockwashers and aluminum terminals. The head of the screw or bolt can be located on the terminal side or the bus bar side, as required to simplify the installation.

a. Use a cadmium plated steel split lockwasher NASM35338 under the head of every bolt or screw and also under the nut.

b. Use plated brass flat washers NASM25440 in contact with aluminum. The washer diameter must be at least equal to the tongue diameter of the terminals. Do not select a washer so large that it will ride on the barrel of the terminals (WP 013 00).

25. **CONNECTING TERMINAL LUGS TO BUS BARS.** In order to obtain maximum efficiency in the transfer of power, the terminal lug and the bus bar should be in direct contact with each other so that the current does not have to go through any of the attaching parts, even if these are good-current-carrying materials. As illustrated in Figures 4 through 7 the above applies whether the terminal lugs and bus bar are of the same or of different materials.

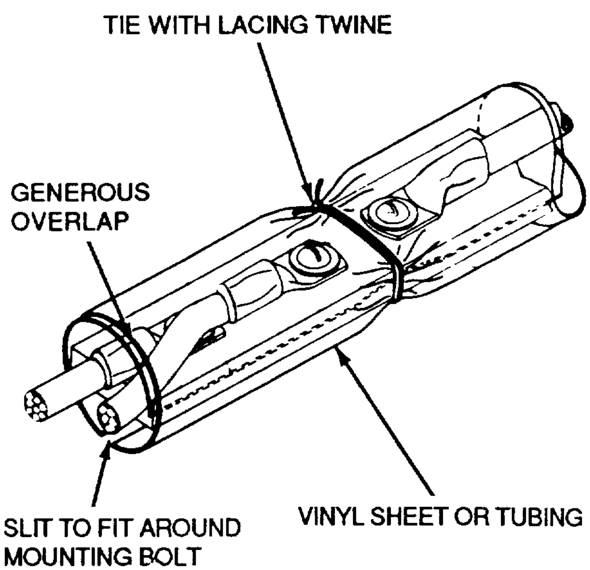


Figure 3. Vinyl Tubing Around Bus Bar

NOTE

Terminal lug offset is positioned so that barrel cannot contact bus bars. This allows proper seating of tongue on bus bar.

26. **PRECAUTIONS WHEN REPLACING EXISTING CONNECTIONS.** When replacing existing terminal lug connections to bus bars, observe the following precautions:

a. Check all flat washers. Replace bent washers. Replace washers which have scratched plating or paint on faying surface.

b. Clean bus bar connection areas.

c. Check plated copper terminal lugs before connecting to an aluminum bus bar. If plating is scratched, replace terminal lug.

27. **CONNECTING TWO TERMINALS.** Terminal lugs must always be in direct contact with bus bar. As shown in Figure 8, connect one terminal lug to top of bus bar and the other to bottom.

28. TERMINAL BOARDS.

29. Terminal boards are used for junctions of wiring requiring infrequent disconnection or for joining two or more wires to a common point. Terminal boards shall be in accordance with MS27212 and shall be installed with MS18029 covers (Figure 9).

30. **MOUNTING.** Terminal boards shall be installed and mounted so that they are both mechanically and electrically secure. Terminal boards shall not be subject to mechanical strain or used to support insulating materials. The following methods are recommended for mounting and installation of the terminal board:

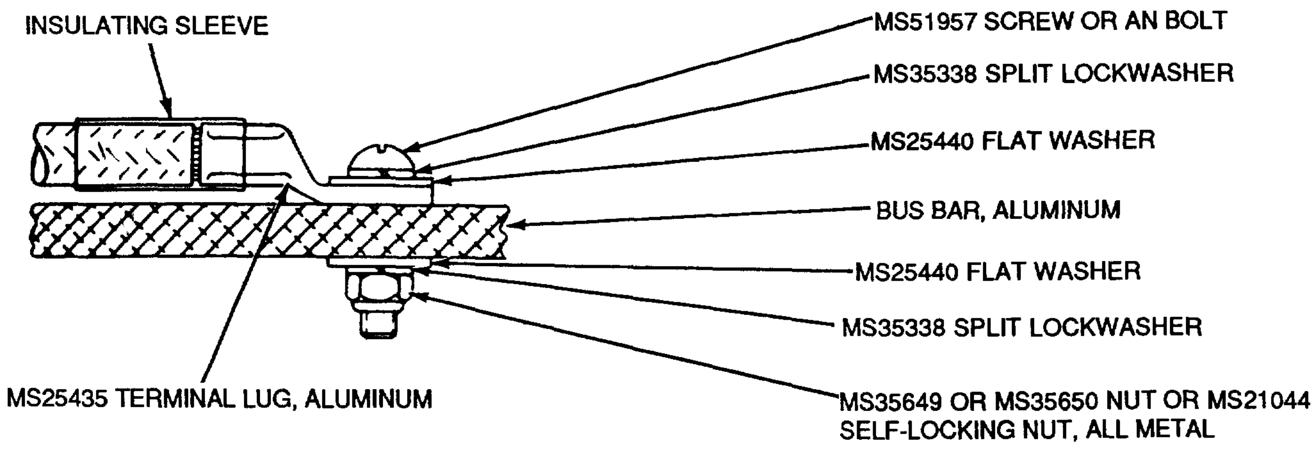


Figure 4. Connecting Aluminum Terminal to Aluminum Bus Bar

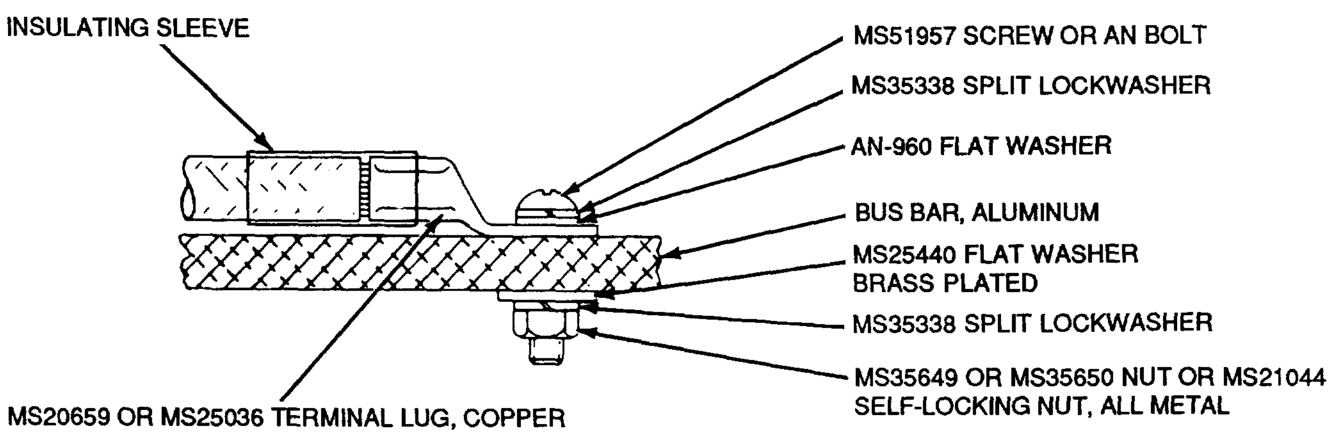


Figure 5. Connecting Copper Terminal to Aluminum Bus Bar

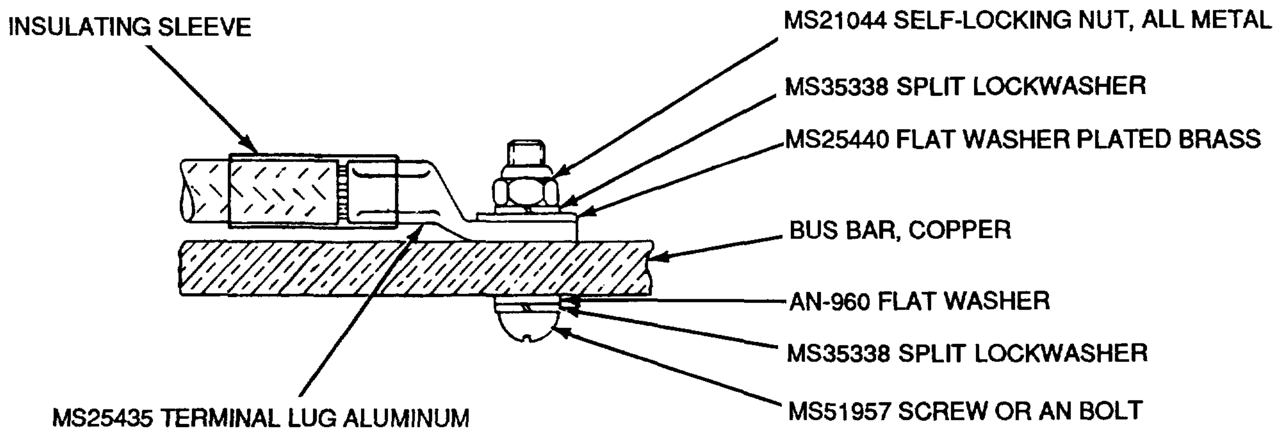


Figure 6. Connecting Aluminum Terminal to Copper Bus Bar

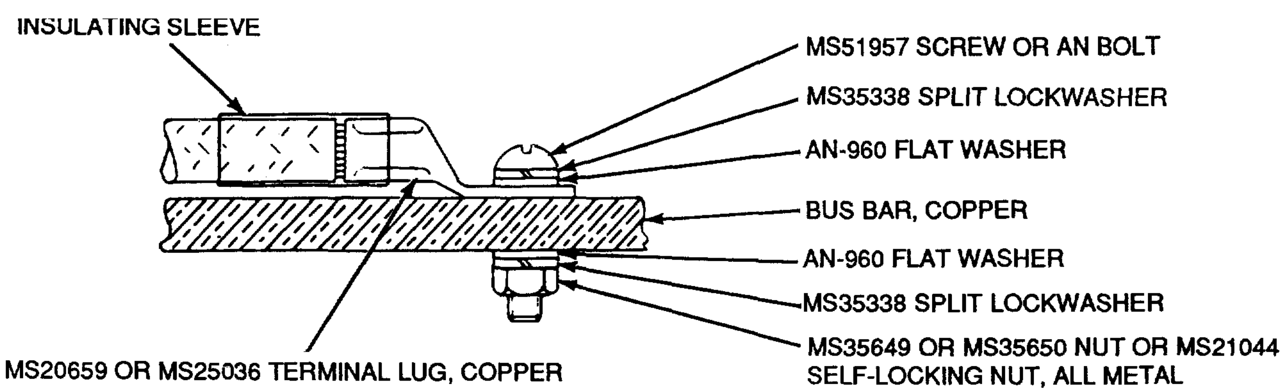


Figure 7. Connecting Copper Terminal to Copper Bus Bar

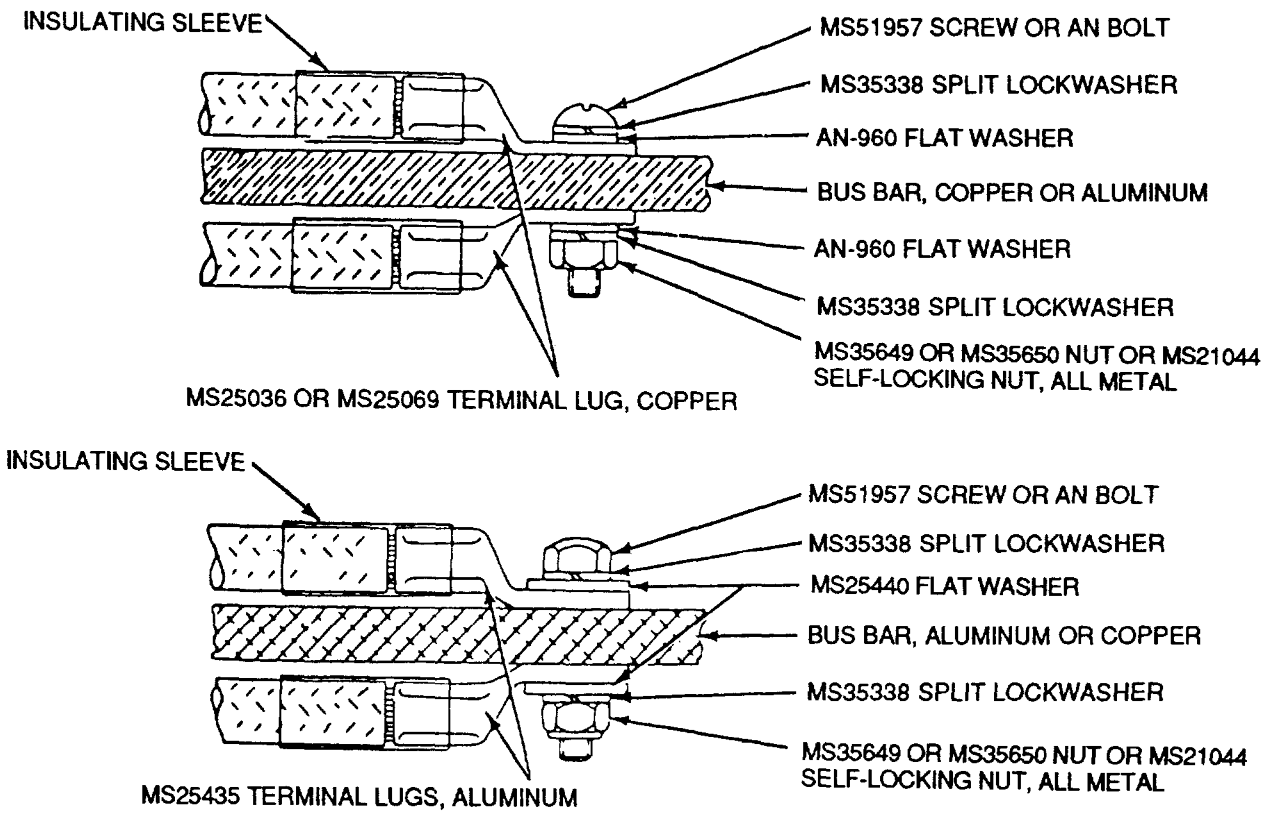


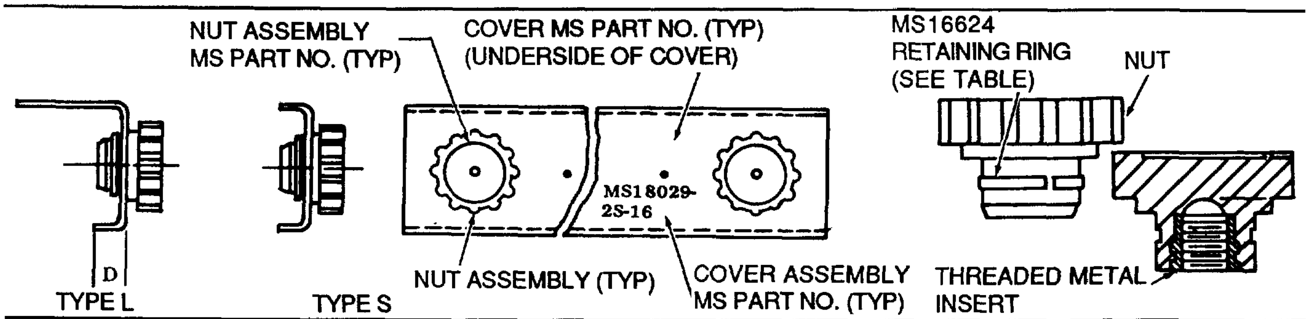
Figure 8. Connecting Two Terminals to Same Point on Bus Bar

Terminal Board MS Part Number	Stud Thread	Number Of Studs	Cover Part Number
MS27212-1-20	6-32UNC-2A	20	MS18029-1(*) - (N)
MS27212-2-16	10-32UNF-2A	16	MS18029-2(*) - (N)
MS27212-3-8	1/4-18UNF-2A	8	MS18029-3(*) - (N)
MS27212-4-8	5/16-24UNF-2A	8	MS18029-4(*) - (N)
MS27212-5-8	3/8-24UNF-2A	8	MS18029-5(*) - (N)
MS27212-6-16	8-32UNF-2A	16	MS18029-6(*) - (N)

NOTE: TERMINAL BOARDS AND COVERS ARE PROCURED IN FULL LENGTHS WITH NUMBER OF STUDS INDICATED. CUT TO SUIT NEEDS AT INSTALLATION.

COVER ASSEMBLY

NUT ASSEMBLY



Cover Assembly Part Number	Cover Part Number Type L Type S	Studs Maximum (N)	Nut Assembly Dash No.	Threaded Metal Insert	Retaining Ring Part Number
MS18029-1(*) - (N)	-11L - (N) -11S - (N)	20	21	0.138-32UNC-2B	MS16624-1040
MS18029-2(*) - (N)	-12S - (N) -12S - (N)	16	22	0.190-32UNF-2B	
MS18029-3(*) - (N)	-13L - (N) -13S - (N)	8	23	0.250-28UNF-2B	MS16624-1062
MS18029-4(*) - (N)			24	0.312-24UNF-2B	
MS18029-5(*) - (N)			25	0.375-24UNF-2B	
MS18029-6(*) - (N)	-14L - (N) -14S - (N)	16	26	0.164-32UNC-2B	MS16624-1040

NOTES:

1. (*) USE LETTER L OR S TO INDICATE TYPE COVER DESIRED.
   (N) INDICATES THE NUMBER OF STUDS IN A MS27212 TERMINAL BOARD ASSEMBLY TO BE COVERED.
2. EXAMPLE OF PART NUMBER:
   MS18029-2S-16 INDICATES A COVER ASSEMBLY FOR A MS27212 TERMINAL BOARD ASSEMBLY HAVING 16 STUDS . . . 190-32 UNF
   THIS COVER ASSEMBLY WILL CONSIST OF THE FOLLOWING:
   1 - MS18029-12S-16 TYPE S COVER
   2 - MS18029-22 NUT ASSEMBLIES
   COVER ASSEMBLY MS PART NUMBER SHALL BE MARKED ON TOP OF COVER.
3. THE GOVERNMENT SERVICES SHALL PROCURE AND STOCK ONLY COVERS MS18029-11L-20, -11S-20, -12L-16, -12S-16, -13L-8, -13S-8, -14L-16, -14S-16, AND NUT ASSEMBLIES MS18029-21 THROUGH -26.
4. THE INSTALLING ACTIVITY SHALL FABRICATE COVER ASSEMBLIES FROM PARTS TO BE STOCKED.
5. (N) CODE IS FOR INDUSTRY USE ONLY, FOR THE PROCUREMENT OF COVER ASSEMBLIES OF VARIOUS LENGTHS.
6. COVER ASSEMBLIES ARE NOT TO BE USED IN INSTALLATIONS WHERE THE TEMPERATURE EXCEEDS 475°F (246°C).
7. A MINIMUM OF THREE THREADS MUST BE EXPOSED AFTER TERMINAL STACKING ON THE END STUDS FOR COVER INSTALLATION.

Figure 9. MS27212 Terminal Boards and Covers

Install mounting screws so that the screws extend through the bottom of the terminal board (Figure 10).

Install washer, lockwasher, and mounting nut.

NOTE

Screws shall not extend more than two threads beyond nut.

Pass a steel scale or other flat piece of metal over the top of nut. If it passes over freely, the screw is too short and must be replaced with the next longer length screw.

31. **ALTERNATE MOUNTING.** When it is not possible to install the mounting screws from the top of the terminal board, install as follows:

Install mounting screws, washers, and lockwashers from the bottom of the terminal board.

Install mounting nut.

Mounting screws shall extend beyond the top of the nut, but not beyond the level of the terminal board mounting surface (Figure 11).

32. **INSULATION.** An insulating strip shall be installed over each mounting screw. Install strips between the adjacent terminal studs under the securing washers and nuts (Figure 12).

33. **TERMINAL BOARD COVERS.** Use terminal board cover MS18029 on the MS27212 terminal board. Attach no more than two terminal lugs on the stud which is to be used for mounting the cover to the terminal board.

34. **IDENTIFICATION.** Each terminal board in the aircraft electrical system is identified by the letters TB,

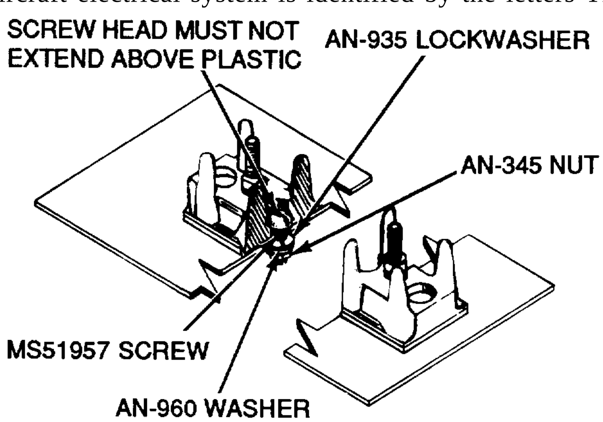


Figure 10. Terminal Board Mounting

followed by a number which is the number of the individual board. Each stud on the terminal board is identified by a number adjacent to it, with the lowest number in the series at the end nearest the terminal board identification number. The identification may be marked on the aircraft structure to which the terminal board is attached or may be on an identification strip cemented to the structure, under the terminal board. When a terminal board is replaced, do not remove the identification marking unless it has been damaged. In that case, replace the identification marking exactly as in the original, in accordance with the applicable wiring diagram.

35. **CONNECTING TERMINAL BOARDS.** Terminal lugs are used to terminate wires to terminal boards (WP

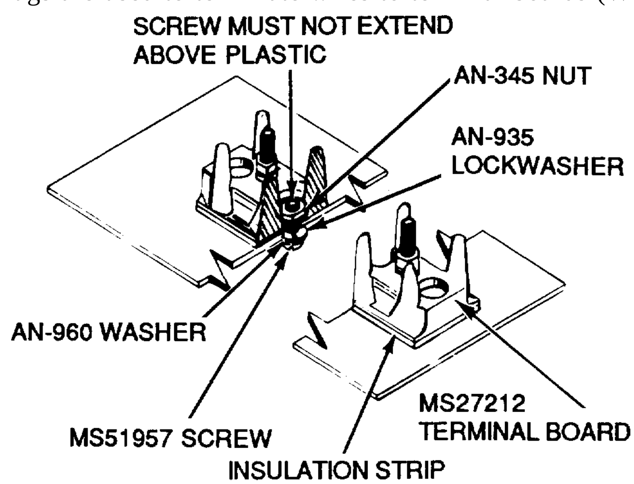


Figure 11. Alternate Method of Mounting Terminal Boards

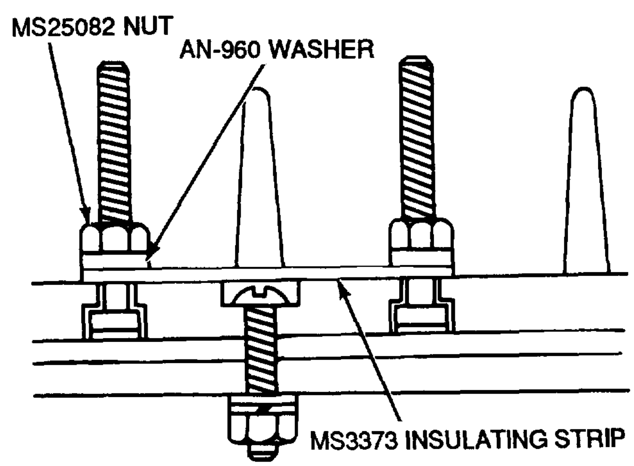


Figure 12. Terminal Board Insulation

013 00). Connections will adhere to the following (Figure 13):

a. No more than four terminal lugs, or three terminal lugs and one bus shall be connected to one terminal stud.

b. Terminal lugs with various diameters shall be stacked with the largest outer diameter on the bottom and the smallest on top.

c. Terminal lugs shall be selected by stud diameter.

d. Tighten but do not over tighten so as to deform either the terminal lug or stud.

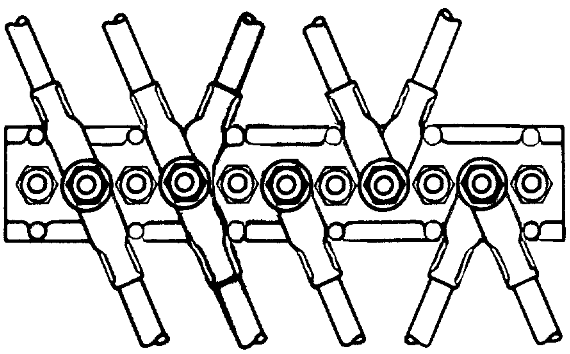


Figure 13. Connecting Terminal Lugs To Terminal Board

e. Position terminal lugs so that bending is not required to remove fastening screw or nut.

f. Position so that movement will tend to tighten the nut.

g. Copper terminal lugs shall not have spacers or washers between the tongues of terminal lugs.

h. Aluminum terminal lugs shall have the tongue or total number of tongues sandwiched between two NASM25440 flat washers. Spacers or washers are not permitted between the tongues.

36. **HARDWARE FOR WIRING TERMINAL BOARDS.** Terminal boards have lugs molded in and do not require stud securing hardware as did the MS25123 terminal board which has been superseded. Attaching hardware is shown (Table 1).

37. **INSTALLATION TORQUE.** As the terminal studs are molded into the terminal board the use of a torque wrench is recommended. The torque values are shown in Table 2.

38. **ATTACHING COPPER TERMINALS.** To attach copper terminals to terminal boards proceed as follows (Figure 14):

a. Select proper hardware (Table 1).

b. Follow procedure as outlined (paragraph 25).

c. Assemble in proper sequence (Figure 13).

d. Torque securing nut (Table 2).

Table 1. Attaching Hardware

Part No. MS27212	Flat Washer	Lockwasher	Nut	
			Plain	Self Locking
-1	AN960-C6	NASM35338-136 or 155	NASM35649-264	NASM21042-06 or NASM21042L06
-2	AN960-C10	NASM35338-138 or 157	NASM35650-304	NASM21042-3 or NASM21042L3
-3	AN960-C416	NASM35338-139 or 158	NASM35650-3254	NASM21042-4 or NASM21042L4
-4	AN960-C516	NASM35338-140 or 159	NASM35650-3314	NASM21042-5 or NASM21042L5
-5	AN960-C616	NASM35338-141 or 160	NASM35650-3384	NASM21042-6 or NASM21042L6
-6	AN960-C8	NASM35338-137 or 156	NASM35649-284	NASM21042-08 or NASM21042L08

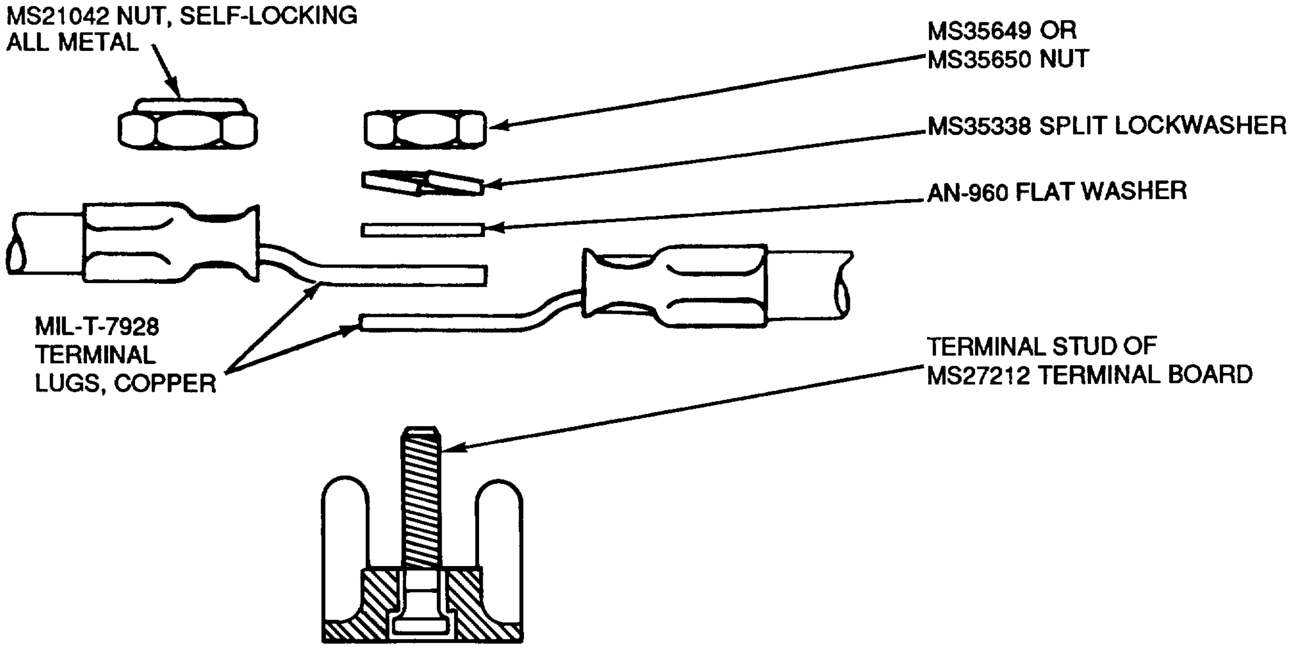


Figure 14. Hardware for Wiring Terminal Boards with Copper Terminals

Table 2. Torque Valves

Stud Size	Torque Values
No. 6	22 Inch-Pounds
No. 8	32 Inch-Pounds
No. 10	40 Inch-Pounds
5/16 Inch	170 Inch-Pounds
3/8 Inch	170 Inch-Pounds

39. **ATTACHING ALUMINUM TERMINALS.** To attach aluminum terminals to terminal boards special washers are required as shown in Table 3. Proceed as follows (Figure 15):

40. Select proper hardware (Tables 1 and 3).

41. Follow procedure as outlined in paragraph 25.

42. Assemble in proper sequence (Figure 15).

43. Torque securing nut (Table 2).

Table 3. Washer for Use with Aluminum Terminal Lugs

Part No, MS25440	Terminal Size	Stud Size
-3	8, 6, 4	No. 10
-4	8, 6, 4, 2, 1,1/0	1/4
-5	8, 6, 4, 2, 1, 1/0, 2/0	5/16
-6	8, 6, 4, 2, 1, 1/0, 2/0	3/8
-6A	3/0, 4/0	3/8
-8	2, 1, 1/0, 2/0, 3/0, 4/0	1/2

44. **ATTACHING COMBINATIONS OF TERMINALS.** To attach copper terminals with aluminum terminals on the same terminals stud proceed as follows (Figure 16).

Select proper hardware (Tables 1 and 3).

Follow procedure as outlined in paragraph 25.

Assemble in proper sequence (Figure 16).

Torque securing nut (Table 2).

45. **TERMINAL JUNCTION BLOCK.** For connection to Terminal Junction Blocks refer to Volume II WP 028 00.

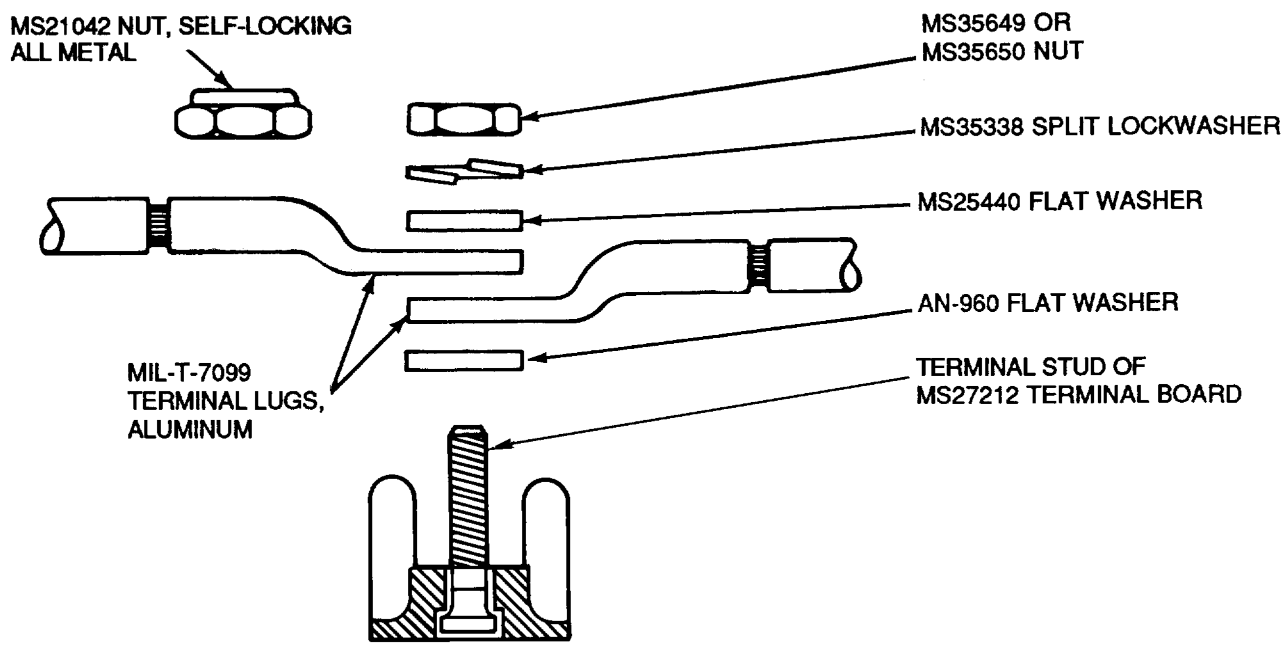


Figure 15. Hardware for Wiring Terminal Boards with Aluminum Terminals

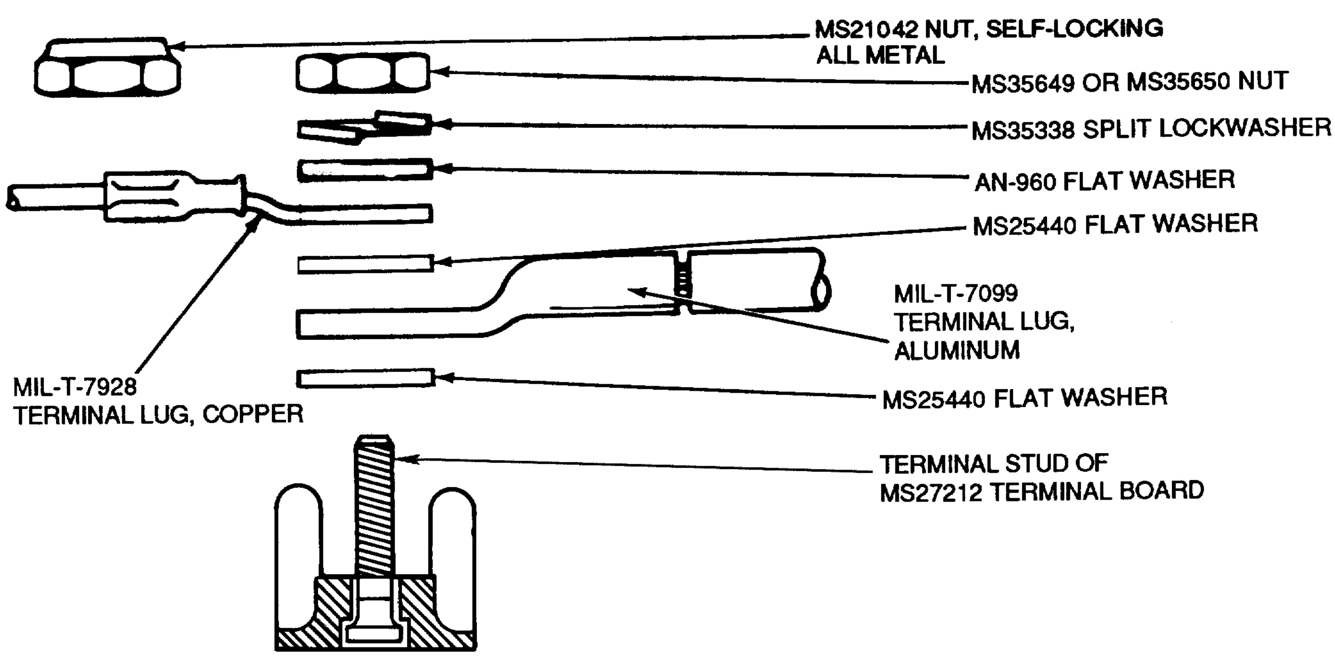


Figure 16. Hardware for Wiring Terminal Boards with Combination of Terminals

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MILITARY STANDARD CIRCULAR CONNECTORS

INSTALLATION AND REPAIR PRACTICES

AIRCRAT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Alphabetical Index (Cont)

Support Equipment Required

Nomenclature	Part. No./Type Designation
Heat Gun	HT-900B
Heat Gun	HT-920B

Materials Required

Nomenclature	Specification/ Part Number
Contact	D-602-16
Contact	D-602-17
Contact	D-602-44
Contact	D-602-45
Contact	D-602-46
Contact	D-602-47
Contact	D-602-54
Contact	D-602-55
Contact	D-602-56
Contact	D-602-57

Materials Required (Cont)

Nomenclature	Specification/ Part Number
Contact	D-602-72
Contact	D-602-73
Contact	D-602-0094
Contact	D-602-0095
Contact	D-602-0104
Contact	D-602-0105
Contact	D-602-0106
Contact	D-602-0107
Isopropyl Alcohol	TT-I-735
Sleeve, Filling	CTA-0006
Sleeve, Filling	CTA-0042

1. **INTRODUCTION.**

2. This work package (WP) covers general information for circular connectors commonly used on military aircraft. Specific information on a particular type connector is contained n the appropriate NAVAIR 01-1A-505 Series manual (Table 1).

TABLE 1. CONNECTOR MANUAL REFERENCE

Connector Type	Manual Number
MIL-C-38999 Series I II, III, and IV	NAVAIR 01-1A-505.6
MIL-C-81511 Series 1 and 2	NAVAIR 0l-1A-505.7
MIL-C-81511 Series 3 and 4	NAVAIR 01-1A-505.8
MIL-C-83723 Series 1, 2, 3	NAVAIR 01-1A-505.9
MIL-C-5015	NAVAIR 01-1A-505.10
MIL-C-26482 Series 1 and 2	NAVAIR 01-1A-505.11
MIL-C-26500	NAVAIR 01-1A-505.12
MIL-C-81703	NAVAIR 01-1A-505.13
NAS 1599	NAVAIR 01-1A-505.14

3. **GENERAL.**

4. **CONNECTORS.** Connectors are electromechanical devices that permit circuit elements to be electrically and mechanically separated and reconnected without disturbing other elements. The connector performs no function electrically except to connect and disconnect circuits, and serves to join wires together.

5. **CONNECTOR SYSTEM.** A connector system (Figure 1) consists of two mating assemblies, a plug and z receptacle. The plug usually is on the end of a cable originating in a piece of equipment. The receptacle is usually fastened to a fixed structure or to piece of equipment.

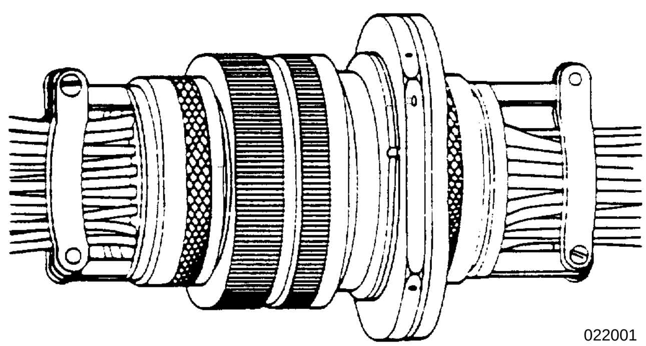

Figure 1. Typical Connector System

6. **RECEPTACLE ASSEMBLY.** The receptacle assembly (Figure 2) is that part of the: connector system that mates with the plug assembly, and is usually fired to a wall, bulkhead, or equipment case. A receptacle consists of an insulator insert, contacts, and a shell. The contacts, whether pin or socket, do not alter the terminology of the receptacle and maybe of any of the following types:

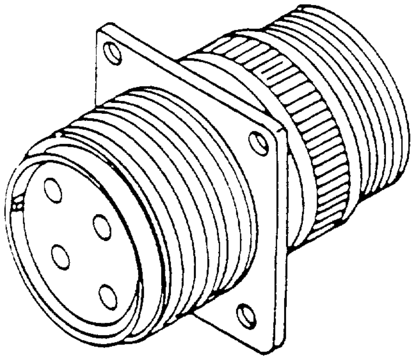

Figure 2. Typical Receptacle

7. **Flanged Receptacle.** Flanged receptacles (Figure 3) are may be box or wall mount. The body of the connector has a rectangular flange with screw mounting holes at each corner. This type requires five holes in the structure, one for the body and four for the mounting screws. Depending on the thickness of the structure, the receptacle can be mounted with the flange either on the front or back.

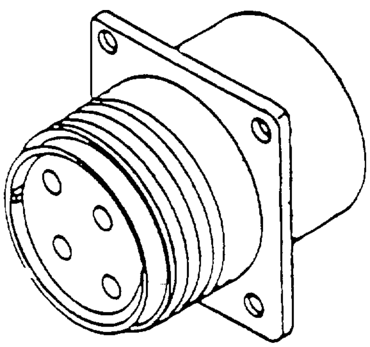

Figure 3. Typical Flanged Receptacle

8. **Jam Nut Receptacle.** Jam nut receptacles (Figure 4) are mounted by means of a large nut, or jam nut, threaded onto the connector body. This method requires one hole in the structure. The connector shell normally has provisions for an O-ring seal.

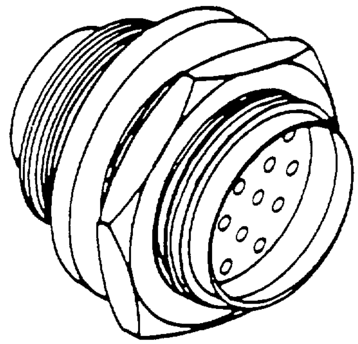

Figure 4. Typical Jam Nut Receptacle

9. **Cable Receptacle.** Cable receptacles (Figure 5) are used when two cables are to be connected together.

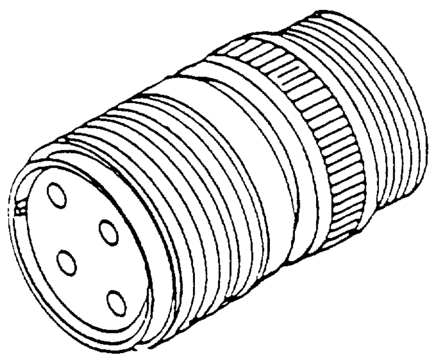

Figure 5. Typical Cable Receptacle

10. **PLUG ASSEMBLY.** The plug assembly (Figure 6) is the removable part of the connector system that mates with the receptacle, and is usually attached to a cable. A plug consists of an insulator insert, contacts,

shell, and coupling mechanism. The contacts, whether pin or socket, do not alter the terminology of the plug.

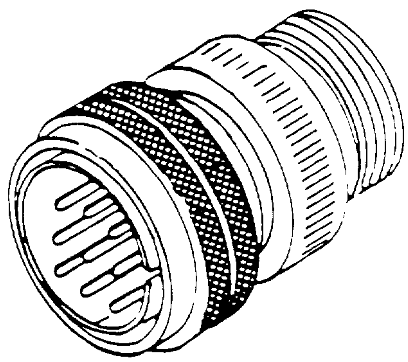

Figure 6. Typical Plug

11. **SHELL.** The shell (Figure 7) is usually fabricated of plated aluminum, steel, or composite, and supports and protects the insulator insert. Some receptacle shells are also used for in mounting. These shells are polarized to prevent mismatching of similar connectors.

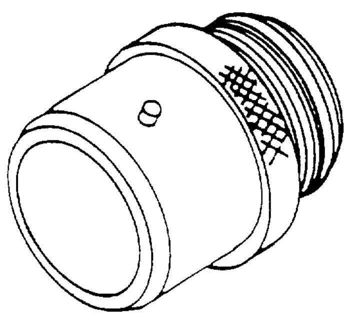

Figure 7. Typical Plug

WARNING

Do not grind cadmium plated parts. Breathing airborne cadmium particles is a health hazard.

l2. **Plating Types.** The following are typical shell plating and finish types: Cadmium over nickel or suitable underplate, electroless nickel, anodized, passivated, cadmium, and fused tin.

NOTE

Nickel plated parts are not for Navy use or new design.

13. **POLARIZATION.** Polarization (Figure 8) is accomplished by use of a key and keyway or series of keys and keyways. One method has a slot or keyway cut into the plug shell with a corresponding protrusion or key on the inside of the receptacle shell. The other method is the opposite. The keys, usually one large and four small, are on the outside diameter of the plug and corresponding keyways are recessed into the inside diameter of the receptacle. Further polarization can be achieved by rotation of the smaller keys and keyways relative to the large ones. In some series, the insert itself can be rotated to allow for alternate insert positions.

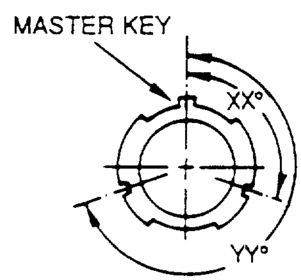

Figure 8. Polarization

14. **CLOCKING.** Clocking is defined as the angle in degrees that the wiring, backshell, boot, or potting are displaced from the connector keyway as read clockwise from the keyway when facing the connector mating surface.

15. **COUPLING.** The most common types of coupling and locking of a plug and receptacle are the threaded, double or triple start; bayonet; breech lock; and push-pull.

16. **Threaded.** The threaded system (Figure 9) employs a captive. Internally threaded coupling ring that mats with the threads on the receptacle. Double start threaded connectors begin coupling within 180 degrees of rotation. Triple start threaded connectors begin coupling within 120 degrees of rotation.

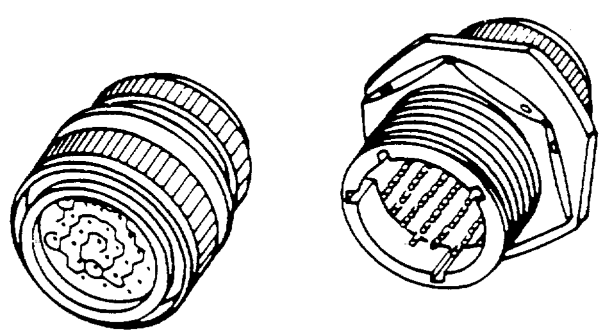

Figure 9. Typical Thread Coupling

17. **Bayonet.** The bayonet system (Figure 10) employs three pins spaced 120 degrees apart on the outside perimeter of the receptacle. The coupling ring of the mating plug contains three corresponding ramped grooves and a spring loaded device that provides a positive lock.

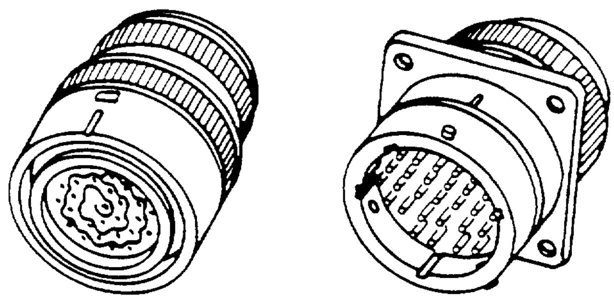

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Figure 10. Typical Bayonet Coupling

18. **Breech Lock.** The breech lock system (Figure 11) is similar to the bayonet system except solid lands and grooves are utilized instead of bayonets. Coupling requires a 90 degree clockwise twist to couple.

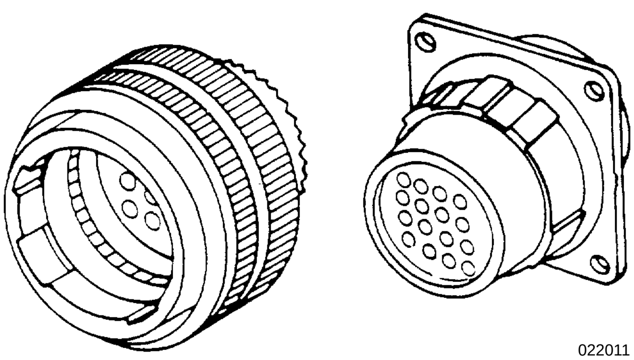

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Figure 11. Typical Breech Coupling.

19. **Push-Pull.** The push-pull coupling system (Figure 12) employs a coupling ring that slides along the axis of the connector.

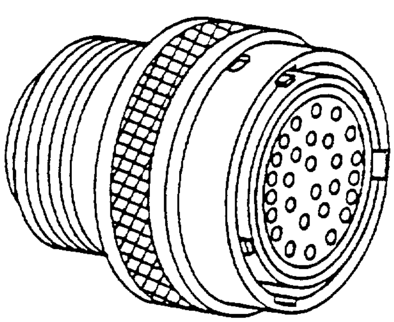

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Figure 12. Typical Push-Pull Coupling

20. **SERVICE CLASS.** Service class pertains to the environmental parameters in which the connector will operate successfully. These parameters include:

a. Environmental sealing

b. Fuel and fluid resistance

c. Vibration and shock

d. Corrosion resistance

e. Operating temperature

f. Special condition

21. **INSERTS.** The entire insert is essentially one integral part designed to provide suitable support around the wires and insulate the contacts from the shell as well as from other contacts. These inserts are usually constructed of a dielectric material such as rubber or plastic compositions, are nonremovable' and are secured to prevent rotation. The design is such that the contacts are able to be inserted and removed to facilitate installation and maintenance, except when using hermetic receptacle in which the contacts are fixed in the insert. A connector contains either a pin insert or socket insert (Figure 13).

22. **Rigid Dielectric.** The rigid dielectric is one molded piece, or more than one piece bonded together. The design is such that the contacts may be inserted and removed to facilitate installation and maintenance, except for hermetic receptacles.

23. **Contact Locking Devices.** The contact locking devices are contained in the rigid dielectric and securely hold the contacts during normal coupling (Figure 14).

24. **Insert Arrangement.** The insert arrangement indicates the service rating, and the quantity, size, and position of the contacts.

25. **Service Rating.** The service rating defines the test voltage that can be applied between adjacent contacts or a contact and the connector shell without evidence of breakdown or flashover.

26. **ENVIRONMENTAL SEALS.** The environmental seal is designed and utilized to prevent moisture from entering the connector and causing shorts. There are several types of seals.

27. **Peripheral Seal.** This is either a flat gasket. O-ring seal, or molded gasket to keep moisture from entering through the shell. As the connectors mate, the seal flattens causing an environmental seal.

28. **Interfacial Seal.** This seal is normally a rubber seal bonded to the pin insert face with a hole pattern

corresponding to the insert. The connector, when mated, compresses the interfacial seal forming the environmental seal round each pin.

29. **Grommet Seal.** Typically, connectors have a grommet seal that is placed at the rear of the connector with a hole pattern corresponding, to the insert. Inside the grommet are one or more seals that hold themselves against the wire to prevent moisture entry. Wire outside diameter must he within tolerances defined in the applicable connector specification to meet the sealing requirements. Undersized wire may be built up with heat shrinkable sleeving to the correct size.

30. **Cable Seal.** When using jacketed cable, an adapter and special seal may be used. As the adapter clamp is tightened. the cable seal is compressed forming the environmental seal.

31. **Hermetic Seal.** A glass-like material is used to insulate and seal the contacts, and all pin contacts will have an interfacial seal. The contacts are nonremovable.

32. **GROMMET SEALING PLUGS.** The grommets of environmental resisting connectors are designed to accept sealing plugs in accordance with MS27488. Sealing plugs are to be used in empty connector cavities or in cavities with unwired contacts to maintain environmental resistance. The connector, when ordered as a unit, will have sealing plugs enclosed so as to equal 15% of the number of contacts, but not less than one.

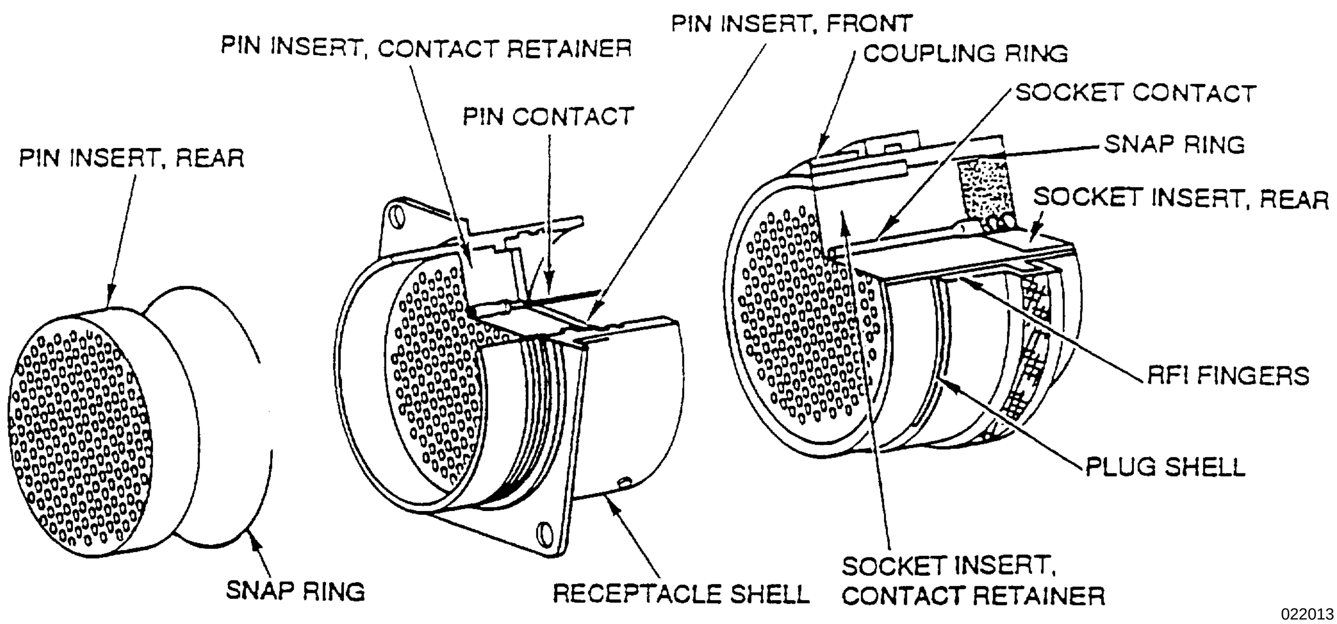


Figure 13. Connector Insert and Design Features

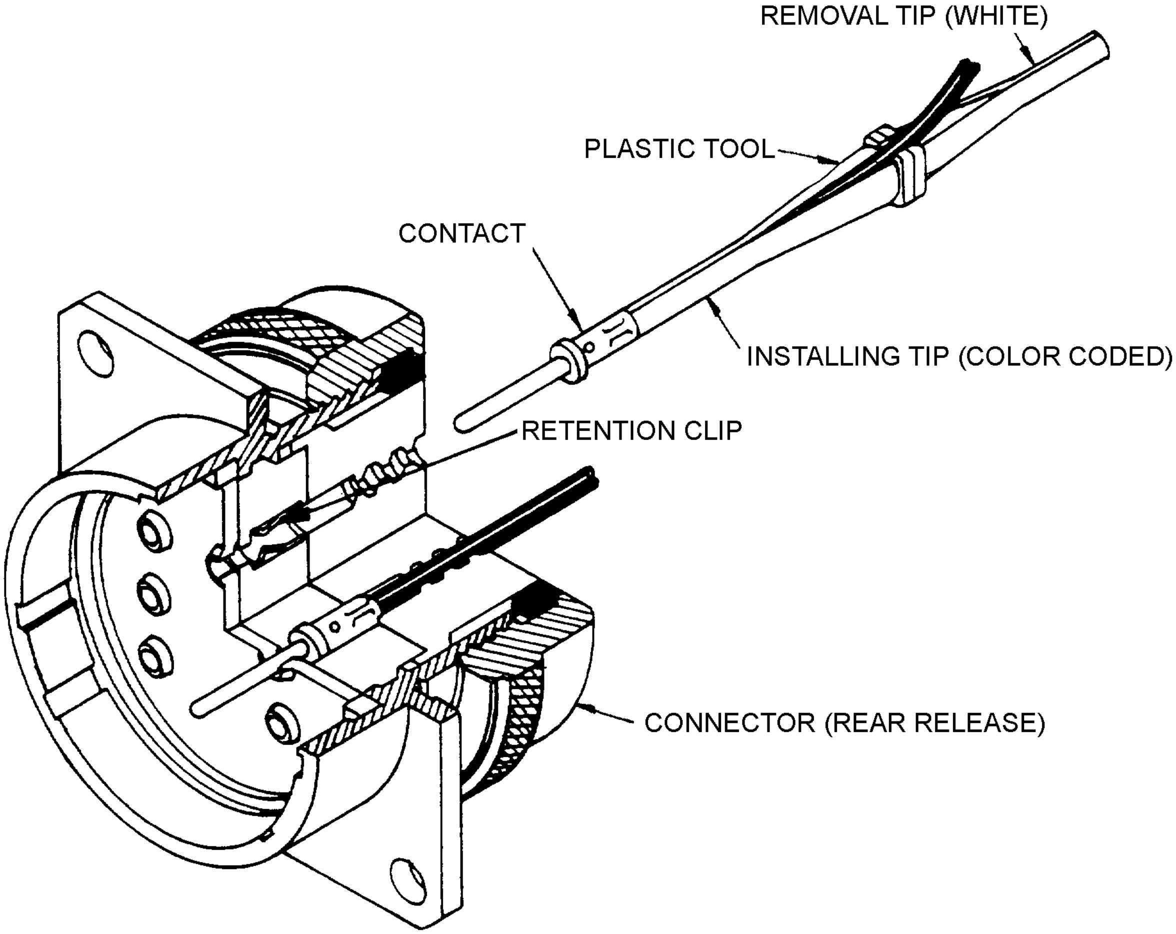


Figure 14. Typical Contact Locking Device (Retention Clip)

33. **Sealing Plug Selection.** Sealing plus are sized according to contact size (Table 2).

TABLE 2. SEALING PLUG SELECTION

Contact size	Sealing Plug Part Number	Color
22	MS27488-22	Black
20	MS27488-20	Red
6	MS27488-16	Blue
12	MS27488-12	Yellow
8	MS27488-8	Red
4	MS27488-4	Blue
0	MS27488-0	Yellow

34. **Installation of Sealing Plugs.** When installing sealing plus in connector cavities without contacts, the end opposite the knob shall be inserted first. and the knob shall be seated against the grommet face. When installing into cavities with contacts, the sealing plugs shall be installed knob end first and shall bottom on the contact wire barrel.

35. **CONTACTS.** Contacts are the pins or sockets within the insert and may be either fixed or removable, solder or crimp, The contacts terminate the wire within the connector.

36. **Solder Contacts.** Solder contacts are normally fixed, but some series connectors have removable solder contacts. The wire are terminated to the contact through a solder cup or barrel on the contact, with solder (WP 017 00).

37. **Crimp Contacts.** Crimp contacts are removable and utilize special tools to insert and remove the contacts.

The contacts are crimped to the wire using standard crimp tools and positioners (WP 009 00 and WP 013 00).

38. **Contact Availability.** Crimp contacts are supplied with each connector unit package and consist of a full complement plus one spare per size for connectors of 26 contacts or less. Connectors with more than 26 contacts will have two spares of each size used. Contacts may also be ordered in individual quantities when necessary.

39. CONNECTOR INSTALLATION.

40. **INSTALLATION GUIDELINES.** Connectors shall be used to join cables to cables, equipment. components, or other wires. The following installation guidelines shall be followed:

a. Adequate space shall be provided for mating and unmating connectors without the use of tools.

b. A minimum of 3/4 inch shall he provided around coupling rings on circular connectors.

c. Circular connectors installed with the axis horizontal shall have the large keyway located at the top.

d. Circular connectors installed with the axis vertical shall have the large keyway located to the front of the aircraft.

e. Locate connectors so as not to provide footrests, handholds, or in areas not to be damaged by cargo or stored materials.

f. Locate both plug and receptacles to be visible for engagements and orientation of polarizing keys.

g. Adequate strain relief shall he provided to prevent pulled wires.

h. Connectors in pressurized structures shall he installed preferably with the flange on the high pressure side.

i. Ground power receptacles shall be installed with the small contacts at the bottom.

41. **ADJACENT INSTALLATION.** The use of identical connectors in adjacent locations shall be avoided. In situations where the use of identical connectors is unavoidable, adhere to the following, guidelines:

a. Route and support wiring to prevent improper connections.

b. Where the same configurations are used, connectors shall be selected with different polarizations.

c. Color code plugs with a colored sleeve near the plug, and the receptacle color coded with a band on the structure.

42. **CONNECTOR DRAINAGE.** Receptacles shall be positioned that when unmated for maintenance, fluids and condensation will drain from the receptacles. External connectors, connectors in engine compartments, wheel wells, and other like locations shall be given special attention to protect them from the entry of oil, moisture, and other fluids. Connectors shall not be mounted in fluid collecting areas.

43. CONNECTOR MAINTENANCE.

44. Before proceeding with maintenance, repair or installation, become familiar with the following warnings, cautions and notes, as each of these are pertinent throughout this section.

WARNING

Assure all power is oil/disconnected prior to performing any wiring system repair.

If the connector has a backshell, it must be removed before maintenance procedures can proceed (WP 025 00).

Safety glasses shall be worn during all wire cutting and stripping operations.

Isopropyl alcohol is highly flammable. Use only with adequate ventilation. Avoid prolonged breathing of vapors.

Unwired contact cavities must have contact and sealing plugs installed.

Metal tool tips are sharp and can cause injury to personnel and/or damage to the connector.

Do not use heating tools with electric motors when working on or near aircraft that have not been defueled and purged, and certified gas-free in accordance with NAVAIR 01-1A-35. Use heating tool HT-900E/ HT-920B (WP 012 00).

Nozzle and output air of heating tools get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT-900B/HT920B heating tool in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

CAUTION

Be careful if using, metal M81969 tools. These tools can damage the wire sealing grommet in the connector if not used properly. Plastic tools are preferred when available.

Inspect tool tips for damage car distortion before each use. Damage to the connector wire sealing grommet can occur. Avoid using metal tooling, to remove and install backshells. These tools, can damage the backshell and connector. Non-metallic tools are designed to wear before damaging connector or backshell. (WP 025 00)

Do not remove a contact attached to a broken wire with an unwired contact removal tool. The connector and tool may be damaged.

Withdraw tool any time it cannot be advanced into connector. Inspect tool tip for nick, cracks, mushrooming and other damage that will prevent proper functioning Replace removal tool and repeat procedure if required.

45. **DETERMINATION OF PROPER INSTALLING AND REMOVAL TOOLS AND CONTACTS.** If the connector part number is an MS number, the basic connector specification and series can be determined from the connector example of part number (Figures 15 through 34). For Lockheed part numbers LS 10164, LS 10166, LS 10215, and LS 10216, see Figure 25; for part numbers LS 13533 and LS 13585, see Figure 22; and for part numbers LS 13572 and LS 13580, see Figure 28. Identity the connector shell size and insert arrangement using the appropriate example of part number in Figures 15 through 34. The contact size for each cavity can be determined by locating the shell size and insert arrangement in the appropriate connector's insert arrangement table or figure (Tables 3 through 20. or Figure 35 for MIL-C-81511 Series 3 and 4). Then Find the connector and series in Table 21, "MIL-C-39029 Contact Summary" under the column "Connector Used with (Specification)". Next, identify the "Military part number M 39029/" by finding the row with the appropriate connector series, contact style (pin or socket), and contact size (using either the "Power Contacts" or "Shielded contacts" columns). Once the contact part number is identified, the installing, removal, and crimping tools can be determined from the appropriate M39029 contact slash sheet. See paragraphs 85 through 143 for additional information regarding specific connector types and maintenance.

46. **WIRE DIAMETER BUILD-UP.** In cases where the outside diameter does not fill the grommet sealing holes, environmental resistance will be severely degraded. The wire diameter must be built up to provide proper sealing prior to contact insertion, by performing the following:

a. Select proper heat shrinkable insulation sleeving in accordance with MIL-I-23053.

b. Cut to length necessary to extend 1/4 inch beyond grommet.

c. Do not apply so as to cover crimp contact area.

d. Using proper reflector, apply heat using HT 900B/HT-920B to shrink sleeving.

e. Repeat above steps until diameter is built up to seal diameter.

47. **CONTACT INSTALLATION AND RELEASE.** Removable contacts, either solder or crimp, may be either front or rear release. Both systems result in the contact being inserted from the rear of the connector. Rear release connectors are required to have one or more blue color bands that are readily visible when the connectors are installed.

NOTE

Before attempting any insertion or removal of contacts from MIL-C-81511 Series 1 or 2 connectors, ensure that the rear nut assembly is in the unlocked position. A yellow colored stripe will appear when the rear nut assembly is rotated counterclockwise. At this point, the connector is in position for both insertion and removal of contacts.

48. FRONT RELEASE CONNECTORS.

CAUTION

Do not attempt to reseat a contact once the insertion tool has been removed. Remove the contact and start over with the contact wire barrel properly seated in the tool. Failure to follow this procedure may cause damage to the connector, contact or tool.

49. **INSERTION FRONT RELEASE.** For front release connectors. the contact. or wired contacts are inserted from the rear of the connector using the specified tool, until the contact seats (Figure 36 for individual contact retention systems, and Figure 37 for gang contact retention systems). An audible click may be heard when the contact is properly seated in an individual contact retention system.

50. **REMOVAL FRONT RELEASE.** To remove the contact or wired contacts. the tool is inserted into the front (mating face) of the connector to release the retaining clips and push the contact from the rear of the connector (Figure 38 for individual contact retention systems, and Figure 39 for gang retention systems).

51. REAR RELEASE CONNECTORS.

CAUTION

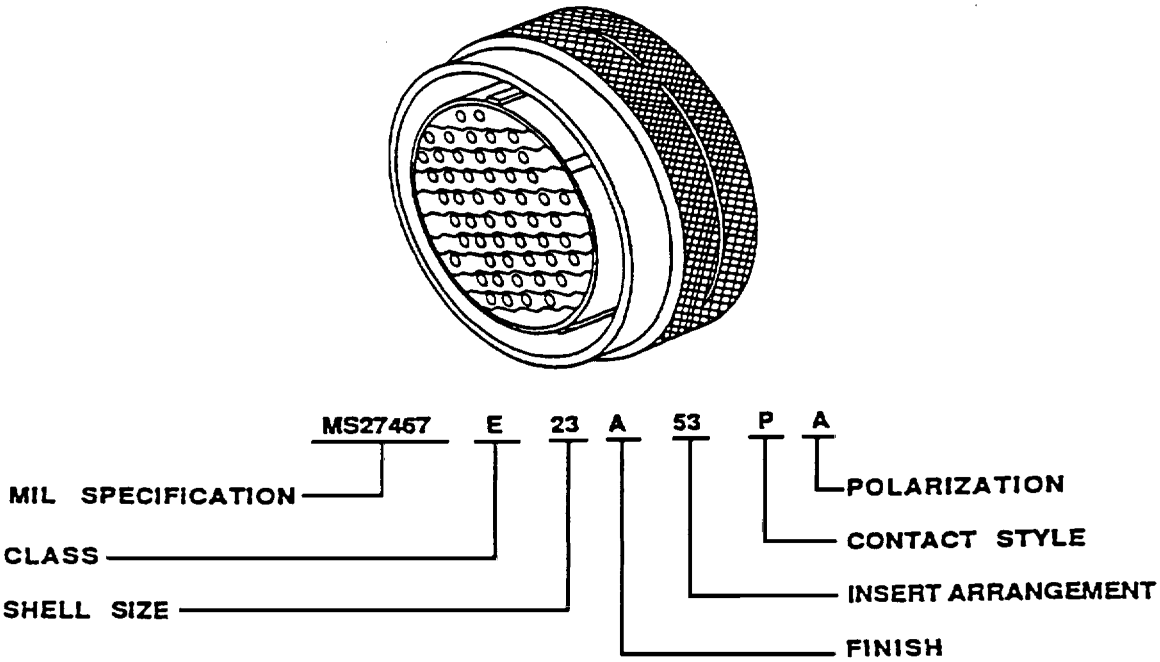
Do not attempt to reseat a contact once the insertion tool has been removed. Remove the contact and start over with the contact wire barrel properly seated in the tool. Failure to follow this procedure may cause damage to the connector, contact or tool.

52. **INSERTION REAR RELEASE.** For rear release connectors, the contacts or wired contacts are inserted, using the specified tool, from the rear of the connector until the contact seats (Figure 40). An audible click may be heard when the contact is properly seated.

53. **REMOVAL REAR RELEASE (WIRED).** Removal of wired contacts is accomplished by inserting the specified tool into tile rear of the connector to release tile retaining, clip. When released, tile wire and tool are Grasped together and pulled from the connector cavity with the contact intact (Figure 41).

54. **REMOVAL REAR RELEASE (UNWIRED).** Removal of unwired contacts is accomplished by inserting the specified tool into the rear of the connector until the plunger locates the end of the contact wire barrel. The tool body is then pushed in until the probe (plastic tip) grasps the contact wire barrel and releases the retaining clips. With the plunger retracted, the tool with the contact intact, is pulled from the connector (Figure 42).

55. **BROKEN WIRE CONTACT REMOVAL.** An unwired contact removal tool should not be used to remove a contact with a broken wire. Select the appropriate removal tool and follow the procedure outlined in Figure 43.



MS27466 WALL MOUNT RECEPTACLE
MS27467 STRAIGHT PLUG, EMI GROUNDING
MS27468 JAM NUT RECEPTACLE
MS27469 HERMETIC WALL MOUNT RECEPTACLE
MS27470 HERMETIC JAM NUT RECEPTACLE
MS27471 HERMETIC SOLDER MOUNT RECEPTACLE
MS27496 BOX MOUNT RECEPTACLE
MS27498 90° PLUG (NOTE 1)
MS27505 BOX MOUNT RECEPTACLE, REAR PANEL MOUNTING

MS27515 WALL MOUNT RECEPTACLE, REAR PANEL MOUNTING (NOTE 1)
MS27652 WALL MOUNT RECEPTACLE (NOTE 1)
MS27653 STRAIGHT PLUG, EMI GROUNDING (NOTE 1)
MS27654 WALL MOUNT RECEPTACLE, REAR PANEL MOUNTING (NOTE 1)
MS27656 WALL MOUNTING RECEPTACLE, REAR PANEL MOUNTING (NOTE 1)
MS27661 STRAIGHT PLUG, LANYARD RELEASE
MS27662 THRU-BULKHEAD RECEPTACLE

NOTE

1.

ACTIVE	SUPERSEDES
MS27467	MS27498
MS27656	MS27515
MS27466	MS27652
MS27467	MS27653
MS27656	MS27654

Figure 15. MIL-C-38999 Series 1 Connector Part Number Breakdown (Sheet 1 of 2)

02201501

CLASS
- E ENVIRONMENT RESISTING - BOX AND THRU-BULKHEAD MOUNTING TYPES ONLY (SEE CLASS T)
- P POTTING - INCLUDES POTTING FORM AND SHORT REAR GROMMET
- T ENVIRONMENT RESISTING - WALL AND JAM-NUT MOUNTING RECEPTACLE AND PLUG TYPES; THREAD AND TEETH FOR ACCESSORY ATTACHMENT
- Y HERMETICALLY SEALED

SHELL SIZE
9, 11, 13, 15, 17, 19, 21, 23, OR 24
(TABLE 2 AND FIGURE 4)

FINISH
- A SILVER TO LIGHT IRIDESCENT YELLOW COLOR CADMIUM PLATE OVER NICKEL (CONDUCTIVE), -65°C TO +150°C (INACTIVE FOR NEW DESIGN)
- B OLIVE DRAB CADMIUM PLATE SUITABLE UNDER PLATE (CONDUCTIVE), -65°C TO +175°C
- C ANODIC (NONCONDUCTIVE), -65°C TO +175°C
- D FUSED TIN, CARBON STEEL (CONDUCTIVE), -65°C TO +150°C

FINISH (CONT)
- E CORROSION RESISTANT STEEL (CRES) PASSIVATED (CONDUCTIVE), -65°C TO +200°C
- F ELECTROLESS NICKEL COATING (CONDUCTIVE), -65°C TO +200°C
- N HERMETIC SEAL OR ENVIRONMENT RESISTING CRES (CONDUCTIVE PLATING), -65°C TO +200°C

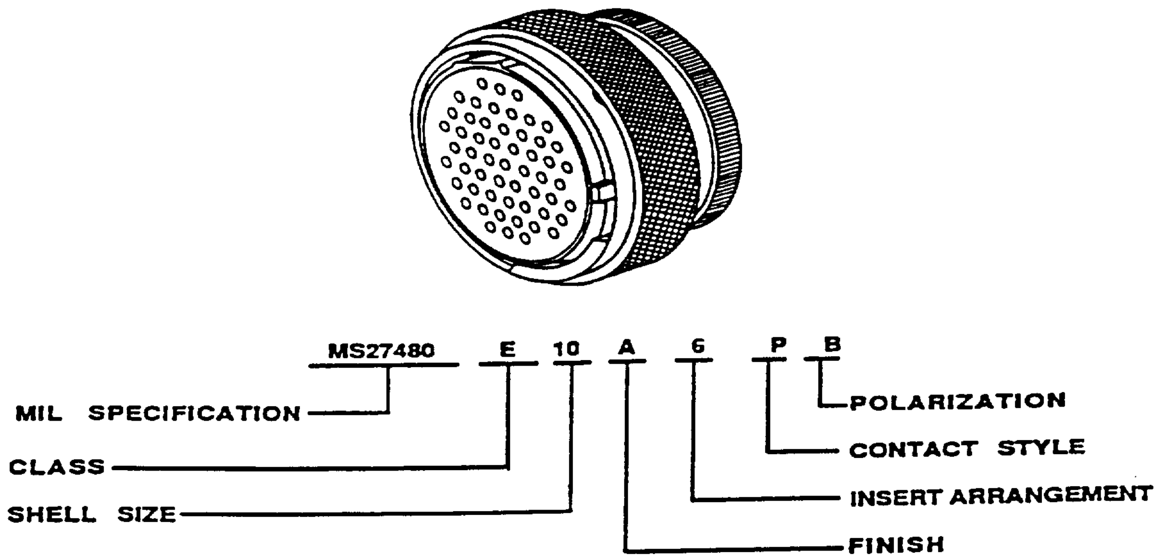
INSERT ARRANGEMENT
(TABLE 2 AND FIGURE 4)

CONTACT STYLE
- A WITHOUT PIN CONTACTS
- B WITHOUT SOCKET CONTACTS
- C FEEDTHROUGH
- P PIN CONTACTS - INCLUDING HERMETICS WITH SOLDER CUPS
- S SOCKET CONTACTS - INCLUDING HERMETICS WITH SOLDER CUPS
- X PIN CONTACTS WITH EYELET (HERMETIC)
- Z SOCKET CONTACTS WITH EYELET (HERMETIC)

POLARIZATION
- A, B, C, OR D NORMAL - NO LETTER REQUIRED

Figure 15. MIL-C-38999 Series 1 Connector Part Number Breakdown (Sheet 2)

02201502



MS27472 WALL MOUNT RECEPTACLE
MS27473 STRAIGHT PLUG
MS27474 JAM NUT RECEPTACLE
MS27475 HERMETIC WALL MOUNT RECEPTACLE
MS27476 HERMETIC BOX MOUNT RECEPTACLE
MS27477 HERMETIC JAM NUT RECEPTACLE
MS27478 HERMETIC SOLDER MOUNT RECEPTACLE
MS27479 WALL MOUNT RECEPTACLE (NOTE 1)
MS27480 STRAIGHT PLUG (NOTE 1)
MS27481 JAM NUT RECEPTACLE (NOTE 1)
MS27482 HERMETIC WALL MOUNT RECEPTACLE (NOTE 1)
MS27483 HERMETIC JAM NUT RECEPTACLE (NOTE 1)
MS27484 STRAIGHT PLUG, EMI GROUNDING
MS27497 WALL RECEPTACLE, BACK PANEL MOUNTING
MS27499 BOX MOUNTING RECEPTACLE
MS27500 90° PLUG (NOTE 1)
MS27503 HERMETIC SOLDER MOUNT RECEPTACLE (NOTE 1)
MS27504 BOX MOUNT RECEPTACLE (NOTE 1)
MS27508 BOX MOUNT RECEPTACLE, BACK PANEL MOUNTING
MS27513 BOX MOUNT RECEPTACLE, LONG GROMMET
MS27664 WALL MOUNT RECEPTACLE, BACK PANEL MOUNTING (NOTE 1)
MS27667 THRU-BULKHEAD RECEPTACLE

NOTE

1. ACTIVE	SUPERSEDES
MS27472	MS27479
MS27473	MS27480
MS27474	MS27481
MS27475	MS27482
MS27477	MS27483
MS27473 WITH MS27507 ELBOW	MS27500
MS27478	MS27503
MS27499	MS27504
MS27497	MS27664

Figure 16. MIL-C-38999 Series II Connector Part Number Breakdown (Sheet 1 of 2)

02201601

CLASS
E ENVIRONMENT RESISTING - BOX AND THRU - BULKHEAD MOUNTING TYPES ONLY (SEE CLASS T)
P POTTING - INCLUDES POTTING FORM AND SHORT REAR GROMMET
T ENVIRONMENT RESISTING - WALL AND JAM-NUT MOUNTING RECEPTACLE AND PLUG TYPES; THREAD AND TEETH FOR ACCESSORY ATTACHMENT
Y HERMETICALLY SEALED

SHELL SIZE
8, 10, 12, 14, 16, 18, 20, 22, OR 24
(TABLE 13 AND FIGURE 32)

FINISH
A SILVER TO LIGHT IRIDESCENT YELLOW COLOR CADMIUM PLATE OVER NICKEL (CONDUCTIVE), -65°C TO +150°C (INACTIVE FOR NEW DESIGN)
B OLIVE DRAB CADMIUM PLATE OVER SUITABLE UNDERPLATE (CONDUCTIVE), -65°C TO +175°C
C ANODIC (NONCONDUCTIVE), -65°C TO +175°C
D FUSED TIN, CARBON STEEL (CONDUCTIVE), -65°C TO +150°C

FINISH (CONT)
E CORROSION RESISTANT STEEL (CRES), PASSIVATED (CONDUCTIVE), -65°C TO +200°C
F ELECTROLESS NICKEL COATING (CONDUCTIVE), -65°C TO +200°C
N HERMETIC SEAL OR ENVIRONMENT RESISTING CRES (CONDUCTIVE PLATING), -65°C TO +200°C

INSERT ARRANGEMENT
(TABLE 13 AND FIGURE 32)

CONTACT STYLE
A WITHOUT PIN CONTACTS
B WITHOUT SOCKET CONTACTS
C FEEDTHROUGH
P PIN CONTACTS -INCLUDING HERMETICS WITH SOLDER CUPS
S SOCKET CONTACTS - INCLUDING HERMETICS WITH SOLDER CUPS
X PIN CONTACTS WITH EYELET (HERMETIC)
Z SOCKET CONTACTS WITH EYELET (HERMETIC)

POLARIZATION
A, B, C, OR D NORMAL - NO LETTER REQUIRED

Figure 16. MIL-C-38999 Series II Connector Part Number Breakdown (Sheet 2)

02201602

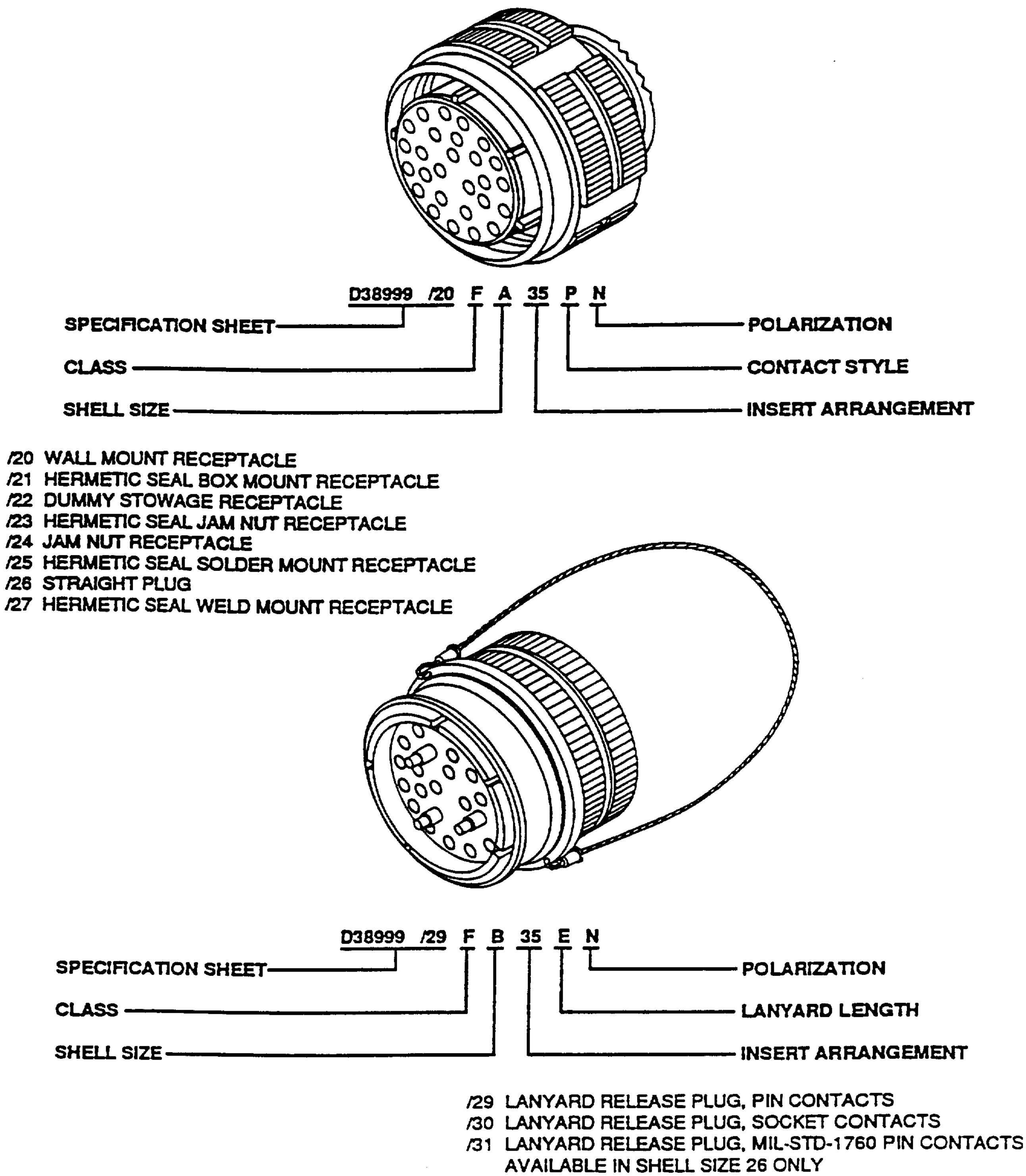


Figure 17. MIL-C-38999 Series III Connector Part Number Breakdown (Sheet 1 of 2)

02201701

CLASS

C ENVIRONMENT RESISTING, ANODIC PLATING (NONCONDUCTIVE), -65°C TO +200°C
F ENVIRONMENT RESISTING, ELECTROLESS NICKEL COATING (CONDUCTIVE), -65°C TO +200°C
K ENVIRONMENT RESISTING, FIREWALL, CRES, PASSIVATED (CONDUCTIVE), -65°C TO +200°C
N HERMETICALLY SEALED, CRES WITH ELECTRO-DEPOSITED NICKEL PLATING (CONDUCTIVE), -65°C TO +200°C
S ENVIRONMENT RESISTING, FIREWALL, CRES WITH ELECTRODEPOSITED NICKEL PLATING (CONDUCTIVE), -65°C TO +200°C
W ENVIRONMENT RESISTING, CORROSION RESISTANT OLIVE DRAB CADMIUM PLATE OVER SUITABLE UNDERPLATE (CONDUCTIVE), -65°C TO +175°C
Y HERMETICALLY SEALED, CRES, PASSIVATED (CONDUCTIVE), -65°C TO +200°C

SHELL SIZE

CODE LETTER	B	C	D	E	F	G	H	J
SHELL SIZE	11	13	15	17	19	21	23	25

D38999/31-J ONLY
(TABLE 19 AND FIGURE 37)

INSERT ARRANGEMENT

D38999/31-J11 AND J20 ONLY
(TABLE 19 AND FIGURE 37)

CONTACT STYLE

A WITHOUT PIN CONTACTS
B WITHOUT SOCKET CONTACTS
C FEEDTHROUGH
P PIN CONTACTS-INCLUDING HERMETICS WITH SOLDER CUPS
S SOCKET CONTACTS-INCLUDING HERMETICS WITH SOLDER CUPS
X PIN CONTACTS WITH EYELET (HERMETIC)
Z SOCKET CONTACTS WITH EYELET (HERMETIC)

LANYARD LENGTH

CODE	MM ±6	INCHES
A	102	4.016
B	115	4.528
C	127	5.000
D	140	5.512
E	153	6.024
F	166	6.535
G	178	7.008
H	191	7.520
I	203	7.992
J	216	8.503
K	229	9.016
L	242	9.528

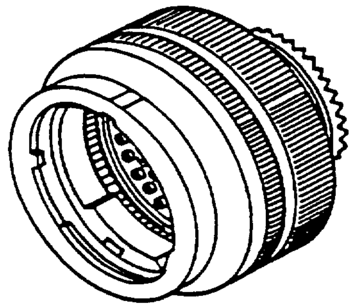
CODE	MM ±6	INCHES
M	254	10.000
N	267	10.512
P	280	11.024
R	293	11.535
S	305	12.008
T	318	12.520
U	331	13.031
V	356	14.016
W	381	15.000
X	407	16.024
Y	432	17.008
Z	458	18.031

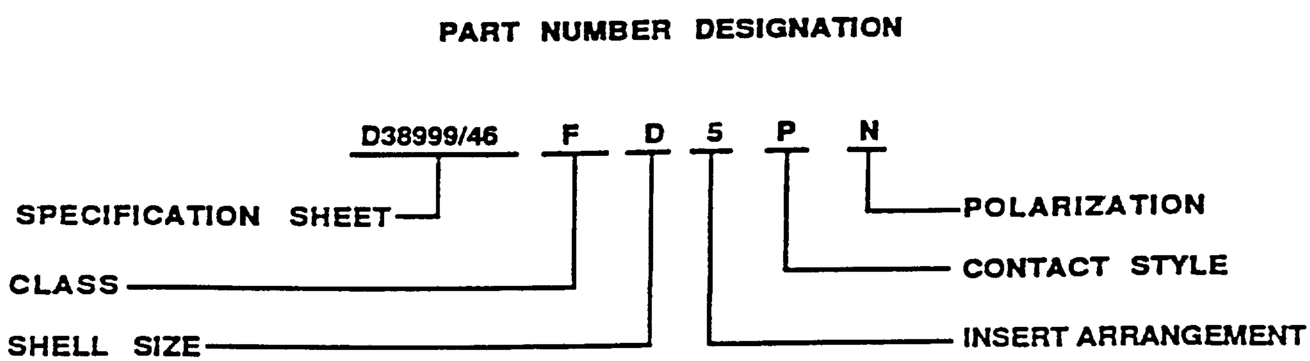
POLARIZATION

N, A, B, C, OR D

Figure 17. MIL-C-38999 Series III Connector Part Number Breakdown (Sheet 2)

02201702





/40 WALL MOUNT RECEPTACLE
/41 HERMETIC BOX MOUNT RECEPTACLE
/42 BOX MOUNT RECEPTACLE
/43 HERMETIC JAM NUT RECEPTACLE
/44 JAM NUT RECEPTACLE
/45 HERMETIC SOLDER MOUNT RECEPTACLE
/46 EMI STRAIGHT PLUG
/47 STRAIGHT PLUG
/48 HERMETIC WELD MOUNT RECEPTACLE
/49 IN-LINE RECEPTACLE
/50 DUMMY STOWAGE RECEPTACLE

Figure 18. MIL-C-38999 Series 1V Connector Part Number Breakdown (Sheet 1 of 2)

02201801

CLASS
C ENVIRONMENT RESISTING, ANODIC PLATING (NONCONDUCTIVE), -65°C TO +200°C
F ENVIRONMENT RESISTING, ELECTROLESS NICKEL COATING (CONDUCTIVE), -65°C TO +200°C
K ENVIRONMENT RESISTING, FIREWALL, CRES, PASSIVATED (CONDUCTIVE), -65°C TO +200°C
N HERMETICALLY SEALED, CRES WITH ELECTRODEPOSITED NICKEL PLATING (CONDUCTIVE), -65°C TO +200°C
S ENVIRONMENT RESISTING, FIREWALL, CRES WITH ELECTRODEPOSITED NICKEL PLATING (CONDUCTIVE), -65°C TO +200°C
W ENVIRONMENT RESISTING, CORROSION RESISTANT OLIVE DRAB CADMIUM PLATE OVER SUITABLE UNDERPLATE (CONDUCTIVE), -65°C TO +175°C
Y HERMETICALLY SEALED, CRES, PASSIVATED (CONDUCTIVE), -65°C TO +200°C

SHELL SIZE

CODE LETTER	B	C	D	E	F	G	H	J
SHELL SIZE	11	13	15	17	19	21	23	25

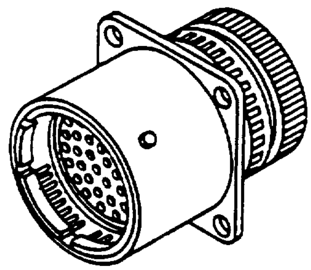
INSERT ARRANGEMENT
(TABLE 30 AND FIGURE 47)

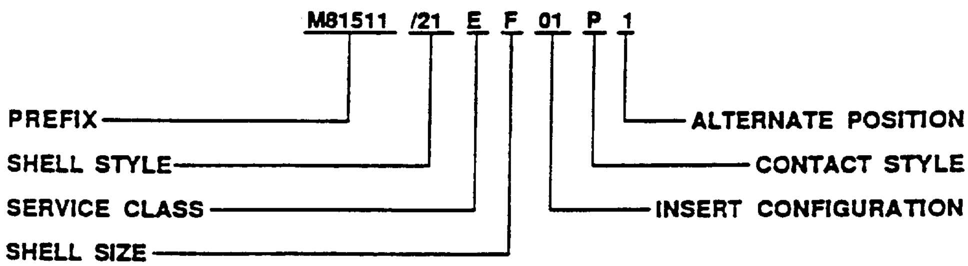
CONTACT STYLE
A WITHOUT PIN CONTACTS
B WITHOUT SOCKET CONTACTS
C FEEDTHROUGH
P PIN CONTACTS-INCLUDING HERMETICS WITH SOLDER CUPS
S SOCKET CONTACTS-INCLUDING HERMETICS WITH SOLDER CUPS
X PIN CONTACTS WITH EYELET (HERMETIC)
Z SOCKET CONTACTS WITH EYELET (HERMETIC)

POLARIZATION
N, A, B, C, OR D

Figure 18. MIL-C-38999 Series 1V Connector Part Number Breakdown (Sheet 2)

02201802





SHELL STYLE

/21	WALL MOUNT RECEPTACLE
/22	HERMETIC SEAL SOLDER MOUNT RECEPTACLE
/23	JAM NUT RECEPTACLE
/24	HERMETIC SEAL JAM NUT RECEPTACLE
/25	IN-LINE RECEPTACLE
/26	STRAIGHT PLUG
/27	HERMETIC SEAL JAM NUT RECEPTACLE, BULKHEAD FEEDTHRU CONTACTS
/35	WALL MOUNT RECEPTACLE, POTTING SEAL
/36	JAM NUT RECEPTACLE, POTTING SEAL
/37	IN-LINE RECEPTACLE, POTTING SEAL
/38	STRAIGHT PLUG, POTTING SEAL

SERVICE CLASS

302°F	(150°C) OPERATING TEMPERATURE
E	GROMMET SEAL
H	HERMETIC SEAL
P	POTTING SEAL
347°F	(175°C) OPERATING TEMPERATURE
F	GROMMET SEAL
G	HERMETIC SEAL
T	POTTING SEAL
392°F	(200°C) OPERATING TEMPERATURE
A	GROMMET SEAL
B	HERMETIC SEAL
C	POTTING SEAL

SHELL SIZE

CODE LETTER	A	B	D	E	F	G	H	J
SHELL SIZE	8	10	14	16	18	20	22	24

INSERT CONFIGURATION

(TABLE 1 AND FIGURE 5)

CONTACT STYLE

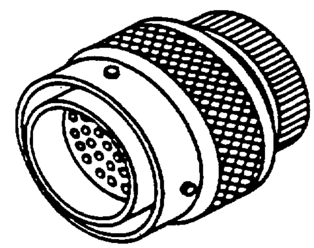
A	WITHOUT PIN CONTACTS
B	WITHOUT SOCKET CONTACTS
C	FEEDTHRU CONTACTS
P	PIN CONTACTS
S	SOCKET CONTACTS

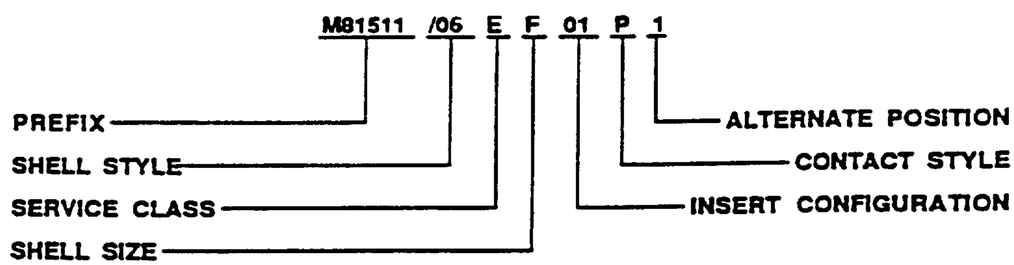
ALTERNATE POSITION

1, 2, 3, 4, 5, OR 6

Figure 19. MIL-C-8151 I Series 1 Part Number Breakdown

022019





SHELL STYLE

/01	WALL MOUNT RECEPTACLE
/02	HERMETIC SEAL SOLDER MOUNT RECEPTACLE
/03	JAM NUT RECEPTACLE
/04	HERMETIC SEAL JAM NUT RECEPTACLE
/05	IN-LINE RECEPTACLE
/06	STRAIGHT PLUG
/28	HERMETIC SEAL JAM NUT RECEPTACLE, BULKHEAD FEEDTHRU CONTACTS
/31	WALL MOUNT RECEPTACLE, POTTING SEAL
/32	JAM NUT RECEPTACLE, POTTING SEAL
/33	IN-LINE RECEPTACLE, POTTING SEAL
/34	STRAIGHT PLUG, POTTING SEAL

SERVICE CLASS

302°F	(150°C) OPERATING TEMPERATURE
E	GROMMET SEAL
H	HERMETIC SEAL
P	POTTING SEAL
347°F	(175°C) OPERATING TEMPERATURE
F	GROMMET SEAL
G	HERMETIC SEAL
T	POTTING SEAL
392°F	(200°C) OPERATING TEMPERATURE
A	GROMMET SEAL
B	HERMETIC SEAL
C	POTTING SEAL

SHELL SIZE

CODE LETTER	A	B	D	E	F
SHELL SIZE	8	10	14	16	18

INSERT CONFIGURATION

(TABLE 7 AND FIGURE 12)

CONTACT STYLE

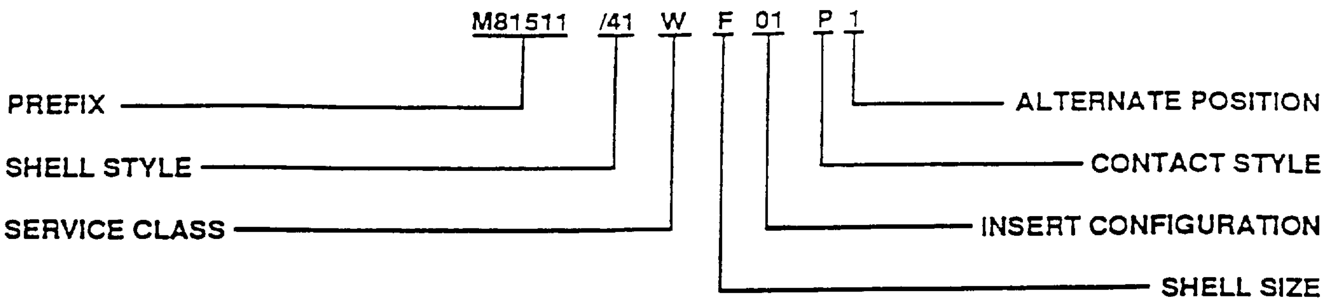
A	WITHOUT PIN CONTACTS
B	WITHOUT SOCKET CONTACTS
C	FEEDTHRU CONTACTS
P	PIN CONTACTS
S	SOCKET CONTACTS

ALTERNATE POSITION

1, 2, 3, 4, 5, OR 6

Figure 20. MIL-C-8151 1 Series 2 Part Number Breakdown

022020



SHELL STYLE
SERIES 3-LONG SHELL (100% SCOOP PROOF)
/41 WALL MOUNT RECEPTACLE
/42 HERMETIC SEAL SOLDER MOUNT RECEPTACLE (CLASS D)
/44 HERMETIC SEAL JAM NUT RECEPTACLE (CLASS D)
/45 IN-LINE RECEPTACLE
/46 STRAIGHT PLUG
/47 HERMETIC SEAL SOLDER MOUNT RECEPTACLE (CLASS L)
/48 HERMETIC SEAL JAM NUT RECEPTACLE (CLASS L)
/49 JAM NUT RECEPTACLE

SERIES 4-SHORT SHELL (50% SCOOP PROOF)
/50 HERMETIC SEAL JAM NUT RECEPTACLE (CLASS L)
/51 WALL MOUNT RECEPTACLE
/52 HERMETIC SEAL SOLDER MOUNT RECEPTACLE (CLASS D)
/53 JAM NUT RECEPTACLE
/54 HERMETIC SEAL JAM NUT RECEPTACLE (CLASS D)
/55 IN-LINE RECEPTACLE
/56 STRAIGHT PLUG
/57 HERMETIC SEAL SOLDER MOUNT RECEPTACLE (CLASS L)

SERVICE CLASS
347°F (175°C) OPERATING TEMPERATURE
F GROMMET SEAL, FLUID RESISTANT
D HERMETIC SEAL, SOLDER CONTACTS
L HERMETIC SEAL, CRIMP CONTACTS
W CADMIUM PLATE
392°F (200°C) OPERATING TEMPERATURE
A GROMMET SEAL, FLUID RESISTANT

SHELL SIZE

CODE LETTER	A	B	D	E	F	G	H	J
SHELL SIZE	8	10	14	16	18	20	22	24

INSERT CONFIGURATION
(FIGURE 6)

CONTACT STYLE

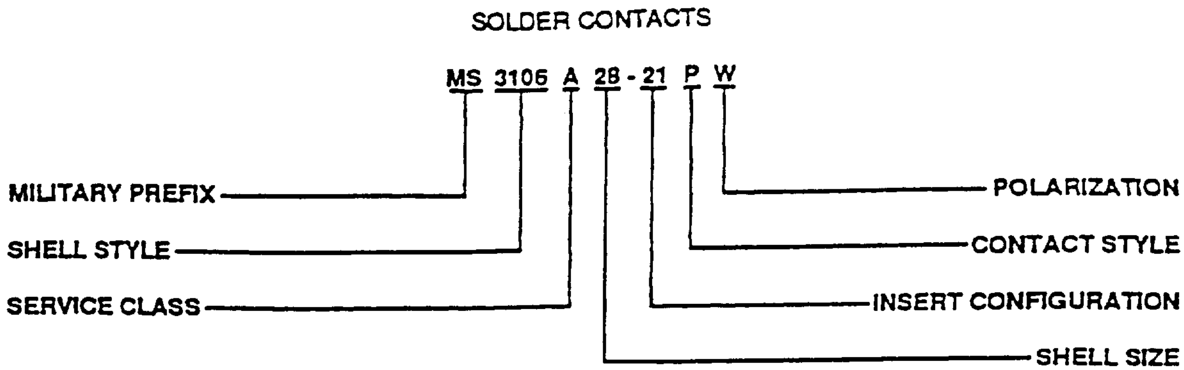
P PIN CONTACTS (MALE)
S SOCKET CONTACTS (FEMALE)
A LESS PIN CONTACTS
B LESS SOCKET CONTACTS

ALTERNATE POSITION

1, 2, 3, 4, 5, OR 6 (FIGURE 4)

Figure 21. MIL-C-8151 l Series 3 and 4 Part Number Breakdown

022021



MILITARY PREFIX

AN	OBSOLETE FOR CURRENT USE.
MS	MILITARY STANDARD.

SHELL STYLE

3100	WALL MOUNT RECEPTACLE.
3101	IN-LINE RECEPTACLE.
3102	BOX MOUNT RECEPTACLE.
3103	WALL MOUNT RECEPTACLE, POTTING SEAL.
3106	STRAIGHT PLUG.
3107	QUICK DISCONNECT PLUG.
3108	90° ANGLE PLUG.
3142	BOX MOUNT RECEPTACLE, HERMETIC SEAL.
3143	SOLDER MOUNT RECEPTACLE, HERMETIC SEAL.
3436	STRAIGHT PLUG.
3507	QUICK DISCONNECT PLUG.
25183	STRAIGHT PLUG, POTTING SEAL.
25183A	STRAIGHT PLUG, POTTING SEAL; WITH GROUND LUG.

SERVICE CLASS

A	SOLID SHELL, NON-ENVIRONMENTAL.
B	SPLIT SHELL, NON-ENVIRONMENTAL.
C	PRESSURIZED.
E	ENVIRONMENTAL. SUPERSEDED BY F.
F	R TYPE WITH STRAIN RELIEF.
H	HERMETIC.
K	FIRE WALL.
M	REPLACED BY E.
PR	REPLACED BY C.
R	ENVIRONMENTAL WITH O RING UNDER COUPLING NUT.

SHELL SIZE
(TABLE 1)

INSERT CONFIGURATION
(FIGURE 7)

CONTACT STYLE

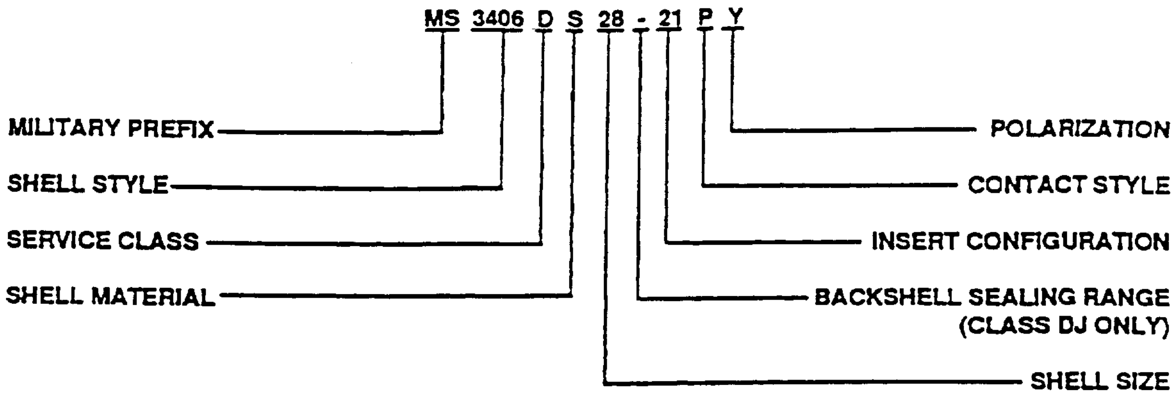
P	PIN CONTACTS.
S	SOCKET CONTACTS.

ALTERNATE POSITION (POLARIZATION)
BLANK (NORMAL) W, X, Y OR Z (FIGURE 3)

Figure 22. MIL-C-5015 and Lockheed LS13583 and LS13585 Part Number Breakdown and Cross Reference
(Sheet 1 of 5)

02202201

CRIMP FRONT RELEASE CONTACTS



SHELL STYLE

3400	WALL MOUNT RECEPTACLE.
3401	IN-LINE RECEPTACLE.
3402	BOX MOUNT RECEPTACLE.
3404	JAM NUT RECEPTACLE.
3406	STRAIGHT PLUG.
3408	90° PLUG.
3409	45° PLUG.
3412	BOX MOUNT RECEPTACLE WITH THREADED REAR SKIRT.

SERVICE CLASS

D	HIGH IMPACT SHOCK, 345°F (175°C).
DJ	HIGH IMPACT SHOCK, CABLE SEALING GLAND, 345°F (175°C).
K	FIREWALL SEAL, 345°F (175°C).
L	FLUID RESISTANT, 392°F (200°C).

SHELL MATERIAL

BLANK	ALUMINUM.
S	STAINLESS STEEL.
T	FERROUS ALLOY, CLASS K ONLY.

SHELL SIZE
(TABLE 1)

BACKSHELL SEALING RANGE
(CLASS DJ ONLY)
A, B, D, E, F, G OR H. WP (055 00)

INSERT CONFIGURATION
(FIGURE 7)

CONTACT STYLE

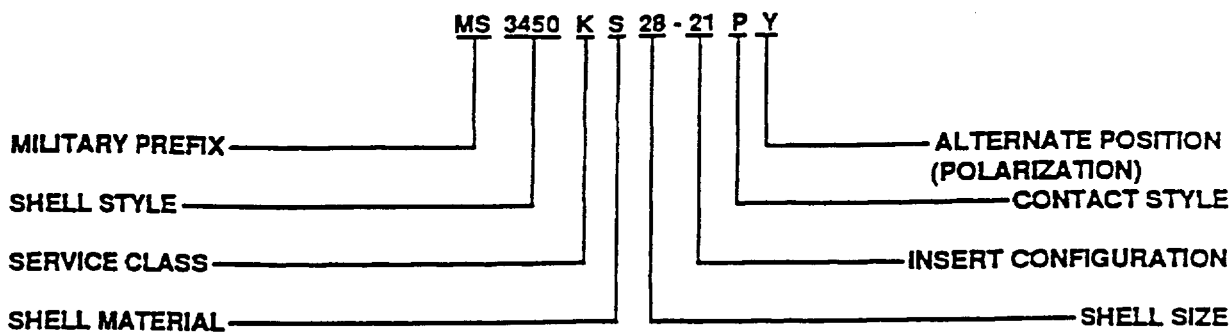
D	16-22 PIN CONTACTS IN LIEU OF 16-16 OR 12-16 PIN CONTACTS IN LIEU OF 12-12. CLASS D CONNECTORS ONLY.
E	16-22 SOCKET CONTACTS IN LIEU OF 16-16 OR 12-16 SOCKET CONTACTS IN LIEU OF 12-12. CLASS D CONNECTORS ONLY.
P	PIN CONTACTS
S	SOCKET CONTACTS

ALTERNATE POSITION (POLARIZATION)
BLANK (NORMAL) W, X, Y OR Z (FIGURE 3)

Figure 22. MIL-C-5015 and Lockheed LS13583 and LS13585 Part Number Breakdown and Cross Reference (Sheet 2)

02202202

CRIMP REAR RELEASE CONTACTS



SHELL STYLE

MS3450	WALL MOUNT RECEPTACLE.
MS3451	IN-LINE RECEPTACLE.
MS3452	BOX MOUNT RECEPTACLE.
MS3454	JAM NUT RECEPTACLE.
MS3456	STRAIGHT PLUG.
MS3459	STRAIGHT PLUG, SELF-LOCKING COUPLING NUT.

SERVICE CLASS

K	FIREWALL, FLUID RESISTANT, 345°F (175°C).
L	FLUID RESISTANT, 392°F (200°C).
U	HIGH TEMPERATURE, 392°F (200°C).
W	GENERAL PURPOSE, 345°F (175°C).

SHELL MATERIAL

BLANK	ALUMINUM.
S	STAINLESS STEEL.
T	FERROUS ALLOY. CLASS K ONLY.

SHELL SIZE
(TABLE 1)

INSERT CONFIGURATION
(FIGURE 7)

CONTACT STYLE

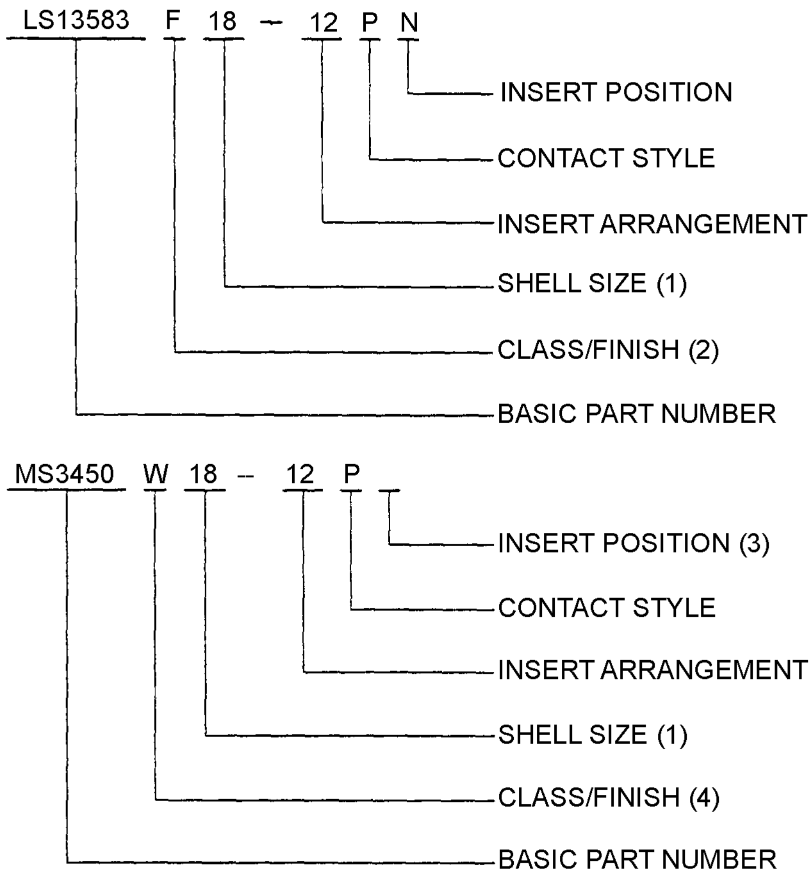
P	PIN CONTACTS.
S	SOCKET CONTACTS.

ALTERNATE POSITION (POLARIZATION)
BLANK (NORMAL) W, X, Y OR Z (FIGURE 3)

Figure 22. MIL-C-5015 and Lockheed LS13583 and LS13585 Part Number Breakdown and Cross Reference (Sheet 3)

02202203

LS13583 RECEPTACLE CROSSES TO MS3450 AS FOLLOWS:



(1) SHELL SIZE 8 CROSSES TO 8S
SHELL SIZE 10 CROSSES TO 10S
SHELL SIZE 11 CROSSES TO 10SL
SHELL SIZE 13 CROSSES TO 12S
SHELL SIZE 15 CROSSES TO 14S
SHELL SIZE 17 CROSSES TO 16S

(2) F = FLUID RESISTANT, ELECTROLESS NICKEL. CROSS TO W
R = ENVIRONMENTAL RESISTANT, ANODIZE. CROSS TO W

(3) NOT REQUIRED IF POSITION IS **N**

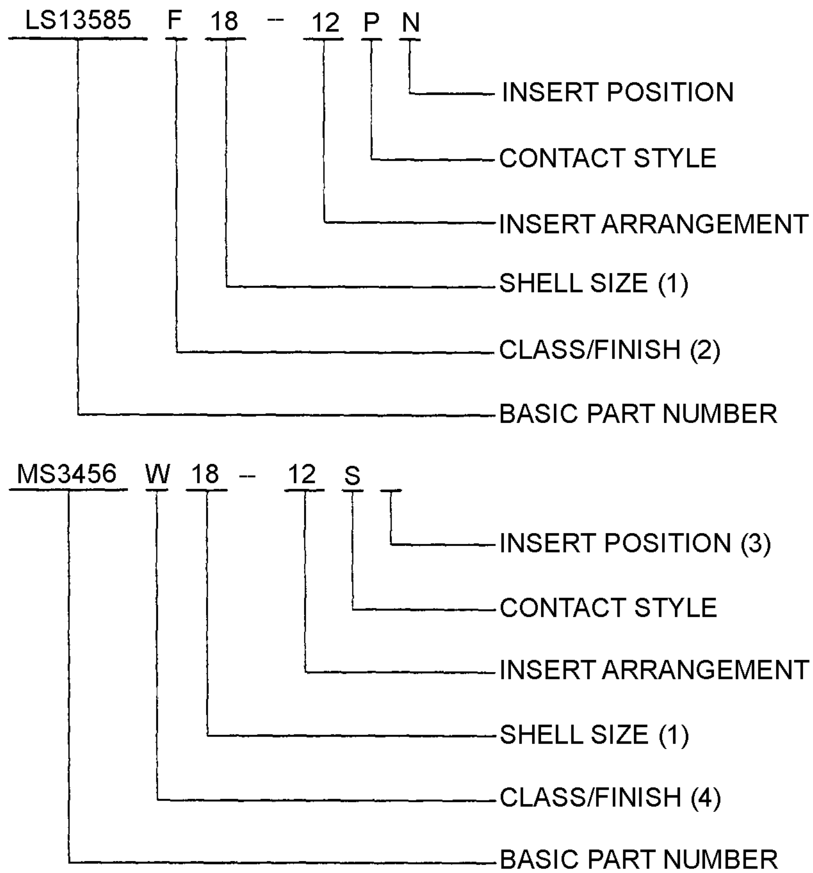
(4) L = ELECTROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM
ANODIZE FINISH NOT AVAILABLE. USE W

EXAMPLES: LS13583F15-5SN CROSSES TO MS3450W14S-5S
LS13583F18-12PX CROSSES TO MS3450W18-12PX

Figure 22. MIL-C-5015 and Lockheed LS13583 and LS13585 Part Number Breakdown and Cross Reference (Sheet 4)

02202204

LS13583 RECEPTACLE CROSSES TO MS3450 AS FOLLOWS:



(1) SHELL SIZE 8 CROSSES TO 8S
SHELL SIZE 10 CROSSES TO 10S
SHELL SIZE 11 CROSSES TO 10SL
SHELL SIZE 13 CROSSES TO 12S
SHELL SIZE 15 CROSSES TO 14S
SHELL SIZE 17 CROSSES TO 16S

(2) F = FLUID RESISTANT, ELECTROLESS NICKEL. CROSS TO W
R = ENVIRONMENTAL RESISTANT, ANODIZE. CROSS TO W

(3) NOT REQUIRED IF POSITION IS **N**

(4) L = ELECTROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM
ANODIZE FINISH NOT AVAILABLE. USE W

EXAMPLES: LS13583F15-5PN CROSSES TO MS3456W14S-5P
LS13583F18-12SX CROSSES TO MS3456W18-12SX

Figure 22. MIL-C-5015 and Lockheed LS13583 and LS13585 Part Number Breakdown and Cross Reference (Sheet 5)

02202205

M83723/01 R 22 10 N

MILITARY SPECIFICATION SHEET — M83723/01
CLASS — R
SHELL SIZE — 22
INSERT CONFIGURATION — 10
ALTERNATE POSITION (POLARIZATION) — N

MILITARY SPECIFICATIONS SHEET

CONTACT STYLE*		CLASS	SHELL STYLE	SUPERSESSION DATA
PIN	SOCKET			
M83723/02	M83723/01	A, G, R	NARROW FLANGE WALL MOUNT RECEP-TACLE	SUPERSEDED BY MS3470
M83723/04	M83723/03	A, G, R	WIDE FLANGE WALL MOUNT RECEPTACLE	SUPERSEDED BY MS3472
M83723/06	M83723/05	A, G, R	JAM NUT RECEPTACLE	SUPERSEDED BY MS3474
M83723/08	M83723/07	A, G, R	IN-LINE RECEPTACLE	SUPERSEDED BY MS3471
M83723/09	—	H	HERMETIC NARROW FLANGE BOX MOUNT RECEPTACLE	SUPERSEDED BY MS3440
M83723/10	—	H	HERMETIC WIDE FLANGE BOX MOUNT RECEPTACLE	SUPERSEDED BY MS3442
M83723/11	—	H	HERMETIC SOLDER MOUNT RECEPTACLE	SUPERSEDED BY MS3443
M83723/12	—	H	HERMETIC JAM NUT RECEPTACLE	SUPERSEDED BY MS3449
M83723/14	M83723/13	A, G, R	STRAIGHT PLUG	SUPERSEDED BY MS3476
M83723/36	M83723/37	A, G, R	PREWIRED SIZE 8 STRAIGHT PLUG	NO SUPERSEDING DOCUMENT
M83723/38	M83723/39	A, G, R	PREWIRED SIZE 8 NARROW FLANGE WALL MOUNT RECEPTACLE	NO SUPERSEDING DOCUMENT
M83723/40	M83723/41	A, G, R	PREWIRED SIZE 8 WIDE FLANGE WALL MOUNT RECEPTACLE	NO SUPERSEDING DOCUMENT
M83723/42	M83723/43	A, G, R	STRAIGHT PLUG, RFI GROUNDING	SUPERSEDED BY MS3475
M83723/48	M83723/49	A, G, R	PREWIRED SIZE 8 STRAIGHT PLUG, RFI GROUNDING	NO SUPERSEDING DOCUMENT

* CONTACTS FOR CLASS G AND R CONNECTORS ARE CRIMP, REAR RELEASE; CONTACTS FOR CLASS H CONNECTORS ARE NON-REMOVABLE, SOLDER POT TERMINATIONS.

CLASS
A ANODIZED ALUMINUM, NON-CONDUCTIVE.
G STAINLESS STEEL, PASSIVATED, 392°F (200°C) FLUID RESISTANT.
H STEEL, FUSED TIN, 302°F (150°C) HERMETIC SEAL.
R ALUMINUM, ELECTROLESS NICKEL, 392°F (200°C) FLUID RESISTANT.

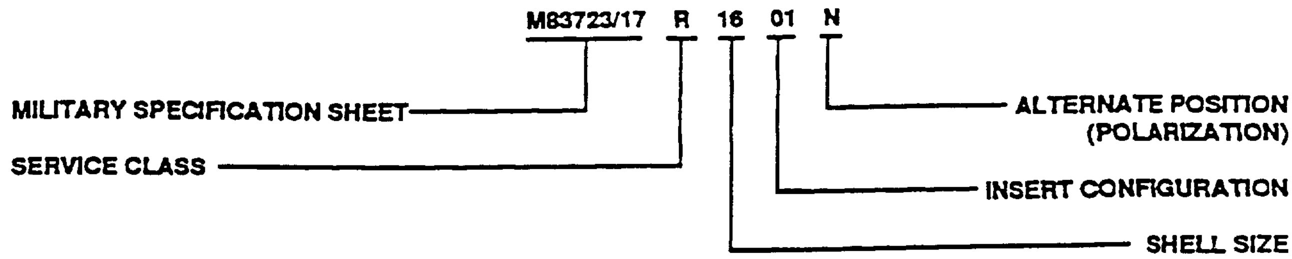
SHELL SIZE
SEE TABLE 2 FOR AVAILABLE SHELL SIZES.

INSERT CONFIGURATION
SEE FIGURE 6.

ALTERNATE POSITION (POLARIZATION)
N NORMAL
W, X, Y & Z INDICATE ROTATION OF INSERT FROM NORMAL POSITION. SEE FIGURE 3.

Figure 23. MIL-C-83723 Series I Part Number Breakdown

022023



MILITARY SPECIFICATION SHEET

M83723/17	IN-LINE RECEPTACLE, SOCKET CONTACTS.
M83723/18	IN-LINE RECEPTACLE, PIN CONTACTS.
M83723/19	WALL MOUNT RECEPTACLE, SOCKET CONTACTS.
M83723/20	WALL MOUNT RECEPTACLE, PIN CONTACTS.
M83723/21	BOX MOUNT RECEPTACLE, SOCKET CONTACTS.
M83723/22	BOX MOUNT RECEPTACLE, PIN CONTACTS.
M83723/23	STRAIGHT PLUG, SOCKET CONTACTS.
M83723/24	STRAIGHT PLUG, PIN CONTACTS.
M83723/25	BOX MOUNT HERMETIC RECEPTACLE, PIN CONTACTS.
M83723/26	SOLDER MOUNT HERMETIC RECEPTACLE, PIN CONTACTS.
M83723/52	STRAIGHT PLUG, SELF-LOCKING COUPLING NUT, PIN CONTACTS.
M83723/53	STRAIGHT PLUG, SELF-LOCKING COUPLING NUT, SOCKET CONTACTS

SERVICE CLASS

A	ALUMINUM, NON-CONDUCTIVE ANODIZE, 392°F (200°C).
F	CANCELLED, SUPERSEDED BY CLASS R.
G	STAINLESS STEEL, PASSIVATED, 392°F (200°C) FLUID RESISTANT.
H	STEEL, FUSED TIN, 302°F (150°C) HERMETIC SEAL.
K	STAINLESS STEEL, PASSIVATED, 392°F (200°C) FLUID RESISTANT FIREWALL.
R	ALUMINUM, ELECTROLESS NICKEL, 392°F (200°C) FLUID RESISTANT.
Y	STAINLESS STEEL, PASSIVATED, 392°F (200°C) HERMETIC SEAL.

SHELL SIZE

M83723 CONNECTOR SERIES SHELL SIZES.

M83723	M83723
08	18
10	20
11	22
12	24
13	28
14	32
15	36
16	40
17	

INSERT ARRANGEMENT

WHEN A SINGLE DIGIT NUMBER IS USED, IT IS PRECEEDED BY THE NUMERAL '0'. EXAMPLE: INSERT NO. 1 WOULD BE WRITTEN AS 01. SEE FIGURE 6 FOR ILLUSTRATIONS AND CODES.

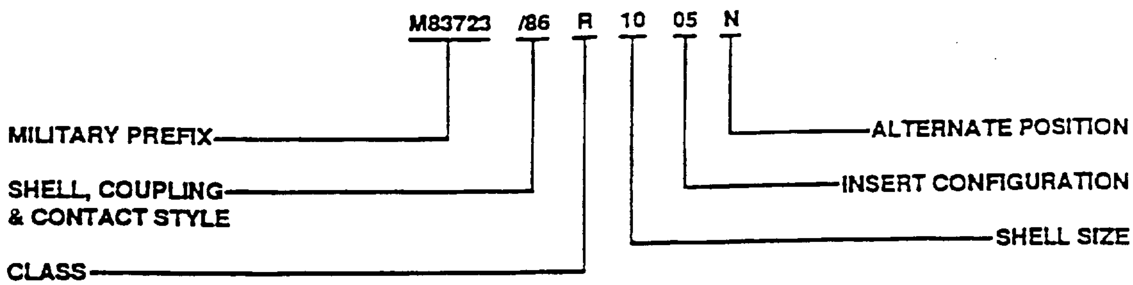
ALTERNATE POSITION (POLARIZATION)

N NORMAL.

W, X, Y & Z INDICATE ROTATION OF INSERT FROM NORMAL POSITION. SEE FIGURE 3.

Figure 24. MIL-C-83723 Series II Part Number Breakdown

022024



SHELL, COUPLING & CONTACT STYLE

Coupling & Contact Style				Shell Style
Bayonet		Threaded		
Socket	Pin	Socket	Pin	
/71	/72	/82	/83	WALL MOUNT RECEPTACLE
—	/79	—	/88	BOX MOUNT RECEPTACLE, HERMETIC SEAL
/73	/74	/84	/85	JAM NUT RECEPTACLE
—	/81	—	/89	JAM NUT RECEPTACLE, HERMETIC SEAL, SOLDER CONTACTS
—	/94	—	—	JAM NUT RECEPTACLE, HERMETIC SEAL, FLEX LEAD CONTACTS
—	/65	—	—	JAM NUT RECEPTACLE, HERMETIC SEAL, CRIMP CONTACTS
—	/80	—	/90	SOLDER MOUNT RECEPTACLE, HERMETIC SEAL
—	/93	—	—	SOLDER MOUNT RECEPTACLE, HERMETIC SEAL, FLEX LEAD CONTACTS
/75	/76	/86	/87	STRAIGHT PLUG
/77	/78	/91	/92	STRAIGHT PLUG, EMI GROUNDING
—	—	/95	/96	STRAIGHT PLUG, SELF-LOCKING COUPLING NUT
—	—	/97	/98	STRAIGHT PLUG, SELF-LOCKING COUPLING NUT, EMI GROUNDING
—	—	/67	/66	STRAIGHT PLUG, PUSH-PULL QUICK DISCONNECT
—	—	/69	/68	STRAIGHT PLUG, PUSH-PULL QUICK DISCONNECT WITH LANYARD

CLASS*

A ALUMINUM, NON-CONDUCTIVE BLACK ANODIZE, FLUID RESISTANT INSERT.
G PASSIVATED STAINLESS STEEL, FLUID RESISTANT INSERT.
H STEEL, HERMETIC SEAL, FLUID RESISTANT INSERT.
K PASSIVATED STAINLESS STEEL, FLUID RESISTANT INSERT, FIREWALL (THREADED ONLY).
N PLUGS SAME AS CLASS S WITH ELECTRODEPOSITED NICKEL FINISH, RECEPTACLES SAME AS CLASS Y OR S WITH ELECTRODEPOSITED NICKEL FINISH (THREADED ONLY).
R ALUMINUM SHELL, CONDUCTIVE FINISH, FLUID RESISTANT INSERT.
S PASSIVATED STAINLESS STEEL, FLUID RESISTANT INSERT, EMI GROUNDING, SELF-LOCKING FIREWALL (THREADED ONLY).
W ALUMINUM, CADMIUM CONDUCTIVE FINISH, 500 HR. SALT SPRAY.
Y STAINLESS STEEL, HERMETIC SEAL.

SHELL SIZE
SEE TABLE 1 FOR APPLICABLE SHELL SIZES.

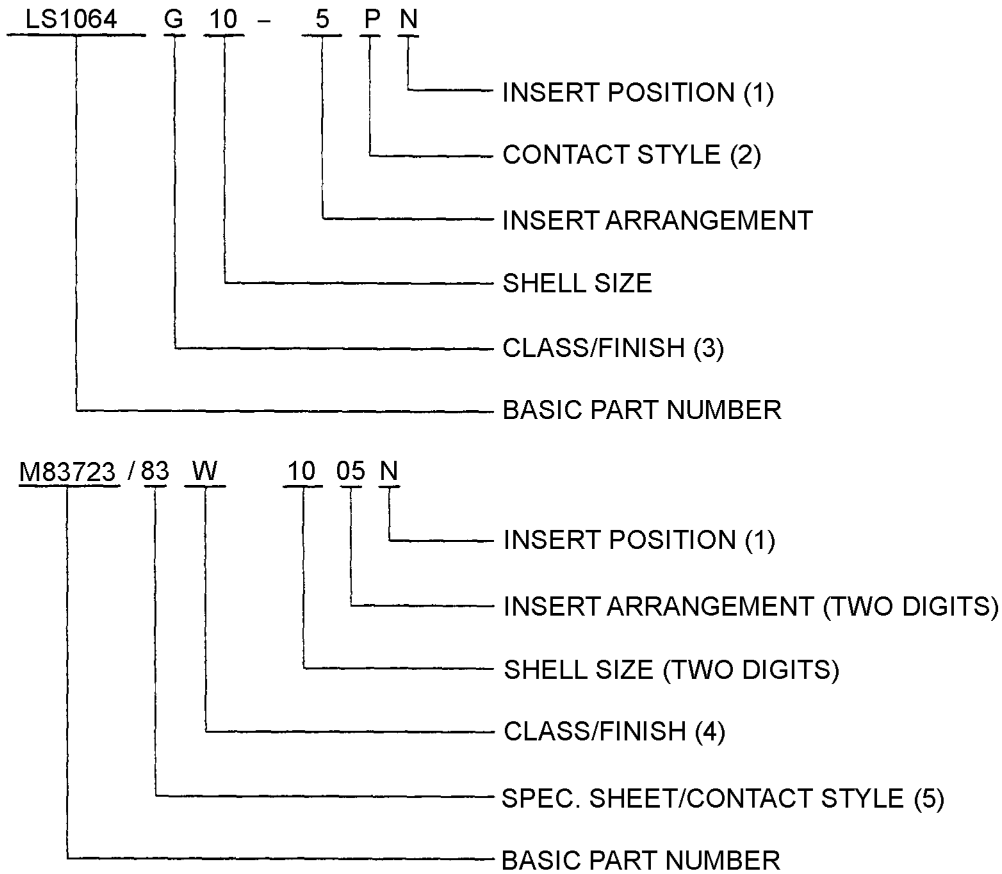
INSERT CONFIGURATION
ILLUSTRATED (FIGURE 7).

ALTERNATE POSITION
(FIGURE 3)

Figure 25. MIL-C-83723 Series III and Lockheed LS 10164, LS 10166, LS 10215, and LS 10216 Part Number Breakdown and Cross Reference (Sheet 1 of 5)

02202501

LS10165 RECEPTACLE CROSSES TO M83723/82 OR /83 AS FOLLOWS:



(1) POSITION 0 CROSSES TO Y. ALL OTHERS STAY THE SAME

(2) S = SOCKET CONTACT. CROSS TO M83723/82
P = PIN CONTACT. CROSS TO M83723/83

(3) R = ANODIZED. CROSS TO A
G = ELECTROLESS NICKEL. CROSS TO W
C = CADIUM. CROSS TO W

(4) A = ANODIZE
R = ELECROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM

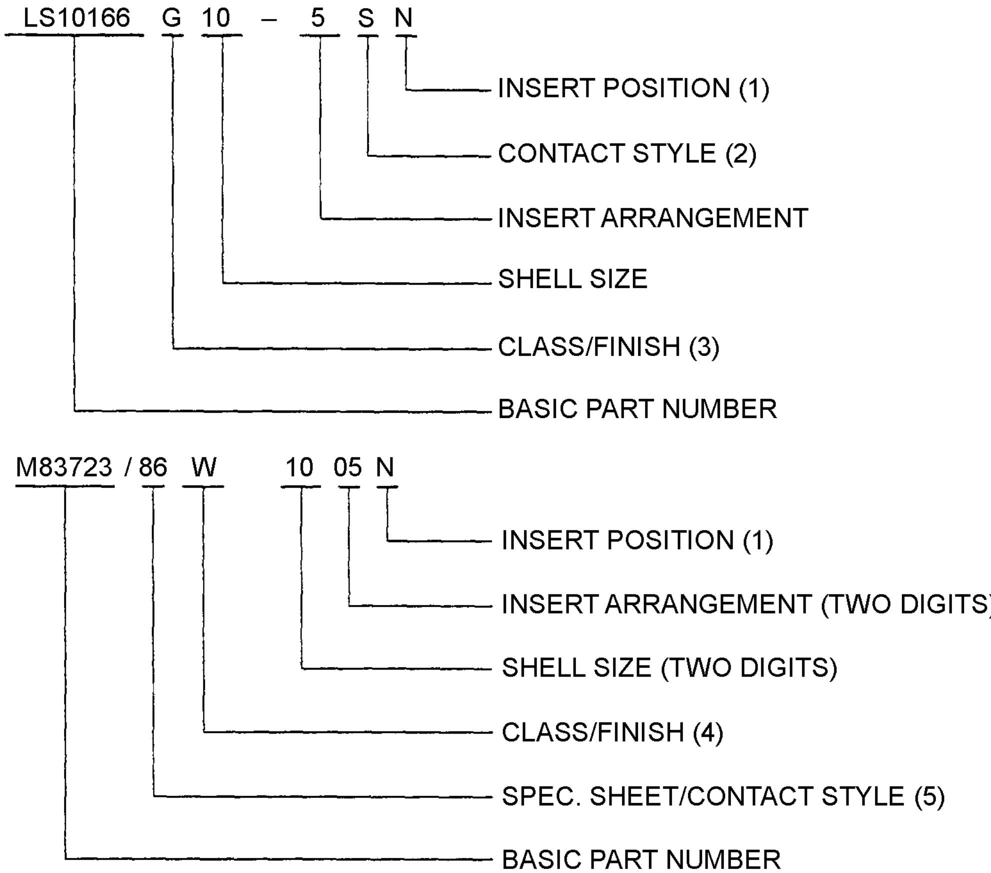
(5) M83723/82 IS CRIMP SOCKET CONTACT PLUG
M83723/83 IS CRIMP PIN CONTACT PLUG

EXAMPLES: LS10164G10-5PN CROSSES TO M83723/83W1005N
LS10164C14-15S0 CROSSES TO M83723/82W1415Y

02202502

Figure 25. MIL-C-83723 Series III and Lockheed LS 10164, LS 10166, LS 10215, and LS 10216 Part Number Breakdown and Cross Reference (Sheet 2)

LS10166 PLUG CROSSES TO M83723/86 OR /87 AS FOLLOWS:



(1) POSITION 0 CROSSES TO Y. ALL OTHERS STAY THE SAME

(2) S = SOCKET CONTACT. CROSS TO M83723/86
P = PIN CONTACT. CROSS TO M83723/87

(3) R = ANODIZED. CROSS TO A
G = ELECTROLESS NICKEL. CROSS TO W
C = CADIUM. CROSS TO W

(4) A = ANODIZE
R = ELECROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM

(5) M83723/86 IS CRIMP SOCKET CONTACT PLUG
M83723/87 IS CRIMP PIN CONTACT PLUG

EXAMPLES: LS10166G10-5SN CROSSES TO M83723/86W1005N
LS10166C14-15P0 CROSSES TO M3723/87W1415Y

02202503

Figure 25. MIL-C-83723 Series III and Lockheed LS 10164, LS 10166, LS 10215, and LS 10216 Part Number Breakdown and Cross Reference (Sheet 3)

LS10215 PLUG CROSSES TO M83723/75 OR /76 AS FOLLOWS:

LS10215 G 8 – 3 P N

- N — INSERT POSITION (1)
- P — CONTACT STYLE (2)
- 3 — INSERT ARRANGEMENT
- 8 — SHELL SIZE
- G — CLASS/FINISH (3)
- LS10215 — BASIC PART NUMBER

M83723 / 76 W 08 03 N

- N — INSERT POSITION (1)
- 03 — INSERT ARRANGEMENT (TWO DIGITS)
- 08 — SHELL SIZE (TWO DIGITS)
- W — CLASS/FINISH (4)
- 76 — SPEC. SHEET/CONTACT STYLE (5)
- M83723 — BASIC PART NUMBER

(1) POSITION 0 CROSSES TO Y. ALL OTHERS STAY THE SAME

(2) S = SOCKET CONTACT. CROSS TO M83723/75
P = PIN CONTACT. CROSS TO M83723/76

(3) R = ANODIZED. CROSS TO A
G = ELECTROLESS NICKEL. CROSS TO W
C = CADIUM. CROSS TO W

(4) A = ANODIZE
R = ELECROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM

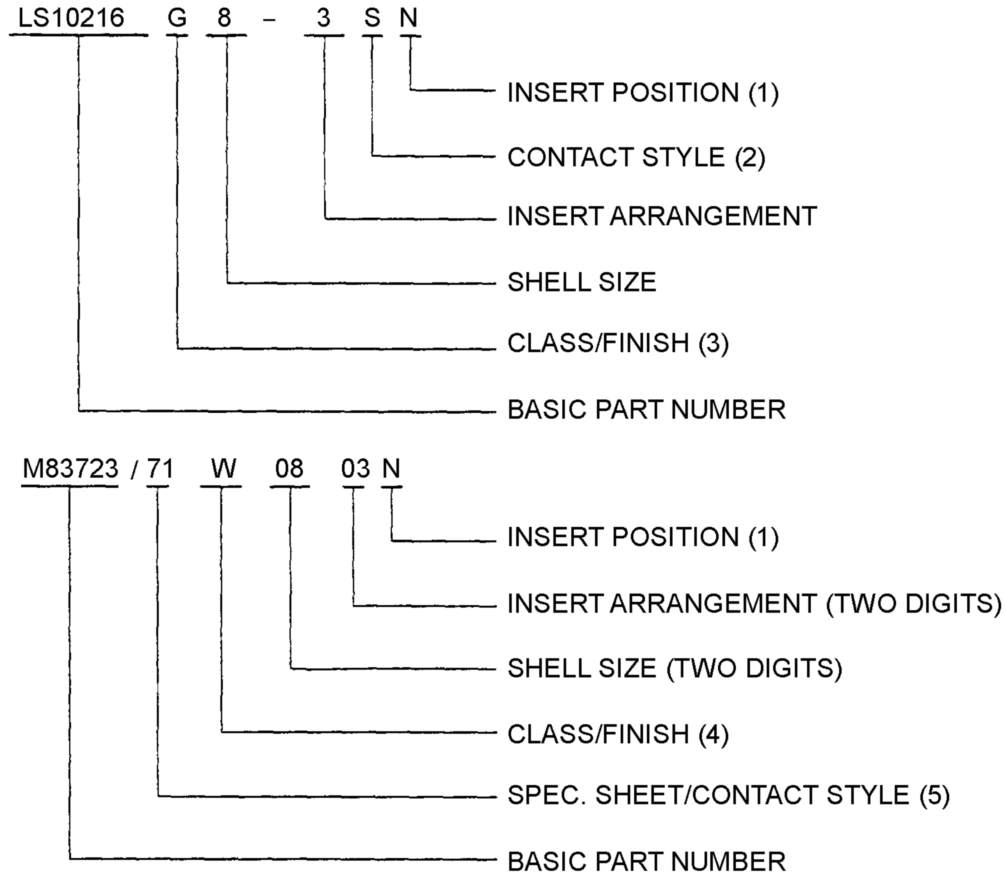
(5) M83723/75 IS CRIMP SOCKET CONTACT PLUG
M83723/76 IS CRIMP PIN CONTACT PLUG

EXAMPLES: LS10215G8-3PN CROSSES TO M83723/76W0803N
LS10215C14-15S0 CROSSES TO M83723/75W1415Y

02202504

Figure 25. MIL-C-83723 Series III and Lockheed LS 10164, LS 10166, LS 10215, and LS 10216 Part Number Breakdown and Cross Reference (Sheet 4)

LS10216 PLUG CROSSES TO M83723/71 OR /72 AS FOLLOWS:



(1) POSITION 0 CROSSES TO Y. ALL OTHERS STAY THE SAME

(2) S = SOCKET CONTACT. CROSS TO M83723/71
P = PIN CONTACT. CROSS TO M83723/72

(3) R = ANODIZED. CROSS TO A
G = ELECTROLESS NICKEL. CROSS TO W
C = CADIUM. CROSS TO W

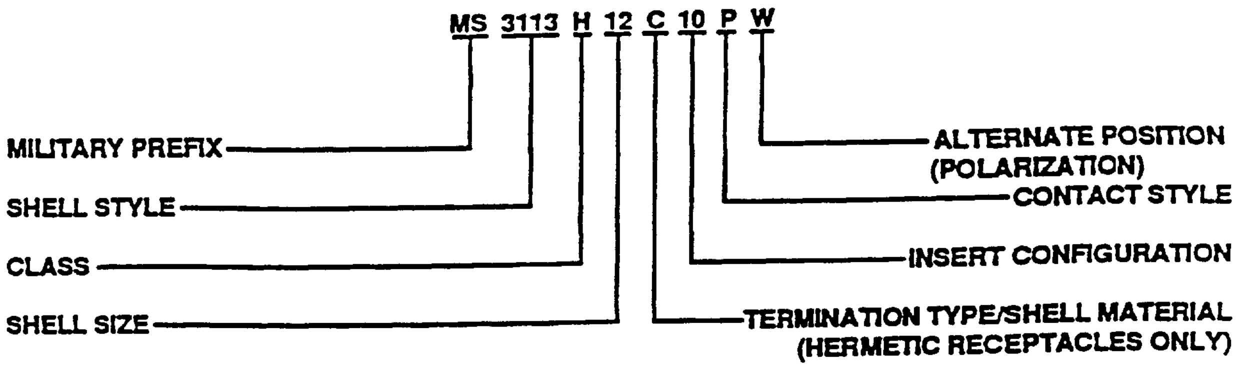
(4) A = ANODIZE
R = ELECROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM

(5) M83723/71 IS CRIMP SOCKET CONTACT PLUG
M83723/72 IS CRIMP PIN CONTACT PLUG

EXAMPLES: LS10216G8-3SN CROSSES TO M83723/71W0803N
LS10216C16-24P0 CROSSES TO M83723/72W1624Y

02202505

Figure 25. MIL-C-83723 Series III and Lockheed LS 10164, LS 10166, LS 10215, and LS 10216 Part Number Breakdown and Cross Reference (Sheet 5)



SHELL STYLE

MS3110	WALL MOUNT RECEPTACLE.
MS3111	IN-LINE RECEPTACLE.
MS3112	BOX MOUNT RECEPTACLE.
MS3113	HERMETIC SEAL SOLDER MOUNT RECEPTACLE.
MS3114	JAM NUT RECEPTACLE.
MS3116	STRAIGHT PLUG.
MS3119	THRU-BULKHEAD RECEPTACLE.

CLASS

A*	GENERAL DUTY, THREADED BACKSHELL.
B*	GENERAL DUTY WITH STRAIN RELIEF CLAMP.
E	GROMMET SEAL.
F	GROMMET SEAL WITH STRAIN RELIEF.
H	HERMETIC SEAL.
J	CABLE SEAL WITH CLAMP.
P	POTTING SEAL.

* OBSOLETE. NOT FOR NEW DESIGN.

SHELL SIZE
SEE TABLE 1 FOR AVAILABLE SHELL SIZES.

TERMINATION TYPE/SHELL MATERIAL
(HERMETIC RECEPTACLES ONLY)

INSERT CONFIGURATION
SEE FIGURE 7 FOR ILLUSTRATIONS AND CODES.

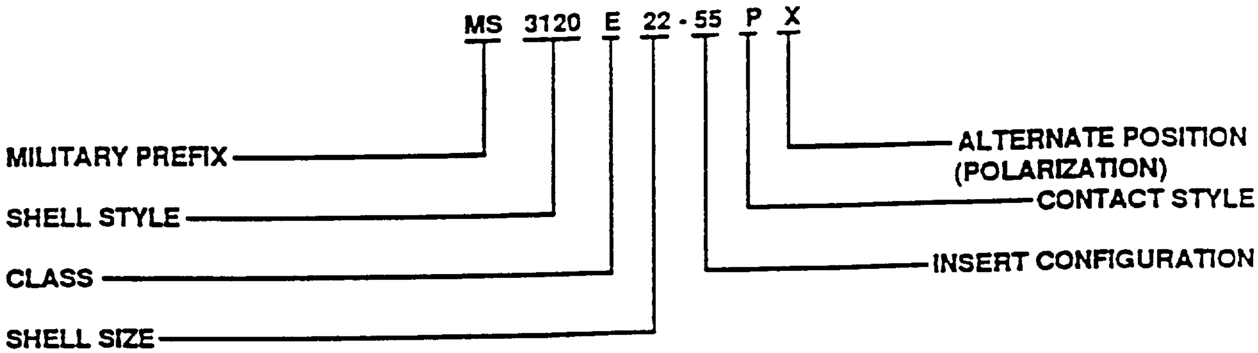
CONTACT STYLE

C	FEEDTHRU CONTACTS (MS3119)
P	PIN CONTACTS.
S	SOCKET CONTACTS.

ALTERNATE POSITION (POLARIZATION)
W, X, Y,Z OR BLANK (NORMAL)

022026

Figure 26. MIL-C-26482 Series I Part Number Breakdown (Solder)



SHELL STYLE

MS3120	WALL MOUNT RECEPTACLE.
MS3121	IN-LINE RECEPTACLE.
MS3122	BOX MOUNT RECEPTACLE.
MS3124	JAM NUT RECEPTACLE.
MS3126	STRAIGHT PLUG.
MS3127	LARGE FLANGE BOX MOUNT RECEPTACLE.
MS3128	LARGE FLANGE WALL MOUNT RECEPTACLE.

CLASS

E	GROMMET SEAL.
F	GROMMET SEAL WITH STRAIN RELIEF.
P	POTTING SEAL.

SHELL SIZE

SEE TABLE 1 FOR AVAILABLE SHELL SIZES.

INSERT CONFIGURATION

SEE FIGURE 7 FOR ILLUSTRATIONS AND CODES.

CONTACT STYLE

A	LESS PIN CONTACTS.
B	LESS SOCKET CONTACTS.
P	PIN CONTACTS.
S	SOCKET CONTACTS.

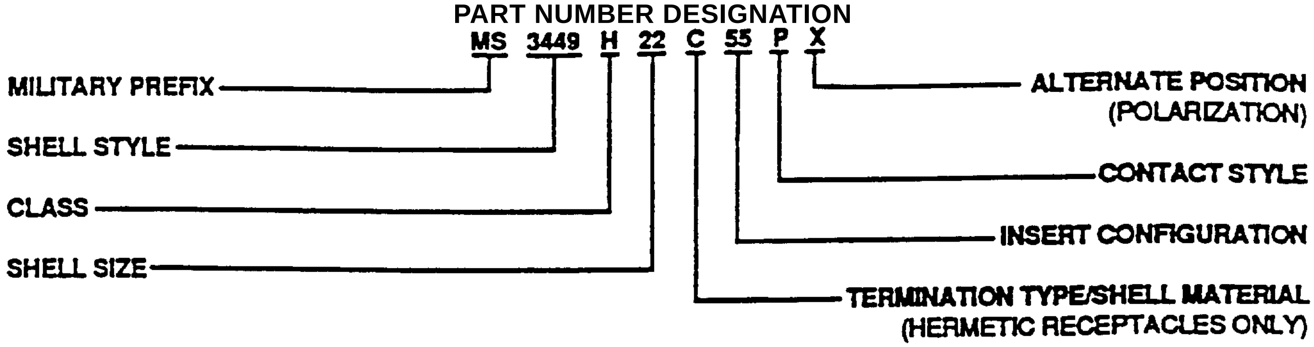
ALTERNATE POSITION (POLARIZATION)

W, X, Y,Z OR BLANK (NORMAL).

Figure 27. MIL-C-26482 Series I Part Number Breakdown (Crimp)

022027

PART NUMBER DESIGNATION



SHELL SIZE

MS No.	Class*	Description
MS3440	H	HERMETIC SEAL BOX MOUNT RECEPTACLE
MS3442	H	WIDE FLANGE HERMETIC SEAL BOX MOUNT RECEPTACLE
MS3443	H	HERMETIC SEAL SOLDER MOUNT RECEPTACLE
MS3449	H	HERMETIC SEAL JAM NUT RECEPTACLE
MS3470	A, L, S, W	WALL MOUNT RECEPTACLE
MS3471	A, L, S, W	IN-LINE RECEPTACLE
MS3472	A, L, S, W	WIDE FLANGE WALL MOUNT RECEPTACLE
MS3473	N	HERMETIC SEAL SOLDER MOUNT RECEPTACLE
MS3474	A, L, S, W	JAM NUT RECEPTACLE
MS3475	L, S, W	STRAIGHT PLUG (RFI GROUNDING)
MS3476	A, L, S, W	STRAIGHT PLUG
MS3477	N	HERMETIC SEAL BOX MOUNT RECEPTACLE
MS3479	N	HERMETIC SEAL JAM NUT RECEPTACLE

* SEE BELOW FOR CLASS DESCRIPTIONS.

CLASS

A GROMMET SEAL, NONCONDUCTIVE FINISH, 392°F(200°C).

E GROMMET SEAL, CONDUCTIVE FINISH. INACTIVE FOR NEW DESIGN. USE CLASS L.

H HERMETIC SEAL, CONDUCTIVE FINISH, 347°F (175°C).

L FLUID RESISTANT GROMMET SEAL, CONDUCTIVE FINISH, 392°F(200°C).

N HERMETIC SEAL, CRIMP TERMINATION, CONDUCTIVE FINISH, 347°F (175°C).

S GROMMET SEAL, STAINLESS STEEL CONDUCTIVE FINISH, 392°F(200°C).

W GROMMET SEAL, 500 HR. SALT SPRAY CONDUCTIVE FINISH, 347°F (175°C).

SHELL SIZE

SEE TABLE 1 FOR AVAILABLE SHELL SIZES

TERMINATION TYPE/SHELL MATERIAL (HERMETIC ONLY)

A SOLDER POT, STAINLESS STEEL SHELL.

B EYELET, STAINLESS STEEL SHELL.

C SOLDER POT, FERROUS ALLOY SHELL.

Y EYELET, FERROUS ALLOY SHELL.

INSERT CONFIGURATION

SEE FIGURE 7 FOR ILLUSTRATIONS AND CODES.

CONTACT STYLE

A LESS PIN CONTACTS.

B LESS SOCKET CONTACTS.

P PIN CONTACTS.

S SOCKET CONTACTS.

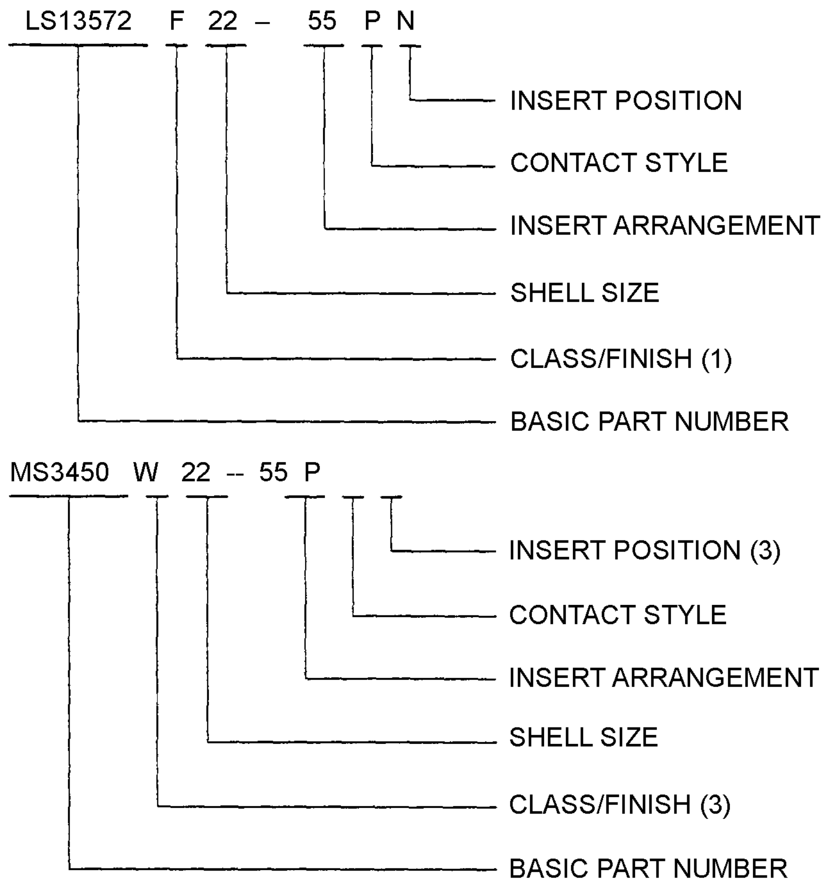
ALTERNATE POSITION (POLARIZATION)

W, X, Y, Z OR BLANK (NORMAL). SEE FIGURE 5.

Figure 28. MIL-C-26482 Series 2 and Lockheed LS 13572 and LS 13580 Part Number Breakdown and Cross Reference (Crimp) (Sheet 1 of 3)

02202801

LS13572 RECEPTACLE CROSSES TO MS3450 AS FOLLOWS:



(1) F = FLUID RESISTANT, ELECTROLESS NICKEL. CROSS TO W

(2) NOT REQUIRED IF POSITION IS N

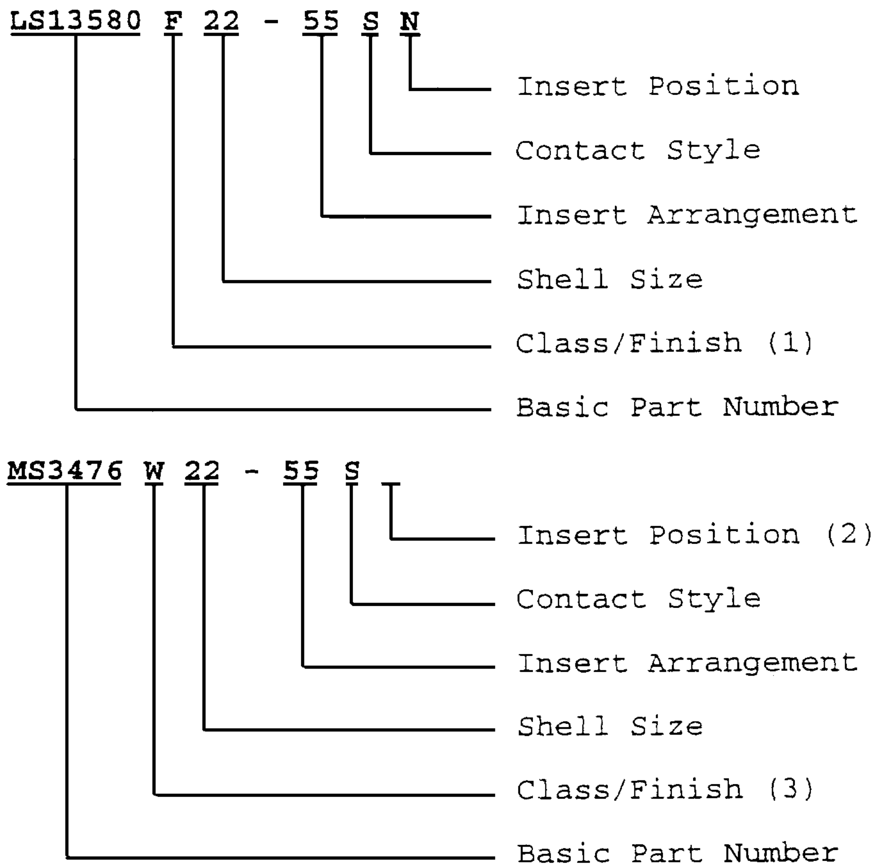
(3) L = ELECTROLESS NICKEL (**NOT FOR NAVY USE.** USE W)
W = CADIUM

EXAMPLES: LS13572F22-55PN CROSSES TO MS3470W22-55P
LS13572F10-6SX CROSSES TO MS3470W10-6SX

02202802

Figure 28. MIL-C-26482 Series 2 and Lockheed LS 13572 and LS 13580 Part Number Breakdown and Cross Reference (Crimp) (Sheet 2)

LS13580 PLUG CROSSES TO MS3476 AS FOLLOWS:



(1) F = FLUID RESISTANT, ELECTROLESS NICKEL. CROSS TO W

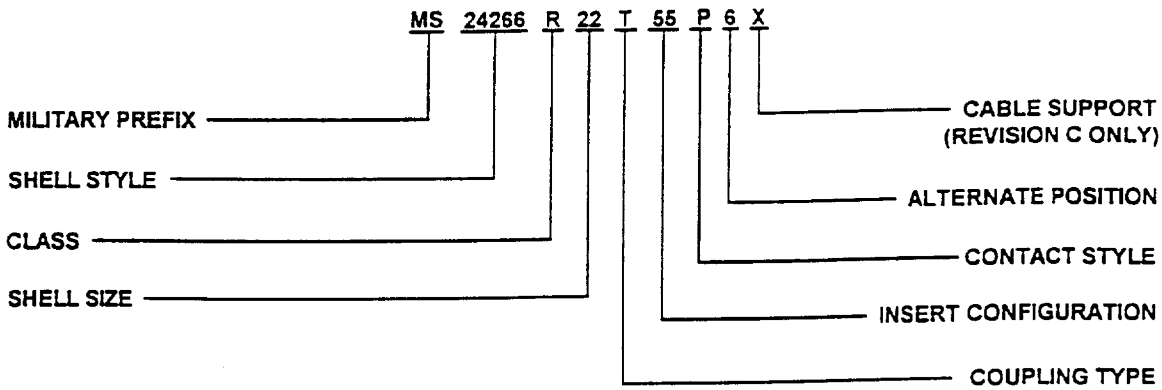
(2) NOT REQUIRED IF POSITION IS N

(3) L = ELECTORLESS NICKEL (NOT FOR NAVY USE . USE W
W = CADIUM

EXAMPLES: LS13580F22-55SN CROSSES TO MS3476W22-55S
LS13580F10-6PW CROSSES TO MS3476W10-6PW

02202803

Figure 28. MIL-C-26482 Series 2 and Lockheed LS 13572 and LS 13580 Part Number Breakdown and Cross Reference (Crimp) (Sheet 3)



SHELL STYLE
MS24264 WALL MOUNT RECEPTACLE.
MS24265 JAM NUT RECEPTACLE.
MS24266 STRAIGHT PLUG.
MS27034 HERMETIC SOLDER MOUNT RECEPTACLE.

CLASS

REVISION C	REVISION D OR E	
-	E	PASSIVATED STAINLESS STEEL, ENVIRONMENT SEAL.
-	F	ALUMINUM, BLACK OR GRAY ANODIZE, ENVIRONMENT SEAL, FLUID RESISTANT.
G	G	ALUMINUM, CONDUCTIVE ENVIRONMENTAL SEAL.
H*	H*	STEEL, TIN OR CADMIUM PLATE, HERMETIC SEAL.
R	R	ALUMINUM, BLACK OR GRAY ANODIZE, ENVIRONMENTAL SEAL.

* USED ONLY ON MS27034.

SHELL SIZE
8, 10, 12, 14, 16, 18, 20, 22, OR 24.

COUPLING TYPE
B BAYONET.
T THREADED.

INSERT CONFIGURATION
SEE FIGURE 6.

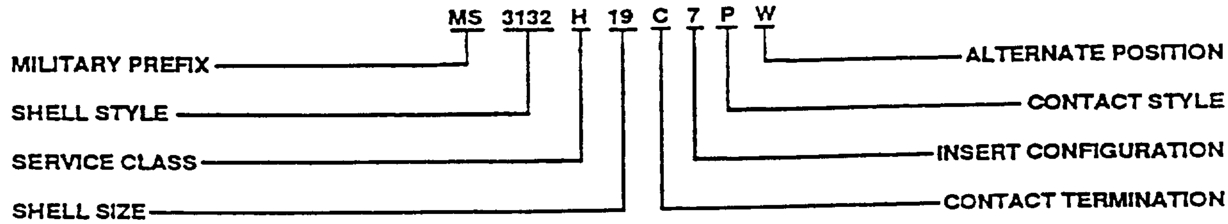
CONTACT STYLE
C PIN SOLDER CUP CONTACT (CLASS H ONLY).
E PIN EYELET CONTACTS (CLASS H ONLY).
P PIN CONTACTS.
S SOCKET CONTACTS.

ALTERNATE POSITION
SEE FIGURE 4.

CABLE SUPPORT (REVISION
BLANK WITH CABLE SUPPORT.
X NO CABLE SUPPORT.

Figure 29. MIL-C-26500 Part Number Breakdown

022029



SHELL STYLE

3140 WALL MOUNT RECEPTACLE.
3144 JAM NUT RECEPTACLE.
3147 STRAIGHT PLUG.
3148 STRAIGHT PLUG, LANYARD RELEASE.
3145 RACK & PANEL PLUG.

SERVICE CLASS

E FLUID RESISTANT, 392°F (200°C) OPERATING TEMPERATURE.
J WATERTIGHT JACKETED CABLE SEAL.

SHELL SIZE

3, 7, 12, 19, 27, 37, OR 61.

CONTACT TERMINATION (HERMETICS ONLY)

C SOLDER CUP.
Y EYELET.

INSERT CONFIGURATION

SEE FIGURE 10.

CONTACT STYLE

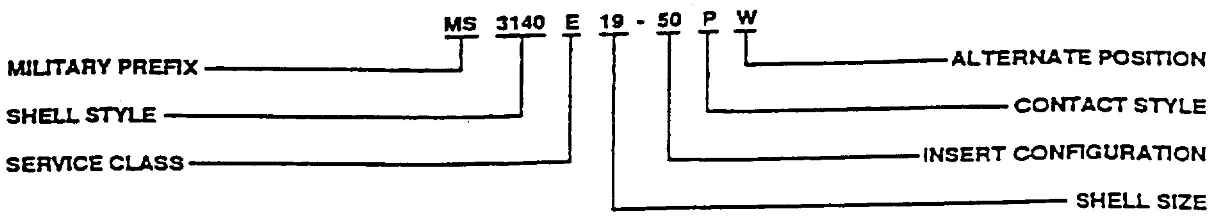
P PIN.
S SOCKET.

ALTERNATE POSITION (POLARIZATION)

BLANK (NORMAL) W, X, Y, B, OR C.

Figure 30. MIL-C-81703 Series I Part Number Breakdown

022030



SHELL STYLE
3140 WALL MOUNT RECEPTACLE.
3144 JAM NUT RECEPTACLE.
3147 STRAIGHT PLUG.
3148 STRAIGHT PLUG, LANYARD RELEASE.
3145 RACK & PANEL PLUG.

SERVICE CLASS
E FLUID RESISTANT, 392°F (200°C) OPERATING TEMPERATURE.
J WATERTIGHT JACKETED CABLE SEAL.

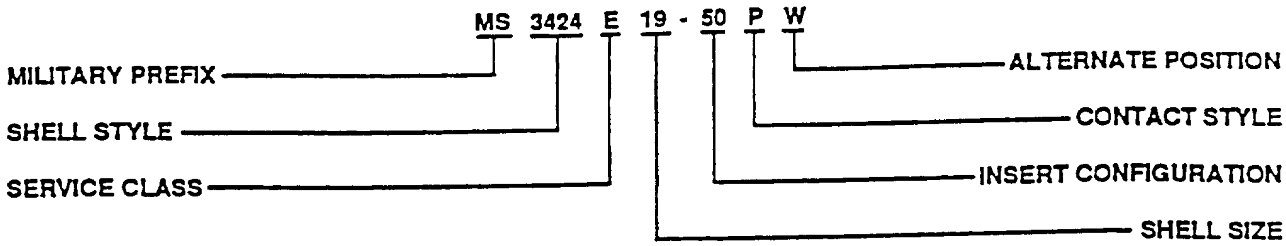
SHELL SIZE
3, 7, 12, 19, 27, 37, OR 61.

INSERT CONFIGURATION
SEE FIGURE 10.

CONTACT STYLE
P PIN.
S SOCKET.

ALTERNATE POSITION (POLARIZATION)
BLANK (NORMAL) W, X, Y, B, OR C.

Figure 31. MIL-C-81703 Series 2 Part Number Breakdown



SHELL STYLE

3145	HERMETIC SEAL BOX MOUNT RECEPTACLE, CRIMP CONTACTS.
3146	HERMETIC SOLDER BOX MOUNT RECEPTACLE, CRIMP CONTACTS.
3149	HERMETIC SEAL JAM NUT RECEPTACLE, CRIMP CONTACTS.
3424	WALL MOUNT RECEPTACLE
2446	RACK & PANEL PLUG.
3463	HERMETIC SOLDER BOX MOUNT RECEPTACLE, SOLDER CONTACTS.
3464	JAM NUT RECEPTACLE.
3466	HERMETIC SOLDER BOX MOUNT RECEPTACLE, SOLDER CONTACTS.
3467	STRAIGHT PLUG.
3468	STRAIGHT PLUG, LANYARD RELEASE.
3469	HERMETIC SEAL JAM NUT RECEPTACLE, CRIMP CONTACTS.

SERVICE CLASS

E	FLUID RESISTANT, 392°F (200°C) OPERATING TEMPERATURE. (3424, 3446, 3464, 3467, 3468 ONLY).
H	HERMETIC SEAL, SOLDER CONTACT (3463, 3466, 3469, ONLY).
L	FLUID RESISTANT EXTENDED 347°F (175°C) OPERATING TEMPERATURE.
N	HERMETIC SEAL, CRIMP CONTACTS (3145, 3146, 3149 ONLY).

SHELL SIZE

3,7,12,19,27,37, OR 61.

INSERT CONFIGURATION

SEE FIGURE 18.

SHELL SIZE

3,7,12,19,27,37, OR 7\61.

INSERT CONFIGURATION

SEE FIGURE 18.

CONTACT SIZE

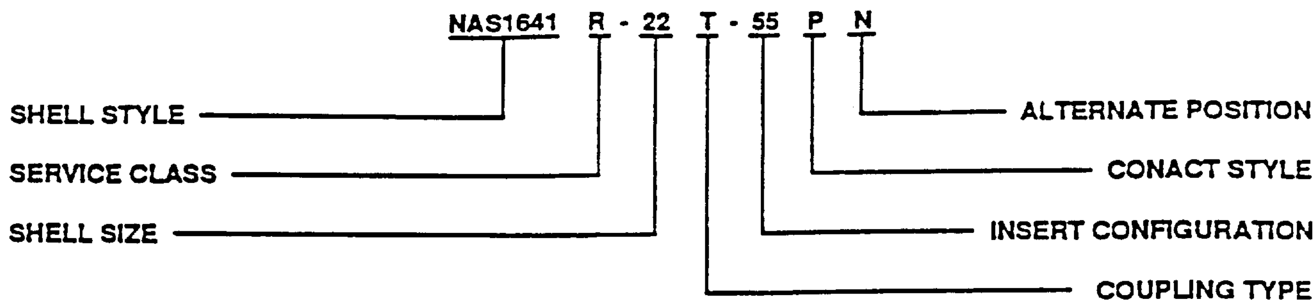
P	PIN.
S	SOCKET.

ALTERNATE POSITION

BLANK (NORMAL) W, X, Y, B OR C.

Figure 32. MIL-C-81703 Series 3 Part Number Breakdown

022032



SHELL STYLE
NAS1641- NARROW FLANGE WALL MOUNT RECEPTACLE
NAS1692- NARROW FLANGE WALL MOUNT RECEPTACLE
NAS1683- NARROW FLANGE HERMETIC SEAL WALL MOUNT RECEPTACLE
NAS1681- HERMETIC SEAL SOLDER MOUNT RECEPTACLE
NAS1642- JAM NUT RECEPTACLE
NAS1693- JAM NUT RECEPTACLE
NAS1682- HERMETIC SEAL JAM NUT RECEPTACLE
NAS1543- PLUG
NAS1694- PLUG

SERVICE CLASS
G GROUNDING, CONDUCTIVE FINISH
H HERMETIC
R ENVIRONMENT RESISTING

SHELL SIZE
(TABLE 2 AND FIGURE 5)

COUPLING TYPE
T THREADED
B BAYONET

INSERT CONFIGURATION
(FIGURE 5)

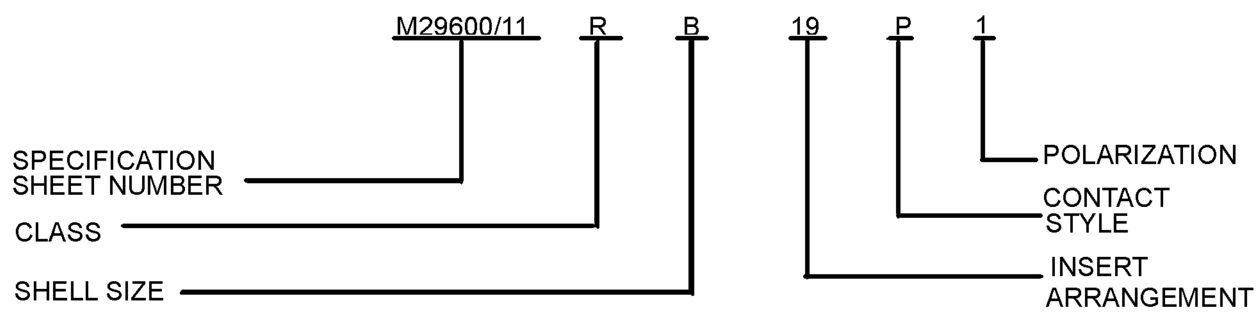
CONTACT STYLE
P PIN
S SOCKET

ALTERNATE POSITION
(FIGURE 3)

Figure 33. NAS 1599 Threaded and Bayonet Coupled Part Number Breakdown

022033

EXAMPLE OF PART NUMBER:



SHELL STYLE

/10 SERIES A, FLANGE RECEPTACLE
/11 SERIES A, JAM NUT RECEPTACLE
/12 SERIES A, PLUG
/20 SERIES B, FLANGE RECEPTACLE
/21 SERIES B, JAM NUT RECEPTACLE
/22 SERIES B, PLUG

SERVICE CLASS

R ENVIRONMENT RESISTANT, CONDUCTIVE SHELL, EMI SHIELDED
E ENVIRONMENT RESISTANT, CONDUCTIVE OR NONCONDUCTIVE SHELL, NON-EMI SHIELDED
G ENVIRONMENT RESISTANT, CONDUCTIVE SHELL EMI SHIELDED, SPACE GRADE

SHELL SIZE

CODE LETTER	A	B	C	D	F	G	H	J	K	M	N	P	R	S	T	U	W
SHELL SIZE	8	9	10	11	13	14	15	16	17	18	19	20	21	22	23	24	25

CONTACT STYLE

A WITHOUT STANDARD PIN CONTACTS
B WITHOUT STANDARD SOCKET CONTACTS
P STANDARD PIN CONTACTS
S STANDARD SOCKET CONTACTS
H HIGH DURABILITY PIN CONTACT
J HIGH DURABILITY SOCKET CONTACT
K WITHOUT HIGH DURABILITY PIN CONTACTS
L WITHOUT HIGH DURABILITY SOCKET CONTACTS

INSERT ARRANGEMENT

SEE TABLE 19 FOR SERIES A
SEE TABLE 20 FOR SERIES B

POLARIZATION

1, 2 OR 3

Figure 34. MIL-C-29600 Series A and B Part Number Breakdown

022034

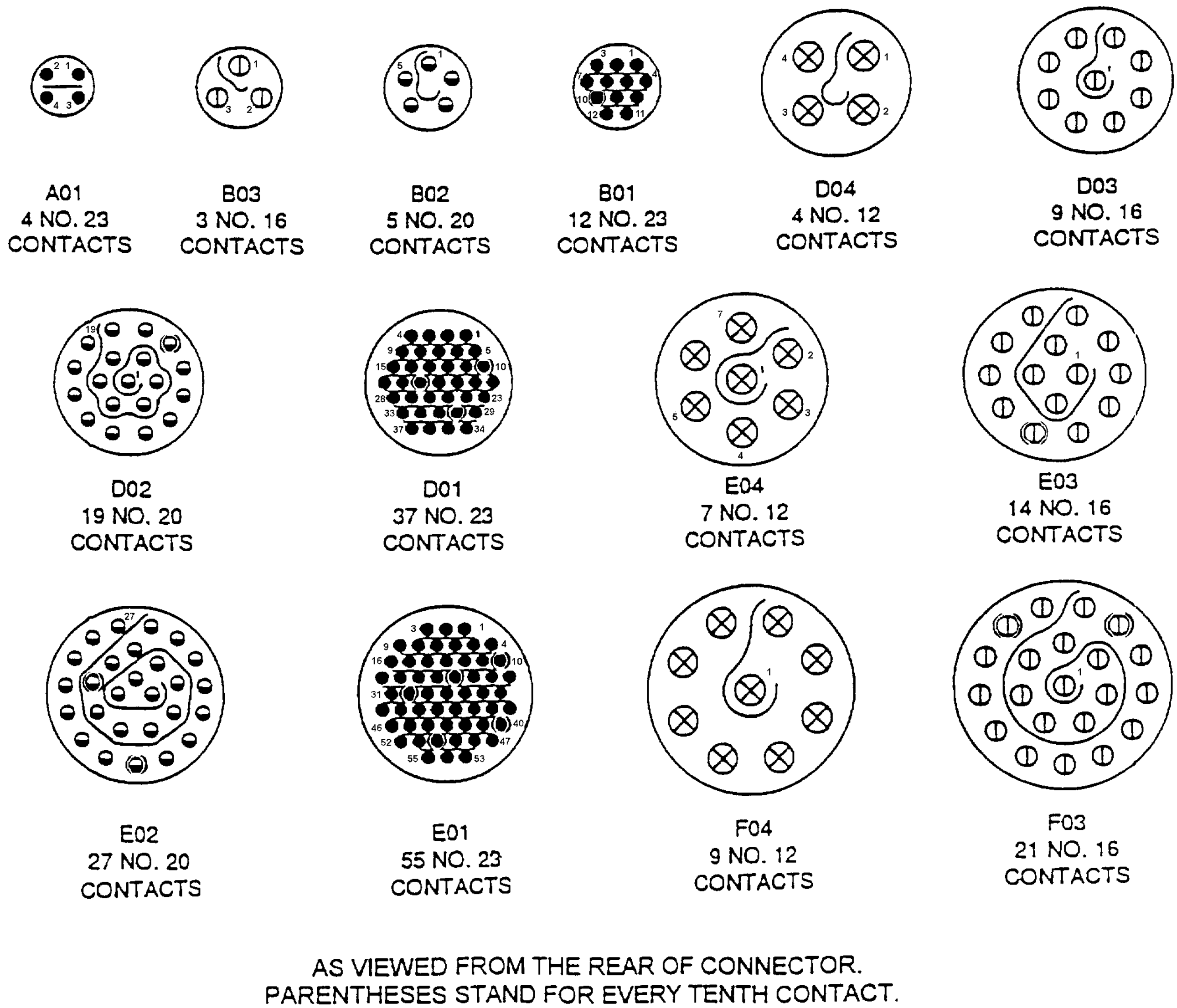


Figure 35. MIL-C-81511 Series 3, and 4 Insert Configurations (Sheet 1 of 3)

02203501

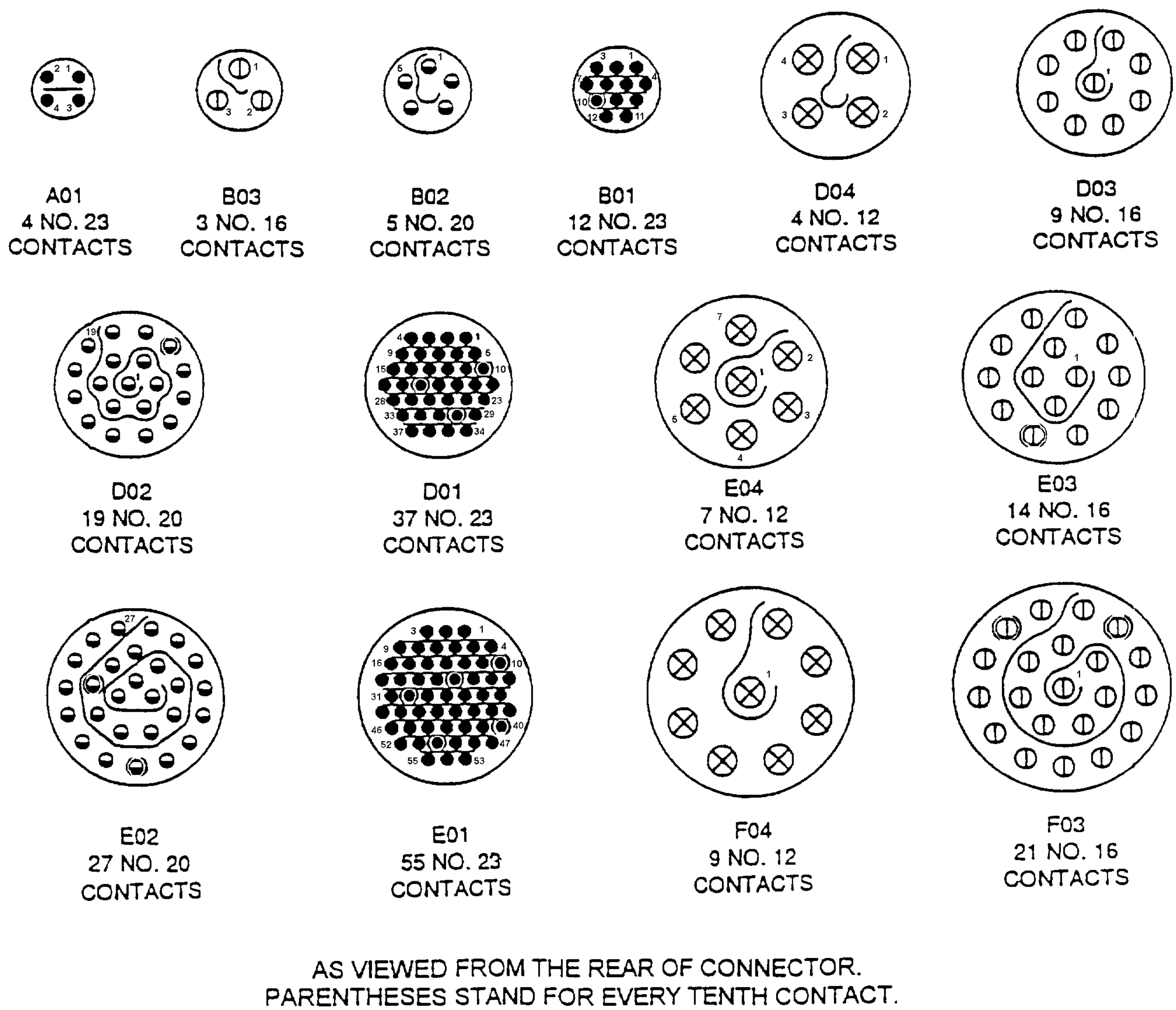
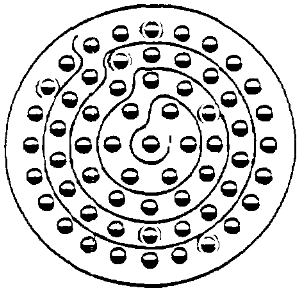
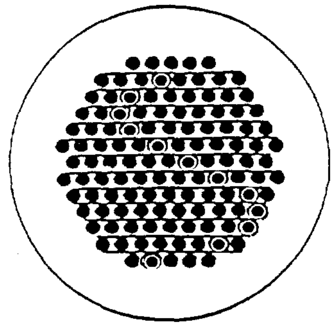


Figure 35. MIL-C-81511 Series 3, and 4 Insert Configurations (Sheet 2)

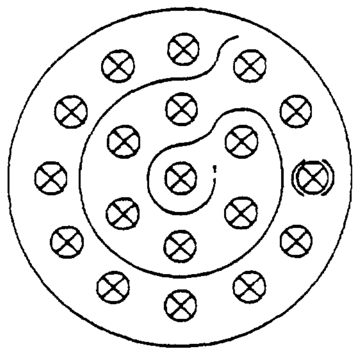
02203502



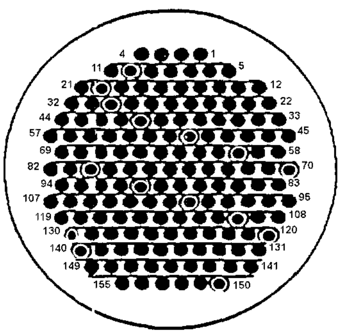
H02
61 NO. 20
CONTACTS



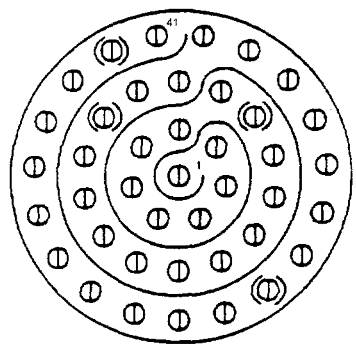
H01
121 NO. 23
CONTACTS



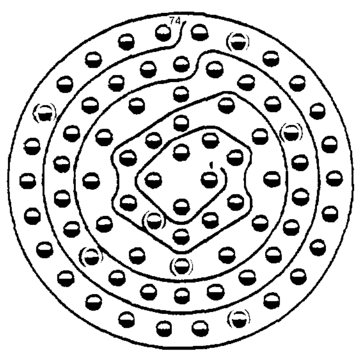
J04
19 NO. 12
CONTACTS



J01
155 NO. 23
CONTACTS



J03
41 NO. 16
CONTACTS



J02
74 NO.20
CONTACTS

AS VIEWED FROM THE REAR OF THE CONTECTOR
PARENTHESIS STAND FOR EVERY TENTH CONTACT

Figure 35. MIL-C-81511 Series 3, and 4 Insert Configurations (Sheet 3)

02203503

A. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

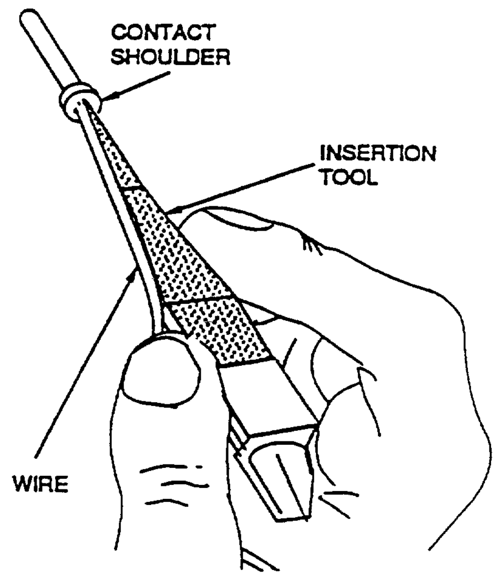
B. ENSURE WIRE OR CABLE ON CONTACT IS ROUTED THROUGH BACKSHELL.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS GO TO FRESH AIR.

C. SELECT CORRECT INSERTION TOOL (PARAGRAPH 45). LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

D. PLACE WIRE AND CONTACT ASSEMBLY INTO TIP OF INSERTION TOOL. ENSURE TOOL TIP IS OVER CONTACT CONDUCTOR BARREL AND BUTTED AGAINST CONTACT SHOULDER.



E. INSERT TIP CONTACT INTO CAVITY. START CONTACT INSERTION NEAR CONNECTOR CENTER CAVITIES AND WORK OUTWARD.

F. AXIALLY ALIGN CONTACT WITH CONTACT CAVITY.

G. WITH FIRM EVEN PRESSURE, PRESS TOOL AGAINST CONTACT SHOULDER AND SEAT CONTACT INTO CAVITY. A SLIGHT CLICK MAY BE HEARD AS RETENTION TINES SNAP INTO PLACE BEHIND CONTACT SHOULDER.

H. PULL TOOL STRAIGHT OUT OF CONTACT CAVITY. REMOVE TOOL FROM WIRE. PULL BACK LIGHTLY ON WIRE TO ENSURE CONTACT IS PROPERLY SEATED.

I. SEAL CONNECTOR AS REQUIRED (WP026 00) AND INSTALL BACKSHELL.

J. FILL ALL UNUSED CAVITIES WITH UNCRIMPED CONTACT.

K. INSERT SEALING PLUG, KNOB END FIRST, UNTIL BOTTOMED IN CONTACT CAVITY. FILL ALL CAVITIES THAT HAVE UNCRIMPED CONTACTS.

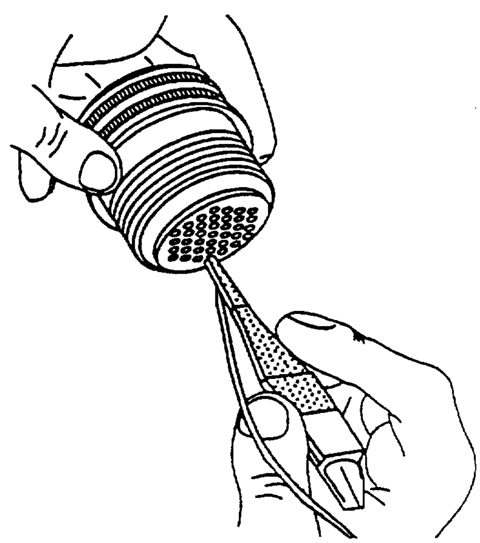
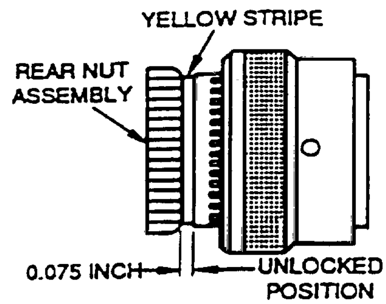


Figure 36. Contact Insertion, Front (Individual) Release

02203601

CONTACT INSERTION

A. IF NOT PREVIOUSLY REMOVED, REMOVE BACKSHELL FROM REAR OF CONNECTOR. TURN REAR NUT ASSEMBLY COUNTERCLOCKWISE UNTIL SLIGHT RESISTANCE IS FELT (2 1/2 TURNS OR 5/64 INCH SPACE, MINIMUM). YELLOW STRIPE WILL BE VISIBLE.



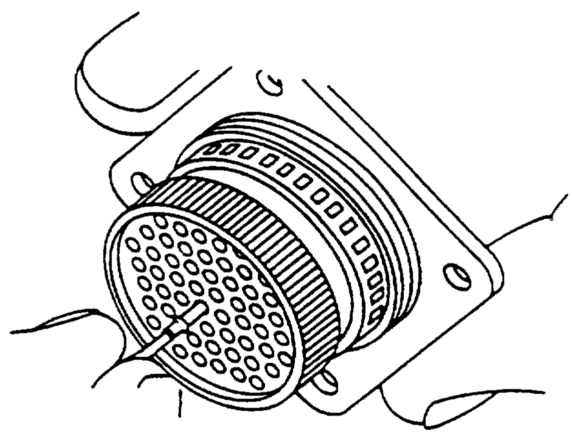
B. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

C. ROUTE WIRE OR CABLE THROUGH BACKSHELL.

NOTE

START CONTACT INSERTION NEAR CENTER CONTACT CAVITIES AND WORK OUTWARD.

D. HAND INSERT CONTACT INTO CORRESPONDING HOLE UNTIL ONLY CRIMP BARREL PORTION OF CONTACT EXTENDS FROM GROMMET.



WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

E. SELECT CORRECT INSERTION TOOL (PARAGRAPH 45). LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

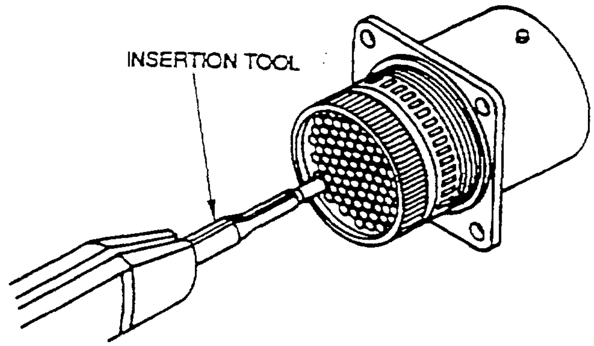
Figure 37. Contact Insertion, Front (Gang) Release (Sheet 1 of 2)

02203701

NOTE

TAKE CARE NOT TO DISTURB OR DISLODGE SEATED CONTACTS BY PUTTING STRAIN ON WIRES OR CABLE WHILE INSERTING OTHER CONTACTS.

F. POSITION INSERTION TOOL AROUND REAR OF CONTACT. CONTACT AND TOOL SHOULD BE ALIGNED WITHIN HOLE AS STRAIGHT AS POSSIBLE TO AVOID DAMAGE TO WIRE SEALING GROMMET. PRESS INSERTION TOOL AGAINST CONTACT SHOULDER FIRMLY TO SEAT CONTACT IN CAVITY.



G. REMOVE INSERTION TOOL BY SLIDING BACK ALONG WIRE INSULATION UNTIL IT CLEARS GROMMET.

H. SEAL CONNECTOR AS REQUIRED (WP 026 00) AND INSTALL BACKSHELL.

SEALING PLUG INSERTION

A. FILL ALL UNUSED CAVITIES WITH UNCRIMPED CONTACTS.

B. SELECT SEALING PLUG ACCORDING TO SIZE OF CONTACT (TABLE 2).

C. INSERT SEALING PLUG KNOB END FIRST UNTIL BOTTOMED IN CONTACT CAVITY. FILL ALL CAVITIES THAT HAVE UNCRIMPED CONTACTS.

D. AFTER ALL CONTACTS AND SEALING PLUGS ARE INSERTED, ROTATE REAR NUT ASSEMBLY BY HAND UNTIL NUT IS FULLY BOTTOMED AGAINST REAR SHELL.

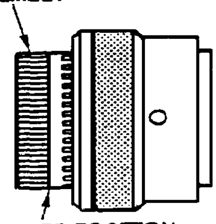


Figure 37. Contact Insertion, Front (Gang) Release (Sheet 2)

02203702

CRIMP FRONT RELEASE CONTACTS

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS GO TO FRESH AIR.

A. SELECT CORRECT REMOVAL TOOL (PARAGRAPH 45) LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

B. IF CONTACT IS UNWIRED, REMOVE SEALING PLUG FROM CAVITY OF CONTACT TO BE REMOVED.

C. WORKING FROM THE FRONT (MATING END) OF CONNECTOR, SLIDE HOLLOW END OF REMOVAL TOOL OVER CONTACT.

D. HOLDING REMOVAL TOOL AT RIGHT ANGLE TO FRONT INSERT FACE, PUSH TOOL STRAIGHT TOWARD REAR OF CONNECTOR, FIRMLY PRESSING TOOL TO POSITIVE STOP WHEN TOOL BOTTOMS IN INSERT CAVITY.

E. MAINTAIN PRESSURE ON TOOL HANDLE AND SLIDE COLLAR OF TOOL FORWARD UNTIL IT STOPS. CONTACT WILL BE PARTIALLY EJECTED FROM REAR OF CONNECTOR INSERT.

F. REMOVE TOOL BY PULLING STRAIGHT BACK TO CLEAR CONNECTOR INSERT FACE. REMOVE CONTACT OUT REAR OF CONNECTOR BY PULLING LIGHTLY ON WIRE OR USING A MATING CONTACT TO PUSH OUT RELEASED CONTACT.

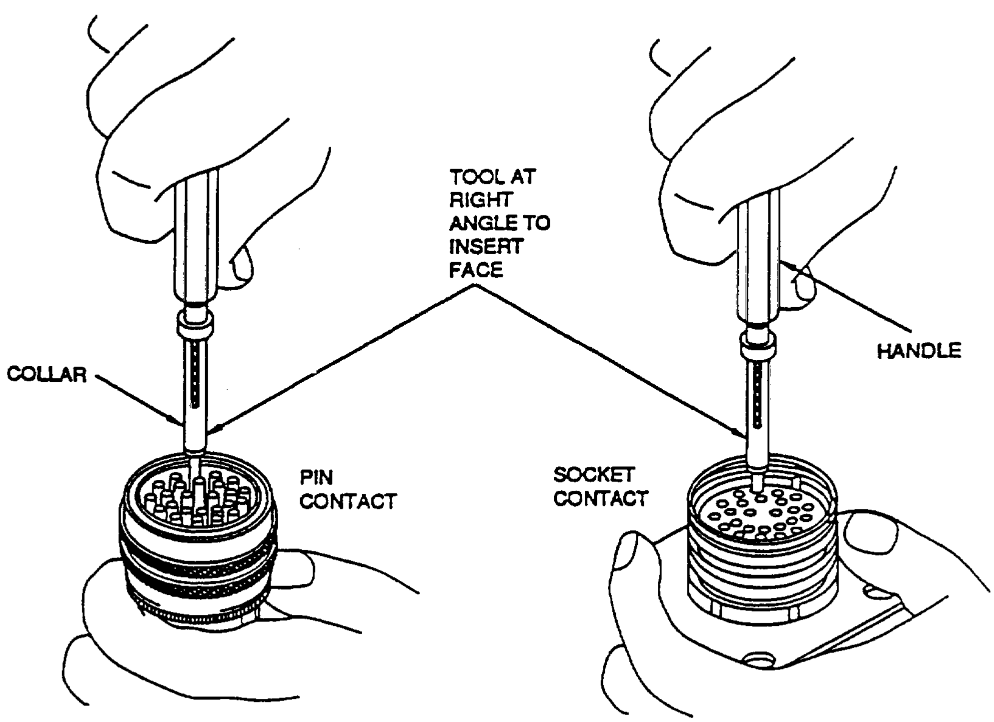


Figure 38. Contact Removal, Front (Individual) Release

022038

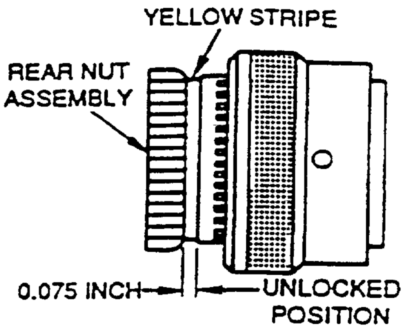
CONTACT REMOVAL

CAUTION

INSPECT TOOL TIPS FOR DAMAGE OR DISTORTION BEFORE USE.

A. IF NOT PREVIOUSLY REMOVED, REMOVE BACKSHELL FROM REAR OF CONNECTOR (WP 025 00). TURN REAR NUT ASSEMBLY COUNTER-CLOCKWISE UNTIL SLIGHT RESISTANCE IS FELT (2 1/2 TURNS OR 5/64 INCH SPACE, MINIMUM). YELLOW STRIPE WILL BE VISIBLE.

B. SELECT REMOVAL TOOL (PARAGRAPH 45).



C. IF REQUIRED, REMOVE SEALING PLUG.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

D. TO REMOVE CONTACTS. LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL AND INSERT TOOL THOUGH INSERT AND INTO SOCKET CONTACT.

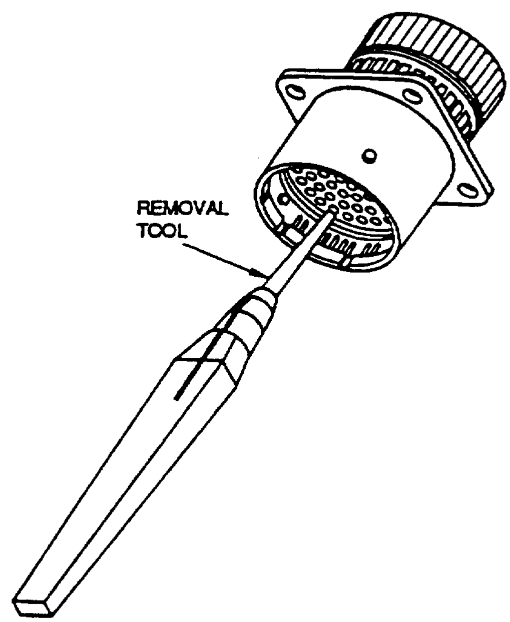


Figure 39. Contact Removal, Front (Gang) Release

022039

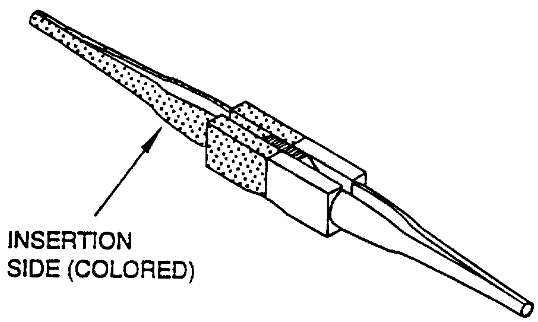
CONTACT INSERTION

A. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

B. ASSURE WIRE OR CABLE ON CONTACT IS ROUTED THROUGH BACKSHELL

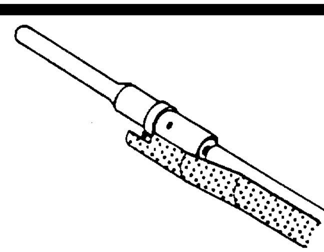
WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

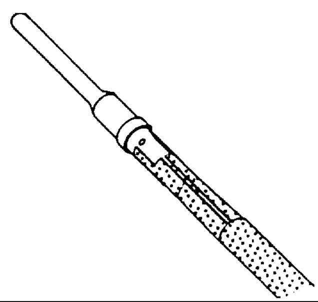


C. SELECT INSERTION TOOL (PARAGRAPH 45)
LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

D. HOLD INSERTION HALF OF TOOL BETWEEN THUMB AND FOREFINGER AND LAY WIRE AGAINST SLOT OF TOOL, THEN SNAP WIRE INTO SLOT.



E. AFTER WIRE SNAPS INTO TOOL, SEAT RETENTION SHOULDER AGAINST TIP OF TOOL.



F. HOLDING CONNECTOR WITH REAR GROMMET FACING YOU, SLOWLY PUSH CONTACT STRAIGHT INTO GROMMET CAVITY. DO NOT TWIST TOOL.

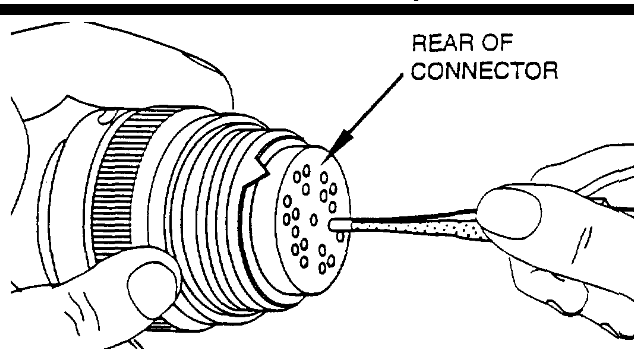


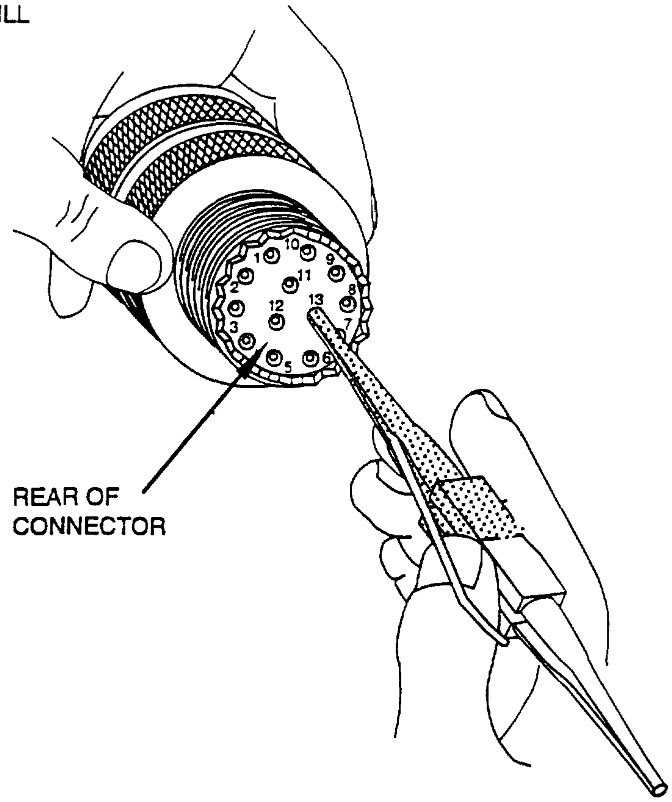
Figure 40. Contact Insertion, Rear Release (Sheet 1 of 2)

02204001

G. KEEP CONTACT AND TOOL CENTERED IN HOLE, APPLY SMOOTH EVEN PUSHING PRESSURE UNTIL CONTACT IS SEATED. A FAINT AUDIBLE SNAP WILL BE HEARD WHEN CONTACT SEATS.

H. WITHDRAW TOOL ONLY AT RIGHT ANGLE TO GROMMET FACE UNTIL COMPLETELY FREE. LIGHTLY PULL ON WIRE TO ENSURE CONTACT IS SECURELY LOCKED IN PLACE.

I. INSERT ALL WIRED CONTACTS FIRST, INSTALL UNWIRED CONTACTS IN REMAINING HOLES.



J. INSERT SEALING PLUG BEHIND EACH UNWIRED CONTACT. KNOB END FIRST PUSH SEALING PLUG UNTIL SEATED.

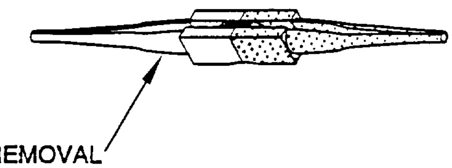
Figure 40. Contact Insertion, Rear Release (Sheet 2)

02204002

WIRED CONTACT REMOVAL.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.



A. SELECT REMOVAL TOOL (PARAGRAPH 45) LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

B. WORKING FROM WIRE SIDE OF CONNECTOR, LAY WIRE OF CONTACT ALONG SLOT OF REMOVAL TOOL LEAVING ABOUT 1/2 INCH FROM END OF TOOL TO REAR OF CONNECTOR. SQUEEZE WIRE FIRMLY INTO TOOL BETWEEN THUMB AND FOREFINGER ABOUT 1/2 INCH FROM TIP AND QUICKLY PULL TOOL AWAY FROM CONNECTOR SNAPPING WIRE INTO SLOT.

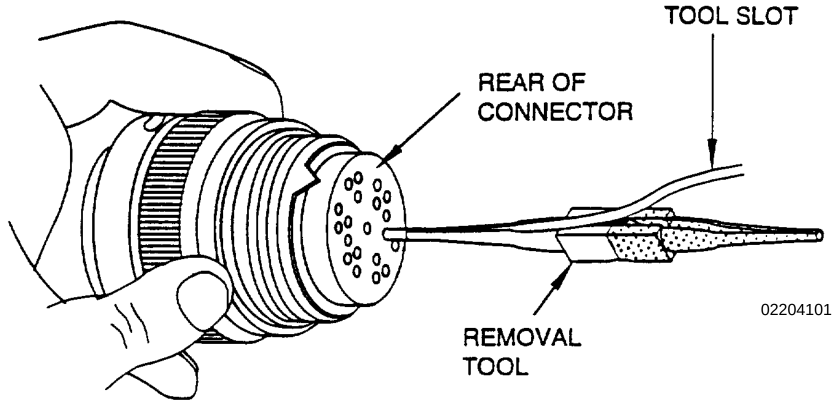
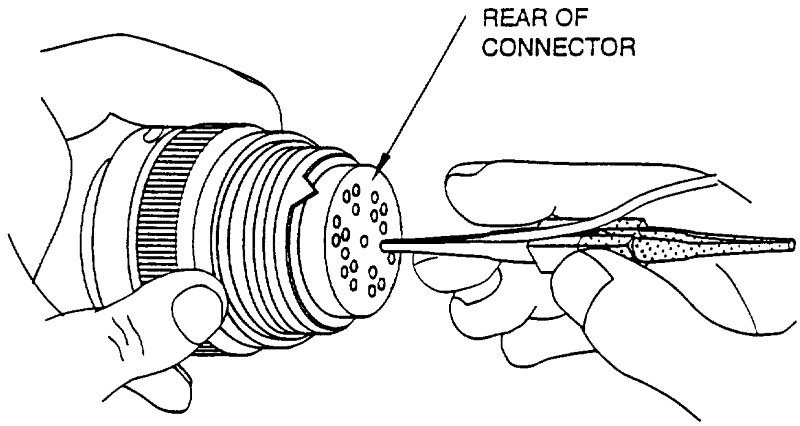
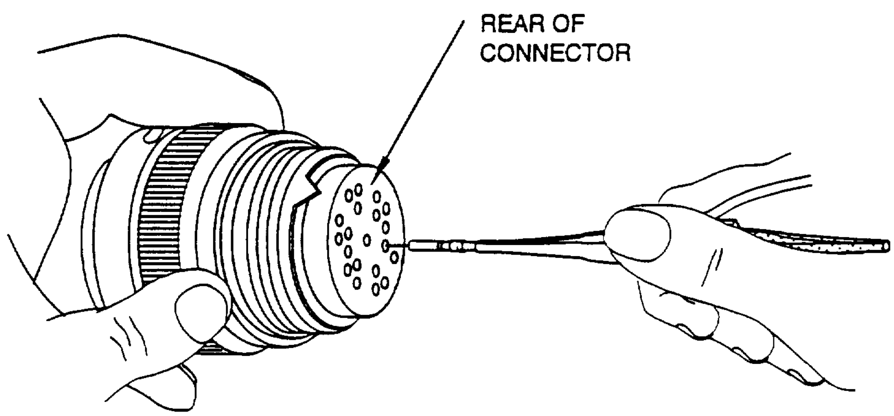


Figure 41. Contact Removal, Rear Release (Sheet 1 of 2)

C. SLIDE REMOVAL TOOL DOWN WIRE AND INTO REAR OF CAVITY AND SLOWLY INTO CONNECTOR UNTIL POSITIVE RESISTANCE IS FELT. AT THIS TIME, CONTACT RETAINING MECHANISM IS IN UNLOCKED POSITION.



D. PRESS WIRE OF CONTACT AGAINST SERRATIONS OF PLASTIC TOOL AND PULL BOTH TOOL AND CONTACT/WIRE ASSEMBLY OUT OF CONNECTOR.



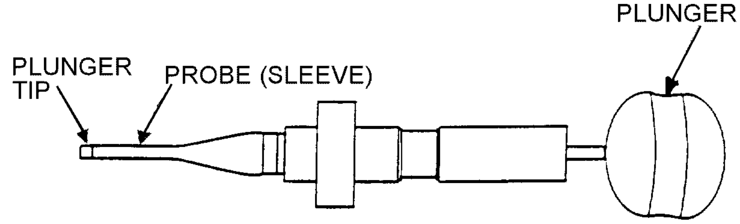
022042

Figure 41. Contact Removal, Rear Release (Sheet 2)

UNWIRED CONTACT REMOVAL

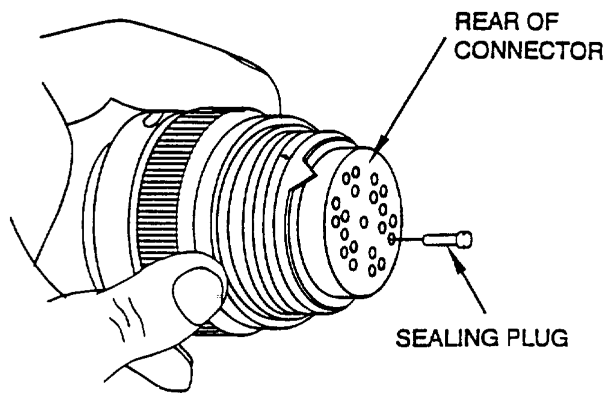
WARNING

ISOPROPYL ALCOHOL IS HIGHLY FLAMMABLE. USE ONLY WITH ADEQUATE VENTILATION. AVOID PROLONGED BREATHING OF VAPORS.



A. SELECT UNWIRED CONTACT REMOVAL TOOL (PARAGRAPH 45). LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

B. WITH REAR OF CONNECTOR EXPOSED, REMOVE SEALING PLUG FROM INSERT CAVITY OF CONTACT TO BE REMOVED.



C. PRESS AND HOLD TOOL PLUNGER UNTIL TIP OF TOOL IS EXPOSED.

D. AXIALLY ALIGN REMOVAL TOOL WITH CONTACT TO BE REMOVED.

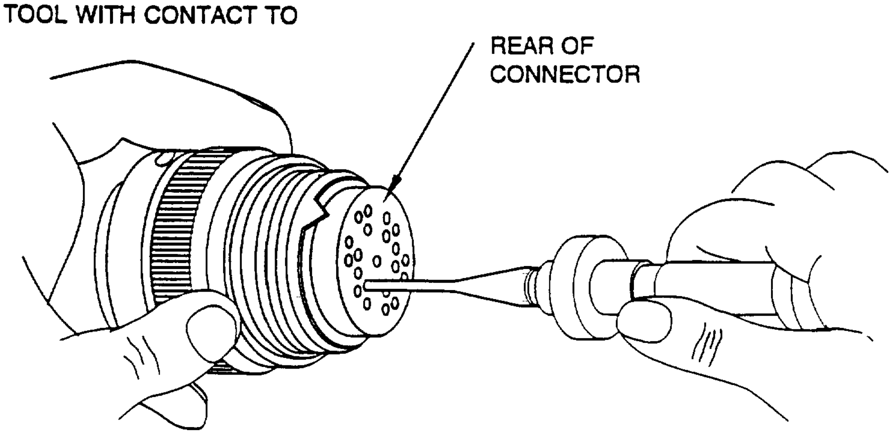


Figure 42. Contact Removal, Unwired Contact, Rear Release (Sheet 1 of 2)

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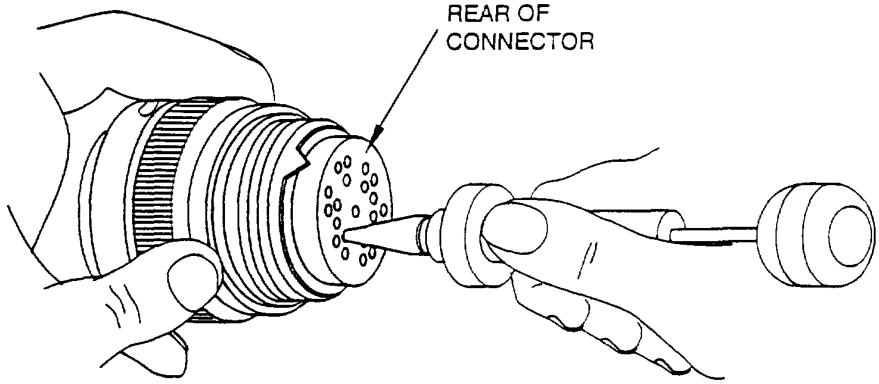
E. INSERT PLUNGER TIP INTO CONTACT CAVITY TO BUTT CONTACT WIRE BARREL, THEN SLIDE REMOVAL TOOL SLEEVE OVER CONTACT AND EXERT PRESSURE UNTIL SLEEVE BOTTOMS.



F. REMOVE TOOL AND UNLOCKED CONTACT FROM CONNECTOR BY WITHDRAWING TOOL FROM CONNECTOR.

G. REMOVE CONTACT FROM REMOVAL TOOL BY PRESSING PLUNGER.

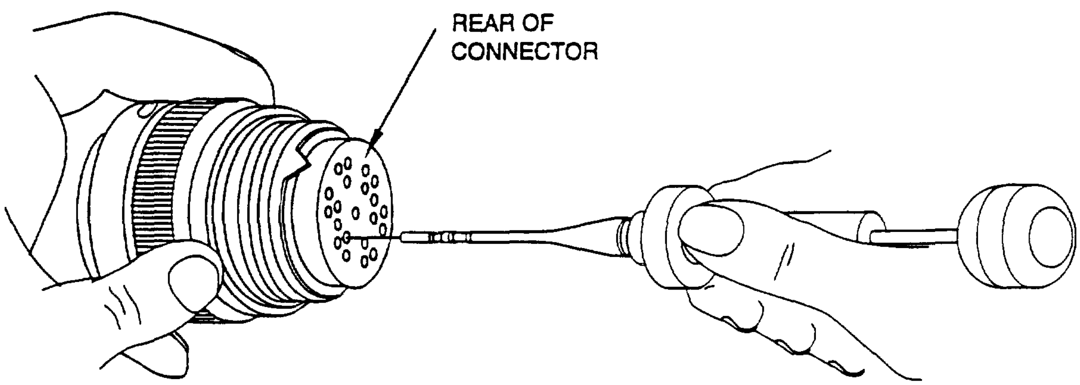


Figure 42. Contact Removal, Unwired Contact, Rear Release (Sheet 2)

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BROKEN WIRE CONTACT REMOVAL.

WARNING

ISOPROPYL ALCOHOL IS HIGHLY FLAMMABLE. USE ONLY WITH ADEQUATE VENTILATION. AVOID PROLONGED BREATHING OF VAPORS.

A. SELECT REMOVAL TOOL (PARAGRAPH 45)
LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

NOTE

DIMENSIONS IN THIS PROCEDURE ARE BASED ON A SIZE 22 CONTACT.

B. INSERT REMOVAL TOOL 1/8 INCH INTO CAVITY FROM REAR OF CONNECTOR. AT RIGHT ANGLE TO GROMMET FACE.

CAUTION

WIRE STRANDS MAY BE ENCOUNTERED AT ANY POINT UP TO 5/16 INCH OF TOOL INSERTION. FORCING TOOL INTO CAVITY IF WIRE STRANDS ARE ENCOUNTERED MAY CAUSE DAMAGE TO REMOVAL TOOL AND/OR CONNECTOR. WITHDRAW REMOVAL TOOL WHENEVER IT CANNOT BE ADVANCED AND INSPECT TOOL TIP FOR NICKS, CRACKS, MUSHROOMING, AND OTHER DAMAGE THAT WILL PREVENT PROPER FUNCTIONING.

C. GENTLY INSERT REMOVAL TOOL INTO CAVITY ABOUT 1/16 INCH UNITS, RELEASING TOOL AFTER EACH UNIT IF RESISTANCE IS FELT.

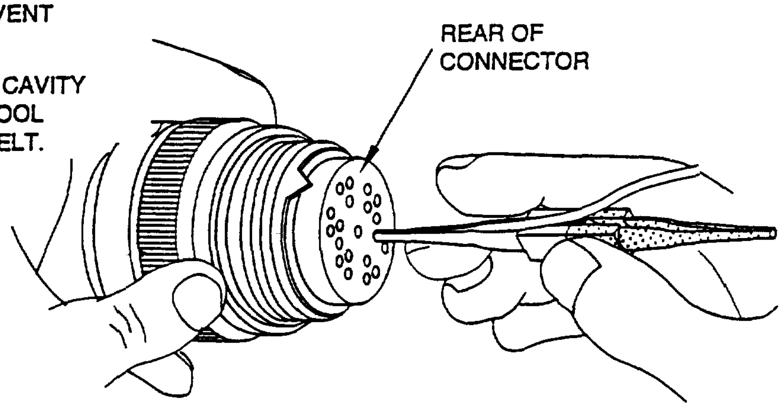
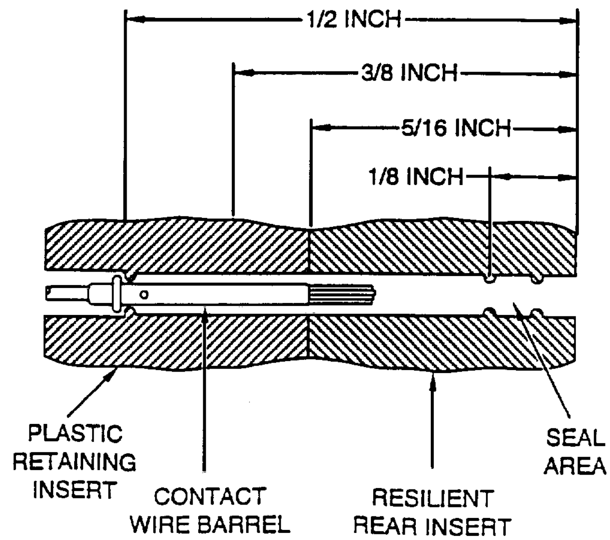


Figure 43. Contact Removal, Broken Wire Contact, Rear Release (Sheet 1 of 2)

NOTE

ROTATING REMOVAL TOOL WORKS SPLAYED WIRE STRANDS INTO SLOT OF TOOL, ALLOWING TOOL TO PASS.

D. IF RESISTANCE IS FELT BEFORE REMOVAL TOOL REACHES BACK OF CONTACT, WITHDRAW TOOL SLIGHTLY, ROTATE 1/6 OF A TURN AND REINSERT TOOL. REPEAT ROTATING AND INSERTION PROCEDURE UNTIL TOOL PASSES WITH MINIMUM ADDITIONAL FORCE TO 5/16 INCH DEPTH (BACK END OF CONTACT).



E. AT REAR OF CONTACT, TOOL MAY BE BLOCKED BY PLASTIC INSERT OR ADDITIONAL STRANDS OF BROKEN WIRES. WIGGLE REMOVAL TOOL GENTLY TO AID INSERTION TOOL INTO CONTACT CAVITY AND OVER CONTACT. ADDITIONAL ROTATION MAY BE REQUIRED IF BROKEN STRANDS ARE ENCOUNTERED.

F. CONTINUE INSERTION OF TOOL UNTIL STOP IS FELT ABOUT 1/2 INCH DEPTH.

G. EXERT AXIAL PRESSURE ON ENGAGING END OF CONTACT USING APPROPRIATE SIZE PIN OR SOCKET CONTACT. IF CONTACT DOES NOT MOVE, SEAT REMOVAL TOOL MORE FIRMLY AND PUSH CONTACT COMPLETELY OUT REAR OF CONNECTOR BEFORE DISENGAGING REMOVAL TOOL.

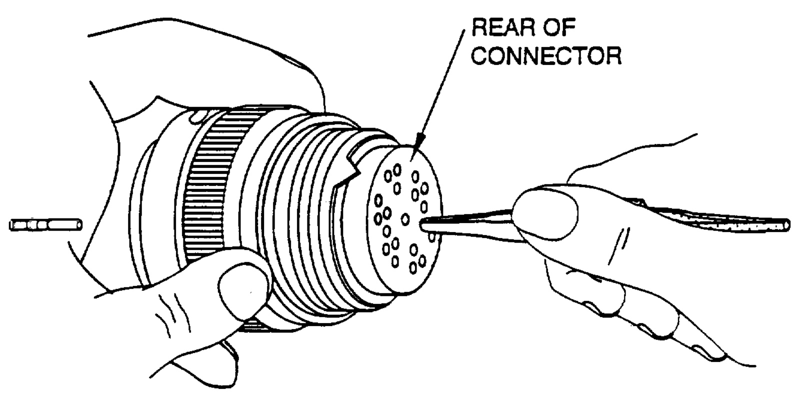


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Figure 43. Contact Removal, Broken Wire Contact, Rear Release (Sheet 2)

TABLE 3. MIL-C-3899 SERIES I INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Number of Contacts (Note 2)								
		Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
9-3	M	—	—	—	—	3	—	—	—	3
9-6	M	—	—	—	—	—	—	6	—	6
9-7	M	—	—	—	—	—	—	7	—	7
9-22	I	—	—	—	—	2	—	—	—	2
9-35	M	—	—	—	—	—	—	—	6	6
9-44	M	—	—	—	—	—	4	—	—	4
9-98	I	—	—	—	—	3	—	—	—	3
11-2	I	—	—	—	2C	—	—	—	—	2
11-4	I	—	—	—	—	4	—	—	—	4
11-5	I	—	—	—	—	5	—	—	—	5
ll-6	I	—	—	—	—	6	—	—	—	6
11-13	M	—	—	—	—	—	—	13	—	13
11-35	M	—	—	—	—	—	—	—	13	13
11-98	I	—	—	—	—	6	—	—	—	6
11-99	I	—	—	—	—	7	—	—	—	7
13-3	II	—	—	—	3C	—	—	—	—	3
13-4	I	—	—	—	4C	—	—	—	—	4
13-8	I	—	—	—	—	8	—	—	—	8
13-22	M	—	—	—	—	—	—	22	—	22
13-35	M	—	—	—	—	—	—	—	22	22
13-98	I	—	—	—	—	10	—	—	—	10
15-4	I	—	—	4C	—	—	—	—	—	4
15-5	II	—	—	—	5C	—	—	—	—	5
15-15	I	—	—	—	1C	14	—	—	—	15
15-18	I	—	—	—	—	18	—	—	—	l8
15-19	I	—	—	—	—	19	—	—	—	19
15-35	M	—	—	—	—	—	—	—	37	37
15-37	M	—	—	—	—	—	—	37	—	37
15-68	I	—	—	—	8C	—	—	—	—	8
15-97	I	—	—	—	4C	8	—	—	—	12
17-6	I	—	—	6C	—	—	—	—	—	6
17-8	II	—	—	—	8C	—	—	—	—	8

TABLE 3. MIL-C-3899 SERIES I INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
17-13	I	—	—	—	13C	—	—	—	—	13
17-26	I	—	—	—	—	26	—	—	—	26
17-35	M	—	—	—	—	—	—	—	55	55
17-42	M	—	—	—	—	—	42	—	—	42
17-55	M	—	—	—	—	—	—	55	—	55
17-99	I	—	—	—	2C	21	—	—	—	23
19-11	II	—	—	—	11C	—	—	—	—	11
19-18	M	4T	—	—	—	—	—	—	14	18
19-28	I	—	—	—	2C	26	—	—	—	28
19-30	I	—	—	—	1C	29	—	—	—	30
19-32	I	—	—	—	—	32	—	—	—	32
19-35	M	—	—	—	—	—	—	—	66	66
19-45	M	—	—	—	—	—	—	—	67	67
19-53	M	—	—	—	—	—	53	—	—	53
19-66	M	—	—	—	—	—	—	66	—	66
19-67	M	—	—	—	—	—	—	67	—	67
19-68	I	—	—	—	18C	—	—	—	—	18
21-1	M	—	—	—	—	—	—	79	—	79
21-2	M	—	—	—	—	—	65	—	—	65
21-11	I	—	—	11C	—	—	—	—	—	11
21-16	II	—	—	—	16C	—	—	—	—	16
21-24	I	—	—	—	—	24	—	—	—	24
21-25	I	—	—	—	—	25	—	—	—	25
21-27	I	—	—	—	—	27	—	—	—	27
21-35	M	—	—	—	—	—	—	—	79	79
21-39	I	—	—	—	2C	37	—	—	—	39
21-41	I	—	—	—	—	41	—	—	—	41
21-75	M	4C	—	—	—	—	—	—	—	4
21-79		2C	—	—	17C	—	—	—	—	19
23-1	M	—	—	—	—	—	—	100	—	100
23-2	M	—	—	—	—	85	—	—	—	85
23-14	I	—	—	14C	—	—	—	—	—	14
23-21	II	—	—	—	21C	—	—	—	—	21

TABLE 3. MIL-C-3899 SERIES I INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
23-32	I	—	—	—	—	32	—	—	—	32
23-34	I	—	—	—	—	34	—	—	—	34
23-35	M	—	—	—	—	—	—	—	100	100
23-36	I	—	—	—	—	36	—	—	—	36
23-53	I	—	—	—	—	53	—	—	—	53
23-55	I	—	—	—	—	55	—	—	—	55
23-97	I	—	—	—	16	—	—	—	—	16
23-99	II	—	—	—	11	—	—	—	—	11
25-1	M	—	—	—	—	—	—	128	—	128
25-2	M	—	—	—	—	—	100		—	100
25-4	I	—	—	—	8C	48	—	—	—	56
25-ll	I	—	9	—	—	2	—	—	—	11
25-19	I	—	—	19C	—	—	—	—	—	19
25-20	I	3T	—	4C	13F	10	—	—	—	30
25-24	I	—	—	12C	12C	—	—	—	—	24
25-29	I	—	—	—	29C	—	—	—	—	29
25-35	M	—	—	—	—	—	—	—	122	128
25-37	I	—	—	—	37C	—	—	—	—	37
25-43	I	—	—	—	20C	23	—	—	—	43
25-46	I	2C	—	—	4C	40	—	—	—	46
25-61	I	—	—	—	—	61	—	—	—	61

NOTES:

1. Service Ratings	Sea Level Operating Voltage (Suggested)	
	AC(RMS)	DC
M	400	550
I	600	850
II	900	1250

2. C - Coaxial or standard contacts
   F - Two contacts dedicated to fiber optics
   T - Twinax contacts

TABLE 4. MIL-C-3899 SERIES II INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series II	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size 8	10	12	16	20	22	22M	22D	Total Contacts
8-2	M	—	—	—	—	2	—	—	—	2
8-3	M	—	—	—	—	3	—	—	—	3
8-6	M	—	—	—	—	—	—	6	—	6
8-35	M	—	—	—	—	—	—	—	—	6
8-44	M	—	—	—	—	—	4	—	—	4
8-97	M	—	—	—	—	2	—	2	—	4
8-98	I	—	—	—	—	3	—	—	—	3
10-2	I	—	—	—	2C	—	—	—	—	2
10-4	I	—	—	—	—	4	—	—	—	4
10-5	I	—	—	—	—	5	—	—	—	5
10-13	M	—	—	—	—	—	—	13	—	13
10-35	M	—	—	—	—	—	—	—	13	13
10-98	I	—	—	—	—	6	—	—	—	6
10-99	I	—	—	—	—	7	—	—	—	7
12-3	II	—	—	—	3C	—	—	—	—	3
12-4	I	—	—	—	4C	—	—	—	—	4
12-8	I	—	—	—	—	8	—	—	—	8
12-22	M	—	—	—	—	—	—	22	—	22
12-35	M	—	—	—	—	—	—	—	22	22
12-98	I	—	—	—	—	10	—	—	—	10
14-4	I	—	—	4C	—	—	—	—	—	4
14-5	II	—	—	—	5C	—	—	—	—	5
14-15	I	—	—	—	1C	14	—	—	—	15
14-18	I	—	—	—	—	18	—	—	—	18
14-19	I	—	—	—	—	19	—	—	—	19
14-35	M	—	—	—	—	—	—	—	37	37
14-37	M	—	—	—	—	—	—	37	—	37
14-68	I	—	—	—	8C	—	—	—	—	8
14-97	I	—	—	—	4C	8	—	—	—	12
16-6	I	—	—	6C	—	—	—	—	—	6
16-8	II	—	—	—	8C	—	—	—	—	8
16-13	I	—	—	—	13C	—	—	—	—	13

TABLE 4. MIL-C-3899 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
16-26	I	—	—	—	—	26	—	—	—	26
16-35	M	—	—	—	—	—	—		55	55
16-42	M	—	—	—	—	—	42	—	—	42
16-55	M	—	—	—	—	—	—	55	—	55
16-99	I	—	—	—	2C	21	—	—	—	23
18-11	II	—	—	—	11C	—	—	—	—	11
18-28	I	—	—	—	2C	26	—	—	—	28
18-30	I	—	—	—	1C	29	—	—	—	30
18-32	1	—	—	—	—	32	—	—	—	32
18-35	M	—	—	—	—	—	—	—	66	66
18-45	M	—	—	—	—	—	—	—	67	67
18-53	M	—	—	—	—	—	53	—	—	53
18-66	M	—	—	—	—	—	—	66	—	66
18-67	M	—	—	—	—	—	—	67	—	67
18-68	I	—	—	—	18C	—	—	—	—	18
18-96	I	—	—	9C	—	—	—	—	—	9
20-1	M	—	—	—	—	—	—	79	—	79
20-2	M	—	—	—	—	—	65	—	—	65
20-11	I	—	—	11C	—	—	—	—	—	11
20-16	II	—	—	—	16C	—	—	—	—	16
20-24	I	—	—	—	—	24	—	—	—	24
20-25	I	—	—	—	—	25	—	—	—	25
20-27	I	—	—	—	—	27	—	—	—	27
20-35	M	—	—	—	—	—	—	—	79	79
20-39	I	—	—	—	2C	37	—	—	—	39
20-41	I	—	—	—	—	41	—	—	—	41
20-75	M	4C	—	—	—	—	—	—	—	4
20-79	M	2C	—	—	17C	—	—	—	—	19
22-1	M	—	—	—	—	—	—	100	—	100
22-2	I	—	—	—	—	—	85	—	—	85
22-14	II	—	—	14	—	—	—	—	—	14
22-21	I	—	—	—	21C	—	—	—	—	21
22-32	I	—	—	—	—	32	—	—	—	32
22-34	I	—	—	—	—	34	—	—	—	34
22-35	M	—	—	—	—	—	—	—	100	100
22-36	I	—	—	—	—	36	—	—	—	36
22-53	I	—	—	—	—	53	—	—	—	53

TABLE 4. MIL-C-3899 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size 8	10	12	16	20	22	22M	22D	Total Contacts
22-55	I	—	—	—	—	55	—	—	—	55
22-97	I	—	—	—	16	—	—	—	—	16
22-99	II	—	—	—	11	—	—	—	—	11
24-1	M	—	—	—	—	—	—	128	—	128
24-2	M	—	—	—	—	—	100	—	—	100
24-4	I	—	—	—	8C	48	—	—	—	56
24-19	I	—	—	19C	—	—	—	—	—	19
24-24	I	—	—	12C	12C	—	—	—	—	24
24-29	I	—	—	—	29C	—	—	—	—	29
24-35	M	—	—	—	—	—	—	—	128	128
24-37	I	—	—	—	37C	—	—	—	—	37
24-43	I	—	—	—	20C	23	—	—	—	43
24-46	I	2C	—	—	4C	40	—	—	—	46
24-61	I	—	—	—	—	61	—	—	—	61

NOTES:

1. Service Ratings	Sea Level Operating Voltage (Suggested)	
	AC(RMS)	DC
M	400	550
I	600	850
II	900	1250

2. C - Coaxial or standard contacts

TABLE 5. MIL-C-3899 SERIES III INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series III	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
A35	M	—	—	—	—	—	—	—	6	6
A98	I	—	—	—	—	3	—	—	—	3
B5	I	—	—	—	—	5	—	—	—	5
B35	M	—	—	—	—	—	—	—	13	13
B98	I	—	—	—	—	6	—	—	—	6
B99	I	—	—	—	—	7	—	—	—	7
C4	I	—	—	—	4C	—	—	—	—	4
C8	1	—	—	—	—	8	—	—	—	8
C35	M	—	—	—	—	—	—	—	22	22
C98	I	—	—	—	—	10	—	—	—	10
D5	II	—	—	—	5C	—	—	—	—	5
D15	I	—	—	—	1C	14	—	—	—	15
D18	I	—	—	—	—	18	—	—	—	18
D19	I	—	—	—	—	19	—	—	—	19
D35	M	—	—	—	—	—	—	—	37	37
D97	I	—	—	—	4C	8	—	—	—	12
E6	I	—	—	6C	—	—	—	—	—	6
E8	II	—	—	—	8C	—	—	—	—	8
E26	I	—	—	—	—	26	—	—	—	26
E35	M	—	—	—	—	—	—	—	55	55
E99	I	—	—	—	2C	21	—	—	—	23
F11	II	—	—	—	11C	—	—	—	—	11
F32	I	—	—	—	—	32	—	—	—	32
F35	M	—	—	—	—	—	—	—	66	66
G11	I	—	—	11C	—	—	—	—	—	11
G16	II	—	—	—	16C	—	—	—	—	16
G35	M	—	—	—	—	—	—	—	79	79
G39	I	—	—	—	2C	37	—	—	—	39
G41	I	—	—	—	—	41	—	—	—	41
G75	M	4C	—	—	—	—	—	—	—	4
H21	II	—	—	—	21C	—	—	—	—	21

TABLE 5. MIL-C-3899 SERIES III INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series III	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size 8	10	12	16	20	22	22M	22D	Total Contacts
H35	M	—	—	—	—	—	—	—	100	100
H53	I	—	—	—	—	53	—	—	—	53
H55	I	—	—	—	—	55	—	—	—	55
J4	I	—	—	—	8C	48	—	—	—	56
J11	I	—	9	—	—	2	—	—	—	11
J19	I	—	—	19C	—	—	—	—	—	19
J20	I	3T	—	4C	13F	10	—	—	—	30
J24	I	—	—	12C	12C	—	—	—	—	24
J29	I	—	—	—	29C	—	—	—	—	29
J35	M	—	—	—	—	—	—	—	128	128
J43	I	—	—	—	20C	23	—	—	—	43
J46	I	2C	—	—	4C	40	—	—	—	46
J61	I	—	—	—	—	61	—	—	—	61

NOTES:

1. Service Ratings	Sea Level Operating Voltage (Suggested)	
	AC(RMS)	DC
M	400	550
I	600	850
II	900	1250

2. C - Coaxial or standard contacts
   F - Two contacts dedicated to fiber optics
   T - Twinax contacts

TABLE 6. MIL-C-3899 SERIES IV INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series IV	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
B5	I	—	—	—	—	5	—	—	—	5
B35	M	—	—	—	—	—	—	—	13	13
B99	I	—	—	—	—	7	—	—	—	7
C4	I	—	—	—	4C	—	—	—	—	4
C35	M	—	—	—	—	—	—	—	22	22
C98	I	—	—	—	—	10	—	—	—	10
D5	II	—	—	—	5C	—	—	—	—	5
D18	I	—	—	—	—	18	—	—	—	18
D35	M	—	—	—	—	—	—	—	37	37
D97	I	—	—	—	4C	8	—	—	—	12
E6	I	—	—	6C	—	—	—	—	—	6
E8	II	—	—	—	8C	—	—	—	—	8
E26	I	—	—	—	—	26	—	—	—	26
E35	M	—	—	—	—	—	—	—	55	55
F11	II	—	—	—	11C	—	—	—	—	11
J19	I	—	—	19C	—	—	—	—	—	19
J24	I	—	—	12	12C	—	—	—	—	24
J29	I	—	—	—	29C	—	—	—	—	20
J35	M	—	—	—	—	—	—	—	128	128
J61	I	—	—	—	—	61	—	—	—	61
G11	I	—	—	11C	—	—	—	—	—	1l
F32	I	—	—	—	—	32	—	—	—	32
F35	M	—	—	—	—	—	—	—	66	66
G16	II	—	—	—	16C	—	—	—	—	16
G35	M	—	—	—	—	—	—	—	79	79
G41	I	—	—	—	—	41	—	—	—	41
H21	II	—	—	—	21C	—	—	—	—	21
H35	M	—	—	—	—	—	—	—	100	100

TABLE 6. MIL-C-3899 SERIES IV INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series IV	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size 8	10	12	16	20	22	22M	22D	Total Contacts
H53	I	—	—	—	—	53	—	—	—	53
H55	I	—	—	—	—	55	—	—	—	55
J4	I	—	—	—	8C	48	—	—	—	56

NOTES:

1. Service Ratings	Sea Level Operating Voltage (Suggested)	
	AC(RMS)	DC
M	400	550
I	600	850
II	900	1250

2. C - Coaxial or standard contacts

TABLE 7. MIL-C-81511 SERIES 1 INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series 1	Service Rating (Note)	Number of Contacts Contact Size 12	16	20	22	Total Contacts
A01	I	—	—	—	4	4
B01	I	—	—	—	12	12
B02	I	—	5	—	—	5
B03	II	3	—	—	—	3
D01	I	—	—	—	37	37
D02	I	—	—	19	—	19
D03	II	—	9	—	—	9
D04	II	4	—	—	—	4
E01	I	—	—	—	55	55
E02	I	—	—	27	—	27
E03	II	—	14	—	—	14
E04	I	7	—	—	—	7
F01	I	—	—	—	85	85
F02	I	—	—	38	—	38
F03	II	—	21	—	—	21
F04	II	9	—	—	—	9
G01	I	—	—	—	92	92
G02	I	—	—	45	—	45
G03	II	—	24	—	—	24
G04	H	11	—	—	—	11
H01	I	—	—	—	121	121
H02	I	—	—	61	—	61
H03	II	—	32	—	—	32
H04	II	14	—	—	—	14
J0l	I	—	—	—	155	155
J02	I	—	—	74	—	74
J03	II	—	41	—	—	41
J04	II	19	—	—	—	19

NOTE:

Maximum recommended working voltage (AC, RMS):

Condition	Service Rating I	Service Rating II
Sea Level	600	1000
50,000 Feet	300	450
70,000 Feet	300	450
110,000 Feet	300	450

TABLE 8. MIL-C-81511 SERIES 2 INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series 2	Service Rating (Note)	Number of Contacts				
		Contact Size				Total Contacts
		12	16	20	22	
A01	I	—	—	—	4	4
B01	I	—	—	—	12	12
B02	I	—	—	5	—	5
B03	II	—	3	—	—	3
D01	I	—	—	—	37	37
D02	I	—	—	19	—	19
D03	II	—	9	—	—	9
D04	II	4	—	—	—	4
E01	I	—	—	—	55	55
E02	I	—	—	27	—	27
E03	II	—	14	—	—	14
E04	I	7	—	—	—	7
F01	I	—	—	—	85	85
F02	I	—	—	38	—	38
F03	II	—	21	—	—	21
F04	II	9	—	—	—	9

NOTE:

Maximum recommended working voltage (AC, RMS):

Condition	Service Rating I	Service Rating II
Sea Level	600	1000
50,000 Feet	300	450
70,000 Feet	300	450
110,000 Feet	300	450

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
8S-1	A	—	—	1	—	—	—	—	1
10S-2	A	—	—	1	—	—	—	—	1
10SL-3	A	—	—	3	—	—	—	—	3
10SL-4	A	—	—	2	—	—	—	—	2
97-10S-656		—	—	1	—	—	—	—	1
CA10SL- 2001-4	A	5	—	—	—	—	—	—	5
12S-1	A	—	—	2	—	—	—	—	2
12S-2	A	—	—	2	—	—	—	—	2
12S-3	A	—	—	2	—	—	—	—	2
12S-4	D	—	—	—	1	—	—	—	1
97-12SL-844		—	—	4	—	—	—	—	4
CA12SA10	A	—	—	4	—	—	—	—	4
CA12S-2002-10	A	—	—	4	—	—	—	4	
145-1	A	—	—	3	—	—	—	—	3
1482	INST	—	—	4	—	—	—	—	4
14S-3	A	—	—	—	—	1	—	—	1
14S-5	INST	—	—	5	—	—	—	—	5
14S-6	INST	—	—	6	—	—		—	6
14S-7	A	—	—	3	—	—	—	—	3
14S-9	A	—	—	2	—	—	—	—	2
14S-10	INST	—	—	4	—	—	—	—	4
14S-11	INST	—	—	4	—	—	—	—	4
14S-12	A	—	—	3	—	—	—	—	3
14S-13	A	—	—	3	—	—	—	—	3
14S-11	INST	—	—	4	—	—	—	—	4
CA14S-2003-17	A	—	7	—	—	—	—	—	7
16S-1	A	—	—	7	—	—		—	7
16S-2	A	—	—	—	1	—	—	—	1
18S-3	E	—	—	1	—	—		—	1
16S-4	D	—	—	2	—	—	—	—	2
16S-5	A	—	—	2	—	1	—	—	3
16S-6	A	—	—	3	—	—	—	—	3
16S-7	A	—	—	2	—	1	—	—	3
16S-8	A	—	—	5	—	—	—	—	5
16-9	A	—	—	2	2	—	—	—	4
16-10	A	—	—	—	3	—	—	—	3

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
16-11	A	—	—	—	2	—	—	—	2
16-12	E	—	—	—	—	—	1	—	1
16S-14	A	—	—	3	—	—	—	—	3
16S-15	D	—	—	2	—	—	—	—	2
16S-16	D	—	—	2	—	—	—	—	2
16S-17	A	—	—	3	—	—	—	—	3
16-59	A	—	—	—	4	—	—	—	4
CA16S-2004-1B	A	—	—	7	—	—	—	—	7
CA16S-19	A	—	—	7	—	—	—	—	7
CA16S-2004-19	A	—	—	7	—	—	—	—	7
CA16S-2204-21	A	—	7	—	—	—	—	—	7
CA16S-2004-22	INST	—	8	—	—	—	—	—	8
18-1	A	—	—	10	—	—	—	—	10
18-3	D	—	—	—	2	—	—	—	2
18-4	D	—	—	4	—	—	—	—	4
18-5	D	—	—	1	2	—	—	—	3
18-6	D	—	—	—	—	—	1	—	1
18-7	B	—	—	—	—	1	—	—	1
18-8	A	—	—	7	1	—	—	—	8
18-9	INST	—	—	5	2	—	—	—	7
18-10	A	—	—	—	4	—	—	—	4
18-11	A	—	—	—	5	—	—	—	5
18-12	A	—	—	6	—	—	—	—	6
18-13	A	—	—	—	3	1	—	—	4
18-14	A	—	—	1	—	—	1	—	2
18-16	C	—	—	—	1	—	1	—	1
18-17	INST	—	—	5	2	—	—	—	7
18-18	INST	—	—	5	2	—	—	—	7
18-19	A	—	—	10	—	—	—	—	10
18-20	A	—	—	5	—	—	—	—	5
18-21	A	—	—	—	3	—	—	—	3
18-22	D	—	—	3	—	—	—	—	3
18-23	A	—	—	10	—	—	—	—	10
18-24	A	—	—	10	—	—	—	—	10
18-25	D	—	—	—	2	—	—	—	2
18-26	D	—	—	—	2	—	—	—	2
18-27	D	—	—	1	2	—	—	—	3

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
18-28	D	—	—	1	2	—	—	—	3
18-29	A	—	—	5	—	—		—	5
18-30	A	—	—	5	—	—	—	—	5
97-18-420	HIGH VOLTAGE	—	—	—	1	—	—	—	1
97-18-683	a	—	—	5	—	—	—	—	5
CA18-2005-3	A	—	—	10	—	—		—	10
CA18-2005-36	D	—	—	—	3	—	—	—	3
20-1	A	—	—	14	—	—	—	—	14
20-2	D	—	—	—	—	—	—	1	1
20-3	D	—	—	—	3	—	—	—	3
20-4	D	—	—	—	4	—	—	—	4
20-5	E	—	—	2	—	—	—	—	2
20-6	D	—	—	3	—	—	—	—	3
20-7	A, D	—	—	8	—	—	—	—	8
20-8	INST	—	—	4	—	2	—	—	6
20-9	A, D	—	—	7	1	—	—	—	8
20-10	A	—	—	4	—	—	—	—	4
20-11	INST	—	—	13	—	—	—	—	13
20-12	A	—	—	1	—	—	1	—	2
20-13	A	—	—	4	—	—	—	—	4
20-14	A	—	—	—	3	2	—	—	5
20-15	A	—	—	—	7	—	—	—	7
20-16	A	—	—	7	2	—	—	—	9
20-17	A	—	—	1	5	—	—	—	6
20-18	A	—	—	6	3	—	—	—	9
20-19	A	—	—	—	—	3	—	—	3
20-20	A	—	—	—	3	—	1	—	4
20-21	A	—	—	8	1	—	—	—	9
20-22	A	—	—	3	—	3	—	—	6
20-23	A	—	—	—	—	2	—	—	2
20-24	D	—	—	2	—	2	—	—	4
20-25	INST	—	—	13	—	—	—	—	13
20-27	A	—	—	14	—	—	—	—	14
20-29	A	—	—	17	—	—	—	—	17
20-30	INST	—	—	13	—	—	—	—	13
20-32	A, D	—	—	8	—	—	—	—	8
20-33	A	—	—	11	—	—	—	—	11

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
20-51	A	—	—	—	3	—	—	—	3
20-57	A	—	—	7	—	—	—	—	7
20-58	A	—	—	5	5	—	—	—	10
20-59	A	—	—	—	—	—	3	—	3
20-66		—	—	1	5	—	—	—	6
20-79	A, D	—	—	7	1	—	—	—	8
20-86		—	—	—	—	S(COAX)	—	—	3
97-20-629	A	—	—	—	4	—	—	4	
97-20-864		—	—	—	—	2	—	—	2
CA20-2006-16	INST	—	—	13	—	—	—	—	13
CA20-2006-37	D	—	—	—	4	—	—	—	4
CA20-2006-41	A	—	—	—	4	—	—	—	4
22-1	D	—	—	—	2	—	—	—	2
22-2	D	—	—	—	3	—	—	—	3
22-3	D	—	—	1	—	—	1	—	2
22-4	A	—	—	—	2	2	—	—	4
22-5	D	—	—	4	2	—	—	—	6
22-6	D	—	—	1	—	2	—	—	3
22-7	E	—	—	—	—	—	—	1	1
22-8	E	—	—	—	2	—	—	—	2
22-9	E	—	—	—	3	—	—	—	3
22-10	E	—	—	4	—	—	—	—	4
22-11	B	—	—	2	—	—	—	—	2
22-12	D	—	—	3	—	2	—	—	5
22-13	A, D	—	—	1	4	—	—	—	5
22-14	A	—	—	19	—	—	—	—	19
22-15	A, E	—	—	1	5	—	—	—	6
22-16	A	—	—	6	3	—	—	—	9
22-17	A, D	—	—	8	1	—	—	—	9
22-18	A, D	—	—	8	—	—	—	—	8
22-19	A	—	—	14	—	—	—	—	14
22-20	A	—	—	9	—	—	—	—	9
22-21	A	—	—	2	—	—	—	1	3
22-22	A	—	—	—	—	4	—	—	4
22-23	A, D	—	—	—	8	—	—	—	8
22-24	A, D	—	—	4	2	—	—	—	6
22-25	A	—	—	2	—	—	—	1	3

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size 20	18	16	12	8	4	0	Number of Contacts
22-26		—	—	5	2	—	—	—	7
22-27	A, D	—	—	8	—	1	—	—	9
22-28	A	—	—	—	7	—	—	—	7
22-29	A	—	—	6	—	—	1	—	7
22-30	A	—	—	19	—	—	—	—	19
22-31	B	—	—	2	—	—	—	—	2
22-32	D	—	—	4	2	—	—	—	6
22-33	A, D	—	—	7	—	—	—	—	7
22-34	D	—	—	2	3	—	—	—	5
22-63	A	—	—	8	4	—	—	—	12
22-65	A, D	—	—	—	8	—	—	—	8
22-70		—	—	5	8	—	—	—	13
22-80		—	—	—	3	—	—	—	3
97-22-570	A	—	—	9	—	—	—	—	9
97-22-871	D	—	—	4	2	—	—	—	6
CA22-2007-42	A	—	20	—	—	—	—	—	20
24-1	D	—	—	1	—	—	—	1	2
24-2	D	—	—	—	7	—	—	—	7
24-3	D	—	—	5	2	—	—	—	7
24-4	A	—	—	3	—	—	—	1	4
24-5	A	—	—	16	—	—	—	—	16
24-6	A, D	—	—	—	8	—	—	—	8
24-7	A	—	—	14	2	—	—	—	16
24-9	A	—	—	—	—	—	2	—	2
24-10	A	—	—	—	—	7	—	—	7
24-11	A	—	—	—	6	3	—	—	9
24-12	A	—	—	—	3	—	2	—	5
24-14	A	—	—	—	2	—	—	1	3
24-15	A	—	—	16	—	—	—	—	16
24-16	A, D	—	—	3	3	1	—	—	7
24-17	D	—	—	3	2	—	—	—	5
24-18		—	—	4	—	—	—	—	4
24-19	A	—	—	12	—	—	—	—	12
24-20	D	—	—	9	2	—	—	—	11
24-21	D	—	—	9	—	1	—	—	10
24-22	A	—	—	—	—	4	—	—	4
24-23	D	—	—	2	—	3	—	—	5

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
24-24	A	—	—	16	—	—	—	—	16
24-25	A, D	—	—	—	8	—	—	—	8
24-26	A, D	—	—	—	8	—	—	—	8
24-27	E	—	—	7	—	—	—	—	7
24-28	INST	—	—	24	—	—	—	—	24
24-51	A	—	—	—	—	5	—	—	5
24-52	HIGH VOLTAGE	—	—	—	1	—	—	-	1
24-53	A	—	—	—	—	5	—	—	5
24-58	A	—	—	—	—	5	—	—	5
24-59	A	—	—	7	7	—	—	—	14
24-60	A	—	—	—	—	7	—	—	7
24-65	A	—	—	4	11	—	—	—	15
24-66	A	—	—	—	7	—	—	—	7
24-67	INST	—	—	—	19	—	—	—	19
24-71	A	—	—	—	—	7	—	—	7
24-75	A	—	—	—	—	7	—	—	7
24-79	A	—	—	—	—	5	—	—	5
24-80	INST	—	—	23	—	—	—	—	23
24-84	A	—	—	19(18 COAX, 1 POWER)				—	19
24-85	INST	—	—	—	—	7(COAX)	—	—	7
97-24-620		—	—	3	2	—	—	—	5
97-24-684	A	—	—	12	—	—	—	—	12
97-24-710		—	—	4	—	—	—	—	4
97-24-835	HIGH VOLTAGE	—	—	—	1	—	—	—	1
97-24-865		—	—	6	—	—	—	—	6
CA24-2008-5	A	—	—	1	2	—	—	1	4
CA24-2008-7	B	—	—	—	4	—	—	—	4
CA24A24	A	—	—	—	12		—	—	12
CA24-2008-24	A	—	—	—	12	—	—	—	12
CA24-2008-35	A	—	—	14	2	—	—	—	16
CA24A40	A	—	—	14	2	—	—	—	16
CA24-2008-40	A	—	—	14	2	—	—	—	16
CA24A42	A	—	—	8	5	1	—	—	14
CA24-2008-42	A	—	—	8	5	1	—	—	14
CA24-2008-47	A	—	—	12	4	—	—	—	16
CA24A49	INST	ALL COAXIAL MICRODOT 93-3913						—	7
CA24A51	INST	—	—	13	5	1	—	—	19

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
28-1	A, D	—	—	—	6	3	—	—	9
28-2	D	—	—	12	2	—	—	—	14
28-3	E	—	—	—	—	3	—	—	3
28-4	D, E	—	—	7	2	—	—	—	9
28-5	D	—	—	2	1	—	2	—	5
28-6	D	—	—	—	—	3	—	—	3
28-7	D	—	—	—	—	—	2	—	2
28-8	A, D, E	—	—	10	2	—	—	—	12
28-9	D	—	—	6	6	—	—	—	12
28-10	A, D	—	—	—	3	2	2	—	7
28-11	A	—	—	18	4	—	—	—	22
28-12	A	—	—	26	—	—	—	—	26
28-13	A	—	—	26	—	—	—	—	26
28-14	D	—	—	11	—	—	—	—	11
28-15	A	—	—	35	—	—	—	—	35
28-16	A	—	—	20	—	—	—	—	20
28-17	A, B, D	—	—	15	—	—	—	—	15
28-18	A, B, D, INST	—	—	12	—	—	—	—	12
28-19	A, B	—	—	6	4	—	—	—	10
28-20	A	—	—	4	10	—	—	—	14
28-21	A	—	—	37	—	—	—	—	37
28-22	D	—	—	3	—	—	3	—	6
28-23	INST	—	—	21		3(SHIELDED)		—	24
28-24	INST	—	—	21		3(SHIELDED)		—	24
28-50	INST	—	—	21	—	3(COAX)	—	—	24
28-51	A	—	—	—	12	—	—	—	12
28-59	A	—	—	10	7	—	—	—	17
28-66	A	—	—	—	14	2	—	—	16
28-72		—	—	—	—	—	—	3(COAX)	3
28-74	A	—	—	9	—	7	—	—	16
28-75	A	—	—	9	—	7	—	—	16
28-79	A	—	—	9	—	7	—	—	16
28-82	D	—	—	—	4	2	—	—	6
28-84	A	—		—	—	9	—	—	9
28-AB	INST	—	—	21	—	3(COAX)	—	—	24
97-28-410	D	—	—	3	1	—	—	—	4
97-28-425		—	—	13	6	—	—	—	19

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
97-28-693	A	—	—	20	—	—	—	—	20
97-28-702		—	—	6	4	—	—	—	10
97-28-745	A	—	—	4	10	—	—	—	14
97-28-766		—	—	2	6	2	—	—	10
97-28-767		—	—	7	5	—	—	—	12
97-28-833		—	—	5	—	2	—	—	7
97-28-840		—	—	—	—	2	2	—	4
97-28-880		ALL COAXIAL							3
CA28-2009-5	A	—	—	1	—	—	2	—	3
CA28-2009-15	A	—	—	3	1	1	—	1	6
CA28A16	A	—	—	5	—	—	4	—	9
CA28-2009-16	A	—	—	5	—	—	4	—	7
CA28-2009-32	E	—	—	3	—	4	—	—	7
CA28-2009-33	HIGH VOLTAGE	—	—	1	—	—	—	—	1
CA28-2009-37	D	—	—	7	—	—	—	—	7
CA28-2009-38	D	—	—	4	—	—	4	—	8
CA28-2009-43		ALL COAXIAL							3
CA28-2009-44	A	18	—	21	2	—	—	—	41
CA28A45	A	—	—	17	—	—	—	—	17
CA28-2009-45	A	—	—	17	—	—	—	—	17
CA28A51	A	—	-43	—	—	—	—	—	43
CA28-2009-51	A	—	—	43	—	—	—	—	43
CA28-2009-53		—	—	9	—	—	—	—	9
CA28A55	A	—	—	—	29	—	—	—	29
CA28-2009-55	A	—	—	29	—	—	—	—	29
CA28-2009-56	A	—	—	64	—	—	—	—	64
32-1	D, E	—	—	—	3	—	—	2	5
32-2	E	—	—	2	—	—	3	—	5
32-3	D	—	—	4	2	—	2	1	9
32-4	A, D	—	—	12	2	—	—	—	14
32-5	D	—	—	—	—	—	—	2	2
32-6	A	—	—	16	2	3	2	—	23
32-7	A, INST	—	—	—	28	7	—	—	35
32-8	A	—	—	24	6	—	—	—	30
32-9	D	—	—	12	—	—	2	—	14
32-10	A, B, D, E	—	—	3	—	2	2	—	7
32-12	A, D	—	—	10	5	—	—	—	15

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size 20	18	16	12	8	4	0	Number of Contacts
32-13	D	—	—	18	5	—	—	—	23
32A13		—	—	—	13	—	—		13
32-14	D	—	—	—	5	—	2	—	7
32-15	D	—	—	—	6	—	—	2	8
32-16	A	—	—	16	2	3	2	—	23
32-17	D	—	—	—	—	—	4	—	4
32-18	A, D	—	—	12	2	—	—	—	14
32-19	D, E	—	—	—	3	—	—	2	5
32-20	A	—	—	16	2	3	2	—	23
32-22	A	—	—	54		—	—	—	54
32-52	D	—	—	—	6	—	—	2	8
32-53	E, INST	—	—	37	5	—	—	—	42
32-56	A	—	—	24	6	—	—	—	30
32-57	D	—	—	—	6	—	—	2(COAX)	8
32-58		—	—	—	—	—	4	(COAX)	4
32-59		—	—	40	—	2	—	—	42
32-60	A	—	—	15	—	8(COAX)	—	—	23
32-62		—	—	16	2	3	2	—	23
32-63		—	—	—	—	—	5	—	5
32-64	INST	—	—	54	—	—	—	—	54
32-68	A	—	—	12	—	—	4(COAX)	—	16
32-73	A		—	46	—	—	—	—	46
32-75	D	—	—	—	2	7(COAX)	—	—	9
32-76	A	—	—	—	19	—	—	—	19
32-79	A	—	—	—	—	1	4	—	5
32-85		—	—	16	2	3(COAX)	2	—	23
32-87	D	—	—	—	2(COAX)		7(COAX)	—	9
32-101	C, D	—	—	10+2COAX	—	—	—	—	12
32-102	A, C, D	—	—	13+1COAX	—	—	—	—	14
97-32-101	C, D	—	—	10+2COAX	—	—	—	—	12
97-32-102	A, C, D	—	—	13+1COAX	—	—	—	—	14
97-32-409	A	—	—	48	—	—	—	—	48
97-32-414	A	—	—	52	—	—	—	—	52
97-32-416		—	—	13+1COAX	—	—	—	—	14
97-32-417		—	—	10+2COAX	—	—	—	—	12
97-32-421		—	—	10+2COAX	—	—	—	—	12
97-32-422		—	—	10+2COAX	—	—	—	—	12

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size 20	18	16	12	8	4	0	Number of Contacts
97-32-428		—		— 13+1COAX —		—	—	—	14
97-32-429		—		— 10+2COAX —		—	—	—	12
97-32-722	A, B, D, E	—	—	3	—	2	2	—	7
97-32-810		—		— 10+2COAX—		—	—	—	12
97-32-811		—		— 13+1COAX—		—	—	—	14
CA32A10	A	—	—	54	—	—	—	—	54
CA32-2010-10	A	—	—	54	—	—	—	—	54
CA32-2010-11	A	—	—	13	1	—	—	1	15
CA32-2010-29	A	—	—	16	2	3	2	—	23
CA32-2010-30	D, E	—	—	—	3	—	—	2	5
CA32A43	D	—	—	—	3	—	3	—	6
CA32-2010-43		D	—	—	—	3	—	—	3
CA32A46		—	—	48	2	—	—	—	50
CA32-2010-46		—	—	48	2	—	—	—	50
CA32A47	A	—	—	47	—	—	—	—	47
CA32-2010-47	A	—	—	47	—	—	—	—	47
CA32A60	A	59	—	7	—	—	—	—	66
CA32-2010-60	A	59	—	7	—	—	—	—	66
CA32A65	A	—	—	28	4+2COAX	—	—	—	34
36-1	D	—	—	18	4	—	—	—	22
36-2	D	—	—	—	2	—	—	3	5
36-3	A	—	—	—	3	—	—	3	6
36-4	A, D	—	—	—	—	—	—	3	3
36-5	A	—	—	—	—	—	—	4	4
36-6	A	—	—	—	—	—	4	2	6
36-7	A	—	—	40	7	—	—	—	47
36-8	A	—	—	46	1	—	—	—	47
36-9	A	—	—	14	14	2	1	—	31
36-10	A	—	—	48	—	—	—	—	48
36-11	A	—	—	48	—	—	—	—	48
36-12	A	—	—	48	—	—	—	—	48
36-13	A, E	—	—	15	2	—	—	—	17
36-14	D	—	—	6	5	5	—	—	16
36-15	A, D	—	—	35	—	—	—	—	35
36-16	A	—	—	40	7	—	—	—	47
36-17	A	—	—	40	7	—	—	—	47
36-18	A	—	—	14	14	2	1	—	31

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
36-19	D	—	—	10	5	—	1	1	17
36-20	A	—	—	30	2	2	—	—	34
36-21	A	—	—	14	14	2	1	—	31
36-51	D	—	—	—	—	—	2	2	4
36-52	A	—	—	52	—	—	—	—	52
36-54	A	—	—	31	—	8	—	—	39
36-55	A	—	—	31	—	8	—	—	39
36-59	A	—	—	50	3	—	—	—	53
36-60		—	—	40	7	—	—	—	47
36-63		—	—	48	—	—	—	—	48
36-64		—	—	—	—	—	—	4(COAX)	4
36-65	A	—	—	—	—	—	—	4(COAX)	4
36-66	A	—	—	52	4	—	—	—	56
36-71	A	—	50	3	—	—	—	—	53
36-73		—	—	—	—	—	7(COAX)	—	7
36-74	A	—	—	43	—	1(COAX)	—	—	44
36-75	A	—	—	48	—	—	—	—	48
36-76	A	—	—	47	—	—	—	—	47
36-77	D	—	—	—	—	—	7	—	7
36-78	A	—	—	2	—	12	—	—	14
36-79	A	—	—	—	20	—	—	—	20
36-80	A	—	—	—	20	—	—	—	20
36-83		—	—	—	—	—	7(COAX)	—	7
36-85	A, D	—	—	35	—	—	—	—	35
97-36-403	A	—	—	52	—	—	—	—	52
97-36-404	A	—	—	52	—	—	—	—	52
97-36-405	HIGH VOLTAGE	—	—	—	15	—	—	—	15
97-36-406	A	—	—	16	18	2	1	—	37
97-36-407		—	—	12	3	—	—	—	15
97-36-646	D	—	—	6	5	5	—	—	16
97-36-648	A, E	—	—	15	2	—	—	—	17
97-36-853		—	—	5	2	—	—	—	7
CA36-2011-4	A	—	—	12	3	—	1	1	17
CA36-2011-11	A	—	—	25	1	—	—	1	27
CA36A12	A	—	—	18	—	—	—	2	20
CA36-2011-12	A	—	—	18	—	—	—	2	20
CA36A16	A	—	—	—	18	—	—	—	18

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
CA36-2011-16	A	—	—	—	18	—	—	—	18
CA36A34	A	—	—	52	—	—	—	—	52
CA36-2011-34	A	—	—	52	—	—	—	—	52
CA36A35	A	—	—	4	—	—	4	—	8
CA36-2011-35	A	—	—	4	—	—	4	—	8
CA36-2011-37	E	—	—	—	9	—	—	—	9
CA36A41	A	—	—	4	—	—	4	—	8
CA36-2011-41	A	—	—	4	—	—	4	—	8
CA36A46	A	—	—	—	27	—	—	—	27
CA36-2011-46	A	—	—	—	27	—	—	—	27
CA3647	B	—	—	—	—	—	—	3	3
CA36-2011-47	B	—	—	—	—	—	—	3	3
CA3650	B	—	—	—	—	3	4	—	7
CA36-2011-50	B	—	—	—	—	3	4	—	7
CA36A63	A	—	—	18+2(COAX)		—	—	—	20
CA36-2011-63	A	—	—	18+2(COAX)		—	—	—	20
CA36-2011-65	A	—	—	28	4+2(COAX)		—	—	34
CA36A66	A	—	—	52	4	—	—	—	56
CA36-2011-66	A	—	—	52	4	—	—	—	56
CA36A70	A	—	—	5	—	—	11	—	16
CA36-2011-70	A	—	—	5	—	—	11	—	16
CA36A71	A	—	—	4	2+4(COAX)	—	—	—	10
CA36-2011-71	A	—	—	4	2+4(COAX)	—	—	—	10
CA36-2011-77		—	—	12	—	—	—	—	12
CA36-2011-79	A	—	—	52	4	—	—	—	56
CA36A83		—	—	7(COAX)	—	—	—	—	7
CA36-2011-83		—	—	7(COAX)	—	—	—	—	7
CA36A86		—	—	7(COAX)	—	—	—	—	7
CA36A89		—	—	7(COAX)	—	—	—	—	7
CA36A90	D	—		12	—	4	—	2	18
CA36A91	A	—	—	30	2	+2(COAX)	—	—	34
CA36A93	A	—	—	—	2	—	4	—	6
CA36A95	A	—	—	65	—	—	—	—	65
40-1	D	—	—	24	6	—	—	—	30
40-2	B, D	—	—	23	—	—	—	—	23
40-3	D	—	—	18	4	—	1	—	23
40-4	D	—	—	16	2	3	2	—	23

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
40-5	A	—	—	—	6	4	2	3	15
40-6	D	—	—	24	1	—	—	1	26
40-7	A, D	—	—	18	2	—	—	2	22
40-9	A	—	—	24	22	1	—	—	47
40-10	A	—	—	16	—	9	4	—	29
40-11	D	—	—	18	4	1	1	1	25
40-12	D	—	—	22	6	—	—	1	29
40-13	B, D	—	—	23	—	—	—	—	23
40-14	D	—	—	21	10	—	—	1	32
40-15	A	—	—	57	—	3	—	—	60
40A31	D	—	—	—	31	—	—	—	31
40A35	D	—	—	—	35	—	—	—	35
40-b3	A	—	—	60	—	—	—	—	60
40-56	A	—	—	85	—	—	—	—	85
40-57	E	—	—	—	—	—	—	4	4
40A60	A	—	—	60	—	—	—	—	60
40-61	A	—	—	55	3	1	—	—	59
40-62	A	—	—	60	—	—	—	—	60
40-63	A	—	—	61	—	—	—	—	61
40-64	A	—	—	20	3	13(COAX)	—	—	36
40-66		—	—	—	—	—	—	4(COAX)	4
40-67	A	—	—	1	—	—	10(COAX)		11
40-68	A	—	—	—	—	21	—	—	21
40-70	A	—	—	61	—	—	—	—	61
40-72	A	—	—	1	—	10(COAX)			11
40-73	A	—	—	61	—	—	—	—	61
40-74	A	—	—	—	1	—	1(COAX)	4(COAX)	6
40-76	D	—	—	—	1	—	—	4	5
40-80	A	—	—	1	—	—	10	—	11
40-81	A	—	—	62	—	—	—	—	62
40-82	A	—	—	62	—	—	—	—	62
40-85	A	—	—	60	—	—	—	—	60
40-86		—	—	—	—	—	—	4(COAX)	4
40-87	D	—	—	—	—	—	7	—	7
40-98	A	—	—	57	—	3(COAX)		—	60
40-99	A	—	—	57	—	3(COAX)		—	60
97-40-60	A	—	—	—	—	—	—	6	6

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
CA40A27	A	—	—	60	—	—	—	—	60
CA40-2012-27	A	—	—	60	—	—	—	—	60
CA40A28	A	—	—	—	—	—	—	4	4
CA40-2012-28	A	—	—	—	—	—	—	4	4
CA40A31	A	—	—	48	3	—	—	1(COAX)	52
CA40-2012-31	A	—	—	48	3	—	—	1(COAX)	52
CA40A32		ALL COAX							7
CA40-2012-32		ALL COAX							7
CA40-2012-33	A	—	—	—	—	7	6	—	13
CA40A34		ALL COAX							3
CA40-2012-34		ALL COAX							3
CA40A40	A	—	—	1	—	—	—	4	5
CA40A41		—	—	—	—	—	4(COAX)	—	4
CA40A56	A	—	—	85	—	—	—	—	85
CA40A67	A	—	—	1+10(COAX)		—	—	—	11
CA40C73	A	—	—	61	—	—	—	—	61
CA40A74	A	—	—	—	1+5(COAX)	—	—	—	6
CA40A75	E	—	—	—	1	—	—	4	5
CA40ABI	A	—	—	62	—	—	—	—	62
CA40A82	A	—	—	62	—	—	—	—	62
44-1	D	—	—	36	6	—	—	—	42
44-2	D	—	—	14	14	2	1	—	31
44-3	D	—	—	24	3	2	2	—	31
44-4	D	—	—	31	8	—	—	2	41
44-5	D	—	—	36	6	—	—	—	42
44-6	D	—	—	36	6	—	—	—	42
44-52	A	—	—	104	—	—	—	—	104
44-53	A	—	—	18	—	18(COAX)	—	—	36
CA44-2013-15		A	—	—	64	3+1(COAX)	—	—	68
CA44-2013-16		A	—	—	12	2+1(COAX)	—	—	15
CA44-2013-17	A	—	—	30	—	—	4	—	34
CA44-2013-19	B, D, E	—	—	4+4(COAX)	—	—	—	—	8
CA44-2013-26	A	—	—	—	—	—	—	6	6
48-1	D, E	—	—	—	6	4	2	3	15
48-2	DE	—	—	46	1	—	—	—	47
48-3	D	—	—	18	1	3	—	3	25
48-4	A, D	—	—	47	1	—	—	2	65

TABLE 9. MIL-C-5015 AND LOCKHEED LS13583 AND LS13585 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
48-5	A	—	—	90	9	1	—	—	100
48-51	A	—	—	42	—	10	—	4	56
48-52	D	—	—	56	—	—	—	5	61
48-53		—	—	—	37	—	—	—	37
48-54	A	—	—	42	—	10	—	4(COAX)	56
48-6E	A	—	—	68	2	2	6	—	78
48-57	A	—	—	42	—	10	—	4	56
48-60	A	—	—	42	—	10	—	4(COAX)	56
48-62	D	—		85		—	—	—	85
CA48-2014-9	A	—	—	88	3	3	—	—	94
CA48-2014-10	A	—	—	99	—	3	—	—	102
CA48-2014-11	A	—	—	18	3	—	3(COAX)		24
CA48-2014-12	A	—	—	72	—	—	1	—	73

NOTE:

Service Rating	Operating Voltage	
	DC	AC(RMS)
INST	250	200
A	700	500
D	1250	900
E	1758	1250
B	2450	1750
C	4200	3000

TABLE 10. MIL-C-83723 SERIES I INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Contacts Size (Note 2)				Number of Contacts
		20	16	12	8	
6-1	1	1	—	—	—	1
8-2	1	2	—	—	—	2
8-3	1	3	—	—	—	3
8-3A	1	3	—	—	—	3
8-4	1	4	—	—	—	4
8-3	1	3	—	—	—	3
8-60 (8-3)	1	Thermocouple 1-IR, 1-CON, 1-CU				3
8-61 (8-4)	1	Thermocouple 1-IR, 1-CON, 2-CU				4
8-62 (3-2)	1	Thermocouple 1-CH, 1-CON				2
8-63 (3-4)	1	Thermocouple 1-CH, 1-AL, 2-CU				4
8-80 (3-4)	1	Thermocouple 2-AL, 2-CH				4
8-82 (3-2)	1	Thermocouple 1-AL, 1-CH				2
8-83 (13-3)	1	Thermocouple 1-AL., 1-CH, +1 No. 20				3
8-84 (8-4)	1	Thermocouple 2-IR, 2-CON				4
8-86 (8-4)	1	Thermocouple 2-CH, 2-CON				4
8-87 (8-3)	1	Thermocouple 1-CON, +2 No. 20				3
8-88 (8-4)	1	Thermocouple 2-CON, +2 No. 20				4
8-89 (8-3)	1	Thermocouple 1-CH, 1-CON, +1 No. 20				3
8-98	1	3	—	—	—	3
10-1	1	1 No. 8 COAX				1
10-2	1	—	2	—	—	2
10-	1	5	—	—	—	5
10-6	1	6	—	—	—	6
10-71	COAXIAL	3+1 No. 12 COAX				4
10-80 (10-6)	1	Thermocouple 1-AL, 1-CH, +4 No. 20				6
10-81 (10-6)	1	Thermocouple 3-AL, 3-CH				6
10-82 (10-6)	1	Thermocouple 1-AL, 1-CH, 1-IR, 1-CON, +2 No. 20				6
10-83 (10-6)	1	Thermocouple 1-AL, -CH, +4 No. 20				6
10-85 (10-6)	1	Thermocouple 2-AL, 2-CH, +2 No. 20				6
10-98	1	6	—	—	—	6
10-99	1	7	—	—	—	7
12-3	11	—	3	—	—	3
12A3	1	—	2	—	—	2

TABLE 10. MIL-C-83723 SERIES I INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Contacts Size (Note 2)				Number of Contacts
		20	16	12	8	
12-4	1	—	4	—	—	4
12-6	1	6	—	—	—	6
12-8	1	8	—	—	—	8
12-10	I	10	—	—	—	10
12-14	1	14	—	—	—	14
12-80 (12-10)	1	Thermocouple 5-AL, 5-CH				10
12-81(12-10)	1	Thermocouple 5-AL; 5-CH				10
12-85 (12-10)	1	Thermocouple 5-IR, 5-CON				10
12-87 (12-8)	1	Thermocouple 1-AL, 1-CH, +6 No. 20				8
12-88 (12-10)	1	Thermocouple 1-AL, I-CH, +8 No. 20				10
12-89 (12-10)	1	Thermocouple 2-CON, +8 No. 20				10
18-72	COAXIAL	10 +4 No. 12 COAX				14
18-75	COAXIAL	4 No. 8 COAX				4
18-76	COAXIAL	3 No. 12 and 1 No. 8 COAX				4
18-80	11	6+2 No. 8 COAX				8
18-84	11	—	11	—	—	11
18-85	1	5	—	8	—	13
18-88	1	4	—	—	4	8
18-90	HIGH VOLTAGE	3 (HIGH VOLTAGE)				3
18-91	HIGH VOLTAGE	6 (HIGH VOLTAGE)				6
18-92	HIGH VOLTAGE	4 (HIGH VOLTAGE)				4
20-8	1	—	8	—	—	8
20-16	11	—	16	—	—	16
20-24	1	24	—	—	—	24
20-25	1	25	—	—	—	25
20-26	1	20	—	6	—	26
20-27	1	2l	—	—	—	27
20-39	1	37	2	—	—	39
20-41	1	27	14	—	—	41
20-70	COAXIAL	10 +4 No. 8 COAX				14
20-71	COAXIAL	2 +8 No. 12 COAX				10
20-73	COAXIAL	8 +2 No. 8 COAX				10
20-84 (2041)	1	Thermocouple 3-AL, 3-CH, +35 No. 20				41
20-85 (2041)	1	Thermocouple 1-AL, 1-CH, +39 No. 20				41

TABLE 10. MIL-C-83723 SERIES I INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Contacts Size (Note 2)				Number of Contacts
		20	16	12	8	
20-90	1	3	—	12	—	15
20-90	HIGH VOLTAGE	7 (HIGH VOLTAGE)				7
22-A	HIGH VOLTAGE	3 +1 (HIGH VOLTAGE)				4
22-7	COAXIAL	ALL No. 8 COAX				7
22-8	11	—	8	—	—	8
22-12	1	—	—	12	—	12
22-19	1	—	—	19	—	19
22-21	11	—	21	—	—	21
22-25	1	—	25	—	—	25
22-32	1	32	—	—	—	32
22-34	1	34	—	—	—	34
22-36	1	36	—	—	—	36
22-37	1	31	6	—	—	37
224-1	1	27	14	—	—	41
22A41	1	27	14	—	—	41
22-53	1	53	—	—	—	53
22-55	1	55	—	—	—	55
22-70	COAXIAL	13 +6 No. 8 COAX		19		19
22-71	COAXIAL	2 +7 No. 9 COAX				9
22-72	COAXIAL	12	4 +3 No. 8 COAX			19
22-75	COAXIAL	ALL No. 8 COAX				7
22-77	COAXIAL	ALL No. 8 COAX				7
22-78	COAXIAL	ALL No. 8 COAX				7
22-79	COAXIAL	ALL No. 12 COAX				7
22-84 02-25)	1	Thermocouple 27-AL, 27-CH +1 No. 20				55
22-85 (22-65)	1	Thermocouple 8-AL, 8-CH +9 No. 20				55
22-86 (22-55)	1	Thermocouple 12-AL, 12-CH +31 No. 20				55
22-95	1	26	—	6	—	32
22-96	1	—	—	—	7	7
22-96	1	—	—	7	—	7
22-97	11	—	16	—	—	16
22-99	31	—	11	—	—	11

TABLE 10. MIL-C-83723 SERIES I INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I	Service Rating (Note 1)	Contacts Size (Note 2)				Number of Contacts
		20	16	12	8	
224A2	COAXIAL	1 +7 COAX	—	8	—	
24-4	1	8	—	—	—	8
24A4	COAXIAL	1 +7 COAX				8
24A8	COAXIAL	1 +7 COAX				8
24A9	COAXIAL	1 +7 COAX				8
24-19	11	—	—	21	—	21
24-25	1	9	8	8	—	25
24-27	1	11	16	—	—	27
24-31	1	31	—	—	—	31
24A31	1	—	31	—	—	31
24-51	1	47 +4 No. 12 COAX				51
24A57	1	5	—	2	—	57
24-61	1	6	—	—	—	61
24-71	1	45	2 +2 No. 8 COAX			49
24-79	COAXIAL	1 +5 No. 8 COAX 11				6
24-80 (24-61)	1	Thermocouple 31-CON +3- No. 20				61
24-82 (24-61)	1	Thermocouple 9-AL, 9-CH, +43 No. 20				61
24-83 (24-61)	1	Thermocouple 26-AL, 26-CH, +9 No. 20				61

NOTES:

1.

Condition 1500	Service Rating I	Service Rating II
Sea Level	1500	2300
50,000 Feet	500	750
70,000 Feet	375	500
110,000 Feet	200	500

2. All thermocouple contacts are size 20 contacts.

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
8-1	A	—	—	1	—	—	—	—	1
10-2	A	—	—	1	—	—	_	—	1
10-3	A	—	—	3	—	—	_	—	3
10-4	A	—	—	2	—	—	—	—	2
12-1	A	—	—	2	—	—	—	—	2
12-2	A	—	—	2	—	—	—	—	2
12-3	A	—	—	2	—	—	—	—	2
12-4	D	—	—	—	1	—	—	—	1
14-1	A	—	—	3	—	—	—	—	3
14-2	INST	—	—	4	—	—	—	—	4
14-3	A	—	—	—	—	1	—	—	1
14-5	INST	—	—	5	—	—	—	—	5
14-6	INST	—	—	6	—	—	—	—	6
14-7	A	—	—	3	—	—	—	—	3
14-9	A	—	—	2	—	—	—	—	2
14-10	INST	—	—	4	—	—	—	—	4
14-11	INST	—	—	4	—	—	—	—	4
14-12	A	—	—	3	—	—	—	—	3
14-13	A	—	—	3	—	—	—	—	3
16-1	A	—	—	7	—	—	—	—	7
16-2	A	—	—	—	1	—	—	—	1
16-3	E	—	—	1	—	—	—	—	1
16-4	D	—	—	2	—	—	—	—	2
16-5	A	—	—	2	—	1	—	—	3
16-6	A	—	—	3	—	—	—	—	3
16-7	A	—	—	2	—	1	—	—	3
16-8	A	—	—	5	—	—	—	—	5
16-9	A	—	—	2	2	—	—	—	4
16-10	A	—	—	—	3	—	—	—	3
16-11	A	—	—	—	2	—	—	—	2

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
16-12	E	—	—	—	—	—	1	—	1
16-14	A	—	—	3	—	—	—	—	3
16-15	D	—	—	2	—	—	—	—	2
16-16	D	—	—	2	—	—	—	—	2
16-17	A	—	—	3	—	—	—	—	3
16-59	A	—	—	—	4	—	—	—	4
18-1	A	—	—	10	—	—	—	—	10
18-3	D	—	—	—	2	—	—	—	2
18-4	D	—	—	4	—	_	—	—	4
18-5	D	—	—	1	2	_	—	—	3
18-6	D	—	—	—	—		1	—	1
18-7	g	—	—	—	—	1	—	—	1
18-8	A	—	—	7	1	—	—	—	8
18-9	INST	—	—	5	2	—	—	—	7
18-10	A	—	—	—	4	—	—	—	4
18-11	A	—	—	—	5	—	—	—	5
18-12	A	—	—	6	—	—	—	—	6
18-13	A	—	—	—	3	1	—	—	4
18-14	A	—	—	1	—	—	1	—	2
18-16	C	—	—	—	1	—	—	—	1
18-17	INST	—	—	5	2	—	—	—	7
18-18	INST	—	—	5	2	—	—	—	7
18-19	A	—	—	10	—	—	—	—	10
18-20	A	—	—	5	—	—	—	—	5
18-21	A	—	—	—	3	—	—	—	3
18-22	D	—	—	3	—	—	—	—	3
18-23	A	—	—	10	—	—	—	—	10
18-24	A	—	—	10	—	—	—	—	10
18-25	D	—	—	—	2	—	—	—	2
18-26	D	—	—	—	2	—	—	—	2
18-27	D	—	—	1	2	—	—	—	3
18-28	D	—	—	1	2	—	—	—	3
18-29	A	—	—	5	—	—	—	—	5
18-30	A	—	—	5	—	—	—	—	5

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
20-1	A	—	—	14	—	—	—	—	14
20-2	D	—	—	—	—	—	—	1	1
20-3	D	—	—	—	3	—	—	—	3
20-4	D	—	—	—	4	—	—	—	4
20-5	E	—	—	2	—	—	—	—	2
20-6	D	—	—	3	—	—	—	—	3
20-7	A, D	—	—	8	—	—	—	—	8
20-8	INST	—	—	4	—	2	—	—	6
20-9	A, D	—	—	7	1	—	—	—	8
20-10	A	—	—	4	—	—	—	—	4
20-11	INST	—	—	13	—	—	—	—	13
20-12	A	—	—	1	—	—	1	—	2
20-13	A	—	—	4	—	—	—	—	4
20-14	A	—	—	—	3	2	—	—	5
20-15	A	—	—	—	7	—	—	—	7
20-16	A	—	—	7	2	—	—	—	9
20-17	A	—	—	1	5	—	—	—	6
20-18	A	—	—	6	3	—	—	—	9
20-19	A	—	—	—	—	3	—	—	3
20-20	A	—	—	—	3	—	1	—	4
20-21	A	—	—	8	1	—	—	—	9
20-22	A	—	—	3	—	3	—	—	6
20-23	A	—	—	—	—	2	—	—	2
20-24	D	—	—	2	—	2	—	—	4
20-25	INST	—	—	13	—	—	—	—	13
20-27	A	—	—	14	—	—	—	—	14
20-28	A	—	—	5	5	—	—	—	10
20-29	A	—	—	17	—	—	—	—	17
20-30	INST	—	—	13	—	—	—	—	13
20-32	A, D	—	—	8	—	—	—	—	8
20-33	A	—	—	11	—	—	—	—	11
20-61	A	—	—	—	—	3	—	—	3
20-57	A	—	—	7	—	—	—	—	7
20-59	A	—	—	—	—	3	—	—	3

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
20-66		—	—	1	5	—	—	—	6
20-79	A, D	—	—	7	1	—	—	—	8
20-86		—	—	—	—	3(COAX)	—	—	3
22-1	D	—	—	—	—	2	—	—	2
22-2	D	—	—	—	—	3	—	—	3
22-3	D	—	—	1	—	—	1	—	2
22-4	A	—	—	—	2	2	—	—	4
22-5	D	—	—	4	2	—	—	—	6
22-6	D	—	—	1	—	2	—	—	3
22-7	E	—	—	—	—	—	—	1	1
22-8	E	—	—	—	2	—	—	—	2
22-9	E	—	—	—	3	—	—	—	3
22-10	E	—	—	4	—	—	—	—	4
22-11	$	—	—	2	—	—	—	—	2
22-12	D	—	—	3	—	2	—	—	5
22-13	A, D	—	—	1	4	—	—	—	5
22-14	A	—	—	19	—	—	—	—	19
22-15	AE	—	—	1	5	—	—	—	6
22-16	A	—	—	6	3	—	—	—	9
22-17	A, D	—	—	8	1	—	—	—	9
22-18	A, D	—	—	8	—	—	—	—	8
22-19	A	—	—	14	—	—	—	—	14
22-20	A	—	—	9	—	—	—	—	9
22-21	A	—	—	2	—	—		1	3
22-22	A	—	—	—	—	4	—	—	4
22-23	A, D	—	—	—	8	—	—	—	8
22-24	A, D	—	—	4	2	—	—	—	6
22-25	A	—	—	2	—	—	—	1	3
22-26		—	—	5	2	—	—	—	7
22-27	A, D	—	—	8	—	1	—		9
22-28	A	—	—	—	7	—	—	—	7
22-29	A	—	—	6	—	—	1	—	7
22-30	A	—	—	19	—	—	—	—	19
22-31	B	—	—	2	—	—	—	—	2

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
22-32	D	—	—	4	2	—	—	—	6
22-33	A, D	—	—	7	—	—	—	—	7
2234	D	—	—	2	3	—	—	—	5
22-63	A	—	—	8	4	—	—	—	12
22-65	A, D	—	—	—	8	—	—	—	8
22-70		—	—	5	8	—	—	—	13
22-80		—	—	—	3	—	—	—	3
24-1	D	—	—	1	—	—	—	1	2
24-2	D	—	—	—	7	—	—	—	7
24-3	D	—	—	5	2	—	—	—	7
24-4	A	—	—	3	—	—	—	1	4
24-5	A	—	—	16	—	—	—	—	16
24-6	A, D	—	—	—	8	—	—	—	8
24-7	A	—	—	14	2	—	—	—	16
24-9	A	—	—	—	—	—	2	—	2
24-10	A	—	—	—	—	7	—	—	7
24-11	A	—	—	—	6	3	—	—	9
24-12	A	—	—	—	3	—	2	—	5
24-14	A	—	—	—	2	—	—	1	3
24-15	A	—	—	16	—	—	—	—	16
24-16	A, D	—	—	3	3	1	—	—	7
24-17	D	—	—	3	2	—	—	—	5
24-18		—	—	4	—	—	—	—	4
24-19	A	—	—	12	—	—	—	—	12
24-20	D	—	—	9	2	—	—	—	11
24-21	D	—	—	9	—	1	—	—	10
24-22	A	—	—	—	—	3	—	—	4
24-23	D	—	—	1	—	3	—	—	5
24-24	A	—	—	16	—	—	—	—	16
24-25	A, D	—	—	—	8	—	—	—	8
24-26	A, D	—	—	—	8	—	—	—	8
24-27	E	—	—	7	—	—	—	—	7
24-28	INST	—	—	24	—	—	—	—	24
24-51	A	—	—	—	—	5	—	—	5

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size 20	18	16	12	8	4	0	Number of Contacts
24-52	HIGH VOLTAGE	—	—	—	1	—	—	—	1
24-53	A	—	—	—	—	5	—	—	5
24-58	A	—	—	—	—	5	—	—	5
24-5S	A	—	—	7	7	—	—	—	14
24-60	A	—	—	—	—	7	—	—	7
24-65	A	—	—	4	11	—	—	—	15
24-86	A	—	—	—	7	—	—	—	7
24-67	INST	—	—	—	19	—	—	—	19
24-71	A	—	—	—	—	7	—	—	7
24-75	A	—	—	—	—	7	—	—	7
24-79	A	—	—	—	—	5	—	—	5
24-80	INST	—	—	23	—	—	—	—	23
24-84	A	—	—	—	19(18 COAX, 1 POWER)			—	19
24-85	INST	—	—	—	—	7(COAX)	—	—	7
28-1	D	—	—	—	6	-3	—	—	9
28-2	D	—	—	12	2	—	—	—	14
28-3	E	—	—	—	—	3	—	—	3
28-4	D,E	—	—	7	2	—	—	—	9
28-5	D	—	—	2	1	—	2	—	6
28-6	D	—	_	—	—	—	3	—	3
28-7	D	—	—	—	—	—	2	—	2
28-8	A, D, E	—	—	10	2	—	—	—	12
28-9	D	—		6	6	—	—	—	12
28-10	A, D	—	—	—	3	2	2	—	7
28-11	A	—	—	18	4	—	—	—	22
28-12	A	—	—	26	—	—	—	—	26
28-13	A	—	—	26	—	—	—	—	26
28-14	D	—	—	11	—	—	—	—	11
28-15	A	—	—	35	—	—	—	—	35
28-16	A	—	—	20	—	—	—	—	20
28-17	A, B, D	—	—	15	—	—	—	—	15
28-18	A, B, D, INST	—	—	12	—	—	—	—	12
28-19	A, B	—	—	6	4	—	—	—	10
28-20	A	—	—	4	10	—	—	—	14

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
28-21	A	—	—	37	—	—	—	—	37
28-22	D	—	—	3	—	—	3	—	6
28-23	INST	—	—	21	—	3(SHIELDED)		—	24
28-24	INST	—	—	21	—	3(SHIELDED)		—	24
28-50	INST	—	—	21	—	3(COAX)	—	—	24
28-51	A	—	—	—	12	—	—	—	12
28-59	A	—	—	10	7	—	—	—	17
28-66	A	—	—	—	14	2	—	—	16
28-72		—	—	—	—	—	—	3(COAX)	3
28-74	A	—	—	9	—	7	—	—	16
28-75	A	—	—	9	—	7	—	—	16
28-79	A	—	—	9	—	7	—	—	16
28-82	D	—	—	—	4	2	—	—	6
28-84	A	—	—	—	—	9	—	—	9
28-AB	INST	—	—	21	—	3(COAX)	—	—	24
32-1	D,E	—	—	—	3	—	—	2	5
32-2	E	—	—	2	—	—	3	—	5
32-3	D	—	—	4	2	—	2	1	9
32-4	A, D	—	—	12	2	—	—	—	14
32-5	D	—	—	—	—	—	—	2	2
32-6	A	—	—	16	2	3	2	—	23
32-7	INST	—	—	—	28	7	—	—	35
32-8	A	—	—	24	6	—	—	—	30
32-9	D	—	—	12	—	—	2	—	14
32-10	A, B, D, E	—	—	3	—	2	2	—	7
32-12	A, D	—	—	10	5	—	—	—	15
32-13	D	—	—	18	5	—	—	—	23
32A13		—	—	—	13	—	—	—	13
32-14	D	—	—	—	5	—	2	—	7
32-15	D	—	—	—	6	—	—	2	8
32-16	A	—	—	16	2	3	2	—	23
32-17	D	—	—	—	—	—	4	—	4
32-18	A, D	—	—	12	2	—	—	—	14
32-19	DE	—	—	—	3	—	—	2	5

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
32-20	A	—	—	16	2	3	9	—	23
32-22	A	—	—	54	—	—	—	—	54
32–52	D	—	—	—	6	—	—	2	8
32-53	E, INST	—	—	37	5	—	—	—	42
32-56	A	—	—	24	6	—	—	—	30
32-57	D	—	—	—	6	—	—	2(COAX)	8
32-58		—	—	—	—	—	4	(COAX)	4
32-59		—	—	40	—	2	—	—	42
32-60	A	—	—	15	—	8(COAX)	—	—	23
32-62		—	—	16	2	3	2	—	23
32-63		—	—	—	—	—	5	—	5
32-64		—	—	54	—	—	—	—	54
32-68	a	—	—	12	—	—	4(COAX)	—	16
32-73	A	—	—	46	—	—	—	—	46
32-75	D	—	—	—	2	7(COAX)	—	—	9
32-76	A	—	—	—	19	—	—	—	19
32-79	A	—	—	—	—	1	4	—	5
32-85		—	—	16	2	3(COAX)	2	—	23
32-87	D	—	—	—	2(COAX)		7(COAX)	—	9
32-101	C, D	—	—	10+2 COAX	—	—	—	—	12
32-102	A, C,D	—	—	13+1 COAX	—	—	—	—	14
36-1	D	—	—	18	4	—	—	—	22
36-2	D	—	—	—	2	—	—	3	5
36-3	A	—	—	—	3	—	—	3	6
36-4	A, D	—	—	—	—	—	—	3	3
36-5	A	—	—	—	—	—	—	4	4
36-6	A	—	—	—	—	—	4	2	6
36-7	A	—	—	40	7	—	—	—	47
36-8	A	—	—	46	1	—	—	—	47
36-9	A	—	—	14	14	2	1	—	31
36-10	A	—	—	48	—	—	—	—	48
36-11	A	—	—	48	—	—	—	—	48
36-12	A	—	—	48	—	—	—	—	48
36-13	A, E	—	—	15	2	—	—	—	17

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
36-14	D	—	—	6	5	5	—	—	16
36-15	A, D	—	—	35	—	—	—	—	35
36-16	A	—	—	40	7	—	—	—	47
36-17	A	—	—	40	7	—	—	—	47
36-18	A	—	—	14	14	2	1	—	31
36-19	D	—	—	10	5	—	1	1	17
36-20	A	—	—	30	2	2	—	—	34
36-21	A	—	—	14	14	2	1	—	31
36-51	D	—	—	—	—	—	2	2	4
36-52	A	—	—	52	—	—	—	—	52
36-54	A	—	—	31	—	8	—	—	39
36-55	A	—	—	31	—	8	—	—	39
36-59	A	—	—	50	3	—	—	—	53
36-60		—	—	40	7	—	—	—	47
36-63		—	—	48	—	—	—	—	48
36-64		—	—	—	—	—	—	4(COAX)	4
36-65	A	—	—	—	—	—	—	4(COAX)	4
36-66	A	—	—	52	4	—	—	—	56
36-71	A	—	50	3	—	—	—	—	53
36-73		—	—	—	—	—	7(COAX)	—	7
36-74	A	—	—	43	—	1(COAX)	—	—	44
36-75	A	—	—	48	—	—	—	—	48
36-76	A	—	—	47	—	—	—	—	47
36-77	D	—	—	—	—	—	7	—	7
36-78	A	—	—	2	—	12	—	—	14
36-79	A	—	—	—	20	—	—	—	20
36-80	A	—	—	—	20	—	—	—	20
36-83	—	—	—	—	—	7(COAX)	—	—	7
36-85	A, D	—	—	35	—	—	—	—	35
40-1	D	—	—	24	6	—	—	—	30
40-2	B, D	—	—	23	—	—	—	—	23
40-3	D	—	—	18	4	—	1	—	23
40-4	D	—	—	16	2	3	2	—	23
40-5	A	—	—	—	6	4	2	3	15

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
40-6	D	—	—	24	1	—	—	1	26
40-7	A, D	—	—	18	2	—	—	2	22
40-9	A	—	—	24	22	1	—	—	47
40-10	A	—	—	16	—	9	4	—	29
40-11	D	—	—	18	4	1	1	1	25
40-12	D	—	—	22	6	—	—	1	29
40-13	D	—	—	23	—	—	—	—	23
40-14	D	—	—	21	10	—	—	1	32
40-15	A	—	—	57	—	3	—	—	60
44A31	D	—	—	—	31	—	—	—	31
40A35	D	—	—	—	35	—	—	—	35
40-63	A	—	—	60	—	—	—	—	60
40-56	A	—	—	85	—	—	—	—	85
40-57	E	—	—	—	—	—	—	4	4
40-60	A	—	—	60	—	—	—	—	60
40-61	A	—	—	55	-3	-1	—	—	59
40-72	A	—	—	60	—	—	—	—	60
40-63	A	—	—	61	—	—	—	—	61
40-64	A	—	—	20	3	13(COAX)	—	—	36
40-66		—	—	—	—	—	—	4(COAX)	4
40-67	A	—	—	1	—	—	-10(COAX)		11
40-68	A	—	—	—	—	21	—	—	21
40-70	A	—	—	61	—	—	—	—	61
40-72	A	—	—	1	—	-10(COAX)		—	11
40-73	A	—	—	61	—	—	—	—	61
40-74	A	—	—	—	1	—	1(COAX)	4(COAX)	6
40-75	D	—	—	—	1	—	—	4	5
40-80	A	—	—	1	—	—	10	—	11
40-81	A	—	—	62	—	—	—	—	62
40-82	A	—	—	62	—	—	—	—	62
40-85	A	—	—	60	—	—	—	—	60
40-86		—	—	—	—	—	—	4(COAX)	4
40-87	D	—	—	—	—	—	7	—	7
40-98	A	—	—	67	—	3(COAX)		—	60

TABLE 11. MIL-C-83723 SERIES II INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series II	Service Rating (Note)	Contacts Size							Number of Contacts
		20	18	16	12	8	4	0	
40-99	A	—	—	67	—	3(COAX)		—	60
44-1	D	—	—	36	6	—	—	—	42
44-2	D	—	—	14	14	2	1	—	31
44-3	D	—	—	24	3	2	2	—	31
44-4	D	—	—	31	8	—	—	2	41
44-5	D	—	—	36	6	—	—	—	42
44-6	D	—	—	36	6	—	—	—	42
44-52	A	—	—	104	—	—	—	—	104
44-53	A	—	—	18	—	18(COAX)	—	—	36
48-1	DE	—	—	—	6	4	2	3	15
48-2	D,E	—	—	46	1	—	—	—	47
48-3	D	—	—	18	1	3	—	3	25
48-4	A, D	—	—	47	16	—	—	2	68
48-5	A	—	—	90	9	1	—	—	100
48-51	A	—	—	42	—	10	—	4	56
48-62	D	—	—	56	—	—	—	5	65
48-53		—	—	—	37	—	—	—	37
48-54	A	—	—	42	—	10	—	4(COAX)	56
48-55	A	—	—	68	2	2	6	—	78
48-57	A	—	—	42	—	10	—	4	66
48-60	A	—	—	42	—	10	—	4(COAX)	56
48-62	D	—	—	85	—	—	—	—	85

NOTE:

Service Rating	Operating Voltage	
	DC	AC(RMS)
INST	250	200
A	700	500
D	1250	900
E	1750	3250
B	2450	1750
C	4200	3000

TABLE 12. MIL-C-83723 SERIES III AND LOCKHEED LS10164, LS10166, LS10215 AND LS10216 INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series III	Service Rating (Note)	Contacts Size				Number of Contacts
		20	16	12	Shielded	
8-2	1	2	—	—	—	2
8-3	1	3	—	—	—	3
8-98	1	3	—	—	—	3
10-2	1	2	—	—	—	2
10-5	1	5	—	—	—	5
10-6	1	6	—	—	—	6
10-20	1	—	2	—	—	2
12-3	1	—	3	—	—	3
12-4	1	4	—	—	—	4
12-12	1	12	—	—	—	12
14-4	1	—	—	4	—	4
14-7	1	—	7	—	—	7
14-12	1	9	3	—	—	12
14-15	1	15	—	—	—	15
16-10	1	—	10	—	—	10
16-24	1	24	—	—	—	24
18-8	1	—	—	8	—	8
18-11	1	—	l0	—	1	11
18-13	1	—	13	—	—	13
18-14	1	—	14	—	—	14
18-31	1	31	—	—	—	31
20-16	l1	—	16	—	—	16
20-25	1	19	—	6	—	25
20-28	1	24	—	4	—	28
20-39	1	37	2	—	—	39
20-41	1	41	—	—	—	41
22-12	1	—	—	12	—	12
22-19	1	—	19	—	—	19
22-23	1	—	23	—	—	23
22-32	1	26	—	6	—	32
22-39	1	27	12	—	—	39
22-55	1	55	—	—	—	55
24-29	1	—	29	—	—	29

TABLE 12. MIL-C-83723 SERIES III AND LOCKHEED LS10164, LS10166, LS10215 AND LS10216 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series III	Service Rating (Note)	Contacts Size				Number of Contacts
		20	16	12	Shielded	
24-30	1	—	30	—	—	30
24-43	1	23	20	—	—	43
24-57	1	55	—	2	—	57
24-61	1	61	—	—	—	61
28-40	1	—	36	4	—	40
28-41	1	—	41	—	—	41
28-42	1	—	-2	—	—	42

NOTE:

Condition	Service Rating
Sea Level	1500
50,000 Feet	500
70,000 Feet	375
110,000 Feet	200

TABLE 13. MIL-C-26482 SERIES 1 AND 2 AND LOCKHEED LS13572,LS113580, INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series I (Note 1)	Service Rating (Note 2)	Contacts Size (Note 3)				Number of Contacts
		20	16	12	8	
6-1	I	1	—	—	—	1
8-2	I	2	—	—	—	2
8-3	I	3	—	—	—	3
8-3A	I	3	—	—	—	3
8-4	I	4	—	—	—	4
8-33	I	3	—	—	—	3
8-60 (8-3)	I	Thermocouple 1-IR, 1-CON, 1-CU				3
8-61 (8-4)	I	Thermocouple 1-IR, 1-CON, 2-CU				4
8-62 (8-2)	I	Thermocouple 1-CH, 1-CON				2
8-63 (8-4)	I	Thermocouple 1-CH, 1-AL, 2-CU				4
8-80 (8-4)	I	Thermocouple 2-AI., 2-CH				4
8-82 (8-2)	I	Thermocouple 1-AL, 1-CH				2
8-83(8-3)	I	Thermocouple 1-AL, 1-CH, +1 No. 20				3
8-84 (8-4)	I	Thermocouple 2-IR, 2-CON				4
8-86 (8-4)	I	Thermocouple 2-CH, 2-CON				4
8-87 (8-3)	I	Thermocouple 1-CON, +2 No. 20				3
8-88 (8-4)	I	Thermocouple 2-CON, +2 No. 20				4
8-89 (8-3)	I	Thermocouple 1-CH, 1-CON, +1 No. 20				3
8-98	I	3	—	—	—	3
10-1	I	1 No. 8 COAX				1
10-2	I	—	2	—	—	2
10-5	I	5	—	—	—	5
10-6	I	6	—	—	—	6
10-71	COAXIAL	3+1 No. 12 COAX				4
10-80 (10-6)	I	Thermocouple 1-AL, 1-CH, +4 No. 20				6
10-81 (10-6)	I	Thermocouple 3-AL, 3-CH				6
10-82 (10-6)	I	Thermocouple 1-AL, 1-CH, 1-IR, 1-CON, +2 No. 20				6
10-83 (10-6)	I	Thermocouple 1-AL, 1-CH, +4 No. 20				6
10-85 (10-6)	I	Thermocouple 2-AL, 2-CH, +2 No. 20				6
10-98	I	6	—	—	—	6
10-99	I	7	—	—	—	7
12-3	II	—	3	—	—	3
12A3	I	—	2	—	—	2
12-4	I	—	4	—	—	4

TABLE 13. MIL-C-26482 SERIES 1 AND 2 AND LOCKHEED LS13572,LS113580, INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I (Note 1)	Service Rating (Note 2)	Contacts Size (Note 3)				Number of Contacts
		20	16	12	8	
12-6	I	6	—	—	—	6
12-8	I	8	—	—	—	8
12-10	I	10	—	—	—	10
12-14	I	14	—	—	—	14
12-80 (12-10)	I	Thermocouple 5-AL, 5-CH				10
12-81 (12-10)	I	Thermocouple 5-AL, 5-CH				10
12-85 (12-10)	I	Thermocouple 5-IR, 5-CON				10
12-87 (12-8)	I	Thermocouple 1-AL, 1-CH, +6 No. 20				8
12-88 (12-10)	I	Thermocouple 1-AL, 1-CH, +8 No. 20				10
12-89 (12-10)	I	Thermocouple 2-CON, +8 No. 20				10
12-98	I	10	—	—	—	10
14-2	I	—	—	2	—	2
14-4	I	—	—	4	—	4
14-5	II	—	5	—	—	5
14-8	I	6	—	2	—	8
14-9	I	5	—	4	—	9
14-12	I	8	4	—	—	12
14-15	I	14	1	—	—	15
14-16	I	—	2	2	—	4
14-18	I	18	—	—	—	18
14-19	I	l9	—	—	—	19
14-22	I	1	—	4	—	5
14-71	COAXIAL	3+1 No. 8 COAX				4
14-80 (14-19)	I	Thermocouple 9-AL, 10-CH				19
14-81.(14-18)	I	Thermocouple 5-AL, 5-CH, +8 No. 20				18
14-84 (14-18)	I	Thermocouple 9-AL, 9-CH				18
14-85 (14-19)	I	Thermocouple 1-AL, 1-CH, +17 No. 20				19
14-87 (14-19)	I	Thermocouple 5-AL, 5-CH, +9 No. 20				19
14-91	HIGH VOLTAGE	3 (HIGH VOLTAGE)				3
14-97	I	8	4	—	—	12
16-5 (16-26)	I	5 (OMIT ALL HOLES EXCEPT S, T, Z, W, J)				5
16-8	II	—	8	—	—	8
16-14	I	8	—	6	—	14
16-23	I	22	1	—	—	23
16-26	I	26	—	—	—	26
16-70	I	14 + 1 NO. 12 COAX				15
16-80 (16-26)	I	Thermocouple 13-IR, 13-CON				26
16-83 (16-26)	I	Thermocouple 12-CH, 12-CON, +2 No. 20				26
16-84 (16-26)	I	Thermocouple 13-AL, 13-CH				26

TABLE 13. MIL-C-26482 SERIES 1 AND 2 AND LOCKHEED LS13572,LS113580, INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I (Note 1)	Service Rating (Note 2)	Contacts Size (Note 3)				Number of Contacts
		20	16	12	8	
16-88 (16-26)	I	Thermocouple 1-AL, 1-CH, +24 No. 20				26
16-89 (16-26)	I	Thermocouple 13-CON, +13 No. 20				26
16-95	I	6	—	—	2	8
16-97	I	—	—	5	—	5
16-99	I	21	2	—	—	23
16A99	I	21	2	—	—	23
18-5	I	—	—	5	—	5
18-7	II	—	7	—	—	7
18-8	I	—	—	8	—	8
18-11	II	—	11	—	—	11
18-14	I	10	—	4	—	14
18-28	I	25	2	—	—	28
18A28	I	26	2	—	—	28
18-30	I	29	1	—	—	30
18-32	I	32	—	—	—	32
18-71	COAXIAL	—	8 +1 No. 8 COAX			9
18-72	COAXIAL	10 +4 No. 12 COAX				14
18-75	COAXIAL	4 No. 8 COAX				4
18-76	COAXIAL	3 No. 12 and 1 No. 8 COAX				4
18-80	II	6 +2 No. 8 COAX				8
18-84	II	—	—	11	—	11
18-85	I	5	—	8	—	13
18-88	I	4	—	—	4	8
18-90	HIGH VOLTAGE		3 (HIGH VOLTAGE)			3
18-91	HIGH VOLTAGE		6 (HIGH VOLTAGE)			6
18-92	HIGH VOLTAGE		4 (HIGH VOLTAGE)			4
20-8	I	—	8	—	—	8
20-16	II	—	16	—	—	16
20-24	I	24	—	—	—	24
20-25	I	25	—	—	—	25
20-26	I	20	—	6	—	26
20-27	I	27	—	—	—	27
20-29	I	37	2	—	—	39
20-41	I	41	—	—	—	41
20-70	COAXIAL	10 +4 No. 8 COAX				14
20-71	COAXIAL	2 +8 No. 12 COAX				10
20-73	COAXIAL	8 +2 No. 8 COAX				10
20-84 (20-41)	I	Thermocouple 3-AL, 3-CH, +35 No. 20				41
20-85 (20-41)	I	Thermocouple 1-AL, 1.CH, +39 No. 20				41

TABLE 13. MIL-C-26482 SERIES 1 AND 2 AND LOCKHEED LS13572,LS113580, INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I (Note 1)	Service Rating (Note 2)	Contacts Size (Note 3)				Number of Contacts
		20	16	12	8	
20-90	I	3	—	12	1	15
20-90	HIGH VOLTAGE		7 (HIGH VOLTAGE)			7
22-4	HIGH VOLTAGE		3 +1 (HIGH VOLTAGE)			4
22-7	COAXIAL	ALL No. 8 COAX				7
22-8	II	—	8	—	—	8
22-12	I	—	—	12	—	12
22-19	I	—	—	19	—	19
22-21	II	—	21	—	—	21
22-25	I	—	25	—	—	25
22-32	I	32	—	—	—	32
22-34	I	34	—	—	—	34
22-36	I	36	—	—	—	36
22-37	I	31	6	—	—	37
22-41	I	27	14	—	—	41
22A41	I	27	14	—	—	41
22-53	1	53	—	—	—	53
22-55	I	55	—	—	—	55
22-70	COAXIAL	13 +6 No. 8 COAX				19
22-71	COAXIAL	2 +7 No. 8 COAX				9
22-72	COAXIAL	12	4 +3 No. 8 COAX			19
22-75	COAXIAL	ALL No. 8 COAX				7
22-77	COAXIAL	ALL No. 8 COAX				7
22-78	COAXIAL	ALL No. 8 COAX				7
22-79	COAXIAL	ALL No. 12 COAX				7
22-84 (22-55)	I	Thermocouple 27-AL, 27-CH +1 No. 20				55
22-85 (22-55)	I	Thermocouple 8-AL, 8-CH +39 No. 20				55
22-86 (22-55)	I	Thermocouple 12-AL, 12-CH +31 No. 20				55
22-95	I	26	—	6	—	32
22-96	I	—	—	—	7	7
22-96	I	—	—	7	—	7
22-97	II	—	16	—	—	16
22-99	II	—	11	—	—	11
24A2	COAXIAL	1 +7 COAX				8
24-4	I	8	—	—	—	8
24A4	COAXIAL	1 +7 COAX				8
24A8	COAXIAL	1 +7 COAX				8
24A9	COAXIAL	1 +7 COAX				8
24-19	II	—	—	19	—	21
24-25	I	9	8	8	—	25

TABLE 13. MIL-C-26482 SERIES 1 AND 2 AND LOCKHEED LS13572,LS113580, INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement Series I (Note 1)	Service Rating (Note 2)	Contacts Size (Note 3) 20	16	12	8	Number of Contacts
24-27	I	11	26	—	—	27
24-37	I	31	—	—	—	31
24A31	I	—	31	—	—	31
24-51	I	47 +4 No. 12 COAL				61
24A57	I	85	—	2	—	57
24-61	I	61	—	—	—	61
24-71	I	45	2 +2 No. 8 COAX			49
24-79	COAXIAL	1 +5 No. 8 COAX				6
24-80 (24-61)	I	Thermocouple 31-CON +3 No. 20				6l
24-82 (24-61)	I	Thermocouple 9-AL, 9-CH, +43 No. 20				61
24-83 (24-61)	I	Thermocouple 26-AL, 26-CH, +9 No. 20				61

NOTES:

1. Number in parenthesis denotes insert configuration (Figure 7).
2.

Condition	Service Rating I	Service Rating II
Sea Level	1500	2300
50,000 Feet	500	750
70,000 Feet	375	500
110,000 Feet	200	500

3. All thermocouple contacts are size 20 contacts.

TABLE 14. MIL-C-26500 INSERT ARRANGEMENTS

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size				Number of Contacts
		20	16	12	Shielded	
8-2	1	2	—	—	—	2
8-3	1	3	—	—	—	3
10-2	1	2	—	—	—	3
10-5	1	5	—	—	—	5
10-20	1	—	2	—	—	2
12-3	1	—	3	—	—	3
12-12	1	12	—	—	—	12
14-3	1	—	2	—	1	3
14-4	1	—	—	4	—	4
14-5	1	—	—	—	4	4
14-7	1	—	7	—	—	7
14-12	1	9	3	—	—	12
14-15	1	15	—	—	—	15
16-10	1	—	10	—	—	10
16-24	1	24	—	—	—	24
18-8	1	—	—	8	—	8
18-9	1	—	—	2	6	8
18-11	1	—	10	—	1	11
18-14	1	—	14	—	—	14
18-31	1	31	—	—	—	31
20-l6	1	—	16	—	—	16
20-25	1	19	—	6	—	25
20-26	1	24	—	4	—	28
20-39	1	37	2	—	—	39
20-41	1	41	—	—	—	41
22-12	1	—	—	12	—	12
22-13	1	—	—	1	11	12
22-14	1	—	—	3	9	12
22-19	1	—	19	—	—	19
22-32	1	26	—	6	—	32
22-55	1	55	—	—	—	55
24-29	1	—	29	—	—	29
24-30	1	—	30	—	—	30

TABLE 14. MIL-C-26500 INSERT ARRANGEMENTS (Cont)

Shell Size Insert Arrangement	Service Rating (Note)	Contacts Size				Number of Contacts
		20	16	12	Shielded	
24-43	1	23	20	—	—	43
24-57	1	55	—	2	—	57
24-81	1	61	—	—	—	61
28-40	1	—	36	4	—	40
28-42	1	—	42	—	—	42

NOTE:

Condition	Service Rating
Sea Level	1500
50,000 Feet	500
70,000 Feet	375
110,000 Feet	200

TABLE 15. MIL-C-81703 SERIES 1 INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series I	Contact Size			Number of Contacts
	20	16	12	
3-50	3	—	—	3
7-50	7	—	—	7
12-50	12	—	—	12
19-4	—	—	4	4
19-7	—	—	7	7
19-50	19	—	—	19
27-2	27	—	—	27
27-5	—	19	—	19
27-50	27	—	—	27
37-50	37	—	—	37
61-42	29	4	8	41
61-50	61	—	—	61

TABLE 16. MIL-C-81703 SERIES 2 INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series II	Contact Size			Number of Contacts
	20	16	12	
3-50	3	—	—	3
7-50	7	—	—	7
12-50	12	—	—	12
19-4	—	—	4	4
19-7	—	—	7	7
19-50	19	—	—	19
27-2	27	—	—	27
27-50	27	—	—	27
37-50	37	—	—	37
67-42	29	4	8	41
61-50	61	—	—	61

TABLE 17. MIL-C-81703 SERIES 3 INSERT ARRANGEMENTS

Shell Size Insert Arrangement	Contact Size			Number of Contacts
	20	16	12	
3-50	3	—	—	3
7-50	7	—	—	7
12-50	12	—	—	12
19-4	—	—	4	4
19-7	—	—	7	7
19-2	19	—	—	19
27-50	27	—	—	2?
27-50	27	—	—	27
37-50	37	—	—	37
61-42	29	4	8	41
61-50	61	—	—	61

TABLE 18. NAS 1599 THREADED COUPLED INSERT ARRANGEMENTS

Shell Size Insert Arrangement	Contact Size			Number of Contacts
	20	16	12	
12-3	—	3	—	3
12-12	12	—	—	12
14-4	—	—	4	4
14-7	—	7	—	7
14-15	15	—	—	15
16-24	24	—	—	24
18-14	—	14	—	14
18-31	31	—	—	31
22-12	—	—	12	12
22-19	—	19	—	19
22-55	55	—	—	55

TABLE 19 MIL-C-29600 SERIES A

Shell Size Insert Arrangement Series A	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size 8	10	12	16	20	22	22M	22D	Total Contacts
A35	M	—	—	—	—	—	—	—	6	6
A98	I	—	—	—	—	3	—	—	—	3
B5	I	—	—	—	—	5	—	—	—	5
B35	M	—	—	—	—	—	—	—	13	13
B98	I	—	—	—	—	6	—	—	—	6
B99	I	—	—	—	—	7	—	—	—	7
C4	I	—	—	—	4C	—	—	—	—	4
C8	I	—	—	—	—	8	—	—	—	8
C35	M	—	—	—	—	—	—	—	22	22
C98	I	—	—	—	—	10	—	—	—	10
D5	II	—	—	—	5C	—	—	—	—	5
D15	I	—	—	—	1C	14	—	—	—	15
D18	I	—	—	—	—	18	—	—	—	18
D19	I	—	—	—	—	19	—	—	—	19
D35	M	—	—	—	—	—	—	—	37	37
D97	I	—	—	—	4C	8	—	—	—	12
E6	I	—	—	6C	—	—	—	—	—	6
E8	II	—	—	—	8C	—	—	—	—	8
E26	I	—	—	—	—	26	—	—	—	26
E35	M	—	—	—	—	—	—	—	55	55
E99	I	—	—	—	2C	21	—	—	—	23
F11	II	—	—	—	11C	—	—	—	—	11
F32	I	—	—	—	—	32	—	—	—	32
F35	M	—	—	—	—	—	—	—	66	66
G11	I	—	—	11C	—	—	—	—	—	11
G16	II	—	—	—	16C	—		—	—	16
G35	M	—	—	—	—	—	—	—	79	79
G39	I	—	—	—	2C	37	—	—	—	39
G41	I	—	—	—	—	41	—	—	—	41
G75	M	4C	—	—	—	—	—	—	—	4
H21	II	—	—	—	21C	—	—	—	—	21
H35	M	—	—	—	—	—	—	—	100	100

TABLE 19 MIL-C-29600 SERIES A (Cont)

Shell Size Insert Arrangement Series A	Service Rating (Note 1)	Number of Contacts (Note 2) Contact Size								Total Contacts
		8	10	12	16	20	22	22M	22D	
H53	I	—	—	—	—	53	—	—	—	53
H55	I	—	—	—	—	55	—	—	—	55
J4	I	—	—	—	8C	48	—	—	—	56
J11	I	—	9	—	—	2	—	—	—	11
J19	I	—	—	19C	—	—	—	—	—	19
J20	I	3T	—	4C	13F	10	—	—	—	30
J24	I	—	—	12C	12C	—	—	—	—	24
J29	I	—	—	—	29C	—	—	—	—	29
J35	M	—	—	—	—	—	—	—	128	128
J43	I	—	—	—	20C	23	—	—	—	43
J46	I	2C	—	—	4C	40	—	—	—	46
J61	I	—	—	—	—	61	—	—	—	61

NOTES:

1.

Service Ratings	Sea Level Operating Voltage (Suggested) AC (RMS)	DC
M	400	550
I	600	850
II	900	1250

2. C - Coaxial or standard contacts

   F - Two contacts dedicated to fiber optics

   T - Twinax contacts

TABLE 20. MIL-C-29600 SERIES B INSERT ARRANGEMENTS

Shell Size Insert Arrangement Series B	Service Rating (Note)	Number of Contacts Contact Size				Total Contacts
		12	16	20	23	
A04	I	—	—	—	4	4
C12	I	—	—	—	12	12
C05	II	—	—	5	—	5
C03	II	—	3	—	—	3
G37	I	—	—	—	37	37
G19	I	—	—	19	—	19

TABLE 20. MIL-C-29600 SERIES B INSERT ARRANGEMENTS (Cont)

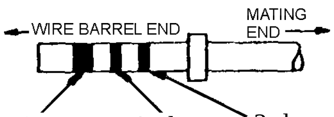
Shell Size Insert Arrangement Series B	Service Rating (Note)	Number of Contacts: Contact Size 12	16	20	23	Total Contacts
G09	II	—	9	—	—	9
G04	II	4	—	—	—	4
J55	I	—	—	—	55	55
J27	I	—	—	27	—	27
J14	II	—	14	—	—	14
J07	I	7	—	—	—	7
M85	I	—	—	—	85	85
M38	I	—	—	38	—	38
M21	II	—	21	—	—	21
M09	II	9	—	—	—	9
P92	I	—	—	—	92	92
P45	I	—	—	45	—	45
P24	II	—	24	—	—	24
P11	II	11	—	—	—	11
S121	I	—	—	—	121	121
S61	I	—	—	61	—	61
S32	II	—	32	—	—	32
S14	II	14	—	—	—	14
U155	I	—	—	—	155	155
U74	I	—	—	74	—	74
U41	II	—	41	—	—	41
U19	II	19	—	—	—	19

NOTE:

Maximum recommended working voltage (AC, RMS):

Condition	Service Rating I	Service Rating II
Sea Level	600	1000
50,000 Feet	300	450
70,000 Feet	300	450
110,000 Feet	300	450

TABLE 21. MIL-C-390299 CONTACT SUMMARY



BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
100	Brown	Black	Black	1-100	P	16	22	—	M39029/1-16-22	MIL-T-81714 (series 1)	.152	—
101	Brown	Black	Brown	1-101	P	16	20	—	M39029/1-16-20	MIL-T-81714 (series 1)	.152	—
102	Brown	Black	Red	1-102	P	14	16	—	M39029/1-14-16	MIL-T-81714 (series 1)	.167	—
103	Brown	Black	Orange	1-103	P	12	12	—	M39029/1-12-12	MIL-T-81714 (series 1)	.117	—
104	Brown	Black	Yellow	2-104	P	22	22	—	M39029/2-22-2	MIL-C-81659 (series 1)	.380	—
105	Brown	Black	Green	2-105	P	20	20	—	M39029/2-20-20	MIL-C-81659 (series1)	.380	—
106	Brown	Black	Blue	2-106	P	16	16	—	M39029/2-16-16	MIL-C-81659 (series 1)	.380	—
107	Brown	Black	Violet	3-107	S	22	22	—	M39029/3-22-22	MIL-C-81659 (series 1)	—	.380
108	Brown	Black	Gray	3-108	S	20	20	—	M39029/3-20-20	MIL-C-81659 (series 1)	—	.380
109	Brown	Black	White	3-109	S	16	16	—	M39029/3-16-16	MIL-C-81659 (series 1)	—	.500
110	Brown	Brown	Black	4-110	P	20	20	—	M39029/4-20-20 M8372/333B20	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3)	.290	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
111	Brown	Brown	Brown	4-111	P	16	16	—	M39029/4-16-16 M8372(3)33B1G	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.290	—
112	Brown	Brown	Red	4-112	P	16	20	—	M39029/4-16-20	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.290	—
113	Brown	Brown	Orange	4-113	P	12	12	—	M39029/4-12-12 M8372(3)33B 12	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	—	—
114	Brown	Brown	Yellow	4-114	P	12	16	—	M39029/4-12-16	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	—	—
115	Brown	Brown	Green	5-115	S	20	20	—	M39029/5-20-20 M83723-34820	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	—	.290

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
116	Brown	Brown	Blue	5-116	S	16	16	—	M39029/5-16-16 M83723-34816	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	—	.290
117	Brown	Brown	Violet	5-117	S	16	20	—	M39029/5-16-20	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	—	.290
118	Brown	Brown	Gray	5-118	S	12	12	—	M39029/5-12-12 M83723/34B12	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 1 & 3)	—	—
119	Brown	Brown	White	5-119	S	12	16	—	M39029/5-12-16	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	—	—
120	Brown	Red	Black	6-120	P	—	—	16	M39029/6-01	MIL-C-81511 (series 1 & 2)	.210 (3)	.210 (3)
121	Brown	Red	Brown	6-121	P	—	—	12	M39029/6-02	MIL-C-81511 (series 1 & 2)	.210 (3)	.154 (3)
122	Brown	Red	Red	6-122	P	—	—	12	M39029/6-03	MIL-C-81511 (series 1 & 2)	.210 (3)	.154 (3)
123	Brown	Red	Orange	6-123	P	—	—	12	M39029/6-04	MIL-C-81511 (series 1 & 2)	.210 (3)	.154 (3)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
124	Brown	Red	Yellow	6-124	P	—	—	12	M39029/6-05	MIL-C-81511 (series 1 & 2)	.120 (3)	.154 (3)
125	Brown	Red	Green	6-125	P	—	—	12	M39029/6-06	MIL-C-81511 (series 1 & 2)	.210 (3)	.154 (3)
126	Brown	Red	Blue	7-126	P	—	—	12	M39029/7-001	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.440 (3)	.280 (3)
127	Brown	Red	Violet	7-127	P	—	—	—	M39029/7-002	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.440 (3)	.280 (3)
128	Brown	Red	Gray	7-128	P	—	—	—	M39029/7-003	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.440 (3)	.280 (3)
129	Brown	Red	White	8-129	S	—	—	—	M39029/8-001	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.280 (4)	.440 (4)
130	Brown	Orange	Black	8-130	S	—	—		M39029/8-002	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.280 (4)	.440 (4)
131	Brown	Orange	Brown	8-131	S	—	—	—	M39029/8-003	MIL-C-26482 (series 2) MIL-C-81703 (series 3)	.280 (4)	440 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
132	Brown	Orange	Red	9-132	P	20	20	—	M39029/9-20-20-C1	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.380	—
133	Brown	Orange	Orange	9-133	P	20	20	—	M39029/9-20-20-C2	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.380	—
134	Brown	Orange	Yellow	9-134	P	20	20	—	M39029/9-20-20-C3	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.380	—
135	Brown	Orange	Green	9-135	P	20	20	—	M39029/9-20-20-C4	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.380	—
136	Brown	Orange	Blue	9-136	P	20	20	—	M39029/9-20-20-C5	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) MIL-C-83733	.380	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
138	Brown	Orange	Gray	10-138	S	20	20	—	M39029/10-20-20-C1	MIL-C-26482 (series 2)	—	.290
139	Brown	Orange	White	10-139	S	20	20	—	M39029/10-20-20-C2	MIL-C-81703 (series 3)	—	.290
140	Brown	Yellow	Black	10-140	S	20	20	—	M39029/10-20-20-C3	MIL-C-83723 (series 2)	—	.290
141	Brown	Yellow	Brown	10-141	S	20	20	—	M39029/10-20-20-C4	MIL-C-83733	—	.290
142	Brown	Yellow	Red	10-142	S	20	20	—	M39029/10-20-20-C5	MIL-C-83733	—	.290
144	Brown	Yellow	Yellow	11-144	P	22	22	—	M39029/11-22-22	MIL-C-81659 (series 2)	.266	—
145	Brown	Yellow	Green	11-145	P	20	20	—	M39029/11-20-20	MIL-C-81659 (series 2)	.321	—
146	Brown	Yellow	Blue	11-146	P	16	16	—	M39029/11-16-16	MIL-C-81659 (series 2)	.413	—
147	Brown	Yellow	Violet	11-147	P	12	12	—	M39029/11-12-12	MIL-C-81659 (series 2)	—	—
148	Brown	Yellow	Gray	12-148	S	22	22	—	M39029/12-22-22	MIL-C-81659 (series 2)	—	.266
149	Brown	Yellow	White	12-149	S	20	20	—	M39029/12-20-20	MIL-C-81659 (series 2)	—	.321
150	Brown	Green	Black	12-150	S	16	16	—	M39029/12-16-16	MIL-C-81659 (series 2)	—	.413
151	Brown	Green	Brown	12-151	S	12	12	—	M39029/12-12-12	MIL-C-81659 (series 2)	—	—
152	Brown	Green	Red	13-152	S	—	—	16	M39029/13-01	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
153	Brown	Green	Orange	13-153	S	—	—	12	M39029/13-02	MIL-C-81511 (series 1)	.160 (4)	.210 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
154	Brown	Green	Yellow	13-154	S	—	—	12	M39029/13-03	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
155	Brown	Green	Green	13-155	S	—	—	12	M39029/13-04	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
156	Brown	Green	Blue	13-156	S	—	—	12	M39029/13-05	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
157	Brown	Green	Violet	13-157	S	—	—	12	M39029/13-06	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
158	Brown	Green	Gray	14-158	S	—	—	16	M39029/14-01	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
159	Brown	Green	White	14-159	S	—	—	12	M39029/14-02	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
160	Brown	Blue	Black	14-160	S	—	—	12	M39029/14-03	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
161	Brown	Blue	Brown	14-161	S	—	—	12	M39029/14-04	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
162	Brown	Blue	Red	14-162	S	—	—	12	M39029/14-05	MIL-C-81511 (series 1)	.160 (4)	210 (4)
163	Brown	Blue	Orange	14-163	S	—	—	12	M39029/14-06	MIL-C-81511 (series 1)	.160 (4)	.210 (4)
166	Brown	Blue	Blue	16-166	S	23	28	—	M39029/16-23-28	MIL-C-81511 (series 4)	—	.190
167	Brown	Blue	Violet	16-167	S	23	22	—	M39029/16-23-22	MIL-C-81511 (series 4)	—	.190
168	Brown	Blue	Gray	16-168	S	20	20	—	M39029/16-20-20	MIL-C-81511 (series 4)	—	.190
169	Brown	Blue	White	16-169	S	16	16	—	M39029/16-16-16	MIL-C-81511 (series 4)	—	.190
170	Brown	Violet	Black	16-170	S	12	12	—	M39029/16-12-12	MIL-C-81511 (series 4)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
171	Brown	Violet	Brown	17-171	S	23	28	—	M39029/17-23-28	MIL-C-81511 (series 3)	—	.190
172	Brown	Violet	Red	17-172	S	23	22	—	M39029/17-23-22	MIL-C-81511 (series 3)	—	.190
173	Brown	Violet	Orange	17-173	S	20	20	—	M39029/17-20-20	MIL-C-81511 (series 3)	—	190
174	Brown	Violet	Yellow	17-174	S	16	16	—	M39029/17-16-16	MIL-C-81511 (series 3)	—	190
175	Brown	Violet	Green	17-175	S	12	12	—	M39029/17-12-12	MIL-C-81511 (series 3)	—	—
176	Brown	Violet	Blue	18-176	P	23	28	—	M39029/18-23-28	MIL-C-81511 (series 3 & 4)	.190	—
177	Brown	Violet	Violet	18-177	P	23	22	—	M39029/18-23-22	MIL-C-81511 (series 3 & 4)	.190	—
178	Brown	Violet	Gray	18-178	P	20	20	—	M39029/18-20-20	MIL-C-81511 (series 3 & 4)	.190	—
179	Brown	Violet	White	18-179	P	16	16	—	M39029/18-16-16	MIL-C-81511 (series 3 & 4)	—	—
180	Brown	Gray	Black	18-180	P	12	12	—	M39029/18-12-12	MIL-C-81511 (series 3 & 4)	.240.(3)	.205 (3)
181	Brown	Gray	Brown	19-181	P	—	—	16	M39029/19-01	MIL-C-81511 (series 3 & 4)	.225 (3)	.205 (3)
182	Brown	Gray	Red	19-182	P	—	—	12	M39029/19-02	MIL-C-81511 (series 3 & 4)	.225 (3)	.205 (3)
183	Brown	Gray	Orange	20-183	P	—	—	12	M39029/19-03	MIL-C-81511 (series 3 & 4)	.225 (3)	.205 (3)
184	Brown	Gray	Yellow	20-184	S	—	—	16	M39029/20-01	MIL-C-81511 (series 3)	.195 (4)	.240 (4)
185	Brown	Gray	Green	20-185	S	—	—	12	M39029/20-02	MIL-C-81511 (series 3)	.180 (4)	.240 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
186	Brown	Gray	Blue	20-186	S	—	—	12	M39029/20-03	MIL-C-81511 (series 3)	.180 (4)	.240 (4)
187	Brown	Gray	Violet	21-187	S	—	—	16	M39029/21-01	MIL-C-81511 (series 4)	.195 (4)	240 (4)
188	Brown	Gray	Gray	21-188	S	—	—	12	M39029/21-02	MIL-C-81511 (series 4)	.180 (4)	.140 (4)
189	Brown	Gray	White	21-189	S	—	—	12	M39029/21-03	MIL-C-81511 (series 4)	.180 (4)	.240 (4)
190	Brown	White	Black	22-190	S	22	28	—	M39029/22-22-28 M39029/15-22-28	MIL-T-81714 (series 2) & MIL-C-81511 (series 3 & 4 class L)	—	.110
191	Brown	White	Brown	22-191	S	22	22	—	M39029/15-22-22 M39029/22-22-22	MIL-T-81714 (series 2) & MIL-C-81511 (series 3 & 4, class L)	—	.110
192	Brown	White	Red	22-192	S	20	20	—	M39029/22-20-20	MIL-T-81714 (series 2) & MIL-C-81511 (series 3 & 4, class L)	—	.110
193	Brown	White	Orange	22-193	S	16	16	—	M39029/22-16-16	MIL-T-81714 (series 2) & MIL-C-81511 (series 3 & 4, class L)	—	.110
194	Brown	White	Yellow	23-194	P	—	—	8	M39029/23-01	MIL-C-26482 (series 1)	.292 (1)	.196 (1)
195	Brown	White	Green	23-195	P	—	—	8	M39029/23-02	MIL-C-26482 (series 1)	.292 (3)	.196 (3)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
196	Brown	White	Blue	23-196	P	—	—	8	M39029/23-03	MIL-C-26482 (series 1)	.292 (3)	.196 (3)
197	Brown	White	Violet	23-197	P	—	—	8	M39029/23-04	MIL-C-26482 (series 1)	.292 (3)	.196 (3)
198	Brown	White	Gray	123-198	P	—	—	8	M39029/23-05	MIL-C-26482 (series 1)	.292 (3)	.196 (3)
199	Brown	White	White	24-199	S	—	—	8	M39029/24-01	MIL-C-26482 (series 1)	.196 (3)	.292 (3)
200	Red	Black	Black	24-200	S	—	—	8	M39029/24-02	MIL-C-26482 (series 1)	.196 (4)	.292 (4)
201	Red	Black	Brown	24-201	S	—	—	8	M39029/24-03	MIL-C-26482 (series 1)	.196 (4)	.292 (4)
202	Red	Black	Red	24-202	S	—	—	8	M39029/24-04	MIL-C-26482 (series 1)	.196 (4)	.29(2) (4)
203	Red	Black	Orange	24-203	S	—	—	8	M39029/24-05	MIL-C-26482 (series 1)	.196 (4)	.292 (4)
204	Red	Black	Yellow	25-204	P	—	—	12	M39029/25-01	MIL-C-26482 (series 1)	.235 (3)	.235 (3)
205	Red	Black	Green	25-205	P	—	—	12	M39029/25-02	MIL-C-26482 (series 1)	.235 (2)	.235 (2)
206	Red	Black	Blue	25-206	P	—	—	12	M39029/25-03	MIL-C-26482 (series 1)	.235 (3)	.235 (3)
207	Red	Black	Violet	26-207	S	—	—	12	M39029/26-01	MIL-C-26482 (series 1)	.235 (3)	.235 (3)
208	Red	Black	Gray	26-208	S	—	—	12	M39029/26-02	MIL-C-26482 (series 1)	.235 (4)	.235 (4)
209	Red	Black	White	26-209	S	—	—	12	M39029/26-03	MIL-C-26482 (series 1)	.235 (4)	.235 (4)
210	Red	Brown	Black	27-210	S	—	—	12	M39029/27-12A	MIL-C-38999 (series II)	.166 (4)	.166 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
211	Red	Brown	Brown	28-211	P	—	—	12	M39029/28-12A	MIL-C-38999 (series II)	.166 (3)	.166 (3)
212	Red	Brown	Red	29-212	P	16	16	—	M39029/29-16-16 MS3162-16-16 MS83723-29T12	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	.430	—
213	Red	Brown	Orange	29-213	P	12	12	—	M39029/29-12-12 MS3162-12-12 MS83723-29T12	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
214	Red	Brown	Yellow	29-214	P	8	8	—	M39029/29-8-8 MS3162-8-8 MS83723-29T8	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
215	Red	Brown	Green	29-215	P	4	4	—	M39029/29-4-4 MS3162-4-4 MS83723-29T4	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
216	Red	Brown	Blue	29-216	P	0	0	—	M39029/29-0-0 MS3162-0-0 M83723-29T0	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
217	Red	Brown	Violet	30-217	S	16S	16	—	M39029/30-16S-16 MS3163-16S-16 M83723-30T17	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	.399
218	Red	Brown	Gray	30-218	S	16	16	—	M3029/30-16-16 MS3163-16-16 M83723-30T16	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	.430

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
219	Red	Brown	White	30-219	S	12	12	—	M39029/30-12-12 MS3163-12-12 M83723-30T 12	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
220	Red	Red	Black	30-220	S	8	8	—	M39029/30-8-8 MS3163-8-8 M83723-30T8	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
221	Red	Red	Brown	30-221	S	4	4	—	M39029/30-4-4 MS3163-4-4 M83723-30T4	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
222	Red	Red	Red	30-222	S	0	0	—	M39029/30-0-0 MS3163-0-0 M83723-30T0	MIL-C-5015 (MS3450) MIL-C-83723 (series 2)	—	—
223	Red	Red	Orange	31-223	P	20	20	—	MS3192-20-20A	MIL-C-26482 (series 1)	.290	—
224	Red	Red	Yellow	31-224	P	20	20	—	MS3192-20-20B	MIL-C-26482 (series 1)	—	—
225	Red	Red	Green	31-225	P	20	20	—	MS3192-20-20C1	MIL-C-26482 (series 1)	—	—
226	Red	Red	Blue	31-226	P	20	20	—	MS3192-20-20C2	MIL-C-26482 (series 1)	—	—
227	Red	Red	Violet	31-227	P	20	20	—	MS3192-20-20C3	MIL-C-26482 (series 1)	—	—
228	Red	Red	Gray	31-228	P	16	16	—	MS3192-16-16-A	MIL-C-26482 (series 1)	.290	—
229	Red	Red	White	31-229	P	16	16	—	MS24254-16P	MIL-C-26482 (series 1) MIL-C-26500	.290	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
230	Red	Orange	Black	31-230	P	16	16	—	MS3192-16-16B	MIL-C-26482 (series 1)	—	—
231	Red	Orange	Brown	31-231	P	16	16	—	MS3192-16-16C1	MIL-C-26482 (series 1)	—	—
232	Red	Orange	Red	31-232	P	16	16	—	MS3192-16-16C2	MIL-C-26482 (series 1)	—	—
233	Red	Orange	Orange	31-233	P	16	16	—	MS3192-16-16C3	MIL-C-26482 (series 1)	—	—
234	Red	Orange	Yellow	31-234	P	12	12	—	MS3192-12-12A	MIL-C-26482 (series 1)	—	—
235	Red	Orange	Green	31-235	P	12	12	—	MS24254-12-12P	MIL-C-26482 (series 1) MIL-C-26500	—	—
236	Red	Orange	Blue	31-236	P	12	12	—	MS3192-12-12B	MIL-C-26482 (series 1)	—	—
237	Red	Orange	Violet	31-237	P	12	12	—	MS3192-12-12C1	MIL-C-26482 (series 1)	—	—
238	Red	Orange	Gray	31-238	P	12	12	—	MS3192-12-12C2	MIL-C-26482 (series 1)	—	—
239	Red	Orange	White	31-239	P	12	12	—	MS3192-12-12C3	MIL-C-26482 (series 1)	—	—
240	Red	Yellow	Black	31-240	P	20	20	—	MS3192A20-20A	MIL-C-26482 (series 1)	.290	—
241	Red	Yellow	Brown	31-241	P	20	20	—	MS24254-20P	MIL-C-26500 MIL-C-26482 (series 1)	.290	—
242	Red	Yellow	Red	32-242	S	20	20	—	MS3193-20-20A	MIL-C-26482 (series 1)	—	.290
243	Red	Yellow	Orange	32-243	S	20	20	—	MS3193-20-20B	MIL-C-26482 (series 1)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
244	Red	Yellow	Yellow	32-244	S	20	20	—	MS3193-20-20C1	MIL-C-26482 (series 1)	—	—
245	Red	Yellow	Green	32-245	S	20	20	—	MS3193-20-20C2	MIL-C-26482 (series 1)	—	—
246	Red	Yellow	Blue	32-246	S	20	20	—	MS3193-20-20C3	MIL-C-26482 (series 1)	—	—
247	Red	Yellow	Violet	32-247	S	16	16	—	MS319316-16A	MIL-C-26482 (series 1)	—	.290
248	Red	Yellow	Gray	32-248	S	16	16	—	MS24255-16S	MIL-C-26482 (series 1) MIL-C-26500	—	.290
249	Red	Yellow	White	32-249	S	16	16	—	MS3193-16-16B	MIL-C-26482 (series 1)	—	—
250	Red	Green	Black	32-250	S	16	16	—	MS3193-16-16C1	MIL-C-26482 (series 1)	—	—
251	Red	Green	Brown	32-251	S	16	16	—	MS3193-16-16C2	MIL-C-26482 (series 1)	—	—
252	Red	Green	Red	32-252	S	16	16	—	MS3193-16-160	MIL-C-26482 (series 1)	—	—
253	Red	Green	Orange	32-253	S	12	12	—	MS3193-12-12A	MIL-C-26482 (series 1)	—	—
254	Red	Green	Yellow	32-254	S	12	12	—	MS24255-12S	MIL-C-26482 (series 1) MIL-C-26482	—	—
255	Red	Green	Green	32-255	S	12	12	—	MS3193-12-12B	MIL-C-26482 (series 1)	—	—
256	Red	Green	Blue	32-256	S	12	12	—	MS3193-12-12C1	MIL-C-26482 (series 1)	—	—
257	Red	Green	Violet	32-257	S	12	12	—	MS3193-12-12C2	MIL-C-26482 (series 1)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
258	Red	Green	Gray	32-258	S	12	12	—	MS3193-12-12C3	MIL-C-26482 (series 1)	—	—
259	Red	Green	White	32-259	S	20	20	—	MS3193A-20-20A	MIL-C-26482 (series 1)	—	.290
260	Red	Blue	Black	32-260	S	20	20	—	MS2455-20S	MIL-C-26482 (series 1) MIL-C-26500	—	.290
261	Red	Blue	Brown	33-261	S	23	28	—	MS3343A23-28	MIL-C-81511 (series 1)	—	.170
262	Red	Blue	Red	33-262	S	23	28	—	MS3343B23-28	MIL-C-81511 (series 1)	—	.170
263	Red	Blue	Orange	33-263	S	23	22	—	MS3343A23-22	MIL-C-81511 (series 1)	—	.170
264	Red	Blue	Yellow	33-264	S	23	22	—	MS3343B23-22	MIL-C-81511 (series 1)	—	.170
265	Red	Blue	Green	33-265	S	20	20	—	MS3343A20-20	MIL-C-81511 (series 1)	—	.270
266	Red	Blue	Blue	33-266	S	20	20	—	MS3343B20-20	MIL-C-81511 (series 1)	—	.270
267	Red	Blue	Violet	33-267	S	16	16	—	MS3343A16-16	MIL-C-81511 (series 1)	—	.270
268	Red	Blue	Gray	33-268	S	16	16	—	MS3343B16-16	MIL-C-81511 (series 1)	—	.270
269	Red	Blue	White	33-269	S	12	12	—	MS3343A12-12	MIL-C-81511 (series 1)	—	—
270	Red	Violet	Black	33-270	S	12	12	—	MS3343B12-12	MIL-C-81511 (series 1)	—	—
271	Red	Violet	Brown	34-271	P	20	20	—	MS17803-20-20	MIL-C-28748/3	.282	—
272	Red	Violet	Red	34-272	P	16	20	—	MS17803-16-20	MIL-C-28748/3	.282	—
273	Red	Violet	Orange	34-273	P	16	16	—	MS17803-16-16	MIL-C-28748/3	.282	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
274	Red	Violet	Yellow	35-274	S	20	20	—	MS17804-20-20	MIL-C-28748/4	—	.282
275	Red	Violet	Green	35-275	S	16	20	—	MS17804-16-20	MIL-C-28748/4	—	.282
276	Red	Violet	Blue	35-276	S	16	16	—	MS17804-16-16	MIL-C-28748/4	—	.282
277	Red	Violet	Violet	36-277	P	16	20	—	MS17804-16-20	MIL-C-28748/9	.312	—
278	Red	Violet	Gray	36-278	P	16	16	—	MS17807-16-16	MIL-C-28748/9	.312	—
279	Red	Violet	White	37-279	S	16	20	—	MS17808-16-20	MIL-C-28748/10	—	.312
280	Red	Gray	Black	37-280	P	16	16	—	MS17808-16-16	MIL-C-28748/10	—	.312
287	Red	Gray	Violet	44-287	P	16	22	—	MS90453-16-22	MIL-C-5015 (MS3400 series)	.510	—
288	Red	Gray	Gray	44-288	P	16	16	—	MS90453-16-16	MIL-C-5015 (MS3400 series)	.510	—
289	Red	Gray	White	44-289	P	12	16	—	MS90453-12-16	MIL-C-5015 (MS3400 series)	—	—
290	Red	White	Black	44-290	P	12	12	—	MS90453-12-12	MIL-C-5015 (MS3400 series)	—	—
291	Red	White	Brown	44-291	P	8	8	—	MS90453-8-8	MIL-C-5015 (MS3400 series)	—	—
293	Red	White	Orange	44-293	P	0	0	—	MS90453-0-0	MIL-C-5015 (MS3400 series)	—	—
294	Red	White	Yellow	45-294	S	16	22	—	MS90453-16-22	MIL-C-5015 (MS3400 series)	—	.510
295	Red	White	Green	45-295	S	16	16	—	MS90454-16-16	MIL-C-5015 (MS3400 series)	—	.510
296	Red	White	Blue	45-296	S	12	16	—	MS90454-12-16	MIL-C-5015 (MS3400 series)	—	—
297	Red	White	Violet	45-297	S	12	12	—	MS90454-12-12	MIL-C-5015 (MS3400 series)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
298	Red	White	Gray	45-298	S	8	8	—	MS90454-8-8	MIL-C-5015 (MS3400 series)	—	—
299	Red	White	White	45-299	S	4	4	—	MS90454-4-4	MIL-C-5015 (MS3400 series)	—	—
300	Orange	Black	Black	45-300	S	0	0	—	MS90454-0-0	MIL-C-5015 (MS3400 series)	—	—
301	Orange	Black	Brown	46-301	S	23	28	—	MS90460A-23-28	MIL-C-81511 (series 2)	—	.170
302	Orange	Black	Red	46-302	S	23	28	—	MS90460B-23-28	MIL-C-81511 (series 2)	—	.170
303	Orange	Black	Orange	46-303	S	23	22	—	MS90460A-23-22	MIL-C-81511 (series 2)	—	.170
304	Orange	Black	Yellow	46-304	S	23	22	—	MS90460B-23-22	MIL-C-81511 (series 2)	—	.170
305	Orange	Black	Green	46-305	S	20	20	—	MS90460A-20-20	MIL-C-81511 (series 2)	—	.220
306	Orange	Black	Blue	46-306	S	20	20	—	MS90460B-20-20	MIL-C-81511 (series 2)	—	.220
307	Orange	Black	Violet	46-307	S	16	16	—	MS90460A-16-16	MIL-C-81511 (series 2)	—	.220
308	Orange	Black	Gray	46-308	S	16	16	—	MS90460B-16-16	MIL-C-81511 (series 2)	—	.220
309	Orange	Black	White	46-309	S	12	12	—	MS90460A-12-12	MIL-C-81511 (series 2)	—	—
310	Orange	Brown	Black	46-310	S	12	12	—	MS90460B-12-12	MIL-C-81511 (series 2)	—	—
311	Orange	Brown	Brown	47-311	P	23	28	—	MS90461A-23-28	MIL-C-81511 (series 1 & 2)	.220	—
312	Orange	Brown	Red	47-312	P	23	28	—	MS90461B-23-28	MIL-C-81511 (series 1 & 2)	.220	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
313	Orange	Brown	Orange	47-313	P	23	22	—	MS90461A-23-22	MIL-C-81511 (series 1 & 2)	.220	—
314	Orange	Brown	Yellow	47-314	P	23	22	—	MS90461B-23-22	MIL-C-81511 (series 1 & 2)	.220	—
315	Orange	Brown	Green	47-315	P	20	20	—	MS90461A-20-20	MIL-C-81511 (series 1 & 2)	.220	—
316	Orange	Brown	Blue	47-316	P	20	20	—	MS90461B-20-20	MIL-C-81511 (series 1 & 2)	.220	—
Refer to bin codes 337 through 339 for remaining contacts of MIL-C-39029/47.												
317	Orange	Brown	Violet	48-317	P	6	6	—	MS90559-11	MIL-C-22992 (class L)	—	—
318	Orange	Brown	Gray	48-318	P	6N	6	—	MS90559-12	MIL-C-22992 (class L)	—	—
319	Orange	Brown	White	48-319	P	6G	6	—	MS90559-14	MIL-C-22992 (class L)	—	—
320	Orange	Red	Black	48-320	P	4	4	—	MS90559-8	MIL-C-22992 (class L)	—	—
321	Orange	Red	Brown	48-321	P	4N	4	—	MS90559-9	MIL-C-22992 (class L)	—	—
322	Orange	Red	Red	48-322	P	4G	4	—	MS90559-13	MIL-C-22992 (class L)	—	—
323	Orange	Red	Orange	48-323	P	1/0	1/0	—	MS90559-5	MIL-C-22992 (class L)	—	—
324	Orange	Red	Yellow	48-324	P	1/ON	1/0	—	MS90559-6	MIL-C-22992 (class L)	—	—
325	Orange	Red	Green	48-325	P	2/0	2/0	—	MS90559-3	MIL-C-22992 (class L)	—	—
326	Orange	Red	Blue	48-326	P	2/ON	2/0	—	MS90559-4	MIL-C-22992 (class L)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
327	Orange	Red	Violet	48-327	P	4/0	4/0	—	MS90559-1	MIL-C-22992 (class L)	—	—
328	Orange	Red	Gray	48-328	P	4/0N	4/0	—	MS90559-2	MIL-C-22992 (class L)	—	—
329	Orange	Red	White	49-329	S	6	6	—	MS90560-7	MIL-C-22992 (class L)	—	—
330	Orange	Orange	Black	49-330	S	6G	6	—	MS90560-8	MIL-C-22992 (class L)	—	—
331	Orange	Orange	Brown	49-331	S	4	4	—	MS90560-5	MIL-C-22992 (class L)	—	—
332	Orange	Orange	Red	49-332	S	4G	4	—	MS90560-9	MIL-C-22992 (class L)	—	—
333	Orange	Orange	Orange	49-333	S	1/0	1	—	MS90560-3	MIL-C-22992 (class L)	—	—
334	Orange	Orange	Yellow	49-334	S	2/0	2/0	—	MS90560-2	MIL-C-22992 (class L)	—	—
335	Orange	Orange	Green	49-335	S	4/0	4/0	—	MS90560-1	MIL-C-22992 (class L)	—	—
337	Orange	Orange	Violet	47-337	P	16	16	—	MS90461B16-16	MIL-C-81511 (series 1 & 2)	.220	—
338	Orange	Orange	Gray	47-338	P	12	12	—	MS90461A12-12	MIL-C-81511 (series 1 & 2)	—	—
339	Orange	Orange	White	47-339	P	12	12	—	MS90461B12-12	MIL-C-22992 (class L)	—	—
340	Orange	Yellow	Black	50-340	P	—	—	12	M8373(3)13-12	MIL-C-83733	.260 (5)	.260 (5)
341	Orange	Yellow	Brown	51-341	S	—	—	12	M8373(3)14-12	MIL-C-83733	.260 (6)	.260 (6)
342	Orange	Yellow	Red	54-342	P	—	—	12	MS27184-22P	MIL-C-26500	.235 (3)	.255 (3)
343	Orange	Yellow	Orange	54-343	P	—	—	8	MS27184-20P	MIL-C-26500	.235 (3)	.255 (3)
344	Orange	Yellow	Yellow	55-344	S	—	—	12	MS27185-22S	MIL-C-26500	.150 (4)	.235 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
345	Orange	Yellow	Green	55-345	S	—	—	8	MS27185-205	MIL-C-26500	.150 (4)	.235 (4)
348	Orange	Yellow	Gray	56-348	S	22	22D	—	MS27490-22D MS27655-22D	MIL-C-38999 (series I, III, and IV)	—	.166
349	Orange	Yellow	White	56-349	S	22	22M	—	MS27490-22M	MIL-C-38999 (series I, III, and IV)	—	.166
350	Orange	Green	Black	56-350	S	22	22	—	MS27490-22	MIL-C-38999 (series I, II and IV	—	.166
351	Orange	Green	Brown	56-351	S	20	20	—	MS27490-20 MS27655-20	MIL-C-38999 (series I, III, and IV)	—	.166
352	Orange	Green	Red	56-352	S	16	16	—	MS27490-16 MS27655-16	MIL-C-38999 (series I, III, and IV)	—	.166
353	Orange	Green	Orange	56-353	S	12	12	—	MS27490-12 MS27655-12	MIL-C-38999 (series I, III, and IV)	—	—
354	Orange	Green	Yellow	57-354	S	22	22D	—	MS27491-22D MS27492-22D M24308/12-1	MIL-C-24308 MIL-C-55302/6 8, /71,/72,8/75 MIL-C-38999 (series II) MIL-C-83733	—	.166
355	Orange	Green	Green	57-355	S	22	22M	—	MS27492-22M MS27492-22M	MIL-C-24308 MIL-C-55302/6 8, /71,/72,8/75 MIL-C-38999 (series II) MIL-C-83733	—	.166

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
356	Orange	Green	Blue	57-356	S	22	22	—	MS27491-22 MS27491-22	MIL-C-24308 MIL-C-55302/6 8, /71,/72,8/75 MIL-C-38999 (series II) MIL-C-83733	—	.166
357	Orange	Green	Violet	57-357	S	20	20	—	MS27491-20 MS27492-20	MIL-C-24308 MIL-C-55302/6 8, /71,/72,8/75 MIL-C-38999 (series II) MIL-C-83733		.166
358	Orange	Green	Gray	57-358	S	16	16	—	MS27491-16 MS27492-16	MIL-C-24308 MIL-C-55302/6 8, /71,/72,8/75 MIL-C-38999 (series II) MIL-C-83733		.166
359	Orange	Green	White	57-359	S	12	12	—	MS27491-12 MS27492-12	MIL-C-24308 MIL-C-55302/6 8, /71 & /75 MIL-C-38999 (series II) MIL-C-83733	—	—
360	Orange	Blue	Black	58-360	P	22	22D	—	MS27493-22D MS27493-22D M24308/13-1	MIL-C-24308 MIL-C-55302/6 9 MIL-C-38999 (series I thru IV) MIL-C-3733	.166	—
361	Orange	Blue	Brown	58-361	P	22	22M	—	MS27493-22M MS27494	MIL-C-24308 MIL-C-55302/6 9 MIL-C-38999 (series I thru IV) MIL-C-3733	.166	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
362	Orange	Blue	Red	58-362	P	22	22	—	MS27493-22 MS27494-22	MIL-C-24308 MIL-C-55302/6 9 MIL-C-38999 (series I thru IV) MIL-C-3733	.166	—
363	Orange	Blue	Orange	58-363	P	20	20	—	MS27493-20 MS27494-20	MIL-C-24308 MIL-C-55302/6 9 MIL-C-38999 (series I thru IV) MIL-C-3733	.166	—
364	Orange	Blue	Yellow	58-364	P	16	16	—	MS27493-16 MS27494-16	MIL-C-38999 (series I & III)	.166	—
365	Orange	Blue	Green	58-365	P	12	12	—	MS27493-12 MS27494-12	MIL-C-38999 (series I & III)	—	—
366	Orange	Blue	Blue	59-366	S	—	—	8	MS27535	MIL-C-24308	.200 (4)	.405 (4)
367	Orange	Blue	Violet	60-367	P	—	—	8	MS27536	MIL-C-24308	.405 (3)	.200 (3)
368	Orange	Blue	Gray	63-368	S	20	20	—	M24308/10-1	MIL-C-24308	—	.188
369	Orange	Blue	White	64-369	P	20	20	—	M24308/11-1	MIL-C-24308	.188	—
384	Orange	Gray	Yellow	69-384	S	16	24	—	M39029/69-1	MIL-C-85028 (AS)	—	.345
385	Orange	Gray	Green	69-385	S	16	20	—	M39029/69-2	MIL-C-85028 (AS)	—	.345
386	Orange	Gray	Blue	69-386	S	16	16	—	M39029/69-3	MIL-C-85028 (AS)	—	.345
387	Orange	Gray	Violet	70-387	P	16	24	—	M39029/70-1	MIL-C-85028 (AS)	.345	—
388	Orange	Gray	Gray	70-388	P	16	20	—	M39029/70-2	MIL-C-85028 (AS)	.345	—
389	Orange	Gray	White	70-389	P	16	16	—	M39029/70-3	MIL-C-85028 (AS)	.345	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
390	Orange	White	Black	71-390	P	22	(2)	—	M39029/71-1	MIL-C-38999 (series II) MIL-C-24308 MIL-C-83733	.166	—
391	Orange	White	Brown	71-391	P	22	(2)	—	M39029/71-2	MIL-C-38999 (series II) MIL-C-24308 MIL-C-83733	.166	—
392	Orange	White	Red	71-392	P	22	(2)	—	M39029/71-3	MIL-C-38999 (series II) MIL-C-24308 MIL-C-83733	.166	—
393	Orange	White	Orange	72-393	S	22	(2)	—	M39029/72-1	MIL-C-38999 (series II) MIL-C-5530(2)6 8, /71 and /75 MIL-C-24308/2, /6	—	.166
394	Orange	White	Yellow	72-394	S	22	(2)	—	M39029/72-2	MIL-C-38999 (series II) MIL-C-55302 /68, /71 and /75 MIL-C-24308	—	.166
395	Orange	White	Green	72-395	S	22	(2)	—	M39029/72-3	MIL-C-38999 (series II) MIL-C-55302 /68, /71 and /75 MIL-C-24308	—	.166
396	Orange	White	Blue	73-396	S	—	—	12	M39029/73-12A	MIL-C-83723 (series 3)	.250 (4)	.300 (4)
397	Orange	White	Violet	73-397	S	—	—	12	M39029/73-12C	MIL-C-83723 (series 3)	.250 (4)	.300 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
398	Orange	White	Gray	73-398	S	—	—	12	M39029/73-12B	MIL-C-83723 (series 3)	.250 (4)	.300 (4)
399	Orange	White	White	74-399	P	—	—	12	M39029/74-12A	MIL-C-83723 (series 3)	.300 (3)	.250 (3)
400	Yellow	Black	Black	74-400	P	—	—	12	M39029174-12C	MIL-C-83723 (series 3)	.300 (3)	.250 (3)
401	Yellow	Black	Brown	74-401	P	—	—	12	M39029/74-12B	MIL-C-83723 (series 3)	.300 (3)	.250 (3)
402	Yellow	Black	Red	27-402	S	—	—	12	M39029/27-12B	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
403	Yellow	Black	Orange	27-403	S	—	—	12	M39029/27-12C	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
404	Yellow	Black	Yellow	27-402	S	—	—	12	M39029/27-12D	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
405	Yellow	Black	Green	27-405	S	—	—	12	M39029/27-12E	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
406	Yellow	Black	Blue	27-406	S	—	—	12	M39029/27-12F	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
407	Yellow	Black	Violet	27-407	S	—	—	12	M39029/27-12G	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
408	Yellow	Black	Gray	27-408	S	—	—	12	M39029/27-12H	MIL-C-83723 (series 3)	.166 (4)	.166 (4)
409	Yellow	Black	White	28-409	P	—	—	12	M39029/28-12B	MIL-C-38999 (series I, II, III, and IV)	.166 (3)	.166 (3)
410	Yellow	Brown	Black	28-410	P	—	—	12	M39029/28-12C	MIL-C-38999 (series I, II, III, and IV)	.166 (3)	.166 (3)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
411	Yellow	Brown	Brown	28-411	P	—	—	12	M39029/28-12D	MIL-C-38999 (series I, II, III, and IV)	.166 (3)	.166 (3)
412	Yellow	Brown	Red	28-412	P	—	—	12	M39029/28-12E	MIL-C-38999 (series I, II, III, and IV)	.166 (3)	.166 (3)
413	Yellow	Brown	Orange	28-413	P	—	—	12	M39029/28-12F	MIL-C-38999 (series I, II, III, and IV)	.166 (3)	.166 (3)
414	Yellow	Brown	Yellow	28-414	P	—	—	12	M39029/28-12G	MIL-C-38999 (series I, II, III, and IV)	.166 /3	.166 (3)
415	Yellow	Brown	Green	28-415	P	—	—	12	M39029/28-12H	MIL-C-38999 (series I, II, III, and IV)	.166 (4)	.166 (4)
416	Yellow	Brown	Blue	75-416	S	—	—	12	M39029/75-12A	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)
417	Yellow	Brown	Violet	75-417	S	—	—	12	M39029/75-12B	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)
418	Yellow	Brown	Gray	75-418	S	—	—	12	M39029/75-12C	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)
419	Yellow	Brown	White	75-419	S	—	—	12	M39029/75-12D	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)
420	Yellow	Red	Black	75-420	S	—	—	12	M39029/75-12E	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
421	Yellow	Red	Brown	75-421	S	—	—	12	M39029/75-12F	MIL-C-38999 (series I, III and IV)	.166 (4)	.166 (4)
422	Yellow	Red	Red	75-422	S	—	—	12	M39029/75-12G	MIL-C-38999 (series I, III, and IV)	.166 (4)	.166 (4)
423	Yellow	Red	Orange	74-423	S	—	—	12	MS39029/28-12H	MIL-C-38999 (series I, II, and IV)	.166 (4)	.166 (4)
424	Yellow	Red	Yellow	76-424	P	—	—	16	M39029/76-16A	MIL-C-38999 (series I, II, and IV)	.166 (3)	.166 (3)
425	Yellow	Red	Green	76-425	P	—	—	16	M39029/76-16B	MIL-C-38999 (series I, II, and IV)	.166 (3)	.166 (3)
426	Yellow	Red	Blue	76-426	P	—	—	16	M39029/76-16C	MIL-C-38999 (series I, II, and IV)	.166 (3)	.166 (3)
427	Yellow	Red	Violet	76-427	P	—	—	16	M39029/76-16D	MIL-C-38999 (series I, II, and IV)	.166 (3)	.166 (3)
428	Yellow	Red	Gray	77-428	S	—	—	16	M39029/77-16A	MIL-C-38999 (series I, II, and IV)	.166 (4)	.166 (4)
429	Yellow	Red	White	77-429	S	—	—	16	M39029/77-16B	MIL-C-38999 (series I, II, and IV)	.166 (4)	.166 (4)
430	Yellow	Orange	Black	77-430	S	—	—	16	M39029/77-16C	MIL-C-38999 (series I, II, and IV)	.166 (4)	.166 (4)

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
431	Yellow	Orange	Brown	77-431	S	—	—	16	M39029/77-16D	MIL-C-38999 (series I, II, III and IV)	.166 (4)	.166.4
432	Yellow	Orange	Red	77-432	S	—	—	16	M39029/78-16A	MIL-C-38999 (series I, II, III and IV)	.166 (4)	.166 (4)
433	Yellow	Orange	Orange	78-433	S	—	—	16	M39029/78-16B	MIL-C-38999 (series I, II, III and IV)	.166 (4)	.166 (4)
434	Yellow	Orange	Yellow	78-434	S	—	—	16	M39029/78-16C	MIL-C-38999 (series I, II, III and IV)	.166 (4)	.166 (4)
435	Yellow	Orange	Green	78-435	S	—	—	16	M39029/78-16D	MIL-C-38999 (series I, II, III and IV)	.166 (4)	.166 (4)
436	Yellow	Orange	Blue	79-436	P	—	—	16	M39029/79-16A	MIL-C-28748/9	.275 (3)	.200 (3)
437	Yellow	Orange	Violet	79-437	P	—	—	16	M39029/79-16B	MIL-C-28748/9	.275 (3)	.200 (3)
438	Yellow	Orange	Gray	80-438	S	—	—	16	M39029/80-16A	MIL-C-28748/10	.200 (4)	.275 (4)
439	Yellow	Orange	White	80-439	S	—	—	16	M39029/80-16B	MIL-C-28748/10	.200 (4)	.275 (4)
440	Yellow	Yellow	Black	34-440	P	22	22	—	M39029/34-22-22	MIL-C-28748/3 and MIL-C-28748/13	—	.175
441	Yellow	Yellow	Brown	35-441	S	22	22	—	M39029/35-22-22	MIL-C-28748/4 and MIL0C-28748/14	—	.175
448	Yellow	Yellow	Gray	31-448	P	20	20	—	M39029/31-20-20	MIL-C-26482 (series 1) MIL-C-26550 and MIL-C-26518	—	.290

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
449	Yellow	Yellow	White	32-449	S	20	20	—	M39029/32-20-20	MIL-C-26482 (series 1) MIL-C-26550 and MIL-C-26518	—	.290
450	Yellow	Green	Black	83-450	P	20	22	—	M39029/83-20-22	MIL-C-28840	.293	—
451	Yellow	Green	Brown	83-451	P	20	28	—	M39029/83-20-28	MIL-C-28840	.293	—
452	Yellow	Green	Red	84-452	S	20	22	—	M39029/83-20-22	MIL-C-28840	—	.293
453	Yellow	Green	Orange	84-453	S	20	28	—	M39029/83-20-28	MIL-C-28840	—	.293
454	Yellow	Green	Yellow	85-454	P	16	16	—	M39029/851616C1	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	.430	—
455	Yellow	Green	Green	85-455	P	16	16	—	M39029/851616C2	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	.430	—
456	Yellow	Green	Blue	85-456	P	16	16	—	M39029/851616C3	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	.430	—
457	Yellow	Green	Violet	85-457	P	16	16	—	M39029/851616C4	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	.430	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
458	Yellow	Green	Gray	85-458	P	12	12	—	M39029/851212C1	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
459	Yellow	Green	White	85-459	P	12	12	—	M39029/851212C2	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
460	Yellow	Blue	Black	85-460	P	12	12	—	M39029/851212C3	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
461	Yellow	Blue	Brown	85-461	P	12	12	—	M39029/851212C4	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
462	Yellow	Blue	Red	86-462	S	16	16	—	M39029/851616C1	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	.430
463	Yellow	Blue	Orange	86-463	S	16	16	—	M39029/851616C2	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	.430

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
464	Yellow	Blue	Yellow	86-464	S	16	16	—	M39029/851616C3	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	.430
465	Yellow	Blue	Green	86-465	S	16	16	—	M39029/851616C4	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	.430
466	Yellow	Blue	Blue	86-466	S	12	12	—	M39029/851212C1	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
467	Yellow	Blue	Violet	86-467	S	12	12	—	M139029/851212C2	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
468	Yellow	Blue	Gray	86-468	S	12	12	—	M39029/851212C3	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
469	Yellow	Blue	White	86-469	S	12	12	—	M39029/851212C4	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
470	Yellow	Violet	Black	87-410	P	22	22	—	M39029/872222C1	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
471	Yellow	Violet	Brown	87-471	P	22	22	—	M39029/872222C2	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
472	Yellow	Violet	Red	87-472	P	22	22	—	M39029/872222C3	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
473	Yellow	Violet	Orange	87-473	P	22	22	—	M39029/872222C4	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
474	Yellow	Violet	Yellow	87-474	P	20	20	—	M39029/872020C1	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
475	Yellow	Violet	Green	87-475	P	20	20	—	M39029/872020C2	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
476	Yellow	Violet	Blue	87-476	P	20	20	—	M39029/872020C3	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
477	Yellow	Violet	Violet	87-477	P	20	20	—	M39029/872020C4	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
478	Yellow	Violet	Gray	87-478	P	16	16	—	M39029/871616C1	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
479	Yellow	Violet	White	87-479	P	16	16	—	M39029/871616C2	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
480	Yellow	Gray	Black	87-480	P	16	16	—	M39029/871616C3	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
481	Yellow	Gray	Brown	87-481	P	16	16	—	M39029/871616C4	MIL-C-38999 (series I, II, III and IV) MIL-C-83733	—	—
482	Yellow	Gray	Red	88-482	S	22	22	—	M39029/872222C1	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
483	Yellow	Gray	Orange	88-483	S	22	22	—	M39029/882222C2	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
484	Yellow	Gray	Yellow	88-484	S	22	22	—	M39029/882222C3	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
485	Yellow	Gray	Green	88-485	S	22	22	—	M39029/882222C4	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
486	Yellow	Gray	Blue	88-486	S	20	20	—	M39029/882020C1	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
487	Yellow	Gray	Violet	88-487	S	20	20	—	M39029/882020C2	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
488	Yellow	Gray	Gray	88-488	S	20	20	—	M39029/882020C3	MIL-C-38999 (series I, III and IV) MIL-C-83723	—	—
489	Yellow	Gray	White	88-489	S	20	20	—	M39029/882020C4	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
490	Yellow	White	Black	88-490	S	16	16	—	M39029/881616C1	MIL-C-38999 (series I, III and IV) MIL-C-83723	—	—
491	Yellow	White	Brown	88-491	S	16	16	—	M39029/881616C2	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
492	Yellow	White	Red	88-492	S	16	16	—	M39029/881616C3	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
493	Yellow	White	Orange	88-493	S	16	16	—	M39029/881616C4	MIL-C-38999 (series I, III and IV) MIL-C-83733	—	—
494	Yellow	White	Yellow	89-494	S	22	22	—	M39029/892222C1	MIL-C-38999 (series II)	—	—
495	Yellow	White	Green	89-495	S	22	22	—	M39029/892222C2	MIL-C-38999 (series II)	—	—
496	Yellow	White	Blue	89-496	S	22	22	—	M39029/892222C3	MIL-C-38999 (series II)	—	—
497	Yellow	White	Violet	89-497	S	22	22	—	M39029/892222C4	MIL-C-38999 (series II)	—	—
498	Yellow	White	Gray	89-498	S	20	20	—	M39029/892020C1	MIL-C-38999 (series II)	—	—
499	Yellow	White	White	89-499	S	20	20	—	M39029/892020C2	MIL-C-38999 (series II)	—	—
500	Green	Black	Black	89-500	S	20	20	—	M39029/8920200	MIL-C-38999 (series II)	—	—
501	Green	Black	Brown	89-501	S	20	20	—	M39029/892020C4	MIL-C-38999 (series II)	—	—
502	Green	Black	Red	89-502	S	16	16	—	M39029/891616C1	MIL-C-38999 (series II)	—	—
503	Green	Black	Orange	89-503	S	16	16	—	M39029/891616C2	MIL-C-38999 (series II)	—	—
504	Green	Black	Yellow	89-504	S	16	16	—	M39029/891616C3	MIL-C-38999 (series II)	—	—
505	Green	Black	Green	89-505	S	16	16	—	M39029/891616C4	MIL-C-38999 (series II)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
507	Green	Black	Violet	1-507	P	20	22D	—	M39029/1-20-20D	MIL-T-81714 (series 1)	—	—
508	Green	Black	Gray	83-508	P	20	20	—	M39029/83-20-22	MIL-C-28840	.287	—
509	Green	Black	White	84-509	S	20	20	—	N/A	MIL-C-28840	—	.287
510	Green	Brown	Black	86-510	S	16S	16	—	N/A	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
511	Green	Brown	Brown	86-511	S	16S	16	—	N/A	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
512	Green	Brown	Red	86-512	S	16S	16	—	N/A	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
513	Green	Brown	Orange	86-513	S	16S	16	—	N/A	MIL-C-5015 (MS3450 series) and MIL-C-83723 (series 2)	—	—
514	Green	Brown	Yellow	9-514	P	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	Color Bands 2nd	Color Bands 3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Power Contacts Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
515	Green	Brown	Green	9-515	P	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
516	Green	Brown	Blue	9-516	P	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
517	Green	Brown	Violet	9-517	P	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
518	Green	Brown	Gray	9-518	P	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
519	Green	Brown	White	10-519	S	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
520	Green	Red	Black	10-520	S	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
521	Green	Red	Brown	10-521	S	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
522	Green	Red	Red	10-522	S	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
523	Green	Red	Orange	10-523	S	16	16	—	N/A	MIL-C-26482 (series 2) MIL-C-81703 (series 3) MIL-C-83723 (series 3) and MIL-C-83733	—	—
524	Green	Red	Yellow	72-524	S	22	(2)	—	N/A	MIL-C-38999 (series I, III and IV)	—	.166
525	Green	Red	Green	72-525	S	22	(2)	—	N/A	MIL-C-38999 (series I, III and IV)	—	.166

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
526	Green	Red	Blue	72-526	S	22	(2)	—	N/A	MIL-C-38999 (series I, III and IV)	—	.166
527	Green	Red	Violet	56-527	S	10	10	—	N/A	MIL-C-38999 (series I, III and IV)	—	.166
528	Green	Red	Gray	58-528	P	10	10	—	N/A	MIL-C-38999 (series I, III and IV)	—	—
529	Green	Red	White	90-529	P	—	—	8	N/A	MIL-C-38999 (series III)	.166 (3)	.166 (3)
530	Green	Orange	Black	91-530	S	—	—	8	N/A		.166 (4)	.166 (4)
531	Green	Orange	Brown	92-531	S	22	22	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
532	Green	Orange	Red	92-532	S	20	20	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
533	Green	Orange	Orange	92-533	S	16	16	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
534	Green	Orange	Yellow	92-534	S	16	20	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
535	Green	Orange	Green	92-535	S	12	12	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
536	Green	Orange	Blue	92-536	S	12	16	—	N/A	MIL-R-6106 MIL-S-12883 /40 & /41	—	—
537	Green	Orange	Violet	93-537	P	22	22	—	N/A	DOD-C-83527	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands 1st	2nd	3rd	Military Part Number M39029/	Pin or Socket	Power Contacts Mating End Size	Wire Barrel Size	Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
538	Green	Orange	Gray	93-538	P	20	20	—	N/A	DOD-C-83527	—	—
539	Green	Orange	White	93-539	P	16	16	—	N/A	DOD-C-83527	—	—
540	Green	Yellow	Black	93-540	P	12	12	—	N/A	DOD-C-83527	—	—
541	Green	Yellow	Brown	94-541	S	22	22	—	N/A	DOD-C-83527	—	—
542	Green	Yellow	Red	94-542	S	20	20	—	N/A	DOD-C-83527	—	—
543	Green	Yellow	Orange	94-543	S	16	16	—	N/A	DOD-C-83527	—	—
544	Green	Yellow	Yellow	94-544	S	12	12	—	N/A	DOD-C-83527	—	—
545	Green	Yellow	Green	95-545	S	—	—	8	N/A	DOD-C-83527	—	—
546	Green	Yellow	Blue	96-546	P	—	—	8	N/A	DOD-C-83527	—	—
547	Green	Yellow	Violet	97-547	P	—	—	1	N/A	DOD-C-83527	—	—
548	Green	Yellow	Gray	98-548	S	—	—	1	N/A	DOD-C-83527	—	—
549	Green	Yellow	White	99-549	S	—	—	5	N/A	DOD-C-83527	—	—
550	Green	Green	Black	100-550	S	—	—	5	N/A	DOD-C-83527	—	—
551	Green	Green	Brown	101-551	S	22	28	—	N/A	MIL-S-12883/44, /45, /46	—	—
552	Green	Green	Red	101-552		22	22	—	N/A	MIL-S-12883/44, /45, /46	—	—
553	Green	Green	Orange	101-553	S	20	20	—	N/A	MIL-S-12883/44, /45, /46	—	—
554	Green	Green	Yellow	101-554	S	16	16	—	N/A	MIL-S-12883/44, /45, /46	—	—
556	Green	Green	Blue	104-556	P	—	—	8	N/A	MIL-C-28840	—	—
558	Green	Green	Gray	102-558	P	—	—	12	N/A	MIL-C-38999 (series I, II, III and IV)	—	—

See footnotes at end of table

TABLE 21. MIL-C-390299 CONTACT SUMMARY (Cont)

BIN Code (1)	Color Bands			Military Part Number M39029/	Pin or Socket	Power Contacts		Shielded Contact Cavity Size	Superseded Military Part Numbers	Connector Used with (Specification)	E (inch)	F (inch)
	1st	2nd	3rd			Mating End Size	Wire Barrel Size					
559	Green	Green	White	103-559	S	—	—	12	N/A	MIL-C-38999 (series I, III and IV)	—	—
605	Blue	Black	Green	22-605	S	12	12	—	N/A	MIL-T-81714 (series 2)	—	—

NOTES:

(1) BIN - Basic identification number.

(2) Solderless wrappost termination.

(3) For shielded pin contacts:
E = O.D. Of outer contact (Figure 2).
F = I.D. of inner contact (Figure 1).

(4) For shielded socket contacts:
E = O.D. of inner contact (Figure 1).
F = I.D. of outer contact (Figure 2).

(5) For shielded pin contacts:
E = O.D. of outer contact (Figure 2).
F = O.D. of inner contact (Figure 1).

(6) For shielded socket contacts:
E = I.D. of outer contact (Figure 2).
F = I.D. of inner contact (Figure 1).

See footnotes at end of table

56. **Solder Tact Contacts.**

57. Removable solder-type contacts are used with connectors conforming to MIL-C-26482, MIL-C-83723, MIL-C-83733, MIL-C26500, and MIL-C-28748. These contacts contain prefluxed solder preforms and heat-shrinkable insulation material, which is available for twisted pair wire, coaxial cable (Figure 1), or single conductor shielded cable.

58. When the contact is heated, the solder melts and the heat-shrinkable insulation shrinks, terminating the wire or cable to the contact, insulating and strain relieving the conductors.

59. **Coaxial Solder Contact Installation.**

60. **Contact Selection.** To select the proper contact, use the following procedure:

a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 22).

c. Verify contact is compatible with size of cable to be terminated (Table 23).

61. **Cable Preparation.** To prepare the cable, use the following procedure:

a. Determine method of cable preparation (Table 23).

b. Determine cable stripping dimensions (Figure 45).

c. Strip cable in accordance with WP 009 00.

d. Straighten center conductor and smooth shield-braid tightly against cable.

e. If stranded or unplated copper, tin center conductor.

62. **Assembly.** To assemble the solder contact to the coaxial cable, perform the following procedure:

NOTE

For conventionally stripped cable, slightly rotate contact during cable insertion to prevent shield-braid strands from splaying.

a. Slip solder contact carefully over end of prepared cable and push contact onto cable until it stops.

b. Inspect assembly to see that shield-braid and center conductor are both visible through the respective inspection windows (Figure 44).

c. If shield braid and center conductor are not visible, remove contact from cable and check for incorrect strip dimension, splayed shield-braid, or bent center conductor.

63. **Heating.** To attach the solder contact to the cable, use the following procedure:

a. Select appropriate adapter (Table 22).

b. Set up holding fixture and adapter as shown (Figure 46).

c. Insert contact and cable assembly into holding fixture and adapter (Figure 47). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

WARNING

Do not use heat guns with electric motors on aircraft that have not been defueled and purged. Use compressed air/nitrogen heating tool on fueled aircraft.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until large outer solder ring melts and flows and outer sleeving is shrunk over cable.

e. Inspect small inner solder ring. If it has not melted and flowed, continue heating until it flows.

f. Allow assembly to cool at least five seconds before removing from holding fixture.

64. **Inspection.** Inspect solder flow through two inspection windows.

65. **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into strands of shield-braid.

b. Inner solder preform must be completely melted and flowed between the cable center conductor and inner contact soldering surface.

c. Fillet of solder should be visible through each inspection window.

d. Insulation sleeve should be fully shrunk onto cable.

66. **Underheated.**

a. Original form of one or both preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

67. **Overheated.**

a. Insulation sleeve is darkened to an opaque brown.

b. There are no solder fillets seen through inspection windows.

c. Cable insulation is melted or charred.

68. **Repair Procedures.** An underheated contact can be reheated to flow solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit insulation lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (paragraphs 63 and 64).

69. **Twisted Pair Solder Contact Installation.**

70. **Contact Selection.** To select the proper contact, use the following procedure:

a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 1).

c. Verify contact is compatible with gage (AWG) size of twisted pair wire to be terminated (Table 24).

71. **Wire Preparation.** To prepare the twisted pair, use the following procedure:

a. Strip wire in accordance with Figure 48.

b. Twist conductors into normal lay and straighten.

c. Tin all stranded and non-plated solid wire.

d. After tinning, ensure wire ends are straight.

72. **Assembly.** To assemble the solder contact to the twisted pair, use the following procedure:

a. Insert signal lead into center insulating sleeve and ground lead into outer insulating sleeve. Ensure wires bottom in contact (Figure 49).

b. Ensure signal lead is visible through forward inspection window inside inner solder preform.

c. Position ground lead so that it is not located directly in rear inspection windows.

73. **Heating.** To attach the solder contact to the twisted pair, use the following procedure:

a. Select appropriate adapter (Table 22).

b. Set up holding fixture and adapter as shown (Figure 46).

c. Insert contact and twisted pair assembly into holding fixture and adapter (Figure 47). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

WARNING

Do not use heat guns with electric motors on aircraft that have not been defueled and purged. Use compressed air/nitrogen heating tool on fueled aircraft.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until small inner solder ring melts and flows and sleeving is shrunk over wires.

e. Inspect large outer solder ring to see if it has melted and flowed. If it has not melted and flowed, continue heating until it flows.

f. Allow the contact and wire assembly to cool for at least five seconds before removing from holding fixture.

74. **Inspection.** Inspect solder flow through two inspection windows.

75. **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into rear inspection window.

b. Inner solder preform must be completely melted and flowed, forming a fillet of solder between signal wire conductor and inner soldering surface.

c. Both insulation sleeves should be fully shrunk onto wire insulation.

76. **Underheated.**

a. Original form of one or both solder preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

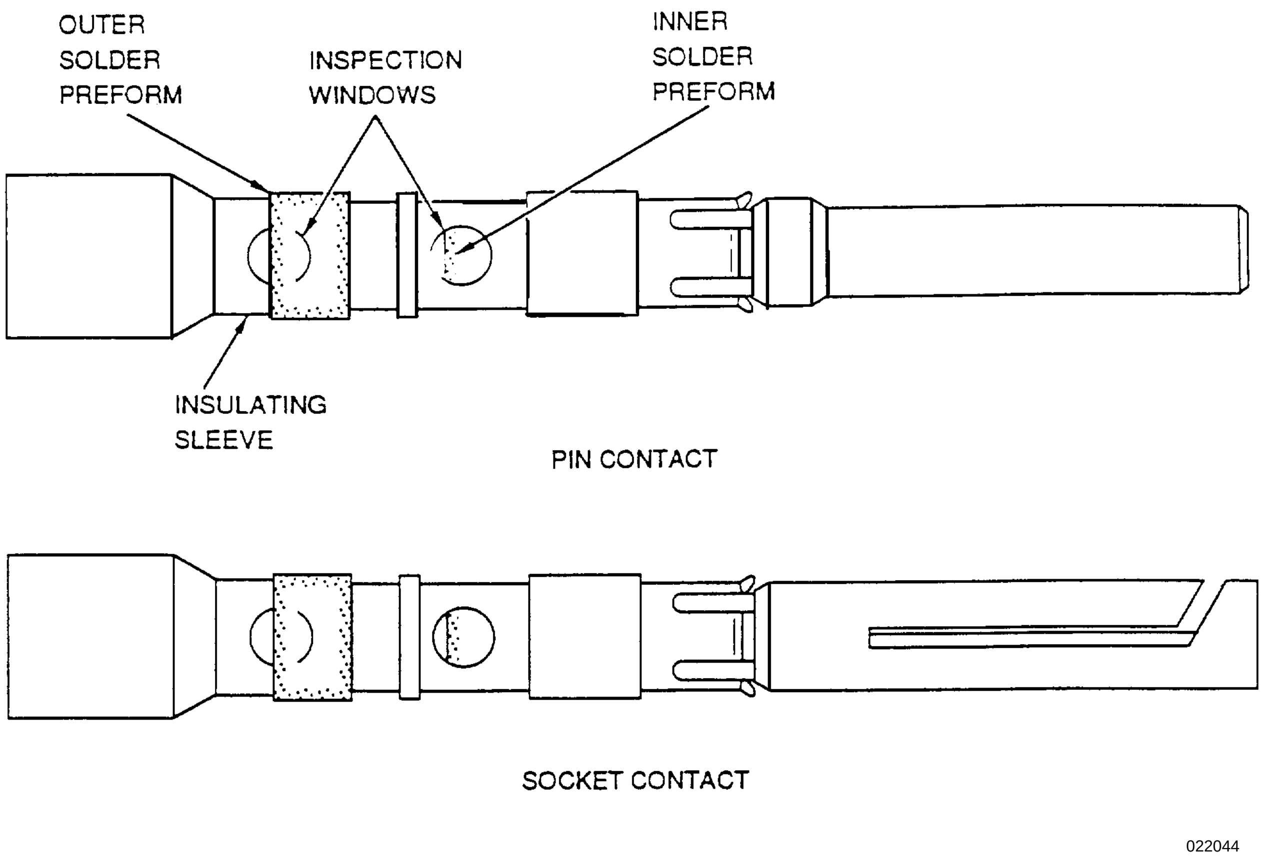
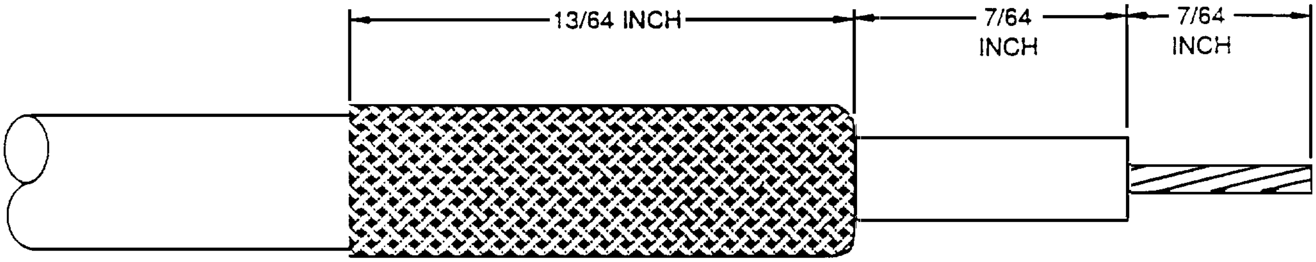
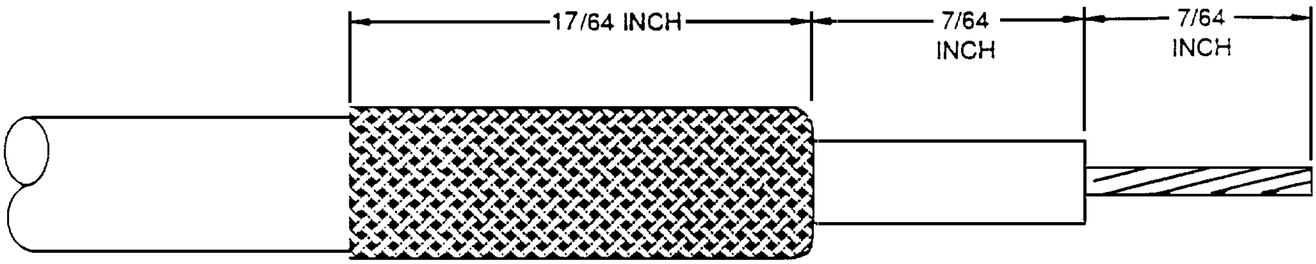


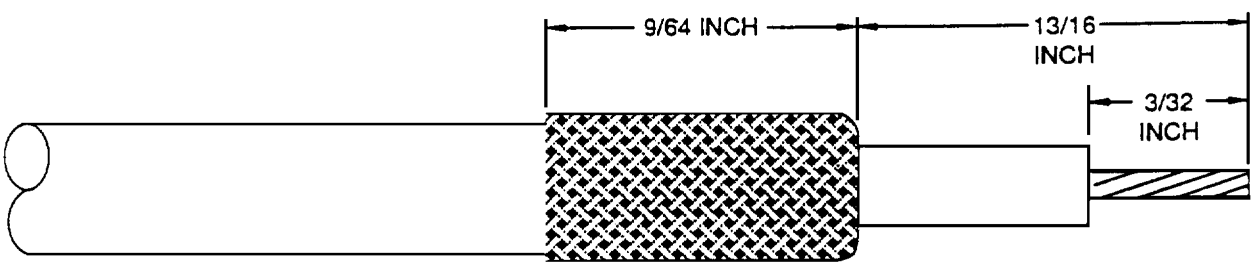
Figure 44. Typical Coaxial Solder Contact



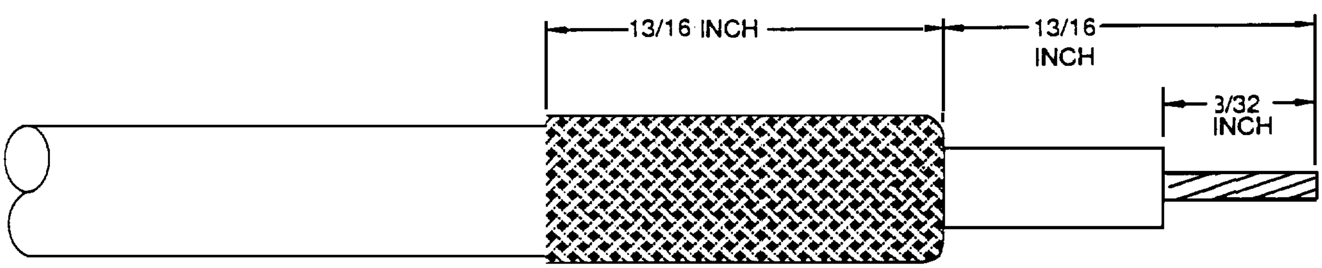
FOR CONTACTS NO. D-602-16, D-602-17
BRAID FOLDED BACK



FOR CONTACTS NO. D-602-16, D-602-17
CONVENTIONAL STRIPPING



FOR CONTACTS NO. D-602-44, D-602-45, D-602-46, D-602-47, D-602-72, D-602-73, D-602-0094, D-602-0095
BRAID FOLDED BACK



FOR CONTACTS NO. D–602–44, D–602–45, D–602–46, D–602–47, D–602–72, D–602–73, D–602–0094, D–602–0095
CONVENTIONAL STRIPPING

02204501

Figure 45. Strip Dimensions for Coaxial Solder Contacts (Sheet 1 of 2)

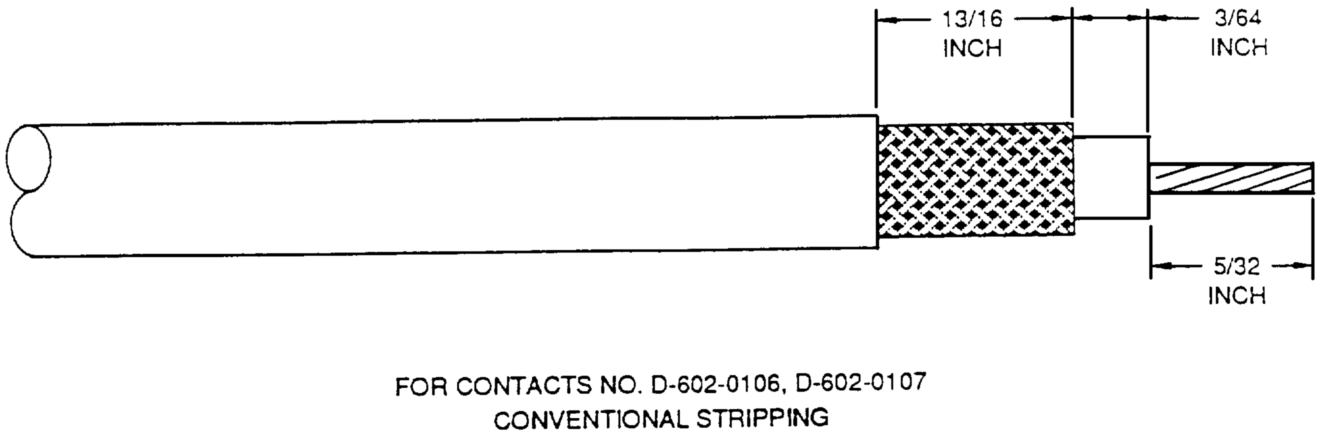


Figure 45. Strip Dimensions for Coaxial Solder Contacts (Sheet 2)

02204502

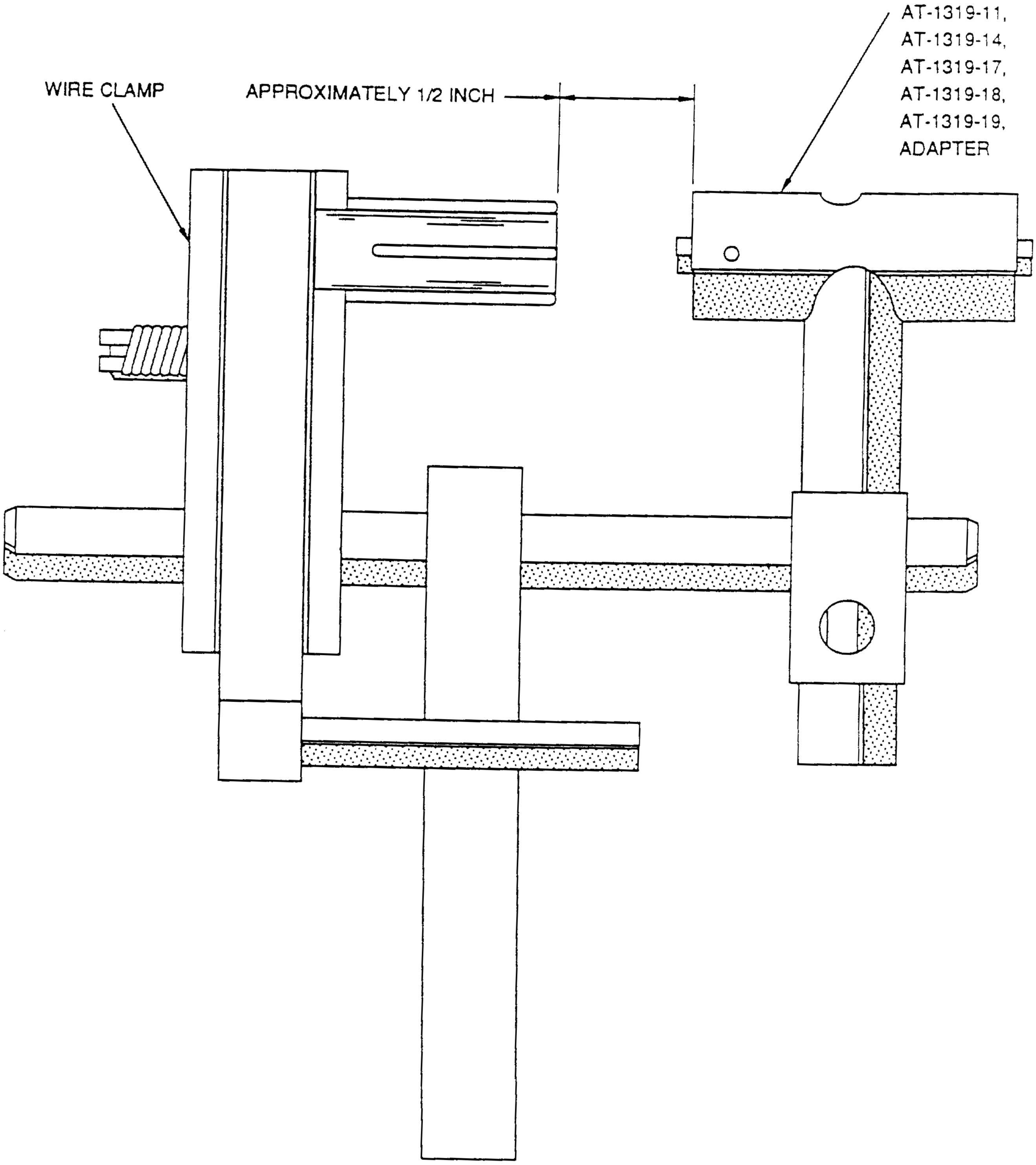


Figure 46. Holding Fixture and Adapter Setup

022046

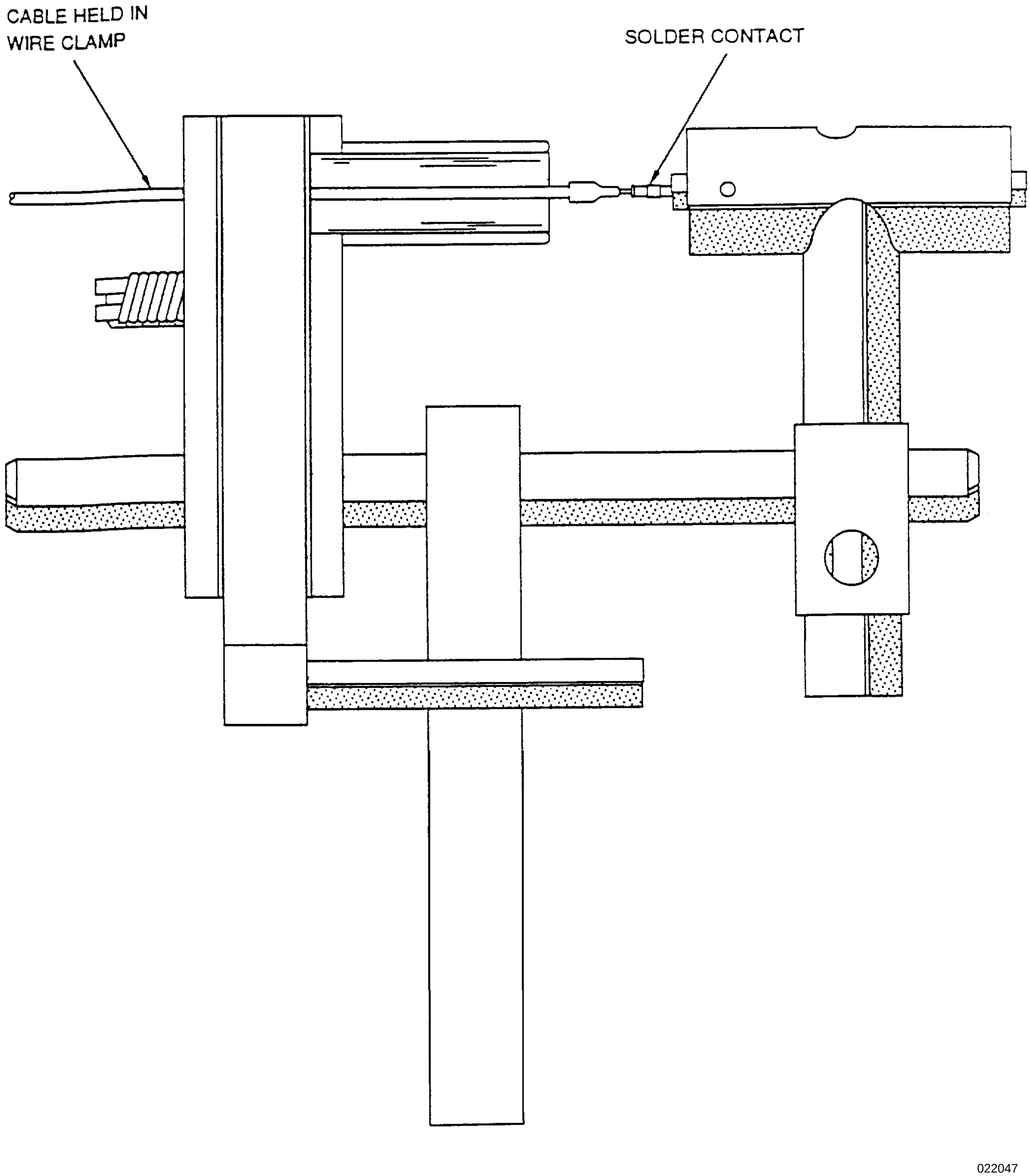


Figure 47. Solder Contact and Cable Prepared for Heating

TABLE 22. SOLDER CONTACT SELECTION

Connector Specification	Contact Cavity Size	Wire or Cable Type	Contact Type	Raychem Solder Contact No.	Raychem Holding Fixture Adapter Number
MIL-C-26482 MIL-C-26500	12	Coaxial Cable	Pin	D-602-17	AT-1319-11
MIL-C-26482 MIL-C-26500	12	Coaxial Cable	Socket	D-602-16	
MIL-C-28748	16	Coaxial Cable	Pin	D-602-44	AT-1319-14
			Socket	D-602-45	
		Twisted Pair	Pin	D-602-54	
			Socket	D-602-55	
MIL C 26482 MIL-C-26500	16	Coaxial Cable	Pin Socket	D-602-46 D-620-47	AT-1319-17
		Twisted Pair	Pin Socket	D-602-56 D-602-57	
MIL-C-83723 MIL-C-83733	12	Coaxial Cable	Pin	D-602-0094	AT-1319-19
				D-602-0106	
			Socket	D-602-0095	
				D-602-0107	
		Twisted Pair	Pin	D-602-0104	
			Socket	D-602-0105	
MIL-C-28748	16	Coaxial Cable	Pin	D-602-72	AT-1319-18
			Socket	D-602-73	

TABLE 23. COAXIAL SOLDER CONTACT CABLE ACCOMMODATION

Raychem Solder Contact No.	Type of Cable Preparation	Cable Dimensions			
		Note 1 Center Conductor Diameter	Dielectric Diameter	Note 1 Shield Braid Diameter	Jacket Diameter
D-602-16, D-602-17	Conventional Strip	.011-.020	.033-.067	.074-.095	.131 Max.
	Braid Foldback	.011-.020	.033-.067	.110 Max. Over Folded Back Braid	—
D-602-72 D-602-73 D-602-44, D-602-45, D-602-46, D-602-47	Conventional Strip	.012-.026	.036-.066	.066-.082	.110 Max.
	Braid Foldback	.012-.026	.036-.066	.086 Max. Over Folded Back Braid	—
D-602-0094	Conventional Strip	.011-.026	.034-.081	.077-.098	.130 Max.
D-602-0095	Braid Foldback Note 2	.011-.026	.034-.081	.099 Max. Over Folded Back Braid	—
D-602-0106	Conventional Strip	.012 Nom.	.102 .103 NOM.	.124 Nom.	.145 Max.

NOTES:
1. Conductors must be silver- or tin-plated.
2. To achieve an environmental seal, install P/N CTA-0042 immediately adjacent to end of metallic body.

77. **Overheated.**

a. Insulation sleeve is darkened to an opaque brown

b. There are no solder fillets seen through inspection windows.

c. Wire insulation is melted or charred.

78. **Repair Procedures.** An underheated contact can be reheated to flow the solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit the insulating sleeve lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (paragraphs 72 and 73).

79. **CONNECTOR REMOVAL AND INSTALLATION (REMOVABLE CONTACT CONNECTORS).** If the connector cannot be repaired or is severely damaged, perform the following:

a. Starting from the outside of the damaged connector, tag each wire after the contact is removed.

b. When contacts cannot be removed, cut the wire as close to the connector as possible, and tag the wire. Install a new contact on the wire (WP 013 00).

c. Install wires with crimped contacts from damaged connector into a new connector.

d. Seal connector in accordance with WP 026 00 when required.

80. **CONNECTOR REPAIR (NON-REMOVABLE CONTACT CONNECTORS).** The procedures for repair are in accordance with the standard maintenance practices and solder procedures (WP 017 00). Seal the connector and provide for moisture barrier in accordance with WP 026 00.

81. **PROTECTION OF ELECTRICAL CONNECTORS.** Connector plugs and receptacles in areas that are not exposed to contaminants (oil, moisture, dirt, etc.) that mate to equipment that is temporarily removed for bench check repair, need not be covered. However, all unmated connectors will be protected with protective covers when the aircraft is operating and when the connectors are to remain unmated for an extended period of time. Standard protective covers for connectors are available with or without an attaching chain (WP 025 00).

CAUTION

Do not use aluminum toil as a protective cover can electrical connectors. The use of aluminum foil as a cover could cause an electrical short circuit**.**

82. **CONNECTOR PREFERRED REPLACEMENTS.** Table 25 provides preferred replacements for certain MIL-C-5015 and MIL-C-26482 connector series and classes.

83. **CONNECTOR POTTING AND SEALING.** See WP 026 00.

84. **CONNECTOR CLEANING AND PRESERVATION.** See WP 027 00.

85. **CONNECTOR ACCESSORIES.** See WP 025 00.

TABLE 24. TWISTED PAIR SOLDER CONTACT ACCOMMODATION

Raychem Solder Contact No.	Twisted Pair Wire Size	Note 1 Conductor Type
D-602-54 D-602-55 D-602-56 D-602-57	30 thru 24 AWG	Stranded Or Solid
Note 2 D-602-0104 D-602-0105	24 thru 26 AWG	Stranded Or Solid

NOTES:
1. Conductors must be silver- or tin-plated.
2. To achieve an environmental seal, install PtN CTA-0006 immediately adjacent to end of inner insulation sleeve.

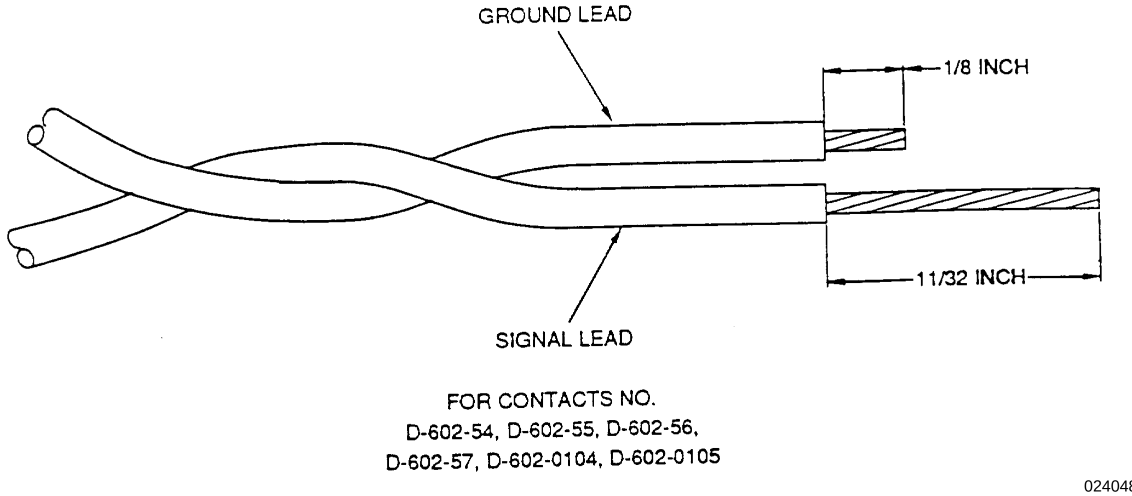


Figure 48. Strip Dimensions for Twisted Pair Solder Contacts

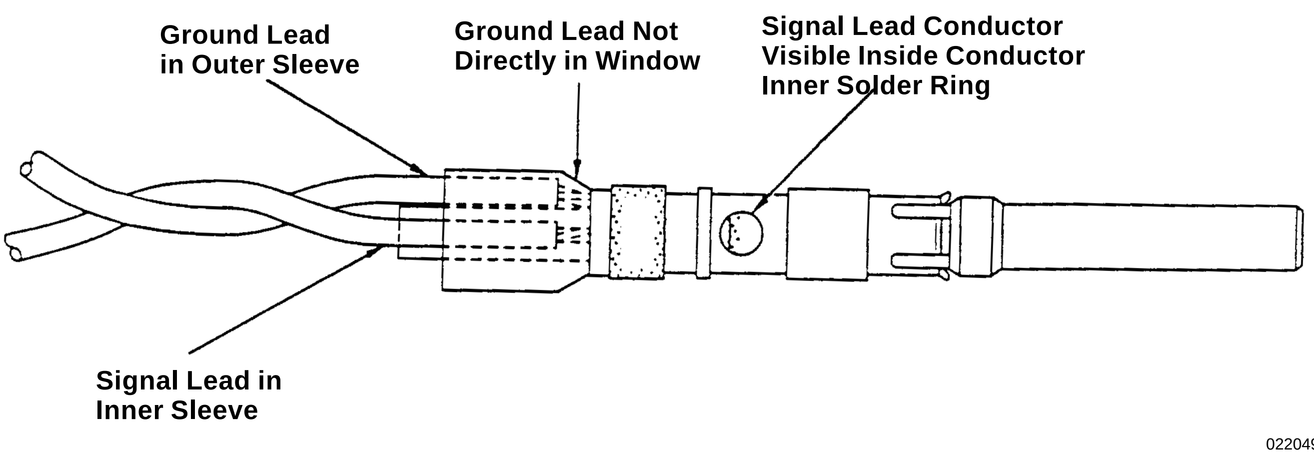


Figure 49. Inserting Twisted Pair into Solder Contact

TABLE 25. PREFERRED REPLACEMENT CONNECTORS.

Old Part Number	Preferred Replacement
MS3l00 thru MS3106 (Notes 1, 2, and 3)	MS3450W thru MS3456W
MS3450L thru MS3456L	MS3450W thru MS3456W
MS3110 thru MS3116	MS3470W thru MS3476W
MS3120 thru MS3126	MS3470W thru MS3476W
MS3470E thru MS3476E	MS3470W thru MS3476W
MS3470L thru MS3476L	MS3470W thru MS3476W

NOTES:

1. If MS3100 thru MS3106 Class F, use MS3450W thru MS3456W with M85049/52 connector accessory.
2. If MS3100 thru MS3106 except Class F, use MS3450W thru MS3456W with M85049/31 connector accessory.
3. For shipboard jacketed cable, use MS3400 thru MS 3406.

86. <u>MILITARY CIRCULAR CONNECTOR SPECIFICATIONS.</u>

87. **MIL-C-38999 CONNECTORS.** MIL-C-38999 covers four series of miniature, high density, circular, environment resistant electrical connectors. Depending on the series, the connectors arc either coupled by bayonet, breech, or threads, so the different series are not intermateable. The contacts are either removable crimp, car fixed hermetic solder, and are capable of continuous operation within a temperature range of -85°F (-65°C) to +392°F +200°C). MIL-STD-1560 defines the size and quantity of contacts, and service rating of each, insert arrangement, These connectors may include power, thermocouple, coaxial, twinax, and fiber optic contacts (Figures 15 through 18 and Tables 3-6 for part number breakdown information.

88. **<u>Description.</u>** This connector displays the following characteristics:

a. All series include rear release removable pin and socket contacts with crimp terminations.

b. All series are designed to ensure proper orientation of the mating halves prior to closure.

c. All series include hermetically sealed receptacles with fixed solder contacts.

d. All series include EMI shielded connectors.

e. Series I, III, and IV provide high tolerance to vibration, and are suitable for Severe Wind and Moisture Problem (SWAMP) areas.

f. Series I, III, and IV provide electrical continuity between mated shells prior to contact engagement with the contacts so located as to be protected from damage due to handling (scoop proof) and from inadvertent electrical contact.

g. Series I and III provide an option for a lanyard release plug.

<u>CAUTION</u>

Avoid use of Series II in blind mate areas.

h. Series II provides low silhouette for minimum size and weight, but is not scoop proof.

i. Series I, II, and III are provided with a peripheral seal, and Series IV incorporates an O-ring seal.

j. All series have the rear release contact retention system that is indicated by at least one blue; color hand that is readily visible when the connector is installed.

k. For Series I and II, a detent is provided in the coupling mechanism so that an audible click is heard when proper coupling is complete.

l. Class J and M composite connectors are available in Series III.

89. **<u>Classes and Finishes.</u>** The classes and finishes available in one or more or the available series are specified in Tables 26 through 28.

90. **Contact Styles.** The contact styles available are specified in Table 29.

TABLE 26. MIL-C-38999 SERIES I AND II CLASSES

Class	Description
E	Environment resisting, box and thru bulkhead mounting types only (class T)
P	Potting, includes potting form and short rear grommet
T	Environment resisting, wall and jam nut mounting receptacle and plug types, thread and teeth for accessory attachment
Y	Hermetically sealed

TABLE 27. MIL-C-38999 SERIES III AND IV CLASSES

Class	Description
C	Environment resisting, anodic plating (nonconductive)
F	Environment resisting, electroless nickel coating (conductive)
K	Environment resisting firewall, CRES, passivated, (conductive)
N	Hermetically sealed, CRES, with electrodeposited nickel plating, (conductive)
S	Environment resisting, firewall, CRES with electrodeposited nickel plating (conductive)
W	Environment resisting, olive drab cadmium plate over suitable underplate (conductive)
Y	Hermetically sealed, CRES passivated (conductive)
J	Composite, olive drab cadmium plate over a suitable underplate (conductive)
M	Composite, electrically conductive electroless nickel plating

TABLE 28. MIL-C-38999 SERIES I AND II FINISHES

Finish	Description
A	Silver to light yellow, cadmium plate over nickel (conductive), inactive for new design
B	Olive drab cadmium plate over suitable under late (conductive)
C	Anodic, (nonconductive)
D	Fused tin, carbon steel (conductive)
E	Corrosion resistant (CRES) steel, passivated (conductive)
F	Electroless nickel coating (conductive)
N	Hermetic seal or environment resisting CRES (conductive plating)

TABLE 29. MIL-C-38999 CONTACT STYLES.

Contact styles	Description
A	Without in contacts
B	Without socket contacts
C	Feedthrough
P	Pin contacts, including hermetics with solder cups
S	Socket contacts, including hermetics with solder cups
X	Pin contacts with eyelet (hermetic)
Z	Socket contact with eyelet (hermetic)

91. **MIL-C-81511 CONNECTORS.**

NOTE

MIL-C-81511 has been declared not for use in new design. This does not preclude use for maintenance, repair, or resupply purposes, or in designs where tile connectors must interface with Government Furnished Equipment.

92. MIL-C-81511 covers four series of circular, high density, quick disconnect, and environment resistant electrical connectors with solder and removable crimp contacts, and accessories (see WP for accessories). Series 1 is intermateable with Series 3 and Series 2 is intertmateable with Series 4, Series 1 and 3 are not intertmateable with Series 2 and 4. Coupling is accomplished using a three pin bayonet design. Full engagement is indicated by an audible sound it the end of the coupling cycle, by ends of the bayonet pins will be visible through holes in the coupling ring (Figures 19 through 21 and 35; and Tables 7 and 8 for part number breakdown information).

93. **Description.** Electrical, mechanical, and environmental features of these connectors include:

a. Environment resistant at sea level and high altitude.

b. EMI/RFI protection

c. Quick disconnect bayonet coupling.

d. High density insert arrangements.

e. Low level circuit capacities.

f. Scoop proof to the extent specified in the individual series.

g. Fluid resistant classes.

h. High temperature classes.

i. Voltage service ratings I and II.

j. Designed to prevent inadvertent electrical contact and provide contact protection during mating.

94. **Classes.** The class defines the physical and environmental characteristics of the connector, including the shell material and the finish (Table 30). File classes are available in either two or all of the Series:

95. **Contact Styles.** The contact styles available care specified in Table 31.

96. MIL-C-81511 Series 1 and 2, MIL-C-81511 Series 1 and 2 connectors have a ganged contact retention and release mechanism (Figure 50). Before attempting any insertion or removal of contacts, ensure that the rear nut assembly is in the unlocked position. The removal tool releases the contacts from the front of the connector, but the contacts are inserted and, removed from the rear. To lock contacts, the retention mechanism is operated by rotating, the rear retention ring clockwise until tile yellow color hand is not exposed. Metal to metal contact dill occur between the shell and retention ring. Unlocking contacts is accomplished by rotating the rear retention ring counterclockwise from the locked position. The yellow color band will be fully exposed. When the color band is exposed, the connector is in position for both insertion and removal of contacts. A sealing ring is provided to achieve a peripheral seal around the mated shell.

TABLE 30. MIL-C-81511 CLASSES

Class	Description
E	Grommet seal connectors, 150°C operating temperature, series 1 and 2 only
F	Grommet seal connectors. fluid resistant, 175°C operating temperature, all series, (Not for Navy Use)
A	Grommet seal connectors, fluid resistant, 200°C operating temperature, all series, (Not for Navy Use)
H	Hermetic seal connectors, solder terminated, ferrous alloy shell, 150°C operating temperature, series 1 and 2 only
D	Hermetic seal connectors, solder terminated, ferrous alloy shell, fluid resistant, 175°C operating temperature, series 3 and 4 only
W	Grommet seal connectors, fluid resistant, 500 hour salt spray, 175°C operating temperature, all series

TABLE 31. MIL-C-81511 CONTACT STYLES

Contact styles	Description
A	Without in contacts
B	Without socket contacts
P	Pin contacts
S	Socket contacts
C	Feedthrough

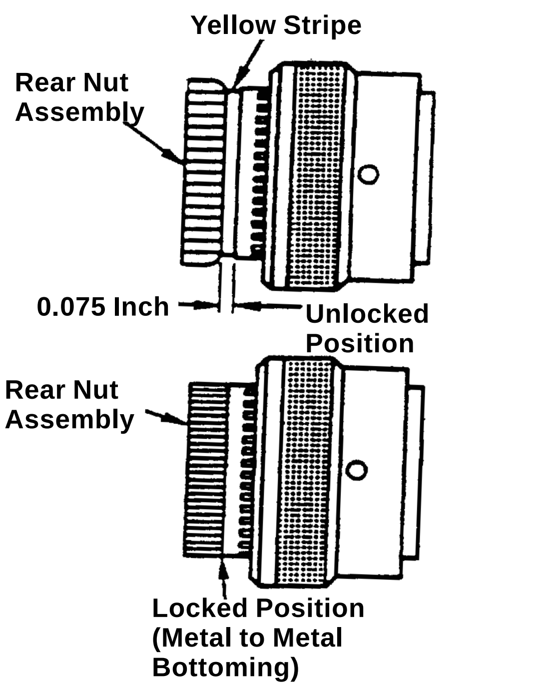


Figure 50. Ganged Contact Retention

97. **MIL-C-81511 Series 1 Connectors.** Series 1 connectors are long shell design in sizes 8 through 24. These connectors are scoop proof when pin contacts are installed in either the plugs or receptacle. Plugs contain the grounding spring members.

98. **MIL-C-81511 Series 2 Connectors.** Series 2 connectors are short shell design in sizes 8 through 18. These connectors are scoop proof when pin contacts are installed in the receptacle, and non-scoop proof, when pins are installed in the plug. Receptacles contain the grounding spring members.

99. **MIL-C-81511 Series 3 and 4.** MIL-C-81511 Series 3 and 4 connectors have individual contact release: systems, and incorporate non-metallic retention mechanism using high strength molded-in plastic retention fingers that are enclosed in rigid plastic cylinders. Elimination of metal retention clips saves weight and increases dielectric strength between contacts. Series 3 and 4 connectors incorporate multiple seals to provide protection against internal and external contamination. The seals incorporated in these connectors are an interfacial compression seal, peripheral static dynamic shell to shell seal, insert to shell, and redundant wire seals to assure absolute sealing against environmental extremes.

100. **MIL-C-81511 Series 3.** Series 3 connectors are a long shell version that is scoop proof with pins installed in either the plug or the receptacle. The plug contains the grounding spring fingers.

101. **MIL-C-81511 Series 4.** Series 4 connectors are a short shell version that is scoop proof when pin contacts are installed in the receptacle. The receptacle contains the grounding spring fingers.

102. **MIL-C-5015 AND LOCKHEED LS1358 AND LS13585 CONNECTORS.**

NOTE

MIL-C-5015 solder connectors have been declared not for use in new design. This does not preclude use for maintenance, repair, or resupply purposes, or in designs where the connectors must interface with Government Furnished Equipment.

103. MIL-C-5015 and Lockheed LS13583 and LS13585 connectors are circular threaded and of the AN Type. These connectors are rated for specific operation with a temperature range of -67°F (-55°C) to 392°F (+200°C) depending upon the class. The upper temperature is the maximum internal hotspot temperature resulting from any combination of electrical load and ambient conditions. MIL-C-5015 Series connectors are environment resistant and come in three varied contact features. The basic design features are similar for all MIL-C-5015 connector;. However, the contacts are either nonremovable solder (except contacts in sizes 0, 4, and 8), removable crimp front release, or removable crimp rear release (Figure 22 and Table 9 for part number breakdown information). Lockheed part numbers LS13583 and LS13585 cross reference to MIL-C-5015 rear release connectors (Figure 22 and Table 9).

104. **Receptacle Mounting.** The MIL-C-5015 receptacle connectors may he flange, jam nut, or solder mounted.

105. **Solder Contacts Connectors.** Solder contacts are typically found in the MS310X series connectors.

106. **Front Release Connectors.** Front release, removable crimp contacts are typically found in the MS340X series connectors.

107. **Rear Release Connectors.** Rear release, removable crimp contacts are typically found in the MS345X series and Lockheed LS13583 and LS13585 connectors.

108. **Classes.** The class defines the physical and environmental characteristics of the connector, including, the shell material and the finish (Table 32). The classes are available on one or more of the drawings:

TABLE 32. MIL-C-5015 CLASSES

Class	Description
A	Solid shell, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish (inactive for new design)
B	Split shell, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish (inactive for new design)
C	Pressurized, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish (inactive for new design)
D	High impact shock, front release crimp contacts, complete fluid resistance, wrought aluminum shell with ca mium olive drab over nickel finish or stainless steel shell with black cadmium over nickel
E	Solder contacts, limited fluid resistance. aluminum shell, cadmium olive drab finish (inactive for new design, use class L)
F	With clamp, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish (inactive for new design)
H	Hermetic seal, solder contacts, complete fluid resistance, ferrous alloy shell with electroless nickel finish, or ferrous alloy shell with electrically conductive fused tin finish (HT), or passivated stainless steel shell (HS)
K	Firewall, front release crimp or rear release crimp contacts, limited or complete fluid resistance, ferrous alloy shell with cadmium olive drab finish, or passivated stainless steel shell (KS), or Ferrous alloy shell with electr less nickel finish (KT)
L	Complete fluid resistance, front release or rear release crimp contacts, aluminum shell with electroless nickel finish or passivated stainless steel shell (LS)
P	Potting seal, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish
R	Grommet seal without clamp, solder contacts, limited fluid resistance, aluminum shell, cadmium olive drab finish
U	Front or rear release crimp contacts, complete fluid resistance, aluminum shell with electroless nickel finish, or passivated stainless steel (inactive for new design, use class L)
W	General purpose, front or rear release crimp contacts, complete fluid resistance, aluminum shell, cadmium olive drab over nickel finish
DJ	High impact shock with backshell connector assembly, front release crimp contacts, complete fluid resistance, wrought aluminum shell, cadmium olive drab over nickel finish

109. **Contact Styles.** The contact styles available are specified in Table 33.

110. **Material Designators.** Shell and coupling ring material may be designated by a letter following the class designator. “S” represents stainless steel, “T” represents ferrous alloy, and a blank may represent aluminum alloy, wrought aluminum, or ferrous alloy.

111. **MIL-C-8 3723, AND LOCKHEED LS10164, LS10166, LS10215, AND LS10216 CONNECTORS.** MIL-C-83723 covers three series of connectors that utilize rear release crimp, or solder contacts (Figures 23 through 25 and Tables 10 through 12 for part number breakdown information). Lockheed part numbers LS10164, LS10166, LS10215, and LS10216 cross refer-

ence to MIL-C-8723 series III connector (Figure 25 and Table 12).

112. **Series 1.** Series 1 connectors are bayonet coupled with solder or rear release, crimp contacts, Hermetic receptacles have solder contacts.

113. **Series II.** Series II connectors are threaded coupled, with rear release crimp contacts. Hermetic connectors are available with nonremovable solder type contacts

114. **Series III.** Series III and Lockheed LS10164, LS10166, LS10215, and LS10216 connectors are bayonet or thread coupled with rear release, crimp contacts.

115. **Classes.** The class defines the physical and environmental characteristics of the connector, including the shell material and the finish (Table 34). Tie classes are available on one or more of the drawings:

116. **MIL-C-26482 AND LOCKHEED LS13572 SMFLS13580 CONNECTORS.** MIL-C-26482 covers two series of environment resistant, quick disconnect, miniature, circular electrical connectors. The connectors utilize crimp type contacts that may he front or rear release, or nonremovable older contacts (Figure 26 through 28 and Table 13 for part number breakdown information). Lockheed part numbers LS13572 and LS13580 cross reference to MIL-C-26482 series 2 connectors (Figure 26 and Table 13).

CAUTION

Series 1 and 2 connectors are intermateable when using power contacts, but are not intermateable when using shielded contacts.

117. **Series 1.** Series 1 connectors are bayonet coupled with solder or front release crimp contacts. Hermetic receptacles have solder contacts.

118. **Classes.** The class defines the physical and environmental characteristics of the connector, including the shell material and the finish (Table 35).

119. **Series 2.** Series 2 and Lockheed LS13572 and LS13580 connectors are bayonet coupled with rear release crimp contacts. Hermetic connectors are available with nonremovable solder contacts or removable crimp contacts.

120. **Classes.** The class defines the physical and environmental characteristics of the connector, including the shell material and the finish (Table 36). The classes are available on one or more of the drawings:

TABLE 33. MIL-C-5015 CONTACT STYLES

Contact Styles	Description
A	Without in contacts Without socket contacts
C	Feedthrough
P	Pin contacts
S	Socket contacts
C	Solder cup termination for class H (designator replaces the dash)
Y	Eyelet termination for class H (designator replaces the dash)
D	16-22 in lieu of 16-16 pin contacts, or 12-16 in lieu of 12-12 pin contacts (class D only)
E	16-22 in lieu of 16-16 socket contacts. or 12-16 in lieu of 12-12 socket contacts (class D only)

TABLE 34. MIL-C-83723 CLASSES

Class	Description
A	Anodized aluminum shell, non conductive
F	Cancelled, superseded by class R
G	Stainless steel, passivated, fluid resistant, crimp rear release contacts
H	Steel, fused tin, hermetic seal, solder of termination contacts
K	Stainless steel, passivated, fluid resistant, firewall
N	Plugs same as class S with electrodeposited nickel finish; receptacle same as class Y or S with eletrodeposited nickel finish (threaded only)
R	Aluminum, electroless nickel, conductive, fluid resistant, crimp rear release contacts
S	Passivated stainless steel, fluid resistant, EMI grounding, self locking, firewall (threaded only)
W	Aluminum, Cadmium conductive finish, 500 hour salt spray
Y	Stainless steel, hermetic seal

121. **Termination Type and Shell Material (hermetic only).** The designators in Table 37 define the termination type and shell material for hermetic connectors.

122. **Contact Styles.** The contact styles available are specified in Table 38.

123. **MIL-C-26500 CONNECTORS.** MIL-C-26500 connectors are bayonet or threaded coupling, miniature, circular, environment resistant, with front release, rear removable crimp contacts. Hermetic receptacles have solder contacts. The connectors are capable of withstanding operating temperatures to 392°F (200°C). The connectors prevent pin or socket damage during normal matins of counterpart connectors. Integral keys and keyways in the shell of the connector prevent engagement of contacts until they are properly aligned (Figure 29 and Table 14 for part number breakdown information).

124. **Classes.** The class defines the material, finish, and environmental characteristics of the connector (Table 39).

125. **Contact Styles.** The contact styles are defined in Table 40.

TABLE 35. MIL-C-26482 SERIES 1 CLASSES

Class	Description
A*	General duty, threaded backshell
B*	General duty with strain relief clam
E	Grommet seal
F	Grommet seal with strain relief
H	Hermetic seal
J	Cable seal with clam
P	Potting seal
* Not for new design.	

TABLE 36. MIL-C-26482 SERIES 2 CLASSES

Class	Description
A	Grommet seal, non-conductive finish
E	Grommet seal, conductive finish, inactive for new design (use class L)
H	Hermetic seal, conductive finish
L	Fluid resistant grommet seal, conductive finish
N	Hermetic seal, crimp termination, conductive finish
S	Grommet seal, stainless steel, conductive finish
W	Grommet seal, 500 hour salt spray, conductive finish

TABLE 38. MIL-C-26482 CONTACT STYLES

Contact styles	Description
A	Without in contacts
B	Without socket contacts
P	Pin contacts
S	Socket contacts
C	Feedthrough

TABLE 37. MIL-C-26482 HERMETIC TERMINATION DESIGNATORS

Termination/Material Designators	Description
A	Solder pot, stainless steel shell
B	Eyelet, stainless steel shell
C	Solder pot, ferrous alloy shell
Y	Eyelet, ferrous alloy shell

TABLE 39. MIL-C-26500 CLASSES

Class	Description
E	Passivated stainless steel, environmental seal
F	Aluminum, black or gray anodize, environmental seal, fluid resistant
G	Aluminum, conductive finish, environmental seal
H*	Steel, tin or cadmium plate, hermetic seal
R	Aluminum, black or gray anodize, environmental seal
*Used only on MS27034	

TABLE 40. MIL-C-26500 CONTACT STYLES

Contact style	Description
C	Pin solder cup contacts (class H only)
E	Pin eyelet contacts (class H only)
P	Pin contacts
S	Socket contacts

126. **MIL-C-81703 CONNECTORS.** MIL-C-51703 covers three series of environment resistant, circular, miniature, rack and panel or push-pull coupling connectors that feature solder, front release, or rear release contacts. The connectors are designed to withstand overall temperatures from -67°F (-55°C) to +392°F (+200°C). The actual temperature range varies for each series of connectors. Each series contains hermetic receptacles. Series l and 2 connectors are interchangeable with each other. All Series 1 and 2 plugs can be mated with Series 3 receptacles. However, a Series 3 plug cannot be mated to a Series 1 or 2 receptacle because of the locksmith keying grooves (Figures 30 through 32 and Tables 15 through 17 for part number breakdown information).

127. **Description.** The connectors display the following characteristics:

a. Environment resisting at sea level and high altitude.

b. Rack and panel or push-pull coupling.

c. High density insert arrangements.

d. Low level circuit capabilities.

e. Fluid resistant classes.

128. **Series 1.** Series 1 connectors are push-pull coupled with solder contacts. Series 1 hermetic box and solder mount receptacles are also available. The Series 1 connector has a temperature range of -67°F (55°C) to +257°F (+125°C).

129. **Series 2.** Series 2 connectors are push-pull coupled. with a single key, removable, crimp, front release contacts. The Series 2 connector has a temperature range of -67°F (-55°C) to +347°F (+175°C).

130. **Series 3.** Series 3 connectors are rack and panel or push-pull coupled, with five keys, and removable, crimp, rear release contacts. Some hermetic receptacles have solder contacts. The Series 3 connector has a temperature range of -67°F (-55°C) to +392°F (+200°C).

131. **Classes.** The classes available in one or more series are as specified in Table 41.

132. **Contact Termination Types.** There are two contact terminations types:

C - solder cup

Y - eyelet

133. **NAS1599 CONNECTORS.** NAS1599 connectors utilize crimp type contacts that are inserted, released, and removed from the rear of the connector. The two methods of coupling utilized for NAS connectors are threaded, conforming to MIL-C-26500 insert configurations, and bayonet, conforming to MIL-C-26482 insert configurations. Bayonet coupled type connectors covered by NAS1599 are intermateable with all MIL-C-26482 connectors, provided the insert configurations are the same. Table 42 provides an intermateability cross-reference from threaded type connectors covered by NAS1599 to MIL-C-26500 and MIL-C-83723 Series III connectors (Figure 33 and Table 18 for part number breakdown information).

134. **Threaded Connectors.** Threaded coupled type connectors conform to MIL-C-26500 insert configurations, but utilize crimp, rear release solder contacts.

135. **Bayonet Coupled Connectors.** Bayonet coupled type connectors conform to MIL-C-26482 insert configurations with crimp, rear release contacts.

136. **Classes.** The classes available in one or more series are as specified in Table 43.

TABLE 41. MIL-C-81703 CLASSES

Class	Description
E	Fluid resistant, 392°F operating temperature
H	Hermetic seal, solder contact
J	Watertight jacketed cable seal
L	Fluid resistant extended, 347°F operating temperature
N	Hermetic seal, crimp contacts

TABLE 42. THREADED COUPLED CONNECTOR INTERMATEABILITY CROSS REFERENCE

Specification Number NAS 1599	Specification Number MIL-C-26500	Specification Number MIL-C-83723 Series III	
		Socket Contact	Pin Contact
NAS1692G	MIS24264G	M83723/82R	M83723/83R
NAS1641R	MS24264R	M83723/82A	M83723183A
NAS1693G	MS24265G	M83723/84R	M83723/85R
NAS1642R	MS24265R	M83723/84A	M83723/85A
NAS1681H	MS27034H	—	M83723/90
NAS1683H	—	—	M83723/88
NAS1682H	MS24265H	—	M83723/89
NAS1694G	MS24266G	M83723/86R	M83723/87R
NAS1643R	MS24266R	M83723/86A	M83723/87A

TABLE 43. NAS1599 CLASSES

Class	Description
G	Grounding, conductive Finish
H	Hermetic seal
R	Environment resisting

137. **MIL-C-29600 CONNECTORS.**

NOTE

MIL-C-29600 is not for Navy use and has been declared not for use in new design. This does not preclude use for maintenance, repair, or resupply purposes, or in designs where the connectors must interface with Government Furnished Equipment.

138. MIL-C-29600 covers miniature, composite, high density, threaded coupling, self-locking, circular, environment resistant, electrical connectors utilizing removable crimp contacts, and associated hardware, which are capable of continuous operation within a temperature range of -65°C to +175°C.

139. **Description.** Electrical, mechanical, and environmental features of these connectors include: The connectors employ rear release removable pin and socket contacts with crimp termination. The connectors are designed to assure proper orientation of the: mating halves prior to electrical circuit closure. The connectors include EMI shielding capability. They also provide electrical continuity between mated shells prior to contact engagement and have the contacts so located as to be protected from handing damage and inadvertent electrical contact. The connectors consist of a composite material with lightweight characteristics, and when used with backshells and contacts specified in document, provide high levels of corrosion resistance (2000 hour salt spray) and durability (1500 cycles) (Figure 34 and Tables 19 through 20 for part number breakdown information).

NOTE

MIL-C-29600 connectors cannot be mated with other military specification connectors, even though some of the internal components and subassemblies may be use by other connectors.

140. **Series A and B.** Series A connectors utilize MIL-C-38999 insert arrangements, and Series B utilize MIL-C-81511 insert arrangements. The Series A and B connectors are not intermateable.

141. **Shell Types.** The plus are the straight type, and the receptacles may be wall mounting, both front and rear panel mounting, and jam nut mounting.

142. **Classes.** The class defines the physical and environmental characteristics of the connector (Table 44).

143. **Contact Styles.** The contact styles available are specified in Table 45.

TABLE 44. MIL-C-29600 CLASSES

Class	Description
R	Environment resistant, conductive shell, EMI shielded
E	Environment resistant, conductive or nonconductive shell, non-EMI shielded
G	Environment resistant, conductive shell, EMI shielded, space grade

TABLE 45. MIL-C-29600 CONTACT STYLES

Contact Styles	Description
A	Without standard pin contacts
B	Without standard socket contacts
P	Standard pin contacts
S	Standard socket contacts
H	High durability pin contact
J	High durability socket contact
K	Without high durability pin contacts
L	Without high durability socket contacts

RADIO FREQUENCY CONNECTORS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Radio Frequency (RF) Cable Characteristics and Replacements 006 00
MIL-PRF-39012 Radio Frequency Connectors 022 00
Installation Practices, Aircraft Electric and Electronic Wiring . . . . NAVAIR 01-1A-505.series
Connectors, Electrical, Miniature, Coaxial, Environment Resistant, General Specification for MIL-C-25516
Connectors, Coaxial, Radio Frequency, Series LT MIL-C-26637
Connectors, Coaxial, Radio Frequency, Series Pulse, General Specification for MIL-C-3607
Connectors, Coaxial, Radio Frequency, Series LC MIL-C-3650
Connectors, Plug and Receptacle, Electrical, Triaxial, Radio Frequency,
General Specifications for MIL-C-3655
Connectors, Coaxial, Radio Frequency, General Specification for MIL-PRF-39012
Connectors, Plugs and Receptacles, Electrical, Triaxial, Radio Frequency,
General Specification for MIL-PRF-49142

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

None

1. INTRODUCTION.

2. This work package (WP) covers coaxial and triaxial connectors commonly utilized for both shielded wire and Radio Frequency (RF) applications. This WP describes these connectors, and their application.

3. GENERAL.

4. **APPLICATION.** Coaxial connectors are applied, in most cases, to circuits carrying RF current. They are also used in many systems where a shielding function is required for low level signal circuits or for audio circuits.

5. **SHIELDING FUNCTION.** The shielding function is important for protecting the center conductor from external electrical fields or the protection of nearby circuits from the influences of the fields surrounding the center conductor. Refer to EMI and EMV (WP 006 00).

6. **DESIGN.** True RF coaxial connectors are designed with a specific relationship between the outside diameter of the single inner contact and the inside diameter of the outer sleeve. This relationship determines the characteristic impedance of the connector (WP 006 00). These connectors have been proportioned internally so that they will match particular cable impedance values so that the circuit will not see any impedance mismatch (WP 006 00).

7. REQUIREMENTS.

8. Coaxial connectors shall be suitable for the particular application and shall be covered by Military Specifications to include:

a. MIL-C-3607 Pulse Series.

b. MIL-C-3650 LC Series.

c. MIL-C-3655 Twin Series.

d. MIL-C-25516 Environment Resisting Series.

e. MIL-C-26637 LT Series.

f. MIL-PRF-39012 General Specification for:

(1) SMA Series.

(2) SMC Series.

(3) BNC Series.

(4) TNC Series.

(5) N Series.

(6) SMB Series.

(7) C Series.

(8) SC Series.

(9) QSC Series.

(10) QNC Series.

(11) MHV Series.

(12) SHV Series.

(13) EIA Series.

g. MIL-PRF-49142 Triaxial Series.

9. Only category D and C connectors of MIL-PRF-39012 will be used for all applications using braided coaxial cables, and category E connectors of MIL-PRF-39012 will be used for applications using semi-rigid coaxial cable. When connector parameters beyond the scope of applicable military specifications are required, non-standard commercial type connectors may be utilized providing the general requirements to the specification are met and approved.

10. DESCRIPTION.

11. RF coaxial connectors are available in plug and receptacle types. Plugs may be straight, angle, or flange mount (Figure 1), and receptacles may be straight, angle, flange or jamnut mount (Figure 2).

12. SPECIFICATIONS.

13. **MIL-C-3607 CONNECTORS, COAXIAL, RADIO FREQUENCY, SERIES PULSE, GENERAL SPECIFICATION FOR.** This specification covers the general requirements for weatherproof, high voltage, series pulse RF coaxial connectors.

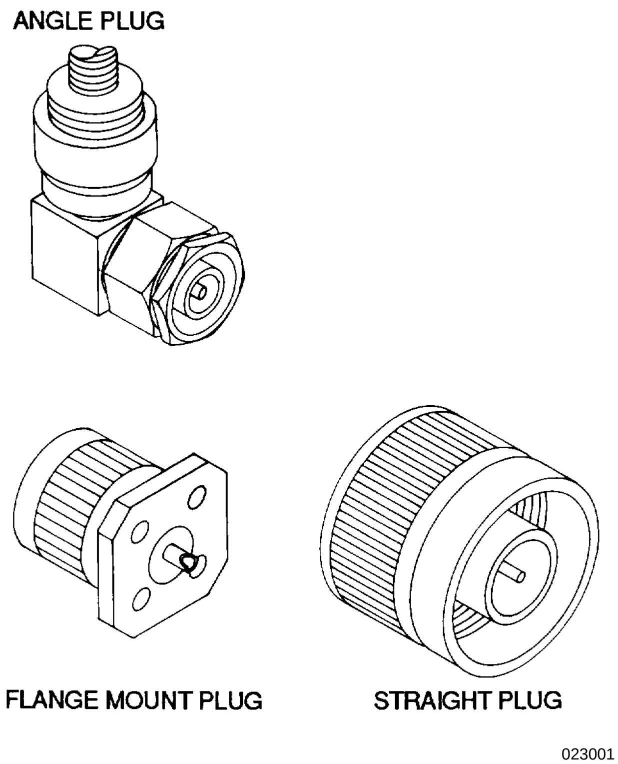


Figure 1. Typical Plug Styles

14. **Description.** These connectors are designed for use with rubber dielectric pulse cables, but may also be used with equivalent size cables of other construction where high voltage is not required. Ceramic or rubber inserts are utilized depending upon voltage requirements. Peak voltage with ceramic inserts is 18,000 volts and 9000 volts with rubber inserts. Connectors are intended for frequencies up to 100 MHz with a maximum operating temperature at 257°(125°C). These connectors are covered by applicable Military Specifications (Table 1). Typical connectors are illustrated (Figure 3).

15. **Selection.** The selection of connectors is determined by the system requirements of voltage, frequency, and cable selected. Consult applicable drawings and diagrams for selection. The connector and its parameters are listed (Table 2).

16. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

17. **MIL-C-3650 CONNECTORS, COAXIAL, RADIO FREQUENCY, SERIES LC.** This specification covers weatherproof, series LC, Radio Frequency coaxial connectors having a nominal impedance of 50 ohms.

18. **Description.** These connectors have threaded couplings for use with large size coaxial cables. They are for use up to 1000 MHz with a maximum operating temperature of 257°F (125°C). These connectors are covered by applicable military standards (Table 3). Typical connectors are illustrated (Figure 4).

19. **Selection.** The selection of connectors is determined by the system requirements of voltage, frequency, and cable selected. Consult applicable drawings and diagrams for selection. The connector and its parameters are shown (Table 4).

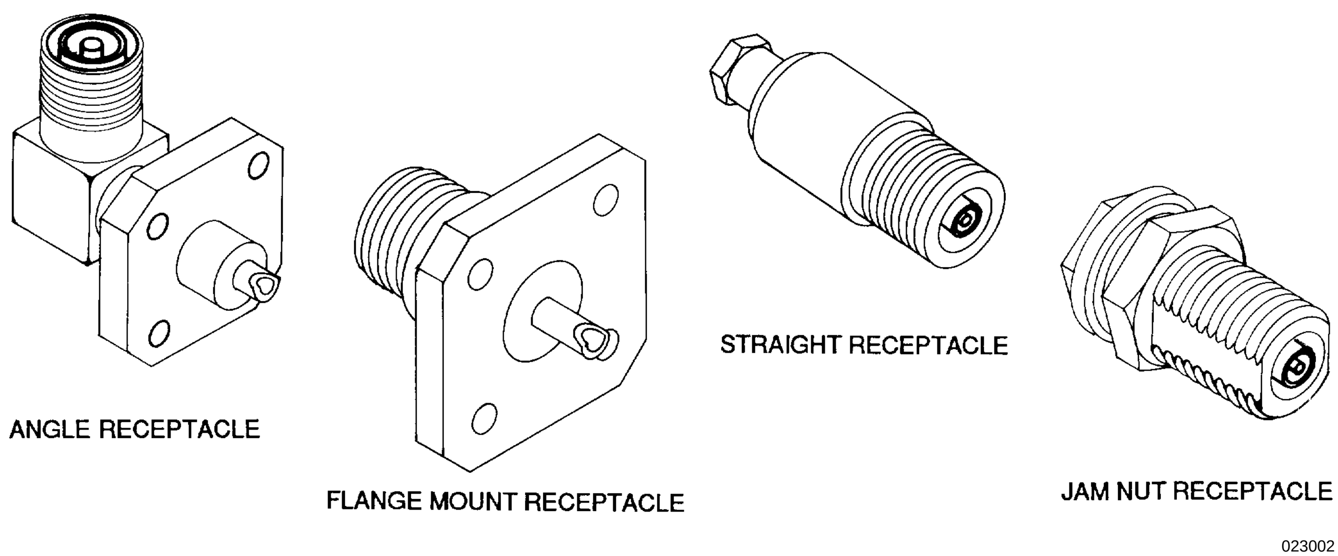


Figure 2. Typical Receptacle Styles

TABLE 1. APPLICABLE MILITARY SPECIFICATIONS

Specification No. MIL-C-3607/	Part No.	Description
1	UG-34/U	Connector Plug
2	UG-36/U	Connector Plug
3	UG-37/A/U	Connector Receptacle
4	UG-38A/U	Connector Receptacle Pressurized
5	UG-62A/U	Connector Receptacle Pressurized
6	UG-174/U	Connector Plug
7	UG-180A/U	Connector Plug
8	UG-181A/U	Connector Receptacle
9	UG-182A/U	Connector Receptacle
10	UG-222B/U	Connector Adapter
11	UG-264/U	Connector Receptacle
12	UG-336A/U	Connector Adapter
13	UG-350/U	Connector Receptacle
14	UG-1110/U	Connector Adapter
15	UG-1141/U	Connector Receptacle

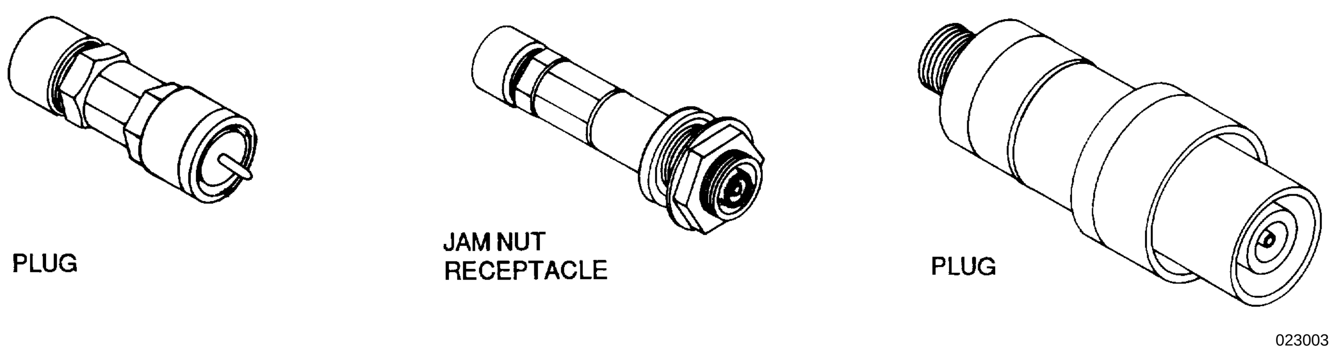


Figure 3. Typical Pulse Series Connectors

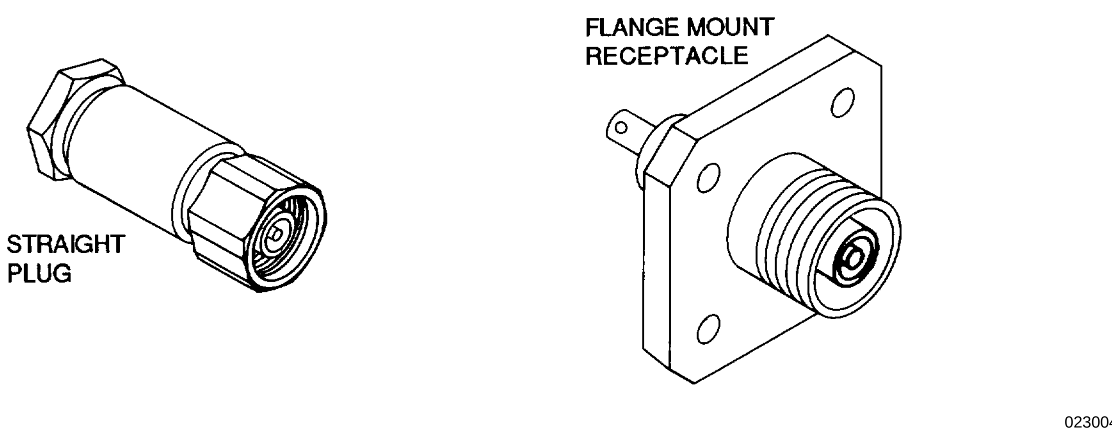


Figure 4. Typical LC Series Connectors

TABLE 2. MIL-C-3607 SELECTION

Part No.	Voltage	Connection or Use
UG-34/U	9000V	RF Pulse Cable RG-25/U
UG-36/U	18000V	RF Pulse Cable RG-27/U
UG-37A/U	18000V	RF Pulse Cables
UG-38A/U	9000V	Pressurized Flange Six-Hole Mount RF Pulse Cables
UG-62A/U	9000V	RF Pulse Cables
UG-174/U	18000V	RF Pulse Cable RG28/U
UG-180A/U	9000V	RF Pulse Cables RG-25/U, 26/U, 64/U, 88/U
UG-181A/U	9000V	RF Pulse Cables RG-25/U, 26/U, 64/U, 88/U
UG-182A/U	9000V	RF Pulse Cables
UG-222B/U	18000V	Plug UG-36/U and UG-174/U
UG-264/U	9000V	RF Pulse Cables
UG-336A/U	9000V	Plug UG-180A/U Receptacle UG-181A/U
UG-350/U	9000V	RF Pulse Cables
UG-1110/U	18000V	Plug UG-34/U and UG-174/U
UG-1141/U	18000V	RF Pulse Cables

20. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

21. **MIL-C-3655 CONNECTORS, PLUG AND RECEPTACLE, ELECTRICAL, (COAXIAL, SERIES TWIN), AND ASSOCIATED FITTINGS, GENERAL SPECIFICATION FOR.** This specification covers the general requirements for series twin coaxial connectors and associated fittings.

22. **Description.** These connectors are weatherproof with one pin and one socket contact. These connectors are covered by applicable military specifications (Table 5). Typical twin series connectors are illustrated (Figure 5).

23. **Selection.** The selection of connectors is determined by the system requirements of voltage, frequency, and cable selected. Consult applicable drawings and diagrams for selection. The connector and its parameters are shown (Table 6).

24. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

25. **MIL-C-25516 CONNECTORS, ELECTRICAL, MINIATURE, COAXIAL, ENVIRONMENT RESISTANT TYPE, GENERAL SPECIFICATION FOR.** This specification covers a series of miniature, moisture proof connectors suitable for operation with shielded and unshielded cable up to 750 volts rms under severe environmental conditions.

29. **Cable Size.** These connectors shall be capable of terminating cables by size (Table 8).

30. **Part Number.** The part number consists of the specification sheet, a sequentially assigned dash number to designate polarity, and cable size designation (Figure 8).

TABLE 3. APPLICABLE MILITARY STANDARDS

MS No.	Part No.	Nomenclature
MS91596	UG-216B/U	Adapter Connector
MS91604	UG-154A/U	Connector Plug
MS91610	UG-352B/U	Connector Receptacle
MS91614	UG-155B/U	Adapter Connector
MS91616	UG-157B/U	Adapter Connector
MS91617	UG-156A/U	Connector Plug
MS91618	UG-287B/U	Adapter Connector
MS91619	UG-219B/U	Adapter Connector
MS91620	UG-208B/U	Adapter Connector

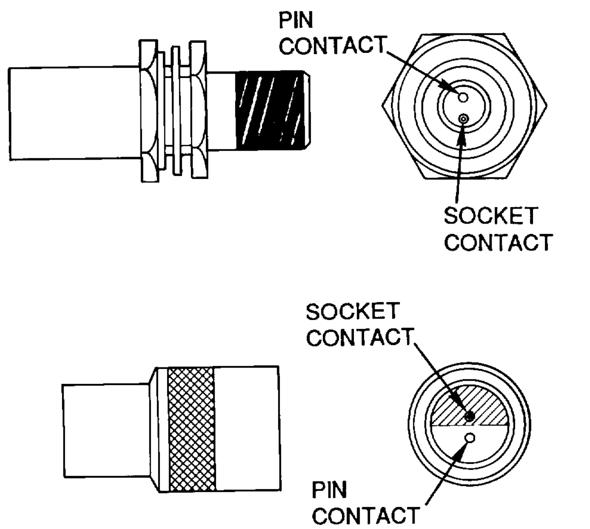


Figure 5. Typical Twin Series Connectors

26. **Description.** These connectors are bayonet coupled miniature coaxial. They are intended primarily for use in capacitance-type fuel quantity measuring systems at lower frequencies. These connectors are not intended for RF applications (Figure 6).

27. **Classification.** The connectors are classified by series, class, and type (Table 7).

a. Series 1. These connectors are plugs and receptacles with cable termination.

b. Series II. These connectors are plugs and receptacles with permanent crimp contacts using a standard MIL-C-22520 tool (WP 013 00).

c. Series III. These are adapters of all types.

d. Series IV. These connectors are plugs and receptacles with solder termination.

e. Class G. These connectors are for general purpose.

f. Class H. These connectors are hermetically sealed with cable termination.

g. Class Y. These are hermetic adapters.

h. Type 1. These connectors have shield termination for a continuous circuit, and grounded.

i. Type 2. These connectors have shield termination for a continuous circuit with isolated ground.

j. Type 3. These connectors have shield termination with interrupted ground.

k. Type 4. These connectors have no shield termination.

l. Type 5. These connectors are Class Y with grounded outer circuit.

m. Type 6. These connectors are Class Y with ungrounded outer circuit.

28. **Polarity.** The mating interface of these connectors are polarized. Where connector configurations are varied, such as mounting features or solder terminations, the first digit may be changed to show the variation (Figure 7).

31. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

32. **MIL-C-26637 CONNECTORS, COAXIAL, RADIO FREQUENCY, SERIES LT.** This specification covers RF coaxial weatherproof connectors of the LT series having nominal characteristic impedance of 50 ohms.

33. **Description.** These connectors have threaded coupling and appear to be similar to the LC series, but they are not interchangeable. Connectors are used in airborne RF applications from 30 to 5000 MHz, and are designed for large size cables (Figure 9).

34. **Selection.** The selection of connectors is determined by the system requirements. Consult applicable drawings and diagrams to determine the required part. The applicable military specifications show the connector parameters (Table 9).

TABLE 4. MIL-C-3650 SELECTION

Part Number	Voltage	Frequency	Connection
UG-216B/U	5000	1000 MHz	Plug UG-154A/U Receptacle UG-352B/U
UG-154A/U	5000 See NOTE	1000 MHz	RF Cable RG-17/U and RG-18/U
UG-352B/U	5000	1000 MHz	Adapter UG-216B/U Pressurized
UG-155B/U	10000	1000 MHz	Plug UG-154A/U Adapter UG-208B/U
UG-157B/U	10000	1000 MHz	Adapter UG-219B/U
UG-156A/U	10000	1000 MHz	RF Cable RG-19/U and RG-20/U
UG-287B/U	5000	1000 MHz	Plug UG-154A/U Adapter UG-216B/U
UG-219 B/U	10000	1000 MHz	Plug UG-156A/U Adapter UG-157B/U
UG-208B/U	10000	1000 MHz	Plug UG-154A/U Adapter UG-155B/U
NOTE: 10,000 V Operation Tool TL-328/U required to counterbore cable.			

TABLE 5. APPLICABLE MILITARY SPECIFICATIONS

Specification No. MIL-C-3655/	Part No. M3655/	Nomenclature
13A	13-0001	Connector Receptacle
14A	14-0001	Connector Plug
15A	15-0001	Connector Plug
16A	16-0001	Connector Receptacle
17	17-0001	Connector Plug Right Angle
18	18-0001	Connector Plug
19	19-0001	Connector Plug
20	20-0001	Connector Plug
21	21-0001	Connector Plug
22	22-0001	Connector Plug Bulkhead
23	23-0001	Connector Plug Bulkhead

35. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

36. **MIL-PRF-49142 CONNECTORS, TRIAXIAL, RADIO FREQUENCY, GENERAL SPECIFICATION FOR.** This specification covers connectors used with triaxial cable in RF applications and serial digital transfer.

37. **Description.** These connectors are similar to other coaxial connectors except for the provision for mating to a third conductor (Figure 10). The applicable military standards with descriptions are shown (Table 10).

38. **Classification.** These connectors are of the following two classes.

a. Class 1. These connectors are intended to provide superior RF performance at specified frequencies for which RF characteristics are completely defined.

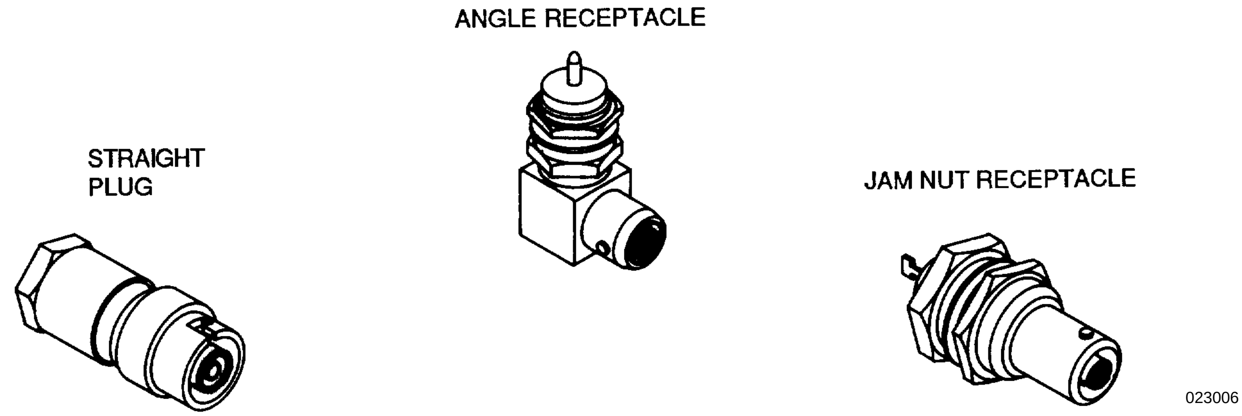
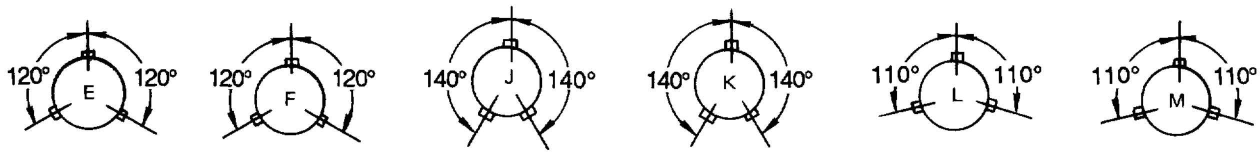


Figure 6. Typical M25516 Series Connectors



Dash Number	Polarity
03	E
04	F
05	J
06	K
07	L
08	M
13	E
14	F
15	J
16	K
17	L
18	M
23	E
24	F
25	J
26	K
27	L
28	M
33	E
34	F

Dash Number	Polarity
35	J
36	K
37	L
38	M
43	E
44	F
45	J
46	K
47	L
48	M
53	E
54	F
55	J
56	K
57	L
58	M
63	E
64	F
65	J
66	K

Dash Number	Polarity
67	L
68	M
73	E
74	F
75	J
76	K
77	L
78	M
83	E
84	F
85	J
86	K
87	L
88	M
93	E
94	F
95	J
96	K
97	L
98	M

023007

Figure 7. Polarity Coding

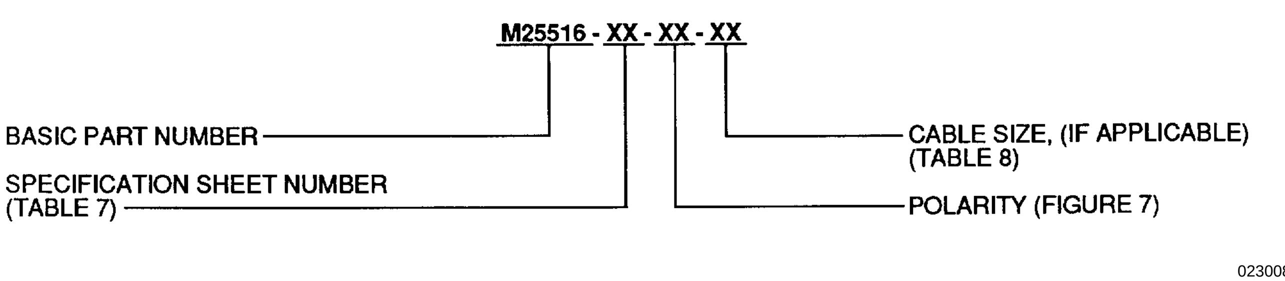


Figure 8. M25516 Part Number Breakdown

TABLE 6. MIL-C-3655 SELECTION

Part No. M3665/	Impedance	Voltage	Frequency	Connection or Use
13-0001	78 ohms	500V	500 MHz	M3665/14-0001 M17/45-RG-108
14-0001	79 ohms	500V	500 MHz	M3665/13-0001 M17/45-RG-108
15-0001	78 ohms	500V	500 MHz	M3665/16-0001 M17/45-RG-108
16-0001	78 ohms	500V	500 MHz	M3665/15-0001 M17/45-RG-108
17-0001	78 ohms	500V	500 MHz	M3665/16-0001 M17/45-RG-108
18-0001	95 ohms	NOTE 1	500 MHz	M3665/19-0001
19-0001	95 ohms	NOTE 1	500 MHz	M3665/18-0001
20-0001	95 ohms	NOTE 1	500 MHz	M3665/18-0001
21-0001	95 ohms	NOTE 1	500 MHz	M3665/20-0001
22-0001	78 ohms	NOTE 2	500 MHz	M3665/14-0001
23-0001	78 ohms	NOTE 2	500 MHz	M3665/15-0001
NOTES: 1 300V at sea level 75V at 70,000 feet 2 500V at sea level 125V at 70,000 feet				

TABLE 7. CLASSIFICATION

Specification No MIL-C-25516/	Series	Class	Type	Description
16C	IV	G	4	Pressurized Receptacle
17D	IV	H	4	Receptacle
18C	III	Y	5	Panel Adapter
19C	I	G	1	Pressurized Receptacle
20C	I	G	1	Plug
21C	IV	H	2	Receptacle
22C	III	Y	6	Triaxial Adapter
23	NOTE 1	NOTE 1	NOTE 1	Plug
24	NOTE 1	NOTE 1	NOTE 1	Pressurized Receptacle
25A	I	H	1	Receptacle
26A	I	G	3	Triaxial Plug
27A	IV	H	4	Receptacle
28A	I	G	1	Plug (Lanyard Release)
29	IV	G	4	Receptacle
NOTE: 1 Will mate with any jack having the same polarity.				

TABLE 8. CABLE SIZE CODE

Specification No. M17/	Cable Designation	Maximum Center Conductor Size (AWG)	Core (Inch) Diameter Min Max	Shield
84-RG223	01	20	.109 .119	Yes
93-RG178	02	20	.035 .045	Yes
	03	19	.065 .075	Yes
	04	19	.082 .092	Yes
	05	19	.085 .095	Yes
	06	20	.075 .095	No
	07	19	.090 .100	Yes
	08	20	.044 .054	Yes
	09	20	.052 .062	Yes
	10	20	.056 .060	No
	11	20	.125 .135	No
	12	19	.090 .100	No
119-RG174 94-RG179 113-RG316	13	20	.050 .060	Yes
94-RG179	14	20	.060 .066	Yes
	15	18	.110 .120	No
54-RG122	16	20	.105 .115	Yes
	17	20	.090 .100	No
95-RG180	18	20	.100 .110	Yes
28-RG58	19	18	.110 .121	Yes
111-RG303	20	18	.066 .070	No

TABLE 8. CABLE SIZE CODE (Cont)

Specification No. M17/	Cable Designation	Maximum Center Conductor Size (AWG)	Core (Inch) Diameter Min / Max	Shield
60-RG142	21	18	.080 / .090	No
	22	19	.068 / .070	Yes
	23	20	.123 / .133	Yes
	24	18	.118 / .128	Yes
95-RG180	25	20	.105 / .115	Yes

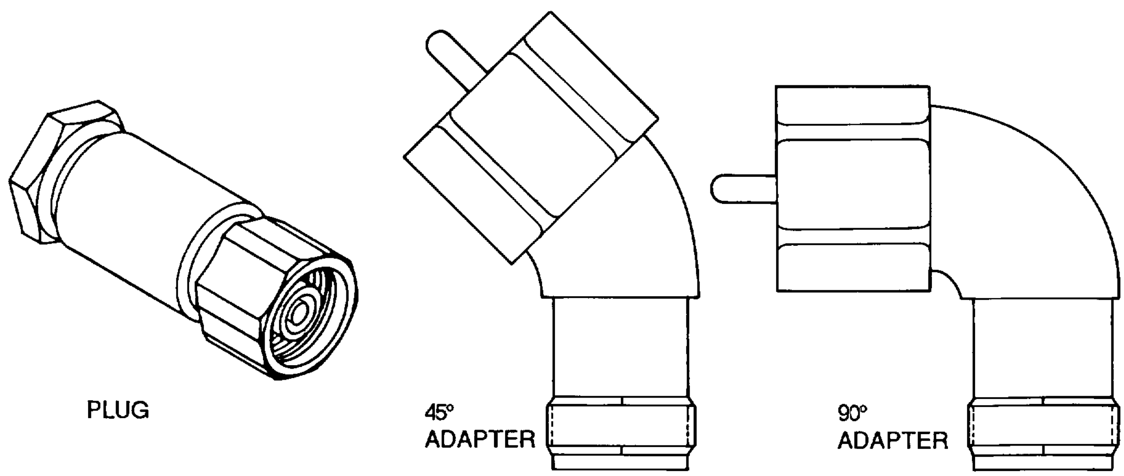


Figure 9. Typical LT Series Connectors

b. Class 2. These connectors are intended to provide mechanical connections within an RF circuit providing specified RF performance.

39. **Selection.** The selection of connectors is determined by the system requirements. Consult applicable drawings and diagrams to determine the required part. The connectors and their parameters are shown (Table 11).

40. **Part Number.** The part number consists of the basic specification sheet number, followed by the detailed specification sheet number, and a four digit dash number. The first digit of the dash number designates the material of the connector shell. The second digit denotes modified bayonet coupling mechanism keying, (when applicable). The third and fourth digits of the dash number are sequentially assigned (Figure 11).

41. **Assembly.** The assembly of this connector is unique to the manufacturer. If assembly instructions are not provided with the connector, see the aircraft maintenance manual or contact the CFA for support.

42. **MIL-PRF-39012 CONNECTORS, COAXIAL, RADIO FREQUENCY, GENERAL SPECIFICATION FOR.** This specification covers RF connectors used with flexible RF cables and certain other types of coaxial transmission lines.

43. **Classification.** These connectors are of the following two classes.

TABLE 9. MIL-C-26637 SELECTION

Specification Number MIL-C-26637/	Frequency	Voltage	Description	Use
1	5 GHz	500V	Plug	RG-211
2	5 GHz	500V	Connector Adapter 90° Male or Female	RG-211
3	5 GHz	500V	Connector Adapter 45° Male or Female	RG-211

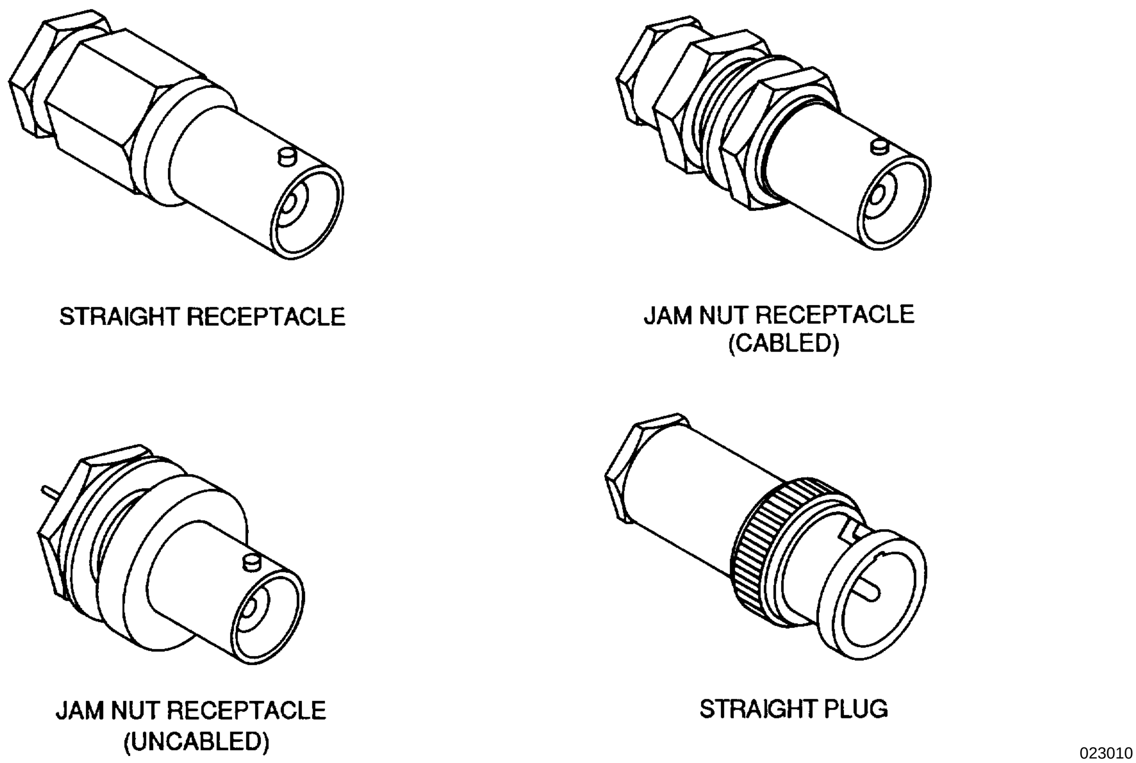


Figure 10. Typical Triax Series Connectors

a. Class 1. Connectors in this class are intended to provide superior RF performance at specified frequencies for which all RF characteristics are defined.

b. Class 2. Connectors in this class are intended to provide mechanical connections within an RF circuit providing specified RF performance.

44. **Categories.** Classes may be subdivided by categories.

a. Category A. These connectors are field serviceable using standard tools with no special tools required.

b. Category B. These connectors are not field replaceable. Special tools are required.

c. Category C. These connectors are field replaceable requiring only standard crimp tool and standard stripping dimensions for assembly.

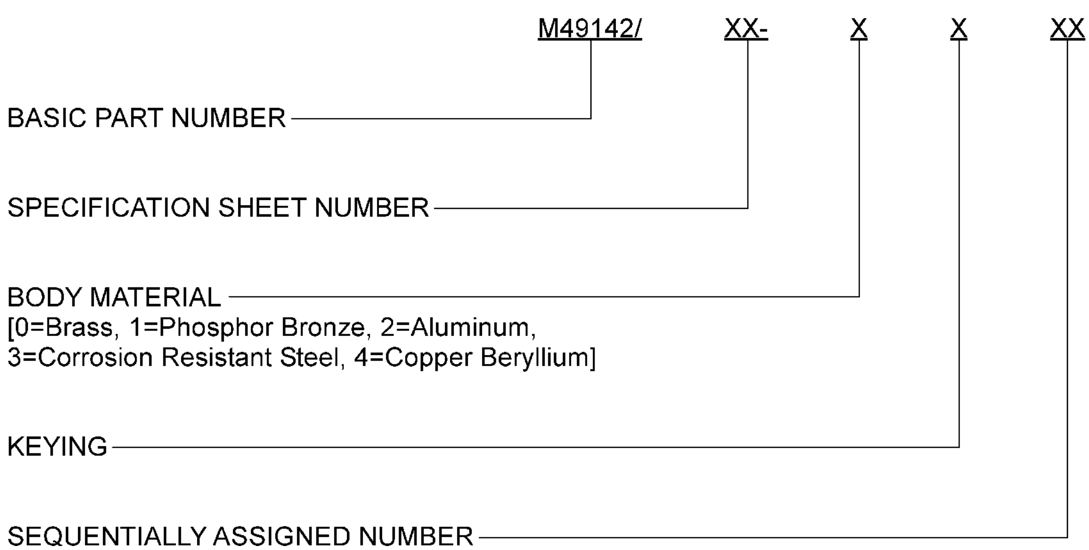
d. Category D. These connectors are field replaceable using crimp center contacts and outer ferrules with standard stripping dimensions for assembly.

e. Category E. These connectors are field replaceable used with semi-rigid cable with standard stripping dimensions and using standard hand tools. Connector is soldered to the outer conductor cable.

f. Category F. These connectors are field replaceable, used with a semi-rigid cable with standard stripping dimensions, and using standard hand tools. Assembly of the connector to the cable is solderless.

TABLE 10. APPLICABLE MILITARY SPECIFICATIONS

Specification No. MIL-PRF-49142	Part No.	Description
8	M49142/08-0001 M49142/08-0002 M49142/08-0005 thru M49142/08-0010	Plugs, Series TRT, Cabled, Pin Contact
9	M49142/09-0001 M49142/09-0002 M49142/09-0006 thru M49142/09-0011	Receptacles, Series TRT, Cabled, Socket Contact, Jam Nut Mounted
10	M49142/10-0001 M49142/10-0002	Receptacles, Series TRT, Uncabled, Socket Contact, Jam Nut Mounted, Hermetic, and Non Hermetic
11	M49142I11-0001 M49142/11-0002 M49142/11-0006 thru M49142/11-0011	Receptacles, Series TRT, Cabled, Socket Contact
12	M49142/12-0001 M49142/12-0002 M49142/12-0005 thru M49142/12-0009	Plugs, Series TRT, Cabled., Pin Contact, Right Angle



023011

Figure 11. MIL-C-49142 Part Number Breakdown

TABLE 11. MIL-PRF-49142 SELECTION

Part Number M49142	Class	Minimum Frequency Range	Cable
/08-0001	2	0 to 500 MHz	M17/134-00001
/08-0002			M17/134-00002
/08-0005			M17/116-RG307
/08-0006			M17/176-00002
/08-0007			M915/49-28WU-1
/08-0008			M17/177-00001
/08-0009			M17/178-00001
/08-0010			M17/179-00001
/09-0001	2	0 to 500 MHz	M17/134-00001
/09-0002			M17/134-00002
/09-0006			M17/176-00002
/09-0007			M17/116-RG307
/09-0008			M915/49-28WU-1
/09-0009			M17/177-00001
/09-0010			M17/178-00001
/09-0011			M17/179-00001
/10-0001	2	0 to 500 MHz	N/A
/10-0002			N/A
/11-0001	2	0 to 500 MHz	M17/134-00001
/11-0002			M17/134-00002
/11-0006			M17/176-00002
/11-0007			M17/116-RG307
/11-0008			M915/49-28WU-1
/11-0009			M17/177-00001
/11-0010			M17/178-0000l
/11-0011			M17/179-00001
/12-0001	2	0 to 500 MHz	M17/134-00001
/l2-0002			M17/134-00002
/12-0005			M17/116-RG307
/12-0006			M17/176-00002
/12-0007			M17/177-00001
/12-0008			M17/178-00001
/12-0009			M17/179-00001

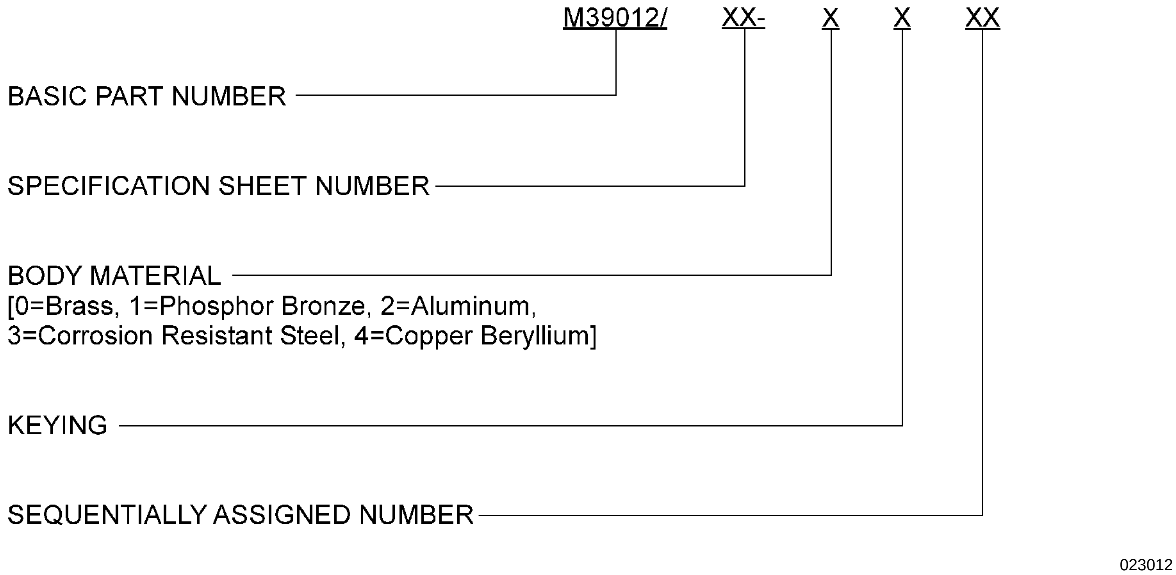


Figure 12. MIL-PRF-39012 Part Number Breakdown

45. **Part Number.** The part number consists of the basic specification sheet number, followed by the detailed specification sheet number, and a four digit dash number. The first digit of the dash number designates the material of the connector shell. The second digit denotes modified bayonet coupling mechanism keying (when applicable). The third and fourth digits of the dash number are sequentially assigned (Figure 12).

46. **Series N Connectors.** These connectors are midsize, weatherproof, screw type coupling, and a metal to metal cable clamp. These connectors operate with a maximum peak voltage of 1500V and a frequency limit of 10,000 MHz. These connectors have a nominal impedance of 50 or 70 ohms. A 50 ohm connector will not mate with a 70 ohm connector (Figure 13).

47. **Series C Connectors.** These connectors are similar to Series N in that they are designed for medium sized cable. These connectors are midsize, weatherproof, bayonet type coupling, and metal to metal cable clamp. They operate with a maximum peak voltage of 1500 volt and a frequency of 10,000 MHz. The nominal impedance is 50 ohms (Figure 14).

48. **Series BNC Connectors.** These connectors are small, lightweight, weatherproof, bayonet type coupling, and metal to metal cable clamp. They operate with maximum peak voltage of 500 volt and frequency of 10,000 MHz. The nominal impedance is 50 ohms (Figure 15).

49. **Series TNC Connectors.** These connectors are similar to the BNC connector, but have threaded coupling. They operate with a maximum peak voltage of 500 volt and a frequency of 11,000 MHz. The nominal impedance is 50 ohms (Figure 16).

50. **Series SC Connectors.** These connectors are designed for medium sized cable. They are weatherproof with screw type coupling. They operate with a peak maximum voltage of 1500 volt and a frequency of 11,000 MHz. The nominal impedance is 50 ohms (Figure 17).

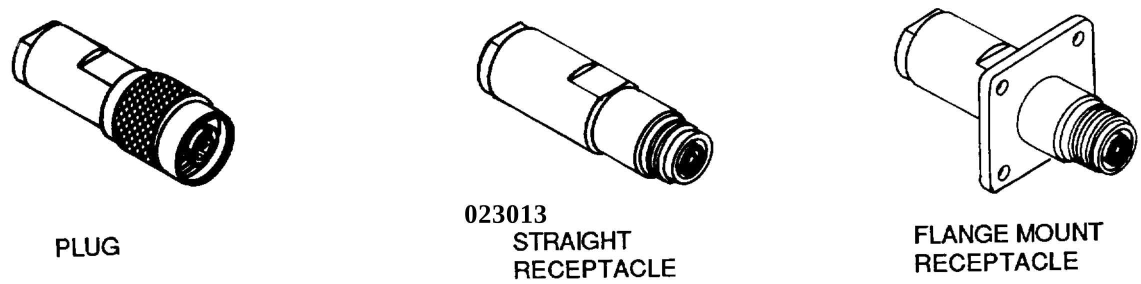
51. **Series SMA Connectors.** These connectors are subminiature, low voltage connectors with threaded coupling, 50 ohm impedance and an operating frequency to 12,400 MHz (Figure 18).

52. **Series SMB Connectors.** These connectors are subminiature, snap on coupling connectors approximately the same size as SMA series. These connectors operate to 10,000 MHz (Figure 19).

53. **Series SMC Connectors.** These connectors are subminiature, threaded coupling connectors approximately the same size as the SMA series. These connectors operate to 10,000 MHz (Figure 20).

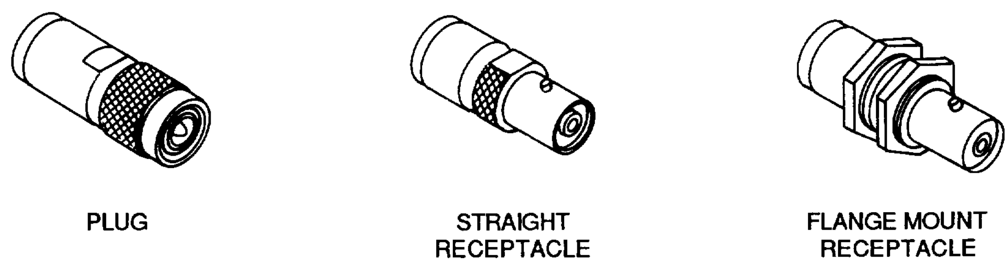
54. **Series QSC Connectors.** These connectors are large, threaded coupling connectors. These connectors operate to 11,000 MHz and to 1500 volt (Figure 21).

55. **Series QNC Connectors.** These connectors are similar to the QSC type both in size and operating characteristics (Figure 22).



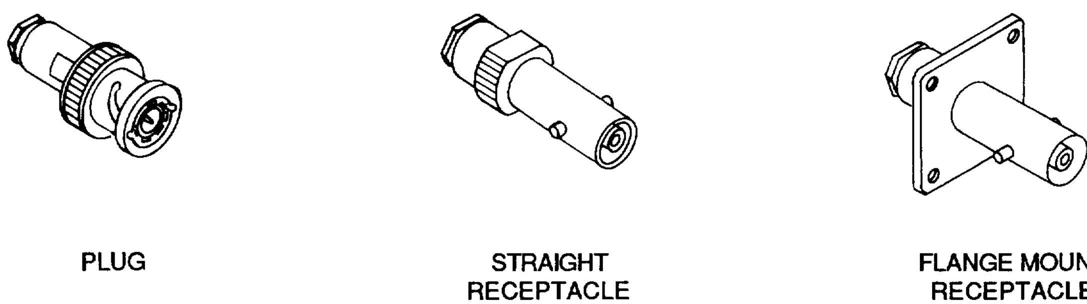
023013

Figure 13. Typical N Series Connectors



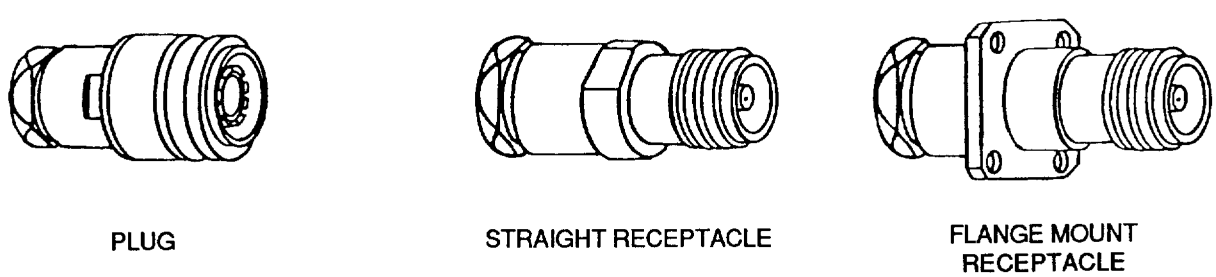
023014

Figure 14. Typical C Series Connectors



023015

Figure 15. Typical BNC Series Connectors



023016

Figure 16. Typical TNC Series Connectors

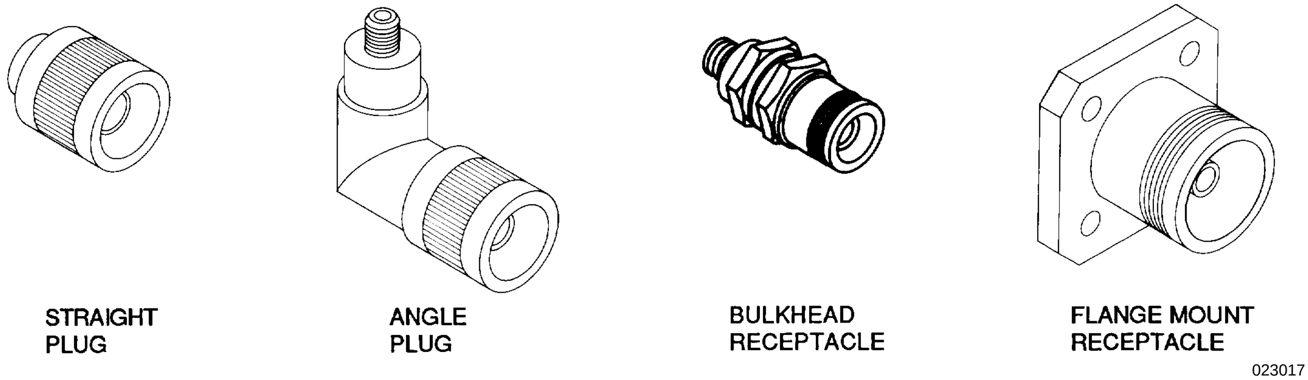


Figure 17. Typical SC Series Connectors

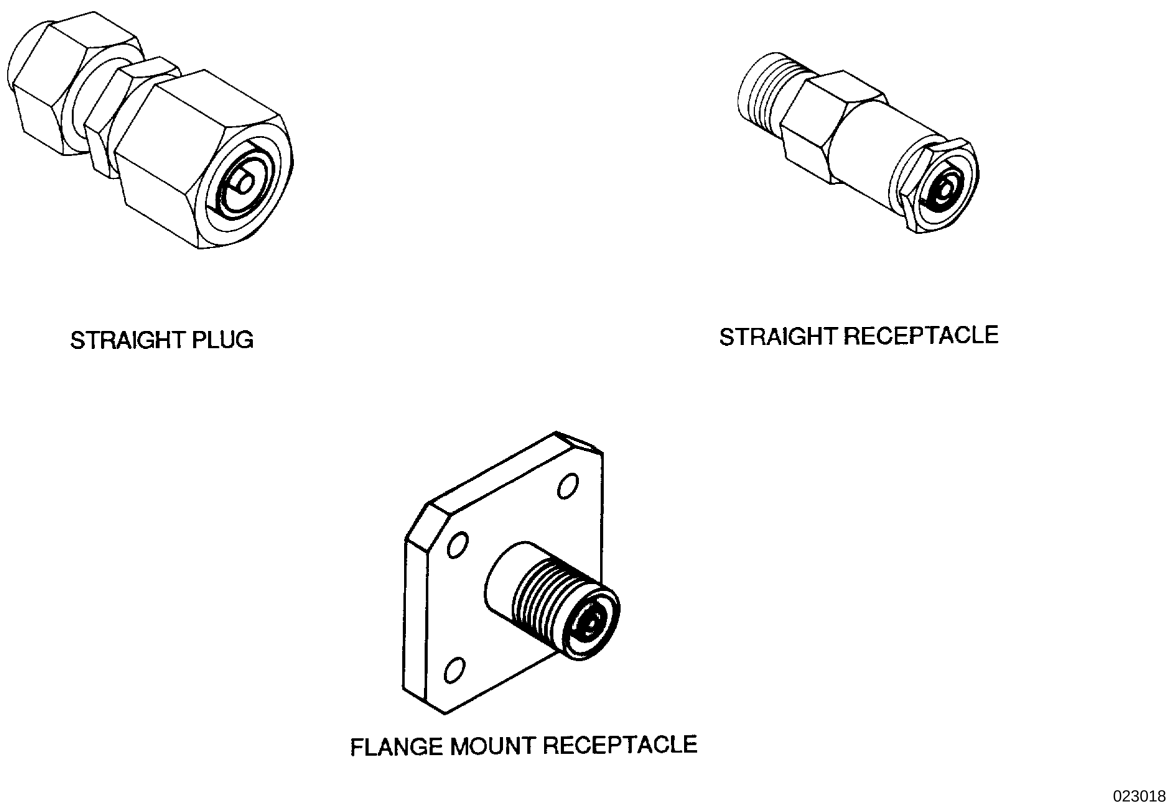


Figure 18. Typical SMA Series Connector

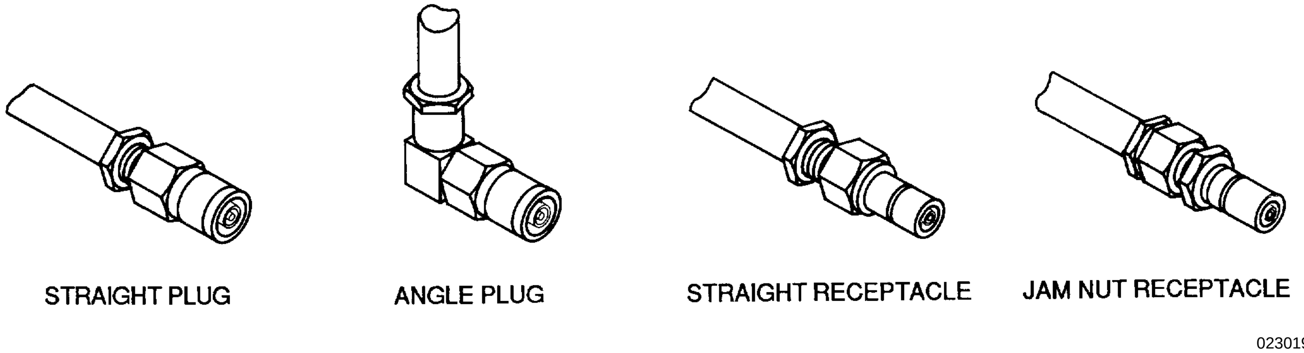


Figure 19. Typical SMB Series Connectors

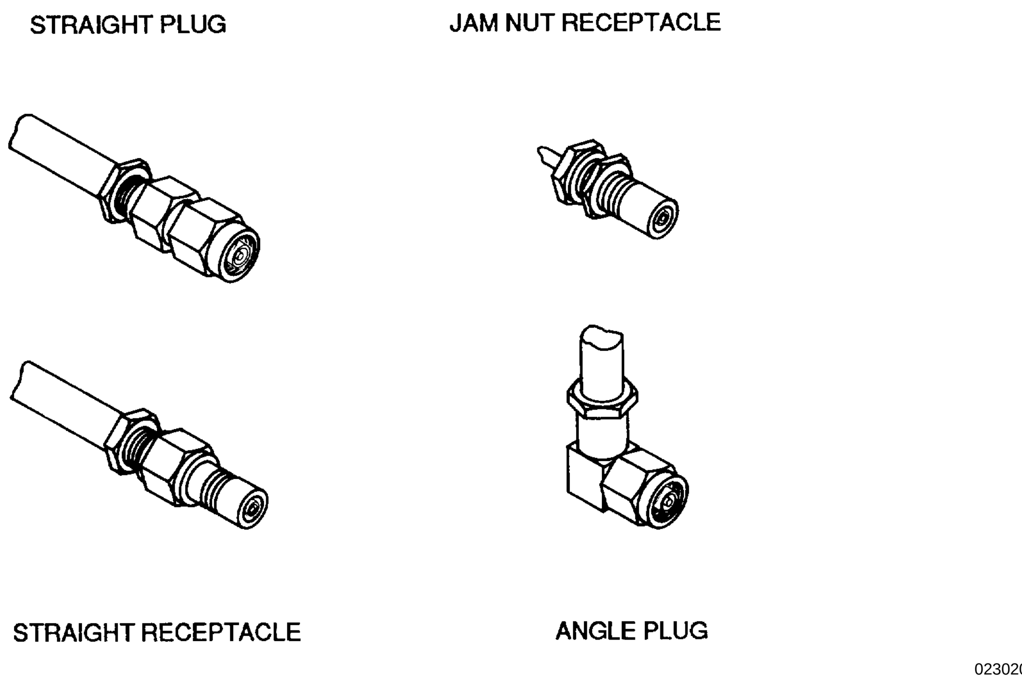


Figure 20. Typical SMC Series Connectors

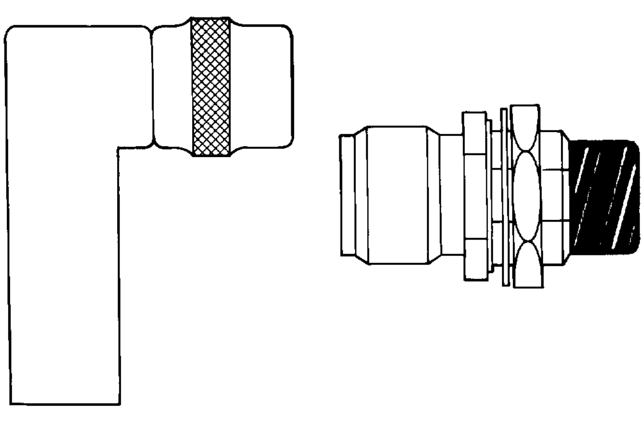


Figure 21. Typical QSC Series Connector

56. **Series MHV Connectors.** These connectors are high voltage, flange mount, bayonet coupled connectors (Figure 23).

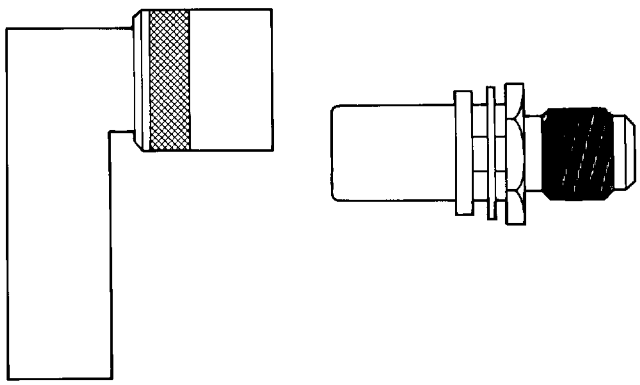
57. **Series SHV Connectors.** These connectors are high voltage, bayonet coupled connectors (Figure 24).

58. **Series EIA Connectors.** These connectors are large, flange mount connectors for use with semi rigid corrugated cables (Figure 25).

59. **Selection.** The selection of connectors is determined by the system requirements. Consult applicable drawings and diagrams to determine the required part.

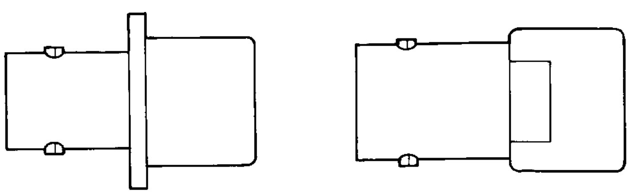
The applicable military specifications with connector description are shown (Table 12).

60. **Assembly.** To assemble MIL-PRF-39012 connectors refer to WP 023 01.



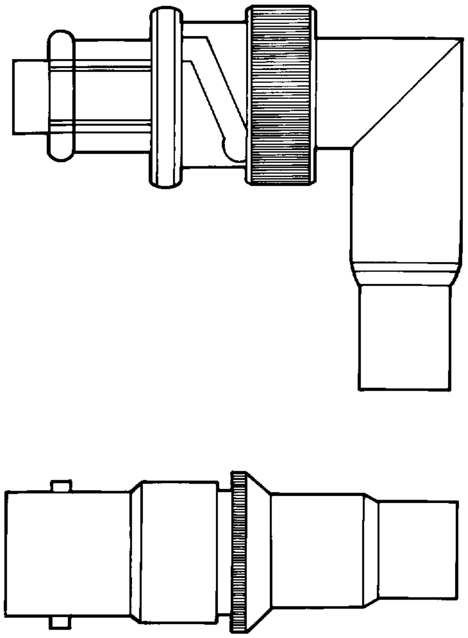
023022

Figure 22. Typical QNC Series Connector



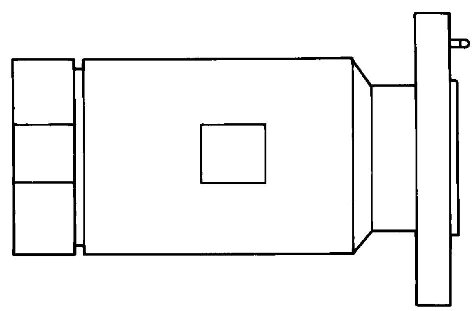
023023

Figure 23. Typical MHV Series Connector



023024

Figure 24. Typical SHV Series Connector



023025

Figure 25. Typical EIA Series Connector

TABLE 12. APPLICABLE MILITARY SPECIFICATIONS

Specification No. 39012/	Series	Contact	Description
1	N	Pin	Plug
2	N	Socket	Plugs and Receptacles Flange Mount
3	N	Socket	Receptacle Jam Nut Mount
4	N	Socket	Receptacle Jam Nut Mount Flange Mount
5	N	Pin	Plug Right Angle
6	C	Pin	Plug
7	C	Socket	Plug
8	C	Socket	Receptacle Flange Rear Mount
9	C	Socket	Receptacle Jam Nut Front Mount
10	C	Pin	Plug Right Angle
11	C	Socket	Receptacle Jam Nut Rear Mount
12	C	Socket	Receptacle Flange Rear Mount
13	C	Socket	Pressurized Receptacle Jam Nut Front Mount
14	C	Socket	Hermetic Receptacle Jam Nut Mount
15	C	Pin	Plug
16	BNC	Pin	Plug
17	BNC	Socket	Plug
18	BNC	Socket	Receptacle Flange Mount
19	BNC	Socket	Receptacle Jam Nut Mount
20	BNC	Pin	Plug Right Angle
21	BNC	Socket	Receptacle Jam Nut Mount
22	BNC	Socket	Receptacle Flange Mount
23	BNC	Socket	Receptacle Right Angle
24	BNC	Socket	Hermetic Receptacle Jam Nut Mount
26	TNC	Pin	Plug
27	TNC	Socket	Plug
28	TNC	Socket	Receptacle Jam Nut Mount
29	TNC	Socket	Receptacle Flange Mount
30	TNC	Pin	Plug Right Angle
31	TNC	Socket	Receptacle Jam Nut Mount
32	TNC	Socket	Receptacle Flange Mount
33	TNC	Socket	Receptacle Right Angle
34	TNC	Socket	Hermetic Receptacle Jam Nut Mount
35	SC	Pin	Plug
36	SC	Socket	Plug

TABLE 12. APPLICABLE MILITARY SPECIFICATIONS (Cont)

Specification No. 39012/	Series	Contact	Description
37	SC	Socket	Receptacle Jam Nut Front Mount
38	SC	Socket	Receptacle Flange Rear Mount
39	SC	Pin	Plug Right Angle
40	SC	Socket	Receptacle Jam Nut Rear Mount
41	SC	Socket	Receptacle Flange Rear Mount
42	SC	Socket	Receptacle Jam Nut Front Mount
55	SMA	Pin	Plug
56	SMA	Pin	Plug Right Angle
57	SMA	Socket	Plug
58	SMA	Socket	Receptacle Flange Mount
59	SMA	Socket	Receptacle Jam Nut Mount
60	SMA	Socket	Receptacle Flange Mount
61	SMA	Socket	Receptacle Jam Nut Mount
62	SMA	Socket	Hermetic Receptacle Jam Nut Mount
67	SMB	Socket	Plug
68	SMB	Pin	Plug
69	SMB	Socket	Plug Right Angle
70	SMB	Pin	Receptacle Jam Nut Rear Mount
71	SMB	Pin	Receptacle Jam Nut Mount
73	SMC	Socket	Plug
74	SMC	Pin	Plug
75	SMC	Socket	Plug Right Angle
76	SMC	Pin	Receptacle Jam Nut Rear Mount
77	SMC	Pin	Receptacle Jam Nut Mount
79	SMA	Pin	Plug For Semi-Rigid Cables
80	SMA	Pin	Plug Right Angle For Semi-Rigid Cable
81	SMA	Socket	Plug For Semi-Rigid Cables
82	SMA	Socket	Receptacle Flange Mount For Semi-Rigid Cable
83	SMA	Socket	Receptacle Jam Nut Mount For Semi-Rigid Cable
84	QSC	Pin	Plug Right Angle
85	QSC	Socket	Receptacle Jam Nut Rear Mount
86	QSC	Socket	Receptacle Jam Nut Front Mount
87	QSC	Socket	Hermetic Receptacle Jam Nut Front and Rear Mount
88	QNC	Pin	Plug Right Angle
89	QNC	Socket	Receptacle Jam Nut Mount

TABLE 12. APPLICABLE MILITARY SPECIFICATIONS (Cont)

Specification No. 39012/	Series	Contact	Description
90	QNC	Socket	Receptacle Jam Nut Front And Rear Mount
91	QNC	Socket	Receptacle Jam Nut Front And Rear Mount
92	SMA	None	Plug For Semi-Rigid Cable
93	SMA	Socket	Receptacle Printed Circuit
94	SMA	Socket	Receptacle Right Angle Printed Circuit
95	SMA	Pin	Receptacle Printed Circuit
96	SMA	Pin	Receptacle Right Angle Printed Circuit
101	MHV	Pin	Plug
102	MHV	Socket	Plug
103	MHV	Socket	Receptacle Flange Mount
104	MHV	Socket	Receptacle Jam Nut Mount
105	SHV	Socket	Plug
106	SHV	Socket	Plug Right Angle
107	SHV	Pin	Receptacle
108	SHV	Pin	Receptacle Flange Mount
109	SHV	Pin	Receptacle Flange Mount
110	SHV	Pin	Receptacle Jam Nut Mount
111	SHV	Pin	Receptacle Jam Nut Mount
112	TNC	Pin	Plug For Semi-Rigid Cable
113	TNC	Socket	Plug For Semi-Rigid Cable
114	TNC	Pin	Plug Right Angle For Semi-Rigid Cable
115	TNC	Socket	Receptacle Jam Nut Mount For Semi-Rigid Cable
116	TNC	Socket	Receptacle Flange Mount For Semi-Rigid Cable
117EC	N	Pin And Socket	Jacks And Plugs For Use With MIL-C-28830/3 Corrugated Semi-Rigid Cable
118EC	N	Socket	
119EC	N	Pin	
120EC	N	Socket	
121EC	N	Socket	
122	EIA	Pin	Flange Receptacle For MIL-C-28830/3 Cable
123	EIA	Pin	Flange Receptacle For MIL-C-28830/4 Cable
124	EIA	Pin	Flange Receptacle For MIL-C-28830/5 Cable

TABLE 12. APPLICABLE MILITARY SPECIFICATIONS (Cont)

Specification No. 39012/	Series	Contact	Description
128	BNC	Socket	Receptacle Solder Pocket Isolated Jam Nut Mount
129	N	Pin	Plug For Semi-Rigid Cable
130	N	Pin	Plug Right Angle For Semi-Rigid Cable
131	N	Socket	Plug For Semi-Rigid Cable
132	N	Socket	Receptacle Jam Nut Mount For Semi-Rigid Cable

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MIL-PRF-39012 RADIO FREQUENCY CONNECTORS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Installation Practices, Aircraft Electric and Electronic Wiring . . . . NAVAIR 01-1A-005.l
Installation Practices, Aircraft Electric and Electronic Wiring, Wire and Cable Stripping . . . . . . NAVAIR 01-1A-005.8
Installation Practices, Aircraft Electric and Electronic Wiring, Crimp Tools . . . . NAVAIR 01-1A-505.13
Installation Practices, Aircraft Electric and Electronic Wiring, Soldering . . . . NAVAIR 01-1A-505.18
Connectors, Coaxial Radio Frequency, General Specifications for MIL-PRF-39012

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part No./Type Designation
Crimp Tool Frame	M22520/1-01
Turret	M22520/1-12
Turret	M22520/1-13
Turret	M22520/1-14
Positioner	M22520/1-15
Crimp Tool Frame	M22520/36-01
Positioner	M22520/36-02
Positioner	M22520/36-03
Locator	M22520/36-04
Locator	M22520/36-05
Locator	M22520/36-15
Positioner	M22520/36-16
Positioner	M22520/36-17
Locator	M22520/36-18
Locator	M22520/5-01
Crimp Tool Frame	M22520/5-03
Die	M22520/5-05
Die	M22520/5-07
Die	M22520/5-09
Die	M22520/5-11
Die	M22520/5-13
Die	M22520/5-19
Die	M22520/5-25
Die	M22520/5-33
Die	M22520/5-35
Die	M22520/5-41
Die	M22520/5-55
Die	M22520/5-57
Die	M22520/5-59
Die	M22520/5-61
Crimping Tool	OMNI SPECTRA T-200
Crimping Tool	901-2500
Torque Wrench, 0-100 in/lbs	—

Materials Required

Nomenclature	Part Number
Sleeving, Heat Shrink	MIL-T-23053
Solder	Sn60WRMAP3
Tape, Insulating	MIL-T-25394

1. **INTRODUCTION.**

2. This subordinate work package (SWP) forms part of WP 023 00. It provides pertinant data necessary for the use and maintenance of MIL-PRF-39012 radio frequency connectors. For all other radio frequency connectors, see instructions provided with the connector. If no instructions are provided, see the aircraft maintenance manual or contact the CFA for support. For information about classification, categories, and part number breakdown, refer to WP 023 00.

3. **GENERAL.** RF connectors are frequently called coaxial connectors because the majority of them are used with coaxial cables. These connectors are primarily used in circuits carrying RF current, however they may be used to serve a shielding function in low-level signal circuits or audio circuits over shielded single conductor wire or coaxial cable.

4. **SUPERSEDED PART NUMBER CROSS-REFERENCE.** Table 1 provides a listing of superseded M39012 and UG part numbered connectors and cross-references them to the superseding M39012 part number.

5. **CONNECTOR FIGURES.** The connector figures for each aeries of RF connector contain the following data:

a. Part number

b. Brief description

c. Category

d. Dash number

e. Cable type

f. Tabling data

g. Cable stripping dimensions

h. Mounting data

i. Hardware

6. **SERIES BNC CONNECTORS.** The Series BNC connectors are small, lightweight, weatherproof connectors having a bayonet-type coupling, metal-to-metal clamp and polytetrafluoroethylene dielectric. These. connectors have a nominal impedance of 50 ohms, maximum peak voltage rating of 500 volts, practical frequency limit of 10 gigahertz and are designed for use with small-size cables (Figure 1).

7. **SERIES C CONNECTORS.** The Series C connectors are medium-size, weatherproof connectors having bayonet-type coupling, metal-to-metal cable clamp and polytetrafluoroethylene dielectric. These connectors have a nominal impedance of 50 ohms, maximum peak voltage rating of 1,500 volts and practical frequency limit of 10 gigahertz and are designed for use with medium size cables (Figure 2).

8. **SERIES N CONNECTORS.** The Series N connectors are medium-size, weatherproof connectors having screw-type coupling, metal-to-metal cable clamp and polytetrafluoroethylene dielectric. These connectors have nominal impedance characteristics of 50 and 70 ohms. The 50 ohm connectors will not properly mate with 70 ohm connectors, but they may be used with 70 cable where impedance matching is not required. These connectors are designed, for use with medium size cables (Figure 3).

9. **SERIES QL CONNECTORS.** The Series QL connectors are high voltage, high power and low VSWR connectors used with large size cables (Figure 4).

10. **SERIES QM CONNECTORS.** The Series QM connectors are high voltage, high power and low VSWR connectors used with large size cables (Figure 5).

11. **SERIES QNC CONNECTORS.** The Series QNC connectors are used with medium size cables. These connectors have a nominal impedance of 50 ohms and a frequency limit of 11 gigahertz (Figure 6).

12. **SERIES QSC CONNECTORS.** The Series QSC connectors are used with medium size cables., These connectors have a nominal impedance of 50 ohms and a frequency limit of 11 gigahertz (Figure 7).

13. **SERIES SC CONNECTORS.** The Series SC connectors are used for large size cables. These connectors have a nominal impedance of 50 ohms and a frequency limit of 11 gigahertz (Figure 8).

14. **SERIES SHV CONNECTORS.** The Series SHV connectors are used for coaxial cabled high voltage applications. These connectors have a voltage rating of 3,500 Vrms and 5,000 Vdc at sea level and 350 Vrms at 70,000 feet (Figure 9).

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE

Superseded Part M39012/	Superseding Part M39012/
01-0001	01-0101
01-0002	01-0005
01-0003	01-0015
01-0004	01-0104
01-0025	01-0125
02-0001	02-0101
02-0002	02-0003
02-0004	02-0104
02-0005	02-0006
02-0031	02-0131
02-0032	02-0132
03-0001	03-0101
03-0002	03-0012
05-0001	05-0101
16-0001	16-0101
16-0002	16-0102
16-0003	16-0103
16-0011	16-0111
16-0018	16-0118
17-0001	17-0101
17-0002	17-0102
17-0003	17-0103
17-0011	17-0111
17-0018	17-0118

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
18-0001	18-0101
18-0002	18-0102
18-0003	18-0103
18-0011	18-0111
18-0018	18-0118
19-0001	19-0101
19-0002	19-0102
19-0010	19-0110
19-0011	19-0001
19-0018	19-0118
20-0001	20-0101
20-0008	20-0108
26-0001	26-0101
26-0002	26-0102
26-0003	26-0103
26-0004	26-0104
26-0017	26-0117
27-0001	27-0101
27-0003	27-0103
27-0004	27-0104
27-0017	27-0117
28-0001	28-0101
28-0002	28-0102
28-0003	28-0103
28-0004	28-0104
28-0017	28-0117
29-0001	29-0101
29-0002	29-0102
29-0003	29-0103
29-0004	29-0104
29-0017	29-0117
30-0001	30-0101
30-0002	30-0102
30-4003	30-0103
30-0004	30-0104
30-0017	30-0117

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
30-0018	30-0118
35-0001	35-0016
35-0002	35-0017
35-0003	35-0018
35-0004	35-0019
35-0005	35-0020
35-0015	35-0021
36-0001	36-0015
36-0002	36-0016
36-0012	36-0018
36-0014	36-0020
36-0011	36-0017
38-0001	38-0010
38-0002	38-0011
38-0009	38-0012
39-0001	39-0101
39-0006	39-0106
39-0007	39-0107
40-0001	40-0023
40-0002	40-0024
40-0003	40-0025
40-0004	40-0026
40-0005	40-0027
55-3001	55-3006
55-4001	44-4006
55-3002	55-0007
55-4002	55-4007
55-3003	55-3008
36-0013	36-0019
55-4003	55-4008
55-3004	55-0009
55-4004	55-4009
55-3005	55-0010
55-4005	55-4010
56-3001	56-3006
56-4001	56-4006

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
56-3002	56-3007
56-4002	56-4007
56-3003	56-3008
56-4003	56-4008
56-3004	56-3009
56-4004	56-4009
56-3005	56-3010
56-4005	56-4010
57-3001	57-3006
57-4001	57-4006
57-3002	57-3007
57-4002	57-4007
57-3003	57-3008
57-4003	57-4008
57-3004	57-3009
57-4004	57-4009
57-3005	57-3010
57-4005	57-4010
57-3001	57-3006
57-4001	57-4006
58-3002	58-3007
58-4002	58-4007
58-3003	58-3008
58-4003	58-4008
58-3004	58-3009
58-4004	58-4009
58-3005	58-3010
58-4005	58-4010
59-3001	58-3006
59-4001	59-4006
59-3002	59-3007
59-4002	59-4007
59-3003	59-3008
59-4003	59-4008

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
59-3004	59-3009
59-4004	59-4009
59-3005	59-3010
59-4005	59-4010
UG-18E/U	01-0101
UG-19E/U	02-0104
UG-20E/U	02-0101
UG-21G/U	01-0005
UG-22F/U	01-0006
UG-23F/U	02-0003
UG-58/U	04-0002
UG-88/U	16-0101
UG-89/U	17-0101
UG-159D/U	03-0101
UG-160E/U	03-0012
UG-167F/U	01-0104
UG-204/U	01-0015
UG-260/U	16-0102
UG-261/U	17-0102
UG-262/U	18-0101
UG-290/U	22-0001
UG-291/U	18-0102
UG-568/U	12-0001
UG-569/U	14-0001
UG-570/U	11-0002
UG-571/U	08-0001
UG-572/U	07-0001
UG-573C/U	06-0002
UG-594C/U	05-0101
UG-625/U	12-0001
UG-626/U	06-0001
UG-627/U	15-0001
UG-629/U	08-0002
UG-630/U	11-0001
UG-631/U	09-0001
UG-633/U	07-0002
UG-680A/U	04-0001
UG-704/U	09-0002

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
UG-705/U	14-0002
UG-706/U	13-0001
UG-707C/U	06-0003
UG-708C/U	06-0005
UG-709/U	15-0002
UG-710/U	14-0001
UG-711C/U	06-0004
UG-909/U	19-0101
UG-910/U	19-0102
UG-911/U	24-0041
UG-912/U	24-0002
UG-913/U	20-0101
UG-935D/U	O2-0032
UG-940C/U	02-0031
UG-941C/U	01-0125
UG-1033/U	16-0103
UG-1055/U	18-0103
UG-1056/U	17-0103
UG-1094/U	21-0002
UG-1098/U	23-0001
UG-1174/U	23-0002
UG-1185A/U	01-0005
UG-1186A/U	02-0003
UG-1187A/U	02-0006
UG-1392/U	44-2001
UG-1393/U	44-2002
UG-1394/U	48-2001
UG-1395/U	46-2001
UG-1396/U	46-2002
UG-1397/U	45-2001
UG-1398/U	45-2002
UG-1399/U	49-2001
UG-1460/U	73-0001
UG-1461/U	75-0001
UG-1462/U	74-0001
UG-1463/U	76-4001
UG-1464/U	77-0002
UG-1465/U	73-0002

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

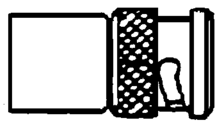
Superseded Part M39012/	Superseding Part M39012/
UG-1466/U	75-0002
UG-1467/U	74-0002
UG-1468/U	76-0002
UG-1487/U	01-0015
UG-1533/U	47-2001
UG-1537A/U	03-0012
UG-1619/U	77-0001
UG-1696/U	02-0015
UG-1697/U	02-0016
UG-1698/U	02-0017
UG-1700/U	03-0004
UG-1707/U	05-0002
UG-1708/U	05-0003
UG-1746/U	06-0006
UG-1748/U	06-0007
UG-1749/U	06-0008
UG-1750/U	06-0009
UG-1751/U	06-0010
UG-1752/U	06-0011
UG-1753/U	06-0012
UG-1754/U	07-0003
UG-1755/U	07-0004
UG-1756/U	07-0005
UG-1758/U	07-0007
UG-1759/U	07-0008
UG-1761/U	08-0003
UG-1762/U	08-0004
UG-1763/U	08-0005
UG-1765/U	08-0007
UG-1767/U	09-0003
UG-1768/U	09-0004
UG-1769/U	10-0002
UG-1770/U	10-0003
UG-1771/U	10-0004
UG-1773/U	11-0004
UG-1774/U	11-0005

TABLE 1. SUPERSEDED PART NUMBER CROSS-REFERENCE (Cont)

Superseded Part M39012/	Superseding Part M39012/
UG-1776/U	11-0007
UG-1777/U	11-0008
UG-1779/U	15-0003
UG-1780/U	15-0004
UG-1785/U	16-0004
UG-1786/U	16-0005
UG-1787/U	16-0006
UG-1788/U	16-0007
UG-1789/U	16-0008
UG-1790/U	16-0010
UG-1791/U	16-0009
UG-1792/U	18-0010
UG-1793/U	18-0009
UG-1794/U	17-0004
UG-1795/U	17-0005
UG-1796/U	17-0006
UG-1797/U	17-0007
UG-1798/U	17-0008
UG-1799/U	17-0010
UG-1800/U	17-0009
UG-1801/U	18-0008
UG-1802/U	18-0004
UG-1803/U	18-0005
UG-1804/U	19-0003
UG-1805/U	19-0004
UG-1806/U	19-0005
UG-1812/U	20-0002
UG-1813/U	20-0003
UG-1814/U	18-0006
UG-1817/U	10-0014
UG-1819/U	03-0011
UG-1807/U	19-0006
UG-1808/U	19-0007
UG-1809/U	19-0009
UG-1810/U	19-0008
UG-1811/U	18-0007

A. CONNECTORS

1. M39012/16 - CABLED PLUG, PIN CONTACT CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12
FERRULE: M22520/5-01 WITH DIE

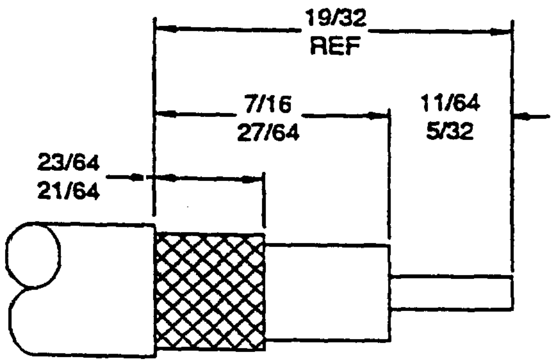
A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

STRIPPING DIMENSIONS

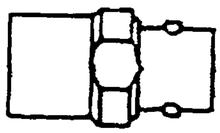


Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0102	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0111	111-RG303	
	0118	110-RG302	
	0220	113-RG3167 119-RG174	
	0225	74-RG213	
C	0013	28-RG058 111-RG303	C
	0014	84-RG223 60-RG142	C
	0015	29-RG59 30-RG062 97-RG210	D
	0016	54-RG122	B
	0017	90-RG71	D
	0020	110-RG302	D
	0222	113-RG316 119-RG174	A
D			
	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23010101

Figure 1. Series BNC Connectors (Sheet 1 of 7)

2. M39012/17 CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: M22520/1-01 WITH M22520/1-01 WITH M22520/1-12 FERRULE: M22520/5-01 WITH DIE

A. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

B. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

D. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

STRIPPING DIMENSIONS

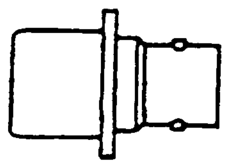
SAME AS M39012/16

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG059 84-RG223 128-RG400 60-RG142	
	0102	29-RG58 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0111	111-RG303	
	0118	110-RG302	
	0220	113-RG316 119-RG174	
	0225	74-RG213	
C	0013	28-RG058 111-RG303	A
	0014	84-RG223 60-RG142	A
	0015	29-RG59 30-RG062 97-RG210	B
	0016	54-RG122	C
	0017	90-RG71	B
	0020	110-RG302	B
	0222	113-RG316 119-RG174	D
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23010102

Figure 1. Series BNC Connectors (Sheet 2)

3. M39012/18 - CABLED RECEPTACLE, SOCKET CONTACT, FLANGE MOUNTED, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: M22520/1-01 WITH M22520/1-12
FERRULE: M22520/5-01 WITH

A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

STRIPPING DIMENSIONS

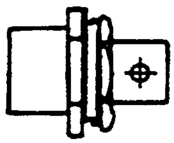
SAME AS M39012/16

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	29-RG059 30-RG062 90-RG71 97-RG210	
	0102	28-RG58 84-RG223 128-RG400 60-RG142	
	0103	54-RG122	
	0111	111-RG303	
	0118	110-RG302	
	0220	113-RG316 119-RG174	
C	0013	28-RG058 111-RG303	C
	0014	84-RG223 60-RG142	C
	0015	29-RG59 30-RG062 97-RG210	D
	0016	54-RG122	B
	0017	90-RG71	D
	0020	110-RG302	D
	0221	113-RG316 119-RG174	A
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23010103

Figure 1. Series BNC Connectors (Sheet 3)

1. M39012/19 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT MOUNTED CAPTVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: M22520/1-01 WITH M22520/1-12
FERRULE: M22520/5-01 WITH

A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

STRIPPING DIMENSIONS

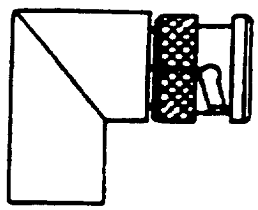
SAME AS M39012/16

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG58 84-RG223 128-RG400 60-RG142	
	0102	29-RG059 30-RG062 90-RG71 97-RG210	
	0110	54-RG122	
	0111	111-RG303	
	0118	110-RG302	
	0220	113-RG316 119-RG174	
C	0013	28-RG058 111-RG303	C
	0014	84-RG223 60-RG142	C
	0015	29-RG59 30-RG062 97-RG210	D
	0016	54-RG122	B
	0017	90-RG71	D
	0020	110-RG302	D
	0221	113-RG316 119-RG174	A
	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23010104

Figure 1. Series BNC Connectors (Sheet 4)

5. M39012/20 - CABLED PLUG, PIN CONTACT, RIGHT ANGLE, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:
M22520/5-01 WITH

A. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

B. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

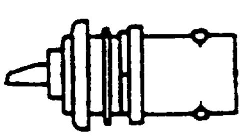
C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/16

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 60-RG142 128-RG400	
	0102	29-RG59 30-RG62 90-RG71 97-RG210	
	0108	110-RG302	
C	0006	28-RG058 111-RG303	A
	007	84-RG223 60-RG142 128-RG400	A
	0010	110-RG302	B
	0011	97-RG210 29-RG59 30-RG062 90-RG71	B
D	0501	54-RG122	C
	0502	95-RG180	C
	0503	60-RG142 128-RG400	A
	0504	28-RG058	A

6. M39012/21 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, CLASS 2

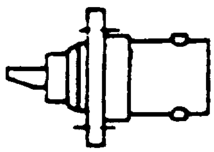


Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.439	.443
0002	.380	.384
0003	.439	.443

23010105

Figure 1. Series BNC Connectors (Sheet 5)

7. M39022/22 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, FLANGE MOUNTED, CLASS 2



TOOLING DATA

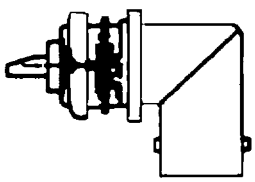
NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

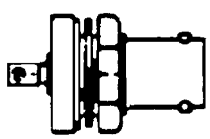
8. M39012/23 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, RIGHT ANGLE, JAM NUT MOUNTED, CLASS 2

Dash No.	Mounting Hole Dia. (inches)	
	Min.	Max.
0001	.439	.443
0002	.380	.384



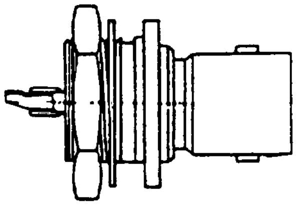
9. M39012/24 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, HERMETIC SEALED, JAM NUT MOUNTED CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.505	.510
0002	.380	.384



10. M39012/128 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, ISOLATED, CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.500	.504



23010106

Figure 1. Series BNC Connectors (Sheet 6)

B. HARDWARE

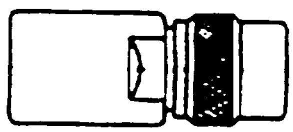
M39012/25 - 0006 - FEMALE CONNECTOR COVER
WITH BEAD CHAIN
M39012/25 - 0007 - FEMALE CONNECTOR COVER
WITH SAFETY CHAIN
M39012/25 - 0008 - MALE CONNECTOR COVER
WITH BEAD CHAIN
M39012/25 - 0009 - MALE CONNECTOR COVER
WITH SAFETY CHAIN
M39012/25 - 0010 - RECEPTACLE SHIELD
M39012/25 - 0015 - FEMALE CONNECTOR CAP
M39012/25-0016 - FEMALE CONNECTOR SHORTING
PLUG WITH BEAD CHAIN
M39012/25-0017 - FEMALE CONNECTOR SHORTING
PLUG WITH SAFETY CHAIN
M39012/25-0106 - FEMALE CONNECTOR COVER
WITH WIRE ROPE
M39012/25-0116 - FEMALE CONNECTOR SHORTING
PLUG WITH WIRE ROPE

23010107

Figure 1. Series BNC Connectors (Sheet 7)

A. CONNECTORS

1. M39012/6 - CABLED PLUG, PIN CONTACT, CLASS 2, DASH NO. 0001 THRU 0013 INACTIVE FOR NEW DESIGN, DASH NO. 0014 THRU 0020 HAVE CAPTIVATED CENTER CONTACTS



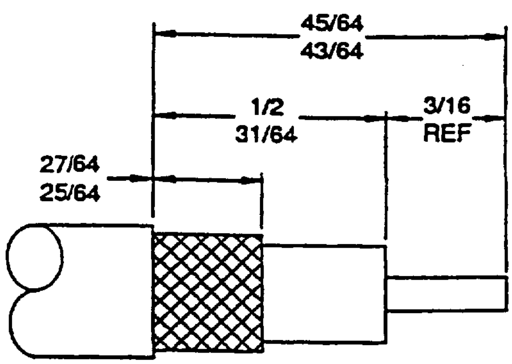
TOOLING DATA

CENTER CONTACT CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

B. M22520/5-61

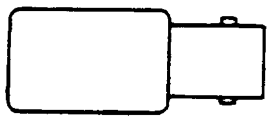
STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	73-RG212 112-RG304	
	0002	65-RG165 74-RG213 75-RG214 86-00001	
	0003	78-RG217	
	0004	72-RG211	
	0005	79-RG218	
	0013	74-RG215	
	0014	73-RG212 112-RG304	
	0015	65-RG165 74-RG213 75-RG214 86-00001	
	0016	78-RG217	
	0017	72-RG211	
	0018	79-RG218	
	0019	74-RG215	
	0020	92-RG115	
C	0027	73-RG212 112-RG30	A
	0028	74-RG213 65-RG165	B
	0029	75-RG214	B
	0030	86-00001	B
	0031	6-RG11	B
	0032	92-RG115	B

Figure 2. Series C Connectors (Sheet 1 of 6)

2. M39012/7 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

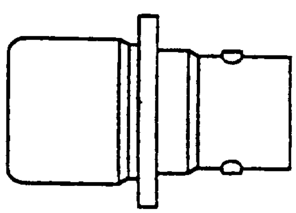
B. M22520/5-61

STRIPPING DIMENSIONS

SAME AS M39012/6

Category	Dash No.	Applicable Cable M17/	Tooling
A	0015	65-RG165 74-RG213 75-RG214 RG-225/U	
	0016	112-RG304 73-RG212	
	0017	74-RG215	
	0018	92-RG115	
C	0010	74-RG213 65-RG165	B
	0011	75-RG214	B
	0012	RG-225/U	B
	0013	73-RG212 112-RG304	A
	0014	92-RG115	B
	0024	6-RG11	B

3. M39012/8 - CABLED RECEPTACLE, SOCKET CONTACT, FLANGE MOUNTED, REAR MOUNTED, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

B. M22520/5-61

STRIPPING DIMENSIONS

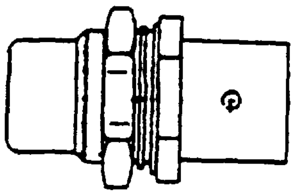
SAME AS M39012/6

Category	Dash No.	Applicable Cable M17/	Tooling
A	0017	65-RG165 74-RG213 75-RG214 RG-225/U	
	0018	73-RG212 112-RG304	
	0019	74-RG215	
	0020	92-RG115	
C	0011	74-RG213 65-RG165	B
	0012	75-RG214	B
	0013	RG-225/U	B
	0014	73-RG212 112-RG304	A
	0015	6-RG11	B
	0016	92-RG115	B

23010202

Figure 2. Series C Connectors (Sheet 2)

4. M39029/9 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT, FRONT MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG062 90-RG71	
	0002	28-RG058 84-RG223	

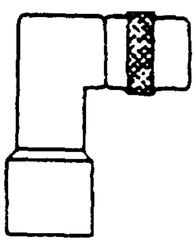
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

5. M39012/10 - CABLED PLUG, PIN CONTACT, RIGHT ANGLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	65-RG165 74-RG213 75-RG214 RG-225/U	
	0005	74-RG215	
	0009	92-RG115	
C	0006	74-RG213 65-RG165	A
	0007	75-RG214	A
	0008	RG-225/U	A
	0011	92-RG115	A

TOOLING DATA

CENTER CONTACT CATEGORY C ONLY:
M22520/5-01 WITH

A. M22520/5-61

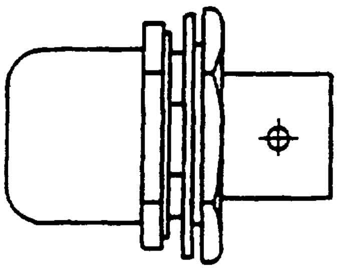
STRIPPING DIMENSIONS

SAME AS M39012/6

23010203

Figure 2. Series C Connectors (Sheet 3)

6. M39012/11 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT, REAR MOUNTED, PRESSURIZED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

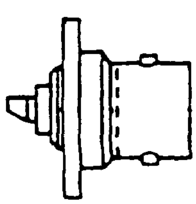
B. M22520/5-61

STRIPPING DIMENSIONS

SAME AS M39012/6

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	73-RG212 112-RG304	
	0002	65-RG165 74-RG213 75-RG214 86-00001	
	0018	73-RG212 112-RG304	
	0019	65-RG165 74-RG213 75-RG214 86-00001	
	0020	74-RG215	
	0021	92-RG115	
C		73-RG212 112-RG30	
		65-RG165 74-RG213	
		75-RG214	
		86-00001	
		6-RG11	
		92-RG115	

7. M39012/12 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, FLANGE MOUNTED, REAR MOUNTED CLASS 2



TOOL DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

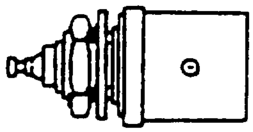
NOT APPLICABLE

23010204

Figure 2. Series C Connectors (Sheet 4)

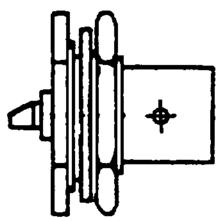
8. M39012/13 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT, FRONT MOUNTED, PRESSURIZED, CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.380	.385

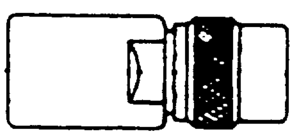


9. M39012/14 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, -0001 PRESSURIZED, -0002 HERMETIC, JAM NUT MOUNTED, CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.760	.765
0002	.760	.765



10. M39012/15 - CABLED PLUG, PIN CONTACT, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG062 90-RG71	
	0002	28-RG058 84-RG223	

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

23010205

Figure 2. Series C Connectors (Sheet 5)

B. HARDWARE

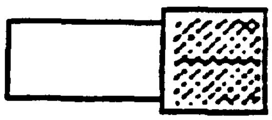
M39012/25 - 0001 - FEMALE CONNECTOR COVER WITH BEAD CHAIN
M39012/25 - 0002 - FEMALE CONNECTOR COVER WITH SAFETY CHAIN
M39012/25 - 0003 - MALE CONNECTOR COVER WITH BEAD CHAIN
M39012/25 - 0004 - MALE CONNECTOR COVER WITH SAFETY CHAIN
M39012/25 - 0005 - SHIELD
M39012/25 - 0013 - ARMOR CLAMP
M39012/25 - 0101 - FEMALE CONNECTOR COVER WITH WIRE ROPE
M39012/25 - 0103 - MALE CONNECTOR COVER WITH WIRE ROPE

23010206

Figure 2. Series C Connectors (Sheet 6)

A. CONNECTORS.

1. M39012/1 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

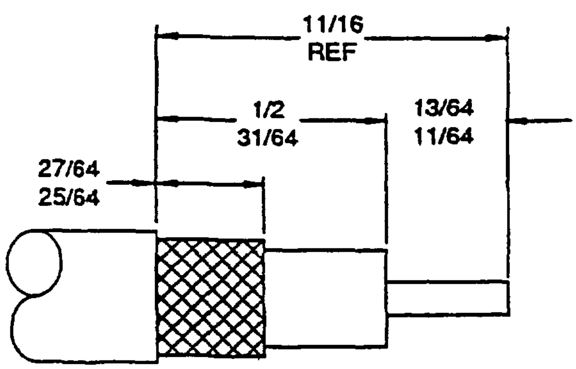
CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-13 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

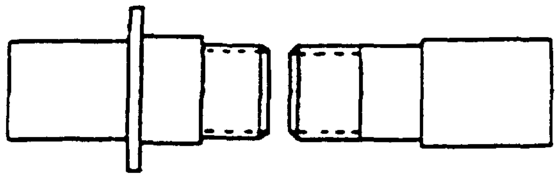
STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	2-RG6 73-RG212 162-00001	
	0104	79-RG218	
	0005	6-RG11 62-RG144 65-RG165 74-RG213 75-RG214 77-RG216 86-00001	
	0015	78-RG217	
	0125	74-RG215	
C	0016	73-RG212 162-00001	A
	0017	74-RG213	B
	0018	75-RG214	B
	0021	65-RG165	B
	0022	86-00001	B
	0023	6-RG11 62-RG144	B
	0024	77-RG216	B
	0027	2-RG6	A
	0501	75-RG214 127-RG393 86-00001	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

Figure 3. Series N Connectors (Sheet 1 of 6)

2. M39012/2 - CABLED PLUG OR RECEPTACLE, SOCKET CONTACT, FLANGE MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-13 FERRULE:
M22520/1-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A
B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/1

RECEPTACLES

Category	Dash No.	Applicable Cable M17/	Tooling
A	0104	2-RG6 73-RG212 RG-222/U	
	0006	6-RG11 62-RG144 65-RG165 74-RG213 75-RG214 77-RG216 RG-225/U	
	0132	74-RG215	
	0133	78-RG217	
C	0027	73-RG212 RG-222/U	A
	0028	74-RG213	B
	0029	75-RG214	B
	0030	77-RG216	B
	0034	RG-225/U	B
	0041	65-RG165	B
	0042	6-RG11 62-RG144	B
	0043	2-RG6	A
D	0511	75-RG214 RG-225/U 127-RG393	B
	0512	74-RG213	B
	0513	60-RG142 128-RG400	C
	0514	28-RG058	C

23010302

Figure 3. Series N Connectors (Sheet 2)

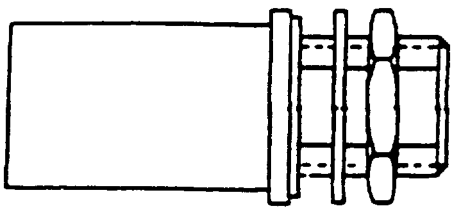
PLUGS

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	2-RG6 73-RG212 RG-222/U	
	0003	6-RG11 62-RG144 65-RG165 74-RG213 75-RG214 77-RG216 RG-225/U	
	0131	74-RG215	
C	0019	73-RG212 RG-222/U	A
	0020	74-RG213	B
	0021	75-RG214	B
	0024	65-RG165	B
	0025	RG-225/U	B
	0026	6-RG11 62-RG144	B
	0039	77-RG216	B
	0040	2-RG6	A
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23010303

Figure 3. Series N Connectors (Sheet 3)

3. M39012/3 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-14 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/1

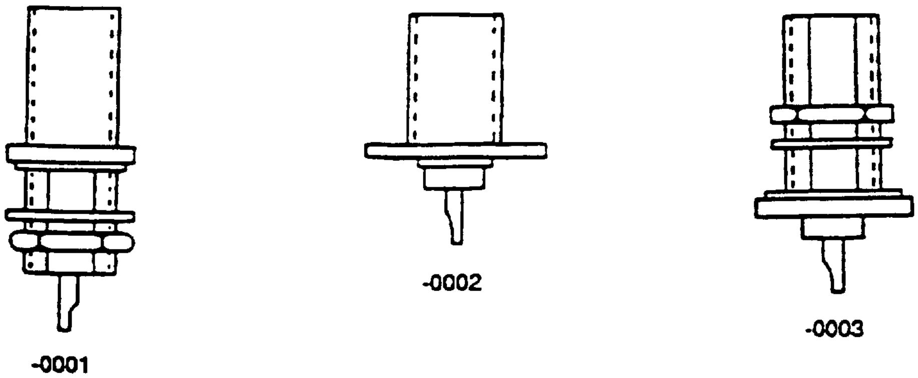
Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	2-RG6 73-RG212 RG-222/U	
	0012	6-RG11 62-RG144 65-RG165 74-RG213 75-RG214 77-RG216	
	0102	78-RG217	
C	0013	73-RG212 RG-222/U	A
	0014	74-RG213	B
	0015	75-RG214	B
	0018	65-RG165	B
	0019	RG-225/U	B
	0020	6-RG11 62-RG144	B
	0021	77-RG216	B
	0023	2-RG6	A
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

4. M39012/4 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT AND FLANGE MOUNTED, CLASS 2

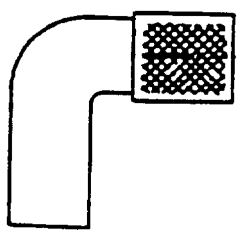
Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.630	.645
0003	.630	.645

23010304

Figure 3. Series N Connectors (Sheet 4)



5. M39012/5 - CABLED PLUG, PIN CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-13 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/1

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	6-RG11 62-RG144 65-RG165 74-RG213 75-RG214 77-RG216 RG-225/U	
	0006	2-RG6 73-RG212 RG-222/U	
C	0004	74-RG213	B
	0005	75-RG214	B
	0013	2-RG6	A
	0014	6-RG11 62-RG144	B
	0015	65-RG165	B
	0016	73-RG212 RG-222/U	A
	0017	77-RG216	B
	0018	RG-225/U	B
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

010305

Figure 3. Series N Connectors (Sheet 5)

B. HARDWARE

M39012/25-0011 FEMALE CONNECTOR CAP WITH BEAD CHAIN
M39012/25-0012 FEMALE CONNECTOR CAP WITH SAFETY CHAIN
M39012/25-0013 ARMOR CLAMP
M39012/25-0111 FEMALE CONNECTOR CAP WITH WIRE ROPE

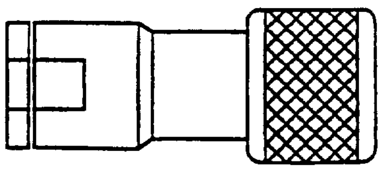
23010306

Figure 3. Series N Connectors (Sheet 6)

A. CONNECTORS.

1. M39012/44 - CABLED PLUG, PIN CONTACT, SOLDER TYPE, CLASS 2

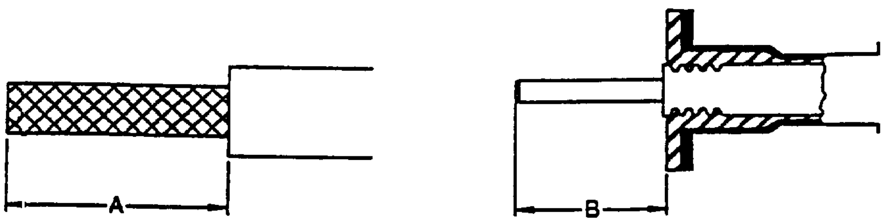
Dash No.	Applicable Cable M17/	Strip Dim. A	Strip Dim. B
2001	RG-218/U	13/16	9/16
2002	RG-220/U	9/16	7/16



TOOLING DATA

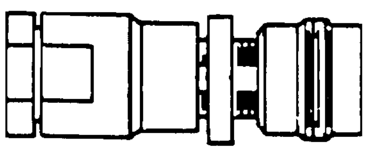
NOT APPLICABLE

STRIPPING DIMENSIONS



2. M39012/45 - CABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, CLASS 2

Dash No.	Applicable Cable M17/	Strip Dim. A	Strip Dim. B
2001	RG-218/U	13/16	9/16
2002	RG-220/U	9/16	7/16



TOOLING DATA

NOT APPLICABLE

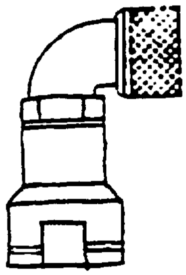
STRIPPING DIMENSIONS

SAME AS M39012/44

23010401

Figure 4. Series QL Connectors (Sheet 1 of 2)

3. M39012/46 - CABLED PLUG, PIN CONTACT, SOLDER TYPE, RIGHT ANGLE, CLASS 2.



Dash No.	Applicable Cable M17/	Strip Dim. A	Strip Dim. B
2001	RG-218/U	13/16	9/16
2002	RG-220/U	9/16	7/16

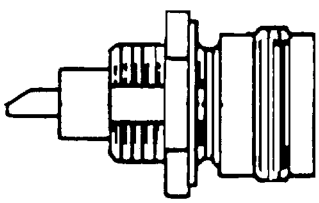
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

SAME AS M39012/44

4. M39012/47 - UNCABLED RECEPTACLE, PIN CONTACT, SOLDER TYPE, FRONT MOUNTED, JAM NUT MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
2001	1.140	1.145

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

B. HARDWARE.

NONE

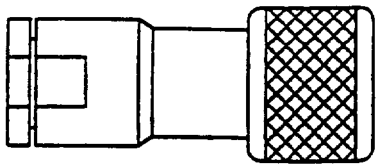
23010402

Figure 4. Series QL Connectors (Sheet 2)

A. CONNECTORS.

1. M39012/48 - CABLED PLUG, PIN CONTACT, SOLDER TYPE, CLASS 2

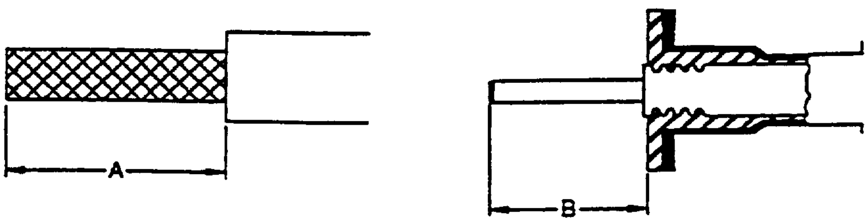
Dash No.	Applicable Cable M17/	Strip Dim. A	Strip Dim. B
2001	RG-217/U	5/8	7/16



TOOLING DATA

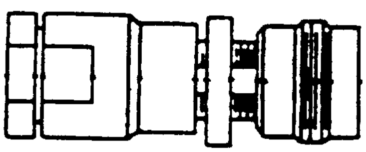
NOT APPLICABLE

STRIPPING DIMENSIONS



2. M39012/49 - CABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, CLASS 2

Dash No.	Applicable Cable M17/	Strip Dim. A	Strip Dim. B
2001	RG-217/U	5/8	7/6



TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

SAME AS M39012/48

B. HARDWARE.

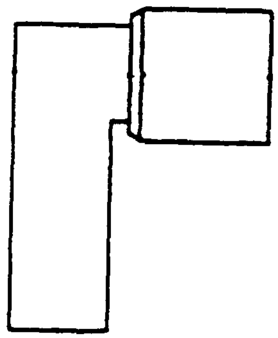
NONE

02301005

Figure 5. Series QM Connectors

CONNECTORS.

1. M39012/88 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

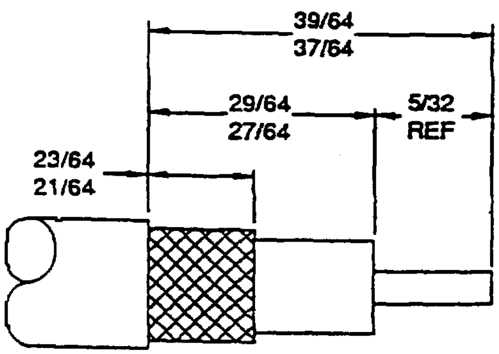
FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

B. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

C. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

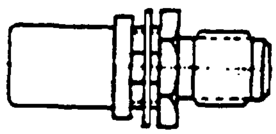
Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	28-RG058 155-00001 84-RG223 167-00001 60-RG142 158-00001	
	0002	29-RG059 30-RG062 90-RG071 110-RG302 97-RG210	
	0003	54-RG122 157-00001	
	0004	111-RG303 170-00001	
C	0010	28-RG058 155-00001 111-RG303 170-00001	B
	0011	84-RG223 167-00001 60-RG142 158-00001	B
	0012	29-RG059 30-RG062 110-RG302 97-RG210	C
	0013	54-RG122 157-00001	A
	0014	90-RG071	C



23010601

Figure 6. Series QNC Connectors (Sheet 1 of 3)

2. M39012/89 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

B. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

C. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A
M22520/5-13 CLOSURE A
M22520/5-59 CLOSURE A

STRIPPING DIMENSIONS

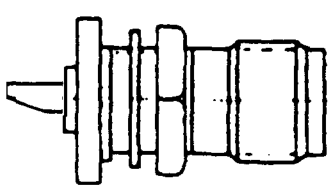
SAME AS M39029/88

MOUNTING HOLE DIMENSIONS

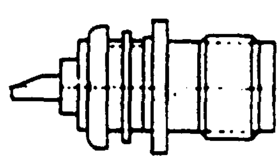
MIN. .750 - MAX . 760

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	28-RG058 155-00001 60-RG142 158-00001 84-RG223 167-00001	
	0002	29-RG059 30-RG062 90-RG071 110-RG302 97-RG210	
	0003	54-RG122 157-00001	
	0004	111-RG303 170-00001	
C	0010	28-RG058 155-00001 111-RG303 170-00001	B
	0011	60-RG142 158-00001 84-RG223 167-00001	B
	0012	29-RG059 30-RG062 110-RG302 97-RG210	C
	0013	54-RG122 157-00001	A
	0014	90-RG071	C

3. M39012/90 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT, FRONT AND REAR MOUNTED, CLASS 2



-0001
FRONT MOUNT



-0002
REAR MOUNT

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.755	.760
0002	.755	.760

TOOLING DATA

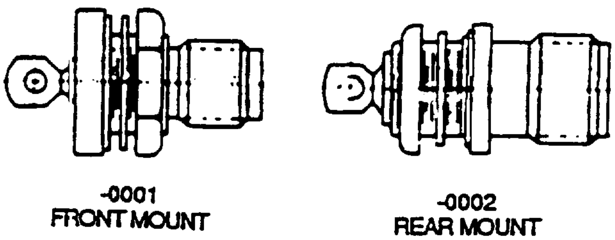
NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

Figure 6. Series QNC Connectors (Sheet 2)

4. M39012/91 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, HERMETIC SEALED JAM NUT, FRONT AND REAR MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.755	.760
0002	.755	.760

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

B. HARDWARE.

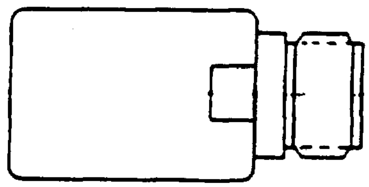
NONE

23010603

Figure 6. Series QNC Connectors (Sheet 3)

A. CONNECTORS.

1. M39012/64 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2

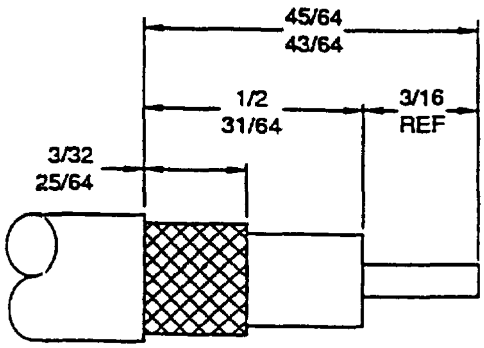


Category	Dash No.	Applicable Cable M17/	Tooling
C	0010	74-213 163-00001	
	0011	75-RG214 164-00001	
	0012	RG225	
	0013	112-RG304 171-00001	
	0014	73-RG212 162-00001	
	0015	6-RG011	
	0016	65-RG165 159-00001	

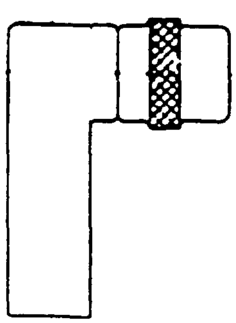
TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH M22520/5-61

STRIPPING DIMENSIONS



2. M39012/84 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61

STRIPPING DIMENSIONS

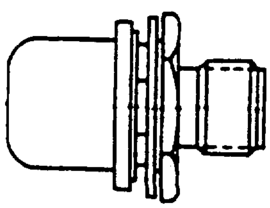
SAME AS M39012/64

23010701

Figure 7. Series QSC Connectors (Sheet 1 of 3)

Category	Dash No.	Applicable Cable M17/	Tooling
C	0013	112-RG304 171-00001	A
	0014	173-RG212 162-00001	A
	0015	74-RG213 163-00001	B
	0016	75-RG214 164-00001	B
	0017	RG225	B
	0018	6-RG011	B
	0019	65-RG165 159-00001	B

3. M39012/85 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT MOUNTED, REAR MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
C	0013	112-RG304 171-00001	A
	0014	173-RG212 162-00001	A
	0015	74-RG213 163-00001	B
	0016	75-RG214 164-00001	B
	0017	RG225	B
	0018	6-RG011	B
	0019	65-RG165 159-00001	B

TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

B. M22520/5-61

STRIPPING DIMENSIONS

SAME AS M39012/64

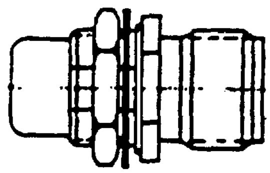
MOUNTING HOLE DIMENSIONS

MIN. .755 - MAX. .760

23010702

Figure 7. Series QSC Connectors (Sheet 2)

4. M39012/86 - CABLED RECEPTACLE, SOCKETCONTACT, JAM NUT MOUNTED, FRONT MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
C	0013	112-RG304 171-00001	A
	0014	173-RG212 162-00001	A
	0015	74-RG213 163-00001	B
	0016	75-RG214 164-00001	B
	0017	RG225	B
	0018	6-RG011	B
	0019	65-RG165 159-00001	B

TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR M22520/5-55 CLOSURE A

B. M22520/5-61

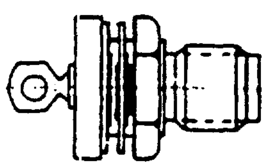
STRIPPING DIMENSIONS

SAME AS M39012/64

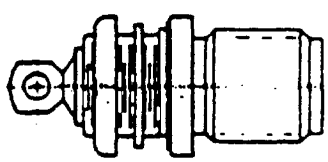
MOUNTING HOLE DIMENSIONS

MIN .755 - MAX .760

5. M39012/87 - UNCABLED RECEPTACLE, SOCKET CONTACT, HERMETIC SEALED, JAM NUT, FRONT AND REAR MOUNTED, CLASS 2



-0001
FRONT MOUNT



-0002
REAR MOUNT

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.755	.760
0002	.755	.760

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

B. HARDWARE.

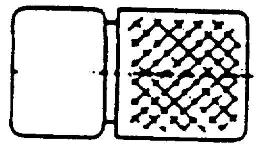
NONE

23010703

Figure 7. Series QSC Connectors (Sheet 3)

A. CONNECTORS.

1. M39012/35 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

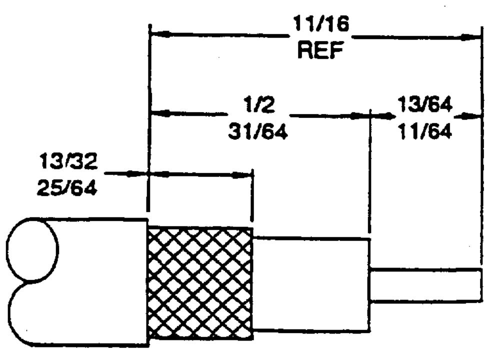
CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-14 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

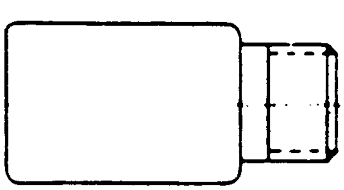
C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS.



Category	Dash No.	Applicable Cable M17/	Tooling
A	0016	73-RG212 112-RG304	
	0017	65-RG165 74-RG213 75-RG214 RG-225/U	
	0018	78-RG217	
	0019	72-RG211	
	0020	79-RG218	
	0021	74-RG215	
	0022	92-RG115	
C	0010	73-RG212 112-RG304	A
	0011	65-RG165 74-RG213	B
	0012	75-RG214 RG-225/U	B
	0013	6RG11 62-RG144	B
	0014	92-RG115	B
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C

2. M39012/36 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-14 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

23010801

Figure 8. Series SC Connectors (Sheet 1 of 6)

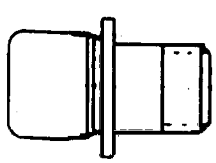
C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/35

Category	Dash No.	Applicable Cable M17/	Tooling
A	0015	65-RG165 74-RG213 75-RG214 RG-225/U	
	0016	73-RG212 112-RG304	
	0017	74-RG215	
	0018	78-RG217	
	0019	72-RG211	
	0020	79-RG218	
	0021	92-RG115	
C	0007	65-RG165 74-RG213	B
	0008	75-RG214 RG-225/U	B
	0009	73-RG212 112-RG304	A
	0010	6RG11 62-RG144	A
	0027	92-RG115	A
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C

3. M39012/38 CABLED RECEPTACLE, SOCKET CONTACT, FLANGE MOUNTED, REAR MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-14 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

23010802

Figure 8. Series SC Connectors (Sheet 2)

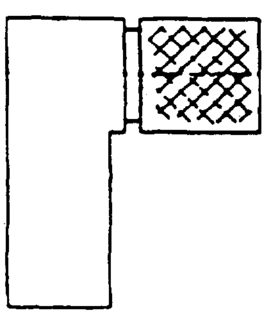
C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/35

Category	Dash No.	Applicable Cable M17/	Tooling
A	0010	65-RG165 74-RG213 75-RG214 RG-225/U	
	0011	73-RG212 112-RG304	
	0012	74-RG215	
	0013	92-RG115	
C	0006	65-RG165 74-RG213	B
	0007	75-RG214 RG-225/U	B
	0008	73-RG212 112-RG304	A
	0018	92-RG115	B
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C

4. M39012/39 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, RIGHT ANGLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	65-RG165 74-RG213 75-RG214 RG-225/U	
	0106	74-RG215	
	0107	92-RG115	
C	0004	65-RG165 74-RG213	
	0005	75-RG214 RG-225/U	
	0009	92-RG115	

23010803

Figure 8. Series SC Connectors (Sheet 3)

TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-13 FERRULE:
M22520/5-01 WITH

A. M22520/5-61 CLOSURE B OR
M22520/5-25 CLOSURE A

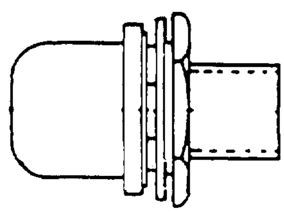
B. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

Category	Dash No.	Applicable Cable M17/	Tooling
D	0501	75-RG214 RG-225/U 127-RG393	
	0502	74-RG213	
	0503	60-RG142 128-RG400	

STRIPPING DIMENSIONS

SAME AS M22520/35

5. M39012/40 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT MOUNTED, REAR MOUNTED CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-14 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE A OR
M22520/5-55 CLOSURE A

B. M22520/5-61 CLOSURE A OR
M22520/5-25 CLOSURE A

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/35

MOUNTING HOLE DIMENSIONS

MIN .760 - MAX .765

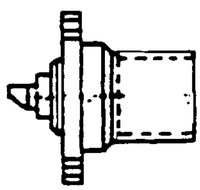
Category	Dash No.	Applicable Cable M17/	Tooling
A	0023	73-RG212 112-RG304	
	0024	65-RG165 74-RG213 75-RG214 RG-225/U	
	0025	74-RG215	
	0026	78-RG217	
	0027	79-RG218	
	0028	92-RG115	
C	0014	73-RG212 112-RG304	A
	0015	65-RG165 74-RG213	B
	0016	75-RG214 RG-225/U	B
	0017	77-RG216	B
	0018	78-RG217	B
	0021	6RG11 62-RG144	B
	0022	92-RG115	B

23010804

Figure 8. Series SC Connectors (Sheet 4)

Category	Dash No.	Applicable Cable M17/	Tooling
D	0501	75-RG214 RG-225/U 127-RG393	B
	0502	74-RG213	B
	0503	60-RG142 128-RG400	C

6. M39012/41 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, FLANGE MOUNT, REAR MOUNTED, CLASS 2



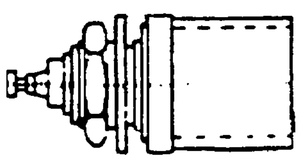
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

7. M39012/42 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, FRONT MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.405	.410

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

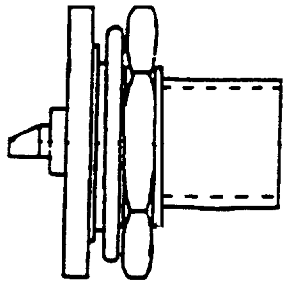
NOT APPLICABLE

8. M39012/43 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, REAR MOUNTED, -0001 PRESSURIZED, -0002 HERMETIC, CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.755	.760
0002	.755	.760

23010805

Figure 8. Series SC Connectors (Sheet 5)



TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

B. HARDWARE

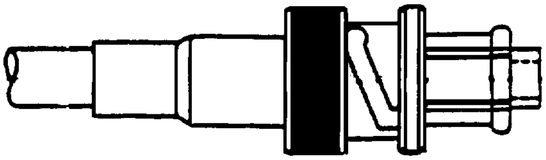
M39012/25 - 0022-FEMALE CONNECTOR CAP
WITH BEAD CHAIN
M29012/25 - 0023 - FEMALE CONNECTOR CAP
WITH SAFETY CHAIN
M39012/25 - 0122 - FEMALE CONNECTOR CAP
WITH WIRE ROPE CHAIN

23010806

Figure 8. Series SC Connectors (Sheet 6)

A. CONNECTORS.

1. M39012/105 - CABLED PLUG, SOCKET CONTACT, HIGH VOLTAGE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

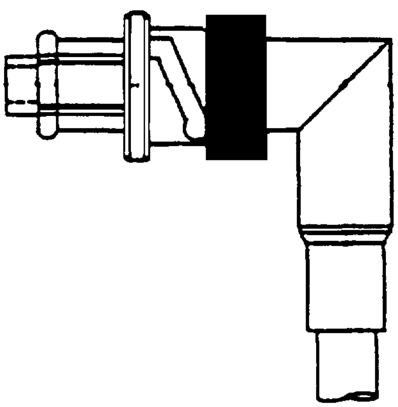
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

2. M39012/106 - CABLED PLUG, SOCKET CONTACT, HIGH VOLTAGE, RIGHT ANGLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

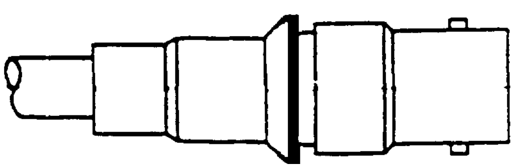
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

3. M39012/107 - CABLED RECEPTACLE PIN CONTACT, HIGH VOLTAGE, CLASS 2



TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

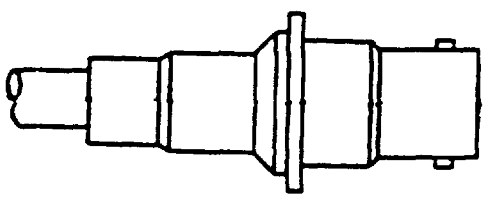
NOT APPLICABLE

23010901

Figure 9. Series SHV Connectors (Sheet 1 of 3)

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

4. M39012/108 - CABLED RECEPTACLE, PIN CONTACT, HIGH VOLTAGE, FLANGE MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

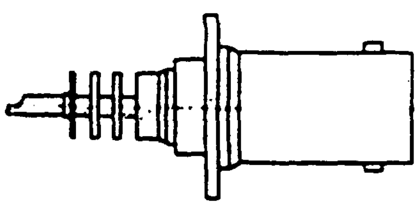
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

5. M39012/109 - CABLED RECEPTACLE, PIN CONTACT, HIGH VOLTAGE, FLANGE MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

TOOLING DATA

NOT APPLICABLE

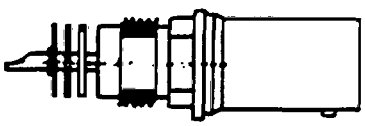
STRIPPING DIMENSIONS

NOT APPLICABLE

23010902

Figure 9. Series SHV Connectors (Sheet 2)

6. M39012/110 - UNCABLED RECEPTACLE, PIN CONTACT, HIGH VOLTAGE, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

NOT APPLICABLE

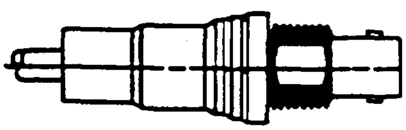
STRIPPING DIMENSIONS

NOT APPLICABLE

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.380	.384
0002	.380	.384

7. M39012/111 - CABLED RECEPTACLE, PIN CONTACT, HIGH VOLTAGE, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	29-RG59 30-RG62 90-RG71 97-RG210	
	0002	29-RG59 30-RG62 90-RG71 97-RG210	

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.505	.510
0002	.505	.510

B. HARDWARE

NONE

23010903

Figure 9. Series SHV Connectors (Sheet 3)

15. **SERIES SM CONNECTORS.** The Series SM connectors are not weatherproof and have been developed for use with coaxial cables of 1/4 inch diameter or smaller. These connectors may be used where electrical matching is not required (Figures 10 thru 12).

16. **SERIES TNC CONNECTORS.** The Series TNC connectors provide low noise levels and optimum stability, and can withstand shock and vibrations often present in hostile environments. These connectors have threaded couplings and provide excellent performance at frequencies up to 7 gigahertz (Figure 13).

17. RF CONNECTOR BUILDUP.

18. **GENERAL PROCEDURES.** Cables with woven or braided outer jackets shall have two wraps of insulating tape placed around the jacket behind the point of stripping.

19. **SOLDERING.** Soldering procedures shall be accomplished in accordance with WP 017 00.

20. **CRIMPING.** Using the tools identified in the connector figures, perform crimping procedures in accordance with WP 013 00.

21. **CABLE STRIPPING.** Using the stripping dimensions from the appropriate connector Figure, strip cable in accordance with WP 009 00.

22. **SERIES BNC CONNECTOR BUILDUP.** To assemble Series BNC connectors perform procedures (Figure 14).

23. **SERIES C CONNECTOR BUILDUP.** To assemble Series C connectors, perform procedures (Figure 15).

24. **SERIES N CONNECTOR BUILDUP.** To assembles Series N connectors, perform procedures (Figure 16).

25. **SERIES QL AND QM CONNECTOR BUILDUP.** To assemble Series QL and QM connectors, perform procedures (Figure 17).

26. **SERIES SC CONNECTOR BUILDUP.** To assemble Series SC connectors, perform procedures (Figure 18).

27. **SERIES SMA CONNECTOR BUILDUP.** To assemble Series SMA connectors, perform procedures (Figure 19).

28. **SERIES SMB CONNECTOR BUILDUP.** To assemble Series SMB connectors, perform procedures (Figure 20).

29. **SERIES SMC CONNECTOR BUILDUP.** To assemble Series SMC connectors, perform procedures (Figure 21).

30. **SERIES TNC CONNECTOR BUILDUP.** To assemble Series TNC connectors, perform procedures (Figure 22).

31. CONNECTOR SEALING.

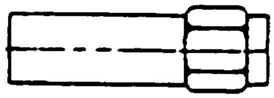
32. **MOISTURE PROOFING.** The preferred method of moisture proofing coaxial connectors is the use of the threaded coupled connectors. The second method is use of the insulating tape. Perform procedures (Figure 23).

33. CLEANING AND PRESERVATION.

34. For connector cleaning and preservation procedures refer to WP 027 00.

A. CONNECTORS.

1. M39012/55 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: SOLDER OR M22520/5-01 WITH M22520/1-15 FERRULE: M22520/5-01 WITH

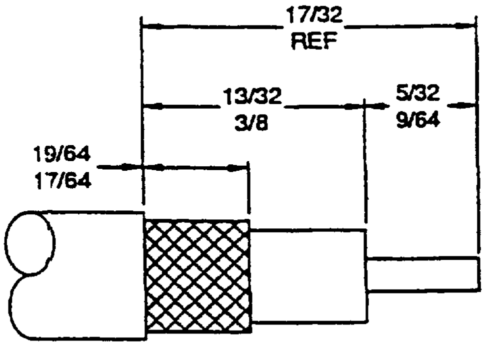
A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520.5-09 CLOSURE A

D. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS



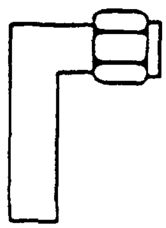
Category	Dash No.	Applicable Cable M17/	Tooling
A	3006 3106 4006 4106	93-RG178 169-00001	
	3007 3107 4007 4107	119-RG174 173-00001 113-RG316 172-00001	
	3008 3108 4008 4108	54-RG122 157-00001	
	3009 3109 4009 4109	28-RG058 60-RG142 84-RG223 155-00001 158-00001 167-00001	
	3010 3110 4010 4110	111-RG303 170-00001	
	3030 3130 4030 4130	152-00001	
C	3025 3125 4025 4125	93-RG178 169-00001	A
	3026 3126 4026 4126	119-RG174 173-00001 113-RG316 172-00001	B
	3027 3127 4027 4127	54-RG122 157-00001	C
	3028 3128 4028 4128	60-RG142 158-00001 167-00001 84-RG223	D
	3029 3129 4029 4129	155-00001 28-RG058 111-RG303 170-00001	D

23011001

Figure 10. Series SMA Connectors (Sheet 1 of 13)

Category	Dash No.	Applicable Cable M17/	Tooling
D	3502 3602 4502 4602	60-RG142 158-00001 128-RG400 175-00001	D

2. M39012/56 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, RIGHT ANGLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	3006 3106 4006 4106	93-RG178 169-00001	
	3007 3107 4007 4107	119-RG174 173-00001 113-RG316 172-00001	
	3008 3108 4008 4108	54-RG122 157-00001	
	3009 3109 4009 4109	28-RG058 60-RG142 84-RG223 155-00001 158-00001 167-00001	
	3010 3110 4010 4110	111-RG303 170-00001	
	3030 3130 4030 4130	152-00001	
C	3025 3125 4025 4125	93-RG178 169-00001	A
	3026 3126 4026 4126	119-RG174 173-00001 113-RG316 172-00001	B

TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: SOLDER OR M22520/1-01 WITH M22520/1-15 FERRULE: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

TOOLING DATA

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

D. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

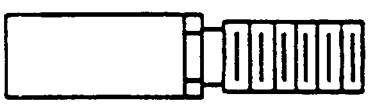
SAME AS M39012/55

23011002

Figure 10. Series SMA Connectors (Sheet 2)

Category	Dash No.	Applicable Cable M17/	Tooling
C (CONT)	3027 3127 4027 4127	54-RG122 157-00001	C
	3028 3128 4028 4128	60-RG142 158-00001 167-00001 84-RG223	D
	3029 3129 4029 4129	155-00001 28-RG058 111-RG303 170-00001	D
D	3502 3602 4502 4602	60-RG142 158-00001 128-RG400 175-00001	D

3. M39012/57 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: SOLDER OR M22520/1-01 WITH M22520/1-15 FERRULE: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

C. M22520/5-41 CLOSURE B, OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

D. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/55

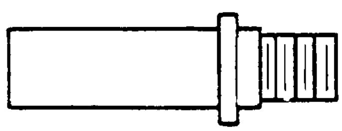
Category	Dash No.	Applicable Cable M17/	Tooling
A	3006 4006	93-RG178 169-00001	
	3007 4007	119-RG174 173-00001 113-RG316 172-00001	
	3008 4008	54-RG122 157-00001	
	3009 4009	28-RG058 60-RG142 84-RG223 155-00001 158-00001 167-00001	
	3010 4010	111-RG303 170-00001	
	3030 4030	152-00001	
C	3025 4025	93-RG178 169-00001	A
	3026 4026	119-RG174 173-00001 113-RG316 172-00001	B

23011003

Figure 10. Series SMA Connectors (Sheet 3)

Category	Dash No.	Applicable Cable M17/	Tooling
C (CONT)	3027 4027	54-RG122 157-00001	C
	3028 4028	60-RG142 158-00001 167-00001 84-RG223	D
	3029 4029	28-RG058 155-00001 111-RG303 170-00001	D
D	3502 4502	60-RG142 158-00001 128-RG400 175-00001	D

4. M39012/58 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, FLANGE MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: SOLDER OR M22520/1-01 WITH M22520/ 1-15 FERRULE: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

C. M22520/5-41 CLOSURE B, OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

D. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/55

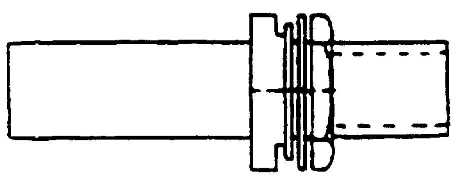
Category	Dash No.	Applicable Cable M17/	Tooling
A	3006 4006	93-RG178 169-00001	
	3007 4007	119-RG174 173-00001 113-RG316 172-00001	
	3008 4008	54-RG122 157-00001	
	3009 4009	28-RG058 60-RG142 84-RG223 155-00001 158-00001 167-00001	
	3010 4010	111-RG303 170-00001	
	3030 4030	152-00001	
C	3025 4025	93-RG178 169-00001	A
	3026 4026	119-RG174 173-00001 113-RG316 172-00001	B

23011004

Figure 10. Series SMA Connectors (Sheet 4)

Category	Dash No.	Applicable Cable M17/	Tooling
C (CONT)	3027 4027	54-RG122 157-00001	C
	3028 4028	60-RG142 158-00001 167-00001 84-RG223	D
	3029 4029	28-RG058 155-00001 111-RG303 170-00001	D
D	3502 4502	60-RG142 158-00001 128-RG400 175-00001	D

5. MS39012/59 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY: SOLDER OR M22520/1-01 WITH M22520/1-15 FERRULE: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B
M22520/5-09 CLOSURE A

D. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A
M22520/5-11 CLOSURE A
M22520/5-57 CLOSURE A

STRIPPING DIMENSIONS

SAME AS M39012/55

Category	Dash No.	Applicable Cable M17/	Tooling
A	3006 4006	93-RG178 169-00001	
	3007 4007	119-RG174 173-00001 113-RG316 172-00001	
	3008 4008	54-RG122 157-00001	
	3009 4009	28-RG058 60-RG142 84-RG223 155-00001 158-00001 167-00001	
	3010 4010	111-RG303 170-00001	
	3030 4030	152-00001	
	3025 4025	93-RG178 169-00001	A
	3026 4026	119-RG174 173-00001 113-RG316 172-00001	B

23011005

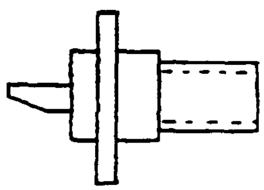
Figure 10. Series SMA Connectors (Sheet 5)

MOUNTING HOLE DIMENSIONS

MIN. .281 - MAX. .285

Category	Dash No.	Applicable Cable M17/	Tooling
C	3027 4027	54-RG122 157-00001	C
	3028 4028	60-RG142 158-00001 167-00001 84-RG223	D
	3029 4029	28-RG058 155-00001 111-RG303 170-00001	D
D	3502 4502	60-RG142 158-00001 128-RG400 175-00001	D

6. M39012/60 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, FLANGE MOUNTED, CLASS 2



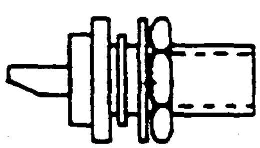
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

7. M39012/61 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
3001	.281	.285
4001	.281	.285

TOOLING DATA

NOT APPLICABLE

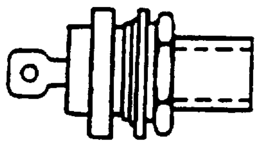
STRIPPING DIMENSIONS

NOT APPLICABLE

23011006

Figure 10. Series SMA Connectors (Sheet 6)

8. M39012/62 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, HERMETIC, CLASS 2.



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
3001	.281	.285
4001	.281	.285

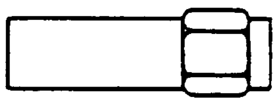
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

9. M39012/79 - CABLED PLUG, PIN CONTACT, SEMIRIGID CABLE



TOOLING DATA

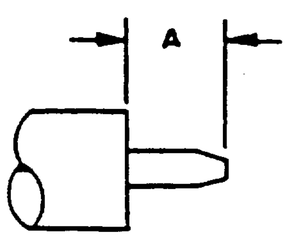
A. OMNI SPECTRA T-200, AMPHENOL 901-2500, OR EQUIVALENT

B. M22520/36-01 WITH M22520/36-02 POSITIONER AND M22520/36-04 OR -18 LOCATOR

C. M22520/36-01 WITH M22520/36-03 POSITIONER AND M22520/36-04 OR -18 LOCATOR

D. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

STRIPPING DIMENSIONS



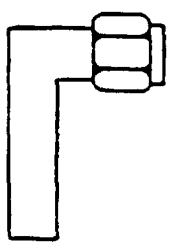
Category	Dash No.	Applicable Cable M17/	Tooling
A	3009 3109 4009 4109	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	
A	3010 3110 4010 4110	130-RG402 130-00001 130-00002 130-00003	
E	3007 3107 4007 4107	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	A
E	3008 3108 4008 4108	130-RG402 130-00001 130-00002 130-00003	A
F	3207 3307 4207 4307	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	B
F	3208 3308 4208 4308	130-RG402 130-00001 130-00002 130-00003	C
F	3210 3310 4210 4310	130-RG402 130-00001 130-00002 130-00003	D

23011007

Figure 10. Series SMA Connectors (Sheet 7)

Cable	Dimension A	
	Min.	Max.
130-RG402 130-00001 130-00002 130-00003	5/64	3/32
133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	1/16	5/64

10. M39012/80 - CABLED PLUG, PIN CONTACT, RIGHT ANGLE, CLASS 2 SEMIRIGID CABLE



TOOLING DATA

A. OMNI SPECTRA T-200, AMPHENOL 901-2500, OR EQUIVALENT

B. M22520/36-01 WITH M22520/36-15 POSITIONER

C. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

STRIPPING DIMENSIONS

SAME AS M39012/79

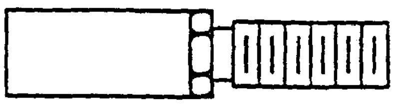
Category	Dash No.	Applicable Cable M17/	Tooling
A	3009 3109 4009 4109	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	
	3010 3110 4010 4110	130-RG402 130-00001 130-00002 130-00003	
E	3007 3107 4007 4107	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	A
	3008 3108 4008 4108	130-RG402 130-00001 130-00002 130-00003	A
F	3207 3307 4207 4307	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	B
	3208 3308 4208 4308	130-RG402 130-00001 130-00002 130-00003	B

23011008

Figure 10. Series SMA Connectors (Sheet 8)

Category	Dash No.	Applicable Cable M17/	Tooling
F (CONT)	3210 3310 4210 4310	130-RG402 130-00001 130-00002 130-00003	C

11. M39012/81 - CABLED PLUG, SOCKET CONTACT, CLASS 2, SEMI RIGID CABLE



TOOLING DATA

A. OMNI SPECTRA T-200, AMPHENOL 901-2500, OR EQUIVALENT

B. M22520/36-01 WITH M22520/36-02 POSITIONER AND M22520/36-05 OR -17 LOCATOR

C. M22520/36-01 WITH M22520/36-03 POSITIONER AND M22520/36-05 OR -17 LOCATOR

D. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

STRIPPING DIMENSIONS

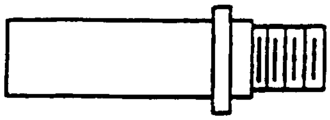
SAME AS M39012/79

Category	Dash No.	Applicable Cable M17/	Tooling
A	3009 4009	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	
	3010 4010	130-RG402 130-00001 130-00002 130-00003	
E	3007 4007	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	A
	3008 4008	130-RG402 130-00001 130-00002 130-00003	A
F	3207 4207	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	B
	3208 4208	130-RG402 130-00001 130-00002 130-00003	C
	3210 4210	130-RG402 130-00001 130-00002 130-00003	D

23011009

Figure 10. Series SMA Connectors (Sheet 9)

12. M39012/82 - CABLED RECEPTACLE, SOCKET CONTACT, FLANGE MOUNTED, CLASS 2, SEMIRIGID CABLE



TOOLING DATA

A. OMNI SPECTRA T-200, AMPHENOL 901-2500, OR EQUIVALENT

B. M22520/36-01 WITH M22520/36-02 POSITIONER AND M22520/36-05 OR -17 LOCATOR

C. M22520/36-01 WITH M22520/36-03 POSITIONER AND M22520/36-05 OR -17 LOCATOR

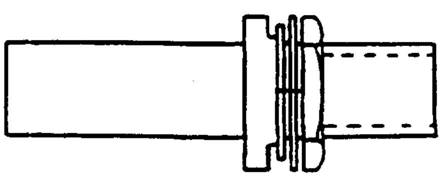
D. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

STRIPPING DIMENSIONS

SAME AS M39012/79

Category	Dash No.	Applicable Cable M17/	Tooling
A	3009 4009	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	
	3010 4010	130-RG402 130-00001 130-00002 130-00003	
E	3007 4007	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	A
	3008 4008	130-RG402 130-00001 130-00002 130-00003	A
F	3207 4207	133-RG405	B
	3208 4208	130-RG402	C
	3210 4210	130-RG402	D

13. M39012/83 - CABLED RECEPTACLE, SOCKET CONTACT, JAM NUT MOUNTED, CLASS 2, SEMIRIGID CABLE



TOOLING DATA

A. OMNI SPECTRA T-200, AMPHENOL 901-2500, OR EQUIVALENT

B. M22520/36-01 WITH M22520/36-02 POSITIONER AND M22520/36-05 OR -17 LOCATOR

Category	Dash No.	Applicable Cable M17/	Tooling
A	3009 4009	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	
	3010 4010	130-RG402 130-00001 130-00002 130-00003	

23011010

Figure 10. Series SMA Connectors (Sheet 10)

C. M22520/36-01 WITH M22520/36-03 POSITIONER AND M22520/36-05 OR -17 LOCATOR

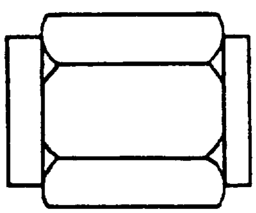
D. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

STRIPPING DIMENSIONS

SAME AS M39012/79

Category	Dash No.	Applicable Cable M17/	Tooling
E	3007 4007	133-RG405 133-00001 133-00002 133-00003 133-00004 133-00005	A
	3008 4008	130-RG402 130-00001 130-00002 130-00003	A
F	3207 4207	133-RG405	B
	3208 4208	130-RG402	C
	3210 4310	130-RG402	D

14. M39012/92 - CABLED PLUG, WITHOUT CONTACT, CLASS 2, 9/64 IN. SEMIRIGID CABLE.



TOOLING DATA

A. STANDARD ASSEMBLY TOOL KIT

B. M22520/36-01 WITH M22520/36-03 POSITIONER AND M22520/36-06 OR -16 LOCATOR

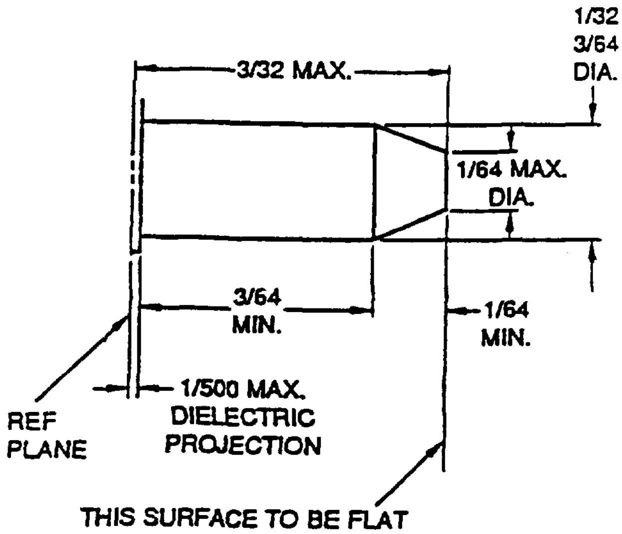
C. M22520/5-01 WITH M22520/5-05 CLOSURE B OR M22520/5-41 CLOSURE B

Category	Dash No.	Applicable Cable M17/	Tooling
A	3002 3102 4002 4102	130-RG402 130-00001 130-00002 130-00003	
E	3003 3103 4003 4103	130-RG402 130-00001 130-00002 130-00003	A
F	3201 3301 4201 4301	130-RG402 130-00001 130-00002 130-00003	B
	3202 3302 4202 4302	130-RG402 130-00001 130-00002 130-00003	C

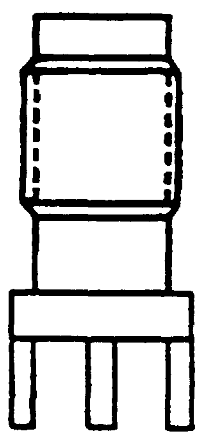
23011011

Figure 10. Series SMA Connectors (Sheet 11)

STRIPPING DIMENSIONS



15. M39012/93 - UNCABLED RECEPTACLE, SOCKET CONTACT, PRINTED CIRCUIT, CLASS 2



TOOLING DATA

NOT APPLICABLE

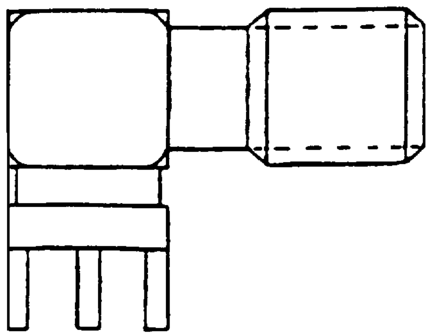
STRIPPING DIMENSIONS

NOT APPLICABLE

23011012

Figure 10. Series SMA Connectors (Sheet 12)

16. M39012/94 - UNCABLED RECEPTACLE, SOCKET CONTACT, PRINTED CIRCUIT, RIGHT ANGLE, CLASS 2



STRIPPING DIMENSIONS

NOT APPLICABLE

TOOLING DATA

NOT APPLICABLE

B. HARDWARE.

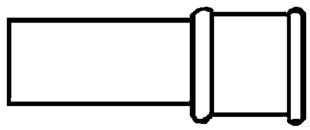
M39012/25 - 0024 - FEMALE CONNECTOR CAP WITH BEAD CHAIN
M39012/25 - 0025 - FEMALE CONNECTOR CAP WITH SAFETY CHAIN
M39012/25 - 0026 - MALE CONNECTOR PLUG WITH BEAD CHAIN
M39012/25 - 0027 - MALE CONNECTOR PLUG WITH SAFETY CHAIN
M39012/25 - 0124 - FEMALE CONNECTOR CAP WITH WIRE ROPE
M39012/25 - 0126 - MALE CONNECTOR PLUG WITH WIRE ROPE

23011013

Figure 10. Series SMA Connectors (Sheet 13)

A. CONNECTORS.

1. M39012/67 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



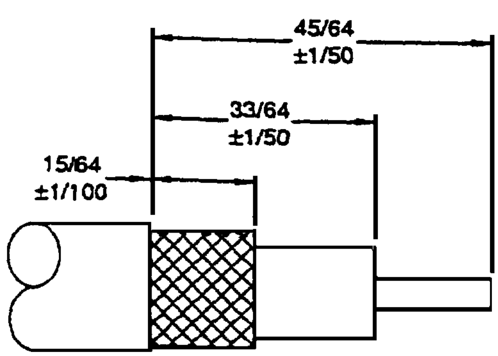
TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

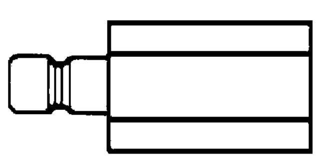
B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0016	93-RG178 169-00001	A
	0017	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

2. M39012/68 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	

23011101

Figure 11. Series SMB Connectors (Sheet 1 of 4)

TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

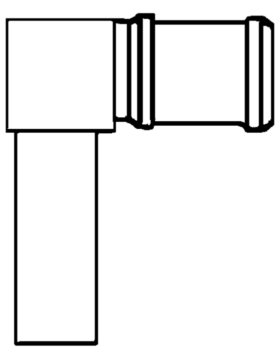
B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

STRIPPING DIMENSIONS

SAME AS M39012/67

Category	Dash No.	Applicable Cable M17/	Tooling
A (CONT)	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0016	93-RG178 169-00001	A
	0017	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

3. M39012/69 - CABLED PLUG, SOCKET CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

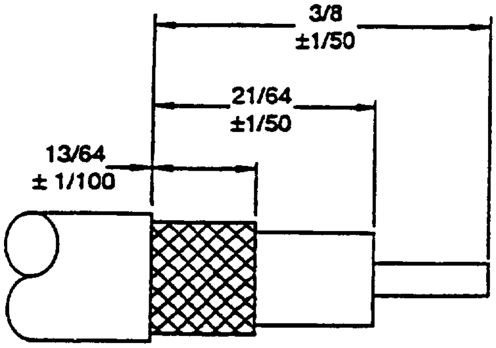
B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

23011102

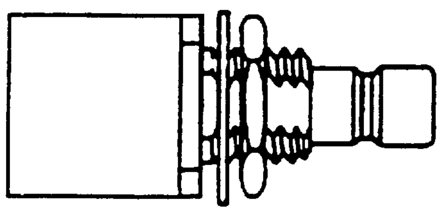
Figure 11. Series SMB Connectors (Sheet 2)

STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
C (CONT)	0016	93-RG178 169-00001	A
	0017	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

4. M39012/70 - CABLED PLUG, PIN CONTACT, JAM NUT MOUNTED, REAR MOUNTED, CLASS 2



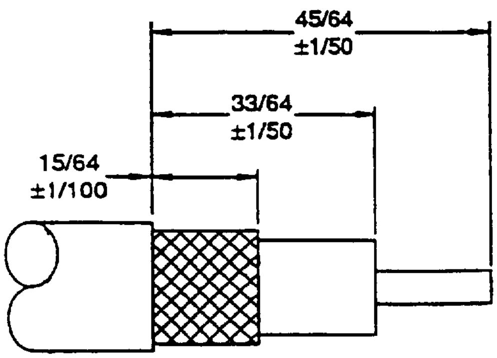
TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

STRIPPING DIMENSIONS



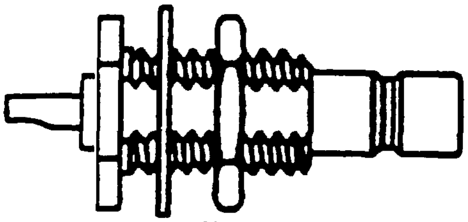
Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0016	93-RG178 169-00001	A
	0017	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

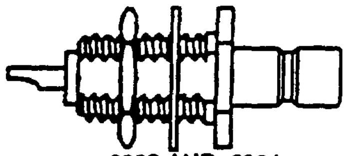
23011103

Figure 11. Series SMB Connectors (Sheet 3)

5. M39012/71 - UNCABLED RECEPTACLE, PIN CONTACT, SOLDER TYPE, JAM NUT MOUNTED, -0001 AND -0003 REAR MOUNTED, -0002 AND -0004 FRONT MOUNTED, CLASS 2

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.192	.197
0002	.192	.197
0003	.192	.197
0004	.192	.197





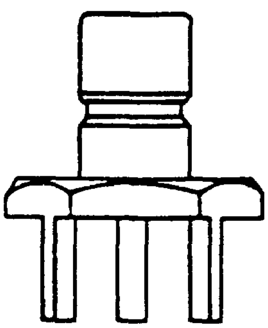
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

6. M39012/95 - UNCABLED RECEPTACLE, PIN CONTACT, PRINTED CIRCUIT, CLASS 2



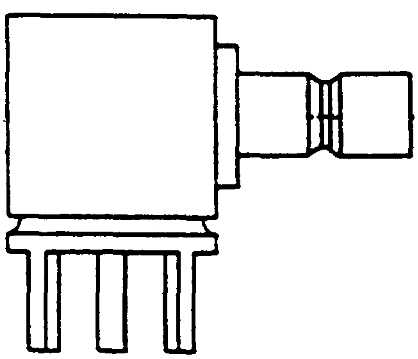
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

7. M39012/96 - UNCABLED RECEPTACLE, PIN CONTACT, PRINTED CIRCUIT, RIGHT ANGLE, CLASS 2



TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

8. HARDWARE.

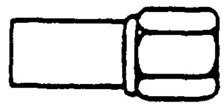
NONE

23011104

Figure 11. Series SMB Connectors (Sheet 4)

A. CONNECTORS.

1. M39012/73 - CABLED PLUG, SOCKET CONTACT, CLASS 2



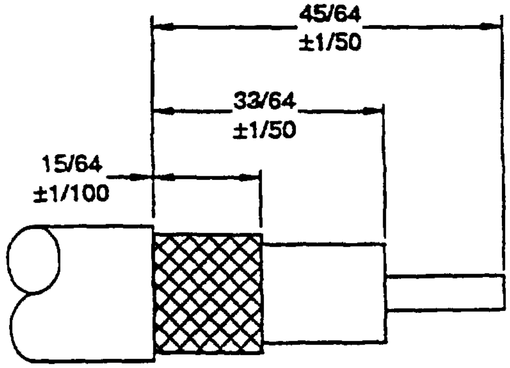
TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

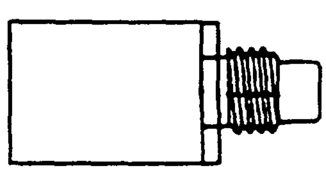
B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0016	93-RG178 169-00001	A
	0017	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

2. M39012/74 - CABLED PLUG, PIN CONTACT, CLASS 2



TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	

23011201

Figure 12. Series SMC Connectors (Sheet 1 of 4)

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

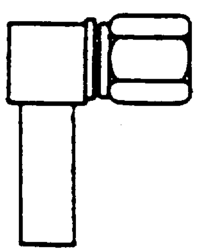
C. M22520/5-41 CLOSURE B OR M22520/5-05 CLOSURE B. M22520/5-09 CLOSURE A.

STRIPPING DIMENSIONS

SAME AS M39012/73

Category	Dash No.	Applicable Cable M17/	Tooling
A (CONT)	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0105	95-RG180	
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0013	95-RG180	C
	0017	93-RG178 169-00001	A
	0018	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

3. M39012/75 - CABLED PLUG, SOCKET CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR M22520/5-03 CLOSURE B.

B. M22520/5-35 CLOSURE B OR M22520/5-03 CLOSURE A.

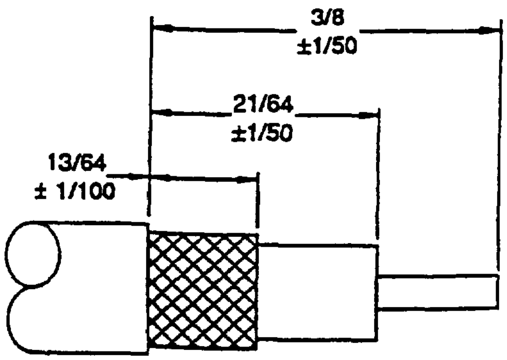
Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0105	95-RG180	

23011202

Figure 12. Series SMC Connectors (Sheet 2)

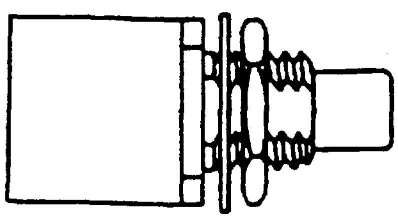
C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

STRIPPING DIMENSIONS



Category	Dash No.	Applicable Cable M17/	Tooling
C	0011	93-RG178 169-00001	A
	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0013	95-RG180	C
	0017	93-RG178 169-00001	A
	0018	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

4. M39012/76 - CABLED RECEPTACLE, PIN CONTACT, JAM NUT MOUNTED, REAR MOUNTED, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0003	93-RG178 169-00001	
	0004	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0103	93-RG178 169-00001	
	0104	119-RG174 173-00001 113-RG316 172-00001 94-RG179	
	0105	95-RG180	
C	0011	93-RG178 169-00001	A

TOOLING DATA

FOR CATEGORY C ONLY: M22520/5-01 WITH

A. M22520/5-33 CLOSURE B OR
M22520/5-03 CLOSURE B.

B. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

STRIPPING DIMENSIONS

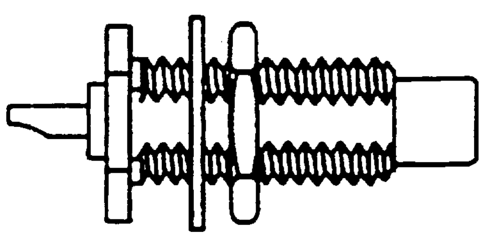
SAME AS M39012/75

23011203

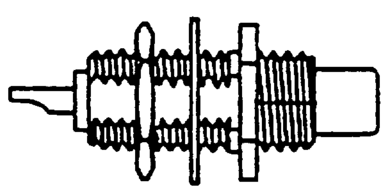
Figure 12. Series SMC Connectors (Sheet 3)

Category	Dash No.	Applicable Cable M17/	Tooling
C (CONT)	0012	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B
	0013	95-RG180	C
	0017	93-RG178 169-00001	A
	0018	119-RG174 173-00001 113-RG316 172-00001 94-RG179	B

5. M39012/77 - UNCABLED RECEPTACLE, PIN CONTACT, SOLDER TYPE, JAM NUT MOUNTED, -0001 AND -0003 REAR MOUNTED, -0002 AND -0004 FRONT MOUNTED, CLASS 2.



-0001 AND -0003



-0002 AND -0004

Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.192	.197
0002	.192	.197
0003	.192	.197
0004	.192	.197

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

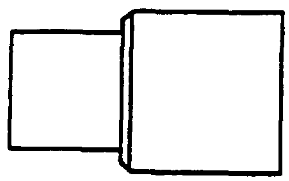
NOT APPLICABLE

23011204

Figure 12. Series SMC Connectors (Sheet 4)

A. CONNECTORS.

1. M39012/26 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:
M22520/5-01 WITH

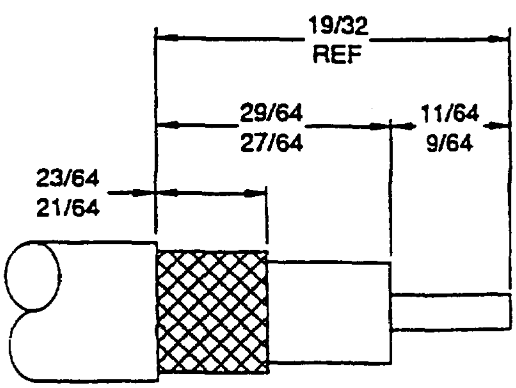
A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A.
M22520/5-11 CLOSURE A.
M22520/5-57 CLOSURE A.

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A.
M22520/5-13 CLOSURE A.
M22520/5-59 CLOSURE A.

STRIPPING DIMENSIONS

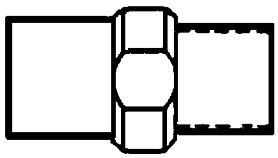


Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0102	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0104	111-RG303	
	0117	110-RG302	
	0018	113-RG316 119-RG174	
C	0010	28-RG058 111-RG303	C
	0011	84-RG223 128-RG400 60-RG142	C
	0012	29-RG59 30-RG062 97-RG210	D
	0013	054-RG122	B
	0014	90-RG71	C
	0021	110-RG302	C
	0022	113-RG316 119-RG174	A
	0023	95-RG180	B
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23011301

Figure 13. Series TNC Connectors (Sheet 1 of 9)

2. M39012/27 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A.
M22520/5-11 CLOSURE A.
M22520/5-57 CLOSURE A.

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A.
M22520/5-13 CLOSURE A.
M22520/5-59 CLOSURE A.

STRIPPING DIMENSIONS

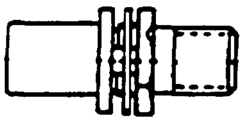
SAME AS M39012/26

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0002	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0104	111-RG303	
	0117	110-RG302	
	0018	113-RG316 119-RG174	
C	0010	28-RG058 111-RG303	C
	0011	84-RG223 128-RG400 60-RG142	C
	0012	29-RG59 30-RG062 97-RG210	D
	0013	54-RG122	B
	0014	90-RG71	D
	0021	110-RG302	D
	0022	113-RG316 119-RG174	A
	0023	95-RG180	B
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG58	C

23011302

Figure 13. Series TNC Connectors (Sheet 2)

3. M39012/28 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, JAM NUT MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:

A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A.
M22520/5-11 CLOSURE A.
M22520/5-57 CLOSURE A.

D. M22520/50-19 CLOSURE A OR
M22520/5-07 CLOSURE A.
M22520/5-13 CLOSURE A.
M22520/5-59 CLOSURE A.

STRIPPING DIMENSIONS

SAME AS M39012/26

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0102	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0104	111-RG303	
	0117	110-RG302	
	0018	113-RG316 119-RG174	
C	0010	28-RG058 111-RG303	C
	0011	84-RG223 128-RG400 60-RG142	C
	0012	29-RG59 30-RG062 97-RG210	D
	0013	54-RG122	B
	0014	90-RG71	D
	0021	110-RG302	D
	0022	113-RG316 119-RG174	A
	0023	95-RG180	B
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG58	C

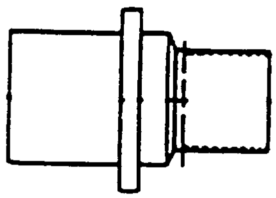
MOUNTING HOLE DIMENSIONS

MIN .505 - MAX .510

23011303

Figure 13. Series TNC Connectors (Sheet 3)

4. M39012/29 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, FLANGE MOUNTED, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:

A. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A.
M22520/5-11 CLOSURE A.
M22520/5-57 CLOSURE A.

B. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A.
M22520/5-13 CLOSURE A.
M22520/5-59 CLOSURE A.

C. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

D. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

STRIPPING DIMENSIONS

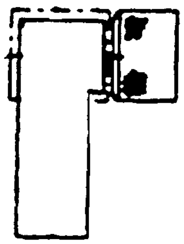
SAME AS M39012/26

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0102	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0104	111-RG303	
	0117	110-RG302	
	0018	113-RG316 119-RG174	
C	0010	28-RG058 111-RG303	A
	0011	84-RG223 128-RG400 60-RG142	A
	0012	29-RG59 30-RG062 97-RG210	B
	0013	54-RG122	C
	0014	90-RG71	B
	0021	110-RG302	B
	0022	113-RG316 119-RG174	C
D	0501	54-RG122	C
	0502	95-RG180	C
	0503	60-RG142 128-RG400	A
	0504	28-RG058	A

23011304

Figure 13. Series TNC Connectors (Sheet 4)

5. M39012/30 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, RIGHT ANGLE, CLASS 2



TOOLING DATA

CENTER CONTACT CATEGORY D ONLY:
M22520/1-01 WITH M22520/1-12 FERRULE:
M22520/5-01 WITH

A. M22520/5-35 CLOSURE B OR
M22520/5-03 CLOSURE A.

B. M22520/5-41 CLOSURE B OR
M22520/5-05 CLOSURE B.
M22520/5-09 CLOSURE A.

C. M22520/5-19 CLOSURE B OR
M22520/5-05 CLOSURE A.
M22520/5-11 CLOSURE A.
M22520/5-57 CLOSURE A.

D. M22520/5-19 CLOSURE A OR
M22520/5-07 CLOSURE A.
M22520/5-13 CLOSURE A.
M22520/5-59 CLOSURE A.

STRIPPING DIMENSIONS

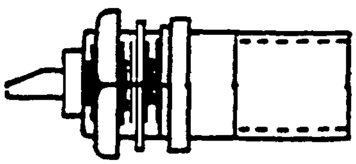
SAME AS M39012/26

Category	Dash No.	Applicable Cable M17/	Tooling
A	0101	28-RG058 84-RG223 128-RG400 60-RG142	
	0102	29-RG59 30-RG062 90-RG71 97-RG210	
	0103	54-RG122	
	0104	111-RG303	
	0117	110-RG302	
	0118	113-RG316 119-RG174	
C	0010	28-RG058 111-RG303	C
	0011	84-RG223 128-RG400 60-RG142	C
	0012	29-RG59 30-RG062 97-RG210	D
	0013	54-RG122	B
	0014	90-RG71	D
	0021	110-RG302	D
	0022	113-RG316 119-RG174	A
D	0501	54-RG122	B
	0502	95-RG180	B
	0503	60-RG142 128-RG400	C
	0504	28-RG058	C

23011305

Figure 13. Series TNC Connectors (Sheet 5)

6. M39012/31 - UNCABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, JAM NUT MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.439	.443
0002	.380	.384
0003	.439	.443

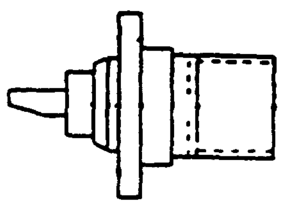
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

7. M39012/32 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, FLANGE MOUNTED, CLASS 2



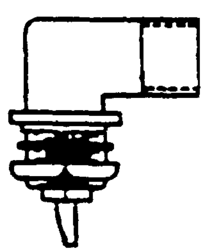
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

8. M39012/33 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, JAM NUT MOUNTED, RIGHT ANGLE, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.380	.394
0002	.439	.443

TOOLING DATA

NOT APPLICABLE

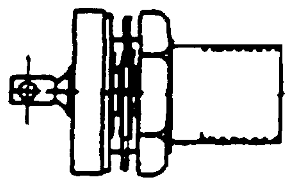
STRIPPING DIMENSIONS

NOT APPLICABLE

23011306

Figure 13. Series TNC Connectors (Sheet 6)

9. M39012/34 - UNCABLED RECEPTACLE, SOCKET CONTACT, SOLDER TYPE, HERMETIC SEALED, JAM NUT MOUNTED, CLASS 2



Dash No.	Mounting Hole Dia. (Inches)	
	Min.	Max.
0001	.505	.510
0002	.380	.384

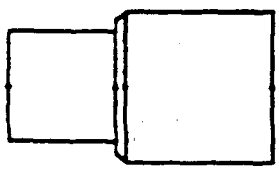
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

10. M39012/112 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, SEMIRIGID CABLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	130-RG402	
	0002	129-RG401	

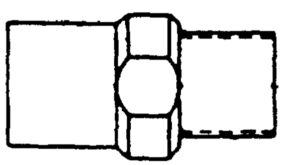
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

11. M39012/113 - CABLED PLUG, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, SEMIRIGID CABLE, CLASS 2.



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	130-RG402	
	0002	129-RG401	

TOOLING DATA

NOT APPLICABLE

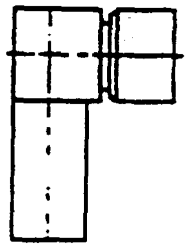
STRIPPING DIMENSIONS

NOT APPLICABLE

23011307

Figure 13. Series TNC Connectors (Sheet 7)

12. M39012/114 - CABLED PLUG, PIN CONTACT, CAPTIVATED CENTER CONTACT, SEMIRIGID CABLE, RIGHT ANGLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	130-RG402	
	0002	129-RG401	

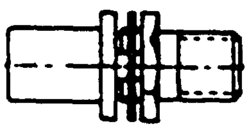
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

13. M39012/115 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, JAM NUT MOUNTED, SEMIRIGID CABLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	130-RG402	
	0002	129-RG401	

MOUNTING HOLE DIMENSIONS

MIN. .493 - MAX. .500

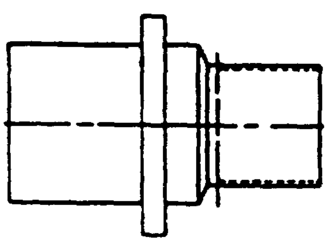
TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

14. M39012/116 - CABLED RECEPTACLE, SOCKET CONTACT, CAPTIVATED CENTER CONTACT, FLANGE MOUNTED, SEMIRIGID CABLE, CLASS 2



Category	Dash No.	Applicable Cable M17/	Tooling
A	0001	130-RG402	
	0002	129-RG401	

TOOLING DATA

NOT APPLICABLE

STRIPPING DIMENSIONS

NOT APPLICABLE

23011308

Figure 13. Series TNC Connectors (Sheet 8)

B. HARDWARE

M39012/25 - 0018 - MALE CONNECTOR CAP
WITH BEAD CHAIN
M39012/25 - 0019 - MALE CONNECTOR CAP
WITH SAFETY CHAIN
M39012/25 - 0020 - FEMALE CONNECTOR CAP
WITH BEAD CHAIN
M39012/25 - 0021 - FEMALE CONNECTOR CAP
SAFETY CHAIN
M39012/25 - 0118 - MALE CONNECTOR CAP
WITH WIRE ROPE
M39012/25 - 0120 - FEMALE CONNECTOR CAP
WITH WIRE ROPE

23011309

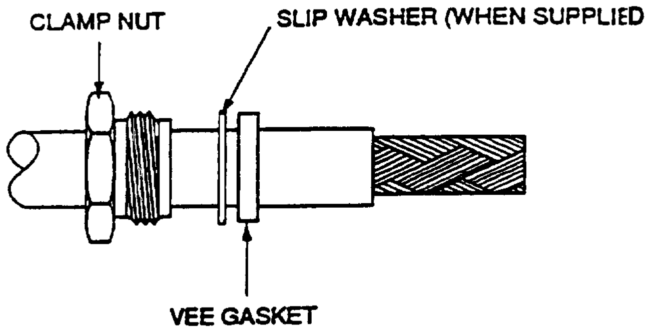
Figure 13. Series TNC Connectors (Sheet 9)

A. STRAIGHT CLAMP CONNECTORS, CATEGORY A.

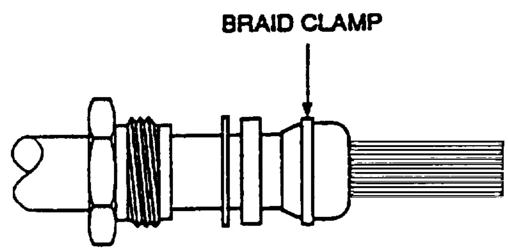
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

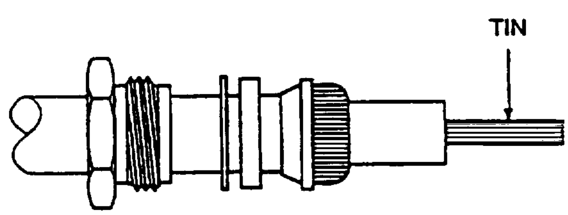
1. CUT CABLE END SQUARE, IF REQUIRED. PLACE INSULATING TAPE ON CABLE. SLIDE CLAMP NUT, SLIP WASHER, AND GASKET OVER CABLE. STRIP CABLE JACKET TO DIMENSION (FIGURE 1).



2. COMB OUT BRAID AND TAPER FORWARD. PLACE BRAID CLAMP OVER BRAID AND BUTT AGAINST JACKET.



3. UNIFORMLY FOLD BRAID BACK OVER BRAID CLAMP AND TRIM FLUSH WITH CLAMP SHOULDER. STRIP CENTER CONDUCTOR TO DIMENSION (FIGURE 1).
4. TIN CENTER CONDUCTOR.

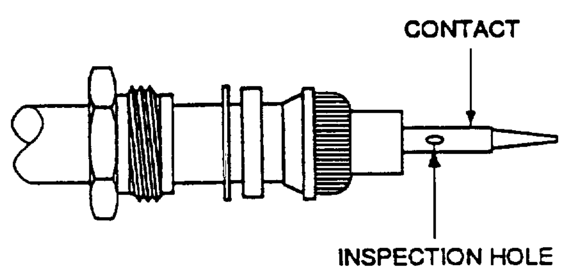


5. INSERT TINNED CONDUCTOR INTO CONTACT UNTIL IT BUTTS AGAINST DIELECTRIC. CONDUCTOR MUST BE VISIBLE THROUGH INSPECTION HOLE.

CAUTION

EXCESSIVE HEAT COULD DAMAGE DIELECTRIC.

6. SOLDER CONTACT TO CENTER CONDUCTOR.



23011401

Figure 14. Series BNC Connector Buildup (Sheet 1 of 5)

7. INSTALL CONNECTOR ON CABLE UNTIL IT BOTTOMS. ENSURE GASKET IS PROPERLY SEATED ON BRAID CLAMP.

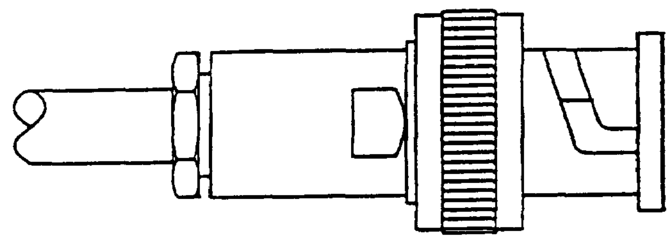
NOTE

HOLD CONNECTOR BODY STATIONARY WHILE TIGHTENING NUT.

8. IF APPLICABLE, REMOVE INSULATING TAPE. TIGHTEN NUT AND TORQUE TO VALVE FOR PROPER CABLE GROUP.

CABLE GROUP (RG/U)	TORQUE IN (IN/LBS)
55, 58, 59, 62, 71, 140, 141, 142, 210	10-15
161, 178	
8, 9, 115, 213, 214, 225	35-45

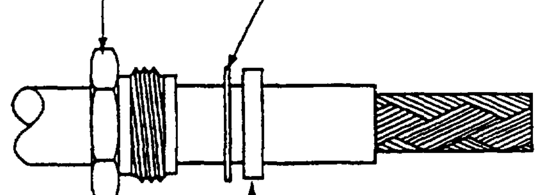
9. COMPLETED ASSEMBLY.



B. RIGHT ANGLE CLAMP CONNECTOR, CATEGORY A.

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

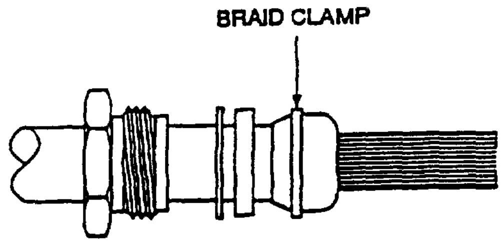


1. CUT CABLE END SQUARE, IF REQUIRED. PLACE INSULATING TAPE ON CABLE. SLIDE CLAMP NUT, SLIP WASHER, AND GASKET OVER CABLE. STRIP CABLE JACKET TO DIMENSION (FIGURE 1).

23011402

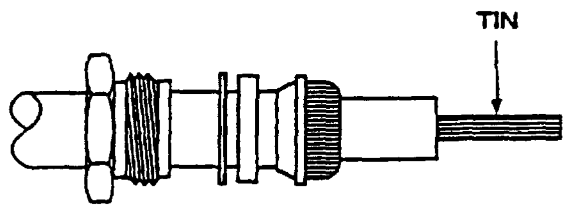
Figure 14. Series BNC Connector Buildup (Sheet 2)

2. COMB OUT BRAID AND TAPER FORWARD. PLACE BRAID CLAMP OVER BRAID AND BUTT AGAINST JACKET.



3. UNIFORMLY FOLD BRAID BACK OVER BRAID CLAMP AND TRIM FLUSH WITH CLAMP SHOULDER. STRIP CENTER CONDUCTOR TO DIMENSION (FIGURE 1).

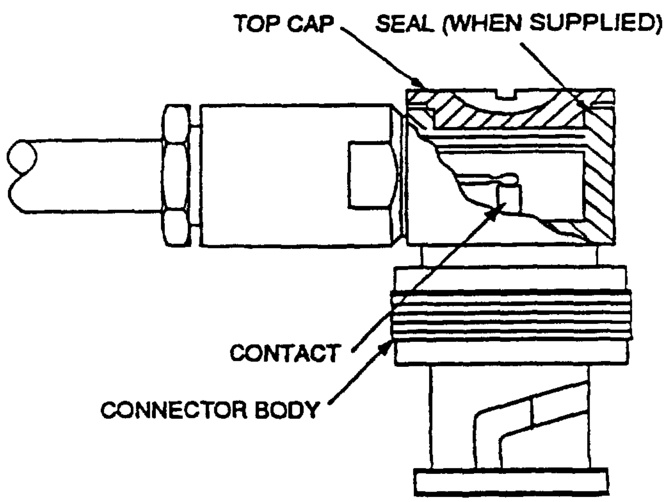
4. TIN CENTER CONDUCTOR.



5. INSTALL CONNECTOR ON CABLE UNTIL IT BOTTOMS. ENSURE GASKET IS PROPERLY SEATED ON BRAID CLAMP.

6. HAND TIGHTEN CLAMP NUT.

7. REMOVE TOP CAP. SOLDER CENTER CONDUCTOR TO CONTACT.



NOTE

HOLD CONNECTOR STATIONARY WHILE TIGHTENING NUT.

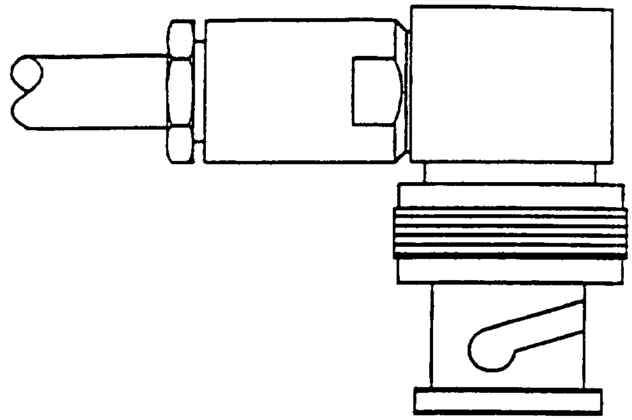
8. TIGHTEN NUT AND TORQUE TO VALVE FOR PROPER CABLE GROUP.

CABLE GROUP (RG/U)	TORQUE IN (IN/LBS)
161, 178	15-25

23011403

Figure 14. Series BNC Connector Buildup (Sheet 3)

9. INSPECT SOLDER JOINT AND INSTALL TOP CAP.



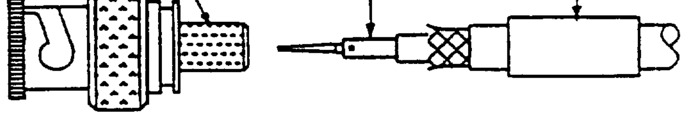
C. CRIMP FERRULE CONNECTOR, CATEGORY C AND D.

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. SLIDE FERRULE ONTO CABLE.
2. STRIP CABLE TO DIMENSIONS FOR APPROPRIATE CONNECTOR (FIGURE 1). FLARE BRAID.

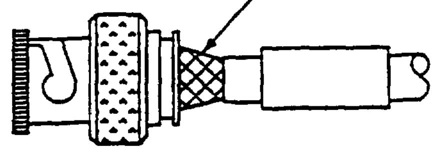
3. CRIMP CONTACT AND INSERT CONTACT INTO CONNECTOR WITH BRAID OVER SUPPORT SLEEVE.



23011404

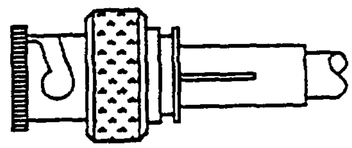
Figure 14. Series BNC Connector Buildup (Sheet 4)

4. ENSURE BRAID IS OVER SUPPORT SLEEVE.



5. SLIDE FERRULE OVER BRAID AND SUPPORT SLEEVE.

6. USING CRIMPING TOOL FOR APPROPRIATE CONNECTOR (FIGURE 1), CRIMP FERRULE.



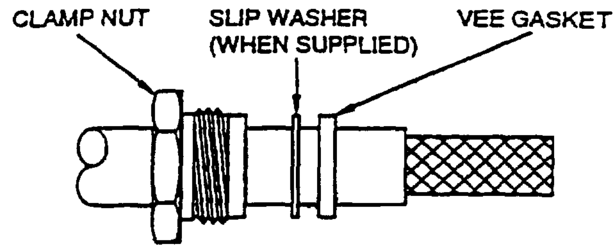
23011405

Figure 14. Series BNC Connector Buildup (Sheet 5)

A. STRAIGHT CONNECTOR, CATEGORY A.

WARNING

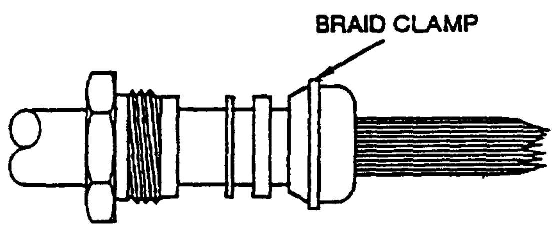
EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.



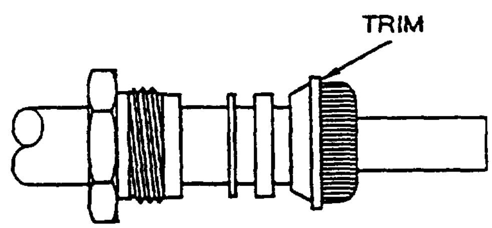
1. TRIM CABLE END SQUARE, PLACE CLAMP NUT, WASHER, AND GASKET WITH GROOVE FACING CONNECTOR OVER OUTER CABLE JACKET.

2. STRIP OUTER CABLE JACKET TO DIMENSION (FIGURE 2).

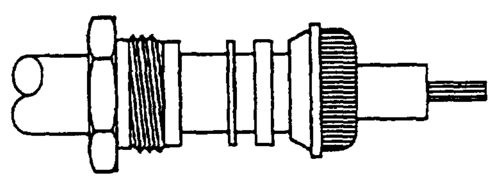
3. COMB OUT BRAID AND TAPER FORWARD. PLACE BRAID CLAMP OVER BRAID AND AGAINST JACKET SHOULDER.



4. FOLD COMBED OUT BRAID OVER BRAID CLAMP AND TRIM.



5. STRIP DIELECTRIC AND CENTER CONDUCTOR TO DIMENSIONS (FIGURE 2).



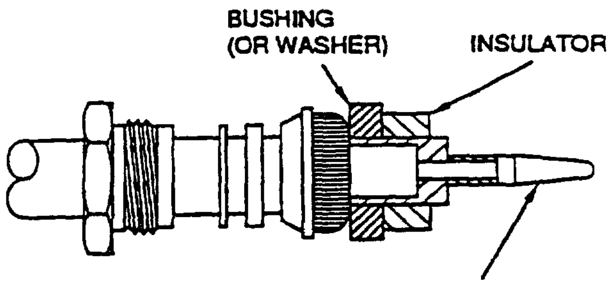
23011501

Figure 15. Series C Connector Buildup (Sheet 1 of 2)

6. PLACE BUSHING OR WASHER AND REAR INSULATOR OR DIELECTRIC BUSHING OVER CABLE DIELECTRIC.

7. TIN CENTER CONDUCTOR.

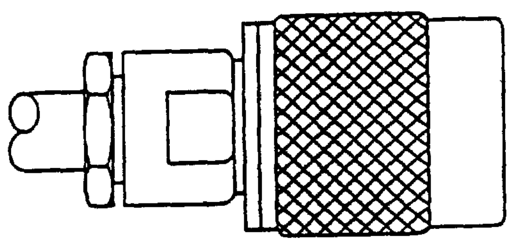
8. PLACE CONTACT ON CENTER CONDUCTOR SO IT BUTTS AGAINST DIELECTRIC SHOULDER OR BUSHING. CENTER CONDUCTOR SHALL BE VISIBLE THROUGH INSPECTION HOLE. SOLDER CONTACT TO CONDUCTOR.



NOTE

HOLD CONNECTOR BODY STATIONARY WHILE TIGHTENING NUT.

9. INSERT CABLE INTO CONNECTOR BODY UNTIL IT BOTTOMS. SLIDE GASKET, WASHER, AND CLAMP NUT FORWARD. HAND TIGHTEN, THEN TORQUE TO 55 ± 5 IN/LBS.



23011502

Figure 15. Series C Connector Buildup (Sheet 2)

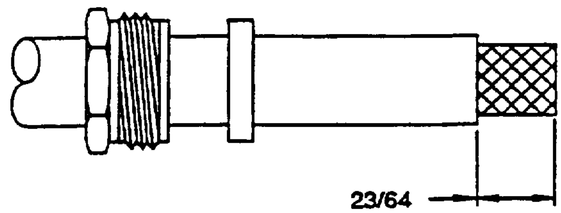
A. STRAIGHT CONNECTOR, CATEGORY A.

WARNING

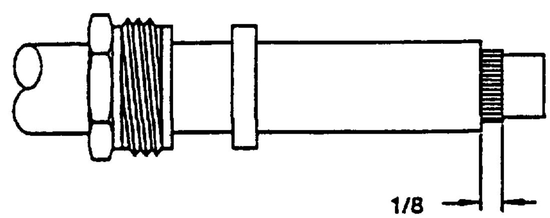
EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. CUT END OF CABLE SQUARE. PLACE NUT AND GASKET, WITH V-GROOVE TOWARD CLAMP OVER CABLE.

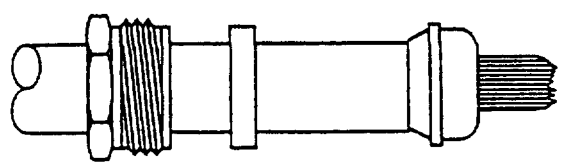
2. STRIP CABLE TO DIMENSIONS JACKET 23/64 INCH FROM END.



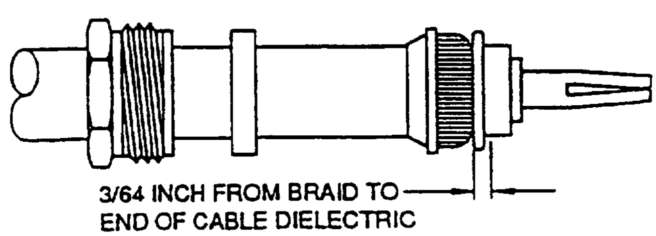
3. COMB OUT BRAID. STRIP CABLE DIELECTRIC 1/8 INCH FROM END OF JACKET.



4. PULL BRAID FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND BUTT AGAINST JACKET.



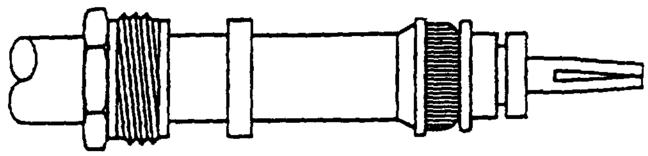
5. FOLD BRAID OVER CLAMP AND TRIM. TIN CENTER CONDUCTOR. PLACE WASHER, INSULATOR, AND CONTACT ON CABLE. SOLDER CONTACT TO CENTER CONDUCTOR.



23011601

Figure 16. Series N Connector Buildup (Sheet 1 of 3)

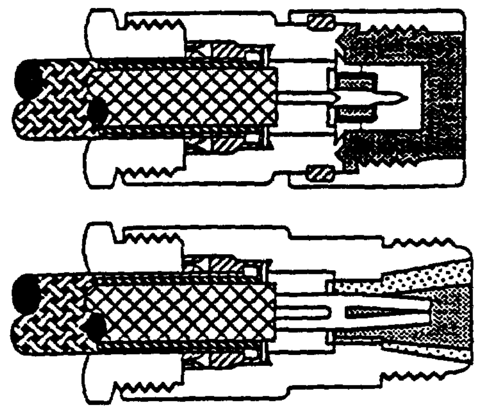
6. PLACE FRONT INSULATOR OVER CONTACT. ENSURE COUNTER BORE END OF INSULATOR IS TOWARD MATING END OF CONTACT.



NOTE

HOLD CONNECTOR BODY STATIONARY WHILE TIGHTENING NUT.

7. INSERT CABLE TERMINATION INTO CONNECTOR BODY. ENSURE SHARP EDGE OF CLAMP SEATS PROPERLY IN GASKET. TIGHTEN NUT.



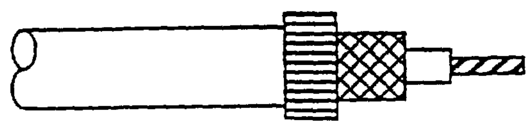
B. STRAIGHT CONNECTOR, CATEGORY D.

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. CUT CABLE END SQUARE AND SLIDE CRIMP FERRULE OVER CABLE.

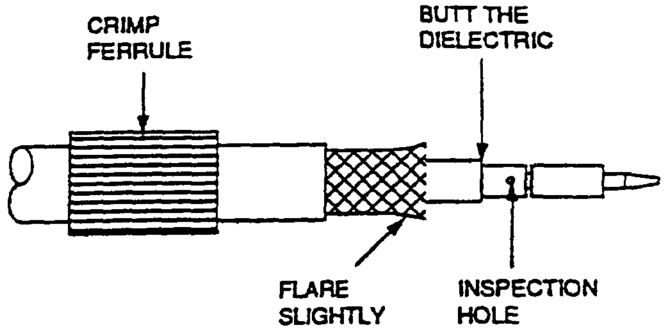
2. STRIP CABLE TO DIMENSIONS (FIGURE 3).



23011602

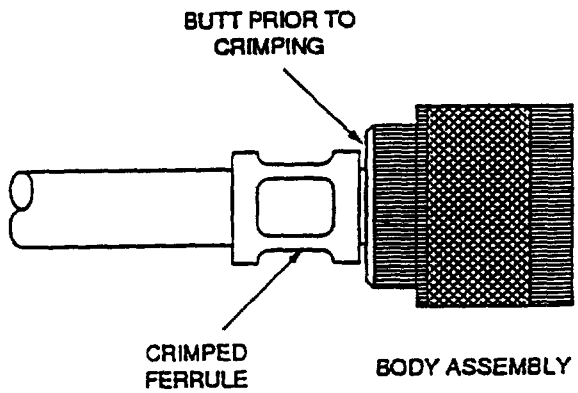
Figure 16. Series N Connector Buildup (Sheet 2)

3. USING APPROPRIATE TOOLS (FIGURE 3), CRIMP CONTACT TO CENTER CONDUCTOR. CENTER CONDUCTOR SHALL BE VISIBLE THROUGH INSPECTION HOLE. FLARE BRAID.



4. INSERT CONTACT AND CABLE INTO CONNECTOR BODY. ENSURE SUPPORT SLEEVE IS UNDER OUTER BRAID.

5. SLIDE FERRULE OVER BRAID UNTIL IT BUTTS AGAINST CONNECTOR BODY. CRIMP OUTER FERRULE WITH APPLICABLE TOOL (FIGURE 3).



23011603

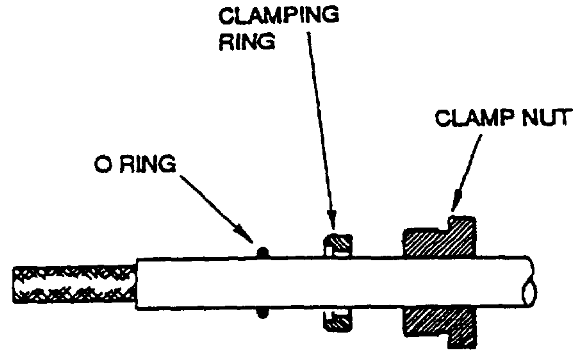
Figure 16. Series N Connector Buildup (Sheet 3)

A. SERIES QL AND QM WITH RG-217/U, RG-218/U, AND RG-220/U CABLES.

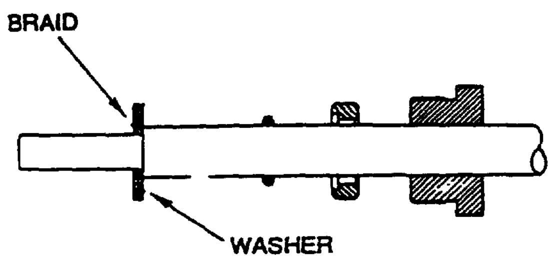
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

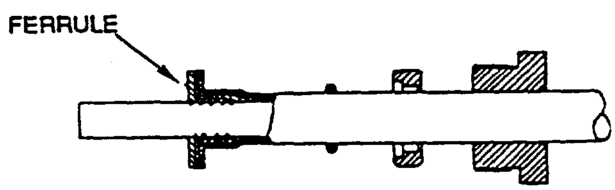
1. CUT CABLE END SQUARE. PLACE CLAMP NUT, CLAMPING RING, AND CABLE SEALING O-RING ON CABLE. STRIP CABLE JACKET SQUARE TO DIMENSION (FIGURES 4 OR 5).



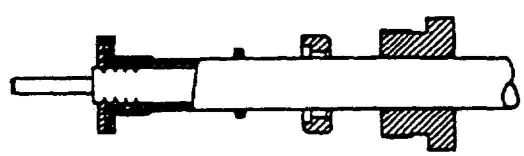
2. PLACE CLAMPING WASHER OVER BRAID UNTIL IT BUTTS AGAINST CABLE JACKET. FOLD BRAID AGAINST WASHER AND TRIM SO THAT NO BRAID EXTENDS BEYOND OUTER DIAMETER OF WASHER.



3. INSTALL FERRULE OVER CABLE CORE UNTIL BRAID IS CONTAINED BETWEEN WASHER AND FERRULE FLANGE.



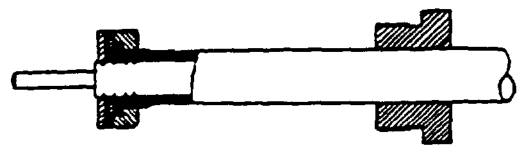
4. STRIP CABLE CORE FLUSH WITH FLANGE OF FERRULE. THREAD FERRULE ONTO CABLE UNTIL CORE EXTENDS BEYOND FERRULE FLANGE 1/64 IN. IF NECESSARY, CUT CENTER CONDUCTOR TO PROPER DIMENSION (FIGURES 4 OR 5).



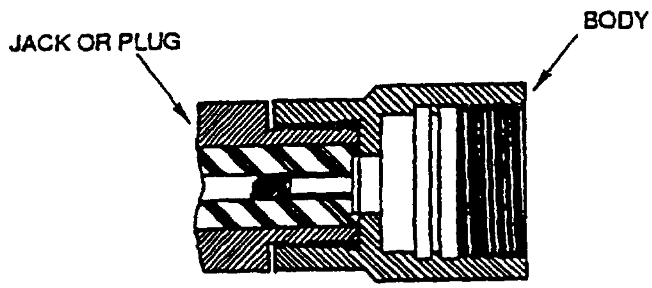
23011701

Figure 17. Series QL and QM Connector Buildup (Sheet 1 of 6)

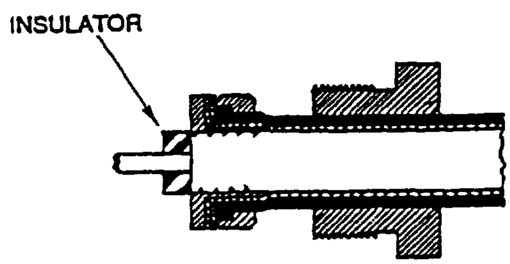
5. INSERT CABLE SEALING O-RING IN CLAMPING GROOVE. APPLY O-RING LUBRICANT ON JACKET AND FORCE CLAMPING RING AGAINST CLAMPING WASHER.



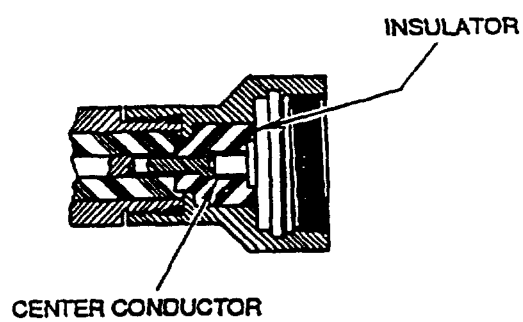
6. ASSEMBLE ACCESSORY BODY TO JACK OR PLUG AND TIGHTEN.



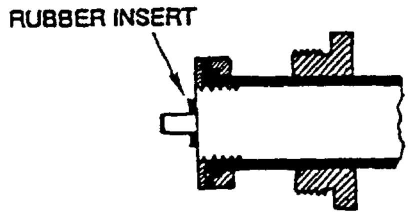
7. FOR RG-217/U AND RG-218/U CABLES, INSTALL SMALL TEFLON INSULATOR ON CENTER CONDUCTOR AND PUSH IT AGAINST CABLE CORE.



8. FOR RG-220/U CABLES, INSTALL LARGE DIAMETER INSULATOR AND CENTER CONDUCTOR IN ACCESSORY BODY.



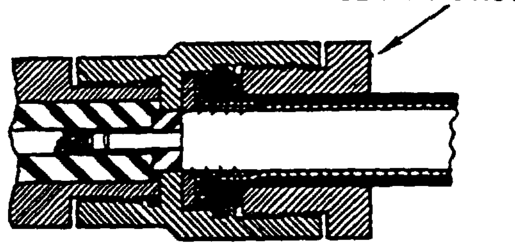
9. FOR RG-220/U CABLES, PLACE RUBBER INSERT ON CENTER CONDUCTOR OF CABLE AND PUSH AGAINST CABLE CORE.



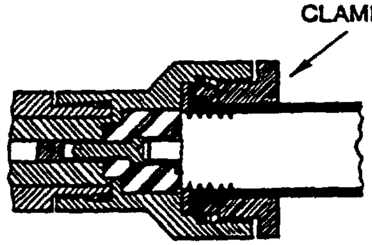
23011702

Figure 17. Series QL and QM Connector Buildup (Sheet 2)

10. INSERT PREPARED CABLE INTO CONNECTOR AND TIGHTEN CLAMPING NUT.



COMPLETED ASSEMBLY FOR
RG-217/U AND RG-218/U



COMPLETED ASSEMBLY FOR
RG-220/U

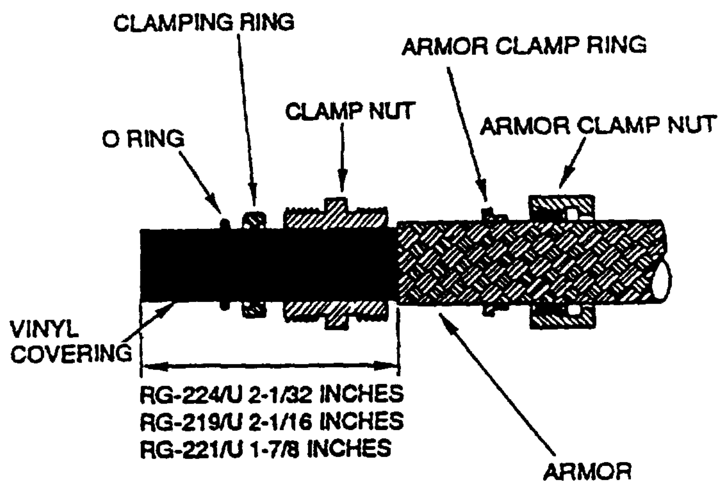
B. SERIES QL AND QM WITH ARMORED CABLE

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. STRIP ARMOR BRAID FROM CABLE TO DIMENSIONS SPECIFIED FOR APPLICABLE CABLE.

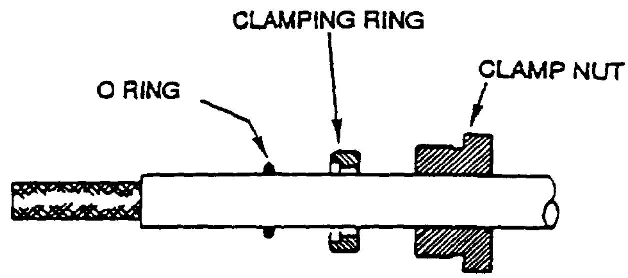
2. PLACE ARMOR CLAMP NUT AND ARMOR CLAMPING RING ON CABLE OVER ARMOR BRAID. PLACE CLAMP NUT, CLAMPING RING, AND SEALING O-RING OVER CABLE VINYL COVERING.



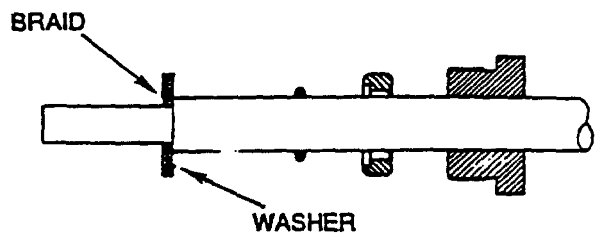
23011703

Figure 17. Series QL and QM Connector Buildup (Sheet 3)

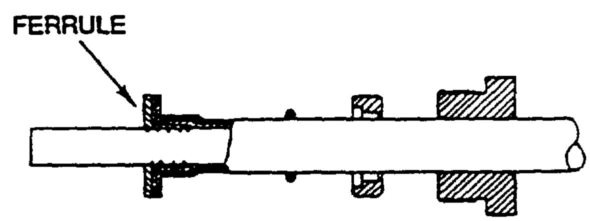
3. CUT CABLE END SQUARE. PLACE CLAMP NUT, CLAMPING RING, AND CABLE SEALING O-RING ON CABLE. STRIP CABLE JACKET SQUARE TO DIMENSION (FIGURES 4 OR 5).



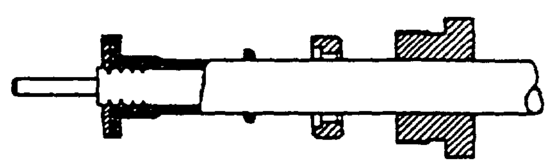
4. PLACE CLAMPING WASHER OVER BRAID UNTIL IT BUTTS AGAINST CABLE JACKET. FOLD BRAID AGAINST WASHER AND TRIM SO THAT NO BRAID EXTENDS BEYOND OUTER DIAMETER OF WASHER.



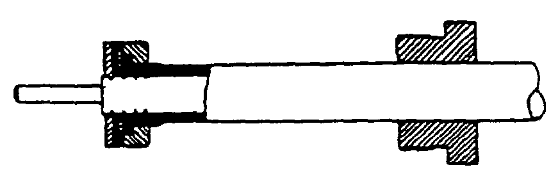
5. INSTALL FERRULE OVER CABLE CORE UNTIL BRAID IS CONTAINED BETWEEN WASHER AND FERRULE FLANGE.



6. STRIP CABLE CORE FLUSH WITH FLANGE OF FERRULE. THREAD FERRULE ONTO CABLE UNTIL CORE EXTENDS BEYOND FERRULE FLANGE 1/64 IN. IF NECESSARY, CUT CENTER CONDUCTOR TO PROPER DIMENSION (FIGURES 4 OR 5).



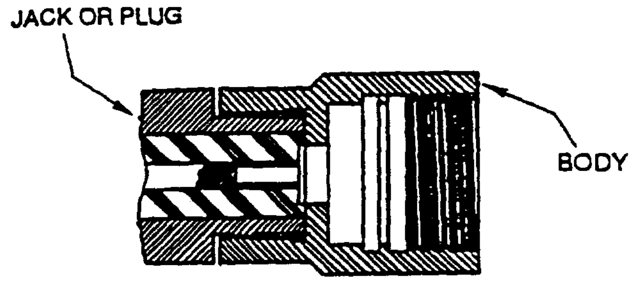
7. INSERT CABLE SEALING O-RING IN CLAMPING GROOVE. APPLY O-RING LUBRICANT ON JACKET AND FORCE CLAMPING RING AGAINST CLAMPING WASHER.



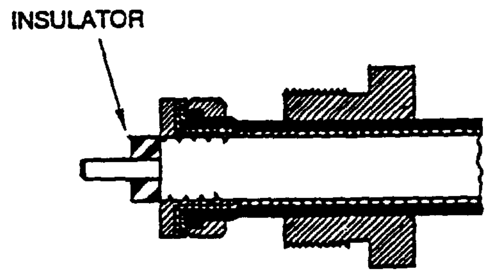
23011704

Figure 17. Series QL and QM Connector Buildup (Sheet 4)

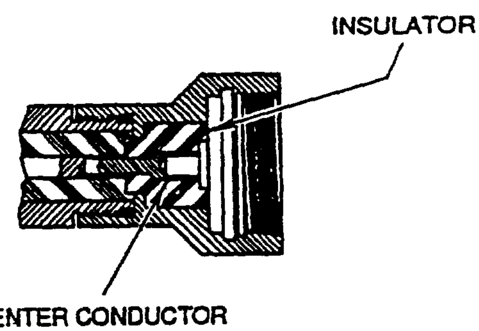
8. ASSEMBLE ACCESSORY BODY TO JACK OR PLUG AND TIGHTEN.



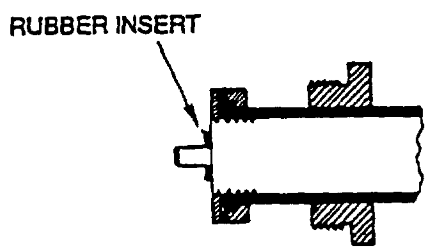
9. FOR RG-219/U AND RG-224/U CABLES. INSTALL SMALL TEFLON INSULATOR ON CENTER CONDUCTOR AND PUSH IT AGAINST CABLE CORE.



10. FOR RG-221/U CABLES, INSTALL LARGE DIAMETER INSULATOR AND CENTER CONDUCTOR IN ACCESSORY BODY.



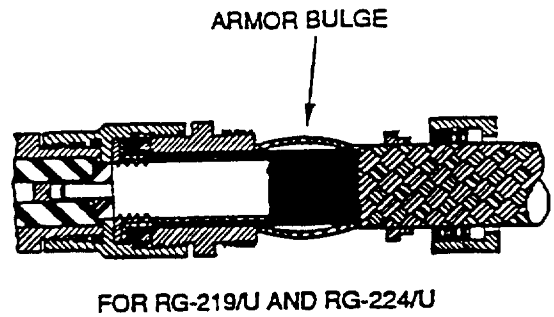
11. FOR RG -221/U CABLES, PLACE RUBBER INSERT ON CENTER CONDUCTOR OF CABLE AND PUSH AGAINST CABLE CORE.

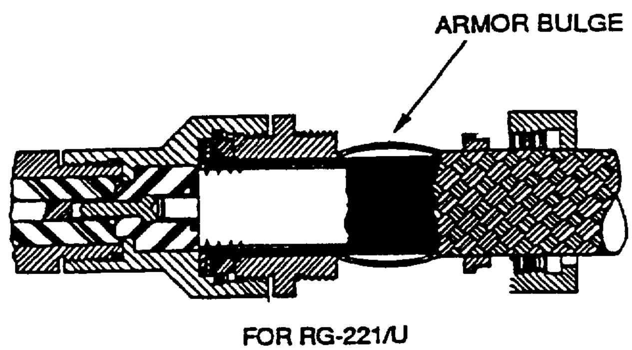


23011705

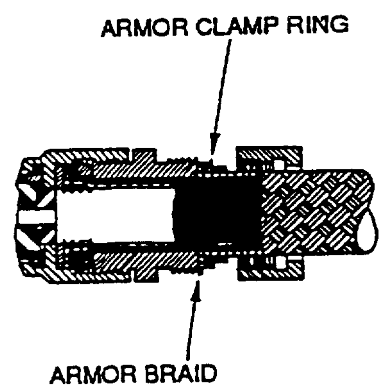
Figure 17. Series QL and QM Connector Buildup (Sheet 5)

12. FORM BULGE IN ARMOR TO MANIPULATE ACCESSORIES INTO PLACE.





13. FOLD ARMOR BRAID AGAINST BACK EDGE OF CLAMP NUT AND TRIM EVEN WITH CLAMP NUT THREADS. SLIDE ARMOR CLAMPING RING AGAINST CLAMP NUT HOLDING ARMOR BRAID SECURELY. TIGHTEN ARMOR CLAMP NUT.



23011706

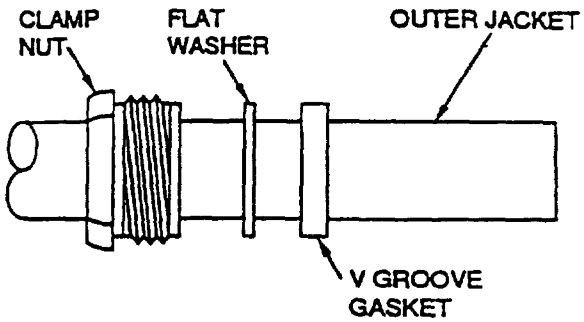
Figure 17. Series QL and QM Connector Buildup (Sheet 6)

A. STRAIGHT CONNECTOR, CATEGORY A.

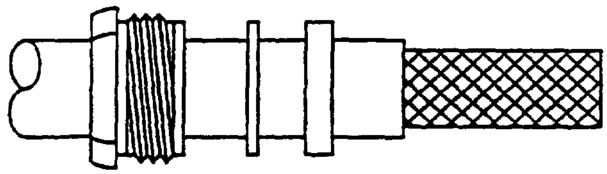
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

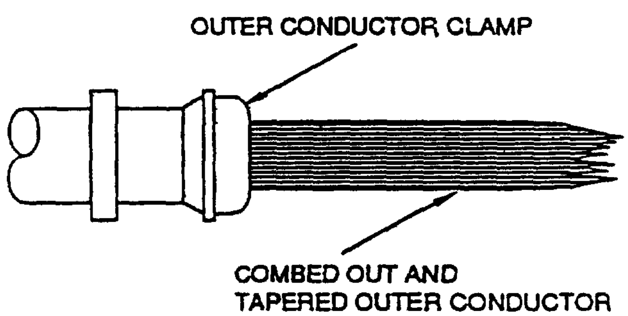
1. PLACE CLAMP NUT, WASHER, AND V-GROOVE GASKET, FLAT SIDE FIRST ON CABLE.



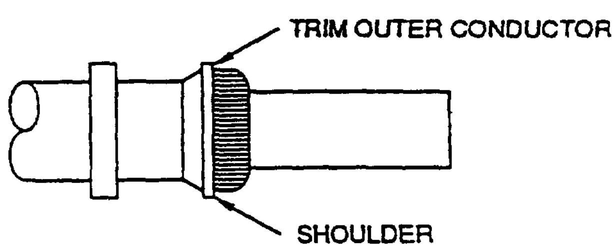
2. STRIP OUTER JACKET TO DIMENSIONS (FIGURE 8).



3. COMB OUTER CONDUCTOR AND TAPER OVER END OF DIELECTRIC, SLIDE OUTER CONDUCTOR CLAMP, BEVELED END FIRST, OVER COMBED CONDUCTOR UNTIL IT BOTTOMS ON OUTER JACKET.



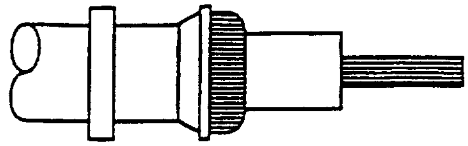
4. FOLD COMBED OUTER CONDUCTOR OVER OUTER CONDUCTOR CLAMP SHOULDER. TRIM OUTER CONDUCTOR FLUSH WITH OUTER CONDUCTOR CLAMP SHOULDER.



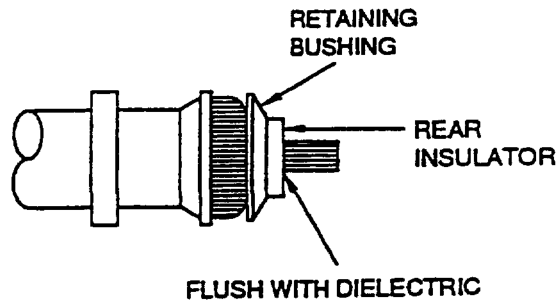
23011801

Figure 18. Series SC Connector Buildup (Sheet 1 of 7)

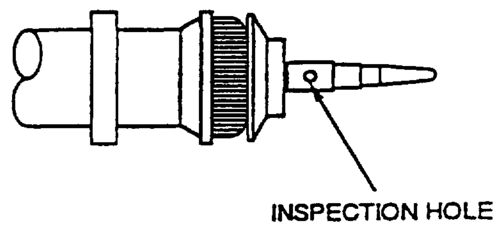
5. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 8).



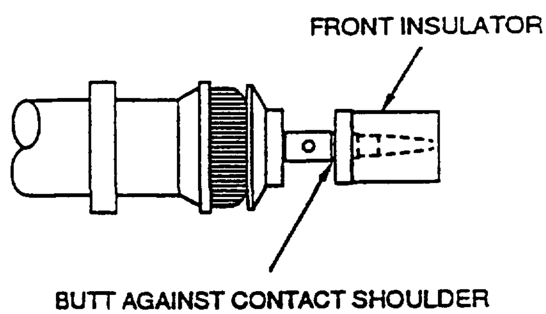
6. SLIDE RETAINING BUSHING, FLAT SIDE FIRST, ONTO DIELECTRIC UNTIL IT BUTTS AGAINST OUTER CONDUCTOR. SLIDE REAR INSULATOR ONTO DIELECTRIC UNTIL IT BUTTS AGAINST RETAINING BUSHING. OPPOSITE END SHALL BE FLUSH WITH END OF DIELECTRIC.



7. INSERT TINNED CONDUCTOR INTO CONTACT UNTIL CABLE BUTTS AGAINST CONTACT. CENTER CONDUCTOR SHALL BE VISIBLE THROUGH INSPECTION HOLE. SOLDER CONTACT TO CONDUCTOR.



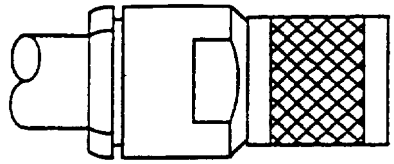
8. SLIDE FRONT INSULATOR ONTO CONTACT UNTIL IT BUTTS AGAINST FRONT SHOULDER.



23011802

Figure 18. Series SC Connector Buildup (Sheet 2)

9. INSERT CABLE ASSEMBLY INTO CONNECTOR BODY UNTIL IT BOTTOMS. ENSURE GROOVE GASKET IS SEATED PROPERLY ON OUTER CONDUCTOR. THREAD CLAMP NUT INTO CONNECTOR AND TIGHTEN.

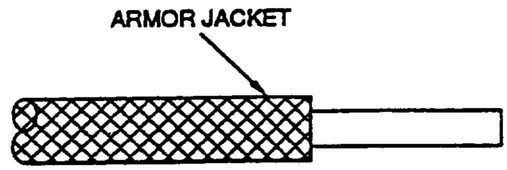


B. STRAIGHT CONNECTOR WITH ARMOR JACKET, CATEGORY A.

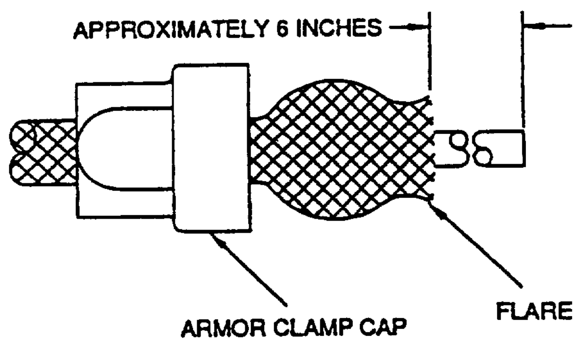
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

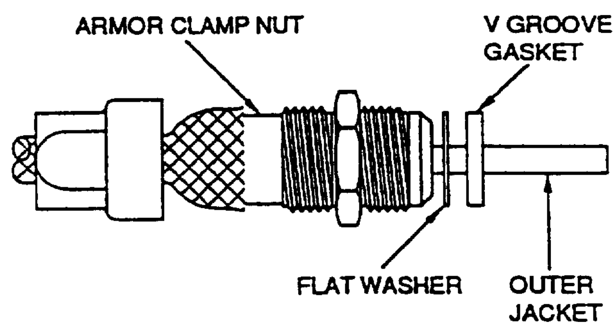
1. PLACE ARMOR CLAMP CAP, HEX END FIRST, ONTO CABLE. STRIP ARMOR JACKET TO DIMENSIONS (FIGURE 9).



2. BIRD CAGE AND FLARE ARMOR JACKET.



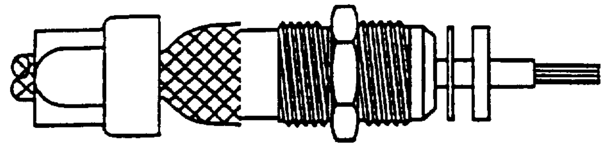
3. PLACE ARMOR CLAMP NUT, BEVELED END FIRST, ON CABLE UNTIL IT BUTTS AGAINST FLARED ARMOR JACKET. PLACE WASHER AND GROOVE GASKET, FLAT SIDE FIRST, ON CABLE.



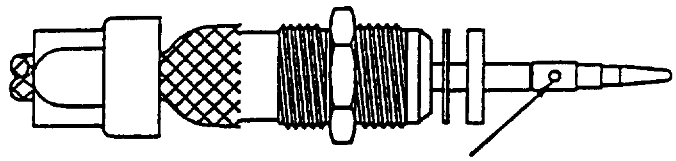
23011803

Figure 18. Series SC Connector Buildup (Sheet 3)

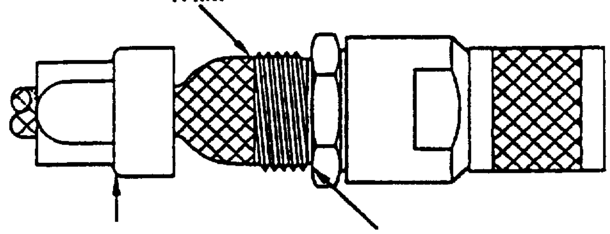
4. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 8). TIN CENTER CONDUCTOR.



5. SOLDER CONTACT TO CENTER CONDUCTOR. CENTER CONDUCTOR SHALL BE VISIBLE THROUGH INSPECTION HOLE.



6. ALIGN CONTACT WITH CONNECTOR BODY AND INSERT CABLE INTO CONNECTOR BODY AND TIGHTEN. PUSH FLARED END OF ARMOR JACKET OVER CLAMP NUT SHOULDER. THREAD CLAMP NUT CAP ONTO CLAMP NUT AND TIGHTEN.

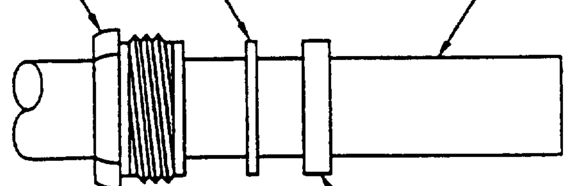


C. RIGHT ANGLE CONNECTOR.

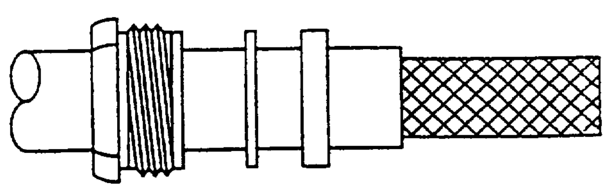
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. PLACE CLAMP NUT, WASHER, AND V-GROOVE GASKET, FLAT SIDE FIRST, ON CABLE.



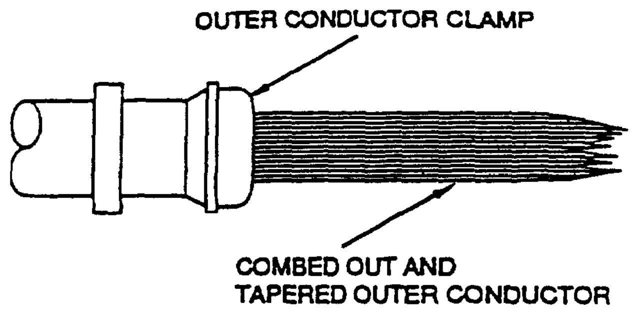
2. STRIP OUTER JACKET TO DIMENSIONS (FIGURE 9).



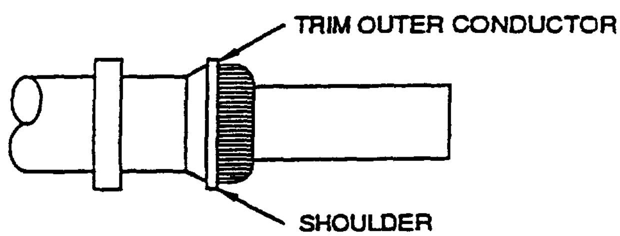
23011804

Figure 18. Series SC Connector Buildup (Sheet 4)

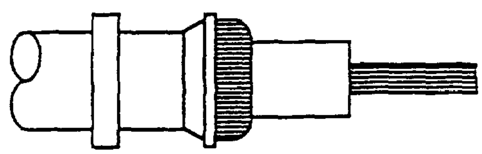
3. COMB OUTER CONDUCTOR AND TAPER OVER END OF DIELECTRIC, SLIDE OUTER CONDUCTOR CLAMP, BEVELED END FIRST, OVER COMBED CONDUCTOR UNTIL IT BOTTOMS ON OUTER JACKET.



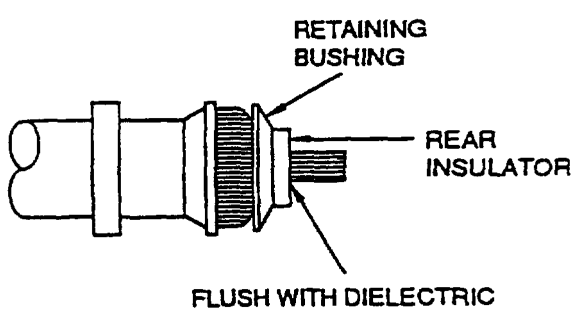
4. FOLD COMBED OUTER CONDUCTOR OVER OUTER CONDUCTOR CLAMP SHOULDER. TRIM OUTER CONDUCTOR FLUSH WITH OUTER CONDUCTOR CLAMP SHOULDER.



5. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 8).



6. SLIDE RETAINING BUSHING, FLAT SIDE FIRST, ONTO DIELECTRIC UNTIL IT BUTTS AGAINST OUTER CONDUCTOR. SLIDE REAR INSULATOR ONTO DIELECTRIC UNTIL IT BUTTS AGAINST RETAINING BUSHING. OPPOSITE END SHALL BE FLUSH WITH END OF DIELECTRIC.



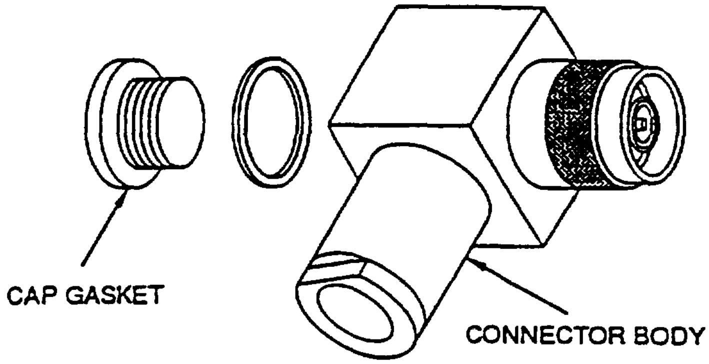
23011805

Figure 18. Series SC Connector Buildup (Sheet 5)

7. REMOVE SOLDER CAP AND GASKET FROM SOLDER PORT. INSERT CABLE INTO CONNECTOR BODY AND SOLDER CENTER CONDUCTOR TO CONTACT.

8. INSTALL GASKET AND SOLDER CAP IN SOLDER PORT.

9. THREAD CLAMP NUT TO CONNECTOR BODY AND TIGHTEN.

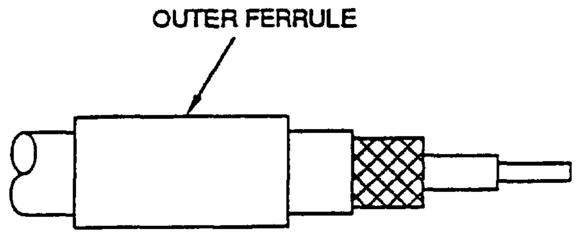


D. STRAIGHT CONNECTOR, CATEGORY D.

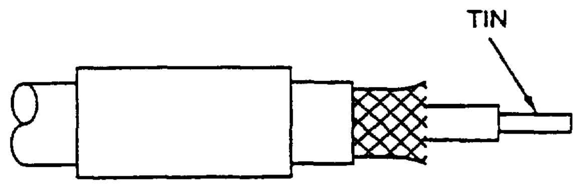
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

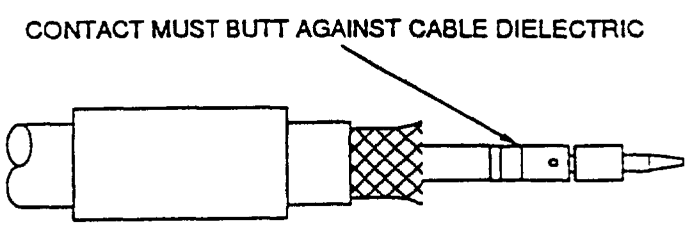
1. CUT CABLE END SQUARE. SLIDE OUTER FERRULE ONTO CABLE. STRIP CABLE TO DIMENSIONS (FIGURE 8).



2. SLIGHTLY FLARE OUTER CONDUCTOR. DO NOT COMB OUT BRAID. TIN CENTER CONDUCTOR.



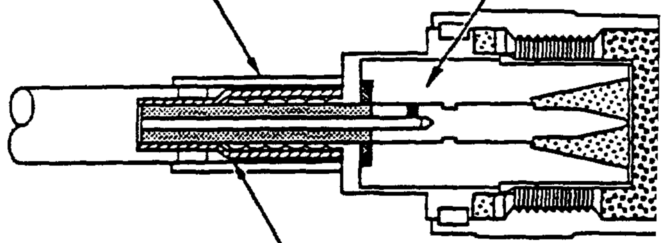
3. PLACE CONTACT ON CENTER CONDUCTOR SO IT BUTTS AGAINST DIELECTRIC. SOLDER CONTACT.



23011806

Figure 18. Series SC Connector Buildup (Sheet 6)

4. INSERT CABLE INTO CONNECTOR BODY WITH FERRULE UNDER FLARED BRAID. PUSH INTO CONTACT SNAPS INTO INSULATOR. SLIDE OUTER FERRULE OVER BRAID AND CRIMP, USING TOOLS (FIGURE 8).



23011807

Figure 18. Series SC Connector Buildup (Sheet 7)

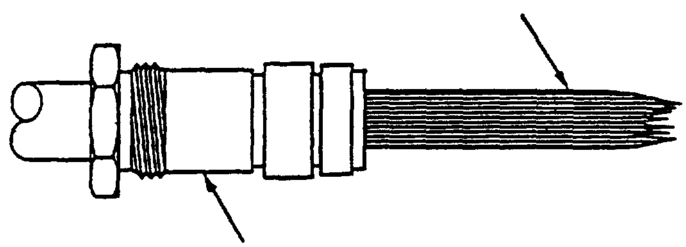
A. STRAIGHT CONNECTOR, CLAMP TYPE

WARNING

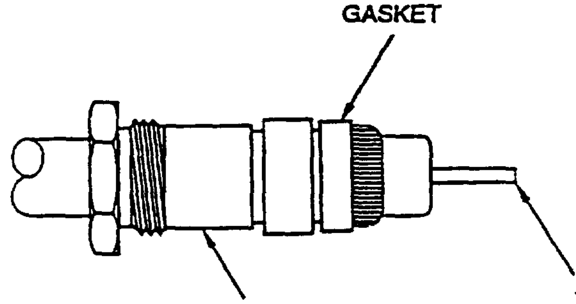
EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

1. CUT CABLE SQUARE AND STRIP TO DIMENSION (FIGURE 10).

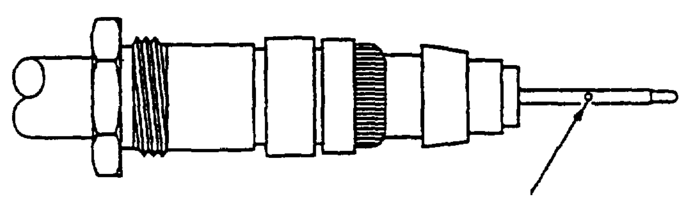
2. COMB OUT BRAID AND TAPER OVER DIELECTRIC. SLIDE CLAMP NUT ON CABLE TOWARD BRAID AND AGAINST JACKET CUT.



3. UNIFORMLY FOLD BRAID OVER CLAMP NUT AND TRIM SO NO STRANDS TOUCH GASKET. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 10). TIN CENTER CONDUCTOR.



4. INSERT CENTER CONTACT INTO BUSHING CONTACT ASSEMBLY SO DIELECTRIC SEATS SQUARELY AGAINST BUSHING. CENTER CONDUCTOR SHALL BE VISIBLE THROUGH INSPECTION HOLE. SOLDER CONTACT.



23011901

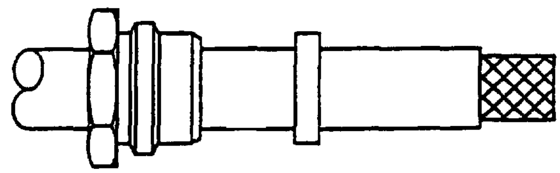
Figure 19. Series SMA Connector Buildup (Sheet 1 of 4)

5. INSERT PREPARED CABLE INTO CONNECTOR BODY UNTIL IT BOTTOMS. THREAD CLAMP NUT INTO CONNECTOR BODY AND TORQUE TO 20-25 IN/LBS.

B. RIGHT ANGLE CLAMP TYPE.

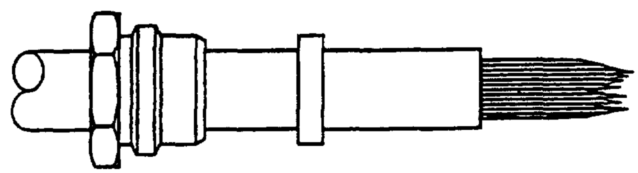
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

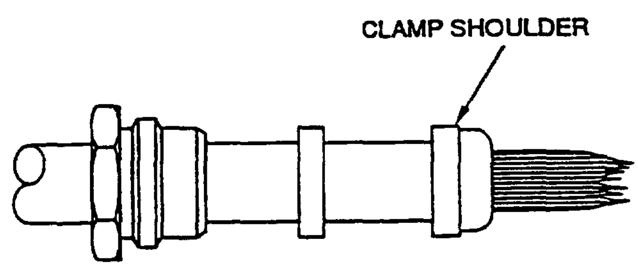


1. CUT CABLE END SQUARE. SLIDE CLAMP NUT AND GASKET OVER CABLE. STRIP OUTER JACKET TO DIMENSIONS (FIGURE 10).

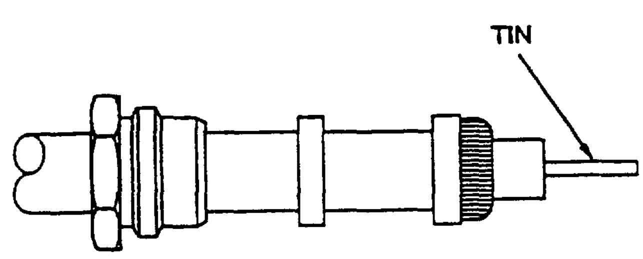
2. COMB OUT OUTER BRAID.



3. INSTALL BRAID CLAMP OVER BRAID STRANDS UNTIL IT BUTTS AGAINST OUTER JACKET. FOLD BRAID BACK AND TRIM AT CLAMP SHOULDER.



4. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 10). TIN CONDUCTOR.



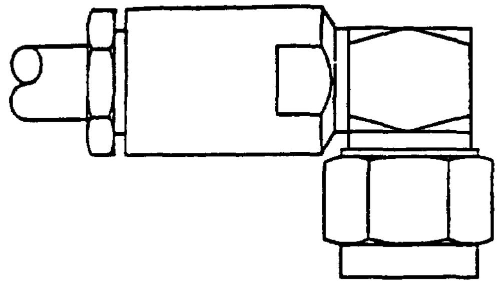
23011902

Figure 19. Series SMA Connector Buildup (Sheet 2)

5. INSERT PREPARED CABLE INTO CONNECTOR BODY. THREAD CLAMP NUT INTO CONNECTOR AND TORQUE TO 15-18 IN/LBS.

6. REMOVE SOLDER PORT CAP. SOLDER CENTER CONDUCTOR TO CENTER CONTACT.

7. INSTALL SOLDER PORT CAP.



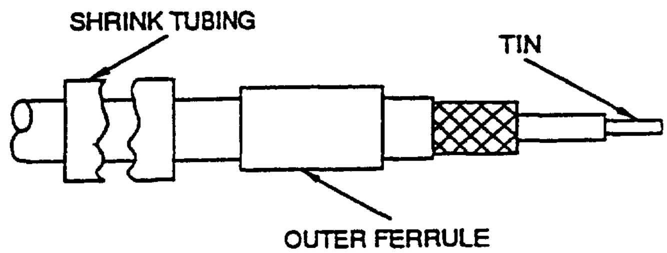
COMPLETED ASSEMBLY

C. <u>STRAIGHT CONNECTOR, CRIMP TYPE.</u>

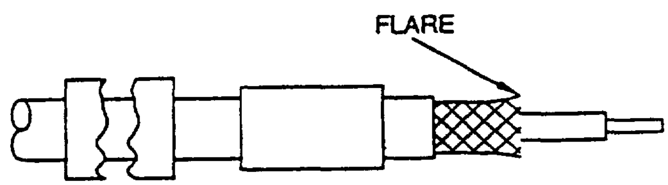
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

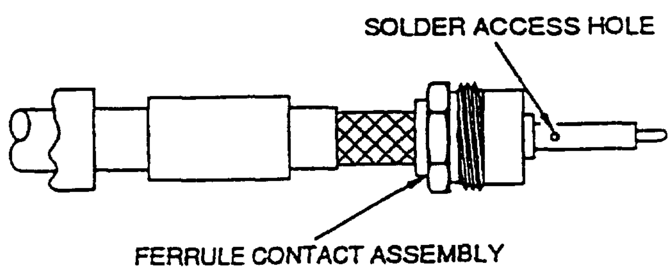
1. SLIDE HEAT SHRINK TUBING AND OUTER FERRULE OVER OUTER CABLE JACKET. STRIP CABLE TO DIMENSIONS (FIGURE 10).



2. SLIGHTLY FLARE END OF BRAID. DO NOT COMB OUT.



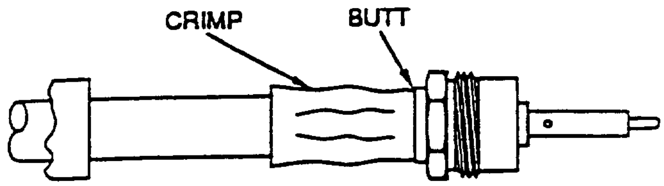
3. INSTALL FERRULE/CONTACT ASSEMBLY ONTO CABLE. SOLDER CONTACT TO CENTER CONDUCTOR.



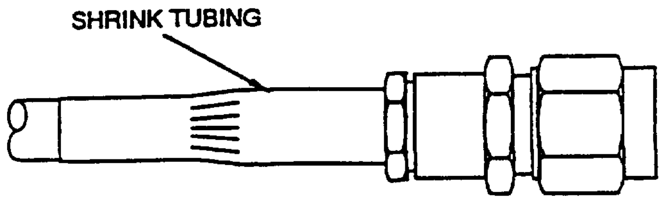
23011903

Figure 19. Series SMA Connector Buildup (Sheet 3)

4. SLIDE OUTER FERRULE OVER BRAID. USING CRIMP TOOLS (FIGURE 10), CRIMP FERRULE.



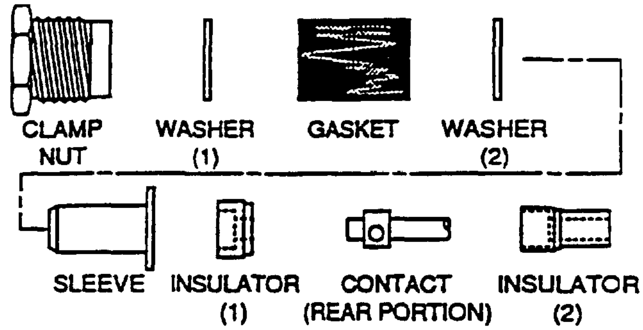
5. THREAD FERRULE/CONTACT ASSEMBLY INTO CONNECTOR BODY AND TORQUE TO 20-25 IN/LBS. SLIDE HEAT SHRINK TUBING OVER FERRULE UNTIL IT BUTTS AGAINST CLAMP NUT AND SHRINK.



23011904

Figure 19. Series SMA Connector Buildup (Sheet 4)

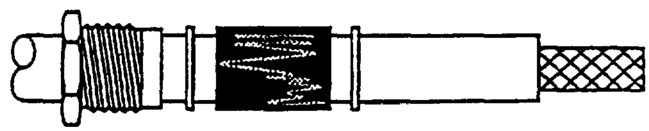
A. STRAIGHT CONNECTOR, CLAMP TYPE, FOR FLEXIBLE CABLE.



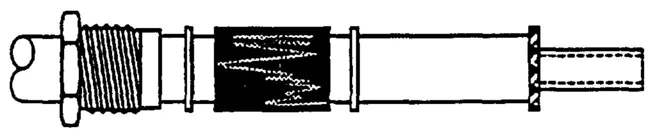
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

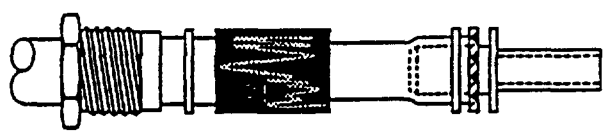
1. SLIDE CLAMP NUT, WASHERS (1 AND 2), AND GASKET OVER CABLE. STRIP CABLE TO DIMENSIONS (FIGURE 11).



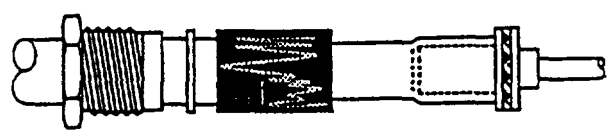
2. SPREAD BRAID. SLIGHTLY CHAMFER CABLE CORE TO ASSIST SLEEVE INSTALLATION.



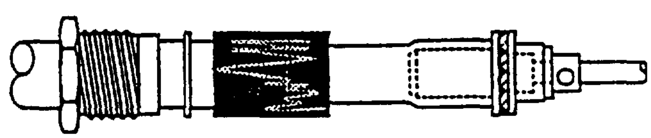
3. SLIDE WASHER (2) CLOSE TO BRAID. INSERT SLEEVE BETWEEN BRAID AND CORE, TRIM BRAID TO DIAMETER SMALLER THAN SLEEVE FLANGE.



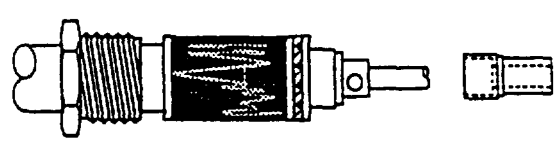
4. SLIDE SLEEVE IN UNTIL FLANGE BUTTS AGAINST BRAID. STRIP CABLE CORE TO DIMENSIONS (FIGURE 11). TIN CENTER CONDUCTOR.



5. SLIDE INSULATOR (1) OVER DIELECTRIC UNTIL IT BUTTS AGAINST SLEEVE FLANGE. SLIDE CONTACT OVER CENTER CONDUCTOR UNTIL FLUSH WITH INSULATOR (1) AND SOLDER.



6. SLIDE INSULATOR (2) OVER CONTACT AND SLIDE GASKET, WASHER (1), AND CLAMP NUT AGAINST WASHER (2). INSERT INTO CONNECTOR BODY AND TORQUE CLAMP NUT TO 5-7 IN/LBS.



23012003

Figure 20. Series SMB Connector Buildup (Sheet 1 of 3)

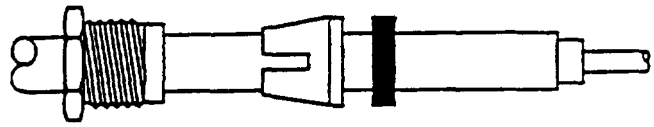
B. STRAIGHT CONNECTOR, CLAMP TYPE, FOR SEMI-RIGID CABLE.

WARNING

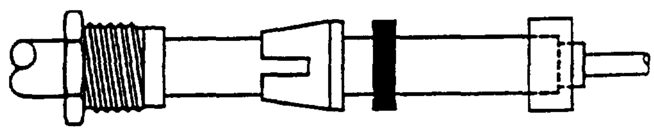
EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

CAUTION

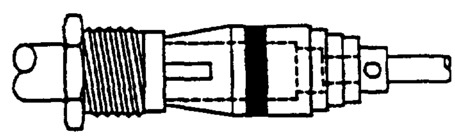
CARE MUST BE TAKEN NOT TO FRACTURE CENTER CONDUCTOR.



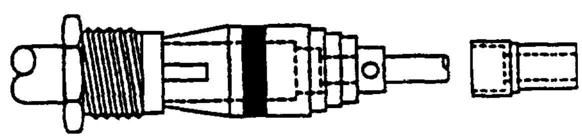
1. CUT CABLE END SQUARE. STRIP CABLE TO DIMENSIONS (FIGURE 11). TIN CENTER CONDUCTOR. SLIDE CLAMP NUT, COLLAR, AND GASKET OVER CABLE.



2. SLIDE BUSHING ON CABLE UNTIL COUNTER BORE RESTS AGAINST JACKET.



3. SLIDE REAR INSULATOR OVER CABLE CORE UNTIL FLUSH AGAINST BUSHING. SLIDE CONTACT ONTO CENTER CONDUCTOR UNTIL CONTACT SHOULDER IS FLUSH AGAINST INSULATOR. SOLDER CONTACT.



4. SLIDE FRONT INSULATOR OVER CONTACT. SLIDE GASKET, COLLAR, AND CLAMP NUT TO BUSHING AND INSERT INTO BACK OF BODY, TIGHTEN NUT AND TORQUE TO 4-6 IN/LBS.

23012002

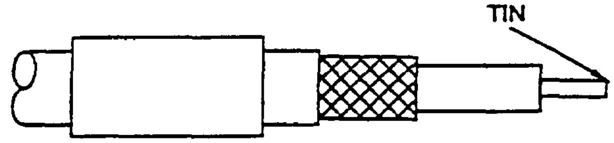
Figure 20. Series SMB Connector Buildup (Sheet 2)

C. STRAIGHT CONNECTOR, CRIMP TYPE FOR FLEXIBLE CABLE.

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

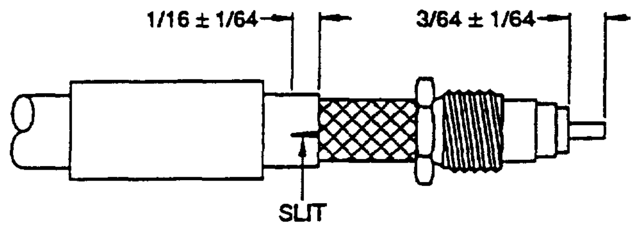
1. CUT CABLE END SQUARE. STRIP CABLE TO DIMENSIONS (FIGURE 11). TIN CENTER CONDUCTOR. SLIDE FERRULE OVER CABLE.



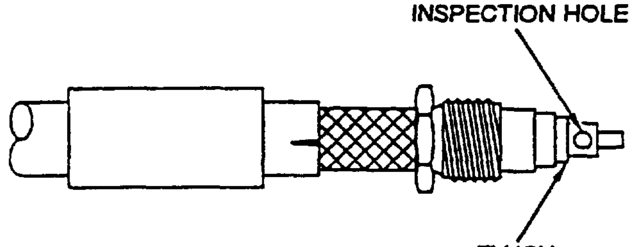
NOTE

ON SMALL DIAMETER CABLES TWO SLITS IN JACKET (180° APART LONGITUDINALLY) MAY BE MADE TO EASE ASSEMBLY.

2. INSERT TRIMMED CABLE INTO BACK OF REAR BODY ASSEMBLY. TUBULAR BODY EXTENSION WILL SLIDE UNDER BRAID AND JACKET. TINNED CENTER CONDUCTOR SHOULD PROJECT 3/64 IN. BEYOND FACE OF INSULATOR.

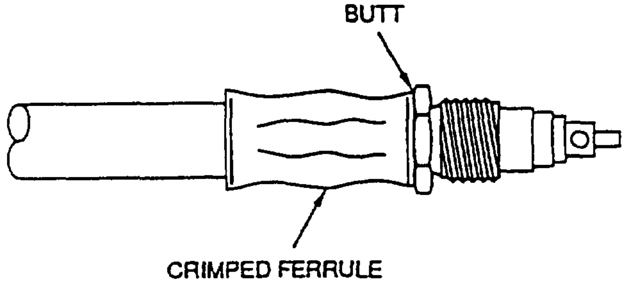


3. INSTALL CONTACT ON CENTER CONDUCTOR WITH CONTACT SHOULDER FLUSH WITH INSULATOR. SOLDER CONTACT.



4. SLIDE FERRULE UNTIL IT BUTTS AGAINST HEX FACE OF REAR BODY. USING CRIMP TOOLS (FIGURE 11), CRIMP FERRULE.

5. INSERT CONTACT INTO FRONT INSULATOR AND THREAD FRONT BODY ONTO REAR BODY. TORQUE TO 6-8 IN/LBS.



23012003

Figure 20. Series SMB Connector Buildup (Sheet 3)

A. STRAIGHT CONNECTOR

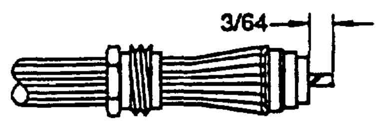
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

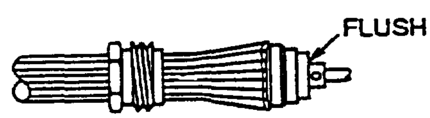
1. CUT CABLE END SQUARE. STRIP TO DIMENSIONS (FIGURE 12). TIN CENTER CONDUCTOR AND SLIDE CLAMP NUT OVER CABLE.

NOTE

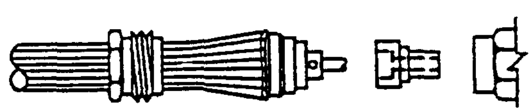
TWO SLITS IN CABLE JACKET (180° APART LONGITUDINALLY, 1/8 IN. LONG), MAY BE CUT TO EASE ASSEMBLY.



2. SPREAD BRAID, INSERT SLEEVE ASSEMBLY BETWEEN BRAID AND DIELECTRIC. TRIM BRAID TO DIAMETER OF SLEEVE FLANGE. TINNED CONDUCTOR SHOULD PROJECT 3/64 IN. BEYOND INSULATOR FACE.



3. INSERT CENTER CONDUCTOR INTO CONTACT UNTIL CONTACT SHOULDER IS FLUSH AGAINST INSULATOR. SOLDER CONTACT.



4. INSTALL FRONT INSULATOR OVER CONTACT AND SLIDE CLAMP NUT FORWARD UNTIL IT BUTTS AGAINST SLEEVE. INSERT INTO BACK OF CONNECTOR BODY, TIGHTEN CLAMP NUT AND TORQUE TO 6-8 IN/LBS.

23012101

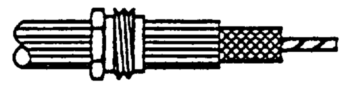
Figure 21. Series SMC Connector Buildup (Sheet 1 of 2)

B. RIGHT ANGLE CONNECTORS.

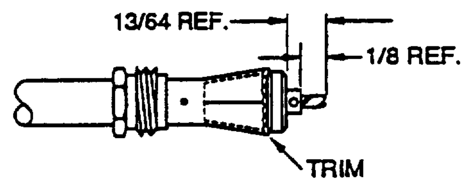
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

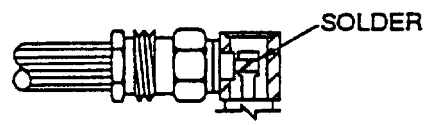
1. CUT CABLE END SQUARE. STRIP CABLE TO DIMENSIONS (FIGURE 12). TIN CENTER CONDUCTOR. SLIDE CLAMP NUT OVER CABLE.



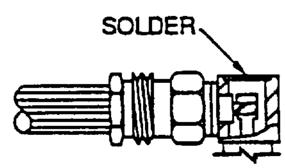
2. SPREAD BRAID AND INSERT SLEEVE ASSEMBLY BETWEEN BRAID AND DIELECTRIC. TRIM BRAID TO DIAMETER OF SLEEVE FLANGE.



3. REMOVE CAP FROM SOLDER PORT. PUSH CABLE INTO CONNECTOR BODY. SOLDER CENTER CONDUCTOR TO CENTER CONTACT.



4. SLIDE CLAMP NUT FORWARD AND THREAD INTO CONNECTOR BODY. TORQUE TO 6-8 IN/LBS. SNAP CAP INTO SOLDER PORT AND SOLDER.



23012102

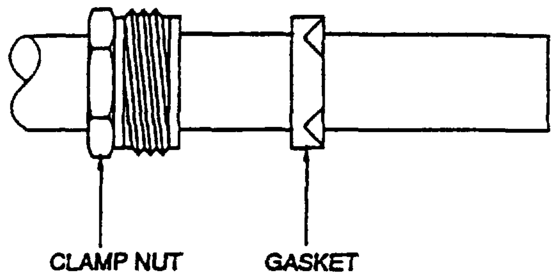
Figure 21. Series SMC Connector Buildup (Sheet 2)

A. STRAIGHT CONNECTOR.

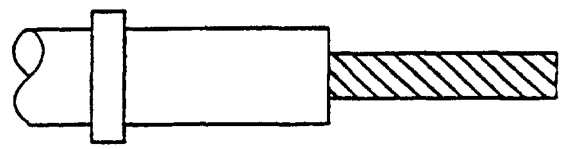
WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

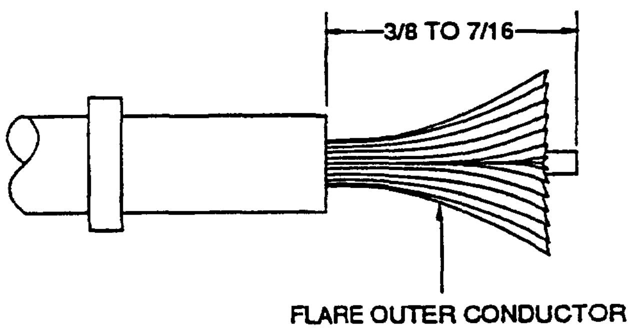
1. CUT CABLE END SQUARE. SLIDE CLAMP NUT AND GASKET (FLAT SIDE FIRST) ON CABLE.



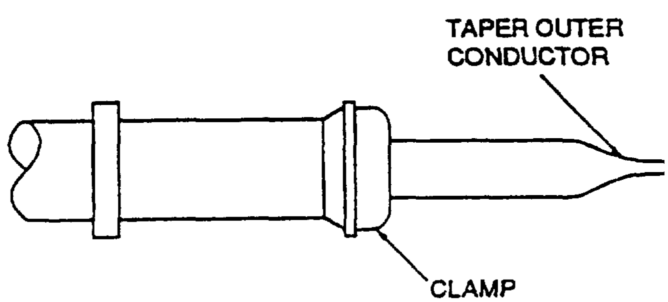
2. STRIP CABLE TO DIMENSIONS (FIGURE 13).



3. COMB OUT AND FLARE OUTER CONDUCTOR



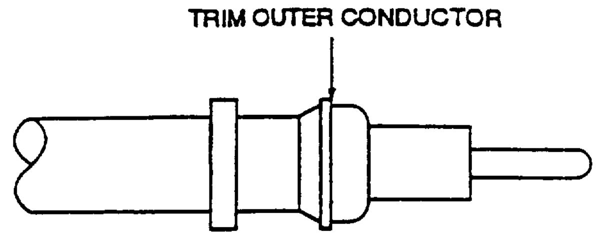
4. TAPER OUTER CONDUCTER OVER DIELECTRIC. SLIDE CLAMP (BEVELED END FIRST) OVER OUTER CONDUCTOR UNTIL IT BUTTS AGAINST OUTER JACKET.



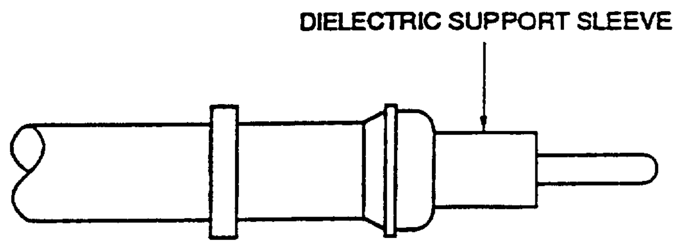
23012201

Figure 22. Series TNC Connector Buildup (Sheet 1 of 4)

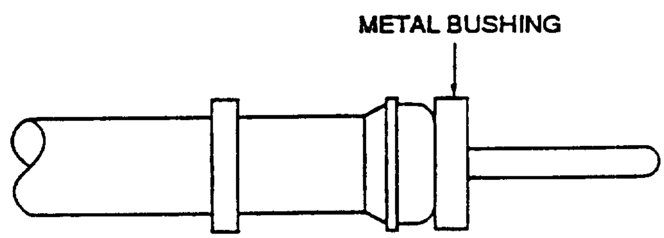
5. FOLD OUTER CONDUCTOR BACK OVER CLAMP AND TRIM. STRIP DIELECTRIC TO DIMENSIONS (FIGURE 13).



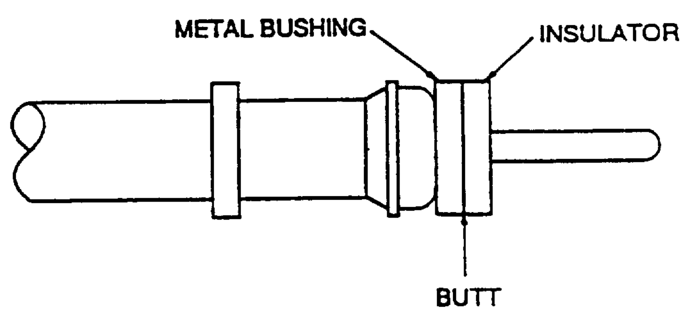
6. SLIDE DIELECTRIC SUPPORT SLEEVE ONTO CABLE DIELECTRIC UNTIL IT BUTTS AGAINST OUTER CONDUCTOR.



7. SLIDE METAL BUSHING (FLAT SIDE FIRST) ONTO DIELECTRIC SUPPORT SLEEVE UNTIL IT BUTTS AGAINST OUTER CONDUCTOR.



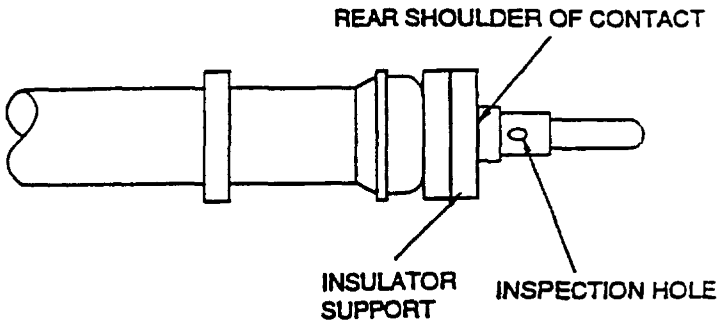
8. INSTALL STEPPED DOWN END OF INSULATOR INTO METAL BUSHING AND OVER DIELECTRIC SUPPORT SLEEVE UNTIL SHOULDER OF INSULATOR BUTTS AGAINST METAL BUSHING.



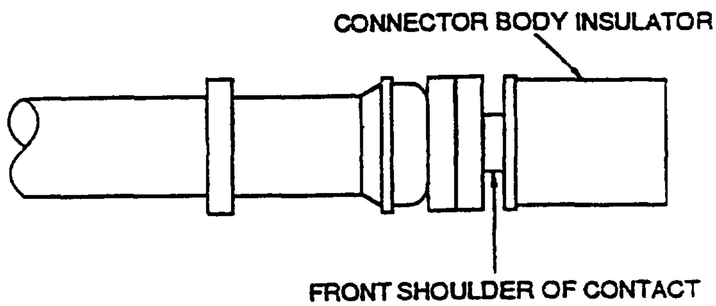
23012202

Figure 22. Series TNC Connector Buildup (Sheet 2)

9. INSERT TINNED CONDUCTOR INTO CONTACT UNTIL SHOULDER BUTTS AGAINST INSULATOR. SOLDER CONTACT.



10. SLIDE CONNECTOR BODY INSULATOR ONTO CONTACT UNTIL IT BUTTS AGAINST FRONT SHOULDER OF CONTACT.

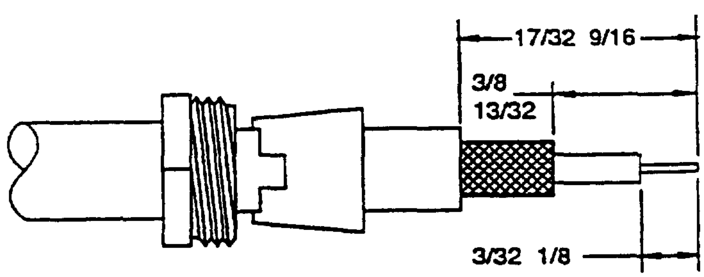


B. <u>STRAIGHT CONNECTOR FOR SUB-MINIATURE CABLES</u>.

WARNING

EYE PROTECTION SHALL BE WORN DURING ALL SOLDERING, CUTTING, AND STRIPPING PROCEDURES.

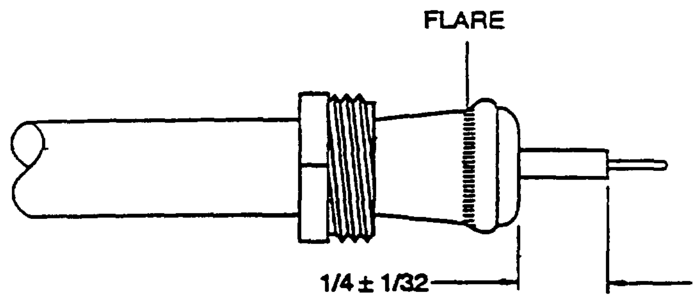
1. CUT CABLE END SQUARE. SLIDE CLAMP NUT AND SLOTTED CLAMP OVER CABLE END. STRIP CABLE TO DIMENSIONS SHOWN.



23012203

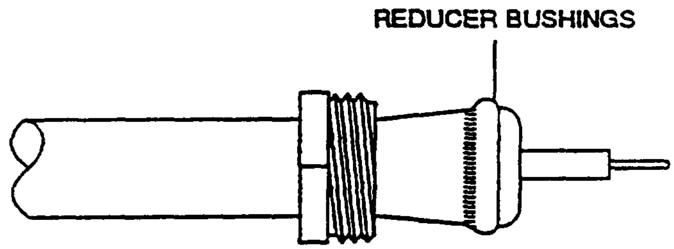
Figure 22. Series TNC Connector Buildup (Sheet 3)

2. FLARE OUTER CONDUCTOR, DO NOT COMB OUT. INSERT WEDGE BETWEEN FLARED OUTER CONDUCTOR AND DIELECTRIC TO A POINT WHERE DIELECTRIC EXTENDS TO DIMENSION SHOWN.



3. PUSH SLOTTED CLAMP OVER WEDGE. TIN CENTER CONDUCTOR.

4. WHEN REQUIRED, SLIDE REDUCER BUSHINGS OVER DIELECTRIC AND CENTER CONDUCTOR.



5. SLIDE ADAPTER AND RETAINER BUSHING OVER REDUCER BUSHING ON DIELECTRIC.

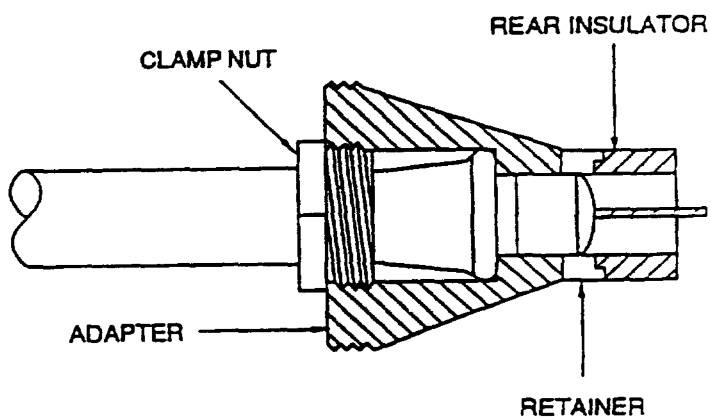
6. THREAD CLAMP NUT INTO ADAPTER. HAND TIGHTEN. SLIDE REAR INSULATOR INTO AND AGAINST RETAINER BUSHING.

7. INSTALL CONTACT ON TINNED CENTER CONDUCTOR UNTIL IT BUTTS AGAINST REDUCER BUSHING OR DIELECTRIC. SOLDER CONTACT.

8. INSERT CABLE ASSEMBLY INTO CONNECTOR BODY AND TIGHTEN ADAPTER.

9. ROTATE CABLE SLIGHTLY TO ENSURE SLOTTED CLAMP IS PROPERLY SEATED.

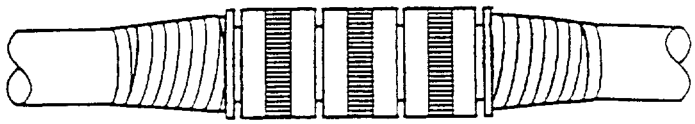
10. TIGHTEN CLAMP NUT AND TORQUE TO 15-20 IN/LBS.



23012204

Figure 22. Series TNC Connector Buildup (Sheet 4)

1. ENSURE CONNECTOR IS CORRECTLY ASSEMBLED AND INSTALLED.
2. TIGHTLY WRAP TAPE IMMEDIATELY BEHIND CONNECTOR TO PROVIDE SMOOTH CONTOUR BETWEEN CABLE AND CONNECTOR.



3. TIGHTLY WRAP SEVERAL LAYERS OF TAPE WITH 50 PERCENT OVERLAP OVER BUILT-UP JUNCTION. LAYERS SHOULD BE APPLIED IN REVERSE DIRECTIONS WITH A MINIMUM OF FOUR LAYERS.
4. COMPLETED TAPED COVERING SHOULD EXTEND BEYOND EACH CONNECTOR FOR A DISTANCE EQUAL TO 8-12 TIMES THE DIAMETER OF CABLE AND HAVE A SMOOTH SYMMETRICAL CONTOUR.

02301023

Figure 23. Moisture Proofing

MILITARY STANDARD RECTANGULAR CONNECTORS

Reference Material

Connector Accessories	025 00
Crimp Tool	013 00
Heating Tools	012 00
Potting and Sealing Connectors, Electrical Cable Assemblies, and Electrical Components	026 00
Soldering	017 00
Wire and Cable Stripping	009 00
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-PRF-24308 Connectors	NAVAIR 01-1A-505.15
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-28731 Connectors	NAVAIR 01-1A-505.16
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-28748 Connectors	NAVAIR 01-1A-505.17
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-28804 Connectors	NAVAIR 01-1A-505.18
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-81659 Connectors	NAVAIR 01-1A-505.19
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-83733 Connectors	NAVAIR 01-1A-505.20
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-8384 Connectors	NAVAIR 01-1A-505.21
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-21617 Connectors	NAVAIR 01-1A-505.22
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-26518 Connectors	NAVAIR 01-1A-505.23
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-83513 Connectors	NAVAIR 01-1A-505.24
Installation Practices, Aircraft Electric and Electronic Wiring, MIL-C-85028 Connectors	NAVAIR 01-1A-505.25
Connectors, Electrical, Rectangular, Rack and Panel, Solder Type and Crimp Type Contacts	MIL-C-28748
Connectors, Electrical Miniature, Rectangular Type, Rack to Panel, Environment Resisting, 200°C Total Continuous Operating Temperature	MIL-C-83733
TBP	MIL-I-23053
TBP	MS27488

Alphabetical Index

Alphabetical Index (Cont)

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part. No./Type Designation
Adapter, Fixture	AT-1319-11
Adapter, Fixture	AT-1319-14
Adapter, Fixture	AT-1319-17
Adapter, Fixture	AT-1319-18
Adapter, Fixture	AT-1319-19
Fixture, Holding	AD-1319
Heat Gun, Mini	CV-5300
Heat Gun	HT-900B
Heat Gun	HT-920B
Heating Tool, Infrared	IR-500
Heater, Two Station	IR-1044

Materials Required

Nomenclature	Specification/ Part Number
Contact	D-602-16
Contact	D-602-17
Contact	D-602-44
Contact	D-602-45
Contact	D-602-46
Contact	D-602-47
Contact	D-602-54
Contact	D-602-55
Contact	D-602-56
Contact	D-602-57
Contact	D-602-72
Contact	D-602-73
Contact	D-602-0094
Contact	D-602-0095
Contact	D-602-0104
Contact	D-602-0105
Contact	D-602-0106
Contact	D-602-0107
Sleeve, Filling	CTA-0006
Sleeve, Filling	CTA-0042

1. INTRODUCTION.

2. This work package (WP) contains general information for rectangular connectors commonly used on military aircraft and electric/electronic equipment. Specific information on a particular type rectangular connector is contained in the appropriate NAVAIR 01-1A-505 Series manual (Table 1).

TABLE 1. CONNECTOR MANUAL REFERENCE

Connector Type	Manual Number
MIL-PRF-24308	NAVAIR 01-1A-505.15
MIL-C-28731	NAVAIR 01-1A-505.16
MIL-C-28748	NAVAIR 01-1A-505.l7
MIL-C-28804	NAVAIR 01-1A-505.18
MIL-C-81659	NAVAIR 01-1A-505.19
MIL-C-83733	NAVAIR 01-1A-505.20
MIL-C-8384	NAVAIR 01-1A-505.21
MIL-C-21617	NAVAIR 01-1A-505.22
MIL-C-26518	NAVAIR 01-1A-505.23
MIL-C-83513	NAVAIR 01-1A-505.24
MIL-C-85028	NAVAIR 01-1A-505.25

3. GENERAL

NOTE

For the purpose of this WP, the general information pertains to rack and panel connectors.

4. **CONNECTORS.** Connectors are electromechanical devices that permit circuit elements to be electrically and mechanically separated and reconnected without disturbing other elements. The connector performs no function electrically except to connect and disconnect circuits, and serves to join wires together.

5. **Rectangular Connectors.** Rectangular connectors are divided into rack and panel connectors and printed circuit connectors.

6. **Rack and Panel Connectors.** Rack and panel connectors are fixed connectors that provide electrical connections between an electric/electronic unit and its rack mount. An alignment device is usually provided to insure proper mating. Coupling devices are normally not used and the connectors are mated by moving the unit into the rack. Typical rack and panel connectors are shown in Figure 1.

7. **Printed Circuit Connectors.** There are two basic types of printed circuit connectors: edge connectors and two-piece connectors.

a. Edge connectors contain socket contacts that interconnect with pin contacts etched or printed on a printed circuit board.

b. Two-piece connectors consist of a mating member that is permanently attached to the board and another member connected to the equipment.

8. **CONNECTOR SYSTEM.** A connector system (Figure 1) consists of two mating assemblies, a plug and a receptacle. The plug usually is on the end of a cable originating in a piece of equipment. The receptacle is usually fastened to a fixed structure or to piece of equipment.

9. **RECEPTACLE ASSEMBLY.** The receptacle assembly is that part of the connector system that mates with the plug assembly, and is usually fixed to a wall, bulkhead, or equipment case. A receptacle consists of an insulator insert, contacts, and a shell. The contacts, whether pin or socket, do not alter the terminology of the receptacle.

10. **PLUG ASSEMBLY.** The plug assembly is the removable part of the connector system that mates with the receptacle, and is usually attached to a cable. A plug consists of an insulator insert, contacts, shell, and coupling mechanism. The contacts, whether pins or sockets, do not alter the terminology of the plug.

11. **SHELL.** The shell is usually fabricated of plated aluminum, steel, or plastic, and supports and protects the insulator insert. Some receptacle shells are also used for mounting.

WARNING

Do not grind cadmium plated parts. Breathing airborne cadmium particles is a health hazard.

12. **Plating Types.** The following are typical shell plating and finish types: Cadmium over suitable underplate, electroless nickel, anodized, passivated, cadmium, gold and tin.

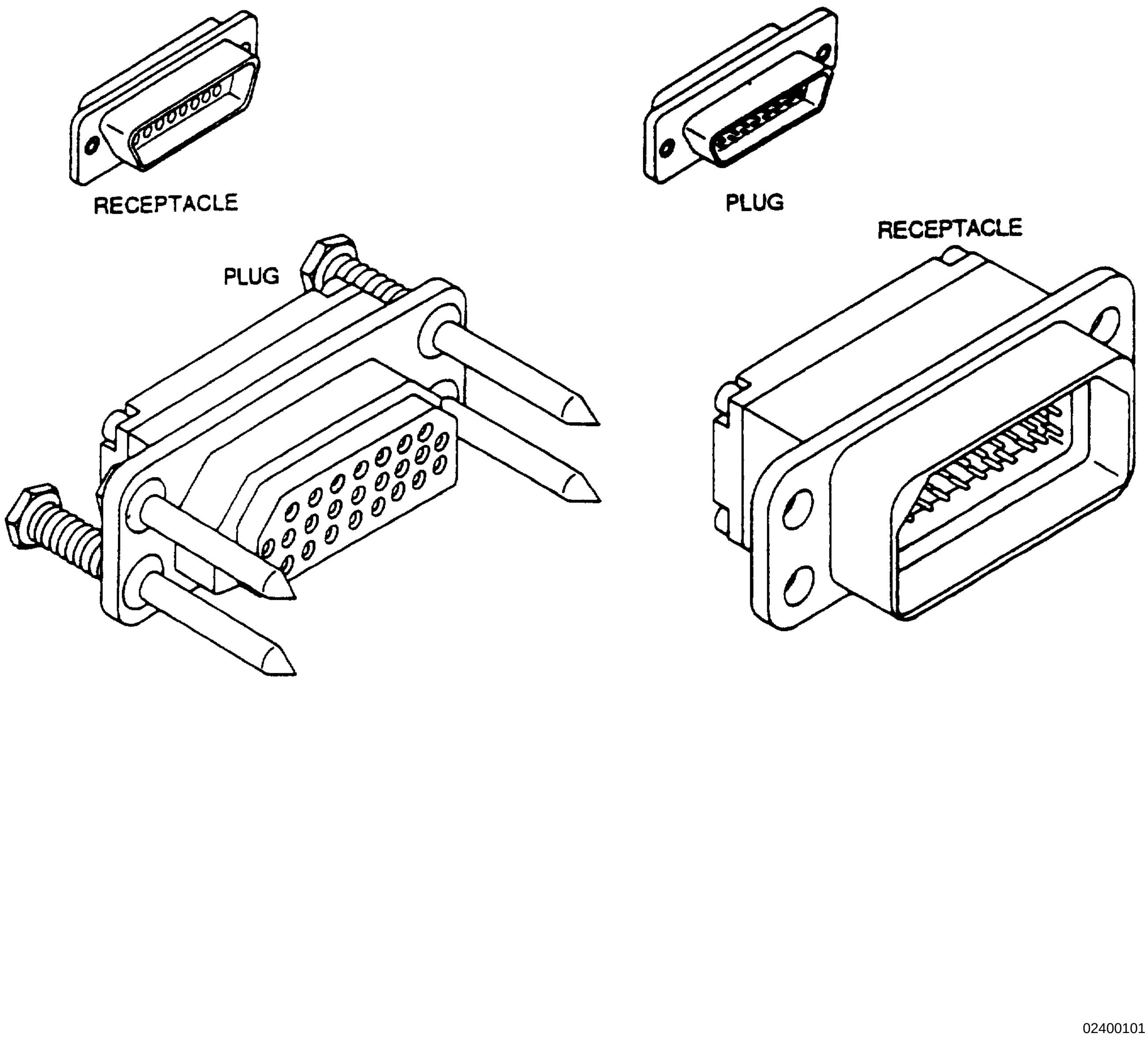


Figure 1. Typical Rack and Panel Connectors (Sheet 1 of 2)

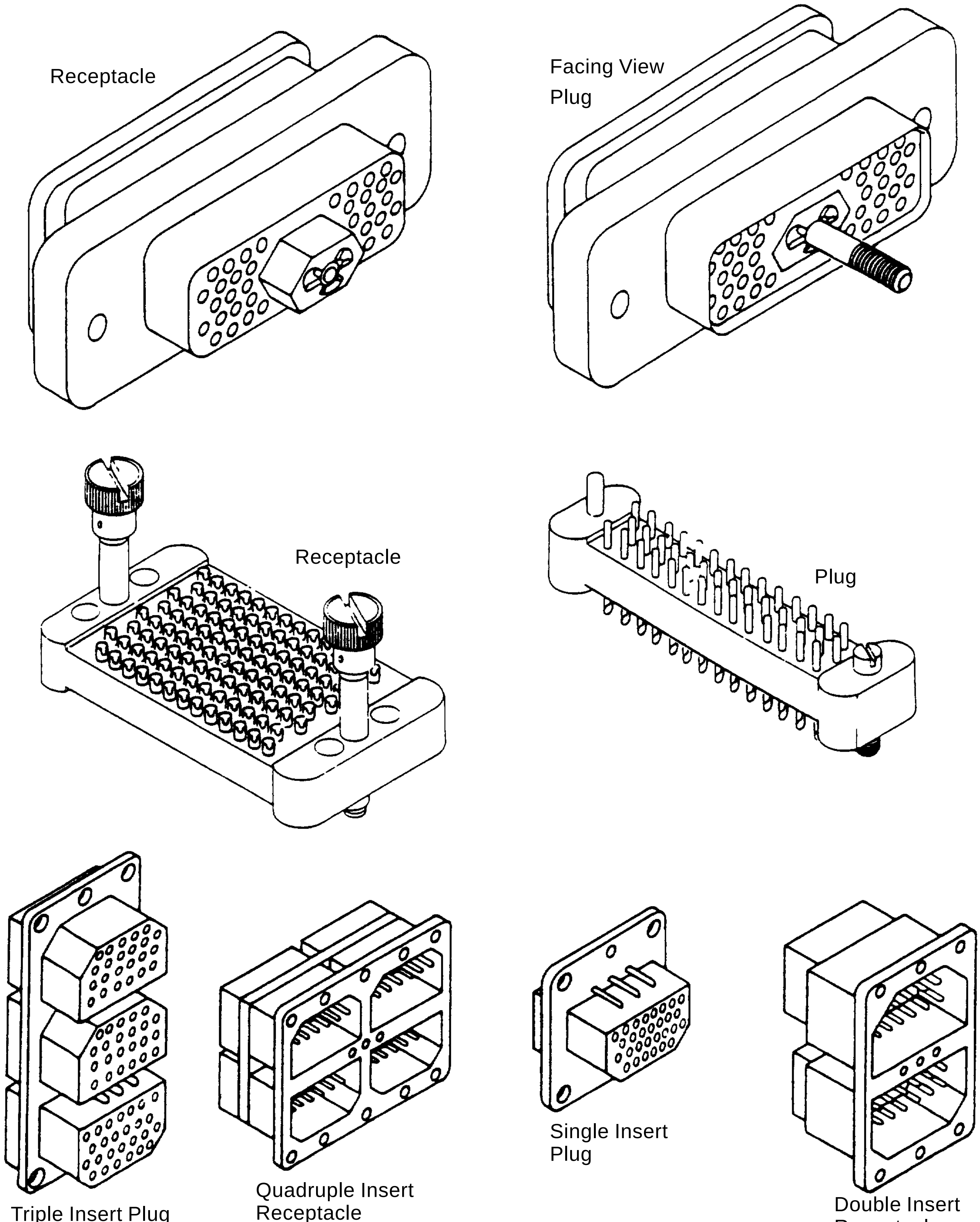


Figure 1. Typical Rack and Panel Connectors (Sheet 2)

02400102

NOTE

Nickel plated parts are not for Navy use or new design.

13. **POLARIZATION.** Polarization may be accomplished by a number of methods. See the paragraphs for the appropriate connector type for more details.

14. **COUPLING.** No special tools are required for coupling rack and panel connectors.

15. **MOUNTING.** Connectors shall be provided with means to fasten the shell securely to a mounting surface. Rack and panel connector shells are capable of being interchangeably mounted in a fixed or floating position. Fixed mounted connectors will mate properly with float mounted connectors. Shells are provided with either captive clinch nuts for fixed mounting or will be provided with or have provisions to allow installation of spring mounts, bushings, or guide pins. MIL-C-24308 class H and K connectors shall be provided with solder mounting provisions, or for provisions with external mounting hardware.

16. **DESIGN AND CONSTRUCTION.** Connectors are designed and constructed to withstand normal handling incidental to installation and maintenance.

17. **SERVICE CLASS.** Service class pertains to the environmental parameters in which the connector will operate successfully. These parameters include:

a. Environmental sealing,

b. Fuel and fluid resistance,

c. Vibration and shock,

d. Corrosion resistance,

e. Operating temperature,

f. Special conditions.

18. **INSERTS.** The entire insert is essentially one integral part, designed to provide suitable support around the wires and insulate the contacts from the shell as well as from other contacts. These inserts are usually constructed of a dielectric material such as rubber or plastic compositions, and are nonremovable. The rigid dielectric is one molded piece, or more than one piece bonded together. The insert design is such that the contacts are able to be inserted and removed to facilitate installation and maintenance, except when using hermetic receptacle in which the contacts are fixed in the insert. A connector contains either a pin insert or socket insert.

19. **Contact Locking Devices.** In connectors with removable contacts, the contact locking devices are contained in the rigid dielectric and securely hold the contacts during normal coupling.

20. **Insert Arrangement.** The insert arrangement indicates the service rating, and the quantity, size, and position of the contacts.

21. **Service Rating.** The service rating defines the test voltage that can be applied between adjacent contacts or a contact and the connector shell without evidence of breakdown or flashover.

22. **ENVIRONMENTAL SEALS.** The environmental seal is designed and utilized to prevent moisture from entering the connector and causing shorts. There are several types of seals.

23. **Shell Seal.** This seal is effected when the plug shell pushes against the sealing ring in the receptacle when connectors are mated.

24. **Peripheral Seal.** This seal is around the edge of the pin insulator, and designed so that when the connectors mate, tension is put on the seal and greatly reduces compression set.

25. **Interfacial Seal.** This seal is normally a rubber seal bonded to the insert face with a hole pattern corresponding to the insert. The connector, when mated, compresses the interfacial seal forming the environmental seal around each contact.

26. **Grommet Seal.** Some connectors have a grommet seal that is placed at the rear of the connector with a hole pattern corresponding to the insert. Inside the grommet are one or more seals that hold themselves against the wire to prevent moisture entry. Wire outside diameter must be within tolerances defined in the applicable connector specification to meet the sealing requirements. Undersized wire may be built up with heat shrinkable sleeving to the correct size.

27. **Cable Seal.** When using jacketed cable. an adapter and special seal may be used. As the adapter clamp is tightened, the cable seal is compressed forming the environmental seal.

28. **Hermetic Seal.** A glass-like material is used to insulate and seal the contacts, and all pin contacts will have an interfacial seal. The contacts are nonremovable.

29. **GROMMET SEALING PLUGS.** The grommets of environmental resisting connectors are designed to accept sealing plugs in accordance with MS27488. Sealing plugs are to be used in empty connector cavities or in cavities with unwired contacts to maintain environmental resistance. The connector, when ordered as a unit, will have sealing plugs enclosed so as to equal 10 or 15% of the number of contacts, but not less than one.

30. **Sealing Plug Selection.** Sealing plugs are sized according to contact size (Table 2).

TABLE 2. SEALING PLUG SELECTION

Contact size	Sealing Plug Part Number	Color
22	MS27488-22	Black
20	MS27488-20	Red
16	MS27488-16	Blue
12	MS27488-12	Yellow
8	MS27488-8	Red
4	MS27488-4	Blue
0	MS27488-0	Yellow

31. **Installation of Sealing Plugs.** When installing sealing plugs in connector cavities without contacts, the end opposite the knob shall be inserted first, and the knob shall be seated against the grommet face. When installing into cavities with contacts, the sealing plugs shall be installed knob end first and shall bottom on the contact wire barrel.

32. **CONTACTS.** Contacts are the pins or sockets within the insert and may be either fixed or removable, solder or crimp. The contacts terminate the wire within the connector.

33. **Fixed Contacts.** Solder contacts are normally fixed, but some connectors may have removable solder contacts. The contacts have either eyelet, solder cup, or solder post terminals. The wires are terminated to the contact through a solder cup or barrel on the contact, with solder (WP 017 00).

34. **Wrappost Contacts.** Wrappost contacts are used for solderless wire wrapping, which is a reliable method for making point to point mechanical and electrical connections between wires and terminals.

35. **Crimp Contacts.** Crimp contacts are removable and utilize special tools to insert and remove the contacts. The contacts are crimped to the wire using standard crimp tools and positioners (WP 009 00 and WP 013 00).

36. **Contact Availability.** Crimp contacts are supplied with each connector unit package and consist of a full complement plus one spare per size for connectors of 26 contacts or less. Connectors with more than 26 contacts will have two spares of each size used. Contacts may also be ordered in individual quantities when necessary.

37. **INTERCHANGEABILITY.** All connectors having the same military part number are completely interchangeable with respect to installation and performance.

38. CONNECTOR INSTALLATION.

39. **INSTALLATION GUIDELINES.** Connectors shall be used to join cables to cables, equipment, components, or other wires. The following installation guidelines shall be followed:

a. Adequate space shall be provided for mating and unmating connectors without the use of tools.

b. Locate connectors so as not to provide footrests, handholds, or in areas not to be damaged by cargo or stored materials.

c. When possible, locate both plug and receptacles to be visible for engagements and orientation of polarizing keys.

d. Adequate strain relief shall be provided to prevent pulled wires.

e. Connectors in pressurized structures shall be installed preferably with the flange on the high pressure side.

f. Ground power receptacles shall be installed with the small contacts at the bottom.

40. **ADJACENT INSTALLATION.** The use of identical connectors in adjacent locations shall be avoided. In situations where the use of identical connectors is unavoidable, adhere to the following guidelines:

a. Route and support wiring to prevent improper connections.

b. Where the same configurations are used, connectors shall be selected with different polarizations.

c. Color code plugs with a colored sleeve near the plug, and the receptacle color coded with a band on the structure.

41. **CONNECTOR DRAINAGE.** Receptacles shall be positioned that when unmated for maintenance, fluids and condensation will drain from the receptacles. External connectors, connectors in engine compartments, wheel wells, and other like locations shall be given special attention to protect them from the entry of oil, moisture, and other fluids. Connectors shall not be mounted in fluid collecting areas.

42. CONNECTOR MAINTENANCE.

43. Before proceeding with maintenance, repair or installation, become familiar with the following warnings, cautions and notes, as each of these are pertinent throughout this section.

WARNING

Assure all power is off/disconnected prior to performing any wiring system repair

If the connector has a backshell, it must be removed before maintenance procedures can proceed (WP 025 00).

Safety glasses shall be worn during all wire cutting and stripping operations.

Isopropyl alcohol is highly flammable. Use only with adequate ventilation. Avoid prolonged breathing of vapors.

Unwired contact cavities must have contact and sealing plugs installed.

Metal tool tips are sharp and can cause injury to personnel and/or damage to the connector.

Do not use heating tools with electric motors when working on or near aircraft that have not been defueled and purged, and certified gas free in accordance with NA 01-1A-35. Use heating tool HT-900B/HT-920B (WP 012 00).

Nozzle and output air of heating tools get very hot. Use extreme care while operating heating tools to avoid serious burns.

Use of nitrogen with the HT-900B/HT-920B heating tools in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

Do not use electrical power from aircraft being repaired. Use electrical power from ground power unit.

CAUTION

Be careful if using metal M81969 tools. These tools can damage the wire sealing grommet in the connector if not used properly. Plastic tools are preferred when available.

Inspect tool tips for damage or distortion before each use. Damage to the connector wire sealing grommet can occur.

Avoid using metal tooling to remove and install backshells. These tools can damage the backshell and connector. Non-metallic tools are designed to wear before damaging connector or backshell (WP 025 00).

Do not remove a contact attached to a broken wire with an unwired contact removal tool. The connector and tool may be damaged.

Withdraw tool any time it cannot be advanced into connector. Inspect tool tip for nicks, cracks, mushrooming and other damage that will prevent proper functioning. Replace removal tool and repeat procedure if required.

44. **DETERMINING PROPER INSTALLING AND REMOVAL TOOLS AND CONTACTS.** If the connector part number is an MS number, the basic: connector specification and series can be determined from the connector example of part number (Figures 2 through 12). Information regarding the insert arrangement, contact size, and installing and removal tools may be obtained from the example of part number and the applicable NAVAIR 01-1A-505 volume listed in Table 1. Contact sizes and installing and removal tool information may also be obtained from the applicable contact specification sheet. (See paragraphs 82 through 153 for additional information regarding specific connector types and maintenance.)

45. **WIRE DIAMETER BUILD-UP.** In cases where the outside diameter does not fill the grommet sealing holes, environmental resistance will be severely degraded. The wire diameter must be built up to provide proper sealing prior to contact insertion, by performing the following:

a. Select proper heat shrinkable insulation sleeving in accordance with MIL-I-23053.

b. Cut to length necessary to extend 1/4 inch beyond grommet.

c. Do not apply so as to cover crimp contact area.

d. Using proper reflector, apply heat using HT-900B/HT-920B to shrink sleeving.

e. Repeat above steps until diameter is built up to seal diameter.

46. **CONTACT INSTALLATION AND RELEASE.** Removable contacts, either solder or crimp, may be either front or rear release. Both systems result in the contact being inserted from the rear of the connector. Rear release connectors are required to have one or more blue color bands that are readily visible when the connectors are installed.

CAUTION

Do not attempt to reseat a contact once the insertion tool has been removed. Remove the contact and start over with the contact wire barrel properly seated in the tool. Failure to follow this procedure may cause damage to the connector, contact or tool.

47. **Front Release Connectors.**

48. **Insertion Front Release.** For front release connectors, the contacts or wired contacts are inserted from the rear of the connector using the specified tool, until the contact seats. An audible click may be heard when the contact is properly seated in an individual contact retention system. Figure 13 outlines the typical method used for inserting front release contacts. Figure 14 describes the method for installing contacts into MIL-C-85028 connectors.

49. Removal Front Release. To remove the contact or wired contacts, the tool is inserted into the front (mating face) of the connector to release the retaining clips and push the contact from the rear of the connector (Figure 15).

CAUTION

Do not attempt to reseal a contact once the insertion tool has been removed. Remove the contact and start over with the contact wire barrel properly seated in the tool. Failure to follow this procedure may cause damage to the connector, contact or tool.

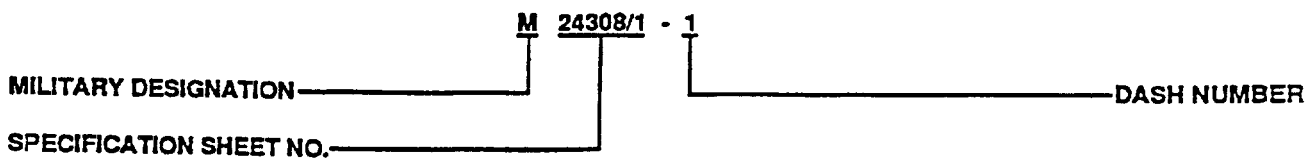
50. Rear Release Connectors.

51. Insertion Rear Release. For rear release connectors, the contacts or wired contacts are inserted, using the specified tool, from the rear of the connector until the contact seats (Figure 16). An audible click may be heard when the contact is properly seated.

52. Removal Rear Release (Wired). Removal of wired contacts is accomplished by inserting the specified tool into the rear of the connector to release the retaining clips. When released, the wire and tool are grasped together and pulled from the connector cavity with the contact intact (Figure l7).

53. Removal Rear Release (Unwired). Removal of unwired contacts is accomplished by inserting the specified tool into the rear of the connector until the plunger locates the end of the contact wire barrel. The tool body is then pushed in until the probe (plastic tip) grasps the contact wire barrel and releases the retaining clips. With the plunger retracted, the tool with the contact intact, is pulled from the connector (Figure 18).

54. Rear Release, Broken Wire Contact Removal. An unwired contact removal tool should not be used to remove a contact with a broken wire. Select the appropriate removal tool and follow the procedure described in Figure 19.



SPEC SHEET	DESCRIPTION
M24308/1	CLASS G GENERAL PURPOSE RECEPTACLE, SOLDER TYPE SOCKET CONTACTS
M24308/2	CLASS G GENERAL PURPOSE RECEPTACLE, REMOVABLE CRIMP TYPE SOCKET CONTACTS
M24308/3	CLASS G GENERAL PURPOSE PLUG, SOLDER TYPE PIN CONTACTS
M24308/4	CLASS G GENERAL PURPOSE PLUG, REMOVABLE CRIMP TYPE PIN CONTACTS
M24308/5	CLASS N NONMAGNETIC RECEPTACLE, SOLDER TYPE SOCKET CONTACTS
M24308/6	CLASS N NONMAGNETIC RECEPTACLE, REMOVABLE CRIMP TYPE SOCKET CONTACTS
M24308/7	CLASS N NONMAGNETIC PLUG, SOLDER TYPE PIN CONTACTS
M24308/8	CLASS N NONMAGNETIC PLUG, REMOVABLE CIRMP TYPE PIN CONTACTS
M24308/9	CLASS H HERMETIC PLUG, SOLDER TYPE PIN CONTACTS
M24308/23	RECEPTACLE, STRAIGHT PCB TERMINATION, SOCKET CONTACTS
M24308/24	PLUG, STRAIGHT AND 90° PCB TERMINATION, PIN CONTACTS

Figure 2. MIL-C-24308 Part Number Breakdown

024002

PART NUMBER DESIGNATION

M28731/1 - 0109

MILITARY PREFIX — M28731/1

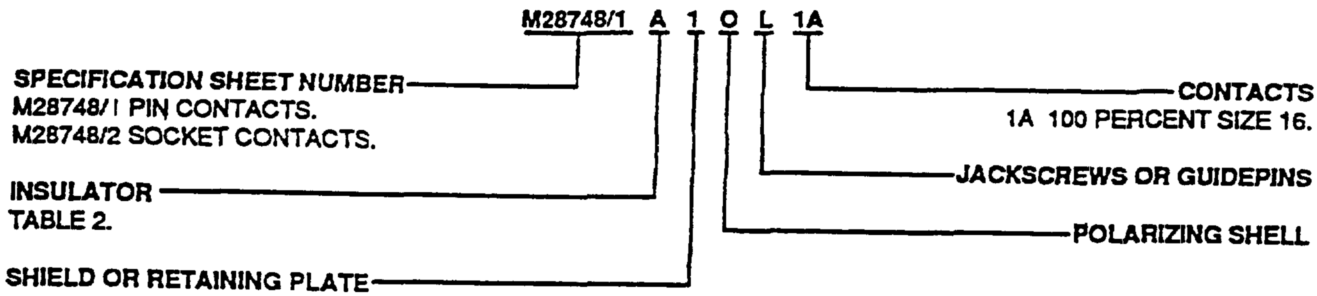
MODIFIER — 0109

Military Prefix	Description
M28731/1	75 CONTACT MALE INSERT PLUG CONNECTOR
M28731/2	75 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/3	100 CONTACT MALE INSERT PLUG CONNECTOR
M28731/4	100 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/5	130 CONTACT MALE INSERT PLUG CONNECTOR
M28731/6	130 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/9	20 CONTACT MALE INSERT PLUG CONNECTOR
M28731/10	20 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/11	38 CONTACT MALE INSERT PLUG CONNECTOR
M28731/12	38 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/13	56 CONTACT MALE INSERT PLUG CONNECTOR
M28731/14	56 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/15	90 CONTACT MALE INSERT PLUG CONNECTOR
M28731/16	90 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/17	120 CONTACT MALE INSERT PLUG CONNECTOR
M28731/18	120 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/27	33 CONTACT MALE INSERT PLUG CONNECTOR
M28731/28	33 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/29	75 CONTACT MALE INSERT PLUG CONNECTOR
M28731/30	75 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/31	117 CONTACT MALE INSERT PLUG CONNECTOR
M28731/32	117 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR
M28731/33	165 CONTACT MALE INSERT PLUG CONNECTOR
M28731/34	165 CONTACT FEMALE INSERT RECEPTACLE CONNECTOR

Figure 3. MIL-C-28731 Part Number Breakdown

024003

PART NUMBER DESIGNATION



SHIELD OR RETAINING PLATE

Part No. Code	Used With Insulator	Description	MS Number
1*	A, B, C	SHIELD, TOP CLAMP	MS24132
2*		SHIELD, SIDE CLAMP	
3*	D, E, F, H	SHIELD, TOP CLAMP	MS24133
4*		SHIELD, SIDE CLAMP	
5†	G,J	SHIELD, TOP CLAMP	MS18193
6†		SHIELD, SIDE CLAMP	
A‡	A, B, C, D, E, F, H	SHIELD, TOP CLAMP	MS18192
B‡		SHIELD, SIDE CLAMP	
7	A, B, C	RETAINING PLATE	MS18198
8	D, E, F		MS18199
9	G, J		MS18200
0	ALL	NO SHIELD OR RETAINING PLATE	

* USED WHEN NO SHELL IS SPECIFIED
† USED WITH OR WITHOUT SHELLS
‡ USED WHEN SHELL IS SPECIFIED

02400401

Figure 4. M28748/1 and /2 Part Number Breakdown (Sheet 1 of 2)

POLARIZING SHELL

M28748/1		Mates With		M28748/2	
Part No. Code	Polarizing Position/ MS Number	Shell Type	Part No. Code	Polarizing Position/ MS Number	Shell Type
A	A OF MS18203	PLUG	A	A OF MS18204	RECEPTACLE
B	B OF MS18203		B	B OF MS18204	
C	C OF MS18203		C	C OF MS18204	
D	D OF MS18203		D	D OF MS18204	
E	E OF MS18203		E	E OF MS18204	
F	F OF MS18203		F	F OF MS18204	
G	G OF MS18203		G	G OF MS18204	
H	UNPOLARIZED MS18203		H	UNPOLARIZED MS18204	
J	A OF MS18204	RECEPTACLE	J	A OF MS18203	PLUG
K	B OF MS18204		K	B OF MS18203	
L	C OF MS18204		L	C OF MS18203	
M	D OF MS18204		M	D OF MS18203	
N	E OF MS18204		N	E OF MS18203	
P	F OF MS18204		P	F OF MS18203	
Q	G OF MS18204		Q	G OF MS18203	
R	UNPOLARIZED MS18204		R	UNPOLARIZED MS18203	
O	NO SHELL INCLUDED		O	NO SHELL INCLUDED	

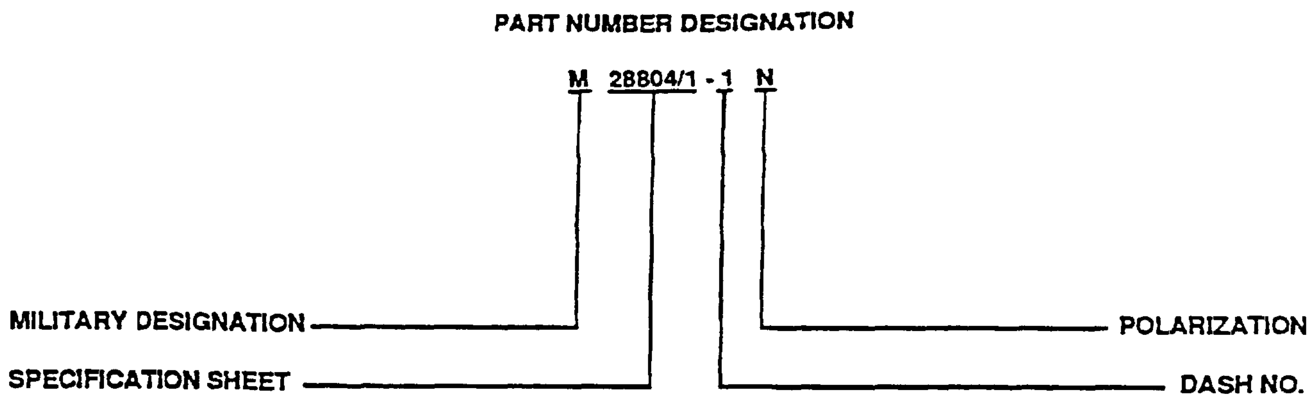
JACKSCREWS OR GUIDEPINS

Part No. Code	Description	MS Number
L	LONG JACKSCREWS	MS18194
S*	SHORT JACKSCREWS	MS18195
F*	FIXED JACKSCREWS	MS18196
G	GUIDEPINS	MS18197
O	NO JACKSCREWS OR GUIDEPINS INCLUDED	

* NOT USED WITH SHIELD

02400402

Figure 4. M28748/1 and /2 Part Number Breakdown (Sheet 2)



SPECIFICATION SHEET NO.

M28804/1 CLASS G NON-ENVIRONMENTAL RECEPTACLE, CRIMP REMOVABLE SOCKET CONTACTS.
M28804/2 CLASS G NON-ENVIRONMENTAL PLUG, CRIMP REMOVABLE PIN CONTACTS.
M28804/3 CLASS E ENVIRONMENTAL RECEPTACLE, CRIMP REMOVABLE SOCKET CONTACTS.
M28804/4 CLASS E ENVIRONMENTAL PLUG, CRIMP REMOVABLE PIN CONTACTS.
M28804/5 CLASS P ENVIRONMENTAL POTTING TYPE RECEPTACLE, CRIMP REMOVABLE SOCKET CONTACTS.
M28804/6 CLASS P ENVIRONMENTAL POTTING TYPE PLUG; CRIMP REMOVABLE SOCKET CONTACTS.
M28804/7 CLASS S NON-ENVIRONMENTAL RECEPTACLE, SOLDER TAIL SOCKET CONTACTS.
M28804/8 CLASS S NON-ENVIRONMENTAL PLUG, SOLDER TAIL PIN CONTACTS.
M28804/9 SIZE 22 REMOVABLE PIN CONTACTS.
M28804/10 SIZE 22 REMOVABLE SOCKET CONTACT.
M28804/11 CLASS SE ENVIRONMENTAL PLUG, INTERFACIAL SEAL, SOLDER TAIL PIN CONTACTS.

DASH NO.

1 SHELL SIZE 8, 14 CONTACTS, STANDARD HARDWARE.
2 SHELL SIZE 10, 38 CONTACTS, STANDARD HARDWARE.
3 SHELL SIZE 12, 88 CONTACTS, STANDARD HARDWARE.
4 SHELL SIZE 14, 108 CONTACTS, STANDARD HARDWARE.
5 SHELL SIZE 16, 132 CONTACTS, STANDARD HARDWARE.
6 SHELL SIZE 18, 244 CONTACTS, STANDARD HARDWARE.
7 SHELL SIZE 8, 14 CONTACTS, REVERSED HARDWARE.
8 SHELL SIZE 10, 38 CONTACTS, REVERSED HARDWARE.
9 SHELL SIZE 12, 88 CONTACTS, REVERSED HARDWARE.
10 SHELL SIZE 14, 108 CONTACTS, REVERSED HARDWARE.
11 SHELL SIZE 16, 132 CONTACTS, REVERSED HARDWARE.
12 SHELL SIZE 18, 244 CONTACTS, REVERSED HARDWARE.

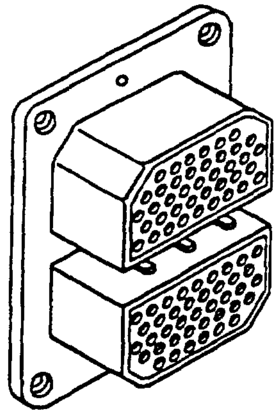
STANDARD HARDWARE CONSISTS OF RECEPTACLE WITH FIXED JACKSOCKET, PLUG WITH TURNABLE JACKSCREW.

REVERSED HARDWARE CONSISTS OF RECEPTACLE WITH TURNABLE JACKSOCKET, PLUG WITH FIXED JACKSCREW.

POLARIZATION

Figure. 5. MIL-C-28804 Part Number Breakdown

024005



PART NUMBER DESIGNATION

M81659 /7 A 1 0012

MIL SPEC — M81659
SPECIFICATION SHEET — /7
SHELL DESIGNATOR — A
SERIES DESIGNATOR — 1
INSERT DESIGNATOR — 0012

SPECIFICATION SHEET

/1 SINGLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/2 SINGLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/3 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/4 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/5 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/6 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/7 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/8 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/9 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/10 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/11 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/12 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/21 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/22 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/23 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/24 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/25 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/26 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/27 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/28 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2

CLASS 1: -85°F (-65°C) to +257°F (+125°C) OPERATING TEMPERATURE.
CLASS 2: -85°F (-65°C) to +392°F (+200°C) OPERATING TEMPERATURE.

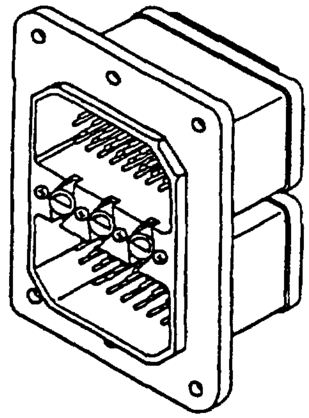
SHELL DESIGNATION
A KEYSTONE INSERT CONFIGURATION.
B RECTANGULAR INSERT CONFIGURATION.

SERIES DESIGNATION
1 FRONT RELEASE CONTACTS.
2 REAR RELEASE CONTACTS.

INSERT DESIGNATION
(TABLE 2)

Figure 6. MIL-C-81659 Series I Part Number Breakdown

024006



PART NUMBER DESIGNATION

M81659 /35 A 2 0011

MIL SPEC — M81659

SPECIFICATION SHEET — /35

SHELL DESIGNATOR — A

SERIES DESIGNATOR — 2

INSERT DESIGNATOR — 0011

SPECIFICATION SHEET

/29 SINGLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/30 SINGLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/31 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/32 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/33 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/34 DOUBLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/35 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/36 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/37 TRIPLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/38 TRIPLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/39 TRIPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/40 TRIPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/41 QUADRUPLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 1
/42 QUADRUPLE INSERT, ENVIRONMENTAL PLUG SHELL, CLASS 2
/43 QUADRUPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 1
/44 QUADRUPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, CLASS 2
/61 SINGLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, LESS GROMMET
/62 DOUBLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, LESS GROMMET
/63 TRIPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, LESS GROMMET
/64 QUADRUPLE INSERT, ENVIRONMENTAL RECEPTACLE SHELL, LESS GROMMET
/65 SINGLE INSERT, NON-ENVIRONMENTAL PLUG SHELL
/66 SINGLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL
/67 SINGLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL, CLINCH NUTS
/68 SINGLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL, FLOATING EYELETS
/69 DOUBLE INSERT, NON-ENVIRONMENTAL PLUG SHELL
/70 DOUBLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL
/71 DOUBLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL, CLINCH NUTS
/72 DOUBLE INSERT, NON-ENVIRONMENTAL RECEPTACLE SHELL, FLOATING EYELETS

Figure 7. MIL-C-81659 Series 2 Part Number Breakdown (Sheet 1 of 2)

02400701

CLASS 1: -85°F (-65°C) to +257°F (+125°C) OPERATING TEMPERATURE.
CLASS 2: -85°F (-65°C) to +392°F (+200°C) OPERATING TEMPERATURE.

SHELL DESIGNATION
A KEYSTONE INSERT CONFIGURATION.
B RECTANGULAR INSERT CONFIGURATION.

SERIES DESIGNATION
1 FRONT RELEASE CONTACTS.
2 REAR RELEASE CONTACTS.

INSERT DESIGNATION
(TABLE 2)

02400702

Figure 7. MIL-C-81659 Series 2 Part Number Breakdown (Sheet 2)

PART NUMBER DESIGNATION

M 83733/12 R B 101

- MILITARY DESIGNATION — M
- SPECIFICATION SHEET NO. — 83733/12
- CLASS — R
- SHELL SIZE — B
- INSERT CONFIGURATION — 101

SPECIFICATION SHEET NO.

M83733/01	PIN INSERT, RECEPTACLE SHELL, THRU HOLE MOUNTING.
M83733/02	SOCKET INSERT, PLUG SHELL, WITH GUIDE PINS AND SPRING MOUNTING.
M83733/03	PIN INSERT, RECEPTACLE SHELL, WITH GUIDE SOCKET MOUNTING.
M83733/04	SOCKET INSERT, PLUG SHELL, WITH CAPTIVE SPRING MOUNTING.
M83733/05	PIN INSERT, RECEPTACLE SHELL, BUSHING MOUNTING.
M83733/06	PIN INSERT, RECEPTACLE SHELL, CLINCH NUT MOUNTING.
M83733/07	SOCKET INSERT, PLUG SHELL, WITH GUIDE SOCKETS AND SPRING MOUNTING.
M83733/08	PIN INSERT, RECEPTACLE SHELL, GUIDE PIN MOUNTING.
M83733/09	PIN INSERT, RECEPTACLE SHELL, STAGGERED HOLE MOUNTING.
M83733/10	PIN INSERT, RECEPTACLE SHELL, STAGGERED BUSHING MOUNTING.
M83733/11	PIN INSERT, RECEPTACLE SHELL, STAGGERED CLINCH NUT MOUNTING.
M83733/12	SOCKET INSERT, PLUG SHELL, WITH STAGGERED SPRING MOUNTING.
M83733/13	SHIELDED PIN CONTACT FOR B71C CONTACT ARRANGEMENT.
M83733/14	SHIELDED SOCKET CONTACT FOR B71C CONTACT ARRANGEMENT.

CLASS

R ENVIRONMENTAL

SHELL SIZE

A SMALL SHELL

B LARGE SHELL

TABLE 2.

INSERT CONFIGURATION

TABLE 2 AND FIGURE 5.

Figure 8. MIL-C-83733 Part Number Breakdown

024008

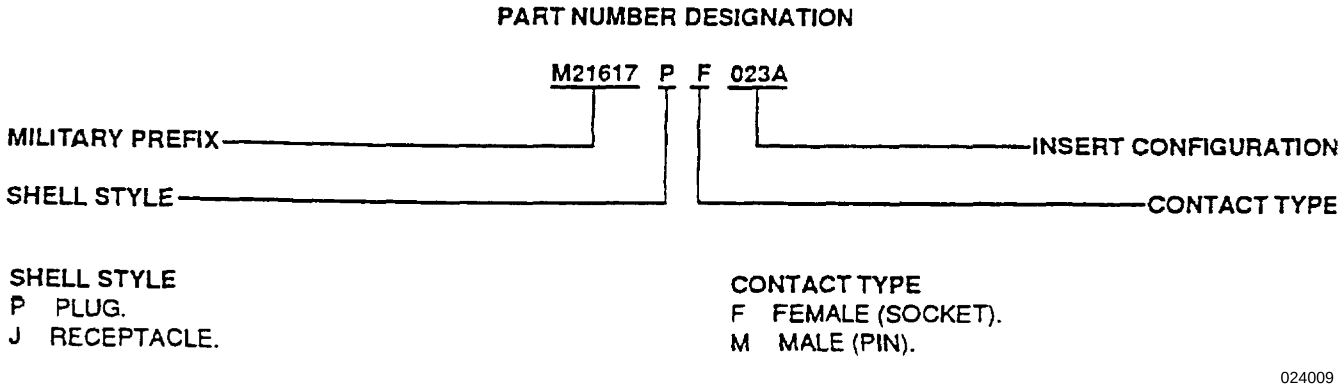


Figure 9. MIL-C-21617 Part Number Breakdown

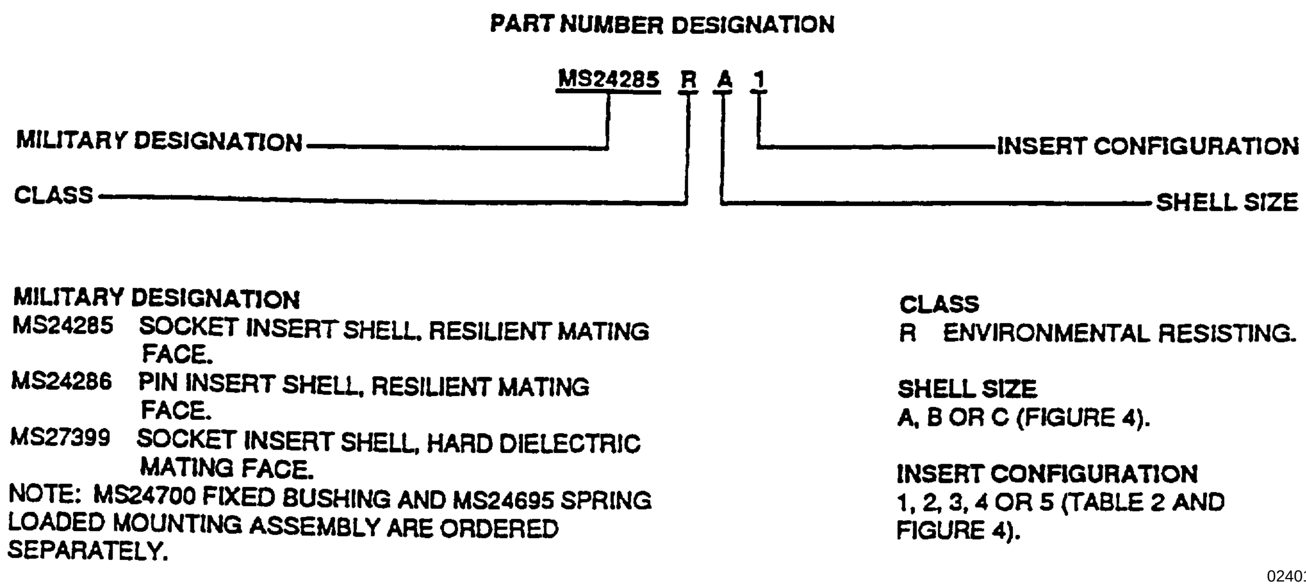
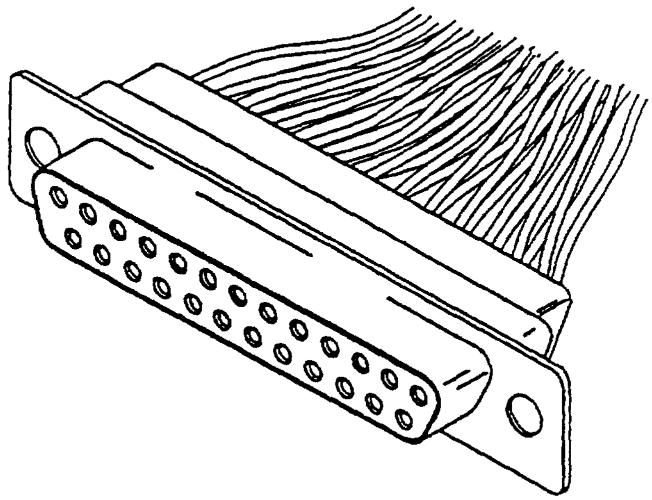
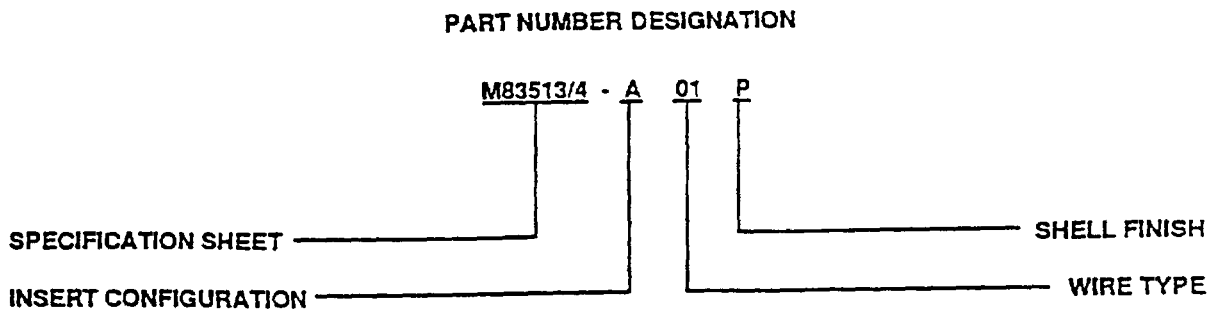


Figure 10. MIL-C-26518 Part Number Breakdown





SPECIFICATION SHEET
SEE SHEET 2

INSERT CONFIGURATION

- A 9 CONTACTS.
- B 15 CONTACTS.
- C 21 CONTACTS.
- D 25 CONTACTS.
- E 31 CONTACTS.
- F 37 CONTACTS.
- G 51 CONTACTS.
- H 100 CONTACTS (CLASS M CONNECTORS ONLY).

WIRE TYPE (M83513/3, /4, /8, AND /9 ONLY)

- 01 M22759/11-26-9, 18 IN. LONG.
- 02 M22759/11-26-9, 36 IN. LONG.
- 03 M22759/11-26-(*), 18 IN. LONG.
- 04 M22759/11-26-(*), 36 IN. LONG.
- 05 QQ-W-343, TYPE S, 25 AWG, GOLD PLATED, .5 IN. LONG.
- 06 QQ-W-343, TYPE S, 25 AWG, GOLD PLATED, 1.0 IN. LONG.
- 07 QQ-W-343, TYPE S, 25 AWG, TIN PLATED, .5 IN. LONG.
- 08 QQ-W-343, TYPE S, 25 AWG, TIN PLATED, 1.0 IN. LONG.

COLOR CODE PER MIL-STD-681, SYSTEM 1.

SHELL FINISH (CLASS M CONNECTORS ONLY)

- BLANK STANDARD CADMIUM OR ZINC PLATED.
- A ELECTROLESS NICKEL. FOR AIR FORCE SPACE APPLICATIONS.
- P PASSIVATED STAINLESS STEEL.

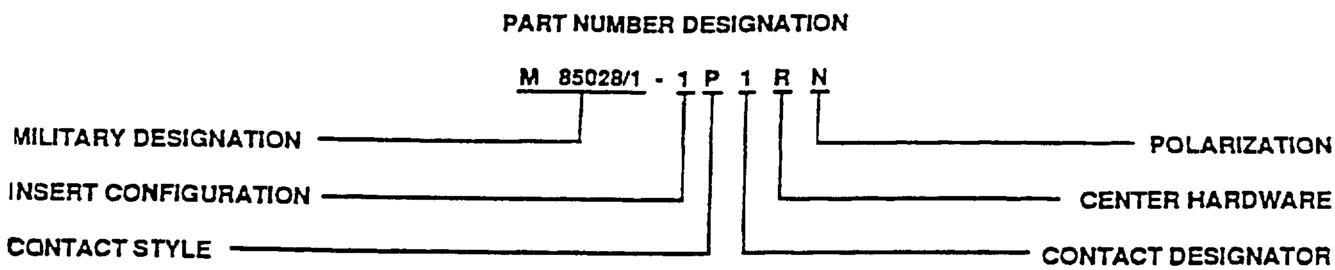
Figure 11. MIL-C-83513 Part Number Breakdown (Sheet 1 of 2)

02401101

Specification	Description
M83513/1	Class M, Metal Shell Plug, Nonremovable Solder Pin Contacts
M83513/2	Class M, Metal Shell Receptacle, Nonremovable Solder Socket Contacts
M83513/3	Class M, Metal Shell Plug, Nonremovable Crimp Pin Contacts
M83513/4	Class M, Metal Shell Receptacle, Nonremovable Crimp Socket Contacts
M83513/5	Connector Mounting Hardware
M83513/6	Class P, All Plastic Plug, Nonremovable Solder Pin Contacts
M83513/7	Class P, All Plastic Receptacle, Nonremovable Solder Socket Contacts
M83513/8	Class P, All Plastic Plug, Nonremovable Crimp Pin Contacts
M83513/9	Class P, All Plastic Receptacle, Nonremovable Crimp Socket Contacts

02401102

Figure 11. MIL-C-83513 Part Number Breakdown (Sheet 2)



MILITARY DESIGNATION
M85028/1 PLUG, ENVIRONMENTAL, CRIMP REMOVABLE PIN CONTACTS.
M85028/2 RECEPTACLE, ENVIRONMENTAL, CRIMP REMOVABLE SOCKET CONTACTS.

INSERT CONFIGURATION (FIGURE 6)
1 52 CONTACTS.
2 80 CONTACTS.
3 104 CONTACTS.
4 158 CONTACTS.
5 212 CONTACTS.
(1–5: PLUG AND RECEPTACLE WITH TYPE R JACKSCREW)
6 52 CONTACTS.
7 80 CONTACTS.
8 104 CONTACTS.
9 158 CONTACTS.
10 212 CONTACTS.
(6–10: RECEPTACLE WITH TYPE J JACKSCREW)

CONTACT STYLE
P PIN.
S SOCKET.
PA LESS PIN CONTACTS.
SB LESS SOCKET CONTACTS.

CONTACT DESIGNATOR
0 NO CONTACTS.
1 CONTACTS FOR 24-28 AWG WIRE.
2 CONTACTS FOR 20-24 AWG WIRE.
3 CONTACTS FOR 16-20 AWG WIRE.

CENTER HARDWARE
F BOSS (RECEPTACLE ONLY).
J EXTENDED TURNABLE JACKSCREW (PLUG ONLY).
R RECESSED TURNABLE JACKSCREW (PLUG ONLY).

POLARIZATION
(FIGURE 2).

024012

Figure 12. MIL-C-85028 Part Number Breakdown

A. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

B. ENSURE WIRE OR CABLE ON CONTACT IS ROUTED THOUGH CONNECTOR BACKSHELL.

WARNING

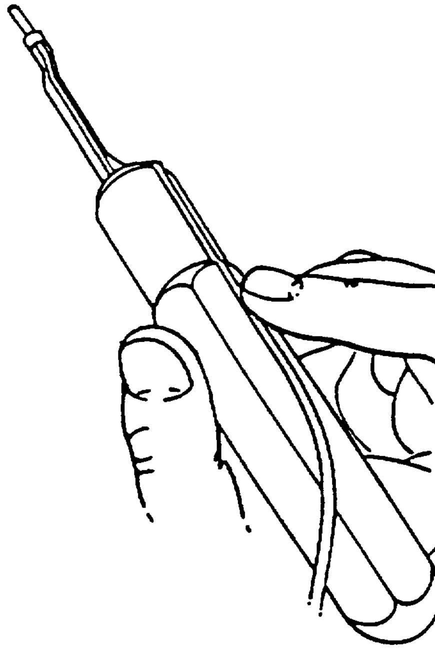
ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

C. SELECT CORRECT INSERTION TOOL. LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

NOTE

WHEN USING DUAL TIP PLASTIC TOOLS, THE COLORED TIP IS THE INSERTION TIP.

D. PLACE WIRE AND CONTACT ASSEMBLY INTO TIP OF INSERTION TOOL. ENSURE TOOL TIP IS OVER CONDUCTOR BARREL AND BUTTED AGAINST CONTACT SHOULDER.



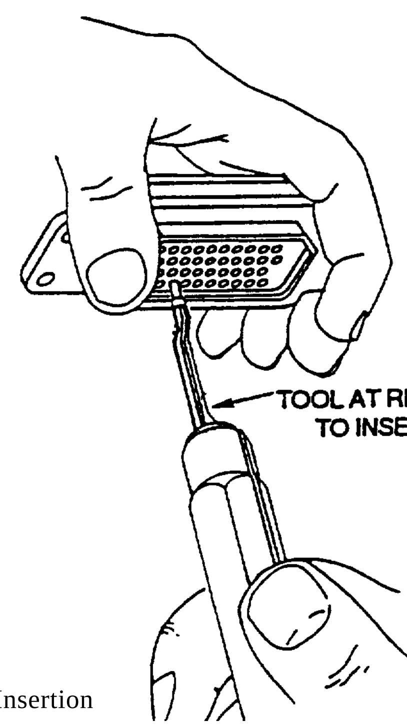
E. INSERT TIP OF CONTACT INTO CAVITY. START CONTACT INSERTION NEAR CONNECTOR CENTER CAVITIES AND WORK OUTWARD.

F. AXIALLY ALIGN CONTACT WITH CONTACT CAVITY.

G. WITH FIRM EVEN PRESSURE, PRESS TOOL AGAINST CONTACT SHOULDER AND SEAT CONTACT INTO CAVITY. A SLIGHT CLICK MAY BE HEARD AS RETENTION TINES SNAP INTO PLACE BEHIND CONTACT SHOULDER.

H. PULL TOOL STRAIGHT OUT OF CONTACT CAVITY. REMOVE TOOL FROM WIRE. PULL BACK LIGHTLY ON WIRE TO ENSURE CONTACT IS PROPERLY SEATED.

I. SEAL CONNECTOR AS REQUIRED (WP 026 00) AND INSTALL BACKSHELL.



024013

Figure 13. Front Release Contact Insertion

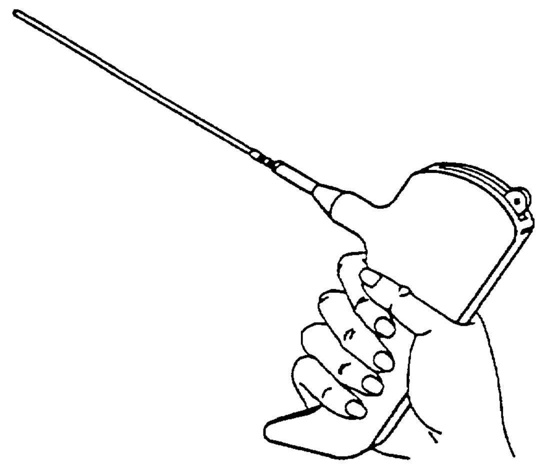
A. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

B. ENSURE WIRE OR CABLE ON CONTACT IS ROUTED THROUGH CONNECTOR BACKSHELL.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

C. SELECT CORRECT INSERTION TOOL (FIGURE 9). LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

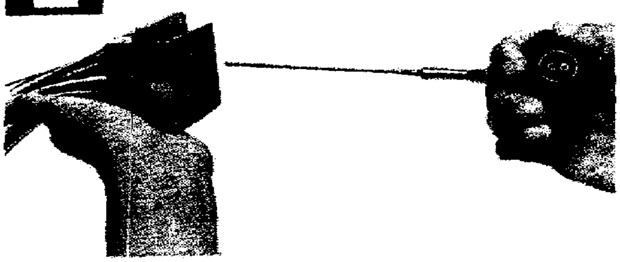


02401401

Figure 14. MIL-C-85028 Connector Front Release Contact Insertion (Sheet 1 of 2)

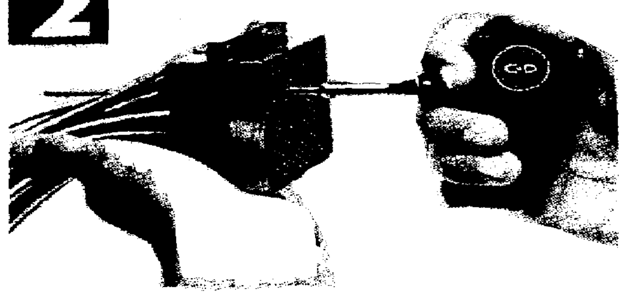
HUGHES
PULL-THRU
INSERTION TOOL
ASSEMBLY PROCEDURES

1



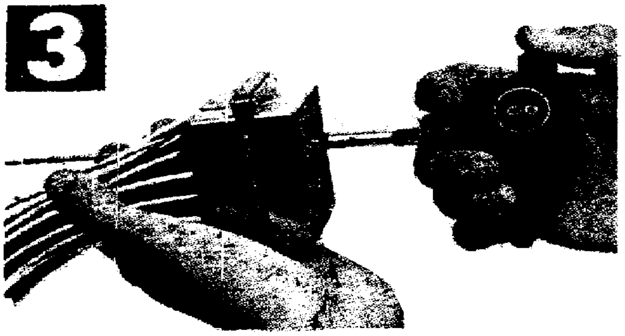
With thumb actuated lever in open (for–ward) position. Insert the tip of the Pull–Thru through front of proper cavity in connector block.

2



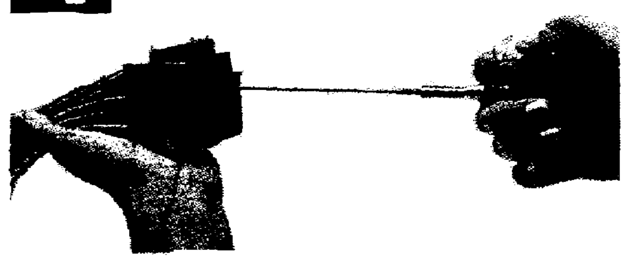
Push forward until tip extends clear of wires at rear of connector block for easy mating of contact with tip.

3



Insert pin or socket contact to the tip and move thumb lever to the closed (rear) position to lock the tip to the contact with firm pressure.

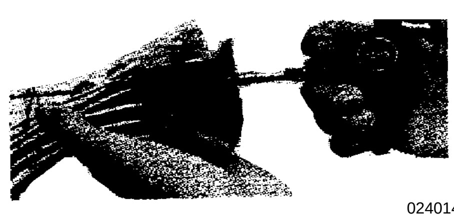
4



WIthdraw the tool with a slight rotating motion until the contact snaps into place. CAUTION: Never “jerk” the contact into place. Move the thumb lever to the open position and remove the tool.

CAUTION

Do not attempt to use the Pull–Thru as a contact removal tool, or seirous damage may result. Once the contact is loosened by use of the proper contact removal tool, the Pull–Thru may be attached to the contact and used to push the contact back through the wire bundle for quick identification and/or inspection or repair. This ability vastly reduces the time necessary for field service.



02401402

Figure 14. MIL-C-85028 Connector Front Release Contact Insertion (Sheet 2)

CRIMP FRONT RELEASE CONTACTS.

A. SELECT CORRECT REMOVAL TOOL.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

B. LUBRICATE TOOL TIP BY DIPPING IN ISOPROPYL ALCOHOL.

C. IF CONTACT IS UNWIRED, REMOVE SEALING PLUG FROM CAVITY OF CONTACT TO BE REMOVED.

D. WORKING FROM THE FRONT (MATING END) OF CONNECTOR, SLIDE HOLLOW END OF REMOVAL TOOL OVER CONTACT.

WARNING

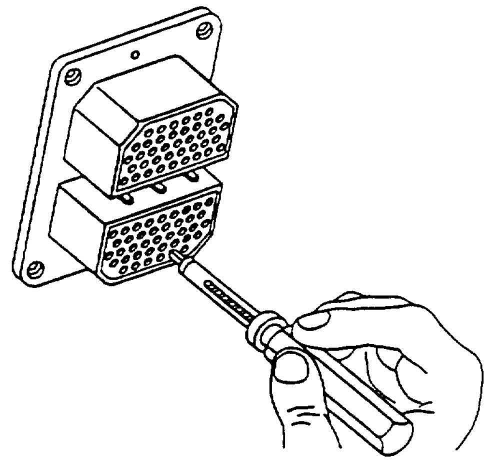
METAL TOOL TIPS ARE SHARP AND CAN CAUSE INJURY TO PERSONNEL AND/OR DAMAGE TO CONNECTORS.

CAUTION

PRESENT METAL TOOLING IN SOME INSTANCES HAS DAMAGED THE WIRE SEALING GROMMET AT THE END OF THE CONNECTORS. PLASTIC TOOLS ARE PREFERRED.

CAUTION SHOULD BE EXERCISED IN THE USE OF TOOLING.

INSPECT TIPS OF METAL TOOLS FOR DISTORTION OF PROBE BEFORE USE AS CONNECTOR DAMAGE CAN OCCUR.



02401501

Figure 15. Front Release Contact Removal (Sheet 1 of 2)

E. HOLDING REMOVAL TOOL AT RIGHT ANGLE TO FRONT INSERT FACE, PUSH TOOL STRAIGHT TOWARD REAR OF CONNECTOR, FIRMLY PRESSING TOOL TO POSITIVE STOP WHEN TOOL BOTTOMS IN INSERT CAVITY.

F. MAINTAIN PRESSURE ON TOOL HANDLE AND SLIDE COLLAR OF TOOL FORWARD UNTIL IT STOPS. CONTACT WILL BE PARTIALLY EJECTED FROM REAR OF CONNECTOR INSERT.

G. REMOVE TOOL BY PULLING STRAIGHT BACK TO CLEAR CONNECTOR INSERT FACE. REMOVE CONTACT OUT THE REAR OF CONNECTOR BY PULLING LIGHTLY ON WIRE OR USING A MATING CONTACT TO PUSH OUT RELEASED CONTACT.

Figure 15. Front Release Contact Removal (Sheet 2)

02401502

A. REMOVE SEALING PLUG AND/OR CONTACT FROM CONTACT CAVITY.

B. ENSURE WIRE OR CABLE ON CONTACT IS ROUTED THROUGH CONNECTOR BACKSHELL.

WARNING

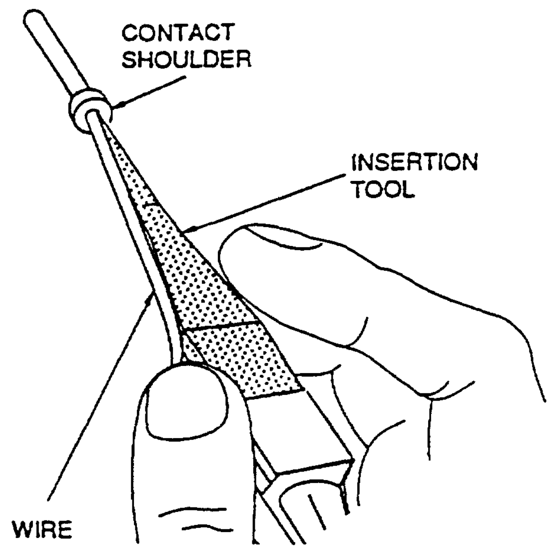
ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATLON OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

C. SELECT CORRECT INSERTION TOOL. LUBRICATE TIP BY DIPPING IN ISOPROPYL ALCOHOL.

NOTE

WHEN USING DUAL TIP PLASTIC TOOLS,THE COLORED TIP IS THE INSERTION TIP.

D. PLACE WIRE AND CONTACT ASSEMBLY INTO TIP OF INSERTION TOOL. ENSURE TOOL TIP IS OVER CONDUCTOR BARREL AND BUTTED AGAINST CONTACT SHOULDER.



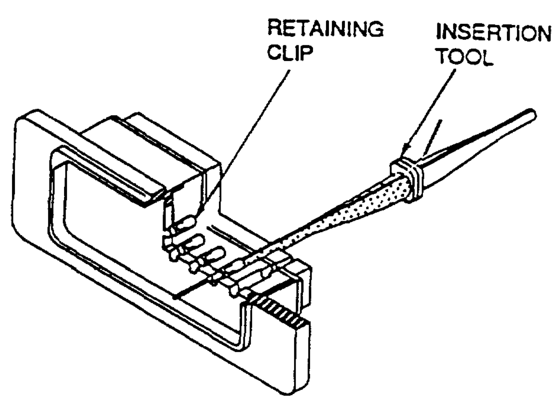
E. INSERT TIP OF CONTACT INTO CAVITY. START CONTACT INSERTION NEAR CONNECTOR CENTER CAVITIES AND WORK OUTWARD.

F. AXIALLY ALIGN CONTACT WITH CONTACT CAVITY.

G. WITH FIRM EVEN PRESSURE, PRESS TOOL AGAINST CONTACT SHOULDER AND SEAT CONTACT INTO CAVITY. A SLIGHT CLICK MAY BE HEARD AS RETENTION TINES SNAP INTO PLACE BEHIND CONTACT SHOULDER.

H. PULL TOOL STRAIGHT OUT OF CONTACT CAVITY. REMOVE TOOL FROM WIRE. PULL BACK LIGHTLY ON WIRE TO ENSURE CONTACT IS PROPERLY SEATED.

I. SEAL CONNECTOR AS REQUIRED (WP 026 00).



024016

Figure 16. Rear Release Contact Insertion

WIRED CONTACT REMOVAL

WARNING

METALTOOLTIPS ARE SHARP AND CAN CAUSE INJURY TO PERSONNEL AND/OR DAMAGE TO CONNECTORS.

CAUTION

PRESENT METAL TOOLING IN SOME INSTANCES HAS DAMAGED THE WIRE SEALING GROMMET AT THE END OF THE CONNECTORS. PLASTIC TOOLS ARE PREFERRED.

CAUTION SHOULD BE EXERCISED IN THE USE OF TOOLING.

INSPECT TIPS OF METAL TOOLS FOR DISTORTION OF PROBE BEFORE USE AS CONNECTOR DAMAGE CAN OCCUR.

A. SELECT CORRECT REMOVAL TOOL.

WARNING

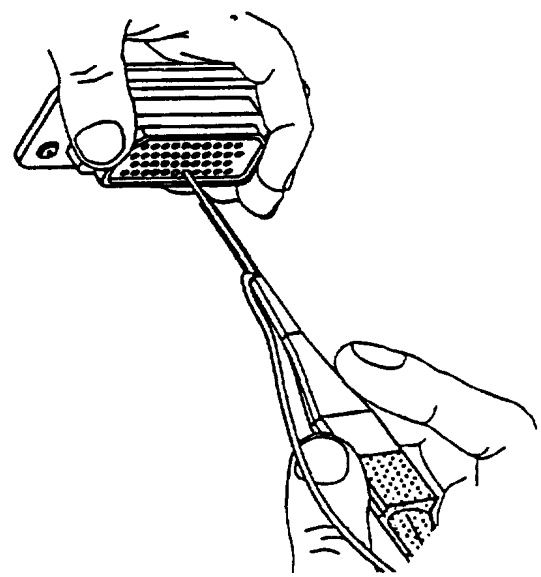
ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

B. LUBRICATE TOOL BY DIPPING IN ISOPROPYL ALCOHOL.

C. PLACE WIRE OF CONTACT TO BE REMOVED INTO REMOVAL TOOL, WITH WHITE TIP FACING CONNECTOR INSERT.

NOTE

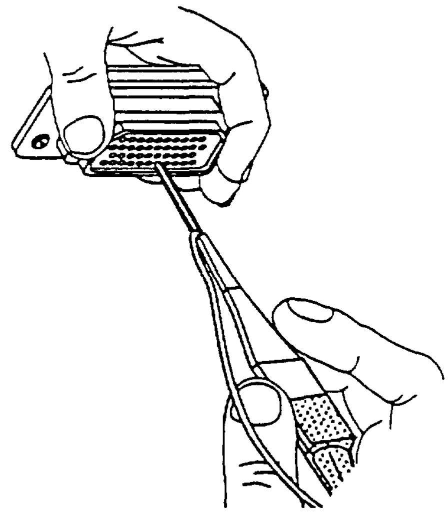
WHEN USING DUAL TIP PLASTIC TOOLS, THE WHITE TIP IS THE REMOVAL TIP.



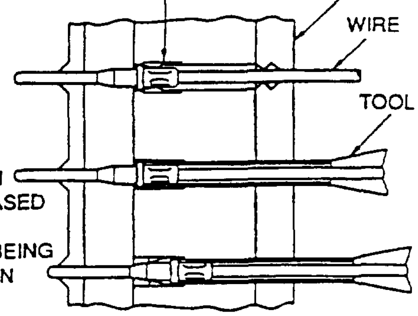
02401701

Figure 17. Rear Release Contact Removal (Sheet 1 of 2)

D. SLIDE REMOVAL TOOL ALONG WIRE AT A RIGHT ANGLE TO CONNECTOR INSERT FACE AND ALIGN WITH CONTACT CAVITY.



E. INSERT TOOL INTO CONTACT CAVITY UNTIL TOOL TIP BOTTOMS AGAINST CONTACT SHOULDER. A SLIGHT INCREASE IN RESISTANCE WILL BE NOTICED JUST BEFORE THE TOOL TIP BOTTOMS. THIS WILL SPREAD THE RETENTION CLIP AND RELEASE ITS HOLD ON THE CONTACT.



F. PRESS WIRE FIRMLY AGAINST SERRATED EDGE OF REMOVAL TOOL AND PULL WIRE STRAIGHT OUT FROM CONTACT CAVITY.

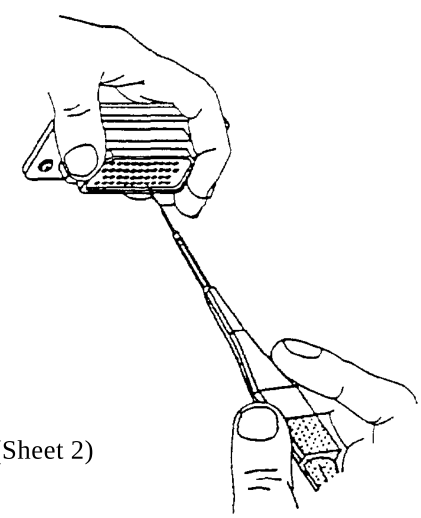


Figure 17. Rear Release Contact Removal (Sheet 2)

02401702

UNWIRED CONTACT REMOVAL.

WARNING

METAL TOOL TIPS ARE SHARP AND CAN CAUSE INJURY TO PERSONNEL AND/OR DAMAGE TO CONNECTORS.

CAUTION

PRESENT METAL TOOLING IN SOME INSTANCES HAS DAMAGED THE WIRE SEALING GROMMET AT THE END OF THE CONNECTORS. PLASTIC TOOLS ARE PREFERRED.

CAUTION SHOULD BE EXERCISED IN THE USE OF TOOLING.

CAUTION

INSPECT TIPS OF METAL TOOLS FOR DISTORTION OF PROBE BEFORE USE AS CONNECTOR DAMAGE CAN OCCUR.

A. SELECT CORRECT UNWIRED REMOVAL TOOL.

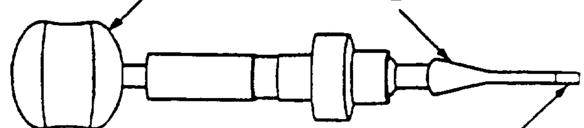
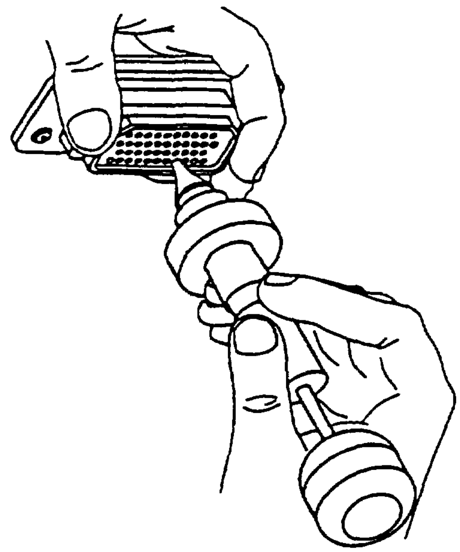


Figure 18. Rear Release Unwired Contact Removal (Sheet 1 of 2)

02401801

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.



B. LUBRICATE TOOL BY DIPPING IN ISOPROPYL ALCOHOL.

C. WITH REAR OF CONNECTOR EXPOSED, REMOVE SEALING PLUG FROM INSERT CAVITY OF CONTACT TO BE REMOVED.

D. PRESS AND HOLD TOOL PLUNGER UNTIL TIP OF TOOL IS ALIGNED WITH CONTACT TO BE REMOVED.

E. AXIALLY ALIGN REMOVAL TOOL WITH CONTACT TO BE REMOVED.

F. INSERT REMOVAL TOOL TIP INTO CONTACT CAVITY TO BUTT CONTACT WIRE BARREL; THEN SLIDE REMOVAL TOOL PROBE OVER CONTACT AND EXERT PRESSURE UNTIL PROBE BOTTOMS.

G. UNLOCK CONTACT FROM CONNECTOR BY WITHDRAWING TOOL FROM CONNECTOR.

H. REMOVE CONTACT FROM REMOVAL TOOL BY PRESSING PLUNGER.

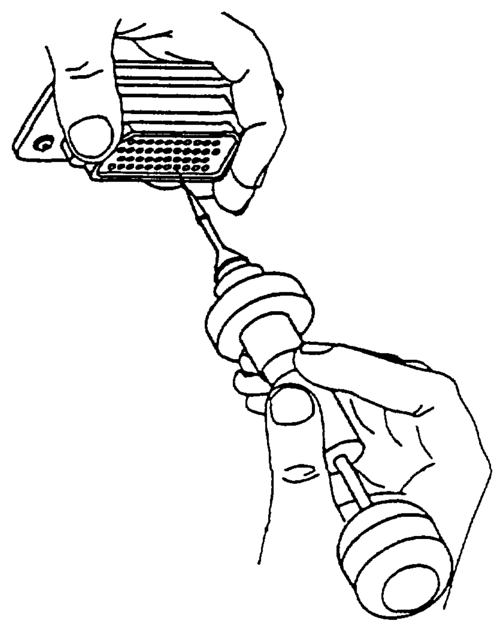


Figure 18. Rear Release Unwired Contact Removal (Sheet 2)

02401802

BROKEN WIRE CONTACT REMOVAL

WARNING

METAL TOOL TIPS ARE SHARP AND CAN CAUSE INJURY TO PERSONNEL AND/OR DAMAGE TO CONNECTORS.

CAUTION

PRESENT METAL TOOLING IN SOME INSTANCES HAS DAMAGED THE WIRE SEALING GROMMET AT THE END OF THE CONNECTORS. PLASTIC TOOLS ARE PREFERRED.

CAUTION SHOULD BE EXERCISED IN THE USE OF TOOLING.

INSPECT TIPS OF METAL TOOLS FOR DISTORTION OF PROBE BEFORE USE AS CONNECTOR DAMAGE CAN OCCUR.

A. SELECT CORRECT REMOVAL TOOL.

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES. DO NOT USE WHILE SMOKING OR WHILE OTHERS ARE SMOKING. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN MAY CAUSE IRRITATION. IF LIQUID TOUCHES SKIN OR EYES, FLUSH THOROUGHLY WITH WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE DROWSINESS, GO TO FRESH AIR.

B. LUBRICATE TOOL BY DIPPING IN ISOPROPYL ALCOHOL.

C. INSERT TIP OF REMOVAL TOOL ABOUT 1/8 INCH INTO CAVITY AT REAR OF CONNECTOR.

Figure 19. Rear Release, Broken Wire Contact Removal (Sheet 1 of 3)

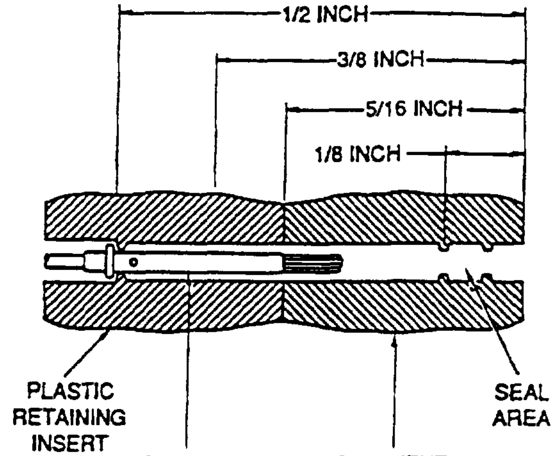
02401901

CAUTION

WIRE STRANDS MAY BE ENCOUNTERED AT ANY POINT UP TO 5/16 INCH OF TOOL INSERTION. IT IS IMPORTANT NOT TO JAM ANY STRANDS OF WIRE UP TO HIS POINT.

WITHDRAW REMOVAL TOOL ANYTIME DURING INSERTION WHEN IT CANNOT BE ADVANCED INTO CONNECTOR USING THESE PROCEDURES. INSPECT TOOL TIP FOR NICKS, CRACKS, MUSHROOMING, AND OTHER DAMAGE THAT WILL PREVENT ITS FUNCTIONING. REPLACE REMOVAL TOOL AND REPEAT PROCEDURE, IF REQUIRED.

D. GENTLY INSERT REMOVAL TOOL INTO CAVITY IN ABOUT 1/16 INCH UNITS, RELEASING TOOL AFTER EACH UNIT IF RESISTANCE IS FELT.



SIZE 22 CONTACT DIMENSIONS

NOTE

ROTATING REMOVAL TOOL WORKS SPLAYED WIRE STRANDS INTO SLOT OF TOOL, ALLOWING TOOL TO PASS.

REMOVAL TOOL MAY BE BLOCKED AT REAR OF CONTACT BY PLASTIC INSERT OR ADDITIONAL STRANDS OF BROKEN WIRE.

E. IF RESISTANCE IS FELT BEFORE REMOVAL TOOL REACHES BACK END OF CONTACT, WITHDRAW SLIGHTLY, ROTATE ABOUT 1/6 OF A TURN, AND REINSERT TOOL. REPEAT ROTATING AND INSERTION PROCEDURE UNTIL TOOL PASSES WITH MINIMUM ADDITIONAL FORCE TO 5/16-INCH DEPTH BACK END OF CONTACT.

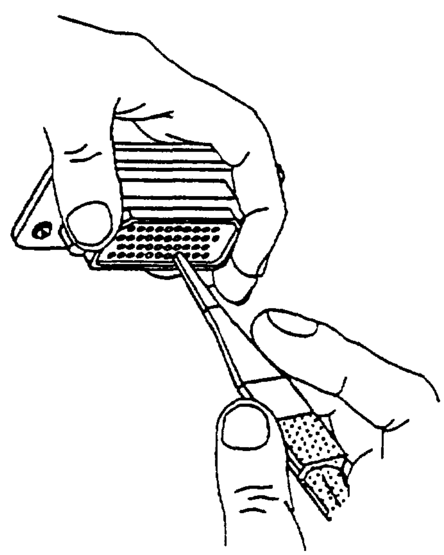


Figure 19. Rear Release, Broken Wire Contact Removal (Sheet 2)

02401902

F. WIGGLE REMOVAL TOOL GENTLY TO HELP IT INTO INSERT BORE AND OVER BACK OF CONTACT. ADDITIONAL ROTATION MAY BE REQUIRED IF BROKEN STRANDS ARE ENCOUNTERED.

G. CONTINUE INSERTION OF REMOVAL TOOL UNTIL POSITIVE STOP IS FELT AT ABOUT 1/2 INCH DEPTH.

H. EXERT AXIAL PRESSURE ON ENGAGING END OF CONTACT, USING APPROPRIATE PIN OR SOCKET AS PUSHER. (IF CONTACT DOES NOT MOVE, SEAT REMOVAL TOOL MORE FIRMLY).

I. PUSH CONTACT COMPLETELY OUT REAR OF CONNECTOR BEFORE DISENGAGING REMOVAL TOOL.

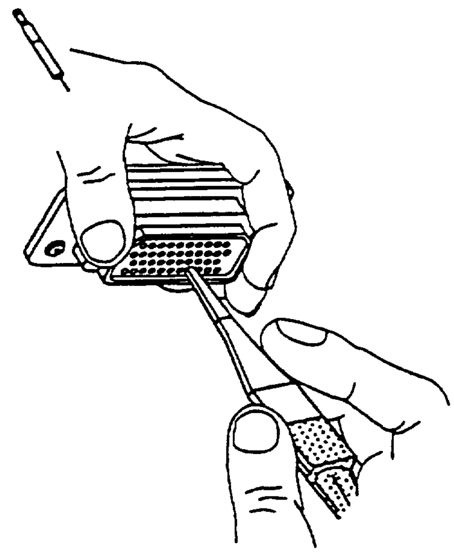


Figure 19. Rear Release, Broken Wire Contact Removal (Sheet 3)

55. **Solder Tact Contacts.**

56. Removable solder-type contacts are used with rectangular connectors conforming to MIL-C-83733 and MIL-C-28748. These contacts contain prefluxed solder preforms and heat-shrinkable insulation material, which is available for twisted pair wire, coaxial cable (Figure 20), or single conductor shielded cable.

57. When the contact is heated, the solder melts and the heat-shrinkable insulation shrinks, terminating the wire or cable to the contact, insulating and strain relieving the conductors.

58. **Coaxial Solder Contact Installation.**

59. **Contact Selection.** To select the proper contact, use the following procedure:

a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 3).

c. Verify contact is compatible with size of cable to be terminated (Table 4).

60. **Cable Preparation.** To prepare the cable, use the following procedure:

a. Determine method of cable preparation (Table 4).

b. Determine cable stripping dimensions (Figure 21).

c. Strip cable in accordance with WP 009 00.

d. Straighten center conductor and smooth shield-braid tightly against cable.

e. If stranded or unplated copper, tin center conductor.

TABLE 3. SOLDER CONTACT SELECTION

Connector Specification	Contact Cavity Size	Wire or Cable Type	Contact Type	Raychem Solder Contact No.	Raychem Holding Fixture Adapter Number
MIL-C-26482 MIL-C-26500	12	Coaxial Cable	Pin	D-602-17	AT-1319-11
MIL-C-26482 MIL-C-26500	12	Coaxial Cable	Socket	D-602-16	
MIL-C-28748	16	Coaxial Cable	Pin	D-602-44	AT-1319-14
			Socket	D-602-45	
		Twisted Pair	Pin	D-602-54	
			Socket	D-602-55	
MIL C 26482	16	Coaxial Cable	Pin	D-602-46	AT-1319-17
			Socket	D-620-47	
MIL-C-26500		Twisted Pair	Pin	D-602-56	
			Socket	D-602-57	
MIL-C-83723	12	Coaxial Cable	Pin	D-602-0094	AT-1319-19
				D-602-0106	
			Socket	D-602-0095	
				D-602-0107	
MIL-C-83733		Twisted Pair	Pin	D-602-0104	
			Socket	D-602-0105	
MIL-C-28748	16	Coaxial Cable	Pin	D-602-72	AT-1319-18
			Socket	D-602-73	

TABLE 4. COAXIAL SOLDER CONTACT CABLE ACCOMMODATION

Raychem Solder Contact No.	Type of Cable Preparation	Cable Dimensions			
		Note 1 Center Conductor Diameter	Dielectric Diameter	Note 1 Shield Braid Diameter	Jacket Diameter
D-602-16, D-602-17	Conventional Strip	.011-.020	.033-.067	.074-.095	.131 Max.
	Braid Foldback	.011-.020	.033-.067	.110 Max. Over Folded Back Braid	—
D-602-72 D-602-73 D-602-44, D-602-45, D-602-46, D-602-47	Conventional Strip	.012-.026	.036-.066	.066-.082	.110 Max.
	Braid Foldback	.012-.026	.036-.066	.086 Max. Over Folded Back Braid	—
D-602-0094, D-602-0095	Conventional Strip	.011-.026	.034-.081	.077-.098	.130 Max.
	Braid Foldback Note 2	.011-.026	.034-.081	.099 Max. Over Folded Back Braid	—
D-602-0106	Conventional Strip	.012 NOM.	.102 .103 NOM.	.124 NOM.	.145 Max.

NOTES:
1. Conductors must be silver- or tin-plated.
2. To achieve an environmental seal, install P/N CTA-0042 immediately adjacent to end of metallic body.

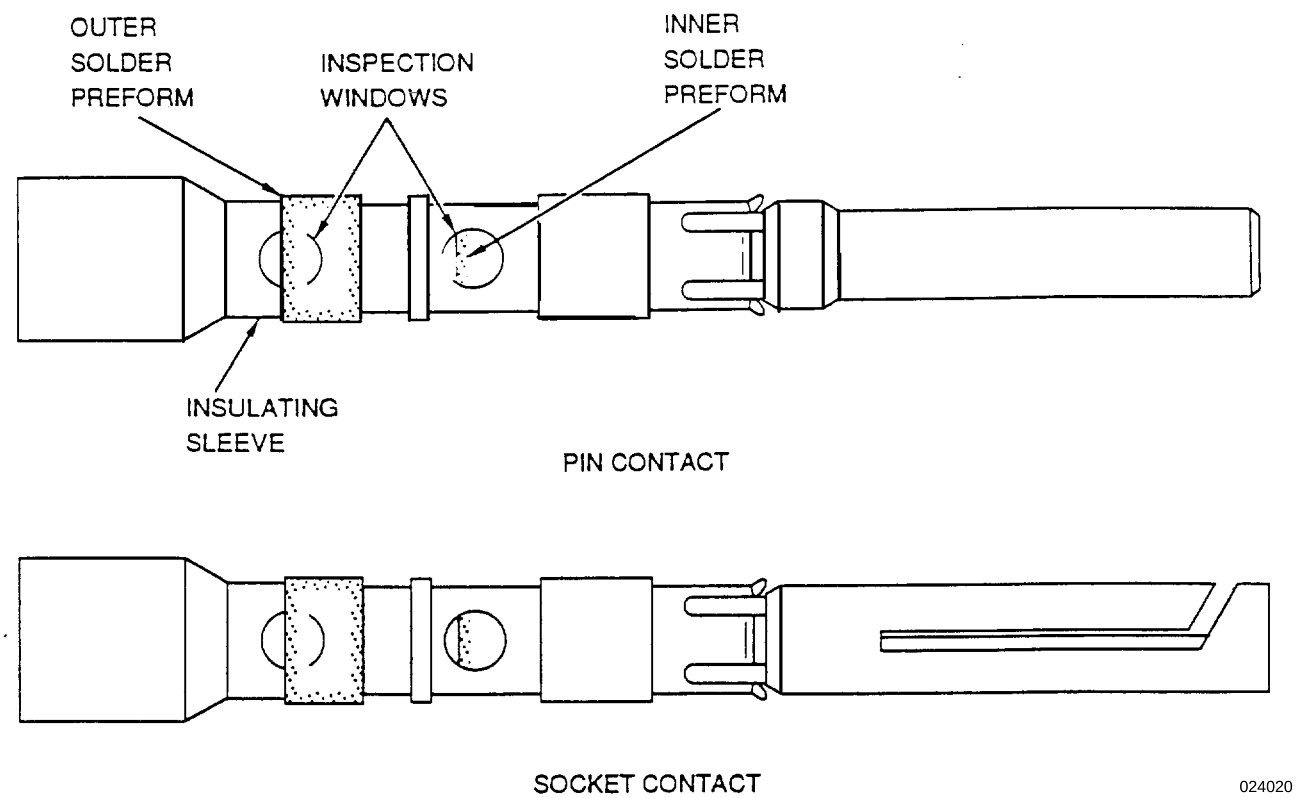
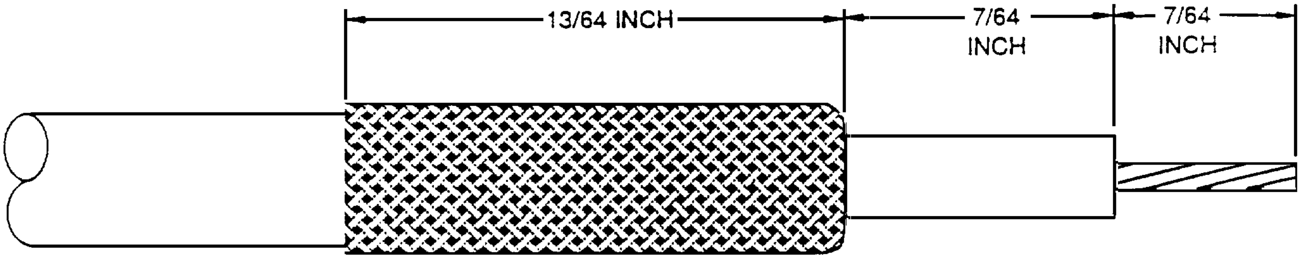
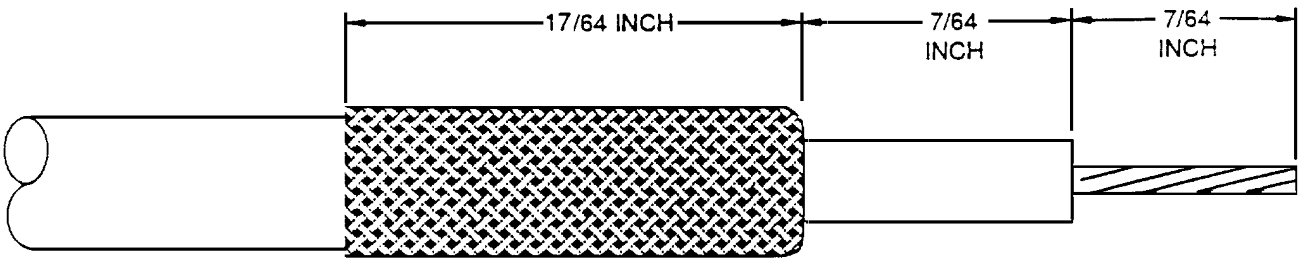


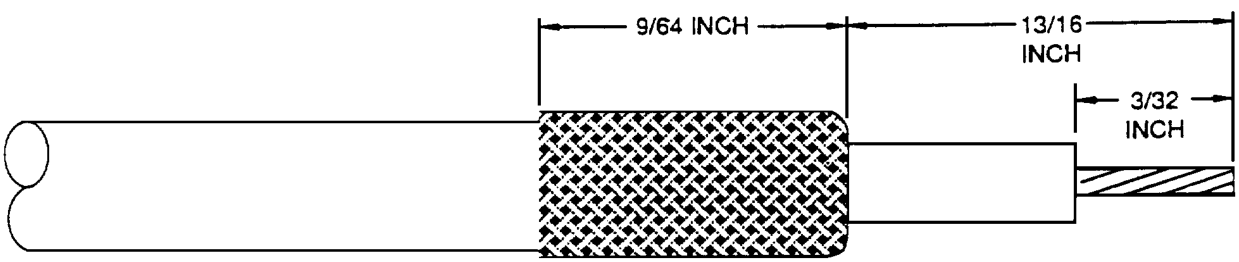
Figure 20. Typical Coaxial Solder Contact



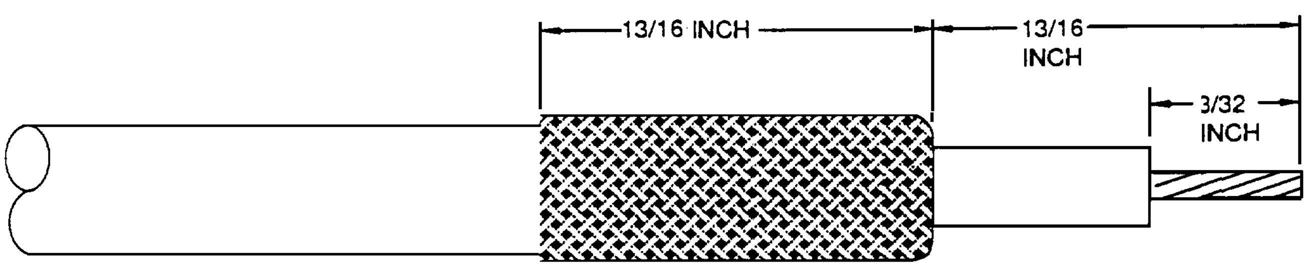
FOR CONTACTS NO. D-602-16, D-602-17
BRAID FOLDED BACK



FOR CONTACTS NO. D-602-16, D-602-17
CONVENTIONAL STRIPPING



FOR CONTACTS NO. D-602-44, D-602-45, D-602-46, D-602-47, D-602-72, D-602-73, D-602-0094, D-602-0095
BRAID FOLDED BACK



FOR CONTACTS NO. D–602–44, D–602–45, D–602–46, D–602–47, D–602–73, D–602–0094, D–602–0095
CONVENTIONAL STRIPPING

02402101

Figure 21. Strip Dimensions for Coaxial Solder Contacts (Sheet 1 of 2)

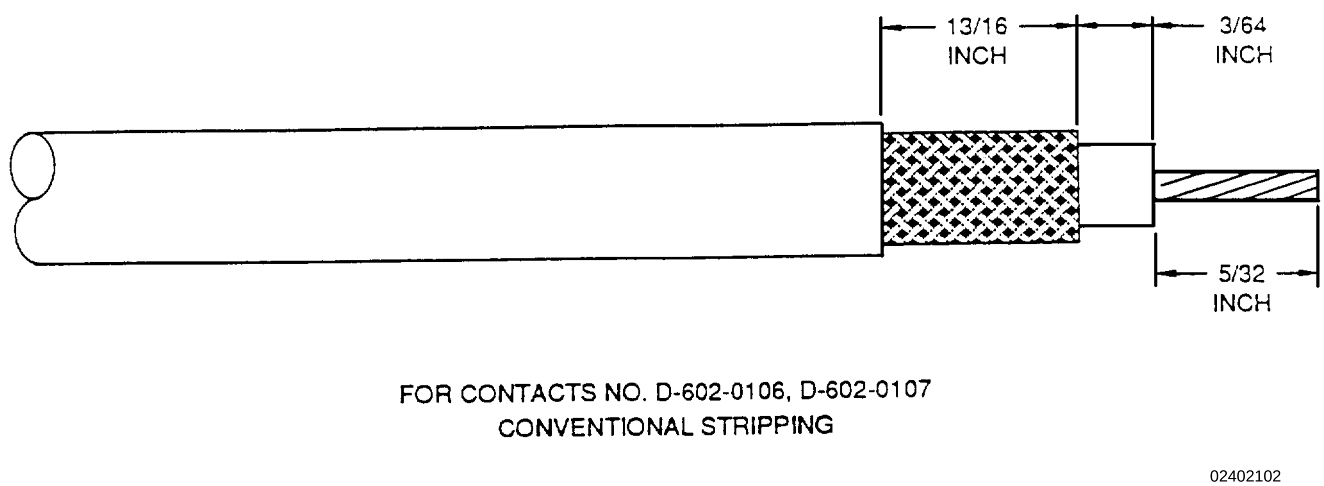


Figure 21. Strip Dimensions for Coaxial Solder Contacts (Sheet 2)

61. **Assembly.** To assemble the solder contact to the coaxial cable, perform the following procedure:

NOTE

For conventionally stripped cable, slightly rotate contact during cable insertion to prevent shield-braid strands from splaying.

a. Slip solder contact carefully over end of prepared cable and push contact onto cable until it stops.

b. Inspect assembly to see that shield-braid and center conductor are both visible through the respective inspection windows (Figure 20).

c. If shield braid and center conductor are not visible, remove contact from cable and check for incorrect strip dimension, splayed shield-braid, or bent center conductor.

62. **Heating.** To attach the solder contact to the cable, use the following procedure:

a. Select appropriate adapter (Table 3).

b. Set up holding fixture and adapter as shown (Figure 22).

c. Insert contact and cable assembly into holding fixture and adapter (Figure 23). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

WARNING

Do not use heat guns with electric motors on or near aircraft that have not been defueled and purged and certified gas-free in accordance with NAVAIR 01-1A-35. Use compressed air/nitrogen heating tool on fueled aircraft.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until large outer solder ring melts and flows and outer sleeving is shrunk over cable.

e. Inspect small inner solder ring. If it has not melted and flowed, continue heating until it flows.

f. Allow assembly to cool at least five seconds before removing from holding fixture.

65. **Inspection.** Inspect solder flow through two inspection windows.

66. **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into strands of shield-braid.

b. Inner solder preform must be completely melted and flowed between the cable center conductor and inner contact soldering surface.

c. Fillet of solder should be visible through each inspection window.

d. Insulation sleeve should be fully shrunk onto cable.

67. **Underheated.**

a. Original form of one or both preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

68. **Overheated.**

a. Insulation sleeve is darkened to an opaque brown.

b. There are no solder fillets seen through inspection windows.

c. Cable insulation is melted or charred.

68. **Repair Procedures.** An underheated contact can be reheated to flow solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit insulation lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (paragraphs 60 and 61).

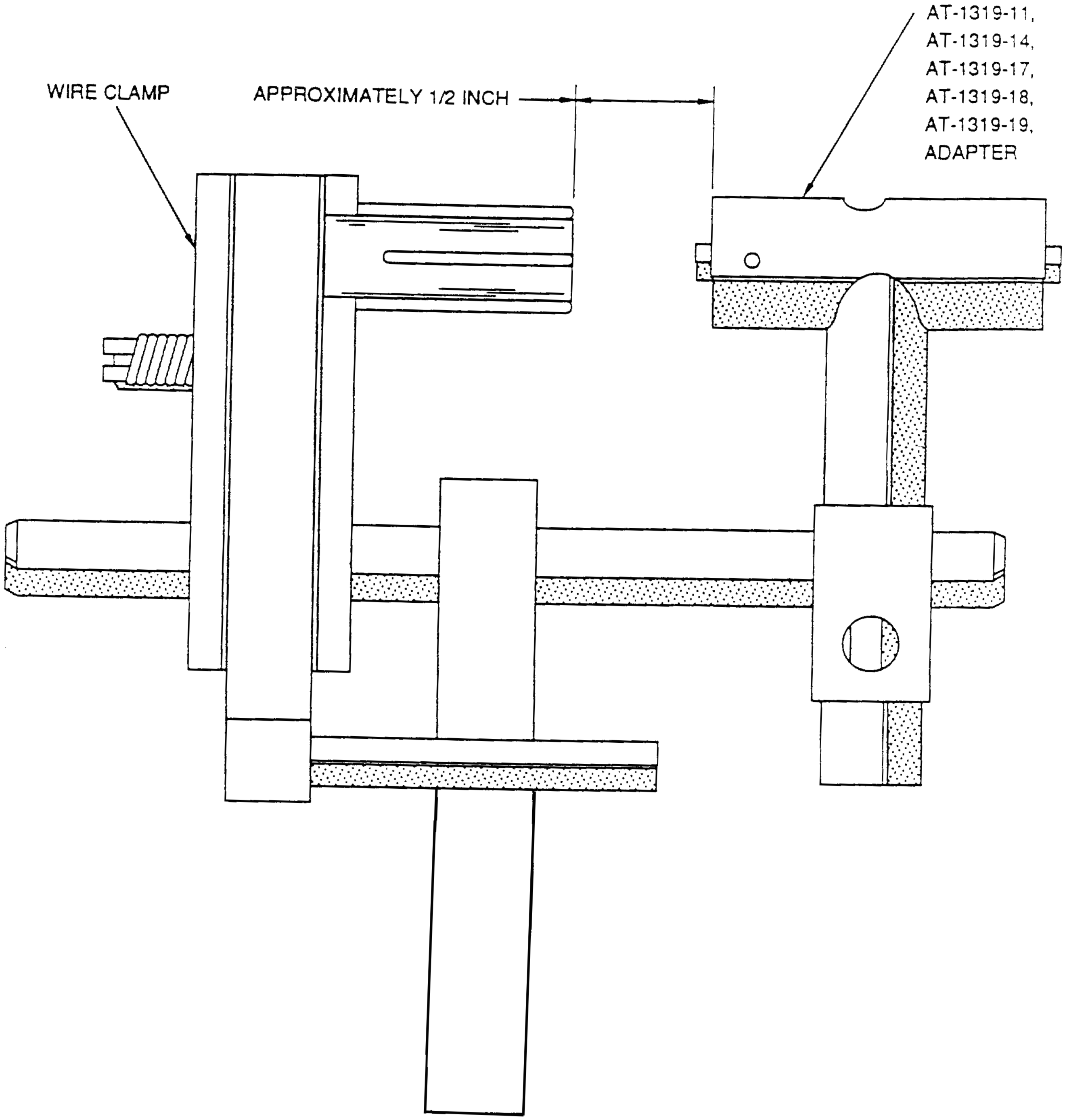


Figure 22. Holding Fixture and Adapter Setup

024022

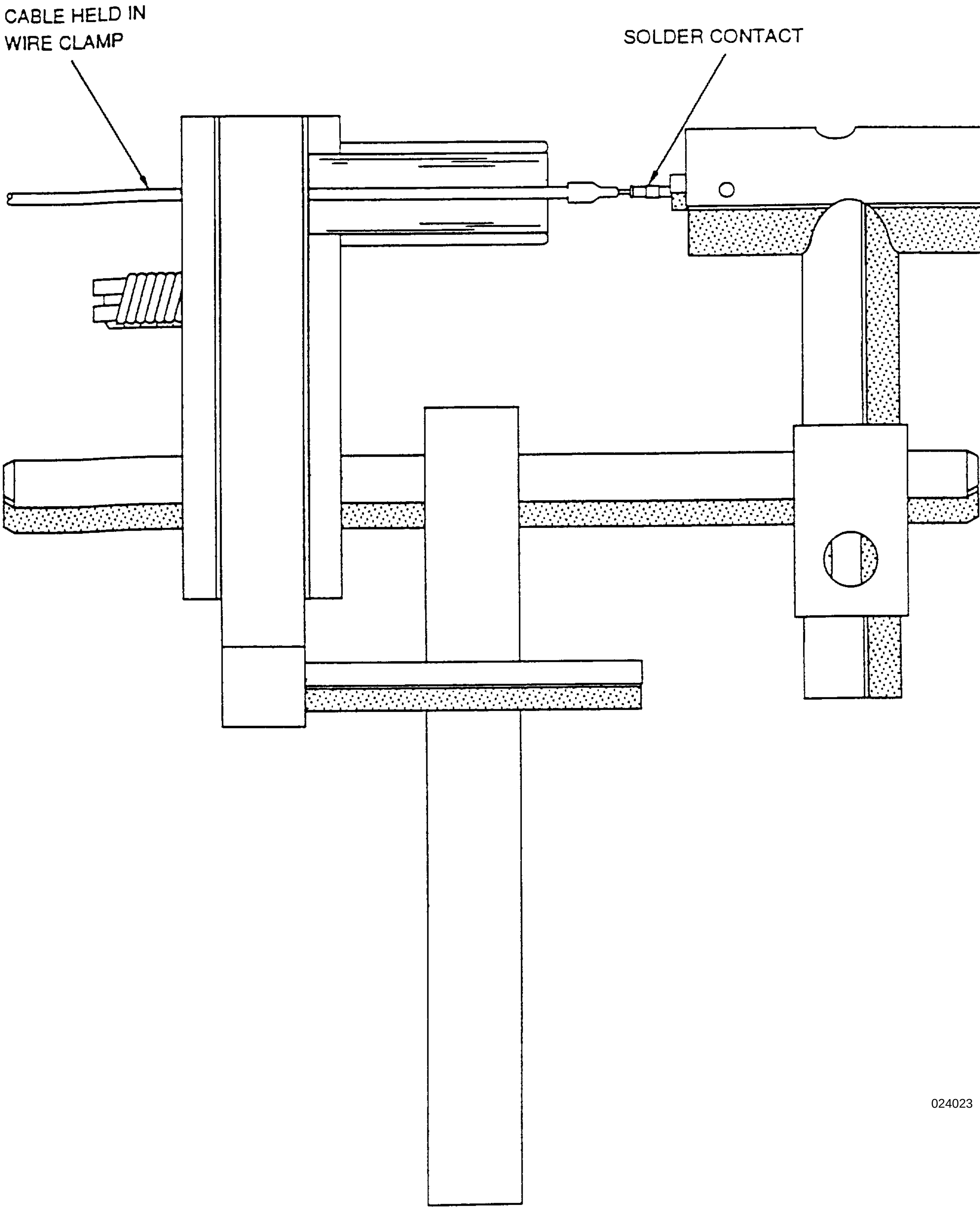


Figure 23. Solder Contact and Cable Prepared for Heating

70. **Twisted Pair Solder Contact Installation.**

71. **Contact Selection.** To select the proper contact, use the following procedure:

a. Determine connector specification, cavity size, and wire type.

b. Select appropriate solder contact (Table 3).

c. Verify contact is compatible with gage (AWG) size of twisted pair wire to be terminated (Table 5).

72. **Wire Preparation.** To prepare the twisted pair, use the following procedure:

a. Strip wire in accordance with Figure 24.

b. Twist conductors into normal lay and straighten.

c. Tin all stranded and non-plated solid wire.

d. After tinning, ensure wire ends are straight.

73. **Assembly.** To assemble the solder contact to the twisted pair, use the following procedure:

a. Insert signal lead into center insulating sleeve and ground lead into outer insulating sleeve. Ensure wires bottom in contact (Figure 25).

b. Ensure signal lead is visible through forward inspection window inside inner solder preform.

c. Position ground lead so that it is not located directly in rear inspection windows.

74. **Heating.** To attach the solder contact to the twisted pair, use the following procedure:

a. Select appropriate adapter (Table 3).

b. Set up holding fixture and adapter as shown (Figure 22).

c. Insert contact and twisted pair assembly into holding fixture and adapter (Figure 23). End of adapter marked P is for plug (pin) contacts and end marked R is for receptacle (socket) contacts.

WARNING

Do not use heat guns with electric motors on or near aircraft that have not been defueled and purged and certified gas-free in accordance with NAVAIR 01-1A-35. Use compressed air/nitrogen heating tool on fueled aircraft.

NOTE

Both inspection windows must be in hot air stream facing air flow.

d. Heat contacts using hot-air heating tool with solder termination sleeve reflector. Apply heat until small inner solder ring melts and flows and sleeving is shrunk over wires.

e. Inspect large outer solder ring to see if it has melted and flowed. If it has not melted and flowed, continue heating until it flows.

f. Allow the contact and wire assembly to cool for at least five seconds before removing from holding fixture.

TABLE 5. TWISTED PAIR SOLDER CONTACT ACCOMMODATION

Raychem Solder Contact No.	Twisted Pair Wire Size	Note 1 Conductor Type
D-602-54 D-602-55 D-602-56 D-602-57	30 thru 24 AWG	Stranded Or Solid
Note 2 D-602-0104 D-602-0105	24 thru 26 AWG	Stranded or Solid
NOTES: 1. Conductors must be silver- or tin-plated. 2. To achieve an environmental seal, install PtN CTA-0006 immediately adjacent to end of inner insulation sleeve.		

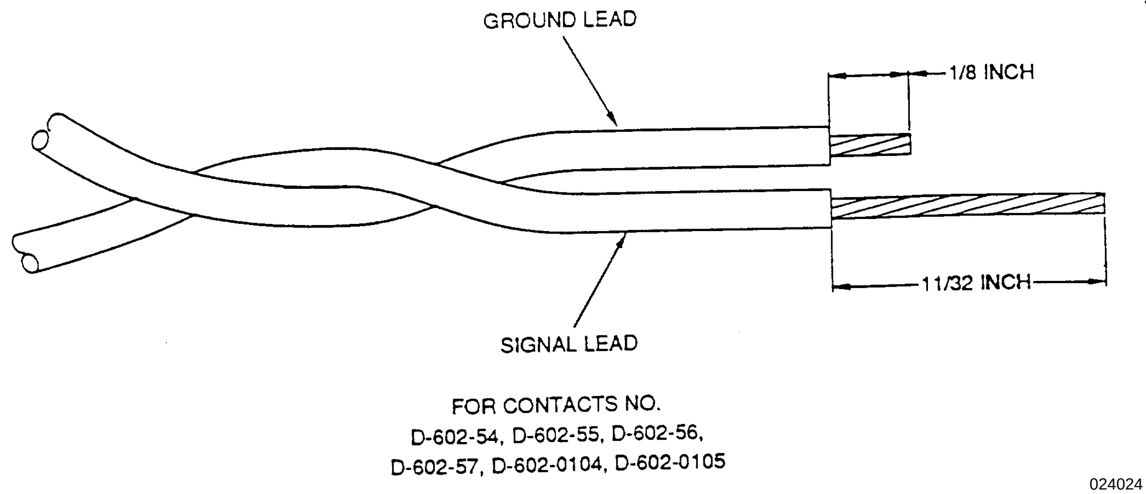


Figure 24. Strip Dimensions for Twisted Pair Solder Contacts

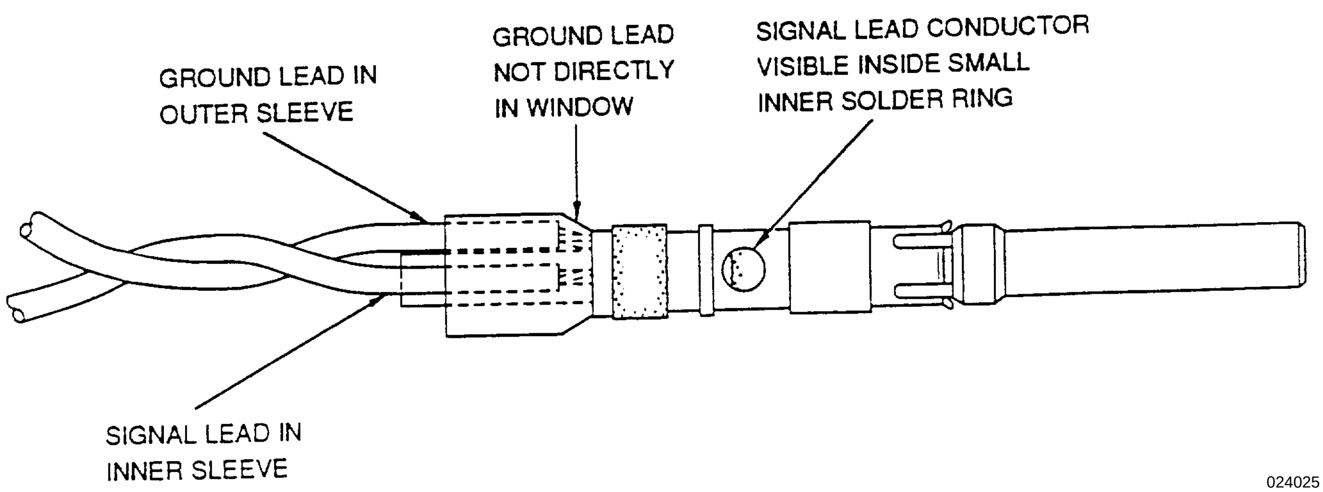


Figure 25. Inserting Twisted pair into Solder Contact

75. **Inspection.** Inspect solder flow through two inspection windows.

76. **Properly Heated.**

a. Outer solder preform must be completely melted and flowed into rear inspection window.

b. Inner solder preform must be completely melted and flowed, forming a fillet of solder between signal wire conductor and inner soldering surface.

c. Both insulation sleeves should be fully shrunk onto wire insulation.

77. **Underheated.**

a. Original form of one or both solder preforms is still partially visible.

b. Insulation sleeve is not fully shrunk.

78. **Overheated.**

a. Insulation sleeve is darkened to an opaque brown

b. There are no solder fillets seen through inspection windows.

c. Wire insulation is melted or charred.

79. **REPAIR PROCEDURES.** An underheated contact can be reheated to flow the solder properly. An overheated contact must be removed and a new contact installed. The procedure is as follows:

a. Using a sharp knife, slit the insulating sleeve lengthwise at two points and peel off sleeve.

b. Using heating tool, heat contact until solder melts and quickly pull off heated contact with pliers.

c. Install new contact (paragraphs 70 and 71).

80. **CONNECTOR REMOVAL AND INSTALLATION (REMOVABLE CONTACT CONNECTORS).** If the connector cannot be repaired or is severely damaged, perform the following:

a. Starting from the outside of the damaged connector, tag each wire after the contact is removed.

b. When contacts cannot be removed, cut the wire as close to the connector as possible, and tag the wire. Install a new contact on the wire (WP 013 00).

c. Install wires with crimped contacts from damaged connector into a new connector.

d. Seal connector in accordance with WP 026 00 when required.

81. **CONNECTOR REPAIR (NON-REMOVABLE CONTACT CONNECTORS).** The procedures for repair are in accordance with the standard maintenance practices and solder procedures (WP 017 00). Seal the connector and provide for moisture barrier in accordance with WP 026 00.

CAUTION

Do not use aluminum foil as a protective cover on electrical connectors. The use of aluminum foil as a cover could cause an electrical short circuit.

82. **PROTECTION OF ELECTRICAL CONNECTORS.** Connector plugs and receptacles in areas that are not exposed to contaminants (oil, moisture, dirt, etc.) that mate to equipment that is temporarily removed for bench check repair, need not be covered. However, all unmated connectors will be protected with protective covers when the aircraft is operating and when the connectors are to remain unmated for an extended period of time. Standard protective covers for connectors are available with or without an attaching chain (WP 025 00).

83. **CONNECTOR POTTING AND SEALING.** See WP 026 00.

84. **CONNECTOR CLEANING AND PRESERVATION.** See WP 027 00.

85. **CONNECTOR ACCESSORIES.** See WP 025 00.

86. **MILITARY RECTANGULAR CONNECTOR SPECIFICATIONS.**

87. **MIL-PRF-24308 CONNECTORS.** MIL-PRF-24308 covers non-environmental. polarized shell, miniature, rack and panel connectors having pin and socket contacts, crimp removable, solder removable, or insulation displacement nonremovable contacts with rigid or float mounting, designed for -67°F (-55°C) to +257°F (+125°C) operating temperature. See Figure 2 for part number breakdown information.

WARNING

Classes G and N zinc-plated parts are not to be used on aerospace or missile applications.

88. **Description.** The connectors covered by MIL-PRF-24308 include the following classes:

G - General Purpose

N - Nonmagnetic

H - Hermetic

M - Same as class N except intended for spaceborne missions where high reliability is required.

D - Same as class G except intended for spaceborne missions where high reliability is required.

K- Same as class H except intended for spaceborne missions where high reliability is required.

89. **Shell Material.** The metal shell material shall be of high grade corrosion resistant material or material treated to be corrosion resistant.

90. **Shell Finish.** The finish specified for each class is as specified in Table 6.

91. **Termination Style.** These connectors are classified by the following termination types:

a. Crimp contacts,

b. Solder contacts,

c. Insulation displacement contacts (DIC),

d. Printed wiring board (PWB).

92. **Types.** These connectors are classified by the following types:

I - Standard density, size 20 contacts,

II - High density, size 22D contacts,

III - Standard density, size 20 IDC contacts.

93. **Polarization.** Polarization is accomplished by a keystone shape shell design before engagement of pins or sockets.

TABLE 6. MIL-PRF-24308 SHELL FINISHES

Finish Designator	Finish Description
G	Cadmium or zinc plated, or equivalent, electrically conductive. Preliminary plating is permissible. Corrosion resistant steel arts shall be passivated.
N	Same as class G.
H	Tin plated. Preliminary plating is permissible.
D	Electrically conductive nickel phosphorus or equivalent. Preliminary plating is permissible. Finish shall be dull.
K	Same as class D.
M	Gold plated. Preliminary plating is permissible. Silver underplate shall not be used.

94. **MIL-C-28731 CONNECTORS.** MIL-C-28731 covers rack and panel mounted connectors that may contain front release removable, wrappost, and solder contacts. The contacts are of the formed blade fork type. A double wire crimp contact is available. The operating temperature range of these connectors is -85°F (-65°C) to +257°F (+125°C). See Figure 3 for part number breakdown information.

95. **Coupling.** Connectors shall be capable of being fully coupled and uncoupled without use of tools.

96. **Inserts.** The inserts are a diallyl phthalate material molded one-piece construction that shall not chip, crack or break during assembly or normal maintenance.

97. **Actuating Hardware Types.** The following types of actuating hardware are available to aid in the engagement of connectors.

a. Type C jackscrew - Rotatable actuating member with a male thread (engages with a type F fixed socket). The actuating knob includes a screwdriver slot.

b. Type D jacksocket - Rotatable actuating member with a female thread (engages with a type E fixed screw).

c. Type E fixed screw - Fixed actuating member with a finale thread (engages with a type D or H jacksocket).

d. Type F fixed socket - Fixed actuating member with a female thread (engages with a type C or G jackscrew).

e. Type G jackscrew - Rotatable actuating member with a male thread (engages with a type F fixed socket). Actuating knob is for hand lightening only.

f. Type H jacksocket - Rotatable actuating member with a female thread (engages with type E fixed screw.) Actuating knob includes a screwdriver slot.

98. **Polarization.** Polarization is accomplished by mechanical means with protective shell, bosses, guide pins, guide sockets or jackscrews.

99. **MIL-C-28748 CONNECTORS.** MIL-C-28748 covers rectangular, rack and panel, electrical connectors that have pin and socket, solder nonremovable and front release crimp contacts. The connectors are nonenvironmental, coupled by friction or jackscrew. The operating temperature range of these connectors is -65°F (-55°C) to +257°F (+125°C). See Figure 4 for part number breakdown information.

100. **Metals and Finishes.** Noncorrosion resisting metal parts shall be cadmium plated or zinc nickel plated, with preliminary plating being permissible. Aluminum alloy parts shall be anodized. Corrosion resistant steel parts shall be passivated. All finishes except anodize shall be conductive.

101. **Coupling.** Connectors shall be capable of being fully coupled and uncoupled without use of tools.

102. **Inserts.** The inserts are a diallyl phthalate material molded one-piece construction that shall not chip, crack or break during assembly or normal maintenance.

103. **Polarization.** Polarization is accomplished by mechanical means with protective shell, bosses, guide pins, guide sockets or jackscrews.

104. **MIL-C-28804 CONNECTORS.** MIL-C-28804 covers environmental or nonenvironmental polarized subminiature connectors that have an operating temperature range of -67°F (-55°C) to +257°F (+125°C). See Figure 5 for part number breakdown information.

105. **Description.** The MIL-C-28804 connectors are classified according to the following classes:

G - General purpose, non-magnetic, high density, size 22, rear release crimp contacts.

P - Environmental resisting, potting type, nonmagnetic, high density, size 22, rear release crimp contacts.

E - Environmental resisting, non-magnetic, high density, size 22, rear release crimp contacts.

S - Solder termination, general purpose, high density, size 22, rear release crimp contacts

SE - Solder termination, environment resisting, high density, nonremovable, size 22 contacts.

106. **Polarization.** Polarization is accomplished by hex keys, and shall be accomplished before engagement of pins and sockets.

107. **MIL-C-81659 CONNECTORS.** MIL-C-81659 covers two series of electrical, rectangular, rack and panel connectors with crimp type removable contacts. The connectors are provided with single, dual, triple, and quadruple insert shell configurations. See Figures 6 and 7 for part number breakdown information.

108. **Types.** There are four types of MIL-C-81659 connectors:

Type I - Short grommet seal. Series I only.

Type II - Standard grommet seal.

Type III - Without grommet seal.

Type IV - Without interfacial and grommet seals.

109. **Class Description.** These connectors have two classifications according to operating temperatures:

Class l - 85°F (-65°C) to +237°F (+125°C)

Class 2 - 85F (-65°C) to +392°F (+200°C)

110. **Shell Designation.** The shell designation shall consist of a letter in accordance with the following:

A - A connector having a shell configuration to accommodate a keystone insert.

B - A connector having a shell configuration to accommodate a rectangular insert.

111. **Series Designation.** The series designation shall consist of a one digit number in accordance with the following:

Series 1 front release contacts.

Series 2 rear release contacts.

112. **Series 1.** Series 1 connectors are front release, crimp pin or socket contacts, environment resistant, class 1 or 2, and are single or double inserts. Use M81969/17 and /19 installing and removal tools.

113. **Series 2.** Series 2 connectors are rear release, crimp pin or socket contacts, environment and nonenvironment resistant, class 1 or 2, and are single double, triple, and quadruple inserts. Each plug and receptacle have at least one readily visible blue color band to indicate the rear release retention system. Use M481969/1 or /14 installing and removal tools.

114. **Shell Material.** The shells are made from high Grade aluminum alloy.

115. **Finish.** Class 1 connectors shall be cadmium plated, and class 2 connectors shall be electroless nickel plated.

116. **Polarization.** Polarization is accomplished by means of mating keys on the plug shell and keyways on the receptacle shell before contact engagement.

117. **MIL-C-83733 CONNECTORS.** MIL-C-83733 connectors arc environment and fluid resisting, miniature, rectangular, rack and panel electrical connectors having pin and socket rear release crimp contacts with fixed or float mounting. See Figure 8 for part number breakdown information.

118. **Description.** MIL-C-83733 connectors have the following features:

a. Environment resistant at sea level and high altitudes.

b. Continuous operation at temperatures ranging from -85°F (-65°C) to +392°F (+200°C).

c. A nonremovable, integral, resilient peripheral seal in the receptacle shell which will engage the mating plug before mating is completed.

d. Voltage service ratings I and II.

e. Fluid resistant.

f. Designed to prevent inadvertent electrical contact and provide contact protection during mating.

119. **Connector Shells.** The connector shells are made from high-grade aluminum alloy to form a solid shell designed to positively retain inserts. The engaging skirts have a keystone shape to prevent mating when either connector is rotated 180 degrees from the correct mating position.

120. **Finishes.** The finishes for MIL-C-83733 connector classes are as follows:

Class R - Aluminum parts shall be electroless nickel plated.

Class S - All metal parts shall be electroless nickel plated with a dull finish. Use of a suitable underplate is permissible. Silver underplate shall not be used.

121. **Polarization.** Polarization is accomplished by engaging skirts that provide a keystone shape to preclude mating when either connector is rotated 180 degrees from the correct mating position.

122. **MIL-C-8384 CONNECTORS.**

NOTE

MIL-C-8384 has been cancelled. Future procurement should be made under military specification MIL-C-28748. This does not preclude use for maintenance, repair, or resupply purposes, or use in designs where the connectors must interface with Government Furnished Equipment.

123. MIL-C-8384 covered rectangular power connectors, rectangular miniature connectors, hexagonal connectors, and rectangular subminiature connectors that consist of insulators and contacts, and in some cases, guide pins and guide sockets.

124. **Description.** The following dash numbers defined the operating temperatures for MIL-C-8384 connectors:

-1 up to 275°F (125°C)

-2 up to 302°F (150°C)

-3 up to 392°F (200°C)

125. **MIL-C-21617 CONNECTORS.** MIL-C-21617 covers are nonenvironmental, rectangular rack and panel mounted connectors that feature nonremovable solder contacts in eight arrangements. See Figure 9 for part number breakdown information.

126. **Classification.** The connectors shall be of the following types, classes, and styles:

a. Types:

P - Plug

J - Receptacle

JS - Receptacle, pressurized type

b. Classes:

M - Male, inserts containing pin contacts

F- Female, inserts containing socket contacts.

c. Styles:

004A - 4 contacts

008A - 8 contacts

013A - 13 contacts

017A - 17 contacts

023A - 23 contacts

026A - 26 contacts

032A - 32 contacts

040A - 40 contacts

007C - 7 coaxial contacts

016C - 3 coaxial contacts and 13 size 20 contacts

127. **Shell Material.** The shell material shall be made from a high-grade aluminum alloy.

128. **Finish.** The finish of all metal exposed parts, other than electrical contacts, shall be cadmium plated, with the resultant finish being electrically conductive. A preliminary plating is permissible.

129. **Polarization.** Polarization is accomplished by use of tapered corners and will mate with existing field equipment.

130. **MIL-C-26518 CONNECTORS.** MIL-C-26518 connectors are miniature, high density, rectangular, rack and panel, environment resistant and hermetic connectors having pin and socket, front and rear release crimp power and coaxial contacts with fixed or float mounting. See Figure 10 for part number breakdown information.

131. **Description.** The connectors covered by MIL-C-26518 have the following features:

a. Environment resistant at sea level and high altitudes.

b. Continuous operation at temperatures ranging from -67°F (-55°C) to +460°F (+238°C).

c. Fluid resistant.

d. Designed to ensure correct orientation of the mating halves prior to mating.

132. **Classification.** The connectors shall be of the following types, classes, styles. and sizes:

a. Types. The types shall be as specified in the applicable military standard.

b. Classes:

R - Environment resistant
H - Hermetic

c. Styles:

P - Inserts containing pin contacts.
S - Inserts containing socket contacts

d. Sizes: Shell sizes A, B, C, and D.

133. **Shell Material.** The shells for class R shall be forged of aluminum alloy, or equivalent. Any other parts shall be of high-grade aluminum-alloy die casting or aluminum forging alloy.

134. **Finish.** Aluminum parts shall be anodized. All other metal parts shall be made of corrosion resistant material. The finish of class H shells shall be suitable for soldering or brazing to the mounting surface.

135. **Polarization.** Polarization is accomplished by variations of the keystone corner method in that two corners have a curvature and two are spare.

136. **Mounting.** Connectors can be mounted in either a fixed position by means of a self-locking busing or in a floating position by means of a spring loaded mounting assembly which must be ordered separately.

137. **MIL-C-83513 CONNECTORS.** MIL-C-83513 connectors are polarized shell, microminiature, rectangular connectors not intended for use in blind mating rack and panel applications. See Figure 11 for part number breakdown information.

138. **Description.** The connectors are either metal or plastic shell plugs and receptacles with nonremovable crimp or solder contacts. They are capable of continuous operation within a temperature range of 67°F(-55°C) to +257°F (+125°C). The connectors can be either front or rear mountable, but front mounting is preferred.

139. **Classification.** The connectors shall be of the following classes and types:

a. Classes:
P - All plastic (shell and insulator)
M - Metal shell (plastic insulator)

b. Types:
I - Crimp contacts (removable)
II - Solder contacts (nonremovable)

140. **Shell Materials.** Shells shall be die cast, extruded, or bar stock aluminum, or aluminum alloy.

141. **Finish (Class M).** Metal shells shall be cadmium plated or equivalent. A suitable underplate is permissible when cadmium is used. For space grade applications only, shells shall be electroless nickel plated.

142. **Polarization.** Polarization is accomplished by a keystone shape shell design with polarization accomplished before engagement of pins and sockets.

142. **MIL-C-85028 CONNECTORS.** MIL-C-85028 covers environment and fluid resisting, rectangular, rack and panel connectors having individually sealing pin and socket crimp removable contacts, designed for an operating temperature range of -85°F (-65°C) to +302°F (+150°C). See Figure 12 for part number breakdown information.

143. **Description.** The MIL-C-85428 connectors, incorporate polarized center jackscrews, contacts that have individual wire seals, and backshells used with recessed jackscrews and 45 or 90 degree cable entries.

144. **Classes.** Class E is the only available class, and is an environmental and fluid resisting.

144. **Center Hardware Designator.** The connector center hardware shall be designated by one of the following:

R - Recessed jackscrew

J - Extended jackscrew

F - Threaded female

145. **Polarization.** Polarization is accomplished by means of three integral keys and matching keyway on the counterpart center boss, and before initial engagement of contacts.

146. **Seals.** Interfacial and rear seals are designed and constructed in such a manner that they become an integral part tit any individual contact. Each seal can be removed and replaced.

CONNECTOR ACCESSORIES

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part. No./Type Designation
Adapter Tool	BT–S–389
Diagonal Cutters	—
Screwdriver, Flat	—
Spacer, 3/8 Dowel	—
Strap Wrench	—
T-Handle, 1/4 inch Drive	—
Heat Gun	HT-900B, HT-920B, HT–71002 or MCH–100–A
Wrench, Torque	0–150 in. lbs.

Materials Required

Nomenclature	Specification/ Part Number
Glue, Epoxy	—
Tape, Silicone	—

46 . INTRODUCTION.

47 . This work package (WP) describes connector accessories, their function, and availability by connector series as governed by applicable Military Specifications and Standards.

WARNING

When using a heat gun, do not use electrical power from the aircraft being repaired. Use electrical power from a ground power unit.

Do not use heat guns with electric motors when working on or near aircraft that have not been defueled, purged, and certified gas free in accordance with NAVAIR 01-1A-35. Use heat gun HT-900B/HT-920B (WP 012 00).

CAUTION

Do not let cable clamp fingers or saddle clamps directly contact the cable or harness. The amount of tape used must be at least one layer plus the amount needed to build up the cable for a secure fit of the clamp to the bundle when a hand is attached, or when screws are tightened to provide metal-to-metal contact.

The white dot on the adapter tool must be in line with the master key of the connector before the tool and connector are mated. Spinning the adapter tool on to the connector until it slips into place causes unnecessary wear on the tools, keys, and keyways.

When cutting heat-shrink sleeving with a sharp tool, do not nick or scrape the wire insulation.

Avoid using metal tooling to remove and install backshells. These tools can damage the backshell and connector. Non-metallic tools are designed to wear before damaging, the connector or backshell.

NOTE

For best results when applying silicone rubber tape, keep hands free of dirt and oil. When the assembly is completed, the leading edge of the tape should protrude 1/8 inch through the clamp.

48 . GENERAL.

NOTE

Shielding of cable-to-connector termination is a very important and critical aspect of achieving electromagnetic compatibility in electrical wiring and cabling systems. The primary considerations in cable-to-connector EMI/RFI applications are to preserve connector integrity and obtaining optimum connector-to-cable compatibility. Complete electrical continuity, with a minimum voltage drop, between connector and cable or harness shielding can be obtained easily with proper selection of backshells and accessories.

49 . CIRCULAR CONNECTOR ACCESSORIES. Circular connector accessories are components added to a connector to enhance the wiring system and/or EMC protection. These accessories include the following types:

. **Backshells.** Backshells are components which are all inclusive of accessories that mount to the rear of the connector (paragraph 19).

. **Conduit Fittings.** Conduit fittings are used to connect conduit, through which wires are routed to a connector, and may either be a ferrule or a hex nut.

. **Dummy Receptacles.** Dummy receptacles have no pins or sockets, and shall be used to stow unmated plugs, caps, or protective covers when the related component is not in operational use. The dummy receptacle shall be marked and located to permit easy location and access.

. **Dust Caps.** Dust caps are protective covers installed on connectors to prevent the intrusion of dirt and moisture.

. **Gaskets for Flange Mounted Receptacles.** Gaskets are used to mount flanged receptacles to a structure to provide environmental protection or pressure sealing. Gaskets are made from silicone rubber (1) or conductive rubber (2), and the 1 or 2 will be the last dash number in the part number.

. **Mounting Hardware.** Mounting hardware includes mounting screws, nuts, jam nuts, and mounting plates used to secure receptacles to structures. Mounting flanges are defined in the MIL-C-85049/94 through MIL-C-85049/96 specification sheets.

. **Rubber Bushings.** MS3420 standard color and material is black neoprene. Primary use is cushion for wires at the connector exit to aid in strain relief.

. **Sealing Plugs.** Sealing plugs are inserted to fill a cavity in a connector insert. The function of the sealing plug is to seal all cavities not occupied by contacts.

50. DESIGN AND CONSTRUCTION. Connector accessories may be straight, or angled at 45 or 90 degrees.

NOTE

Spin coupling, self-locking circular connector accessories are preferred for Navy use.

. **Safety Wire Holes.** When safety wire holes are required, there shall be a minimum of two holes equally spaced for shell size 14 or smaller, and at least three equally spaced holes for sizes 16 and larger. Holes shall be of a diameter sufficient to accommodate .020 inch diameter wire. For non-self-locking accessories, safety wire holes shall not be optional. Self-locking accessories shall not have safety wire holes on the coupling nut.

. **Spin Coupling.** Spin coupling connector accessories have a coupling ring that is captivated to, and free to rotate on, the follower of the accessory. The spin coupling nut may be either self-locking or non-self-locking.

NOTE

The letter “S” in a M85049 accessory part number may represent the self-locking feature or stainless steel material. Review the part number breakdown for the component in question.

. **Self-locking.** The self-locking device is a corrosion resistant material that provides either a positive detent or an internal captivated anti-decoupling device that maintains applied torque. Lockwire, set screws and/or locking compounds are not permitted as anti-coupling devices. The self-locking feature is identified in the part number by the letter “S”.

CAUTION

If connectors and accessories are not fully mated, the accessories may vibrate loose in application.

. **Proper Mating of Connectors and Accessories.** The teeth of the connector and connector accessories need to mate “peak-to-valley” to ensure proper mating. If the teeth are peak to peak, the components may seem properly mated, but the teeth may eventually slide into the “peak-to-valley” position, causing the coupling ring to become loose (Figures 1 and 2). Install the accessory hand tight, then wiggle the accessory to allow the peaks of the teeth to slide past each other. Hand tighten the coupling ring again. Repeat this procedure until the accessory cannot be tighten.

. **Materials and Finishes.** The materials and finishes used in the construction of MIL-C-85049 circular connector accessories are defined in Table 1. Elastomers and nylon are also used for some accessory subcomponents.

51. BACKSHELLS. Backshells are connector accessories that provide strain relief, environmental sealing, EMI shielding, and cable entry position. Backshells are divided into the following types:

. **Grommet and Grommet Nuts.** Grommets are pliable seals placed on the cable side of the connector, with a hole pattern matching the insert configuration. The grommet holes are sized to seal to the wire upon insertion to prevent moisture and dirt contamination. The grommet nut is a threaded ring used to secure the grommet when a strain relief, backshell, shrink adapter, or potting ring is not used (Figure 3).

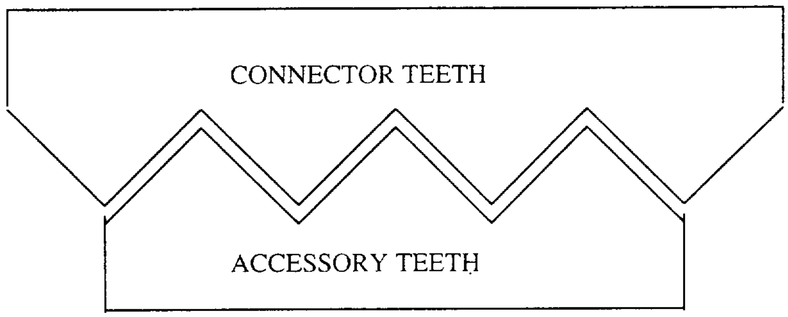


Figure 1. Proper (Peak-to-Valley) Position of Connector and Accessory Teeth in Mated Condition

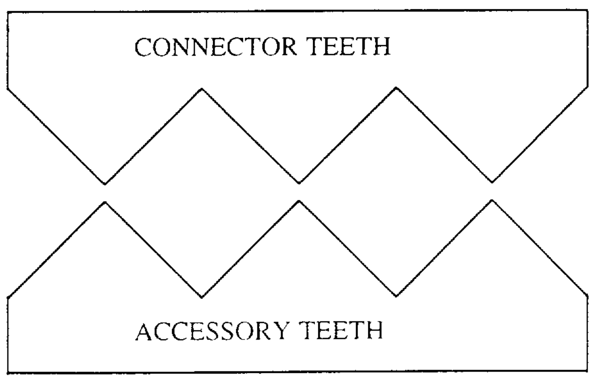


Figure 2. Improper (Peak-to-Peak) Position of Connector and Accessory Teeth in Mated Condition

Table 1. MIL-C-8049 Circular Connector Accessories Materials and Finishes

Component Material	Finish Designator	Finish Description
Aluminum		Black anodize
Aluminum	N	Electroless Nickel (Note 1)
Aluminum	W	Olive drab cadmium over suitable under late (Note 2)
Aluminum	P	Cadmium over electroless nickel (selective plating)
Corrosion resisting steel	B	Black Cadmium
Corrosion resisting steel	S	Passivated
Composite	J	Olive drab cadmium over suitable underplate, electrically conductive
Composite	M	Electrically conductive electroless nickel
Composite	T	Unplated
Composite	L	Cadmium over electroless nickel (selective plating)

NOTES:
1. Not for Navy use.
2. Not for space applications.

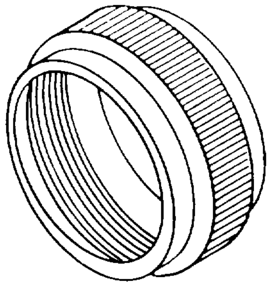


Figure 3. Typical Grommet Nut

. **Cable Clamp/Strain Relief.** A strain relief is a cable support or clamping device which attaches directly to the connector. The strain reliefs attach to the connector and absorb vibration and shock transmitted by the wires or cable to the contact connection. A cable clamp requires an intermediate component for attachment (Figure 4).

. **Potting Rings and Boots.** Potting boots are plastic molds held in place by a threaded potting ring. They are used together to form a neat potting seal when used with potting or sealing compound (Figure 5).

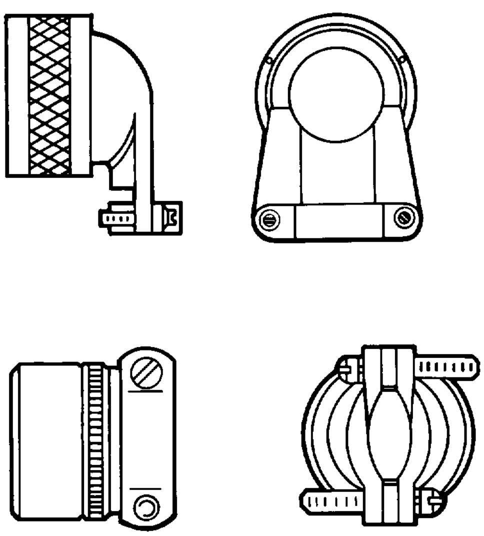


Figure 4. Typical Strain Relief

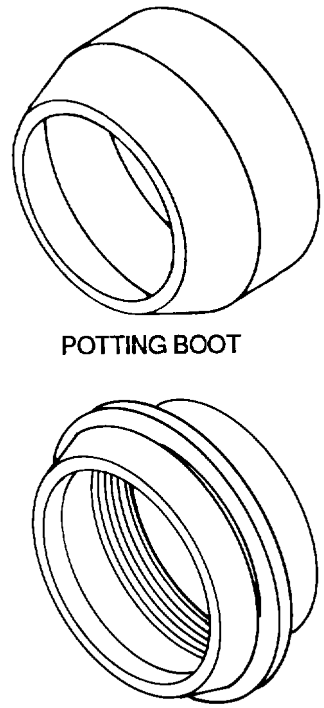


Figure 5. Typical Potting Ring and Boot

. **Shrink Boot and Adapters.** Shrink boots are heat shrinkable insulation sleeves used to insulate and seal the connector. Shrink boots are procured by the recovered or shrunk diameter. The adapter is a threaded coupling which attaches to the connector and to which the shrink boot seals (Figure 6).

. **Non-Environmental Backshell.** The nonenvironmental backshell is used when moisture entry protection is not required, but the need for additional space is required for maintenance (Figure 7).

. **Environmental Backshell.** The environmental backshell is used when moisture entry protection is required. This protection is afforded by the use of O-rings, extra grommets, and other sealing devices (Figure 8).

. **EMI/RFI Grounding Terminator.** The grounding terminators are a two piece unit used to ground the shield or shield terminations to a common point using a common lead (Figure 9). Ground terminators reduce electromagnetic radiation and radio frequency interference from other equipment. A physical anti-electrical shield is employed which is terminated at one or both end, to a ground or some other predetermined point with respect to the ground. The EMI/RFI grounding terminators are either bonding rings or ferrule assemblies. These grounding terminators are not to be confused with EMI/RFI back-shells. Their function is to place all the shields within the cable at the same potential eliminating EMI/RFI potentials within the cable. Shields can be applied to individual wires, cables, bundle, or harness.

. **Non-Environmental EMI/RFI Backshell.** This type of backshell is used when moisture entry protection is not required, but the need for EMI/RFI is required (Figure 10).

. **Environmental EMI/RFI Backshell.** This type of backshell is used when moisture entry and EMI/RFI protection is required (Figure 11). Protection is afforded by the use of O-rings, grommets, and other sealing devices.

. **Quick-Tye Strain Reliefs.** Quick-Tye strain reliefs are installed with lacing tape instead of saddle clamps to secure the wires. The use of this type eliminates frequent tape wrapping to alter cable diameters for secure clamping (Figure 12).

. **Banding Adapter.** Banding adapters (Figure 13) provide 360 degree shield termination for overall shielded cables/harnesses. The 360 degree shield termination is accomplished by use of a shield terminating band that is pulled tightly around the backshell, trapping the shield between the backshell and the band.

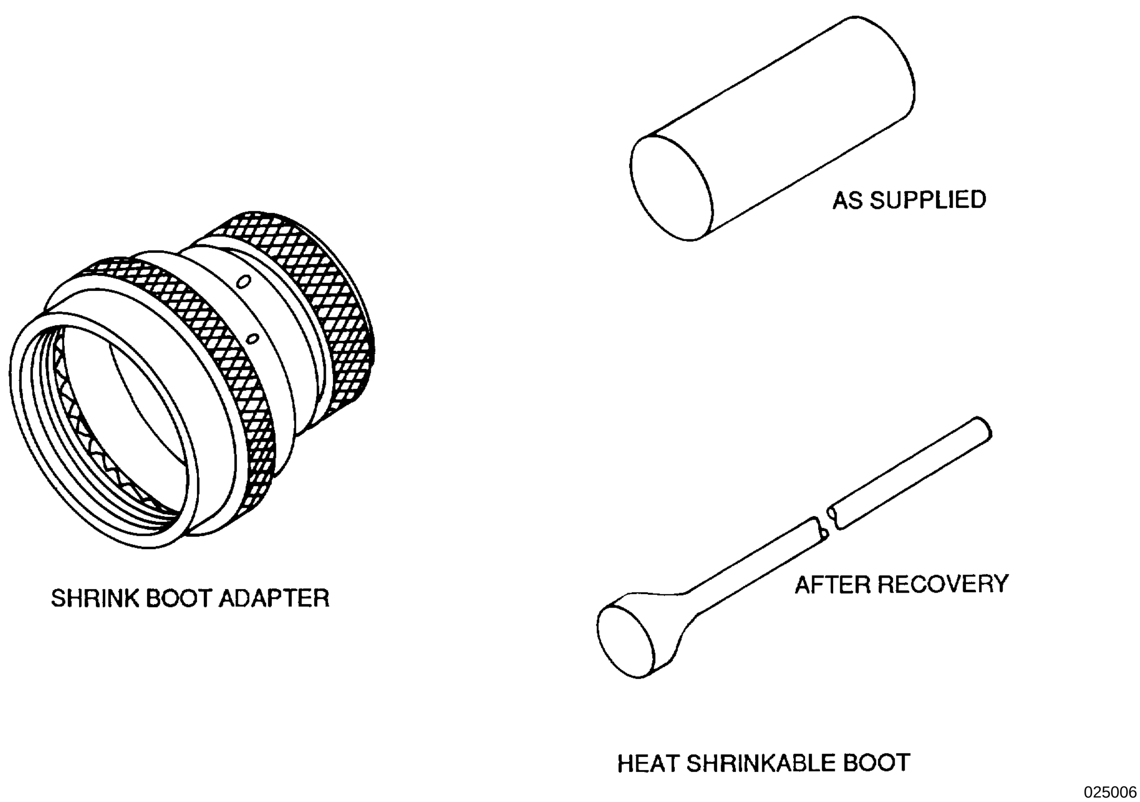


Figure 6. Typical Shrink Boot and Adapter.

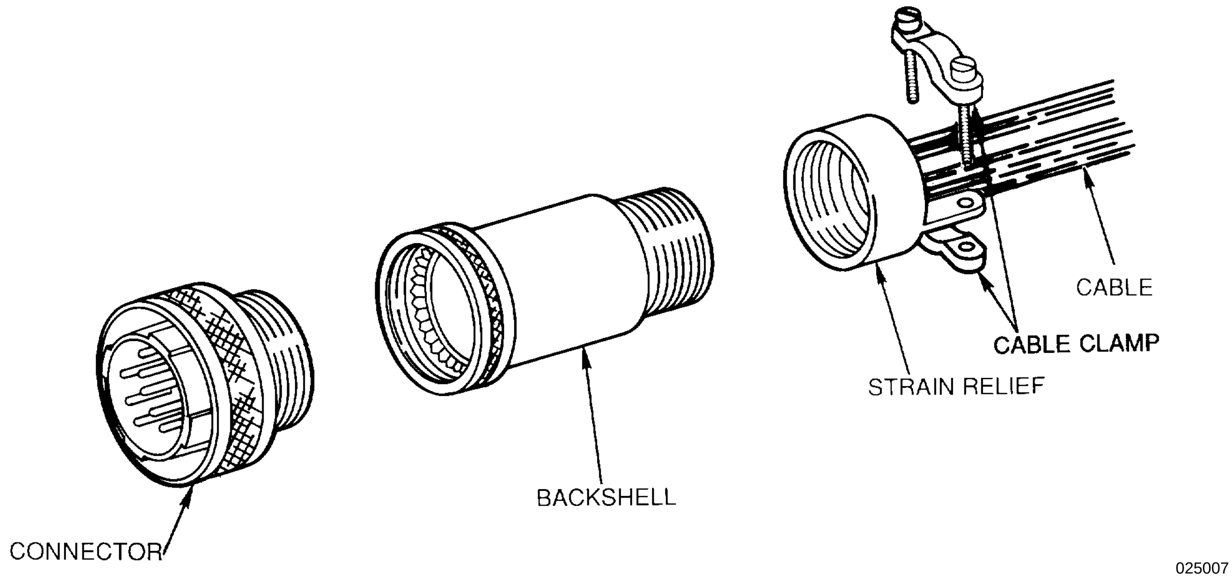


Figure 7. Typical Non–Environmental Backshell.

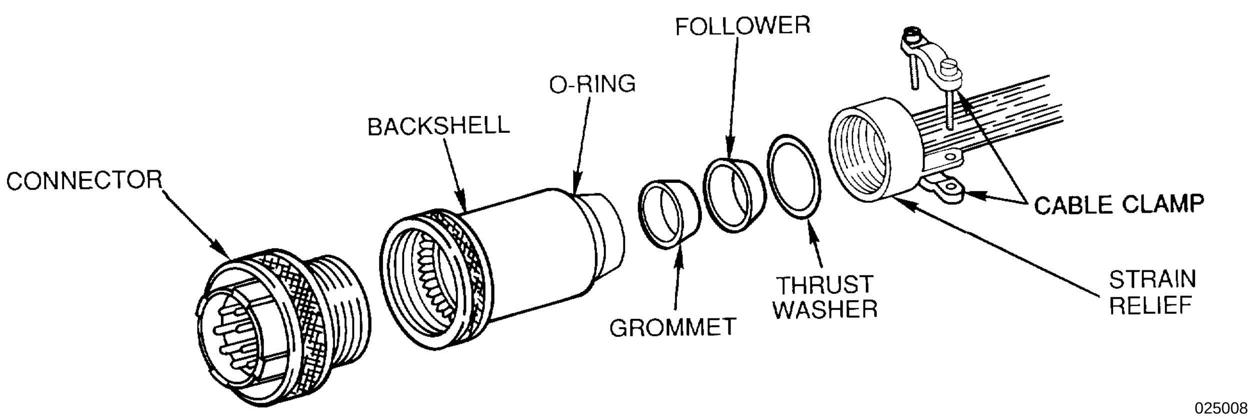


Figure 8. Typical Environmental Backshell.

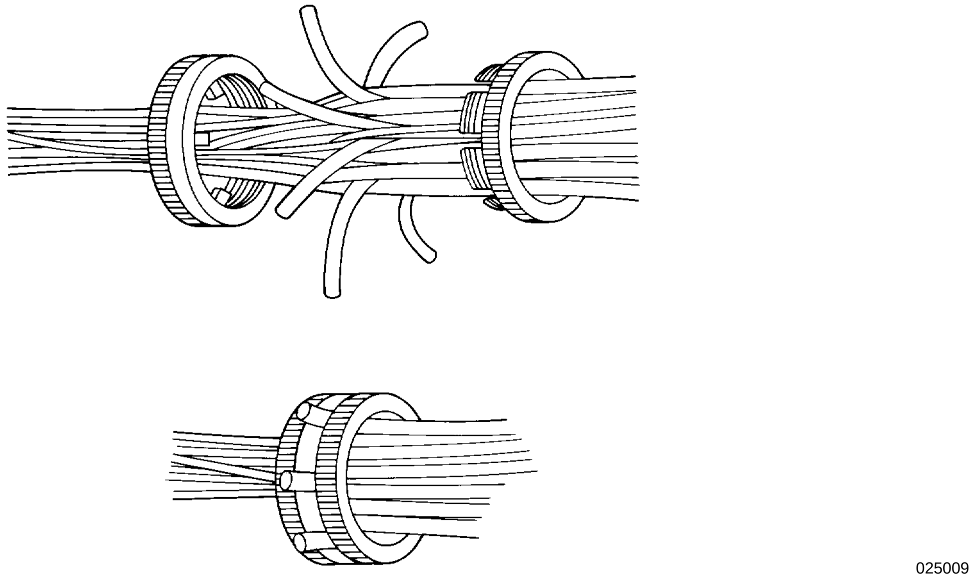


Figure 9. Grounding Terminator

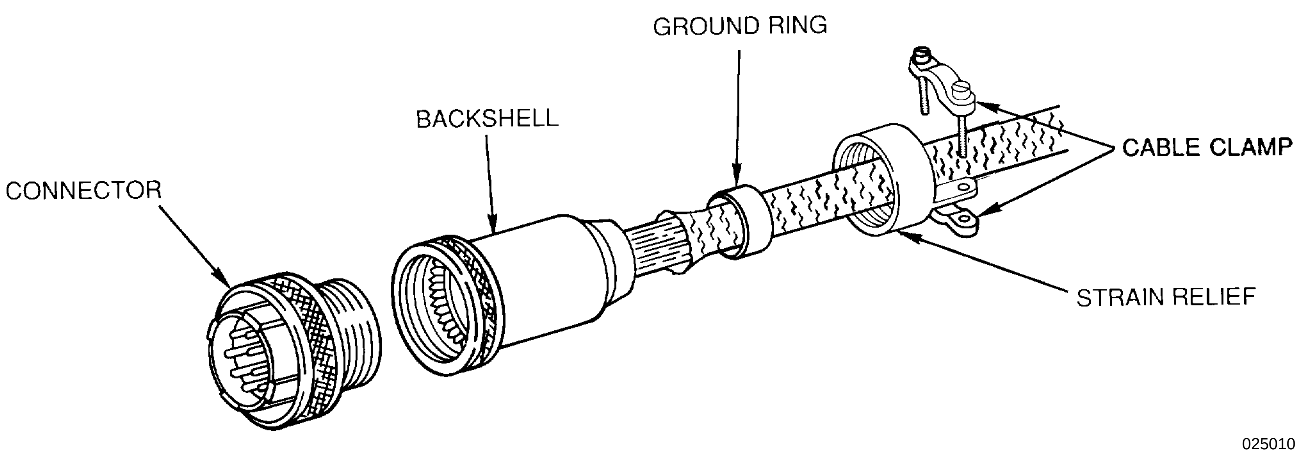


Figure 10. Typical Non–Environmental EMI/RFI Backshell

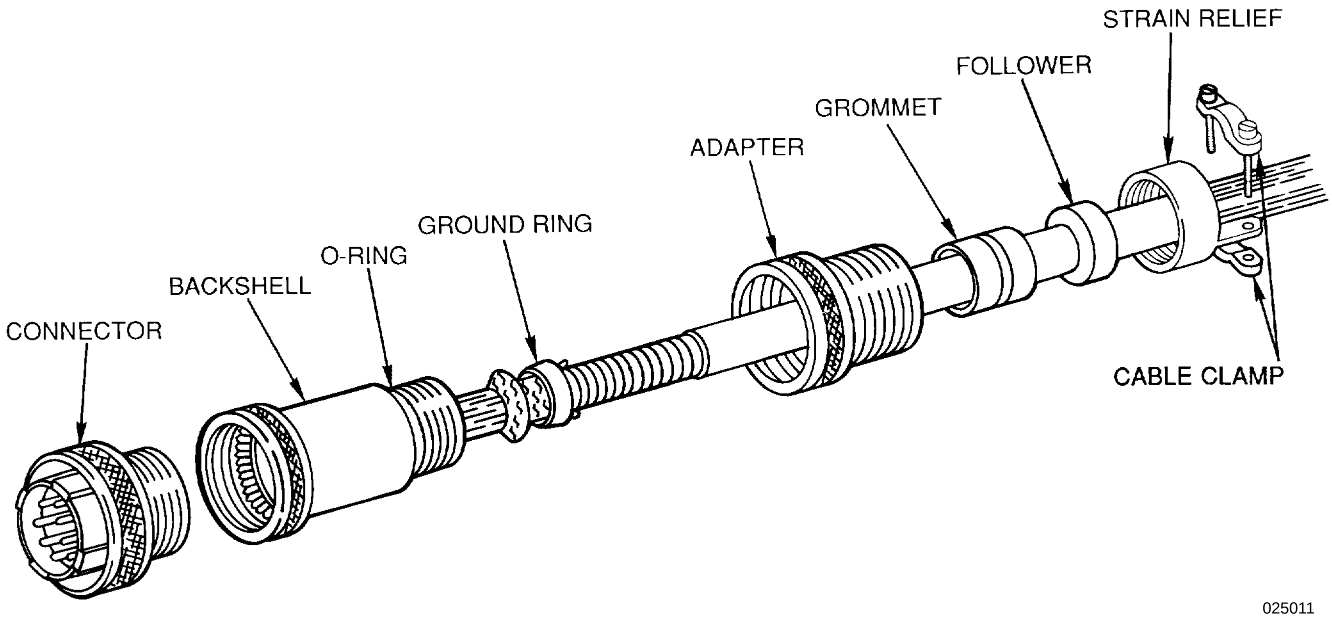


Figure 11. Typical EMI/RFI Environmental Backshells

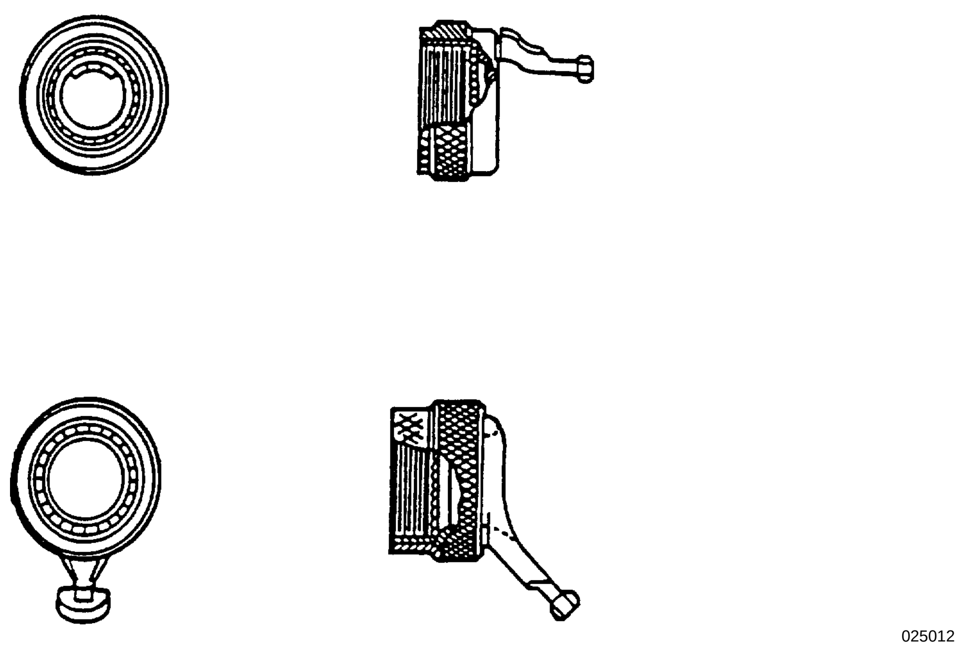


Figure 12. Quick-Tye Strain Reliefs

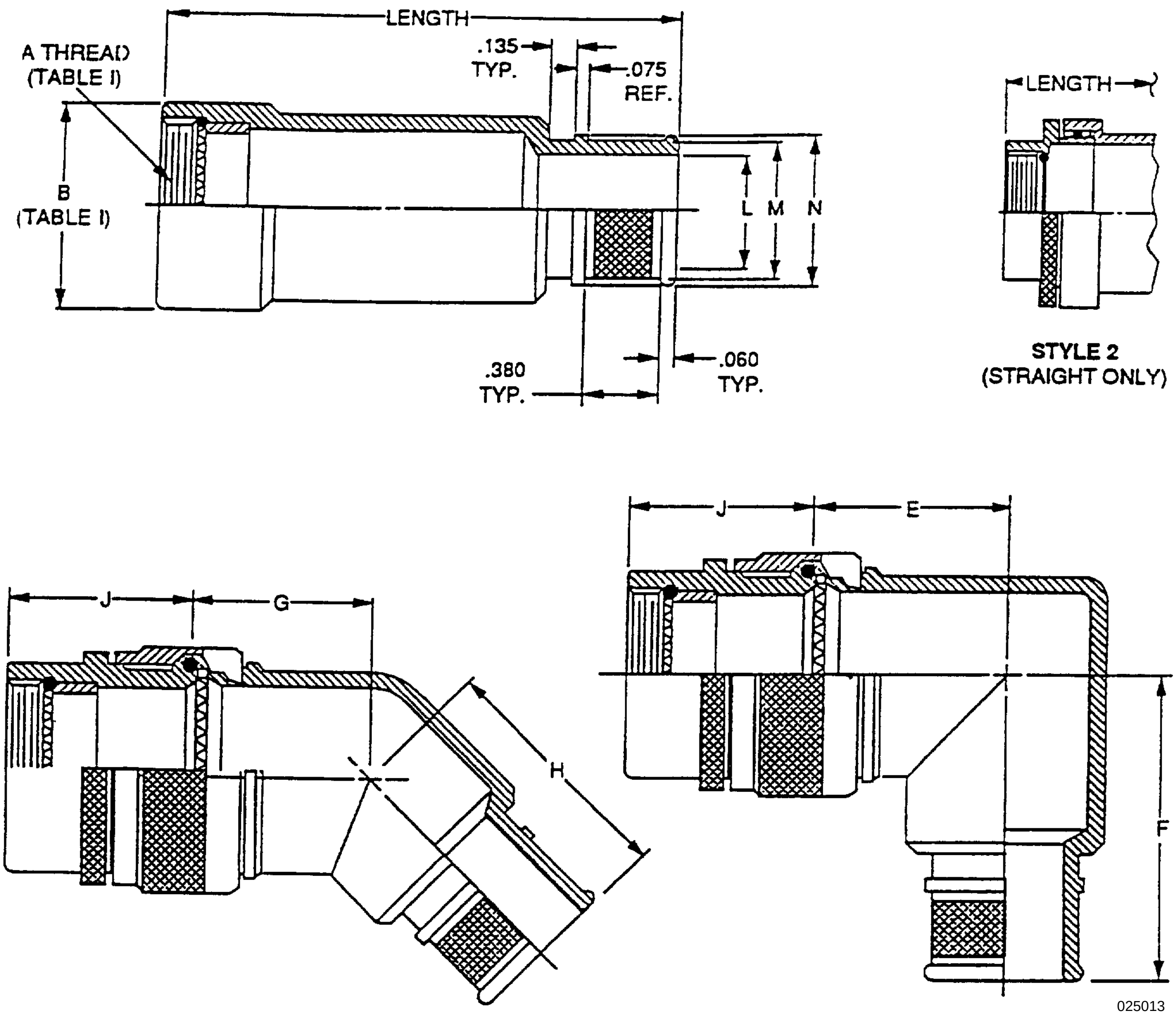


Figure 13. Banding Adapter

. **MIL-C-29600 Composite Backshells.** MIL-C-29600 backshells (Figure 14) provide backshell to backshell EMI/RFI protection and increased corrosion resistant.

NOTE

MIL-C-29600 connectors are not for Navy use and have been declared not for use in new design. This does not preclude use for maintenance, repair, resupply purposes or in designs where the connectors must interface with Government Furnished Equipment.

52. MIL-C-85049 CONNECTOR ACCESSORIES, ELECTRICAL, GENERAL SPECIFICATION FOR. This specification covers accessories for use with electrical connectors under environmental and non-environmental conditions, and for the suppression of radio frequency and electromagnetic interference. The specification is applicable to connectors by type, category, and function in accordance with individual specification sheets.

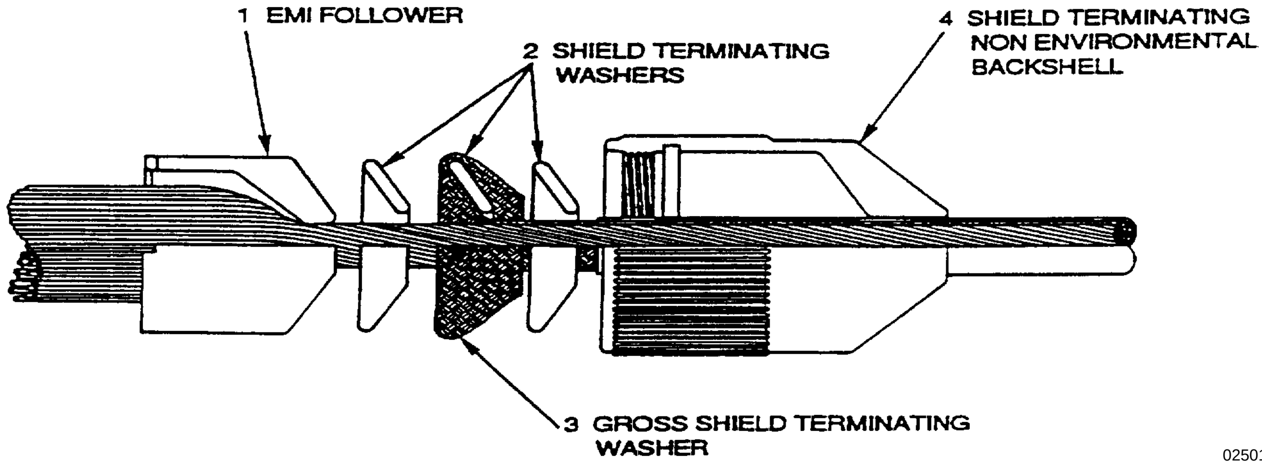


Figure 14. MIL-C-29600 Backshell to Backshell

. **Categories.** MIL-C-85049 connector accessories include. but are not limited to, the following categories:

a. 1A - Heavy duty, connector accessory, cable sealing, environmental

b. 1B - Medium duty, connector accessory, cable sealing,, environmental

c. 1C - Light duty, connector accessory, cable sealing, environmental

d. 2A - Heavy duty, connector accessory, environmental

e. 2B - Medium duty, connector accessory, environmental

f. 2C - Light duty, connector accessory, environmental

g. 3C - Heavy duty, connector accessory, nonenvironmental

h. 3B - Medium duty, connector accessory, nonenvironmental

i. 3C - Light duty, connector accessory, nonenvironmental

j. 4A - Heavy duty, connector accessory, strain relief. nonenvironmental

k. 4B - Medium duty, connector accessory, strain relief, nonenvironmental

l. 4C - Light duty, connector accessory, strain relief, nonenvironmental

m. 5 - Connector accessory, adapter, shrink boot and rink potting boot

n. 6 - Boots and sleeves, heat shrinkable (cancelled)

o. 7 - Connector accessory, miscellaneous devices

p. 8A - Connector accessory. adapter. conduit, cable sealing

q. 8B - Connector accessory, adapter. conduit, nonenvironmental

. **Part Number Breakdown.** See the following part number examples. See the appropriate specification sheet for more details.

a. M85049/2-3C, where M85049 is the military designator
/2 is the specification sheet
-3C is the dash number

b. M85049/3Wl0A1, where M85049 is the military designator
/3 is the specification sheet
W is the finish
10 is the size number

A is the type
1 is the style

c. M85049/7-10W, where M85049 is the military designator
/7 is the specification sheet
-10 is the dash number
W is the finish

d. M85049/14S11W, where M85049 is the military designator
/14 is the specification sheet
S is for self-locking
11 is the shell size
W is the finish

e. M85049/1724W10A, where M85049 is the military designator
/17 is the specification sheet
24 is the shell size
W is the finish
10 is the clamp size
A is the length code

f. M85049/26-3-10W, where M85049 is the military designator
/26 is the specification sheet
-3 is the figure
-10 is the dash number
W is the finish

g. M85049/3724W01L, where M85049 is the military designator
/37 is the specification sheet
24 is the shell size
W is the finish
01 is the clamp size
L is for encapsulating hole (D is for 3 drain holes)

h. M85049/45W10 where M85049 is the military designator
/45 is the specification sheet
W is the finish
10 is the dash number

i. M85049/47SW10 where M85049 is the military designator
/47 is the specification sheet
S is for self-locking
W is the finish
10 is the dash number

j. M85049/49-2S10S, where M85049 is the military designator
/49 is the specification sheet
-2 is nonsignificant
S is for self-locking
10 is the dash number
S is the finish

k. M85049/60-1W10, where M85049 is the military designator
/60 is the specification sheet
-1 is the figure
W is the finish
10 is the dash number

l. M85049/62-10WD, where M85049 is the military designator
/62 is the specification sheet
-10 is the dash number
W is the finish
D is the drain hole option

m. M85049/74-10-1, where M85049 is the military designator
/74 is the specification sheet
-10 is the shell size
-1 is the geometry (straight)

n. M85049/82-16P02, where M85049 is the military designator
/82 is the specification sheet
-16 is the shell size
P is the finish
02 is the entry size

o. M85049/31-10W, where M85049 is the military designator
/31 is the specification sheet
-10 is the shell size
W is the finish

p. M85049/52-1-12W, where M85049 is the military designator
/52-1 is the specification sheet
-12 is the shell size
W is the finish

q. M85049/51-1-14W, where M85049 is the military designator
/51-1 is the specification sheet
-14 is the shell size
W is the finish

53 . RECTANGULAR CONNECTOR ACCESSORIES. Rectangular connector accessories are components added to a connector to enhance the wiring system and/or EMC protection. These accessories include the following types of components or variations of them.

. **Shield Cover.** A shield cover is a variation of a backshell in that it protects the connections at the rear of the connector (Figure 15).

. **Shield Cover with Clamps.** This accessory is a shield cover with an integral clamp (Figure 16).

. **Potting Shell.** A potting shell is a form used with potting compound to provide a compound containment area (Figure 17).

. **Dust Caps.** Dust caps are protective covers installed to prevent the intrusion of dirt and moisture (Figure18). Also used to protect pins, sockets, and coupling devices.

. **Strain Relief Clamps.** A strain relief clamp is a support or clamping device that attaches to the connector (Figure 19).

. **Bushings.** Bushings are used to seal cable access into the shell, cover, or clamp (Figure 20).

. **Mounting Gaskets.** Mounting gaskets are gaskets used to seal the connector and the mounting structure.

. **Environmental Seals.** Environmental seals are used to prevent the intrusion of dirt and moisture into mated connectors (Figure 21).

. **Retaining Plates.** Retaining plates are used for rack and panel mounting the connector. When a retaining plate is used, there is no shield.

. **Shells.** The shell supports and protects the insulator and is used to mount the connector to the equipment.It is also used for the attachment of coupling and/or fields.

. **Guidepins.** Guidepins are used to align plug and receptacle connectors during mating.

. **Jackscrews.** Jackscrews are used to mate some plug and receptacle connectors.

. **Environmental Backshells.** Environmental backshells are used when moisture entry protection is required. The protection is afforded by the use of gaskets, extra grommets, and other sealing devices.

. **Non-environmental Backshells.** Non-environmental backshells are used when moisture protection is not required.

. **Environmental EMI/RFI Backshells.** EMI/RFI backshells are designed to ground or shield a connector to reduce electromagnetic radiation and radio frequency interference from other equipment. This backshell is used when moisture entry and EMI/RFI protection is needed.

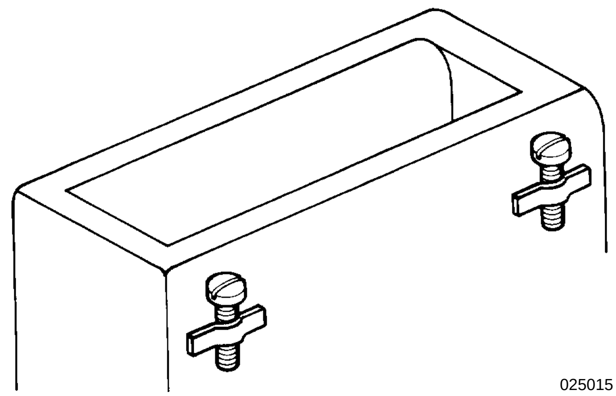


Figure 15. Typical Shield Cover

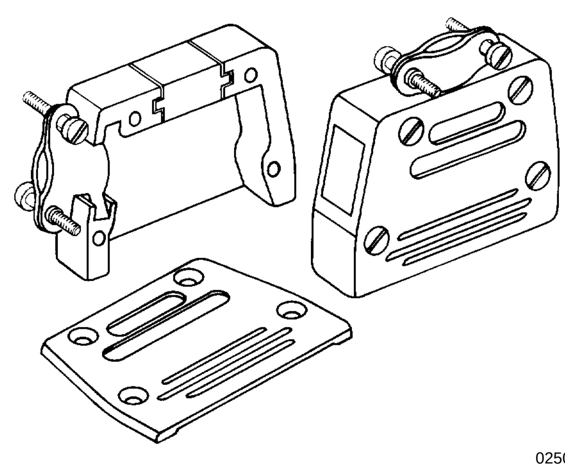
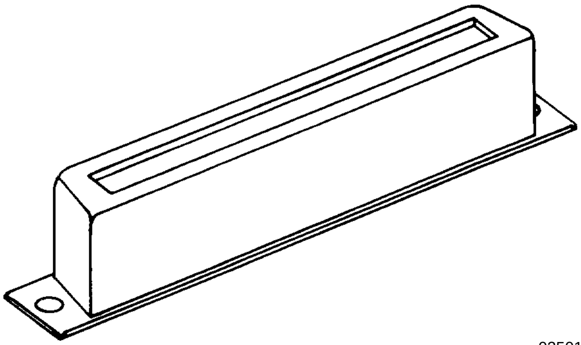
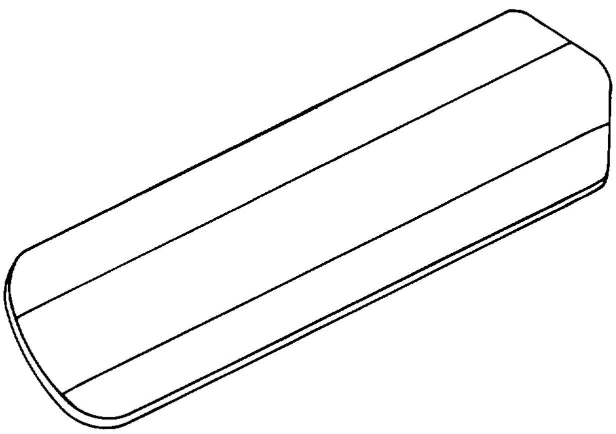


Figure 16. Typical Shield Cover with Clamp



025017

Figure 17. Typical Potting Shell



025018

Figure 18. Typical Dust Cap

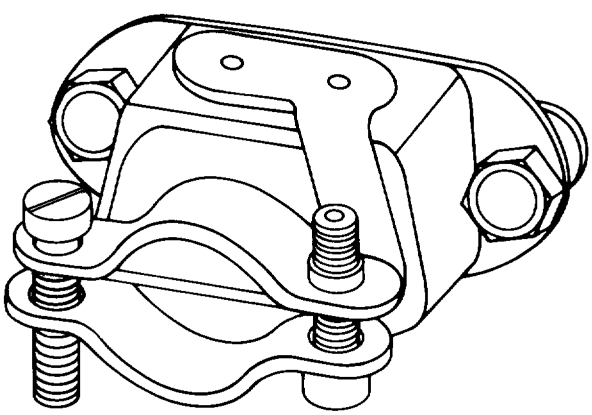
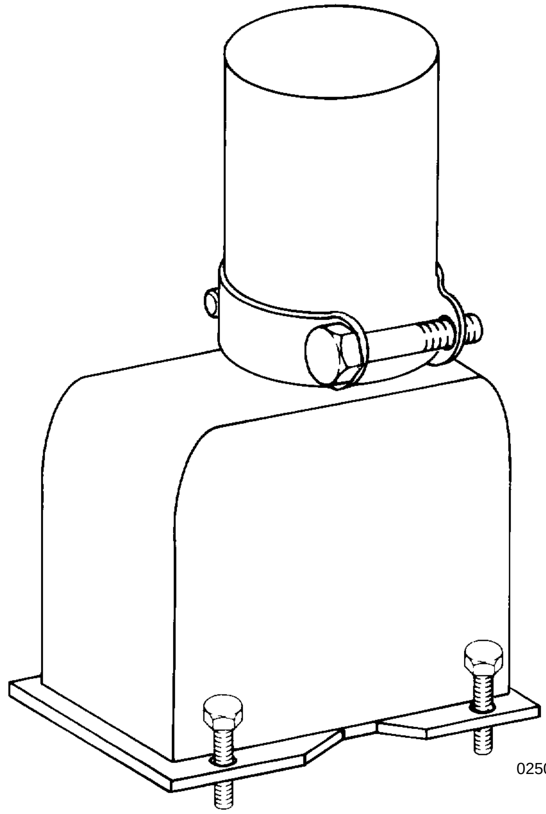


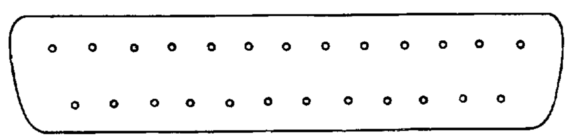
Figure 19. Typical Strain Relief Clamp

025019



025020

Figure 20. Typical Bushing



025021

Figure 21. Typical Environment Seal

54. **<u>MAINTENANCE ON CONNECTOR ACCESSORIES</u>**

55. **CIRCULAR CONNECTOR ACCESSORY MAINTENANCE.**

. **Special Tools.** Connector backshells come in a wide variety of types, depending on the application. To install backshells or accessories, adapter tools and a strap wrench are needed. Adapter tools are used to hold the connector during backshell installation and removal. The strap wrench is used to tighten or loosen the backshell. Special tools are used so as not to damage the connector shells or accessories.

. **Adapter Tool Selection.** To select the proper adapter tool, the shell size, series, and type of connector plug or receptacle must be known (See 01–1A–505). The adapter tool is illustrated in Figure 22. Select the applicable tool from Tables 2 through 15 using the applicable connector specification.

. **Adapter Tool Accessory.** To hold the adapter tool and to keep the connector from turning when installing or removing backshells, the use of a 1/4 inch drive T-handle is recommended. A strap wrench (Figure 23) is used on the backshell for installation and removal to apply end pressure without causing damage to accessories.

. **Backshell Removal.** Backshells are used to protect, shield, and add strength to connectors. When modification or repair to the connector is necessary, the backshell must be removed. Proceed using the following steps:

a. Select the correct adapter tool by connector and series (Tables 2 through 15). For MIL-C-38999 Series III receptacles, use two strap wrenches.

b. Mate the adapter tool to the connector. Ensure the white dot on the adapter tool aligns with the master key of the connector. Spinning the tool on the connector will cause damage to the tool and/or the connector. MIL-C-38999 Series III receptacles use a mating plug and a second strap wrench. Mount the strap wrench on the mating plug, opposite to step c, to provide holding.

c. Install the strap wrench around the part to be removed. Draw the strap tightly through the locking link. The backshell will rest on the nose of the wrench (Figure 24).

d. Insert the T-handle into the socket of the adapter tool to provide holding (Figure 24).

e. To loosen the backshell. apply force counter-clockwise as viewed from the connector rear (Figure 25).

f. Tape the backshell to the bundle to prevent loss.

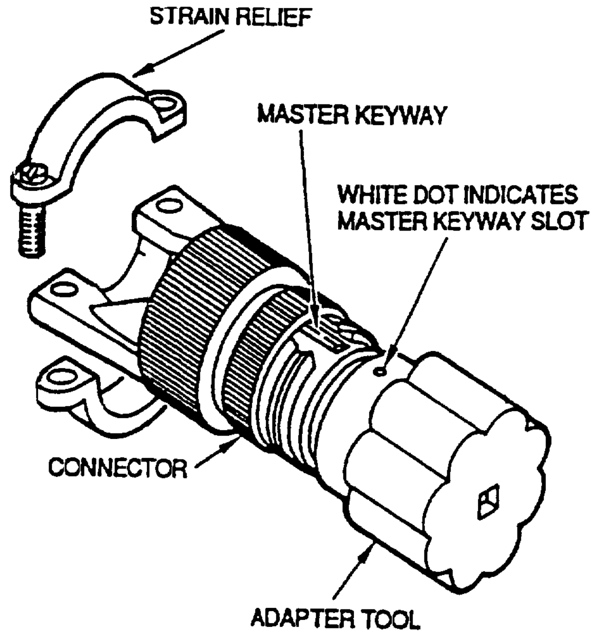


Figure 22. Adapter Tool (BT-S-389)

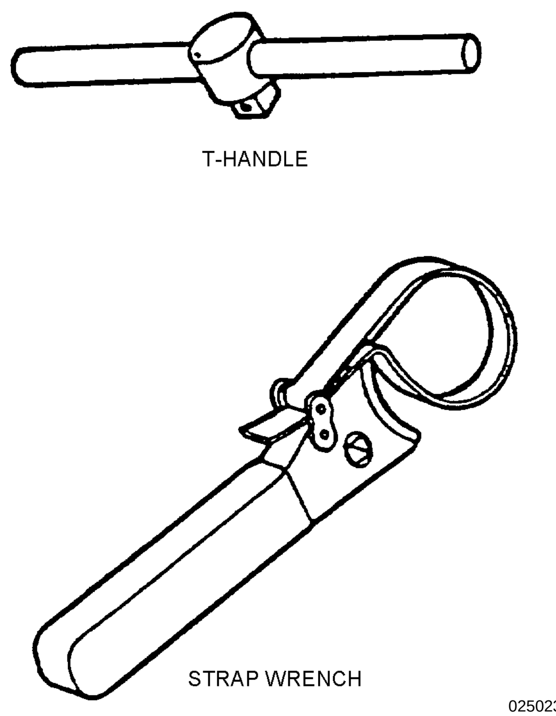


Figure 23. Adapter Tool Accessories

Table 2. MIL-C-38999 Series I Adapter Tool Selection

Individual Tool Part Numbers For Plugs	Shell Size	Keying Positions	Color Coding	Individual Tool Part Numbers For Receptacles	Shell Size	Keying Positions	Color Coding
BT389L-9	9	All	Blue	BT389LR-9	9	All	Blue
BT389L-11	11	All	Blue	BT389LR-11	11	All	Blue
BT389L-13	13	All	Blue	BT389LR-13	13	All	Blue
BT389L-15	15	All	Blue	BT389LR-15	15	All	Blue
BT389L-17	17	All	Blue	BT389LR-17	17	All	Blue
BT389L-19	19	All	Blue	BT389LR-19	19	All	Blue
BT389L-21	21	All	Blue	BT389LR-21	21	All	Blue
BT389L-23	23	All	Blue	BT389LR-23	23	All	Blue
BT389L-25	25	All	Blue	BT389LR-25	25	All	Blue

Table 3. MIL-C-38999 Series II Adapter Tool Selection

Individual Tool Part Numbers For Plugs	Shell Size	Keying Positions	Color Coding	Individual Tool Part Numbers For Receptacles	Shell Size	Keying Positions	Color Coding
BT389S-8	8	All	Gray	BT264R-8	8	All	Orange
BT389S-10	10	All	Gray	BT264R-10	10	All	Orange
BT389S-12	12	All	Gray	BT264R-12	12	All	Orange
BT389S-14	14	All	Gray	BT264R-14	14	All	Orange
BT389S-16	16	All	Gray	BT264R-16	16	All	Orange
BT389S-18	18	All	Gray	BT264R-18	18	All	Orange
BT389S-20	20	All	Gray	BT264R-20	20	All	Orange
BT389S-22	22	All	Gray	BT264R-22	22	All	Orange
BT389S-24	24	All	Gray	BT264R-24	24	All	Orange

Table 4. MIL-C-38999 Series III Adapter Tool Selection

Individual Tool Part Numbers	Shell Size	Keying Positions	Color Coding
BT389T-9A	9	N,C,D	Lavender
BT389T-11A	11	N,D,E	Lavender
BT389T-13A	13	N,D,E	Lavender
BT389T-15A	15	N,D,E	Lavender
BT389T-17A	17	N,A,B	Lavender
BT389T-19A	19	N,A,B	Lavender
BT389T-21A	21	N,A,B	Lavender
BT389T-23A	23	N,A,B	Lavender
BT389T-25A	25	N,A,B	Lavender
BT389T-9B	9	A,B,E	Lavender
BT389T-11B	11	A,B,C	Lavender
BT389T-13B	13	A,B,C	Lavender
BT389T-15B	15	A,B,C	Lavender
BT389T-17B	17	C,D,E	Lavender
BT389T-19B	19	C,D,E	Lavender
BT389T-21B	21	C,D,E	Lavender
BT389T-23B	23	C,D,E	Lavender
BT389T-25B	25	C,D,E	Lavender

Table 5. MIL-C-38999 Series IV Adapter Tool Selection

Individual Tool Part Numbers For Plugs	Shell Size	Keying Positions	Color Coding	Individual Tool Part Numbers For Receptacles	Shell Size	Keying Positions	Color Coding
BT389B-11	11	All	Beige	BT389BR-11	11	All	Beige
BT389B-13	13	All	Beige	BT389BR-13	13	All	Beige
BT389B-15	15	All	Beige	BT389BR-15	15	All	Beige
BT389B-17	17	All	Beige	BT389BR-17	17	All	Beige
BT389B-19	19	All	Beige	BT389BR-19	19	All	Beige
BT389B-21	21	All	Beige	BT389BR-21	21	All	Beige
BT389B-23	23	All	Beige	BT389BR-23	23	All	Beige
BT389B-25	25	All	Beige	BT389BR-25	25	All	Beige

Table 6. MIL-C-81511 Series 1 Adapter Tool Selection

Individual Tool Part Numbers for Plugs	Shell Size	Keying Positions	Color Coding
BT815L-8A	8	1,2,3	Yellow
BT815L-10A	10	1,2,6	Yellow
BT815L-14A	14	1,2,6	Yellow
BT815L-16A	16	1,2,3	Yellow
BT815L-18A	18	1,2,3	Yellow
BT815L-20A	20	1,2,3	Yellow
BT815L-22A	22	1,2,3	Yellow
BT815L-24A	24	1,2,3	Yellow
BT815L-8B	8	4,5,6	Yellow
BT815L-10B	10	3,4,5	Yellow
CM815L-22B	22	4,5,6	Yellow
CM815L-24B	24	4,5,6	Yellow
BT815L-14B	14	3,4,5	Yellow
BT815L-16B	16	4,5,6	Yellow
BT815L-18B	18	4,5,6	Yellow
BT815L-20E	20	4,5,6	Yellow
BT815L-22B	22	4,5,6	Yellow
BT815L-24B	24	4,5,6	Yellow
CM815L-8A	8	1,2,3	Yellow
CM815L-10A	10	1,2,6	Yellow
CM815L-14A	14	1,2,6	Yellow
CM815L-16A	16	1,2,3	Yellow
CM815L-18A	18	1,2,3	Yellow
CM815L-20A	20	1,2,3	Yellow
CM815L-22A	22	1,2,3	Yellow
CM815L-24A	24	1,2,3	Yellow
CM815L-8B	8	4,5,6	Yellow
CM815L-10B	10	3,4,5	Yellow
CM815L-14B	14	3,4,5	Yellow
CM815L-16B	16	4,5,6	Yellow
CM815L-18B	18	4,5,6	Yellow
CM815L-20B	20	4,5,6	Yellow

Table 7. MIL-C-81511 Series 2 Adapter Tool Selection

Individual Tool Part Numbers for Plugs	Shell Size	Keying Positions	Color Coding
CM815S-8A	8	All	Red
CM815S-10A	10	1,4,5	Red
CM815S-14A	14	1,4,5	Red
CM815S-16A	16	1,2,4	Red
CM815S-18A	18	1,2,4	Red
CM815S-10B	10	2,3,6	Red
CM815S-14B	14	2,3,6	Red
CM815S-16B	16	3,5,6	Red
CM815S-18B	18	3,5,6	Red
BT815S-8	8	All	Red
BT815S-10A	10	1,4,5	Red
BT815S-14A	14	1,4,5	Red
BT815S-16A	16	1,2,4	Red
BT815S-18A	18	1,2,4	Red
BT815S-10B	10	2,3,6	Red
BT815S-14B	14	2,3,6	Red
BT815S-16B	16	3,5,6	Red
BT815S-18B	18	3,5,6	Red

Table 8. MIL-C-81511 Series 3 Adapter Tool Selection

Individual Tool Part Number for Plugs	Shell Size	Keying Positions	Color Coding
BT815L-8A	8	1,2,3	Yellow
BT815L-10A	10	1,2,6	Yellow
BT815L-14A	14	1,2,6	Yellow
BT815L-16A	16	1,2,3	Yellow
BT815L-18A	18	1,2,3	Yellow
BT815L-20A	20	1,2,3	Yellow
BT815L-22A	22	1,2,3	Yellow
BT815L-24A	24	1,2,3	Yellow
BT815L-8B	8	4,5,6	Yellow
BT815L-10B	10	3,4,5	Yellow
BT815L-14B	14	3,4,5	Yellow
BT815L-16B	16	4,5,6	Yellow
BTS15L-18B	18	4,5,6	Yellow
BT815L-20B	20	4,5,6	Yellow
BT815L-22B	22	4,5,6	Yellow
BT815L-24B	24	4,5,6	Yellow
CM815L-8A	8	1,2,3	Yellow
CM815L-10A	10	1,2,6	Yellow
CM815L-14A	14	1,2,6	Yellow
CM815L-16A	16	1,2,3	Yellow
CM815L-18A	18	1,2,3	Yellow
CM815L-20A	20	1,2,3	Yellow
CM815L-22A	22	1,2,3	Yellow
CM815L-24A	24	1,2,3	Yellow
CM815L-8B	8	4,5,6	Yellow
CM815L-10B	10	3,4,5	Yellow
CM815L-14B	14	3,4,5	Yellow
CM815L-16B	16	4,5,6	Yellow
CM815L-18B	18	4,5,6	Yellow
CM815L-20B	20	4,5,6	Yellow
CM815L-22B	22	4,5,6	Yellow
CM815L-24B	24	4,5,6	Yellow

Table 9. MIL-C-81511 Series 4 Adapter Tools Selection

Individual Tool Part Number For Plugs	Shell Size	Keying Positions	Color Coding
CM815S-8A	8	All	Red
CM815S-10A	10	1,4,5	Red
CM815S-14A	14	1,4,5	Red
CM815S-16A	16	1,2,4	Red
CM815S-18A	18	1,2,4	Red
CM815S-10B	10	2,3,6	Red
CM815S-14B	14	2,3,6	Red
CM815S-16B	16	3,5,6	Red
CM815S-18B	18	3,5,6	Red
BT815S-8A	8	All	Red
BT815S-10A	10	1,4,5	Red
BT815S-14A	14	1,4,5	Red
BT815S-16A	16	1,2,4	Red
BT815S-18A	18	1,2,4	Red
BT815S-10B	10	2,3,6	Red
BT815S-14B	14	2,3,6	Red
BT815S-16B	16	3,5,6	Red
BT815S-18B	18	3,5,6	Red

Table 10. MIL-C-83723 Adapter Tools Selection

Connector Family	Shell Size	Adapter Adapter Set P/N		Adapters In Set
		Plug	Receptacle	
MIL-C 83723 Series I	8 thru 24	CM-S-264	CM-S-264R	9
MIL-C-83723 Series II	8 thru 48	CMS-5015	CM-S-5015R	15
MIL-C-83723 Series III	8 thru 24	CM-S-837	CM-S-837RB	20 9

Table 11. MIL-C-5015 Adapter Tool Selection

Shell Size	Polarization	Plug	Adapter Tool Part Number Color Code	Receptacle	Color Code
8	All	CM5015-8	Chrome	CM5015R-8	Chrome
10	All	CM5015-10	Chrome	CM5015R-10	Chrome
12	All	CM5015-12	Chrome	CM5015R-12	Chrome
14	All	CM5015-14	Chrome	CM5015R-14	Chrome
16	All	QM5015-16	Chrome	CM5015R-16	Chrome
18	All	CM5016-18	Chrome	CM5015R-18	Chrome
20	All	CM5015-20	Chrome	CM501SR-20	Chrome
22	All	CM5015-22	Chrome	CM5015R-22	Chrome
24	All	CM5015-24	Chrome	CM5015R-24	Chrome
26	All	CM5015-26	Chrome	CM5015R-26	Chrome
28	All	CM5015-28	Chrome	CM5015R-28	Chrome
32	All	CM5015-32	Chrome	CM5015R-32	Chrome
36	All	CM5015-36	Chrome	CM5015R-36	Chrome
40	All	CM5015-40	Chrome	CM5015R-40	Chrome
44	All	CM5015-44	Chrome	CM5015R-44	Chrome
48	All	CM5015-48	Chrome	CM5015R-48	Chrome

Table 12. MIL-C-26482 Series 1 and 2 Adapter Tool Selection

Connector Family	Shell Size	Polarization	Part Number Plug	Color Code	Receptacle	Color Code
MIL-C-26482, Series I & II	8	All	BT264-8	Orange	BT264R-8	Orange
MIL-C-26482, Series I & II	10	All	BT264-10	Orange	BT264R-10	Orange
MIL-C-26482, Series I & II	12	All	BT264-12	Orange	BT264R-12	Orange
MIL-C-26482, Series I & II	14	All	BT264-14	Orange	BT264R-14	Orange
MIL-C-26482, Series I & II	16	All	BT264-16	Orange	BT264R-16	Orange
MIL-C-26482, Series I & II	28	All	BT264-18	Orange	BT264R-18	Orange
MIL-C-26482, Series I & II	20	All	BT264-20	Orange	BT264R-20	Orange
MIL-C-26482, Series I & II	22	All	BT264-22	Orange	BT264R-22	Orange
MIL-C-26482, Series I & II	24	All	BT264-24	Orange	BT264R-24	Orange

Table 13. MIL-C-26500 Adapter Tools Selection

Shell Size	Polarization	Part Number Plug	Color Code	Receptacle	Color Code
8	All	BT264-8	Orange	BT264R-8	Orange
10	All	BT264-10	Orange	BT264R-10	Orange
12	All	BT264-12	Orange	BT264R-12	Orange
14	All	BT264-14	Orange	BT264R-14	Orange
16	All	BT264-16	Orange	BT264R-16	Orange
18	All	BT264-18	Orange	BT264R-18	Orange
20	All	BT264-20	Orange	BT264R-20	Orange
22	All	BT264-22	Orange	BT264R-22	Orange
24	All	BT264-24	Orange	BT264R-24	Orange

Table 14. MIL-C-81703 Adapter Tool Selection

Shell Size	Polarization	Part Number Part Number Plug	Color Code	Receptacle	Color Code
8	All	BT265-8	Orange	BT265-8	Orange
10	All	BT264-10	Orange	BT264-10	Orange
12	All	BT264-12	Orange	BT264-12	Orange
14	All	BT264-14	Orange	BT264-14	Orange
16	All	BT264-16	Orange	BT264-16	Orange
18	All	BT264-18	Orange	BT264-18	Orange
20	All	BT264-20	Orange	BT264-20	Orange
22	All	BT264-22	Orange	BT264-22	Orange
24	All	BT264-24	Orange	BT264-24	Orange

Table 15. NAS1599 Adapter Tool Selection

Shell Size	Polarization	Adapter Tool Pin P/N Plug	Color Code	Receptacle	Color Code
8	All	CM264-8	Orange	CM264R-8	Orange
10	All	CM264-10	Orange	CM264R-10	Orange
12	All	CM264-12	Orange	CM264R-12	Orange
14	All	CM264-14	Orange	CM264R-14	Orange
16	All	CM264-16	Orange	CM264R-16	Orange
18	All	CM264-18	Orange	CM264R-18	Orange
20	All	CM264-20	Orange	CM264R-20	Orange
22	All	CM264-22	Orange	CM264R-22	Orange
24	All	CM264-24	Orange	CM264R-24	Orange

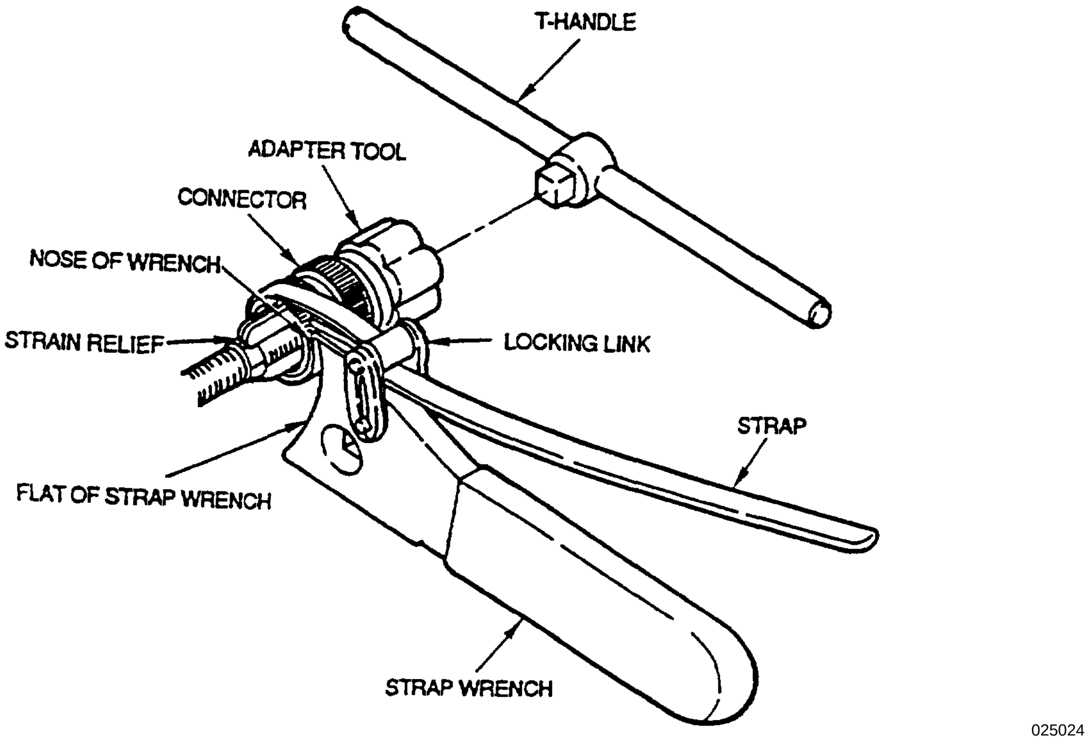


Figure 24. Strap Wrench Set-up and Adjustment

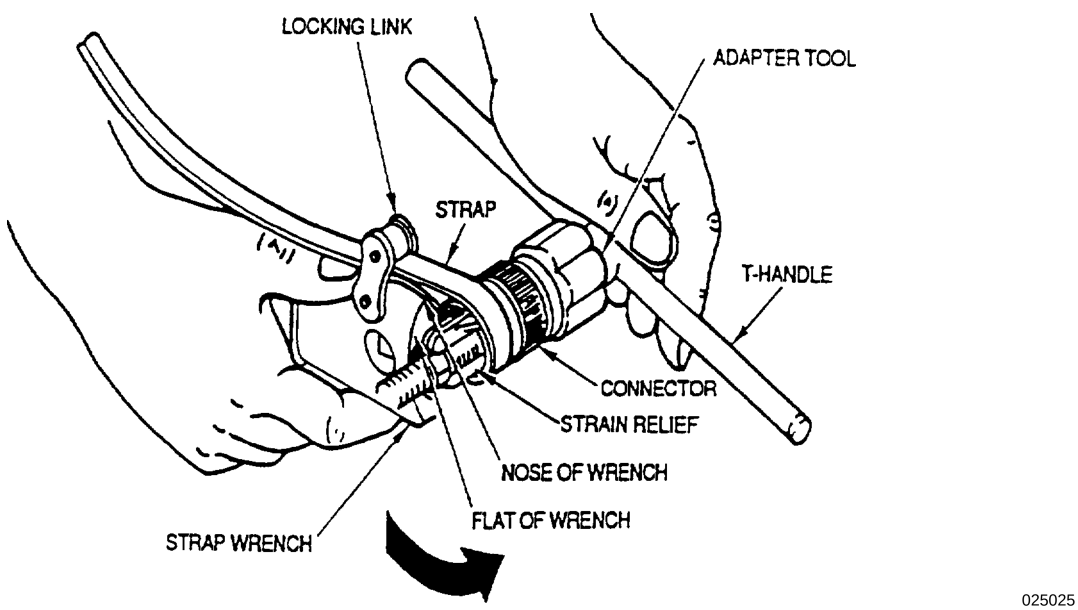


Figure 25. Loosening Position of Wrench

. **Backshell Installation.** Upon completion of maintenance or modification, the backshell must be replaced. Proceed using the following steps:

g. Untape the backshell from the bundle. Start threading the backshell onto the connector by hand to prevent cross threading.

h. Select the correct adapter tool from the appropriate table, and a T-handle and strap wrench. Select two strap wrenches for MIL-C-38999 Series III connectors.

i. Mate the adapter tool to the connector. Ensure the white dot on the adapter tool aligns with the master keyway of the connector. Spinning the tool on the connector will cause damage to the tool and/or the connector (Figure 24). MIL-C-38999 Series III receptacles use a mating plug and a second strap wrench. Mount the strap wrench on the mating plug, opposite to step d, to provide holding.

j. Install the strap wrench around the part to be installed. Draw the strap tightly through the locking link. The backshell will rest on the nose of the wrench (Figure 24).

k. Insert the T-handle into the socket of the adapter tool to provide holding (Figure 24).

l. To tighten the backshell, apply a clockwise force as viewed from the connector rear (Figure 26).

. **Cable Clamp-Type Strain Relief Removal.** To remove this type of strain relief, use the following procedure (Figure 27):

m. Loosen saddle clamp screws.

n. Unwrap any reinforcing silicone tape.

o. Remove strain relief using tools and tool procedure for backshell removal (paragraph 56).

p. Perform connector repair.

. **Cable Clamp-Type Strain Relief Installation.** Upon completion of the connector repair, install the strain relief using the following procedure (Figure 27):

q. Wrap cable with reinforcing silicone tape to build cable diameter where necessary.

r. Install the strain relief using the tools and tool procedure for backshell installation (paragraph 57).

s. Restore the proper dress of wire at the connector. The wire should not elongate the grommet holes, be pulled tightly, or be kinked (Figure 28).

t. Tighten the screws in the saddle clamp to provide firm gripping and to prevent wire movement without damage or crushing.

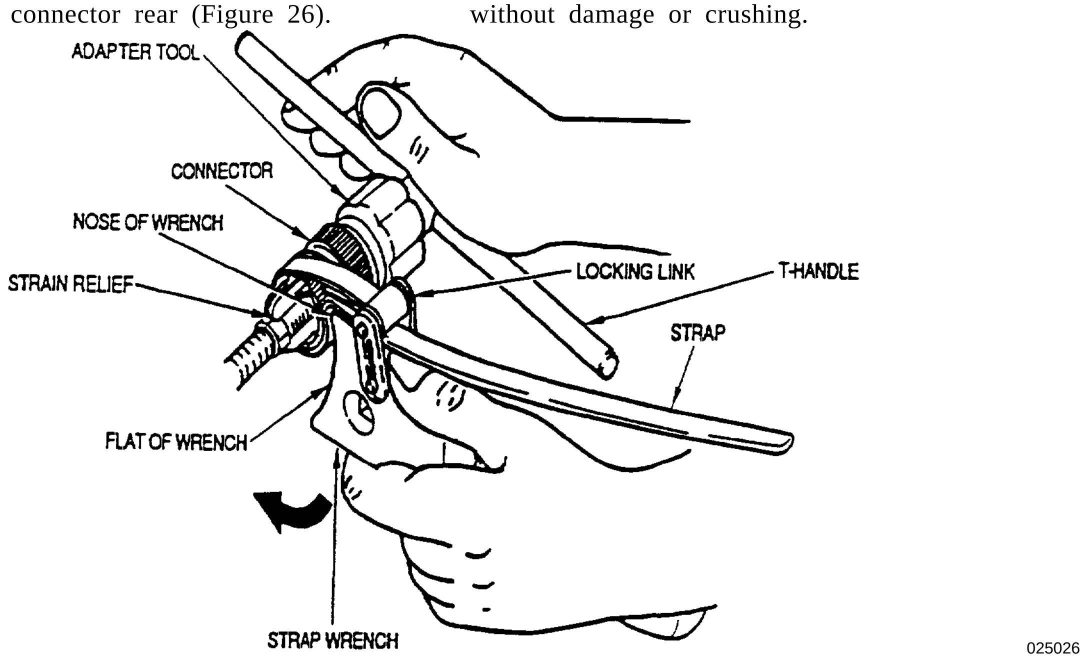


Figure 26. Tightening Position of Wrench

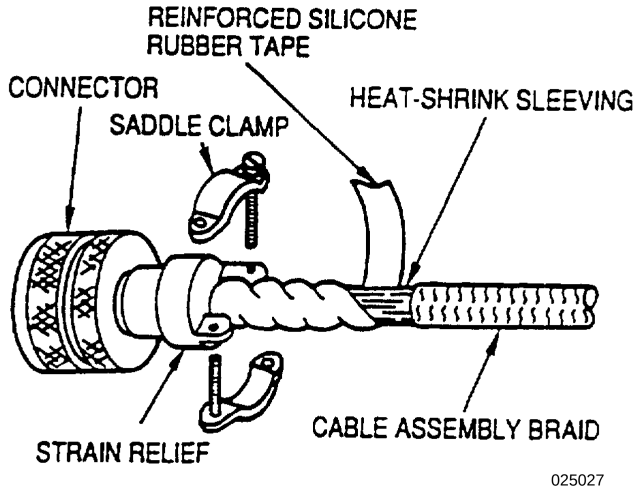


Figure 27. Saddle Clamp Removal/Installation

. **Quick-Tye Strain Relief Removal.** When connector repair is necessary, remove the Quick Tye strain relief using the following procedure:

u. Cut the lacing tape that secures the cable or wires to the strain relief.

v. Remove the strain relief using the tools and procedure for backshell removal (paragraph 56).

w. Perform the connector repair.

. **Quick-Tye Strain Relief Installation.** Upon completion of the connector repair, install the Quick-Tye strain relief as follows (Figure 29):

x. Install the Quick-Tye strain relief using the tools and procedures for backshell installation (paragraph 57).

y. Using silicone tape, wrap a cushion strip around the wire bundle where it contacts the Quick-Tye arm.

z. Use a 3/8 inch dowel or similar spacer aid between the connector and 90 degree Quick-Tye arm.

aa. Using lacing tape, wrap the tape around the wires. then around the Quick-Tye arm. Keep wires slack so as to not distort the connector grommet.

ab. Tie the lacing tape so as to not damage or crush the wire or insulation, but tighten enough to prevent the wire from shifting.

ac. Remove the spacer.

. **Potting Boot and Ring Removal.** To gain access to the connector for repair, the potting ring and boot must be removed using the following procedure:

ad. Using, diagonal cutters, cut the potting boot lengthwise.

ae. Peel the boot and sealant from the connector.

af. Remove the potting ring using the tools and procedure for backshell removal (paragraph 56).

ag. When the connector plug is removed, slide a new potting boot and ring onto the cable.

ah. When the connector is not removed,l do not discard the potting boot. Salvage the boot.

ai. Perform the connector repair.

. **Potting Ring and Boot Installation.** Upon completion of the connector repair, install the potting boot and ring using the following procedures:

aj. When the connector was not removed for repair:

(1) Install the potting, ring using, tools and procedure in paragraph 57.

(2) Remove the old potting compound from the salvaged boot.

(3) Place the cleaned salvaged boot over the lip of the potting ring and tape into position.

(4) Apply the potting compound in accordance with WP 026 00.

ak. When the connector was removed:

(1) Install the potting ring using the tools and procedure in paragraph 57.

(2) Snap the potting boot over the lip of the potting ring.

(3) Apply the potting compound in accordance with WP 026 00.

. **Shrink Boot and Adapter Removal.** To gain access to the connector rear, the shrink boot and adapter are removed using the following procedures:

al. To salvage the boot, apply heat using a heat gun in accordance with WP 012 00 until the boot is pliable.

am. Using a flat screwdriver, gently pry the boot from the adapter and wires.

an. Remove the adapter using the tools and procedure in paragraph 56.

ao. Perform the connector repair.

. **Shrink Boot and Adapter Installation.** Upon completion of the connector repair, install the shrink boot and adapter using the following procedures:

ap. Install the adapter using the tools and tool procedure in paragraph 57.

aq. Slide the shrink boot to the connector.

ar. Apply a coat of epoxy glue to the adapter lip and inside the shrink hoot.

as. Seat the shrink boot on the adapter lip.

at. Apply heat to the boot to shrink it to the adapter and cable, using a heat gun in accordance with WP 012 00.

. **EMI/RFI Grounding Terminator Installation.** Follow, the procedure in Figure 30 for installing EMI/ RFI grounding terminators.

. **EMI/RFI Environmental Backshell Assembly.** Follow the procedure in Figure 31 for the assembly of EMI/RFI environmental backshells.

NOTE

For non-EMI/RFI and non-environmental backshells, the assembly procedure is similar to that for EMI/RFI environmental backshell, except not all subcomponents are applicable.

. **Banding Adapter Installation.** Follow the procedure in Figure 32 for installation of banding adapters.

. **MIL-C-29600 Connector Accessory Removal.** The MIL-C-29600 connector accessory shall be removed using the following procedure:

au. Unscrew and slide the backshell coupling nut from the follower, braid, and washers.

av. Slide the third washer (farthest from the connector) back over the outer braid.

aw. Carefully unwrap the outer braid from the center washer and slide the washer toward the coupling nut.

ax. Carefully unwrap the individual shields from the washer closest to the connector and slide back toward the coupling nut.

ay. Slide the follower back from the connector toward the coupling nut to expose wires in the wire bundle.

. **MIL-C-29600 Connector Accessory Installation.** Follow the procedure in Figure 33 for installation (buildup) of MIL-C-29600 accessories. The MIL-C-29600 accessory torque values shall be in accordance with Table 16.

56 . RECTANGULAR CONNECTOR ACCESSORY MAINTENANCE. No special instructions are typically needed for maintenance on rectangular connector accessories.

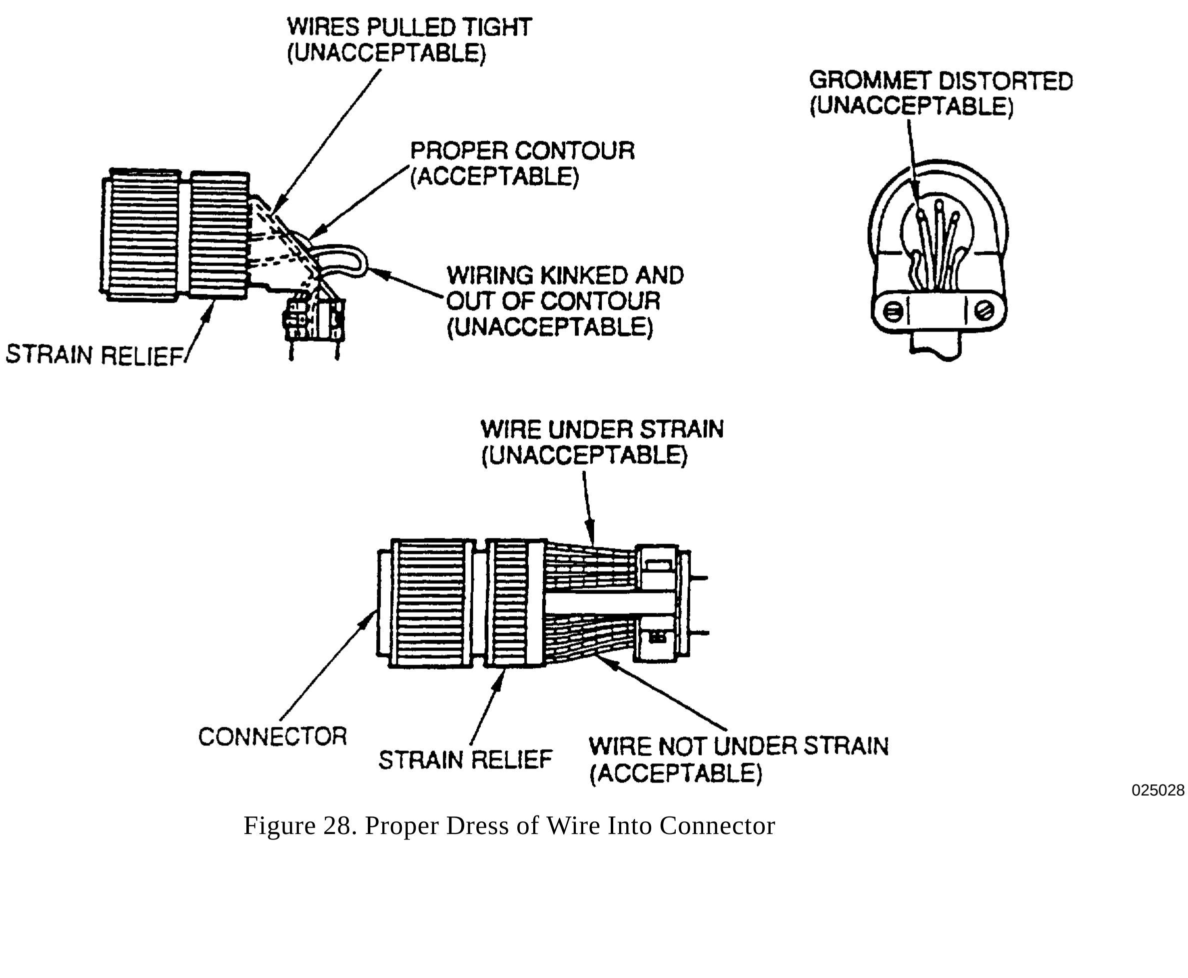


Figure 28. Proper Dress of Wire Into Connector

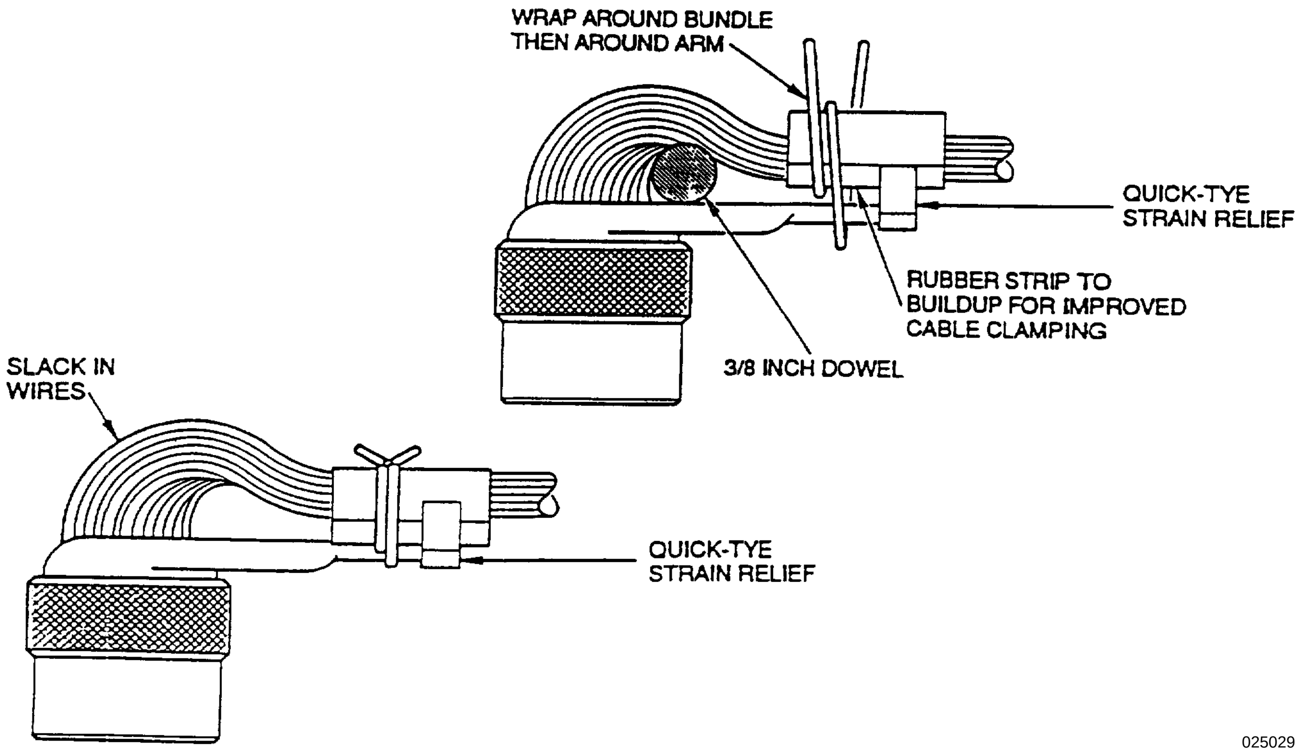


Figure 29. Lacing a Quick-Tye Strain Relief

57 . CONNECTOR MAINTENANCE. For procedures regarding installation and removal of wired and unwired contacts from connectors, see 01–1A–505.

58 . Connector Accessory Availability. The availability and all pertinent information regarding selection, procurement, installation, and special tools is found in the appropriate NAVAIR connector manual as specified in Table 17.

Table 16. MIL-C-29600 Backshell Torque Values

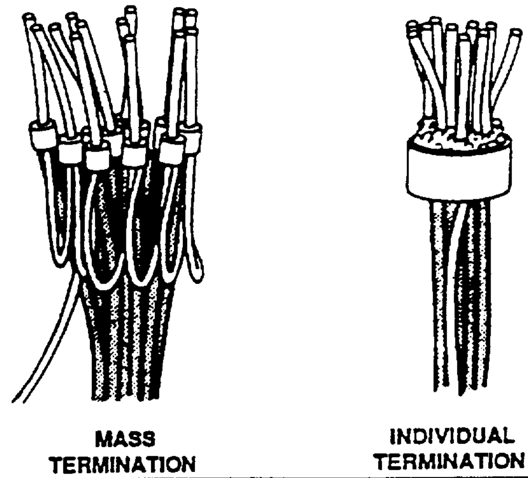
Shell Size	Torque in/lbs Min.	Torque in/lbs Max.
08 thru 16	20	30
18 thru 24	20	50

Table 17. Connector/Accessory Manual References

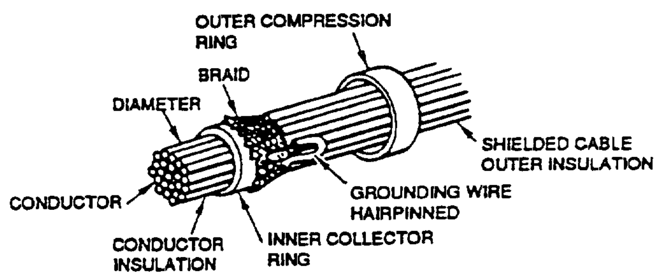
Connector Type	Manual Number
MIL-C-38999	NAVAIR 01-1A-505.6
MIL-C-81511 Series 1 and 2	NAVAIR 01-1A-505.7
MIL-C-81511 Series 3 and 4	NAVAIR 01-1A-505.8
MIL-C-83723	NAVAIR 01-1A-505.9
MIL-C-5015	NAVAIR 01-1A-505.10
MIL-C-26482	NAVAIR 01-1A-505.11
MIL-C-26500	NAVAIR 01-1A-505.12
MIL-C-81703	NAVAIR 01-1A-505.13
NAS1599	NAVAIR 01-1A-505.14
MIL-C-24308	NAVAIR 01-1A-505.15
MIL-C-28748	NAVAIR 01-1A-505.17
MIL-C-28804	NAVAIR 01-1A-505.18
MIL-C-81659	NAVAIR 01-1A-505.19
MIL-C-83733	NAVAIR 01-1A-505.20

MASS OR MULTIPLE TERMINATION
MS3161 OUTER FERRULE

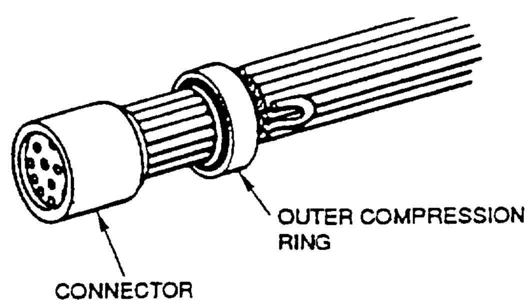
1. AFTER SHIELDING IS EXTRACTED ATTACH GROUND WIRE(S) TO CONNECTOR PIN.



2. PLACE GROUND WIRE(S) BETWEEN COLLECTOR AND COMPRESSION RING.



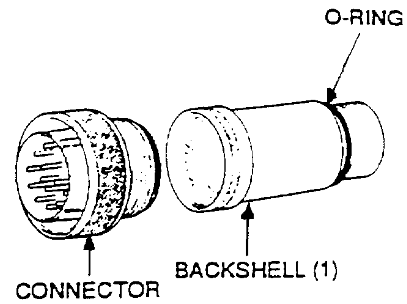
3. SLIDE COMPRESSION RING OVER COLLECTOR SHIELD AND GROUND WIRE.



FORWARD FOLD METHOD

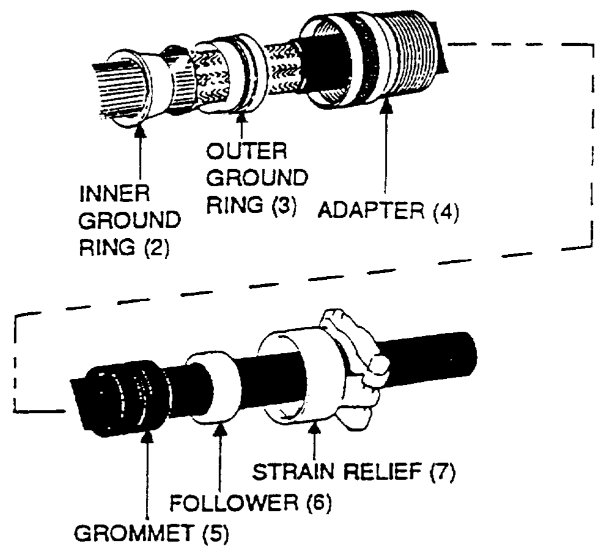
Figure 30. EMFI/RFI Environmental Terminatin Assembly

A. TEMPORARILY ASSEMBLE BACKSHELL (1) TO CONNECTOR.



B. REMOVE SADDLES FROM STRAIN RELIEF (7).

C. PLACE REMAINING BACKSHELL ASSEMBLY COMPONENTS (2 THRU 7) ON CABLE IN SEQUENCE SHOWN. KEEP THOSE COMPONENTS AT A CONVENIENT DISTANCE FROM END OF CABLE, SO THEY WILL NOT INTERFERE WITH SUBSEQUENT ASSEMBLY STEPS.



D. INSERT CABLE BACKSHELL (1) AND BOTTOM AGAINST CONNECTOR. HOLD CABLE IN POSITION AND MARK AT REAR OF BACKSHELL.

CAUTION

IF CABLE CONDUCTORS ARE TO HAVE SERVICE LOOPS, OR IF CONDUCTORS WILL HAVE CROSSOVERS, ETC., ALLOW SUFFICIENT ADDED LENGTH TO CABLE TO COMPENSATE FOR THESE FACTORS.

E. REMOVE BACKSHELL (1) FROM CONNECTOR AND PLACE ON CABLE WITH COMPONENTS IN STEP (C) ABOVE.

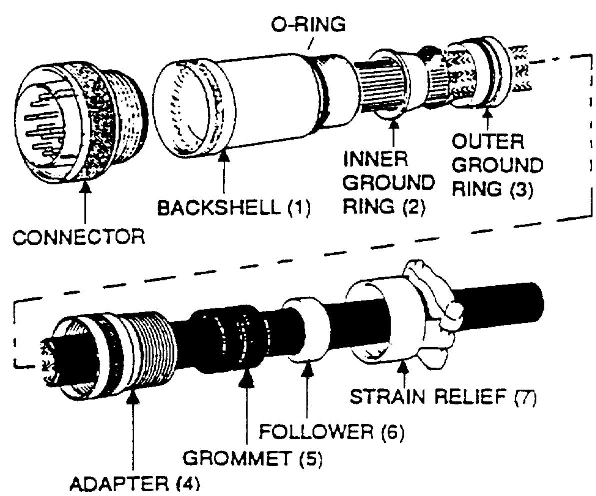


Figure 31. EMFI/RFI Environmental Backshell (Type A Shield Termination) Assembly (Sheet 1 of 2)

F. TRIM CABLE JACKET AND SHIELD AT MARK MADE IN STEP (D) ABOVE (ALLOWING FOR SERVICE LOOPS AND CROSS-OVERS).

G. STRIP JACKET 3/4-INCH BACK FROM TRIM POINT IN STEP (F) TO EXPOSE SHIELD.

H. PREPARE AND TERMINATE CABLE CONDUCTORS.

I. ASSEMBLE BACKSHELL (1) TO CONNECTOR AND TIGHTEN SECURELY. SLIDE INNER GROUND RING (2) INTO BACKSHELL (1).

J. FLARE SHIELD OVER TAPERED END OF INNER GROUND RING (2) AND GENTLY FORCE CABLE TOWARD CONNECTOR UNTIL SHIELD COVERS TAPER OF RING (2).

K. INSERT OUTER GROUND RING (3) INTO BACKSHELL (1) OVER SHIELD.

L. ENGAGE ADAPTER (4) ON BACKSHELL (1) AND TIGHTEN SECURELY.

M. INSERT GROMMET (5) AND FOLLOWER (6) INTO ADAPTER (4).

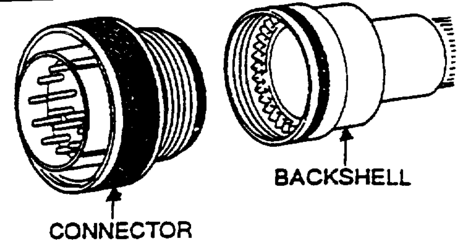
N. ENGAGE STRAIN RELIEF (7) AND TIGHTEN SECURELY. TIGHTEN STRAIN RELIEF SADDLES ON CABLE JACKET.

Figure 31. EMFI/RFI Environmental Backshell (Type A Shield Termination) Assembly (Sheet 2)

02503102

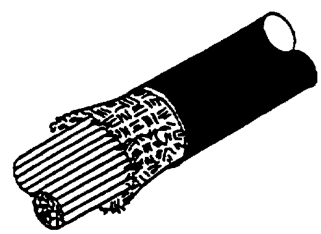
A. TEMPORARILY ASSEMBLE BACKSHELL TO CONNECTOR.

B. INSERT CABLE INTO BACKSHELL UNTIL IT BOTTOMS AGAINST CONNECTOR. HOLD IN POSITION AND MARK CABLE AT REAR END OF BACKSHELL.



C. REMOVE BACKSHELL FROM CONNECTOR AND SLIDE BACK ON CABLE SO IT WILL NOT INTERFERE WITH SUBSEQUENT ASSEMBLY STEPS.

D. STRIP JACKET FROM CABLE AT MARK IN STEP (D) ABOVE.



E. PREPARE AND TERMINATE CONDUCTORS TO CONNECTOR.

F. ASSEMBLE BACKSHELL TO CONNECTOR AND TIGHTEN.

G. PREPARE BAND.

(1) ROLL TAIL LENGTH INDICATOR MARK THROUGH BUCKLE SLOT TWICE.

(2) PULL ON BAND UNTIL INDICATOR MARK IS 1 INCH THROUGH BUCKLE SLOT.

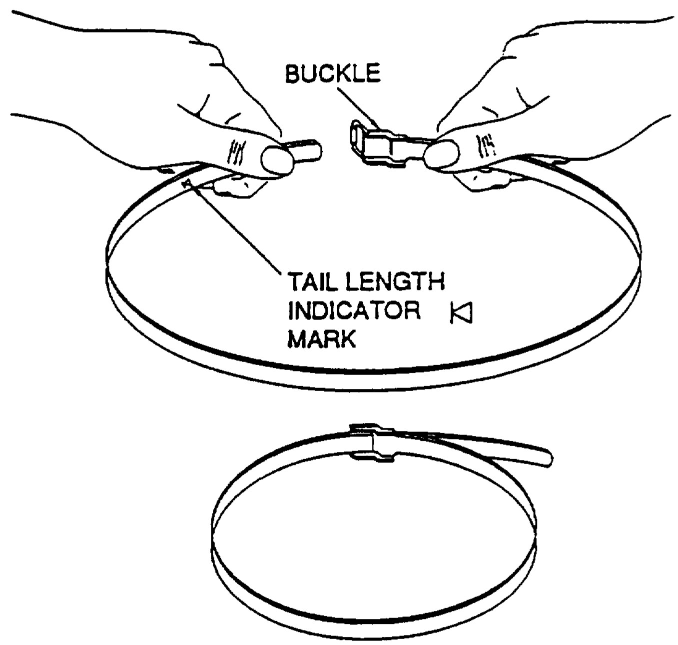


Figure 32. Banding Adapter Assembly (Sheet 1 of 2)

H. INSTALL BAND.

(1) UNLOCK BANDING TOOL HANDLES BY SEPARATING PULL-UP HANDLE FROM TOOL BODY BY PULLING AWAY.

(2) PUSH RELEASE LEVER FORWARD AND INSERT PREPARED BAND INTO FRONT END OPENING OF TOOL UP TO TAIL LENGTH INDICATOR MARK.

(3) ALIGN BAND AND TOOL WITH SHIELD TERMINATION AREA.

(4) PUSH RELEASE LEVER IN BACK POSITION. TIGHTEN BAND BY COMPRESSING PULL-UP HANDLE UNTIL HANDLE LOCKS IN PLACE AGAINST TOOL BODY, INDICATION BAND IS COMPRESSED TO TOOL PRESET TENSION.

(5) COMPLETE CLAMPING PROCESS BY LIFTING TOOL FORWARD AND SQUEEZING CUT-OFF HANDLE. WITH CUT-OFF HANDLE LOCKED, REMOVE EXCESS BAND BY PULLING THROUGH AND DISCARD.

(6) INSPECT SHIELD TERMINATION FOR SECURITY.

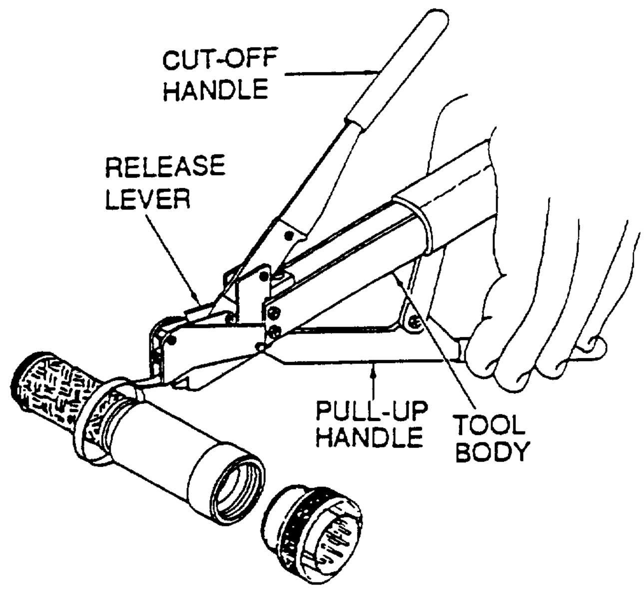


Figure 32. Banding Adapter Assembly (Sheet 2)

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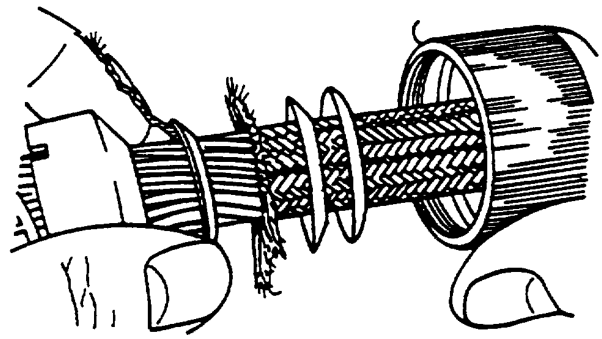
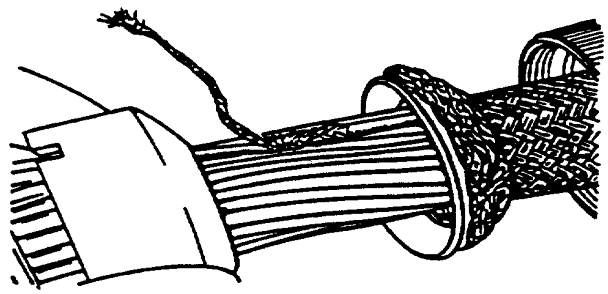
A. PULL INNER FOLLOWER OVER WIRE BUNDLE UNTIL SEATED AGAINST BACK OF CONNECTOR.



B. FLARE END OF OUTER (GROSS SHIELD) BRAID AND FOLD OVER CENTER WASHER.



C. WRAP BRAID FROM ANY SHIELD WIRES WITHIN THE WIRE BUNDLE AROUND WASHER NEAREST TO CONNECTOR.

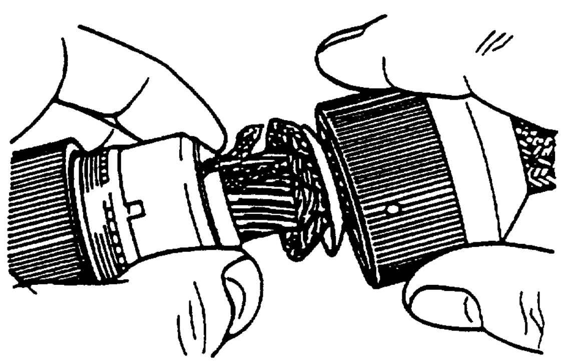


Figure 33. MIL-C-29600 Backshell Buildup (Sheet 1 of 2)

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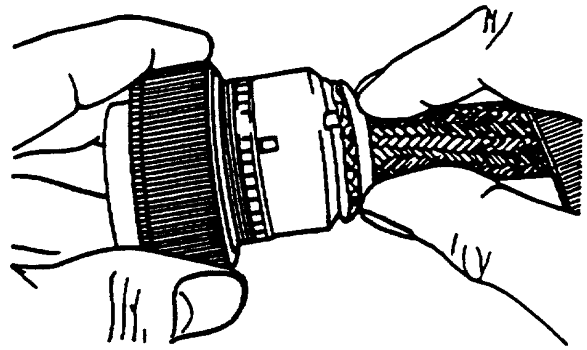
D. PUSH THIRD WASHER (FARTHEST FROM CONNECTOR) AGAINST BRAID-WRAPPED WASHER.



E. SLIDE BACKSHELL OUTER COUPLING NUT OVER WASHERS, BRAID, AND INNER FOLLOWER AND HAND-TIGHTEN UNTIL FIRMLY SECURED AGAINST CONNECTOR BACK.

F. TORQUE BACKSHELL COUPLING NUT IN ACCORDANCE WITH TABLE 16.

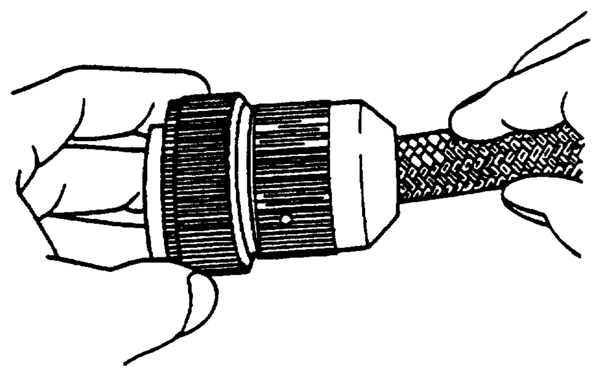


Figure 33. MIL-C-29600 Backshell Buildup (Sheet 2)

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POTTING AND SEALING CONNECTORS, ELECTRICAL CABLE ASSEMBLIES, AND ELECTRICAL COMPONENTS

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Flat (Ribbon) Cable and Assemblies 007 00
Sealing Compound, Polysulfide . . . . AMS 3276 Class B–1/4
Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured MIL–PRF–8516
Surface Clearing and Preparating . . . . SAE AIR 4069

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part No./Type Designation
Heat Gun	HT-900B
Heat Gun	HT-920B
Aliphatic Naptha	MIL–PRF–680 TYPE II
Brush, Acid Swabbing	—
Carbon Dioxide, Solid	—
Casting Compound, Epoxy (Stycast 2651 - Emerson and Cuming)	MIL-I-16923
Cleaning Cloth	CCC-C-46, Class 4
Cleaning Compound	MIL-PRF-29608, Type I, Class C
Dichloromethane (Methylene Chloride)	ASTM D4701 or other approved solvent
Fluorocarbon Etchant (WL Gore, etc.) (or Equivalent Such as Bondaid or S16943)	Tetra Etch
Isopropyl Alcohol (Isopropanol)	TT-I-735
Methyl Ethyl Ketone (MEK)	ASTM D740 or other approved solvent
Polyethylene Bags	—
Polyethylene Wax	—
Primer for Specific Sealing Compound	Primer
Primer for Silicone Substrates	MIL–P–47215
Push-On End Caps	—
Sealing Compound, Polysulfide	MIL-PRF-8516
Sealing Compound, Polysulfide	AMS 3276
Sealing Compound, Polyurethane	MIL-M-24041
Sealing Compound, Silicone	MIL-PRF-23586
Sealing Compound, Silicone (DC3140, DC3145 - Dow Corning)	MIL-A-46146
Sealing Compound, Silicone, Oil Resistant (Dow Corning)	RTV 735

1. **INTRODUCTION.**

2. **GENERAL.** This work package covers the processes related to the potting of electrical connectors with sealants to protect against moisture, vibration, metallic particles, and various aircraft fluids. The work package covers procedures for surface preparation, pretreating and etching wire insulation, mixing, applying, curing and storing sealing compounds, and depotting old sealants.

3. **SURFACE CLEANING AND PREPARATION.**

4. The surface of all materials must be clean, dry, and properly prepared in order for etchants to work well and sealants to bond properly. For a more thorough discussion of surface preparation see the SAE Aerospace Information Report AIR 4069.

WARNING

Do not let Aliphatic Naptha (MIL–PRF–680 TYPE II) contact etchant solution.

Do not let etchant contact metal components.

WARNING

Methyl Ethyl Ketone is highly flammable. Avoid prolonged breathing of vapors and ensure there is adequate ventilation.

CAUTION

Do not abrade too deeply, as protective coatings may be damaged, and electrical integrity compromised.

5. **ABRASION**. Remove any old, loose, or cracking sealant that may be present. The surfaces of silicone, polyurethane, polyolefin, neoprene, polyvinyl chloride (PVC), and polysulfide materials should be lightly abraded and wiped clean with a clean cloth and Methyl Ethyl Ketone (MEK) or other approved solvent. Abrasion will wear away coatings that may resist bonding, and will increase the surface area of the material to be bonded and the bond strength.

6. **SOLVENT WIPE**. With a clean cloth, wipe the surfaces to be bonded with an appropriate oil-free solvent, such as MEK or other approved solvent. Clean and dried surfaces not etched, primed or bonded within two hours after cleaning shall be protected with polyethylene bags or shall be recleaned prior to further processing.

7. **ETCHING FLUOROCARBON INSULATION.**

8. **Scope.** Etching the surface of fluorocarbon based materials is necessary in order to achieve a surface which can be properly bonded. The following procedure outlines pre-treatment and etching of Polytetrafluoroethylene (PTFE), Fluorinated Ethylene Propylene (FEP), Ethylene-tetrafluoroethylene (ETFE), crosslinked modified Ethylene-tetrafluorethylene (XLETFE), Perfluoroalkoxy (PFA), and Polychlorotrifluoroethylene (PCTFE) wire installation.

WARNING

The safety precautions listed in paragraphs 9 thru 12 shall be strictly followed.

9. **Safety Precautions in Etching.**

a. Fire. Do not let etchant contact water. It may ignite. Keep away from open flame, chlorinated solvents (Inhibisol, chlorothene, Tri-Ethane, and degreasing fluid), dry ice, and water containing materials. In case of fire while using solutions, use only dry chemical or other inactive agents such as sand or table salt. Do not use carbon dioxide, acid water, or water extinguishers.

b. Smoking. Do not smoke within 25 feet of etchants.

c. Breathing. Avoid breathing etchant vapors. Use in well-ventilated, non-confined areas. Use under an approved vented hood when possible.

d. Skin. Protect skin from contact with etchants by using polyethylene gloves, goggles, and protective clothing. If etchant touches skin, wash with water for 15 to 30 minutes and report to medical department.

WARNING

Etchants are toxic and flammable. Use chemical splash proof goggles, gloves, and rubber aprons. Ensure adequate ventilation. Keep sparks, flames, and heat away. Keep solution off skin, eyes, and clothes. Do not breathe vapors.

Isopropyl alcohol is extremely flammable. Use only in well ventilated areas. Avoid prolonged breathing of vapors.

NOTE

When using one of the following methods, do not strip ends of wire. Allow a minimum of 1 inch excess wire for each end to be etched.

10 . **Etching Procedures.** Treat wires using one of the following methods:

a. Method I - U Method.

(1) Pour enough etchant, Tetra Etch or equivalent etchant, into approved glass, polyethylene, or corrosion resistant container.

(2) Form wire into U shape.

NOTE

If quick drying is required, immerse etched wire in fresh, clean isopropyl alcohol. Change used isopropyl alcohol daily.

(3) Dip formed wire into etchant for 5 to 50 seconds with open or cut ends of wire above surface of etchant solution. If possible during treatment, keep solution in a nitrogen atmosphere. A visible color change of surface being etched to brown or deep brown is sign of proper etching. The treated wire surface shall be visible above potted area of connector. Etch a minimum of 5 inches of wire. When treating wires that do not show a significant color change due to their initial color (black, brown, etc.), treat at the same time a white fluorocarbon-insulated wire as a process control specimen. Certain wire types will take a longer time to properly etch than others.

(4) Remove treated wire from etchant and neutralize with isopropyl alcohol by dipping until bubbling ceases.

(5) Rinse treated wire in clean, fresh tap water and gently wipe dry. Do not rub treated ends hard or let them contact untreated surfaces.

(6) Cut off and discard unetched wire ends. A minimum of 4 inches of etched wire shall remain.

(7) Protect remaining etched and neutralized ends by wrapping in polyethylene bags until used for subsequent operations.

b. Method II - End Sealing Method.

(1) Pour enough etchant, Tetra Etch or equivalent etchant, into approved glass, polyethylene, or corrosion-resistant container.

NOTE

To melt solid pelletized polyethylene wax, place in metal container. Heat on hot plate at about 210°F (99°C) until all wax has melted.

(2) Dip end of wire into melted polyethylene wax, to a maximum depth of 1/2 inch or place approved push-on end caps on end of wire. When using melted polyethylene, several dips of the wire maybe needed to build up enough wax to seal wire ends.

NOTE

If quick drying is required, immerse etched wire in fresh, clean isopropyl alcohol. Change used isopropyl alcohol daily.

(3) Dip wire into etchant for 5 to 50 seconds. If possible during treatment, keep solution in a nitrogen atmosphere. A visible color change of surface being etched to brown or deep brown is a sign of proper etching. The treated wire surface shall be visible above potted area of connector. Etch a minimum of 5 inches of wire. When treating wires that do not show a significant color change due to their initial color (black, brown, etc.), treat at the same time a white fluorocarbon-insulated wire as a process control specimen. Certain wire types will take a longer time to properly etch than the others.

(4) Remove treated wire from etchant and neutralize with isopropyl alcohol by dipping until bubbling ceases.

(5) Rinse treated wire in clean, fresh tap water and gently wipe dry. Do not rub treated ends hard or let them contact untreated surfaces.

(6) Cut off and discard unetched wire ends. A minimum of 4 inches of etched wire shall remain. Strip off insulation coated with any residual polyethylene.

(7) Protect remaining etched and neutralized ends by wrapping in polyethylene bags until used for subsequent operations.

c. Method III alternate shrink tube method.

(1) Select shrink tubing SAE AMS–DTL–25038 that has an unrestricted shrinkage that is at least 20% smaller than the outside diameter of the wire being used.

(2) Shrink a section of the tubing to the portion of individual wire insulation that is to be encased in potting compound. Tubing should extend approximately 3/8 inch beyond the anticipated potting level. Abrade the sleeving lightly and clean as outlined above.

11 . **Rework.** If the etchant does not significantly change insulation color, insulation must be re-etched as follows:

a. Clean wire insulation of all traces of residual etchant salts by scrubbing vigorously with isopropyl alcohol.

b. Treat insulation (paragraphs (5) thru (8)).

12 . Rework of Wires With Contacts Attached. Limit rework of wires with attached contacts to occasions when replacement of contacts is not feasible and when necessary to etch wire with contacts attached. Rework as follows:

a. Slip a length of heat-shrinkable tubing over contact extending at least 1/4 inch beyond each end of the contact.

WARNING

Do not use heat guns with electric motors when working on aircraft that have not been defueled and purged. Use heat gun, HT-900B/HT-920B.

Nozzle and output air of heat gun get very hot. Use extreme care while operating heat gun to avoid serious burns.

Use of nitrogen with the HT-900B/HT-920B heat gun in an enclosed area can be hazardous. Discharge of nitrogen into a poorly ventilated area can result in asphyxiation.

b. Shrink the tubing using heat gun. Ensure both ends shrink completely without splitting.

NOTE

To melt solid pelletized polyethylene wax, place in metal container. Heat on hot plate at about 210°F (99°C) until all wax has melted.

c. Immerse the tubing-enclosed contact in hot molten polyethylene wax. Remove and allow to cool.

d. Etch wire (paragraph 10 steps (3), (4), and (5)).

e. Remove waxed tubing by using heat gun to melt wax and cause tubing to split for removal. Needle nose pliers may help remove tubing.

13 . Rework of Wire Attached to Connectors. When feasible, remove wire from connector before rework. Treat wires (paragraphs (5) thru (8)).

14 . **Disposal of Etchant Solutions.** Refer to local Safety Officer for proper local disposal requirements of etchant solutions.

NOTE

The sealants and primers from each manufacturer may contain unique process requirements. In all cases, refer to the sealant manufacturer’s guidelines for more thorough information.

15 . **PRIMER APPLICATION**. Primers must be used for best adhesion and moisture resistance. Apply Primers

in accordance with the recommendations of the sealant manufacturer. Each sealant type will have different primer guidelines. Refer to Table 1 for general guidelines on the primer to use for a given substrate and sealant. Always apply the primer to a properly cleaned and dry surface.

NOTE

Silicone based release agent will contaminate areas beyond where used, and will degrade the bonds of adhesives and sealants.

16 . **MOLDS**. If removable molds are used during the application of sealants, apply a non-silicone based mold release agent to all surfaces of the mold exposed to the sealant prior to use.

WARNING

Sealants contain toxic compounds. Always become familiar with Material Safety Data Sheets (MSDS) prior to working with materials. Consult MSDS for proper Personal Protection Equipment (PPE) to use when working with materials. Always wear gloves and eye protection and avoid skin contact. If sealant or any sealant compound contacts skin, clean thoroughly.

17 . **SEALANT PREPARATION, APPLICATION, AND STORAGE.**

18 . **POLYSULFIDE SEALANT MIL-PRF-8516.**

a. Frozen Pre-Mixed Compound Preparation.

NOTE

Never use heat to raise sealant temperature.

After removal from deep freeze, sealant work life reduces significantly. Use compound as soon as possible.

(1) Bring frozen compound to room temperature by warming outside of container with compressed air.

(2) Pour compound into dispenser.

(3) Frozen material, especially sealant which has been refrozen, shall be considered suitable for use if it is still pourable and has sufficient pot life remaining for application purposes.

b. Unmixed Compound Preparation. For best results, observe the following general guidelines when mixing MIL-PRF-8516 sealant:

(1) Follow the manufacturer's instructions carefully when mixing base compound and accelerator. Substitution, partial mixing, or using incorrect portions of base and accelerator may cause sealant to have inferior properties.

(2) Make sure entire amount of accelerator is mixed into entire amount of base. Any change in catalyst ratio will affect the electrical properties of the sealant and may also affect the pot life, reversion resistance, and hardness of the cured compound. Do not mix base compounds and accelerators of different batch numbers because substandard electrical properties may result.

(3) Sealants may contain small quantities of flammable solvents or release flammable by-products when curing. Observe adequate ventilation and fire precautions during curing, mixing, and storage.

(4) Sealants having an application time of one hour or less shall be hand mixed on the job. Do not freeze such material.

c. Mixing Procedure.

(1) Using a clean spatula, wooden tongue depressor, or putty knife, stir accelerator slowly into a smooth, creamy paste. Do not beat or whip; too much air could be trapped in compound. Continuously scrape sides, corners, and bottom of container to mix completely.

(2) Using clean spatula, wooden tongue depressor, or putty knife, stir base until it has a smooth texture. Do not beat or whip. Scrape sides, corners, and bottom of container.

(3) If base and accelerator are supplied in bulk, weigh out needed amounts of base and accelerator in separate containers.

(4) Combine accelerator and base. Thoroughly mix until no streaks or traces of unmixed material are visible. Mixing normally requires 5 to 8 minutes (Figure 1).

TABLE 1. GENERAL GUIDELINES FOR PRIMERS TO BE USED ON VARIOUS SUBSTRATES AFTER CLEANING

Substrate	Polysulfide MIL-PRF-8516	Silicone MIL-PRF-23586	Silicone MIL-A-46146	Polyurethane MIL-M-24041	Epoxy (e.g. Stycast)
Metal	Primer such as PR-148	Primer such as DC-1200 or SS4004	Primer such as DC-1204	Primer such as PR-420	Abrade/Clean No Primer
Fluorocarbon (PTFE, ETFE, etc.)	Tetra-etch, No Primer	Tetra-etch, Primer such as DC-1200 or SS4004	Tetra-etch, Primer such as DC-1205	Tetra-etch	Tetra-etch No Primer
Polychloroprene (Neoprene)	CS9922 H-1 (Primer may not be needed)	Primer such as DC-1200 or SS4004	Primer such as DC-1205	Primer such as PR-1523M	Abrade/Clean No Primer
Polyvinyl Chloride (PVC)	Primer such as ASTM D740 (Tough to bond)	Primer such as DC-1200 or SS4004	Primer such as DC-1205 or ASTM D740	Primer such as PR-1543 or ASTM D740	Abrade/Clean No Primer
Epoxy	Abrade/Clean surface, No Primer	Do not use this sealant on Amine cured epoxy	Primer such as DC-1205	Abrade/Clean	Abrade/Clean No Primer
Polyurethane	Abrade/Clean surface, No primer	Do not use this sealant	Primer such as DC-1205	Abrade/Clean, No Solvents to clean, No Primer	Abrade/Clean No Solvents, No Primer
Polysulfide	PR-182 if fuel soaked	Do not use this sealant	Primer such as DC-1205	Abrade/Clean	Abrade/Clean No Primer
Silicone	Primer such as MIL–P–47215	Do not use with organometallic (i.e. dbt) cured silicone.	Abrade/Clean No Primer		Abrade/Clean No Primer
NOTE: Material incompatibilities exist when using certain sealants with certain substrates.					

(5) When large quantities of sealant are to be mixed, mechanical mixing can be used to improve efficiency. Use an air motor with a T-shape, flat blade or similar mixing paddle attached to a steel rod (Figure 2). Limit speed of the paddle to 80 rpm since higher speeds will generate internal heat, reduce application life, and whip air into the sealant.

(6) Determine if mixing is complete by spreading a drop of sealant very thinly on a piece of white paper. Close examination should not reveal any specks or streaks. Do not mix sealant beyond point where tests show thorough mixing.

(7) If mixed compound is not used immediately, store (paragraph 30).

NOTE

The base absorbs moisture from the air. Do not open containers until ready to use.

d. Two-Part Sealant Cartridges. (Semkits).

e. Wear safety glasses.

f. Hold cartridge, grasp dasher rod and pull back approximately one inch.

NOTE

Use even pressure, do not use force, tap, pound or jolt ramrod if piston does not break loose readily.

g. Insert ramrod into hollow of dasher rod, break piston loose and inject about 1/3 of contents into cartridge.

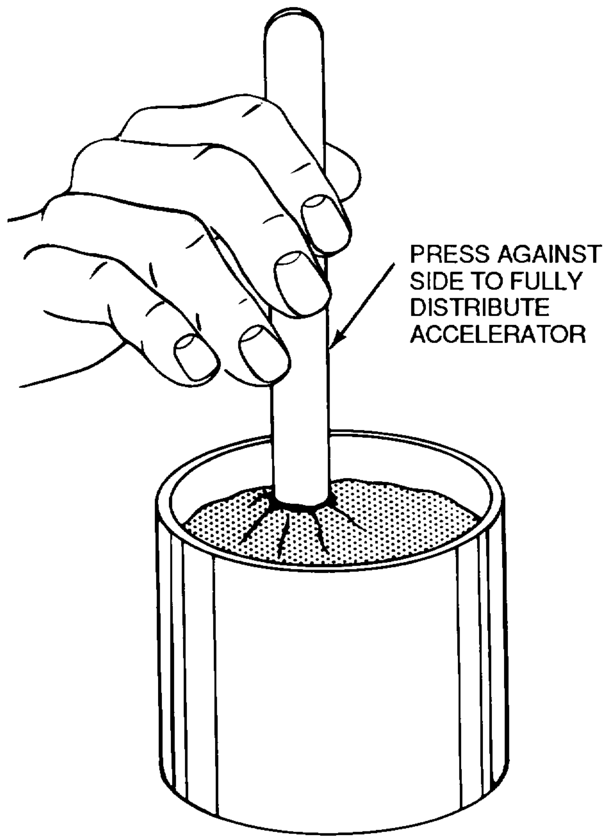

Figure 1. Hand Mixing Potting Compound

h. Repeat steps (2) and (3) until all of contents of rod are emptied into cartridge then remove ramrod.

CAUTION

After mixing base and accelerator, use quickly to minimize reduction in application life.

i. Mix material for required number of strokes for hand mix or for required time for machine mix, as indicated on instructions provided with kit.

j. After mixing, remove bottom cap.

k. Pull dasher rod back to neck of cartridge, grasp cartridge firmly at neck, unscrew dasher rod and remove.

l. Screw nozzle into cartridge, insert into extrusion gun and use as required. For hand extrusion, press used dasher rod against plunger to force material from cartridge.

19 . **POLYURETHANE SEALANT MIL-M-24041.**

a. Frozen Pre-mixed Compound Preparation.

CAUTION

Thawing time and temperature must be controlled closely to obtain the maximum application life in the shortest thawing period. Application life will be reduced by an increase in either the thawing time or temperature. An incomplete thaw will result if thawing time or temperature is reduced.

(1) Remove cartridge from storage and place upright in an oven, heating block, or in a dry metal sleeve in a water bath. Heat cartridge at 130°F (54°C) for 20 minutes.

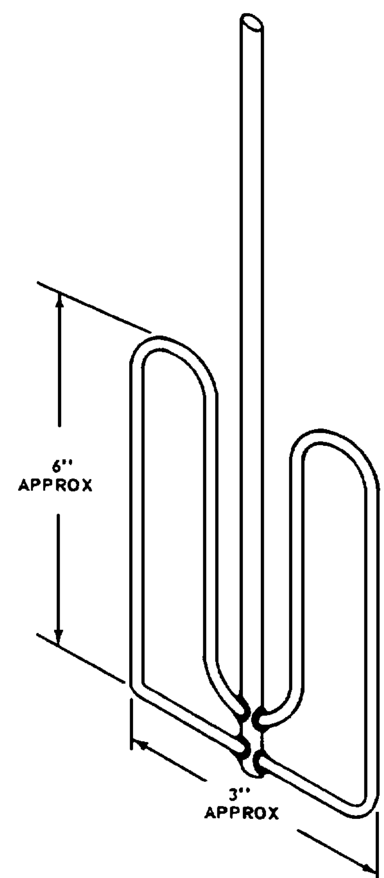

Figure 2. Mixing Paddle for Potting Compound

(2) Remove cartridge from heat and work the pliable cartridge with hands to distribute heat.

(3) Heat cartridge an additional 5 minutes at 130°F (54°C).

(4) Remove cartridge from heat and bleed any entrapped air from under the plunger.

(5) Insert cartridge into sealant gun.

(6) Attach nozzle to sealant gun; compound is ready for application.

(7) Frozen material, especially sealant which has been refrozen, shall be suitable for use if it is still pourable and has sufficient pot life remaining for application purposes.

b. Two-Component Kit Preparation.

NOTE

The base absorbs moisture from the air. Do not open containers until ready to use.

(1) Prolonged storage of base below 65°F (18°C) will cause thickening. Base may be liquified by warming to 180°F (82°C) for about 2 to 3 hours and stirring thoroughly.

(2) Accelerator thickens at ambient temperatures. Warm accelerator 200°F (93°C) to 210°F (99°C). Stir occasionally until thoroughly mixed.

CAUTION

After mixing base and accelerator, use quickly to minimize reduction in application life.

(3) Cool base and accelerator 70°F (21°C) to 80°F (27°C). Combine components and mix thoroughly.

(4) Place mixture in a container about two times the volume of the compound. Vacuum degas if possible to release entrapped air and gas in the mixture. Allow foaming to subside. Compound is ready to use.

c. Mixing Procedure.

(1) Using a clean spatula, wooden tongue depressor, or putty knife, stir accelerator slowly into a smooth, creamy paste. Do not beat or whip; too much air could be trapped in compound. Continuously scrape sides, corners, and bottom of container to mix completely.

(2) Using clean spatula, wooden tongue depressor, or putty knife, stir base until it has a smooth texture. Do not beat or whip. Scrape sides, corners, and bottom of container.

(3) If base and accelerator are supplied in bulk, mix 1 part (by weight) of accelerator with 10 parts (by weight) of base compound.

(4) Combine accelerator and base. Thoroughly mix until no streaks or traces of unmixed material are visible. Mixing normally requires 5 to 8 minutes (Figure 1).

d. Two-Part Sealant Cartridges. (Semkits).

NOTE

The base absorbs moisture from the air. Do not open containers until ready to use.

(1) Wear safety glasses.

(2) Hold cartridge, grasp dasher rod and pull back approximately one inch.

NOTE

Use even pressure, do not use force, tap, pound or jolt ramrod if piston does not break loose readily.

(3) Insert ramrod into hollow of dasher rod, break piston loose and inject about 1/3 of contents into cartridge.

(4) Repeat steps (b) and (c) until all of contents of rod are emptied into cartridge then remove ramrod.

CAUTION

After mixing base and accelerator, use quickly to minimize reduction in application life.

(5) Mix material for required number of strokes for hand mix or for required time for machine mix, as indicated on instructions provided with kit.

(6) After mixing, remove bottom cap.

(7) Pull dasher rod back to neck of cartridge, grasp cartridge firmly at neck, unscrew dasher rod and remove.

(8) Screw nozzle into cartridge, insert into extrusion gun and use as required. For hand extrusion, press used dasher rod against plunger to force material from cartridge.

20. SILICONE SEALANT, TWO-PART MIL-PRF-23586.

a. Frozen Pre-Mixed Compound Preparation.

NOTE

Never use heat to raise sealant temperature.

After removal from deep freeze, sealant work life reduces significantly. Use compound as soon as possible.

(1) Bring frozen compound to room temperature by warming outside of container with compressed air.

(2) Pour compound into dispenser.

(3) Frozen material, especially sealant which has been refrozen, shall be considered suitable for use if it is still pourable and has sufficient pot life remaining for application purposes.

b. Unmixed Compound Preparation. For best results, observe the following general guidelines when mixing MIL-PRF-23586 sealant:

(1) Follow the manufacturer’s instructions carefully when mixing base compound and accelerator (catalyst). Substitution, partial mixing, or using incorrect portions of base and accelerator may cause sealant to have inferior properties.

(2) Make sure entire amount of accelerator is mixed into entire amount of base. Any change in catalyst ratio will affect the electrical properties of the sealant and may also affect the pot life, reversion resistance, and hardness of the cured compound. Do not mix base compounds and accelerators of different batch numbers because substandard electrical properties may result.

(3) Sealants may contain small quantities of flammable solvents or release flammable by-products when curing. Observe adequate ventilation and fire precautions during curing, mixing, and storage.

(4) Sealants having an application time of one hour or less shall be hand mixed on the job. Do not freeze such material.

c. Mixing Procedure.

(1) Using a clean spatula, wooden tongue depressor, or putty knife, stir accelerator slowly into a smooth, creamy paste. Do not beat or whip; too much air could be trapped in compound. Continuously scrape sides, corners, and bottom of container to mix completely.

(2) Using clean spatula, wooden tongue depressor, or putty knife, stir base until it has a smooth texture. Do not beat or whip. Scrape sides, corners, and bottom of container.

(3) If base and accelerator are supplied in bulk, weigh out needed amounts of base and accelerator in separate containers.

(4) Combine accelerator and base. Thoroughly mix until no streaks or traces of unmixed material are visible. Mixing normally requires 5 to 8 minutes (Figure 1).

(5) Determine if mixing is complete by spreading a drop of sealant very thinly on a piece of white paper. Close examination should not reveal any specks or streaks. Do not mix sealant beyond point where tests show thorough mixing.

(6) If mixed compound is not used immediately, store (paragraph 33).

CAUTION

Do not use silicone RTV sealant that releases acetic acid. The liberated acetic acid vapors will cause corrosion and damage metals and electronic equipment.

21. SILICONE SEALANT, ONE PART ROOM TEMPERATURE VULCANIZING (RTV)

NON-CORROSIVE MIL-A-46146 (e.g. DC 3140, DC-3145, RTV 735).

NOTE

Sealant can be placed in a small syringe for ease of use.

a. The one part RTV silicone sealants are supplied in tubes, cartridges, or cans and do not need mixing or preparation. They are ready to apply.

(1) Sealant shall be considered suitable for use if it has not cured in the tube and retains sufficient pot life for application purposes.

(2) If material is not used immediately, store (paragraph 34).

22. **EPOXY CASTING RESIN, TWO-PART MIL-I-16923 (e.g. Stycast 2651 with Catalyst 9 or Catalyst 11).**

NOTE

Pre-mixed and frozen materials are the recommended form of epoxy to use as needed.

a. Frozen Pre-Mixed Compound Preparation.

NOTE

Do not place in hot water. Material will cure before center of cartridge or syringe can thaw.

After removal from deep freeze, the pot life of the mixed compound reduces significantly. Use compound as soon as possible.

Do not allow water to contaminate epoxy materials.

(1) Bring frozen mixed compound to room temperature by allowing to stand at room temperature. Generally 1-cc to 10-cc syringes will thaw in about 4 to 8 minutes, whereas larger syringes and cartridges will require approximately 12-20 minutes depending on the room temperature. Material may be thawed by placing syringe or cartridge in a water bath. Water should be just warm to bare hands, lukewarm.

(2) Compound is considered suitable for use if the viscosity is acceptable, and it has sufficient pot life remaining for application purposes.

b. Two Component Epoxy Preparation.

(1) The base resin, catalyst, and any support equipment should be held at room temperature (70-75°F (21-24°C)) a minimum of six hours until equilibrated. Cool materials will be difficult to mix thoroughly, and warm materials will shorten the pot life.

(2) Mix the catalyst thoroughly in its original container, and mix the base resin thoroughly in its original container until uniform in consistency. During storage, fillers may separate and either float to the top or sink to the bottom of the container, and they must be fully redispersed for proper results.

(3) Weigh the proper amount of base resin and then add the appropriate amount of catalyst according to the manufacturer’s instructions. Each catalyst and resin combination will have its own mix ratio:

Stycast 2651 is mixed with Catalyst 9 at 100 parts resin to 6.5 parts catalyst.

Stycast 2651 is mixed with Catalyst 11 at 100 parts resin to 8 parts catalyst.

(4) Blend the mixture thoroughly by hand. Fold in the catalyst using extreme care to prevent entrapment of air into the mixture. Do not use mixing equipment, as this will generate internal heat, reduce application life, and whip air into the sealant.

(5) Pot life, the time available before the mixed compound cures to become unusable, is different for each base/resin combination. The pot life of mixed Stycast 2651/Catalyst 9 is approximately 30 minutes, while the pot life of Stycast 2651/Catalyst 11 is about 4 hours at room temperature.

(6) If mixed compound is not used immediately, store (paragraph 35).

NOTE

Do not use Two-Part Silicone RTV (MIL-PRF-23586 Grade A) for thick sections (>1/2 inch thick) or in confined or partially confined areas as the material will not cure properly.

Do not use Two-Part Silicone RTV (MIL-PRF-23586) for anything other than repairing itself. It must not be used to repair Grade A or B1 material.

Certain types of materials will inhibit the cure of Two-Part Silicone RTV (MIL-PRF-23586). Do not use this material with materials containing sulfur (polysulfide sealant), amines (polyurethane or amine-cured epoxy), or organometallics (dbt-cured silicone, rosin flux residues).

Do not use silicone RTV sealant that releases acetic acid. The liberated acetic acid vapors will cause corrosion and damage metals and electronic equipment.

23 . **APPLICATION OF SEALANTS**. The following procedures cover the application of all types of sealants in this document.

24 . **Potting Boots and Potting Boot Rings.** Potting boots are forms placed around the wire terminations of the connectors to contain liquid potting compound while hardening. Potting boot rings are threaded rings used as intermediate devices between the connector and the potting boot. A lip, on the opposite end of the threads, provides a means for the boot to grip the ring (Figure 3).

a. Removal.

(1) Using diagonal edge cutting pliers, snip potting boot lengthwise. Peel boot and old sealant away from connector.

(2) Remove potting boot ring.

(3) Slide new potting boot on cable or harness.

(4) Perform connector repair.

b. Installation.

(1) Install potting boot ring.

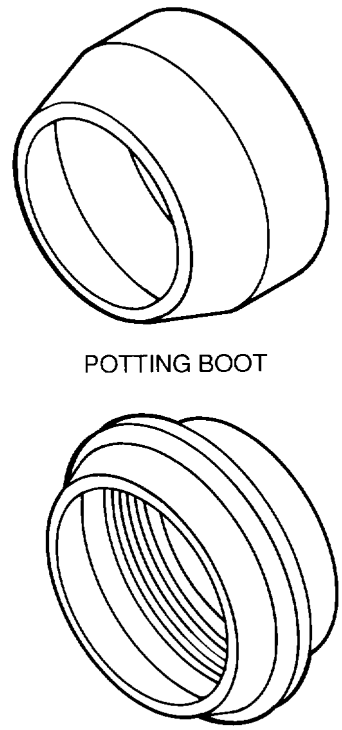

Figure 3. Potting Boot and Potting Boot Ring

(2) Snap potting boot over lip of potting boot ring.

(3) Apply sealant.

25 . **Applying Sealants to Connectors.**

a. Locate connector in suitable open mold and remove any ties within 6 inches of the connector.

b. Secure spare wires to wire bundle with masking tape, a minimum of 6 inches from crimped connection.

c. Fill dispenser with prepared sealant.

d. Insert nozzle between wires as close as possible to connector insert without touching it. Inject sealant slowly, moving nozzle back from connector as compound fills mold. Ensure no bubbles are trapped during injection (Figure 4).

e. When level of sealant is above nozzle, slowly withdraw nozzle keeping end below level of sealant until mold is filled. Allow to settle for 5 to 10 minutes; refill if necessary. To release trapped air, connector may be tapped or gently vibrated and wires may be slightly flexed.

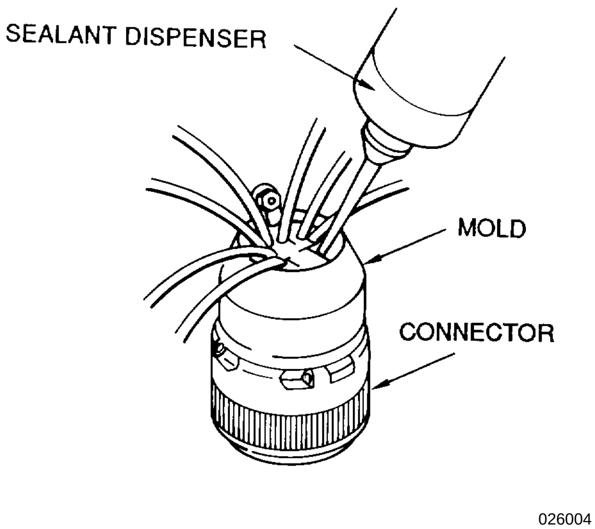

Figure 4. Injecting Sealant

NOTE

Do not end sealant abruptly to keep stress at joint to a minimum.

f. When mold is filled, taper sealant 1/2 to 1 inch up along wires.

g. Suspend connector by cable clamp attached to bracket so sealant stays level. Air cure for 1-1/2 hours at 75°F (24°C) without moving (Figure 5).

NOTE

Each sealant requires specific curing time and temperature. Refer to paragraph 30 for the cure schedule of the sealant being used.

h. Place suspended connector in the oven for the recommended curing time and temperature of the sealant used.

26 . **Connector Sealing.** The following procedure is for applying sealant to the connector wire sealing grommet (Figures 6 and 7).

a. Remove backshell and slide back over cable or wire bundle. Spread out wiring to access wiring sealing grommet.

NOTE

Do not remove bulkhead mounted connectors from bulkhead. Remove tape up to first clamp.

Inspect previously sealed connectors for separation and repair as required.

b. Remove any debris from wire sealing grommet area.

WARNING

Cleaning compound for avionics components, MIL-PRF-29608, is toxic. Protection: chemical splash proof goggles and good ventilation. Keep cleaning compound off skin, eyes, and clothes; do not breathe vapors. Wear gloves. Do not immerse connector or wiring in cleaning compound.

c. Remove oil and/or grease contamination from wire sealing grommet, internal backshell area, and adjacent wires by applying cleaning compound to connector. Loosen and remove contaminants using acid swabbing brush. Clean quickly, draining compound from connector. Wipe residue with cleaning cloth. Allow to dry (Figure 8).

d. Ensure contacts and sealing plugs are installed in any unused contact cavities.

NOTE

Sealant RTV-3140 is supplied in a collapsible aluminum squeeze tube with a plastic applicator nozzle. Sealant may be transferred to a small hypodermic syringe as an alternative (Figure 9).

e. Restore proper dress of wire leading into connector. Wire should not be elongating rubber environmental seal.

f. Insert nozzle into wire bundle close to connector and squeeze tube while pulling nozzle backward. Repeat application two or three times in different locations. Sealant will level itself in about 15 minutes. Recommended thickness is 1/16 ± 1/32 inch across entire wire sealing grommet (Figure 10).

g. If after 15 minutes from first application there is insufficient coverage, additional sealant may be added.

Thickness shall not exceed 1/8 inch; otherwise sealant will no longer be transparent, longer curing time will be required, and connector repairs will be more difficult.

NOTE

Cure time is related to 77°F (25°C) and 50% relative humidity. High temperatures and low humidity will decrease cure times; low temperatures and high humidity will increase cure time.

h. After applying sealant, rig harness so that connector face is parallel to floor. This is necessary for sealant flow to cover wire sealing grommet with uniform thickness. After 30 minutes, harness and connectors may be placed in any orientation. Total cure time, for practical purposes, is 24 hours.

i. Contact may be removed for rework using standard tools and procedures. After replacing contact, add small amount of sealant around replaced wire at wire sealing grommet. Allow connector face to remain parallel to floor for 30 minutes before mating.

j. Install backshell.

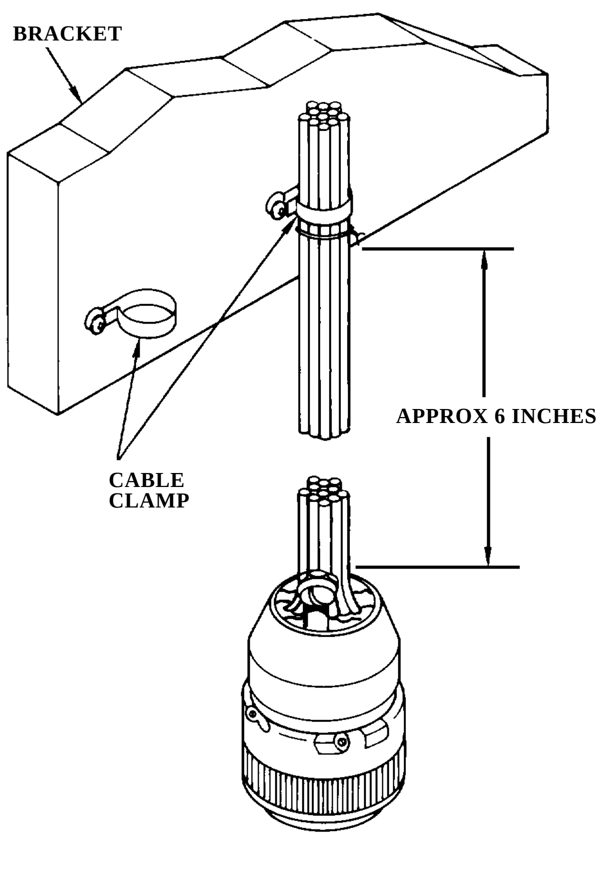

Figure 5. Curing Sealed Connector

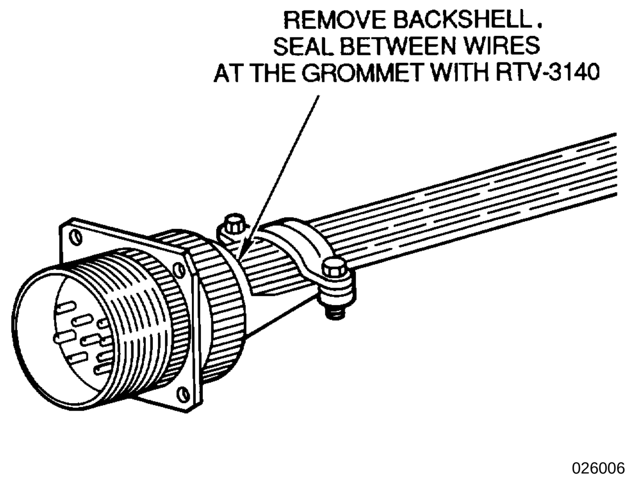

Figure 6. Connectors with Strain Relief

27 . **Sealing Electrical Cable Assemblies.** The following procedure is for sealing around the bulkhead and EMI cables while installing electrical cable assemblies.

WARNING

Solvent, wipe should be used with care. Gloves must be worn to prevent injury.

a. Clean surfaces to be sealed using solvent, wipe. Apply solvent, wipe with clean, moistened cloth to applicable surfaces. Wipe dry before cleaning solvent evaporates.

b. Mixing of sealers should be done using the instructions provided with the sealing compound.

c. Mask areas to be protected from sealants.

d. Remove cable ties (plastic tie-down straps) within 6 inches of the area to be sealed.

e. Where cable clamps restrict the flow of sealants in and around cable assemblies or wires, loosen clamps so that sealant must flow under clamps.

f. Inject sealant in and around cable assemblies, and under cable clamps (Figure 11, detail A).

g. Tighten cable clamps.

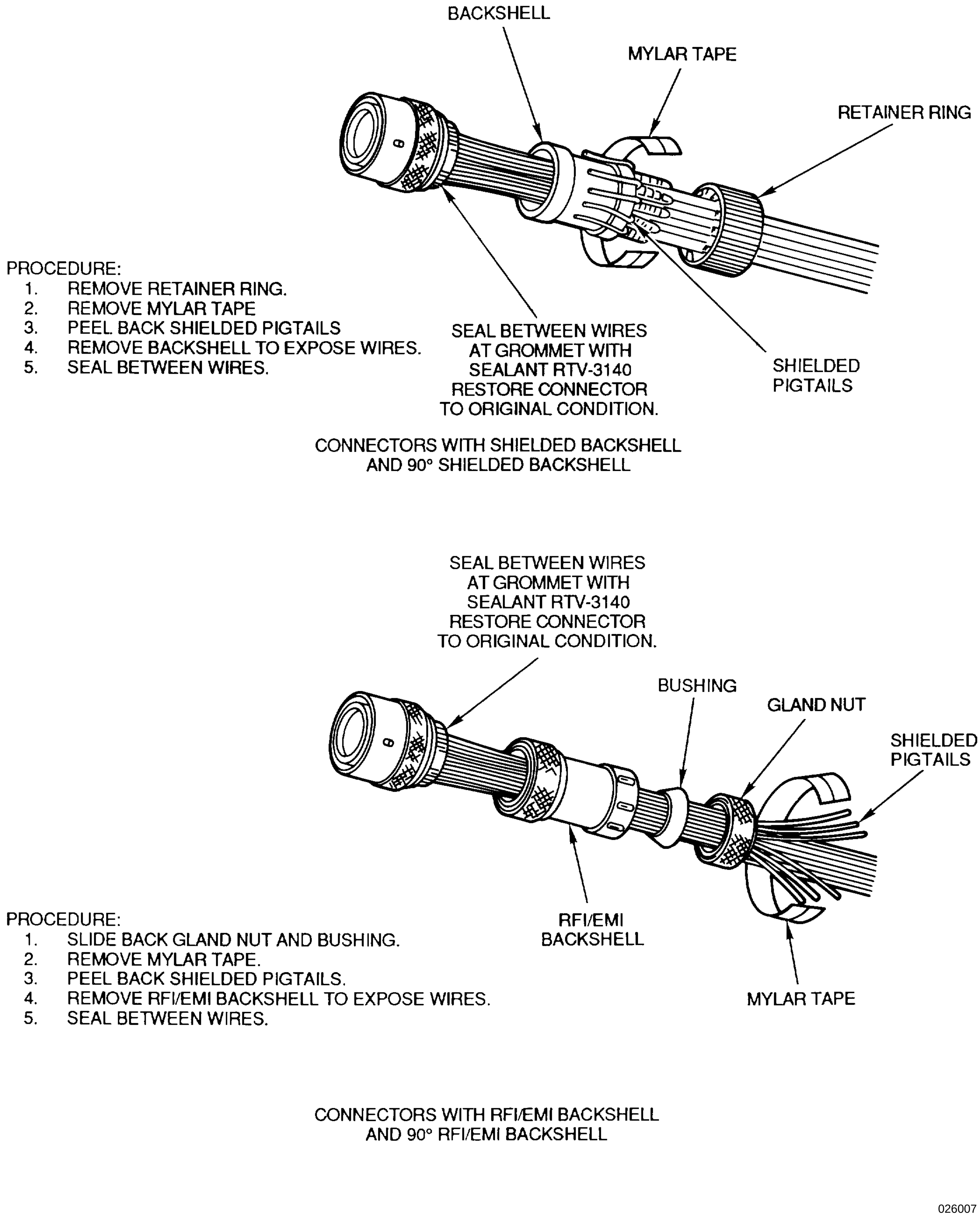

Figure 7. Connectors with Shielded and EMI/RFI Backshells

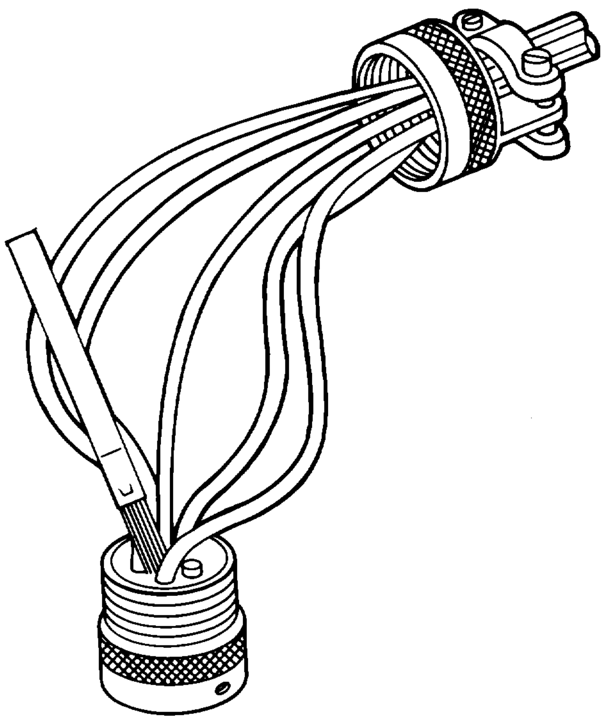
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Figure 8. Connector Cleaning

CAUTION

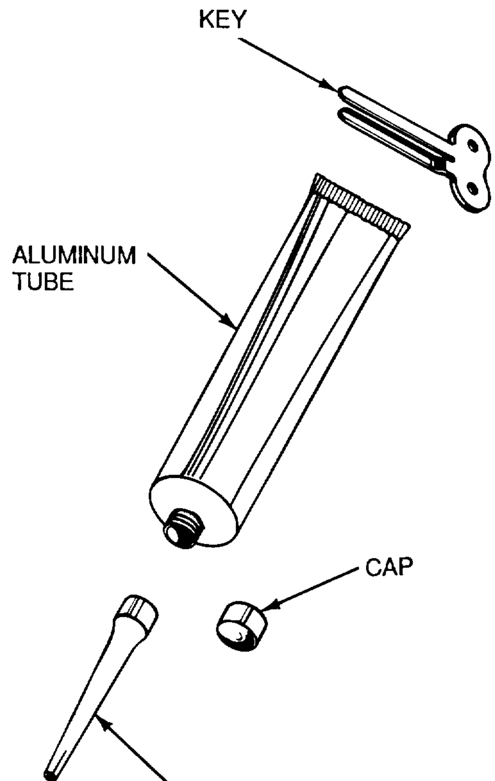
When ground cork is used, apply a heavy coat of AMS 3276 Class A–4 sealing compound over fillet to prevent the ground cork from absorbing fuel or moisture.

NOTE

AMS 3276 Class B–1/4 sealing compound may be combined in a ratio of 1 part sealing compound to 1.5 parts ground cork to fill voids exceeding 1/2 inch. Voids to be filled with this mixture must exist between cable assemblies and conduit or cable assemblies and bulkheads.

h. Apply a fillet of sealant around the cable assembly on both sides of the bulkhead when accessible (Figure 11, details A and B).

i. Remove masking tape from protected areas and smooth sealant around clamps with a wooden tongue depressor.



026009

Figure 9. Typical Tube Dispenser

28 . **EMI Sealing Procedures.**

a. Refer to paragraph 27a for cleaning procedure.

b. Follow special instructions in WP 007 00 when assembling EMI shielding and boots.

c. Mask areas to be protected from sealants.

d. Inject sealant into wire mesh buildup at EMI boot areas.

e. Fashion sealant to a smooth surface using wooden tongue depressor (Figure 12).

f. Remove masking tape and clean excess or unwanted sealant from area by use of a clean dry wiper.

29 . **Sealing Electrical Components.** The following procedure is for sealing electrical components against

foreign object damage and corrosion. Use only Silicone Sealant to MIL-A-46146 Group 3 (such as DC-3145).

a. Check all connections for correct attachment.

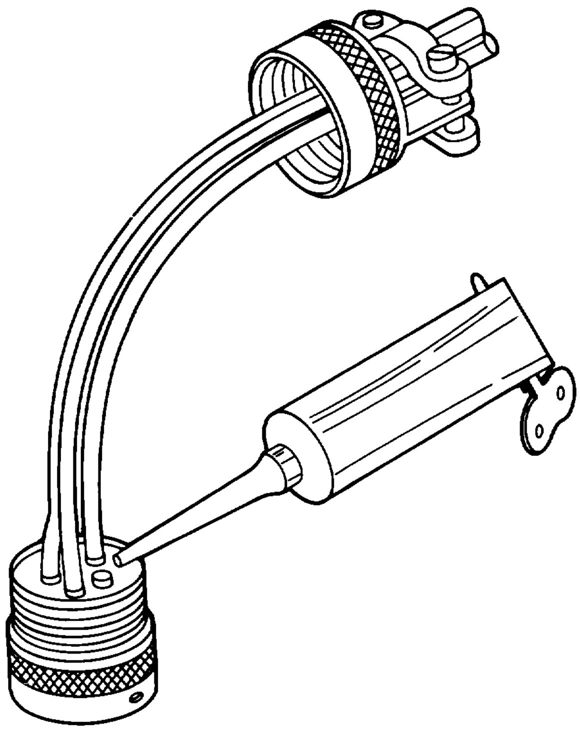

026010

Figure 10. Sealant Application

WARNING

Cleaning compound is flammable and toxic to eyes, skin, and respiratory tract. Skin/eye protection required. Avoid repeated/continued contact. Use only in well ventilated areas. Keep away from open flames or other sources of ignition.

b. Clean all surface areas to be sealed with cleaning compound.

c. Apply a thin coat (1/8-inch thick) of adhesive over the terminations. See Figure 13.

CAUTION

To prevent corrosion because of condensation, do not leave voids and air entrapments.

d. When filling cavities avoid air entrapment by using a fine pointed nozzle and start filling from the bottom up.

e. Curing of the adhesive requires 72 hours.

f. Handling of the assemblies can be done within 2 to 4 hours after which the surface area of the adhesive should be tack free.

WARNING

Camie A1000 is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin and respiratory irritation. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

g. When adhesive contacts a cover which is removable, apply a release agent (Camie A1000).

30 . **CURING SEALANTS.** Cure sealants according to the manufacturers' recommendations. The following are general guidelines only. Each manufacturer's material will have specific cure schedules that should be followed. Thickness of the sealant, temperature and humidity are factors which determine the time for a sealant to reach full cure and develop the intended properties.

CAUTION

Unless recommended by the sealant manufacturer, do not exceed 130°F (55°C) or the sealant will begin to degrade.

a. Polysulfide Sealant (MIL-PRF-8516) may be cured at room temperature for 24 to 72 hours, depending on the class. Alternately, polysulfide sealant may be cured at room temperature for 2 hours minimum, then in an oven up to 130°F (55°C).

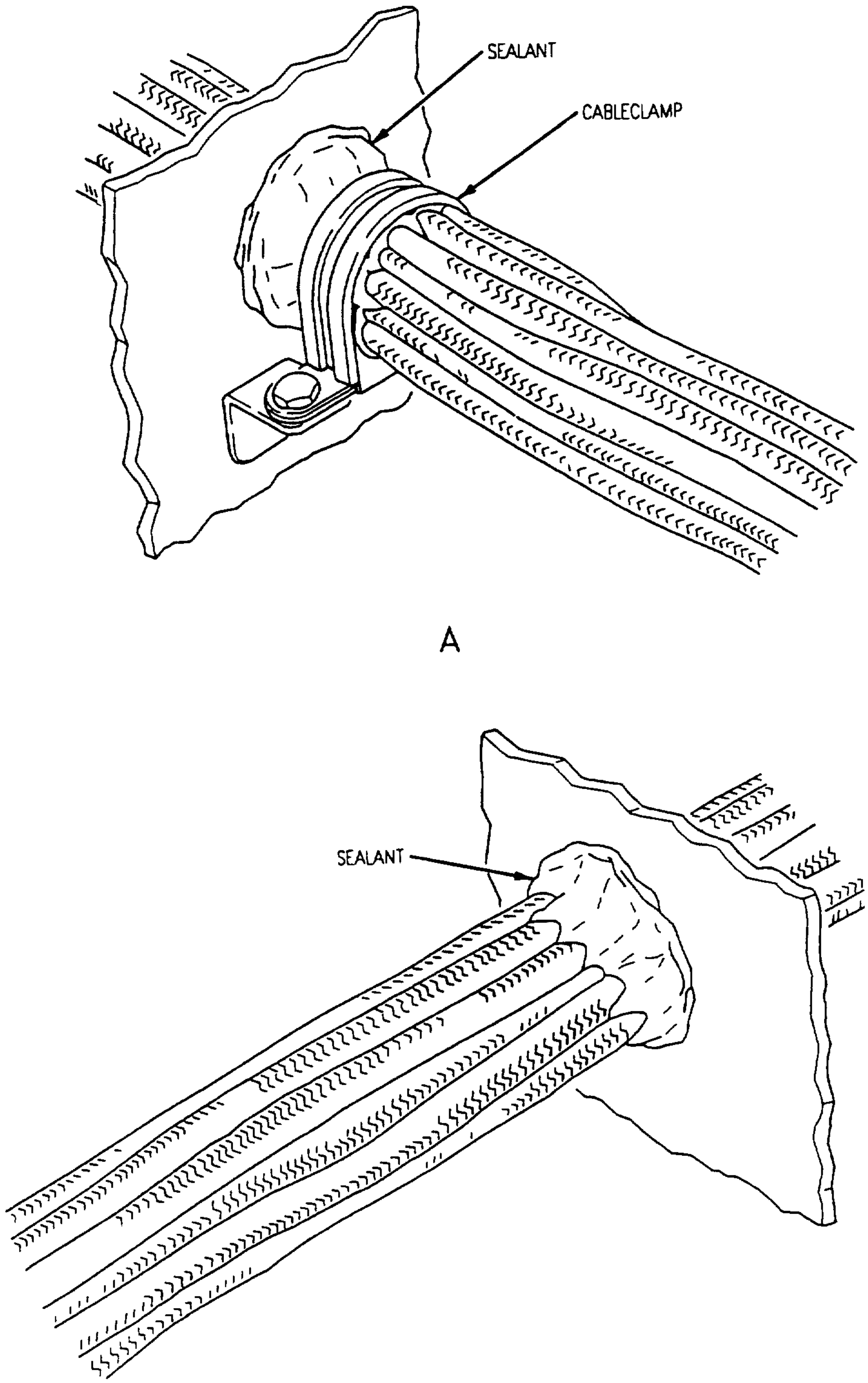


Figure 11. Sealing Cable Assemblies

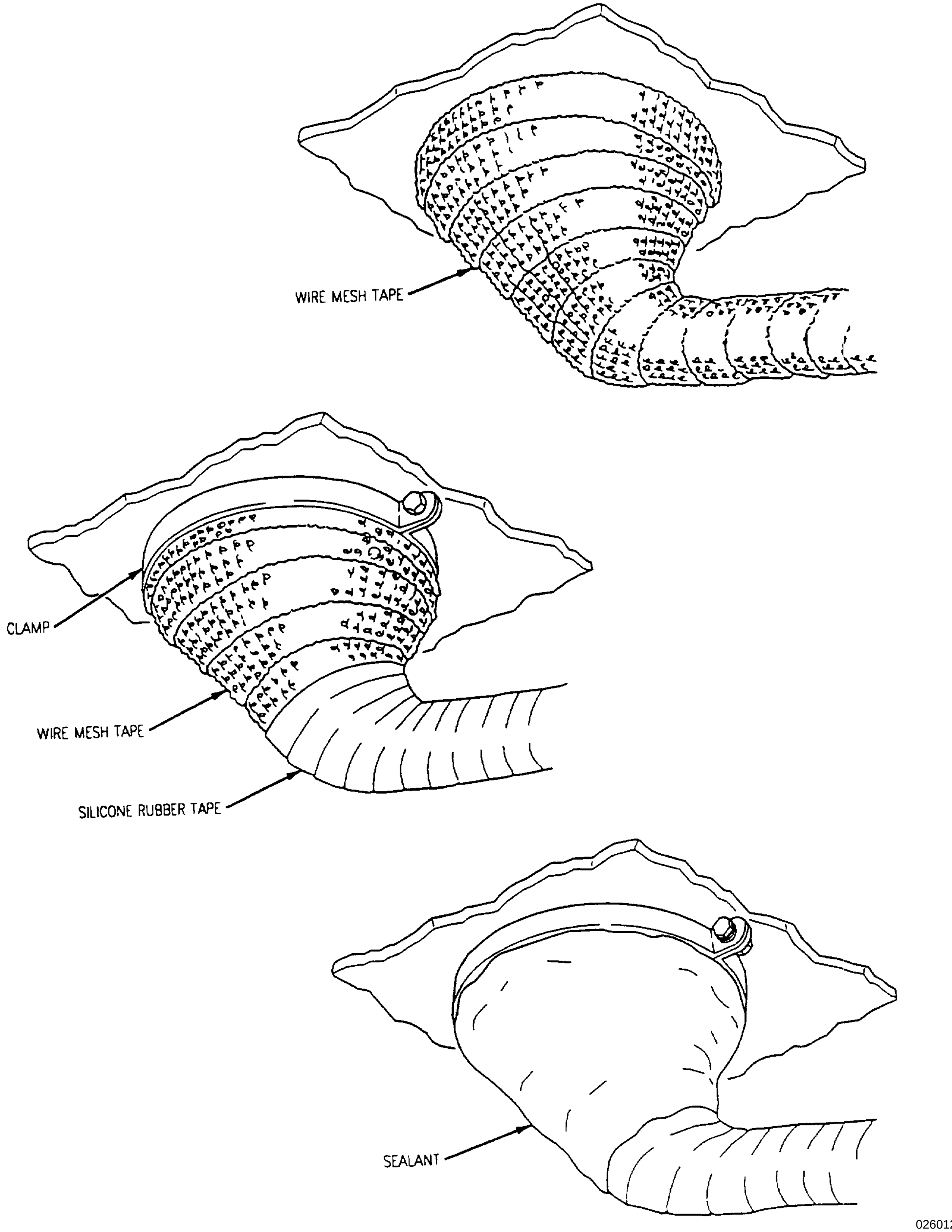


Figure 12. Sealing EMI Cable Assemblies

NOTE

Degas material prior to curing using a vacuum if air is trapped in material.

b. Polyurethane Sealant (MIL-M-24041) may be cured for 7 days at room temperature. Alternately, cure at room temperature for 2 hours, then 6 hours at 180°F (82°C).

c. Silicone Sealant (MIL-PRF-23586) must be cured according to the class of sealant. Class 1, 2 and 3 are room temperature cure materials, while the Class 4 is cured at 175°F (80°C).

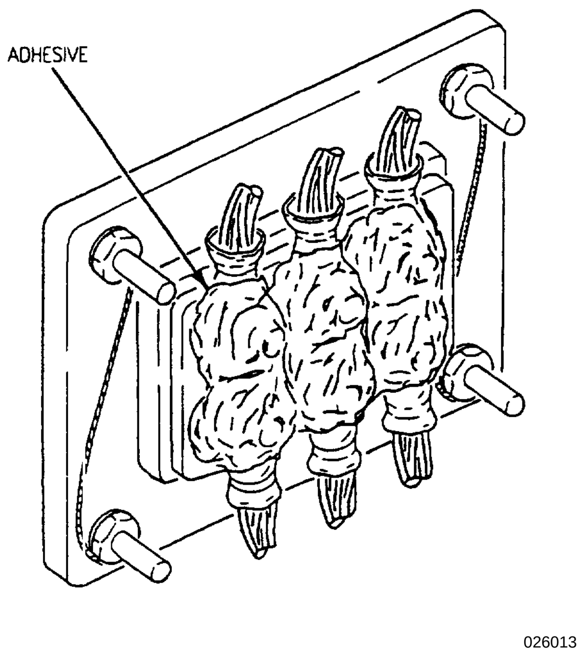


Figure 13. Sealing Electrical Components

d. Silicone Sealant (MIL-A-46146) are cured at room temperature for 5 days to achieve full bond strength. Thin sections may cure in less time. Care requires moisture.

e. Epoxy Casting Resin (MIL-I-16923) cure is dependent on the resin and catalyst used.

(1) With Stycast 2651/Catalyst 9, let mixture stand at room temperature for eight hours. Removal from mold is possible prior to that time if the casting is hard. Full cure for 24 hours at room temperature. Cure can be accelerated using slightly elevated temperatures, 1 hour minimum at 160°F (71°C).

(2) With Stycast 2651/Catalyst 11 the recommended sure is 2 hours at 165°F (74°C) followed by 2 hours at 220°F (104°C). The material can be allowed to gel at room temperature (about 6 hours) followed by 3 hours at 200°F (94°C).

31. **POLYSULFIDE SEALANT (MIL-PRF-8516) STORAGE.**

a. Unmixed Sealant Storage. Store base and accelerator in a cool place, refrigerate if possible. Shelf life is about 6 months when stored below 75°F (24°C), and about one year when stored at 45°F (7°C) or below.

b. Mixed Sealant Storage. Mixed MIL-PRF-8516 compound can be stored in cartridge tubes for periods of 30 to 60 days provided the filled tubes are quick frozen immediately after mixing and are stored at 40°F (-40°C) (paragraph 36). In general, extended storage of mixed, frozen compound shortens pot life and cure time after thawing. Sealant which has a working life of less than one hour should not be refrozen.

32. **POLYURETHANE SEALANT (MIL-M-24041) STORAGE.**

a. Two-Component Kit Storage. Store components in a cool place. Shelf life is about 6 months when stored below 75°F (24°C), and about one year when stored at 45°F (7°C) or below.

b. Frozen Pre-mixed Compound Storage. When stored at -20°F (-29°C), storage life is at least 7 days. When stored at -90°F (-68°C), minimum storage life is 28 days.

c. Mixed Sealant Storage. Mixed Polyurethane Sealant can be stored in cartridge tubes for periods of 7 to 30 days provided the filled tubes are quick-frozen immediately after mixing and degassing and stored at -40°F (-40°C) (paragraph 36). In general, extended storage of mixed, frozen compound shortens pot life and cure time after thawing. Sealant which has a working life of less than one hour should not be refrozen.

33. **SILICONE SEALANT, TWO-PART RTV (MIL-PRF-23586) STORAGE.**

a. Unmixed Sealant Storage. Store base and accelerator in a cool place, refrigerate if possible. Shelf life is about 6 months when stored below 75°F (24°C), and about one year when stored at 45°F (7°C) or below.

b. Mixed Sealant Storage. The storage life of quick-frozen MIL-PRF-23586 compounds is usually less then three weeks provided the filled tubes are quick-frozen immediately after mixing and are stored at -40°F (-40°C) (paragraph 36). In general, extended storage of mixed, frozen compound shortens pot life and cure time after thawing. Sealant which has a working life of less than one hour should not be refrozen.

34. SILICONE SEALANT, ONE-PART RTV STORAGE.

a. Store below 90°F (32°C). Refrigerated storage is not essential but will extend useful shelf life. Shelf life shall not exceed twelve months without evaluation as to condition prior to use. Since this material cures upon exposure to humidity in the air, keep container sealed when not in use. A plug of cured material may form in tip of tube during storage. This is easily removed and does not affect remaining contents.

35. EPOXY RESIN (MIL-I-16923) STORAGE.

a. Unmixed Sealant Storage. Resin and catalyst, unmixed in original unopened containers, should be stored between 40°F (4°C) and -55°F (-48°C) for maximum shelf life. At these temperatures, shelf life of material is greater than 6 months.

b. Mixed Sealant Storage. In general, extended storage of mixed, frozen compound shortens pot life and cure time after thawing

(1) Stycast 2651/Catalyst 9 mixture maybe stored in small syringes for up to 7 days when quick-frozen (paragraph 36) immediately after mixing and stored at -40°F (-40°C). Sealant which has a working life of less than one hour should not be refrozen.

(2) Stycast 2651/Catalyst 11 mixture may be stored in small syringes for up to 30 days when quick-frozen immediately after mixing and stored at -40°F (-40°C) (paragraph 36).

36. QUICK-FREEZE PROCEDURE FOR SEALANTS.

WARNING

Isopropanol and the vapors are extremely flammable. Consult MSDS for proper personal protection equipment.

Do not allow solid carbon dioxide to contact the skin due to danger of frostbite.

a. Quick freezing of filled tubes of mixed compound is done by immersing in a mixture of Isopropanol and solid carbon dioxide for five minutes. This will cool the tubes to below -50°F (-46°C). Store properly once frozen. Freezing by slow cooling in air may significantly reduce the storage life of the mixed compound.

37. **DEPOTTING SEALANTS.**

NOTE

Solvents are hazardous materials. Always become familiar with the Material Safety Data Sheets (MSDS) prior to use of the chemical. Consult MSDS for the proper personal protection equipment (PPE) to use when working with the material. PPE must be worn when working with solvents, including safety goggles, rubber gloves, and aprons when necessary. Personnel should not be exposed to solvent vapors for extended periods of time. Work with solvents in a properly ventilated area. In confined locations, use portable ventilation equipment.

38. REMOVAL OF POLYURETHANE, POLYACRYLATE, AND EPOXY SEALING COMPOUNDS.

a. Prior to cleaning operation, rope off area involved and provide suitable signs indicating unauthorized personnel will stay clear of area.

CAUTION

Dichiloromethane ASTM D4701 (Methylene Chloride) will damage most paint films.

b. Prepare the area below all items subject to solvent for solvent spillage.

(1) Lay down a sheet of polyethylene covered with absorbent material.

(2) Should any solvent be spilled on the absorbent materials, this material should be removed and disposed of or laundered.

c. Prepare aircraft taking all outlined safety precautions.

d. Remove plastic mold from potting on connector or relay (if installed), using soldering iron or cutting pliers (paragraph 24) to cut plastic.

NOTE

Soldering iron tip should be modified to resemble a small spoon with no sharp or blunt edges. New tips may be fabricated from brass welding rod.

CAUTION

Use extreme care to prevent damage to wire insulation or to the component body.

e. Trim excess potting from component using soldering iron with modified tip. or cutting pliers.

f. Fill the polyethylene bag with enough dichlorometnane to completely immerse the potting compound, and check the bag for leakage. If the bag is leaking, transfer the solvent to a. new bag and discard the leaky bag. Label the starting time on the bag with a marking pen to keep an accurate count of the soaking time.

CAUTION

Be sure polyethylene bags are tightly sealed. The alternate procedure must be accomplished in a ventilated booth area approved by the resident Bio-environmental Engineer.

NOTE

An alternate method is to place the connector in a large can or bucket, filling the container with enough dichloromethane to completely immerse the potting compound. Then add about one inch of water to it. The water will stay on top of the dichloromethane keeping the vapors from getting into the air. This will also prevent evaporation of the solvent.

Also, the use of ZIP-LOCK polyethylene bags in lieu of the tie type bags is permitted.

g. Insert the connector or relay in the polyethylene bag. Tie the top of the bag in place with a nylon cord or a wire to prevent evaporation of the solvent.

h. While the compound is soaking, inspect the bags for leaks every 10 to 20 minutes. Leaking bags found during this period shall have a second bag tied around them. This soak period shall be restricted to a maximum of one hour. Connectors which have the potting compound swelled or dissolved in less than one hour should be removed as soon as possible from the solvent to minimize soak time.

i. After the old potting compound has been dissolved, swelled, or one hour soaking time has been obtained, remove the bag of solvent. Contaminated solvent must be disposed of in an environmentally safe manner. Contact the Bioenvironmental Engineer to establish an approved procedure.

j. Using tweezers, needle nose pliers, or picks, remove swollen potting compound.

CAUTION

Never allow the soaking time to be extended over two hours. Prolonged immersion can swell and damage neoprene inserts in connectors.

k. Repeat swelling and picking operation until all potting compound is removed.

l. Brush the connector briskly to remove all residues; rinse while brushing with small quantities of dichloromethane. Allow the solvent to run over the connector and collect in a container or polyethylene bag below the connector.

m. Allow the component to dry for thirty minutes minimum, then apply heat with Raychem HT900 or an explosion proof heat gun starting 6 to 8 inches above the component and work down. Five minutes heating time is sufficient. The applied temperature should not exceed 250°F.

n. Let stand for twenty-four hours. Inspect for cleanliness and check all wires for insulation damage.

39. REMOVAL OF SILICONE AND POLYSULFIDE SEALING COMPOUNDS.

CAUTION

Use extreme care not to damage adjacent connector can facts or wire.

a. Using a soldering iron with a modified tip as shown in Figure 14, cut away the potting to gain access to the desired contact(s).

b. Using a lull knife, scrape away the remaining potting in the contact area.

WARNING

Dichiloromethane ASTM D4701 (Methylene Chloride) is highly toxic to skin, eyes, and respiratory tract; avoid all exposure. Skin, eye, and respiratory protection is required.

c. Wash area thoroughly with dichloromethane (paragraph 36).

d. Final traces of polysulfide may be removed manually or with Dichilorornethane ASTM D4701 (Methylene (paragraph 37). Final traces of silicone may be removed using a soldering iron and a dull tool.

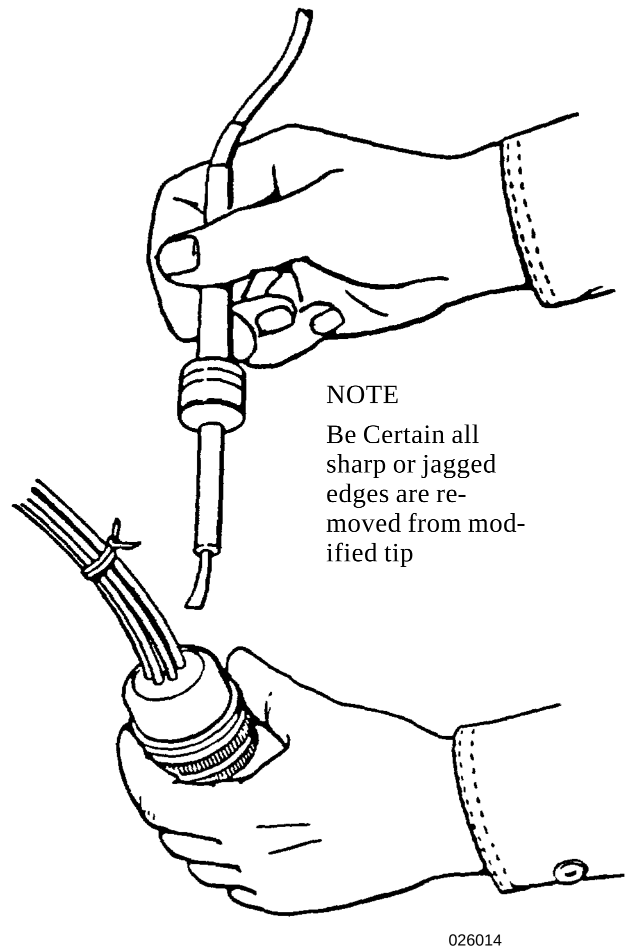


Figure 14. Potting Removal

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CONNECTOR CLEANING AND PRESERVATION

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Potting and Sealing Connectors, Electrical Cable Assemblies, and Electrical Components 025 00
Toxicity, Flash Point, and Flammability of Chemicals . . . . NAVAIR 07-1-505
Avionic Cleaning and Corrosion Prevention/Control . . . . NAVAIR 16-1-540
Consolidated Hazardous Item List . . . . NAVSUP Publication 4500

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

None

Materials Required

Nomenclature	Part Number/Type Designation
Abrasive Mat	MIL-A-9962, Type I, Grade A
Brush	H-B-681
Brush, Acid Swabbing	H-B-643
Cleaning Cloth	CCC-C-46, Class 4
Pipe Cleaner	840507
Toothbrush	H-T-560
Trichlorotrifluorethane	MIL-C-81302, Type I and Type II
Corrosion Preventive Compound	MIL-C-81309, Type II and Type III
Water-Displacing Corrosion Preventive Compound	MIL-C-85054, Type I

1 . **INTRODUCTION.**

2 . This work package (WP) describes the cleaning, preservation and corrosion prevention/control procedures for connectors.

3 . **SAFETY.**

4 . The following warnings shall be observed.

WARNING

Some of the materials identified in this manual can create hazardous conditions or damage equipment unless used strictly in the applications and manner described.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Refer to NAVAIR 07-1-505, Toxicity, Flash Point, and Flammability of Chemicals, or NAVSUP Publication 4500, Consolidated Hazardous Item List. When in doubt, contact the local Safety Officer.

Do not use Dry Cleaning Solvent, P-D-680, Type II, or Aircraft Cleaning Compound, Class 1, MIL-C-43616, around oxygen, oxygen fittings, or oxygen regulators since fire or explosion may result. Use only solvent Trichlorotrifluoroethane, MIL-C-81302, Type I and Type II to clean these areas.

Do not use synthetic fiber wiping cloths with Isopropyl Alcohol, TT-I-735, due to the low flash point of the solvent. Dry fiber wiping cloths will cause a static charge build-up and can result in fire.

Solvents are flammable and solvent vapors are toxic. Keep solvents away from open flames and use only in a well-ventilated area. Avoid solvent contact with skin.

Do not use Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Water-Displacing Corrosion Preventive Compound, MIL-C-85054, Corrosion Preventive Compound, MIL-C-16173, or Lubricating Oil, General Purpose Preservative, VV-L-800 around oxygen, or oxygen fittings, since fire or explosion may result.

Chemical film materials are strongly oxidizing and are a fire hazard in contact with organic materials such as paint thinners. Do not store or mix surface treatment materials in containers previously containing flammable products. Rags contaminated with chemical film material should be burned as soon as practicable.

Solvent, Trichlorotrifluoroethane, MIL-C-81302, may react with conformal coatings and acrylic plastics. Test affected area for adverse reactions prior to general applications.

Experimentation with cleaning and corrosion removal equipment is not an authorized practice. Damage to circuit components may result from reactions to the chemical solutions used in the cleaning and corrosion removal support equipment.

5 . **RECOGNIZING CORROSION.**

6 . Recognizing corrosion in metals is an important part of Corrosion Cleaning and Prevention Program (Refer to NAVAIR 161-540). Modern avionics systems make use of many metals not normally considered for airframe structures. In addition to recognizing corrosion in metals, the inspection process must include the recognition of corrosion caused by solder fluxes and the deterioration of metals and non-metals caused by microbial, insects, and animal attack.

7 . **COMMON TYPES OF CORROSION.** There are many forms of corrosion that may occur depending upon the types of metal, configuration of the metal, and environment in which the components are placed. The following types of corrosion are common to avionics equipment on naval aircraft:

a. Uniform Surface Attack

b. Galvanic (dissimilar metals)

c. Pitting

d. Crevice (concentration cell)

e. Inter-granular

f. Stress

g. Erosion

8 . Left untreated, corrosion on electrical connectors will continue to spread to adjacent surfaces and to mating connectors.

9 . External corrosion on cable connectors will, if left untreated, continue to corrode into the electrical contacts causing system degradation and eventual failure.

10 . The characteristics of corrosion on metals used in avionics systems are summarized in Table 1**.**

11 . **CLEANING AND PRESERVATION OF CONNECTORS AND BACKSHELLS.**

WARNING

Cleaning compounds and solvents identified in this work package may react with some encapsulants or plastics used to form wire harness tubing, wire coatings, gaskets, and seals. Test a small area for softening or other adverse reactions prior to general application.

Ensure that all electrical power is disconnected from the aircraft and all systems in the aircraft are de-activated. Disconnect all batteries.

12 . Connectors require special attention when installed in areas exposed to salt water, such as speed brake, wingfold, and landing gear areas. The following procedures will assist in the prevention of corrosion of multi-contact and coaxial connectors:

a. Whenever possible, mount the connectors horizontally. This will prevent water from running along the wire bundle and into the connector.

b. When system configuration requires the connector to be mounted vertically, place a drip loop in the attached wire bundle which will cause water to run off prior to reaching the connector.

c. If connector boots are installed and water intrusion cannot be prevented, a small drain hole may be cut in the low point of the connector boot to allow the water to escape.

d. Protect open connectors with plastic or metal caps.

e. (For multi-contact connectors only.) The repeated removal and replacement of contacts, or omission of the sealing plugs, may cause the water tight seals within the connector to lose their effectiveness. The use of potting compounds may be required to prevent water intrusion in extreme cases where the connector cannot be replaced. Refer to WP 026 00.

13 . **CORROSION REMOVAL AND CLEANING.** Corrosion removal and cleaning procedures are not the same for metallic and non-metallic (composite) connectors. Since composite connectors and accessories depend solely on plating for shell conductivity, it is extremely important not to damage the plating during cleaning. The following process is for corrosion removal and cleaning of metallic and non-metallic connectors and backshells:

a. Inspect connectors and backshells for corrosion damage. If corrosion is severe, connector and/or backshell shall be replaced. If corrosion is found at the contact to wire connection, inspect wire harness or cable (paragraph 16).

b. Disconnect connector.

c. If connector is metallic remove external corrosion connectors by scrubbing with an abrasive mat. If connector is non-metallic (composite) remove external corrosion by scrubbing with a nonabrasive pad.

d. Remove residue by wiping with cleaning cloth.

WARNING

Do not use Trichlorotrifluoroethane on very hot surfaces or near flame. Ensure adequate ventilation exists in work area. Vapors are harmful and toxic when ultra-violet rays are present. Do not take internally. Avoid prolonged or repeated contact with skin. Wear approved gloves and goggles or face shield when handling. Store only in approved metal safety containers.

e. Apply Trichlorotrifluoroethane to external connector surfaces with brush or toothbrush. Use acid swabbing toothbrush to apply Trichlorotrifluoroethane to internal connector areas.

Table 1. Corrosion of Metals - Nature and Appearance of Corrosion Products

Alloy	Type of Attack to Which Alloy Is Susceptible	Appearance of Corrosion Product
	Extended or repeated contact with chlorinated solvents may result in embrittlement. Cadmium plated tools can cause embrittle of titanium.	
Magnesium alloy	Highly susceptible to pitting.	White powder snow-like mounds, and white spots on surface.
Carbon and low alloy steel (1000-800 series)	Surface oxidation and pitting, surface and intergranular.	Reddish-brown oxide (rust).
Stainless steel (300-400 series)	Intergranular corrosion. Some tendency to pitting in marine environment (300 series more corrosion resistant than 400 series).	Corrosion evidenced by rough surface; sometimes by red, brown or black stain.
Nickel-Base alloy (Inconel)	Generally has good corrosion-resistant qualities. Sometimes susceptible to pitting.	Green powdery deposit.
Copper-Base alloy (Inconel)	Surface and intergranular corrosion.	Blue or blue-green powder deposit.
Cadmium (used as a protective plating for steel)	Good corrosion resistance. Will cause embrittlement if not properly applied.	White to brown to black mottling of the surface.
Chromium (used as a wear-resistant plating for steels)	Subject to pitting in chloride environments.	Chromium being cathodic to steel, does not corrode itself, but promotes rusting of steel where pits occur in the coating.
Silver	Will tarnish in presence of sulfur.	Brown to black film.
Gold	Highly corrosion resistant.	Deposits cause darkening of reflective surfaces.
Tin	Subject to whisker growth.	Whisker-like deposits.

f. Remove solvent and residue with cleaning cloth. Use pipe cleaner to remove solvent from internal connector areas. Ensure all solvent and debris are removed from connector.

14. **WATER DISPLACEMENT AND PRESERVATION OF MULTI-CONTACT CONNECTORS.** This section applies to both metallic and non-metallic (composite) connectors. Any time connectors are separated for maintenance, preserve using the following procedure:

WARNING

Do not apply Corrosion Preventive Compound, MIL-C-81309, Type III, to internal sections of plugs and receptacles on E-2C-T56A-427 TMT/DEC, and E-2C radar high power connectors. T56-A-427 TMT/DEC connector pairs include the following: REF DES 12J/P5, 12J/P6, 12A7J/P1, 12A7J/P2, 95M56J/P1, and fire shield connector pair consisting of engine thermocouple pickup connector plug 23056742 and engine thermocouple harness connector receptacle 23056710. Avoid breathing vapors or spray mist from Water Displacing Corrosion Preventive Compounds. Wear goggles or face shield. Avoid prolonged skin contact.

a. Apply a light film of Water-Displacing Corrosion Preventive Compound, MIL-C-81309, Type III, to the internal sections of plugs and receptacles.

b. Tilt plug or receptacle down to drain excess, when possible. Wipe off extra preservative with cleaning cloth.

c. Lubricate threaded areas of connectors and backshells with Water-Displacing Corrosion Preventive Compound, MIL-C-85054, Type I prior to assembly.

d. Preserve outer shell of connectors with a thin coating of Water-Displacing Corrosion Preventive compound, MIL-C-85054, Type I.

15 . **WATER-DISPLACEMENT AND PRESERVATION OF COAXIAL CONNECTORS.**

WARNING

Do not apply Water-Displacing Corrosion Preventive Compound (MIL-C-81309, Type II or III), or Water-Displacing Corrosion Preventive Compound (MIL-C-85054, Type I), to internal areas of coaxial connectors. Application of preservatives to internal sections of coaxial connectors may cause erroneous indications in system performance.

Avoid breathing vapors or spray mist from Water-Displacing Corrosion Preventive Compounds. Wear goggles or face shield. Avoid prolonged skin contact.

Mate connectors together. Preserve external areas of connectors with thin coating of waterdisplacing corrosion preventive compound (MIL-C-85054, Type I). Avoid excessive application of preservative.

16 . **CLEANING AND PRESERVATION OF WIRE HARNESSES AND CABLES.**

17 . When corrosion is found at the pin-to-wire interface on electrical connectors, the wire harnesses and cables should be inspected for corrosion attack and cracking of the wire insulation. Coaxial cable shielding is particularly susceptible to corrosion. Clean and preserve wire harnesses and cables as follows (refer to NAVAIR 16-1-540):

a. If corrosion is apparent at the back of a connector, it may be necessary to remove an inch or two of the wire harness cable cover to inspect for corrosion.

WARNING

Do not use Trichlorotrifluoroethane on very hot surfaces or near flame. Ensure adequate ventilation exists in work area. Vapors are harmful and toxic when ultra-violet rays are present. Do not take intemally. Avoid prolonged or repeated contact with skin. Wear approved gloves and goggles or face shield when handling. Store only in approved metal safety containers.

Avoid breathing vapors or spray mist from Water-Displacing Corrosion Preventive Compounds. Wear goggles or face shield. Avoid prolonged skin contact.

b. Apply Trichlorotrifluoroethane with brush or toothbrush Scrub affected area until contaminants are loosened. Flush area with Trichlorotrifluoroethane.

c. Shake extra solvent from wire harness and wipe with cleaning cloth.

d. Allow to air-dry. To preserve exposed wire, apply a light film of Water-Displacing Corrosion Preventive Compound (MIL-C-81309, Type III). On bare wire of shielding, it may be necessary to use a heavier application of preservative. In this case, spray a light film of Water-Displacing Corrosion Preventive Compound (MIL-C 81309, Type II). Where applicable, repair wire harness and cable covering.

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TERMINAL JUNCTION SYSTEM

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Military Standard Circular Connectors 020 00
Wire and Cable Stripping 009 00
Composite Termination System Socket Connectors MIL-T-81714
Electrical Contacts Series I or crimp type external socket contacts MIL-C-39029/1
Electrical Contacts Series II or crimp type external socket contacts MIL-C-39029/22
Wiring Aerospace Vehicle, MIL-W-5088K AS50881

Alphabetical Index

Support Equipment Required

Nomenclature	Part Number./Type Designation
3/8 Inch Socket	—
TJS Block Removal Tool	M81714/39-01
TJS Block Removal Tool	M81714/69-02

Materials Required

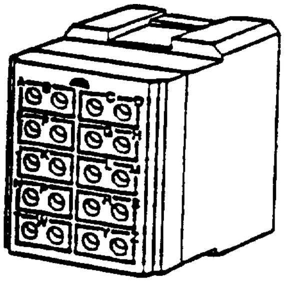
Nomenclature	Type No./ Part Number
Component Rack Assembly	M81714/67
Pin Contact	MIL-C-39029

1 . .INTRODUCTION.

2 . The Terminal Junction System (TJS) consists of bussing blocks, racks, brackets, wire-in-line junctions, grounding terminals, grounding blocks, electronics blocks and electronic in-line junctions that are used for innerconnecting electrical components and equipment in an electrical or electronic system. These environment resistant components have in common the use of crimp type external pin contacts in accordance with MIL-C-39029/1 for series I or crimp type external socket contacts in accordance with MIL-C-39029/22 for series II This family of TJS components is designed to operate continuously over a temperature range of -85°F to +392°F (-65°C to +200°C) (Figure 1).

3 . INTENDED USE. TJS components are intended for electrical distribution use. They are suitable for use in Integrated Wire Termination Systems (IWTS), and environment resistant wiring, in accordance with AS50881.

4 . FUNCTIONAL MARKING. Top marking of cavities and circuit identification are as specified. Functional marking on bussed components is white and on electronic components is yellow. SKT is marked on the face of the grommet to indicate series II TJS block components required.



028001

Figure 1. TJS Block

5 . SERIES I CLASSES. Series I terminal junction components described herein are Class D. Classes A, B and C components are inactive for new design and shall not be used for direct government acquisiton.. Class D components must be used to substitute for class A, B or C components.

6 . SUPERSEDED PART NUMBERS. The superseding Series I class D part number is developed by replacing the A, B or C class letter with D in the superseded part number (Figure 4). Examples of such supersessions are as follows:

7 . **Bussing Blocks.** Part numbers M81714/7-AA1, -BA1 and -CA1 are superseded by M81714/7-DA1.

8 . **Electronic Blocks.** Part numbers M81714/18-A-001, -B-001 and C-001 are superseded by M81714/18-D-001.

9 . **Wire In-Line Junctions (splices).** Part Numbers M81714/12-20A-l, -20B-1 and -20C-1 are superseded by M81714/12-20D-1.

10 . **Electronic In-Line Junctions.** Part numbers M81714/21-1A001, -1B001 and -1C001 are superseded by M81714/21-1D001.

11 . **CLASSIFICATION.** Terminal junction components are classed and color coded as follows:

a. Series I, Class A 302°F (150°C) maximum environmental type, limited fluid resistance, green housing, green grommet.

b. Series I. Class B 347°F (175°C) maximum environmental type, extended fluid resistance, red housing, white grommet.

c. Series I, Class C 392°F (200°C) maximum environmental type, limited fluid resistance, black housing, red grommet.

d. Series I, Class D 392°F (200°C) maximum environmental type, extended fluid, resistance, black housing, blue grommet.

e. Series II, 392°F (200°C) maximum environmental type, extended fluid resistance, black housing, and reddish brown grommet.

12 . GENERAL.

13 . BUSSING. Bussed means interconnected electrically within the component housing. Bussing arrangements and their circuit designators are shown in the boxed areas on top of the grommet (Figure 1). Each common bussed area is called a module.

14 . BLOCK. A block consists of one or more bussing modules. The internal structure of a typical block is shown in Figures 2 and 3.

15 . INTERNAL CONTACT. Internal contact is the non-removable contact contained in the TJS components (Figure 3).

16 . PACKAGE CONTENTS. The number of contacts supplied with blocks and in-line junctions should be a minimum of one more for feedback and two more for feedthrough blocks than the number of cavities specified. For feedback blocks two end seal plugs and for feedthrough blocks four end seal plugs are provided.

17 . MILITARY IDENTIFICATION. The components are identified by a military part number, as shown by the applicable MIL-T-81714 military specification sheet. Components are identified as in the examples (Figure 4).

18 . TYPES OF TERMINAL JUNCTIONS.

19 . TERMINAL JUNCTION FEEDBACK BUSSING BLOCKS. A terminal junction feedback bussing block is a receptacle having multiple internal contacts interconnected in parallel to form one or more circuits. A feedback bussing block (Figure 5) has one face containing contact cavities and is used for general purpose interconnection and bussing. Blocks are normally contained and retained in a rack or mounting bracket (Figures 7 and 8).

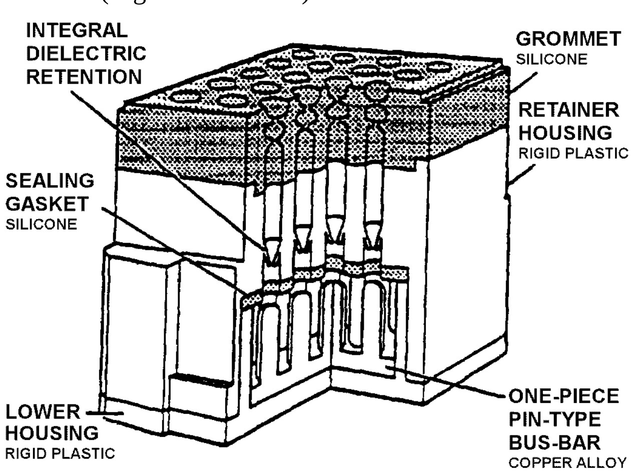


Figure 2. TJS Block

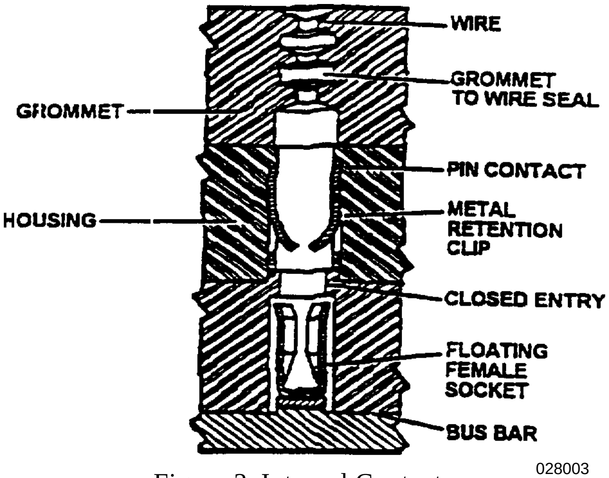


Figure 3. Internal Contact

20 . FEEDTHROUGH BUSSING BLOCKS. A feedthrough bussing block (Figure 6) has two faces containing contact cavities. The faces are diametrically opposite each other. A contact on one face of a block is electrically and mechanically common with a contact having the same identification letter but exiting from the other face of the block. Feedthrough bussing blocks are used for general purpose interconnection and bussing in applications where circuit wiring must be connected to two sides of the panel, bulkhead or patch board.

21 . RACKS (TRACKS OR RAILS). A rack (Figure 7) is used to contain and retain a number of blocks. Two types are available, one for feedback blocks and one for feedthrough blocks. The Series I racks have provisions for side or bottom mounting. Blocks are secured to the track by a sliding stop (Series I) or by a latch release system (Series II). The latch system requires a special tool (Figure 14).

22 . MOUNTING BRACKET. A mounting bracket is used for a single feedback bussing block or electronic block which requires mounting by itself or in a confined space (Figure 8).

23 . WIRE IN-LINE JUNCTION, SINGLE AND DOUBLE (SPLICE). A wire-in-line junction is essentially a feedthrough environment resistant disconnect component for joining wires. It consists of a body with internal contacts that accommodate removable external contacts. The inline junction splice (Figure 9) is particularly suitable for incorporation into harness wiring, terminating equipment pigtails or single wire repairs that do not affect the overall diameter.

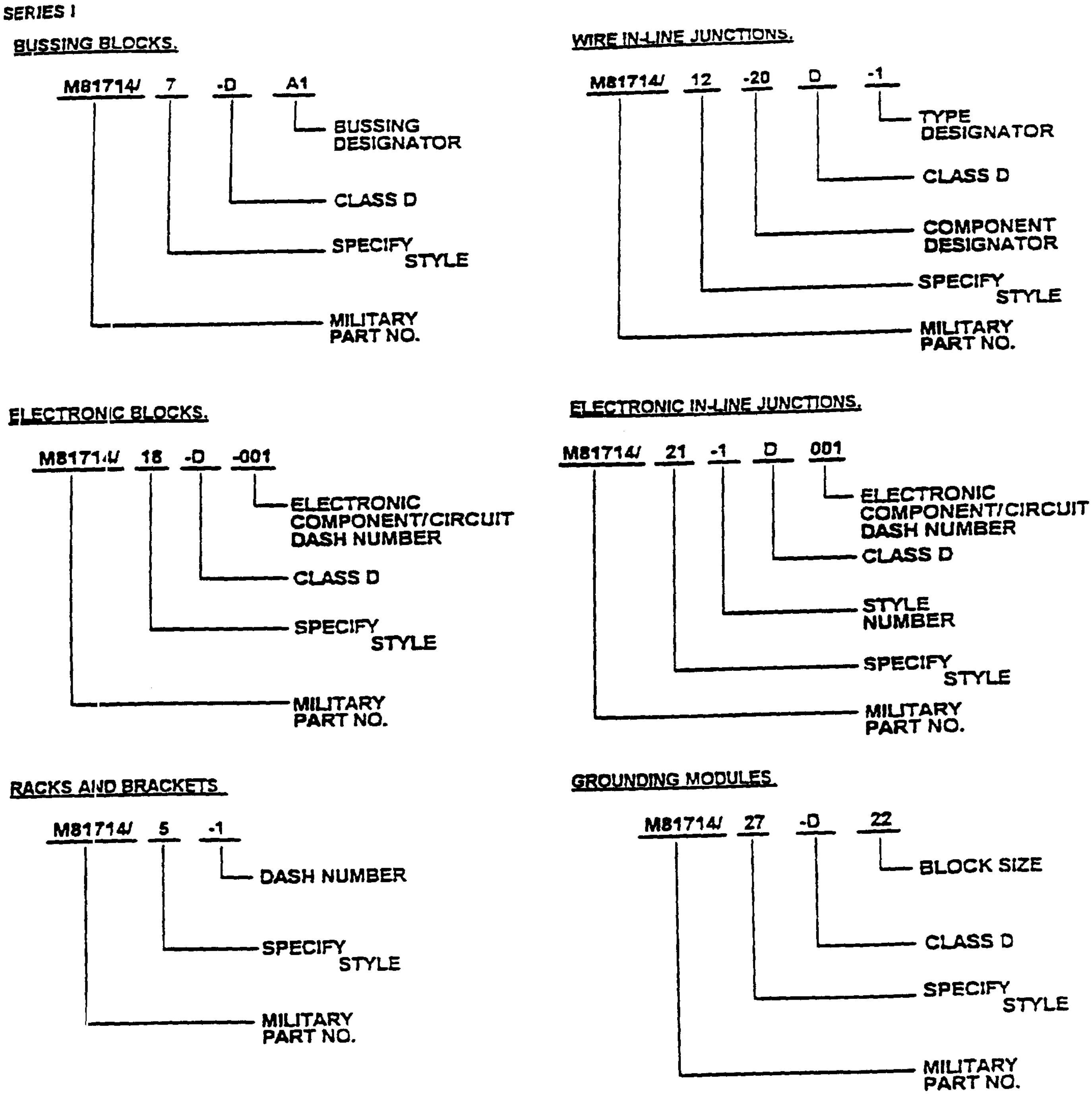


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Figure 4. Identification Examples (Sheet 1 of 3)

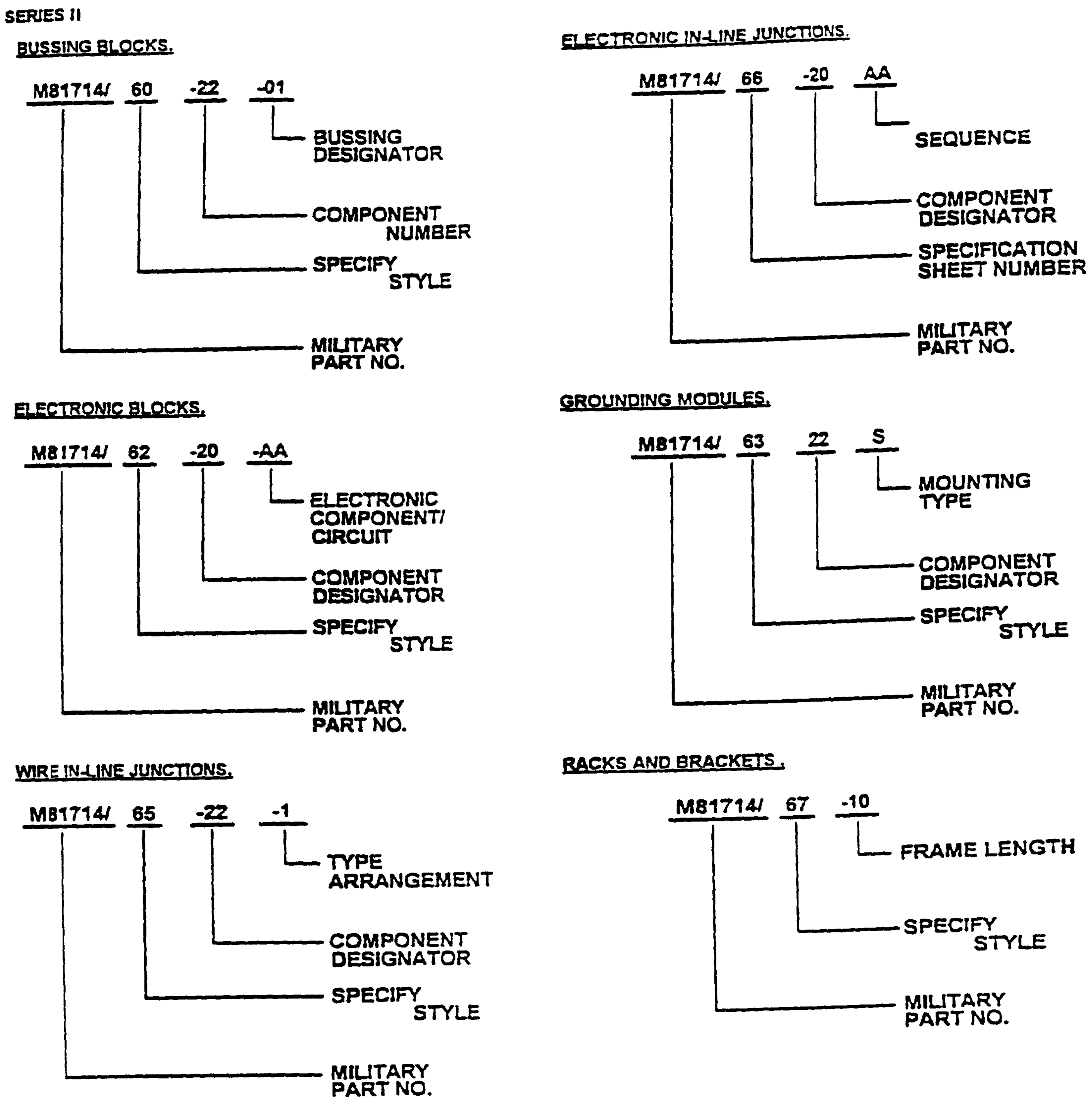

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Figure 4. Identification Examples (Sheet 2)

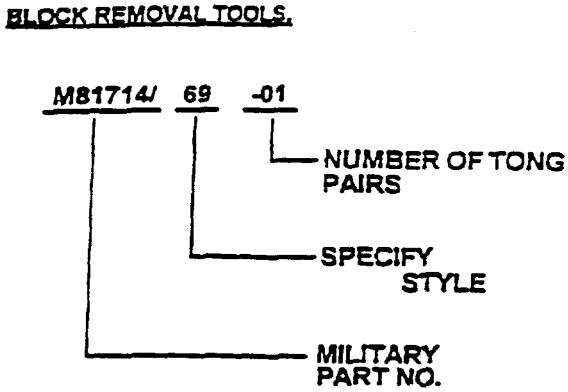

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Figure 4. Identification Examples (Sheet 3)

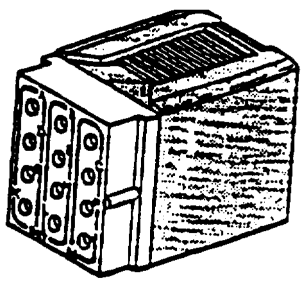

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Figure 5. Feedback TJS Block

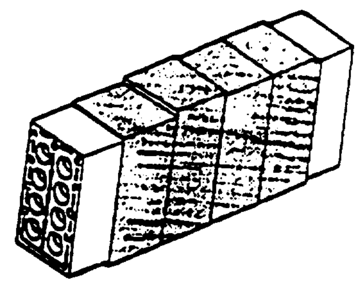

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Figure 6. Feedthrough TJS Block

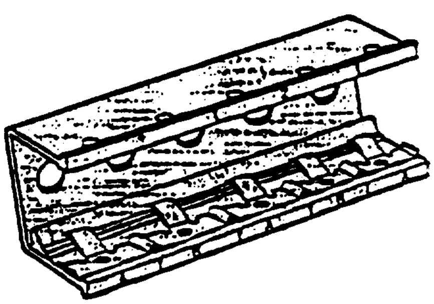

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Figure 7. Series II TJS Rack

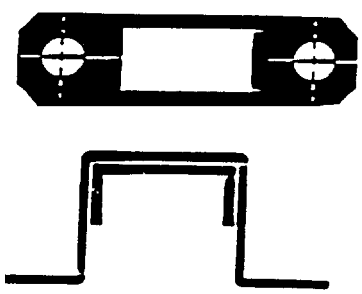

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Figure 8. Series I Mounting Bracket

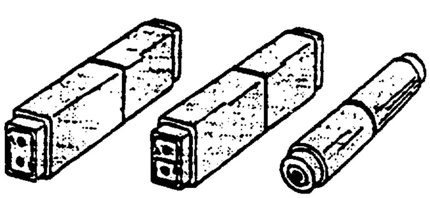

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Figure 9. Wire In-Line Junctions

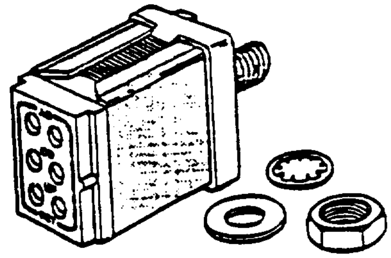

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Figure 10. Grounding Terminals

24. GROUNDING TERMINALS. The grounding terminal is a feedback receptacle having multiple internal contacts interconnected to form one circuit that in turn is connected to an external mounting stud. Grounding terminals (Figure 10) are used where grounding or a power connection of equipment is necessary.

25. GROUNDING BLOCKS (GROUNDING MODULES). The grounding blocks (Figure 11) are feedback receptacles having multiple internal contacts interconnected to form one circuit that in turn is connected to a grounding plate. These components can also be used for power distribution connections at a buss.

26. ELECTRONICS BLOCKS (ELECTRONIC MODULES). Like the feedback bussing blocks, electronic blocks (Figure 12) have one face containing contact cavities. The contact cavities are internally connected by passive electronic components in various combinations. Blocks are normally contained and retained in a rack or mounting bracket.

27. ELECTRONIC IN-LINE JUNCTION (SPLICE). Electronic in line junctions (Figure 13) serve the same function as the standard wire in-line junction except these components have resistor, diode or fuse type components incorporated.

28. SERIES II TJS BLOCK REMOVAL TOOLS. These tools are intended only for the removal of series II TJS blocks. The M81714/69-01 tool (Figure 14) is designed to remove M81714/60 size 22, 20, or 16 blocks and M81714/61 size 16 or 20 blocks from the M81714/67 component rack assembly. The M81714/69-02 tool (Figure 14) is designed to remove M81714/60 size 12 blocks, M81714/61 size 12 or 16 blocks and M81714/62 blocks from M81714/67 component rack assemblies.

29. EXTERNAL CONTACT (Figure 15). Series I blocks require a MIL-C-39029 pin contact and Series II requires a socket contact crimped to the wire. Table 1 specifies the contact types and related conductor size ranges for each series. Table 2 specifies crimp, installing, and removal tools for each series.

30. END SEAL PLUGS (SEALING PLUGS). End seal plugs (Figure 16) are the plastic devices used to seal unused cavities in the grommet of a TJS component. Use Table 3 for the correct end seal plug; to fill cavities left in the grommet. End seal plugs should be installed in all unused contact holes in the grommet to prevent the entrance of moisture, dust or other contaminants. When installed, sealing plugs shall have the knob end protruding out of the grommet wire hole and be seated against the grommet top. Sealing plug knobs always protrude out for module blocks regardless whether unused cavities have unwired contacts or no contacts. Other connector types may require the sealing plug knob to be inserted in the contact cavity.

31. CONTACT PREPARATION AND INSTALLATION IN BLOCK. Prepare the wire, crimp the contact and insert the contact in the block as follows:

a. Strip the wire in accordance with WP 009 00.

b. Crimp the appropriate Series I pin or Series II socket contact, in accordance with WP 013 00, on the appropriate sized conductor specified in Table 1. Use the required crimp tool and positioner specified in Table 2.

c. Insert the contact in the block in accordance with WP 022 00 using the insertion-tool specified in Table 2. For most applications the contact should be inserted after the block is mounted in the track.

d. When required, insert the un-wired spare contacts in the unused contact cavities.

e. Insert the appropriate sealing plug from Table 3 in all unwired cavities in accordance with Figure 16.

f. Removal of contacts is accomplished by reversing steps c through a of above procedure using the contact removal tool specified in Table 2.

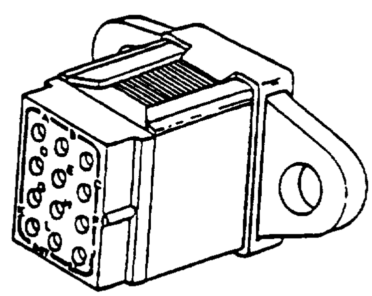

Figure 11. Grounding Block

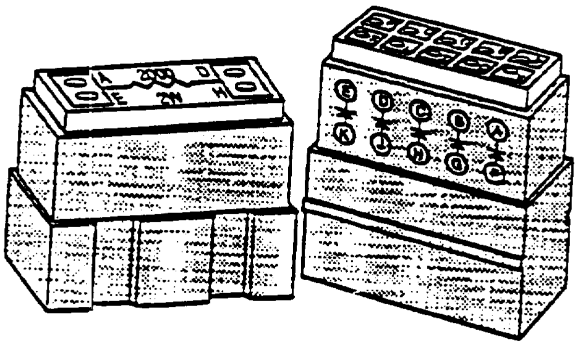

Figure 12. Series I Electronic TJS Blocks

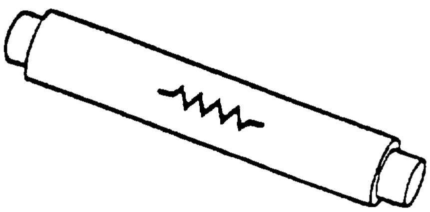

Figure 13. Electronic In-Line Junctions

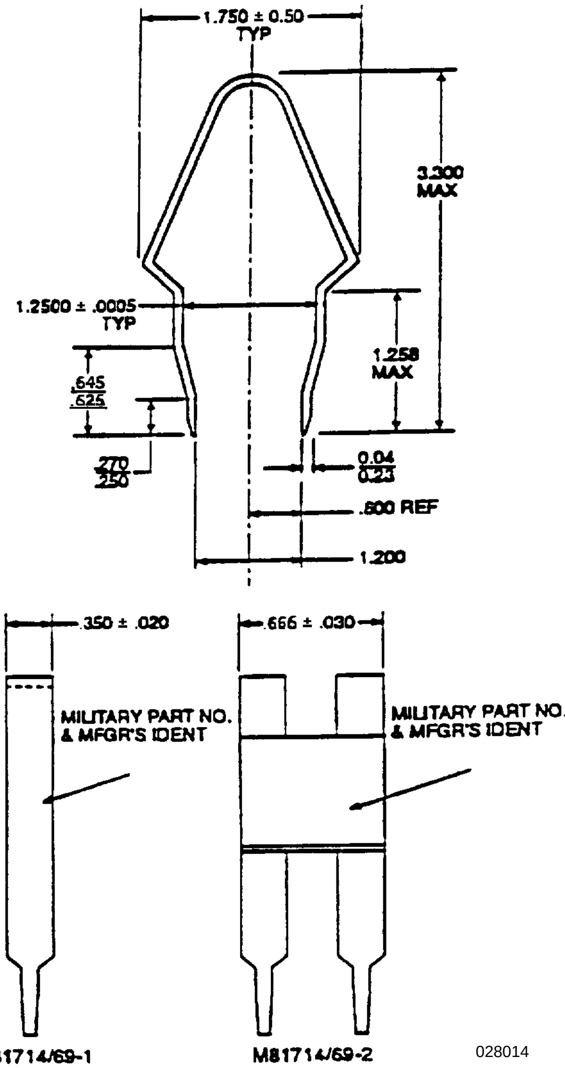

Figure 14. Series II TJS Block Removal Tools

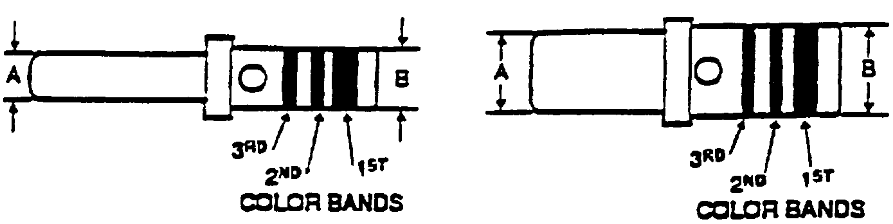

Figure 15. External Contact

Table 1. Contact Data

M39029/1 Contacts (Series I blocks)							
Part No. M39029	Pin Size Mating	Conductor Size (Wire Barrel)	Color Band 1st	2nd	3rd	Diameter (Figures 15) A(max)	B(max)
/1-100	16	26, 24, 22	Brown	Black	Black	.063	.051
/1-101	16	24, 22, 20	Brown	Black	Brown	.063	.078
/1-102	14	20, 18, 16	Brown	Black	Red	.078	.105
/1-103	12	14, 12	Brown	Black	Orange	.095	.153
/1-507	20	28, 26, 24, 22	Green	Black	Violet	.041	.048
M39029/22 Contacts (Series II blocks)							
Part No. M39029	Socket Size Mating	Conductor Size (Wire Barrel)	Color Band 1st	2nd	3rd	Diameter A(max)	B(max)
/22-191	22	26, 24, 22	Brown	White	Brown	.060	.048
/22-192	20	24, 22, 20	Brown	White	Red	.076	.070
/22-193	16	20, 18, 16	Brown	White	Orange	.108	.103
/22-605	12	14, 12	Blue	Black	Green	.168	.152

Table 2. Contacts Tooling

M39029/1 Contacts				
Pin M39029/1	Basic Crimping Tool	Positioner	Installing Tool	Wire Contact Removal Tool
-100	M22520/2-01	M22520/2-11	M81969/14-11	M81969/14-11
-101	M22520/2-01	M22520/2-11	M81969/14-11	M81969/14-11
	M22520/1-01	M22520/1-02	M81969/8-205	M81969/8-206
-102	M22520/1-01	M22520/1-02	M81969/14-03	M81969/14-03
			M81969/8-207	M81969/8-208
-103	M22520/1-01	M22520/1-02	M81969/14-04	M81969/14-04
			M81969/8-209	M81969/8-210
-507	M22520/2-01	M22520/2-32	M81969/14-01	M8I969/14-01
			M81969/8-01	M81969/8-02
M39029/22 Contacts				
Socket M39029/22-	Basic Crimping Tool	Positioner	Installing Tool	Wire Contact Removal Tool
-191	M22520/7-01	M22520/7-11	M81969/16-04	M81969/16-04
-192	M22520/7-01	M22520/7-12	M81969114-11	M81969/14-11
			M81969/8-205	M8196918-206
-193	M22520/7-01	M22520/7-13	M81969/14-03	M81969/14-03
			M81969/8-207	M81969/8-208
-605	M22520/1-01	DMC#TH343	M819691/16-03	M81969/16-03

Table 3. End Seal Plugs

Contact Part Number	Sealing Plug Part Number	Color Code
M39029/1-507	MS27488-22	Black
M39029/1-100	MS27488-20	Red
M39029/1-101	MS27488-20	Red
M39029/1-102	MS27488-16	Blue
M39029/1-103	MS27488-12	Yellow
M39029/22-191	MS27488-22	Black
M39029/22-192	MS27488-20	Red
M39029/22-193	MS27488-16	Blue
M39029/22-605	MS27488-12	Yellow

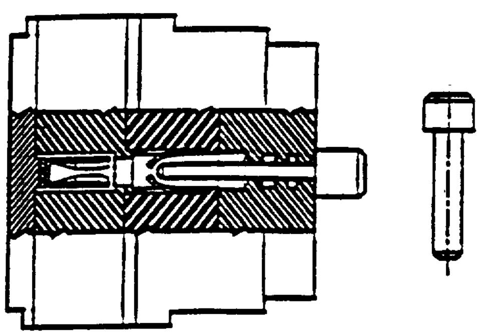

Figure 16. End Seal Plugs

32. SERIES I BLOCK RAIL/BRACKET INSTALLATION AND REMOVAL. Install the blocks in the specified MIL-T-81714 track or bracket as follows (Figures 17 through 21):

a. Loosen screw in locking clamp and slide clamp to end of rail opposite the stop (Figures 17 and 20).

b. Insert block into rail next to locking clamp with block index indicator on grommet on same side as the rail indexing indicators. A block can only be installed one way in the rail (Figures 17 and 20).

c. Slide block against the permanent stop at the opposite end of the rail (Figures 18 and 21).

d. Install additional blocks as required, sliding each block against the last previously installed block (Figures 19 and 21).

e. Slide locking clamp against last block and tighten screw securely (Figures 19 and 21).

f. Rails are secured to equipment on aircraft as specified in the aircraft maintenance manuals. Brackets are mounted on top or side of the block then secured to equipment on aircraft.

g. Removal of blocks is accomplished by reversing the procedure given above.

33. SERIES II BLOCK RAIL/BRACKET INSTALLATION AND REMOVAL. Install the blocks in the specified MIL-T-81714 track or bracket as follows (Figures 22 through 25):

a. Blocks are pressed into the rail as shown in Figure 22. Press the block by hand into the rail until a definite stop is felt. An audible click may be heard.

b. Visually inspect for block clip retention through the inspection windows on the rail (Figure 23).

34. Removal of the blocks requires the tool shown in Figure 14.

a. Slide the double-sided tool down the indents of the block to the maximum depth to unlock the retaining clips (Figure 24).

b. While holding the tool tightly, remove both the tool and block from the rail (Figure 25).

35. Rails are secured to the equipment or aircraft as specified in the aircraft maintenance manual. Brackets are mounted on the top or side of the block then secured to the equipment or aircraft.

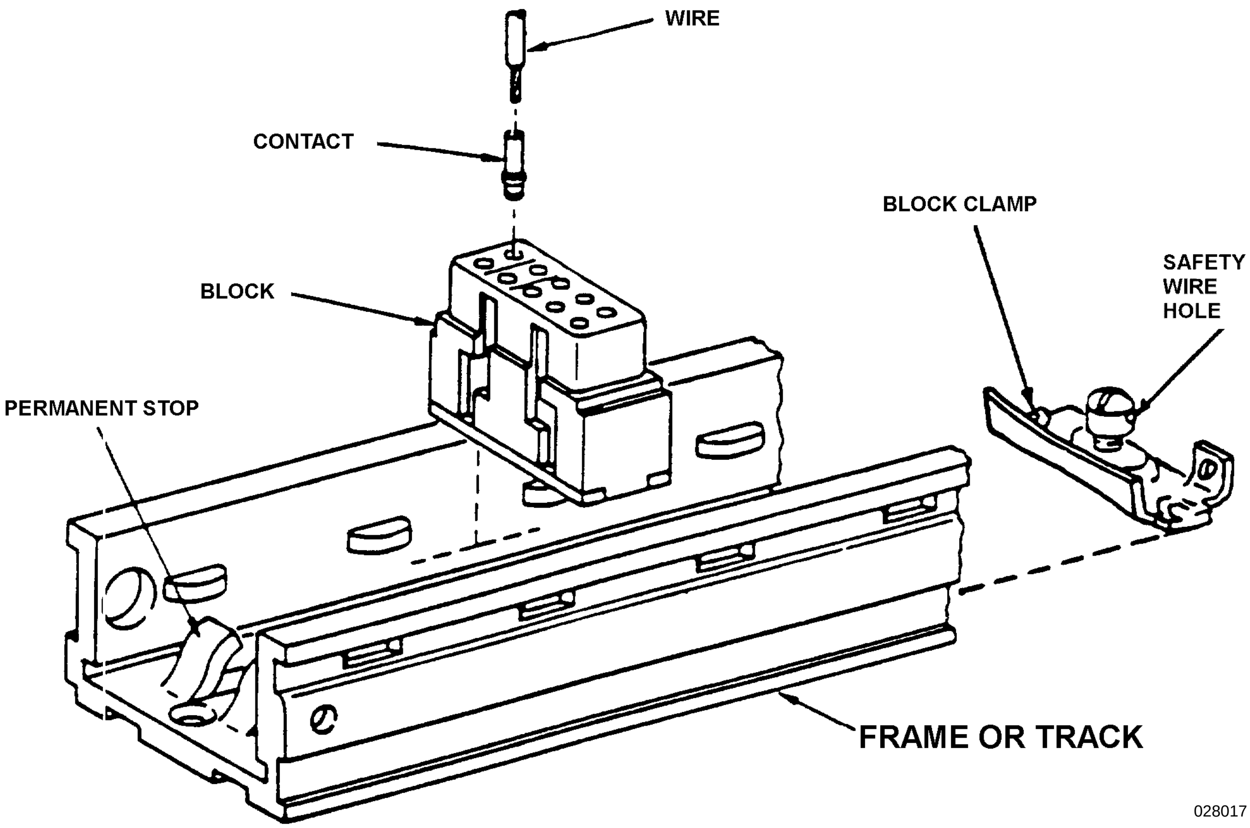

Figure 17. Feedback Terminal Junction Assembly

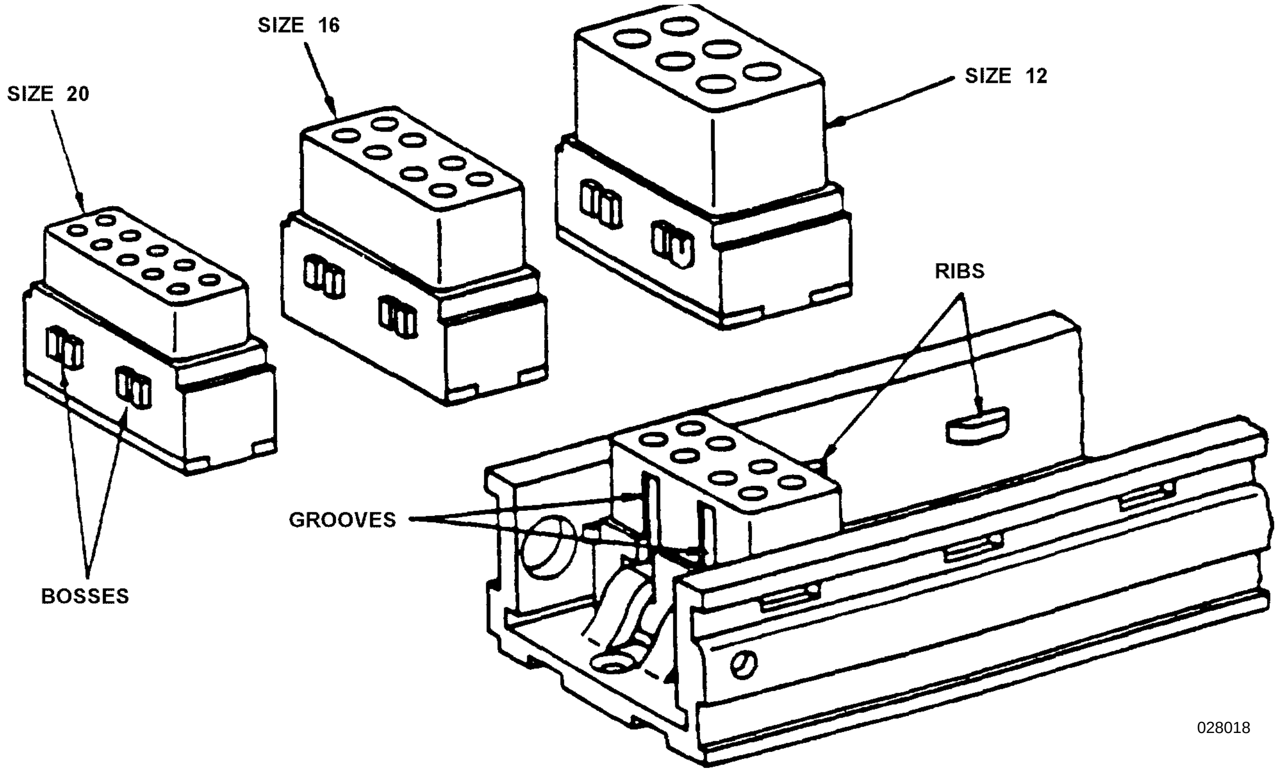

Figure 18. Feedback Terminal Junction Assembly

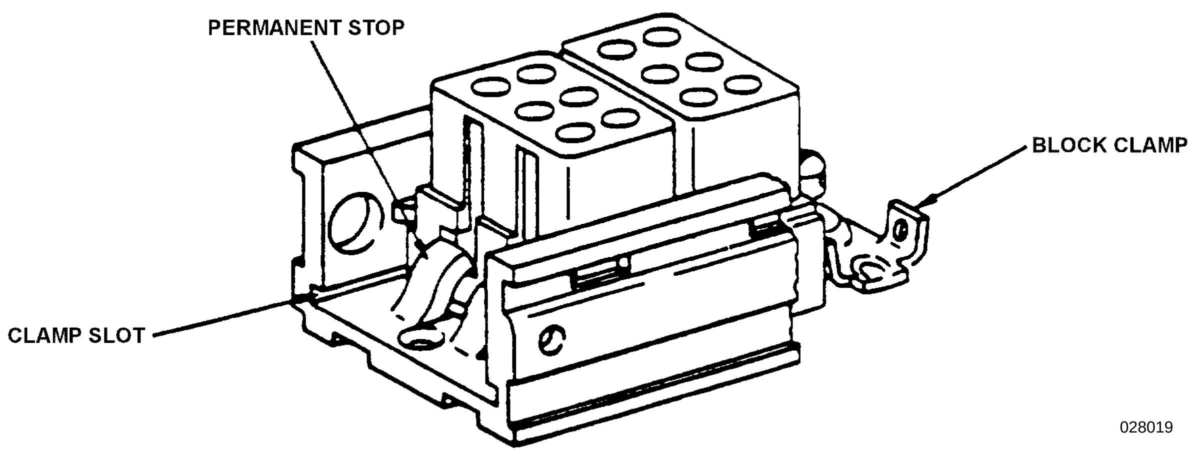

Figure 19. Feedback Terminal Junction Assembly

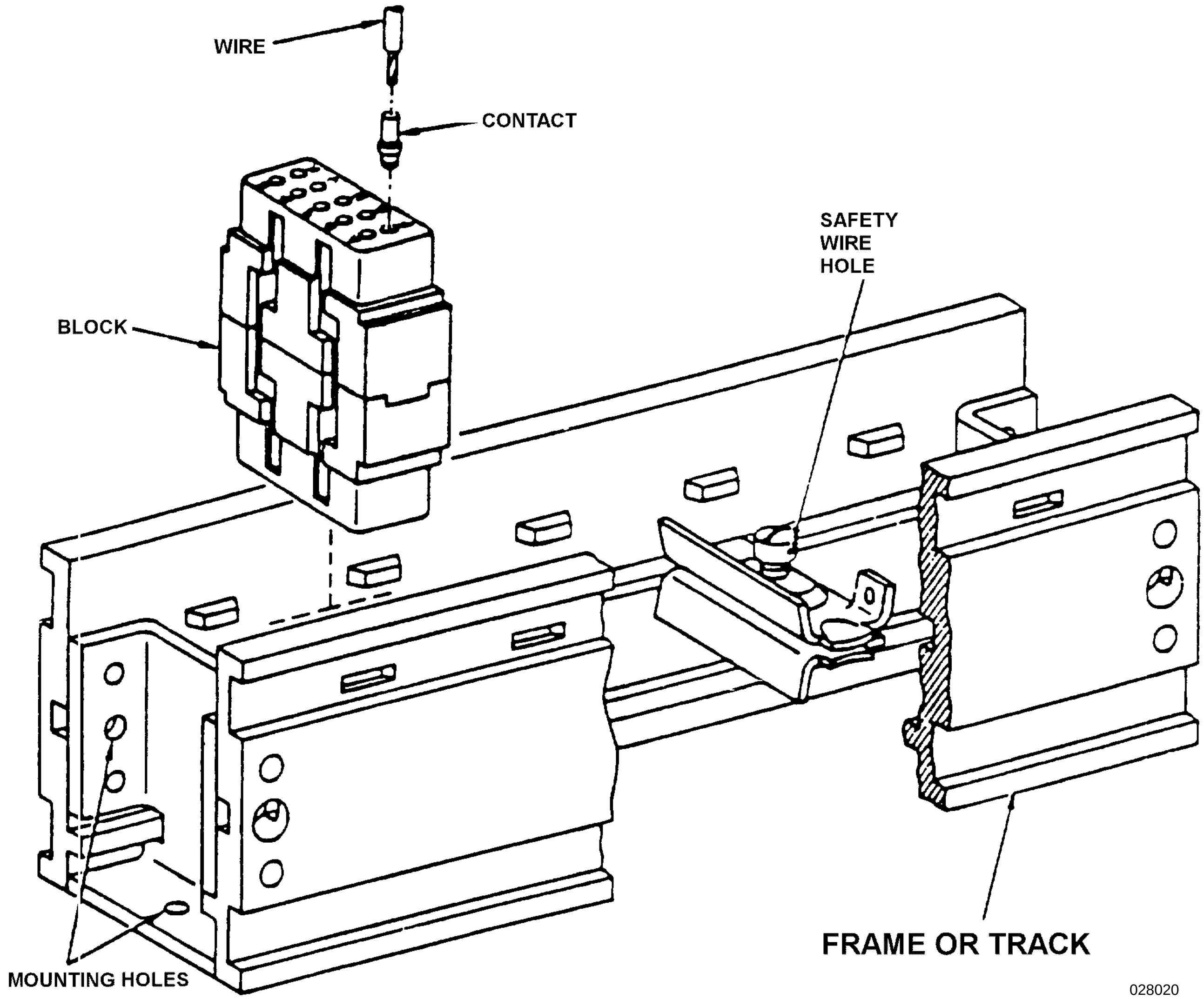

Figure 20. Feedthrough Terminal Assembly (exploded view)

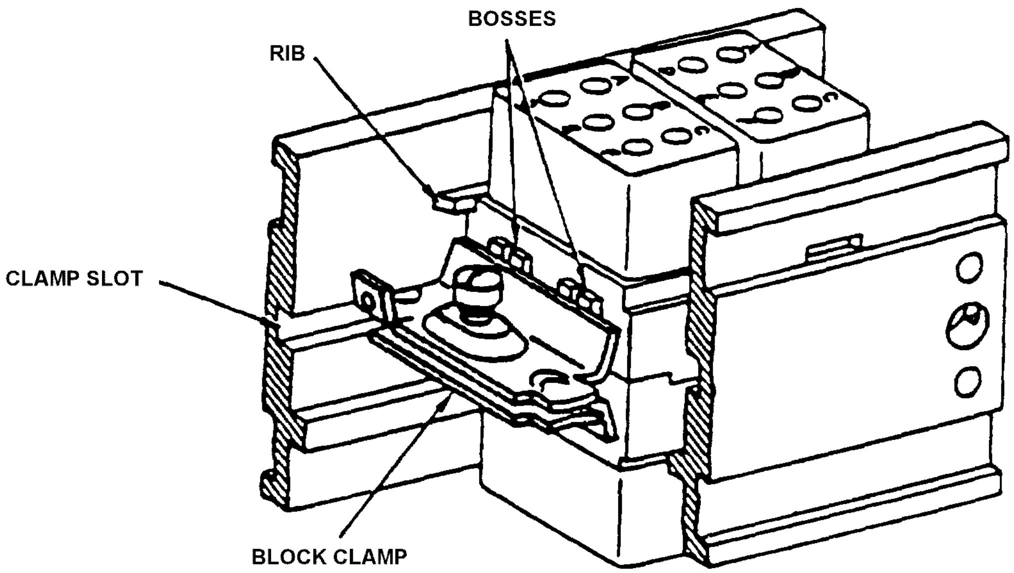

Figure 21. Feedthrough Terminal Assembly

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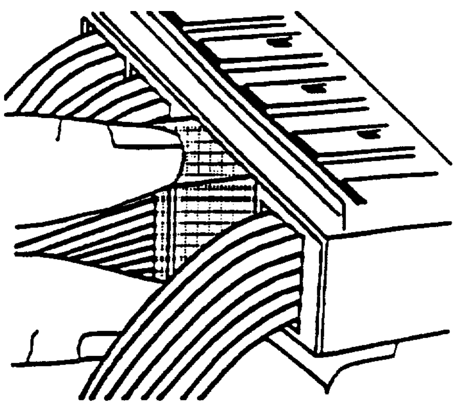

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Figure 22. Series II Assembly

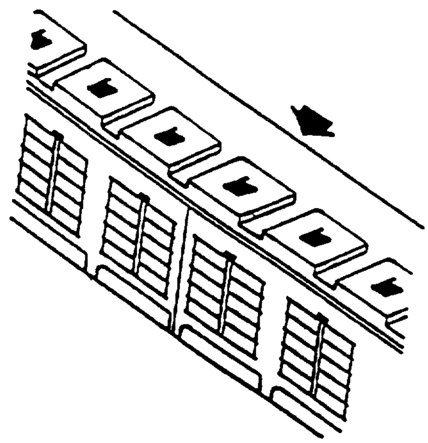

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Figure 23. Series II Rail Inspection Holes

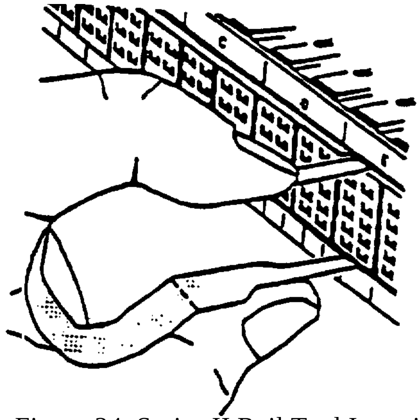

Figure 24. Series II Rail Tool Insertion

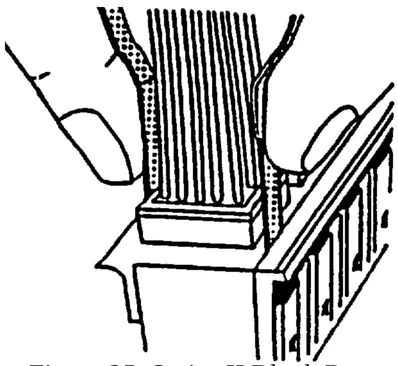

Figure 25. Series II Block Removal

36. GROUNDING STUD INSTALLATIONS. Grounding studs (Figures 26 and 27) are mounted into threaded screw holes on equipment or aircraft grounding surfaces. The studs are mounted as follows:

a. Screw the grounding stud in the threaded grounding hole using the hex wrench specified in Table 4. The Series I and II grounding studs are not interchangeable. Be sure the Series II stud has the flat washer on the stud shaft (Figure 27).

b. Firmly tighten the stud to the grounding surface with the wrench. Apply the wrench to the Series I terminal stud nut (Figure 26) or the Series II housing (Figure 27). Do not tighten the stud beyond 25 inch pounds.

c. Reverse the above procedure for removal of the grounding stud.

37. GROUNDING BLOCK INSTALLATION. Grounding blocks (Figures 28 and 29) are mounted into through holes on equipment or aircraft grounding surfaces. The blocks are mounted as follows:

NOTE

The Series I and Series II grounding blocks are not interchangeable.

a. Insert the grounding block into the hole then mount the flat washer followed by the lock washer then the hex nut to the stud.

b. Hand tighten the nut then using a 3/8 inch socket tighten the nut to 25 inch pounds. A 3/8 wrench may be used in confined locations, but caution must be taken not to over torque the nut.

Table 4. Hex Wrench Sizes

Series I Studs	Hex Wrench Size (inches)
M81714/15-22	5/16
-20	5/16
-16	3/8
-12	3/8
Series II Studs	**Hex Wrench Size (inches)**
M81714/64-22	3/16
-20	3/16
-16	1/4
-12	5/16

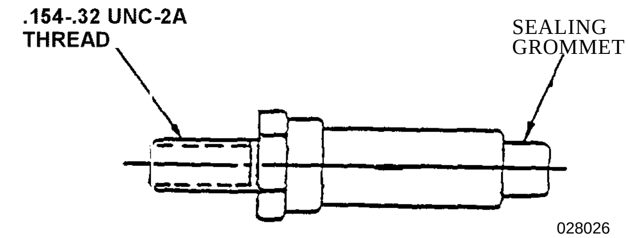

Figure 26. Series I Grounding Stud

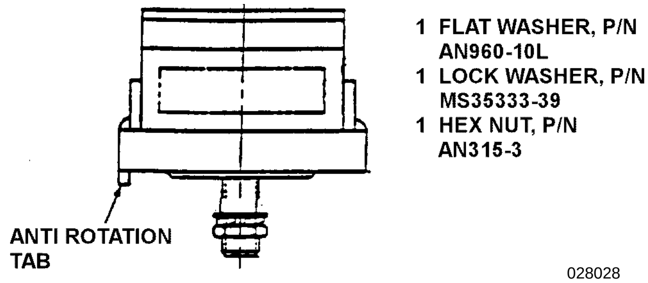

Figure 28. Series I Grounding Block

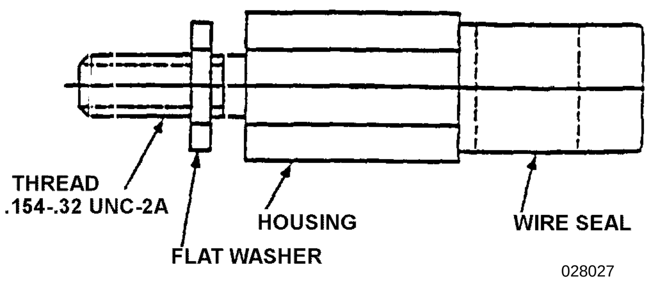

Figure 27. Series II Grounding Stud

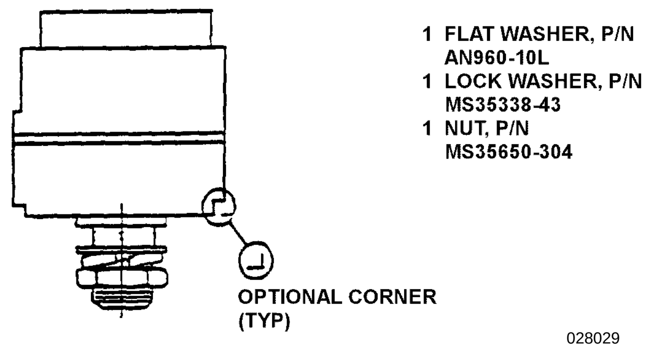

Figure 29. Series II Grounding Block

PROTECTIVE DEVICES

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Wire and Cable Stripping	009 00
Circuit Breaker, Aircraft, Trip Free, Push–Pull, 1/2–20 Amp, Type 1, –55 to +121 Deg. C.	AS32201
Fuse, Limiter Type, Enclosed Link, 5–60 Amp, Aircraft	MS28937
Fuse, Current Limiter Type, Aircraft	MIL–F–5372
Fuse, Instrument Type	MIL–F–23419
Fuseholders, Block Type, Aircraft	MIL–F–5373
Fuseholders, Extractor Post Type, Blown Fuse Indicating and Nonindicating	MIL–F–19207
Fuses; Instrument, Power and Telephone	MIL–F–15160

Alphabetical Index

Alphabetical Index (Cont)

Record of Applicable Technical Directives

None

Support Equipment

Nomenclature	Part Number/Type Designation
Screwdriver, Torque Limiting	—
Wrench, Torque Limiting Socket	—

Materials Required

None

1. **INTRODUCTION**.

2. This work package (WP) describes the circuit breaker, fuses and limiters for use in the circuitry of aerospace vehicles.

3. **PROTECTIVE DEVICES.** Protective devices are items of electrical equipment such as circuit breakers, fuses, etc., installed in aircraft to protect the electrical system against overloads caused by short circuits or other faults. Protective devices for wired-in equipment shall be connected to the load side of the equipment power switch (main circuit power disconnect). The protective device may be on the line side or the load side of the equipment on-off switch. If possible, mount protective devices in junction boxes or protected areas. If this is not possible, and the devices are to be installed in locations where they may be subject to damage or where the terminals may be dangerous to the personnel, provide a cover to go over the protective device.

4. **AIRCRAFT CIRCUIT BREAKER PROTECTION.**

5. A circuit breaker is used to help provide automatic protection that will limit an electrical fault to a single circuit. It minimizes the danger of smoke and fire to components. Its primary function, however, is to minimize the danger of smoke and fire to the conductors (or cables) leading to and from components. It isolates the fault from the power source so that the non-faulted circuits can be kept functioning in a normal manner. This may not always be achieved by a single circuit breaker, but by a combination of devices, wire size, and routing.

6. **PRACTICAL OVERCURRENT CONCEPTS**. There are two basic principles in use for the protection of electrical and electronic equipment from failures caused by current overloads:

7. **Current Sensing.** The current sensing principle is found in devices such as magnetic or fully ambient compensated circuit breakers. In some applications, practical considerations make it necessary for the circuit breaker and wire to be in entirely different ambient temperatures. In this case it may be necessary to use an ambient insensitive circuit breaker and apply it on the basis of maximum temperature rise expected at any point in the circuit. Increases in the ambient temperature around the circuit breaker will reduce its current trip level.

8. **Combined Current and Temperature Sensing.** Some thermal circuit breakers not only anticipate thermal failures due to overcurrent, but also compensate for variations in the ambient temperature. This compensation helps the circuit breaker follow the changes in wire current carrying capacity due to ambient temperature. These circuit breakers may be located in the same ambient temperature as the wire. They are selected to match the thermal characteristics of the wire being protected.

9. **EXTENT OF CIRCUIT PROTECTION**. Equipment and component protection should receive separate consideration. Any protection provided by the circuit breaker is incidental and must not compromise the prime intention of protecting the wiring.

10. **DESCRIPTION**.

11. **INTRODUCTION**. In its simplest form, the circuit breaker is a device to open and close an electrical circuit by non-automatic means, and to open the current automatically on a predetermined overload of current, without injury to itself, when properly applied within its rating. Two most common types of circuit breakers are magnetic and thermal. A protective device is chosen with the lowest rating that will not open inadvertently. It must interrupt the fault or overload current disconnecting the faulted line from the power distribution system before the wire insulation is destroyed. Circuit breakers will be applied within the electrical rating,

environmental conditions, and other parameters as described in the applicable Military Specification.

12. **CLASSIFICATION OF CIRCUIT BREAKERS**.

13. **THERMAL**. Thermal circuit breakers generally operate dependent on the heating and subsequent deflection of a bimetallic thermostatic element due to the fault current (resistance heating). Some devices operate with the thermal expansion of a strand wire. Some devices may compensate for ambient temperatures. Thermal circuit breakers are generally not as affected by the start up surges and brief transients as many other devices. Figure 1 shows a typical circuit breaker.

14. **THERMAL-MAGNETIC ASSIST**. Thermal circuit breakers may also include a magnetic assist mechanism used only on high current overloads. However, due to their operating principles, thermal circuit breakers inherently produce less magnetic field interference than magnetic circuit breakers.

15. **MAGNETIC**. Magnetic circuit breakers generally operate using the solenoid principle, where a moveable piece held with a spring may be moved by the magnetic field of a coil energized by the fault current. Some devices may compensate for ambient temperatures. Magnetic circuit breakers often have an instantaneous trip feature that functions during high current overloads. Normally, magnetic circuit breakers are used on the type of current for which they are calibrated.

16. **REMOTE CONTROL CIRCUIT BREAKERS. (RCCB).** These circuit breakers combine the features of a relay (contactor) and circuit breaker. This permits location near the load or power source and control from a remote location such as a cockpit. Control wiring may therefore be of light gauge.

17. **ELECTROMAGNETIC POWER CONTROLLER (EMPC)**. This type of circuit breaker is considered to be electronically controlled, incorporating circuit protection, relay and switch features in a single device. An EMPC is a device that utilizes a solid state sensing mechanism for overcurrent protection. The EMPC may also use solid state switches in combination with discrete contacts to switch the load.

18. **SOLID STATE POWER CONTROLLER (SSPC)**. An SSPC is generally considered to be electronically controlled, incorporating circuit protection, relay and switch features in a single device. A SSPC is a device that uses a solid state sensing mechanism for overcurrent protection, and a solid state switching mechanism, employing electromechanical parts.

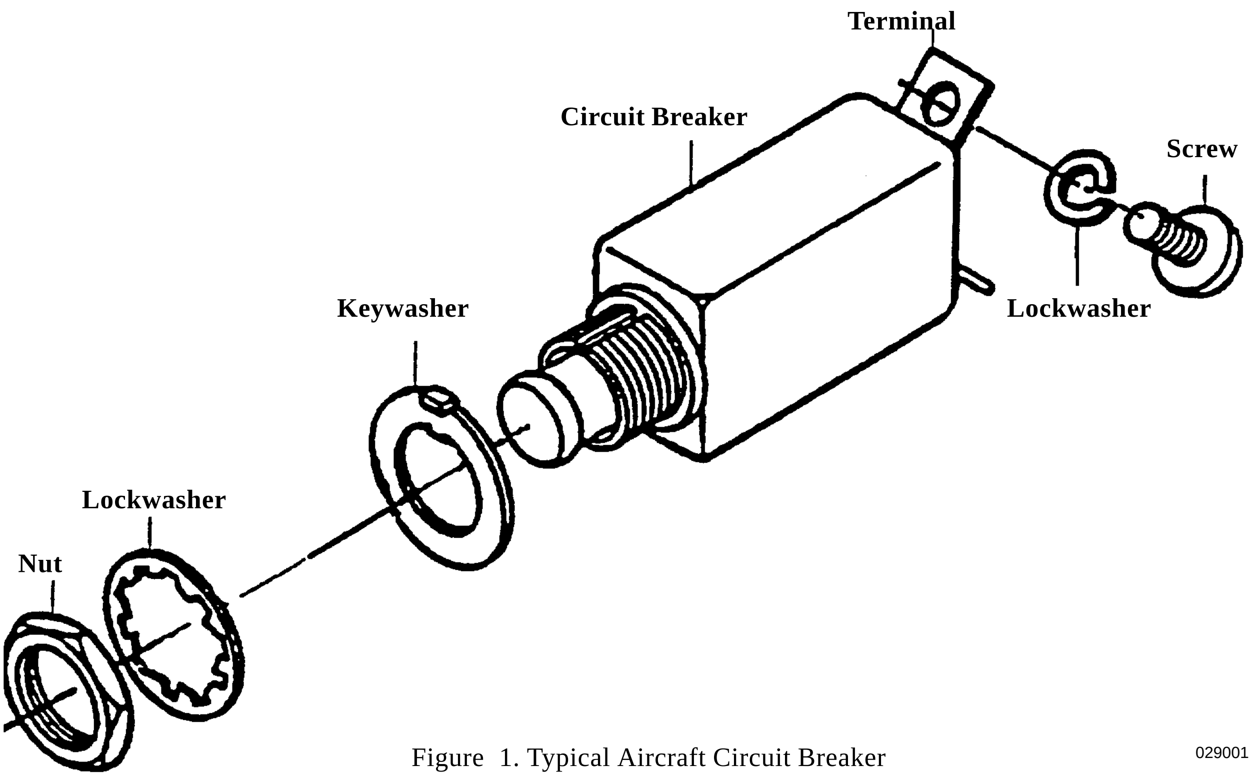

Figure 1. Typical Aircraft Circuit Breaker

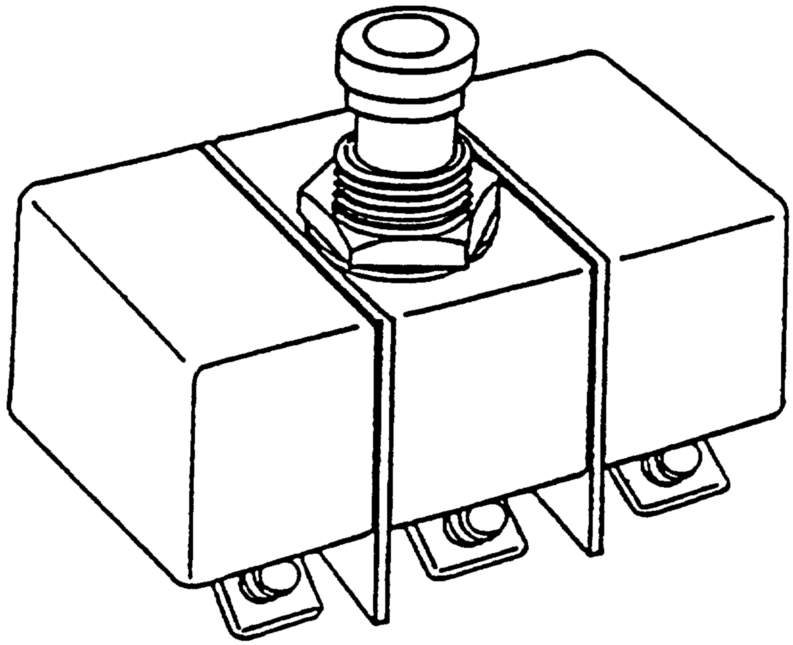

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Figure 2. Typical 3–phase Circuit Breaker

19. **SPECIAL FEATURES**. Certain features may be incorporated into several classifications of circuit breakers, depending on the particular specification.

20. **Multipole.** A multi-phase circuit breaker has two or more poles controlled by a single-actuating member. It may be used on a multi-phase circuit such that an overload on an individual phase will cause the circuit breaker to open all phases of the circuit. Usually, operating limits and performances are different than single phase circuit breakers. Figure 2 shows a typical multi-phase circuit breaker.

21. **High Vibration.** Circuit breakers identified with a V suffix on the MS specification and ID markings have been designed to operate in a high sine vibration environment. Those additionally identified with a C through K suffix on the MS specification and ID markings have been designed to operate in a random vibration environment.

CAUTION

Some care should be taken to reduce the possibility of extreme side forces on the buttons.

22. **Long Pushbuttons.** Some circuit breakers may have longer push buttons than others. These may be identified with an L suffix on the specification and ID markings.

23. **Sealed.** Sealed circuit breakers may be of any type. They are usually sealed against adverse environments and are generally restricted to use on lower power circuits. Non-sealed circuit breakers provide for higher power requirements, but are more restricted as to environment. It is important to handle them carefully so as not to damage the seal.

24. **P Bracket.** Circuit breakers with a special P cover plate mounting bracket are identified with a P suffix on the specification and ID markings. They require different mounting hardware from non-P marked circuit breakers of the same type.

25. **AMPERE RATING**.

26. **DEFINITION**. The nameplate current rating of most circuit breakers is a nominal rating for device identification. The actual usable rating for a particular application may be considerably different from the nameplate rating. The time-current characteristics of the circuit breaker are compared to the time current characteristics (including starting or overload surges) of the equipment, component, and wire. Refer to Safety Factors paragraph 28.

27. **ORIENTATION**. The nominal ampere rating of the circuit breaker is generally marked on the actuator (push button) of the circuit breaker. The ampere rating number is oriented to maximize readability by the user.

28. **SAFETY FACTOR** Safety factor is the value above the steady state application current that helps to ensure

that the circuit breaker will handle the application without nuisance trips. Typically a circuit breaker is specified to operate continuously at no more than approximately 80 percent of its nominal rating. This provides a safety factor of 20 percent. Different factors may apply at different ambient temperatures and altitudes.

29. **IDENTIFICATION MARKINGS.** All circuit breakers are permanently and legibly marked. These markings will be resistant to most aircraft fluids. Markings generally include a part number, ampere rating and manufacturers date code.

30. **PART NUMBERS SCHEME FOR CIRCUIT BREAKERS.** The following part numbering example for circuit breakers will typically apply:

MS 3320-D 5 A V L

Where:

MS 3320 is the military designation.
D is the random vibration capability.
5 is the ampere rating.
A is for auxiliary terminals.
V is the high sine vibration capability.
L is the pushbutton type.

31. **TERMINALS**

32. **Line** The line side terminal of a circuit breaker is connected to the power source, or to the power source of the electrical system. This terminal may be connected to any bus bar feed system where the system is used.

33. **Load** The load side terminal of the circuit breaker is connected to the load, or to the load side of the electrical system.

34. **SOLID CONNECTIONS.** A solid electrical and mechanical connection of the wire to the circuit breaker is critical for the operation of the breaker. A loose or minimal wire connection can cause increased circuit resistance and create heat. Wire heating near the circuit breaker terminals can cause premature tripping or failure of the breaker. It is equally important to use correct specified size and type of termination, that it be free of corrosion and properly attached.

35. **Markings.** Terminals may be marked LINE or LOAD, 1 or 2, etc., as called out in the circuit breaker specification. It is important that the terminals are wired correctly according to their markings. Circuit breakers with unmarked terminals may or may not have a preferred line or load wiring. Multiphase circuit breakers may have sets of terminals for individual phases or circuits marked A, B, C, etc.

36. **Hardware.** Most terminals are threaded for a specified screw or bolt. It is important to use the specified hardware. Terminal screws that are too short may not hold the terminations properly. Screws that are too long may interfere with or damage the breaker case. Incorrect hardware may also produce excessive, damaging torque.

37. **Captive Nuts.** When available, captive nuts will be solidly attached to the terminals.

CAUTION

The mounting tab should not be used as an anti-rotation tab, as it is not designed to resist the torque that may be transmitted due to rotation of the mounting nut, terminals, or circuit breaker body.

38. **Mounting Tabs.** Mounting Tabs are found on most circuit breakers, and are also called mounting keys. They orient the circuit breaker about the Z-axis through the panel hole.

39. **TRIP BARS.** Trip bars may be used to externally connect the buttons of several circuit breakers, so that they operate together.

40. **OPERATION**

41. The following paragraphs contact information on how circuit breakers may be used, not used, and possible concerns during their lifetime.

42. **AS A SWITCH.** Normally, a circuit breaker should not be used as a switch. Most circuit breakers have a life expectancy of 1/10 or less of the life of a switch. They are not usually snap-action devices and should not be considered as substitutes for switches, unless defined as such in the particular specification. Refer to paragraph 45.

CAUTION

Excessive force, often by using tools to pull the button, can cause hidden damage to the mechanism.

43. **OPENING**. Only reasonable force should be used to open the contacts of a circuit breaker, normally much less than 25 pounds.

44. **RESETTING**. Only reasonable force should be used to reset a circuit breaker, generally less than 25 pounds. They should not be reset by impact. Excessive force can cause hidden damage to the mechanism. Resetting a breaker once may not be a problem, but

it should not be held in the set position or repeatedly reset in an effort to get a system to work. Circuit breakers are designed to open if there is an overcurrent. condition. Repeated resetting into an overload condition may allow too much current through the wire, connectors, and the breaker itself.

CAUTION

Teasing should be avoided to reduce contact pitting, wear and arcing and to increase the life of the circuit breaker.

45. **TEASING**. Teasing is the slow action of opening or closing a circuit breaker actuator (push-button, toggle, etc.), such that the contacts come in close proximity to each other without engaging the latching mechanism. This action will cause an arc to be drawn across the gap between the contacts, without physically mating or touching each other.

46. **CHANGE IN CHARACTERISTICS.** The operating characteristics of a circuit breaker may change over the life of the device. Heavy fault currents may degrade the current overload sensor. Excessive manual operation may cause dynamic wear of the latching mechanism. Even a circuit breaker that has been dormant for a long period of time may change due to internal spring forces and static wear. This may be reduced by periodic manual operation of the breaker. A suspect breaker should always be replaced.

47. **AIRCRAFT COMPONENTS**

48. The following paragraphs contain information on aircraft parts and components that may have an effect on circuit breakers or their installation.

49. **MOUNTING PANELS**. The spacing of mounting holes for circuit breakers are to be properly spaced to allow sufficient space between successive circuit breakers, in both vertical and horizontal directions. This is important for thermal, dielectric and mechanical reasons.

50. **BOOTS**. Boots may be part of the mounting nut, separate from the nut, or integral to the push-button. Boots protect the circuit breaker and/or seal the panel from environmental conditions.

51. **WIRES**. The aircraft wires form an inherent part of thermally activated circuit breakers. Wires and connection both transfer and produce heat that may affect the calibration of the circuit breaker. Wires are kept as far as possible from the body of the circuit breaker behind the panel.

CAUTION

Mechanical force of bending on the terminals should also be considered when routing larger wires.

52. **WIRE GAUGE**. Wires must be of the correct specified size for the particular circuit breaker. Failure to size the wire properly may adversely affect the operating characteristics of the circuit breaker.

53. **INSULATION**. Wire insulation should be of the proper, specified type for the application. Insulation should not be allowed to touch the case of the circuit breaker. Insulation should be visually examined for cracks, burn marks and other defects (paragraph 58).

54. **CRIMPING**. Wires should be stripped and crimped using procedures in WP 009 00.

55. **REPAIR.**

56. **CIRCUIT BREAKER REPAIR**. Most circuit breakers are consumable items and source coded PAOZZ. Only replacements are authorized in the fleet.

57. **EVALUATION**. In some cases a circuit breaker may have to be removed for evaluation. If possible, records of the events leading up to the removal of the circuit breaker should be included. If evaluation of operational characteristics is to be performed, it is most important that the circuit breaker not be operated and the case not be opened before returning it for evaluation.

58. **REMOVAL AND INSTALLATION.**

59. Perform the procedure in Figure 3 for the installation and removal of circuit breakers in aircraft panels.

WARNING

To prevent electrical shock, ensure electrical power is off before commencing work.

To prevent fire and damage to electrical equipment, do not replace a circuit breaker with one of a higher amperage rating.

60. **REMOVAL**.

a. Verify all electrical power is off and batteries are disconnected.

b. If a boot is present, carefully remove without damaging. If the boot cannot be removed, carefully pass the boot through the panel-mounting hole. Care should be taken not to puncture or otherwise damage the boot.

c. Remove nut (1), (Figure 3) and lockwasher (2) securing circuit breaker (5) to panel (3). Remove circuit breaker and key washer (4).

d. Remove screws (7). lockwashers (8), and terminals (6) from circuit breaker.

e. Tag and cover terminals with silicone tape.

61. **INSPECTION**. Inspect the circuit breaker being installed for the correct amperage.

WARNING

To prevent electrical shock, ensure electrical power is off before commencing work.

To prevent fire and damage to electrical equipment, do not replace a circuit breaker with one of a higher amperage rating.

A torque limiting screwdriver and socket wrench should be used to minimize torque damage.

62. **INSTALLATION**.

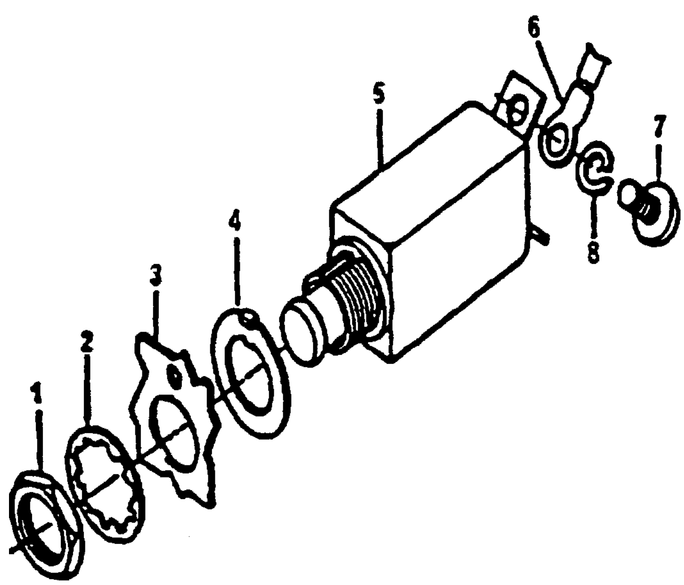
a. Verify all electrical power is off and batteries are disconnected.

b. Remove silicone tape from terminals.

WARNING

Be sure line and load side to termination are connected (paragraphs 30 through 32).

c. Install terminals (6), (Figure 3) on circuit breaker (5) and secure with lockwashers (8) and screws (7). Remove tags.



1. NUT
2. LOCKWASHER
3. PANEL
4. KEYWASHER
5. CIRCUIT BREAKER
6. TERMINAL
7. SCREW
8. LOCKWASHER

Figure 3. Circuit Breaker Installation

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d. Place keywasher (4) on circuit breaker and insert through rear of panel (3). Secure with lockwasher (2) and nut (1). The circuit breaker must be held to prevent rotation while tightening the nuts to prevent strain on the mounting key.

e. If required, perform electrical check in accordance with the applicable NAVAIR manual.

63. **AIRCRAFT USE PROTECTION.**

64. **GENERAL** A fuse is a device that protects a circuit by the melting of its current responsive element when an overcurrent passes through it. Fuses are available in a variety of characteristics to meet the requirements of the circuit designer.

65. **CLASSIFICATION OF FUSES.**

66. **NORMAL**. This type of fuse is often referred to as a “normal opening” fuse and may or may not be current limiting. Normal fuses contain single elements and possess a time-current characteristic curve that is essentially a smooth curve with no discontinuities. Figure 4 shows a typical aircraft fuse.

67. **TIME–DELAY**. Time-delay fuses also may or may not be current limiting. The fuses are often referred to as “dual-element” fuses in that they possess two elements thermal cutout with very high time-lag characteristics which handles harmless transient overloads and blows on continuous light overloads, plus a short-circuit element which blows on heavy overloads and short circuits. The thermal cutout is designed to pass momentary surges such as motor starting transients and switching transients. The time-current characteristics of the time delay fuse show a non-uniform curve with considerable time lag.

68. **VERY FAST ACTING**. These fuses do not possess time-delay features as they are designed to be extremely fast under short-circuit conditions. Very fast-acting fuses are designed to protect semiconductor rectifiers because of their speed of response to overcurrent. These fuses also may or may not be current limiting.

69. **CURRENT LIMITING**. The ability of a fuse to fit into this category depends upon its short-circuit performance. Current limitation is defined as the degree of current-limiting ability a fuse possesses under short-circuit conditions. To be current-limiting, the fuse, under specific short-circuit conditions, must limit the instantaneous peak current to a value less than that which would flow if the fuse were not in the circuit, and it must clear the fault within one-half cycle.

70. **PART NUMBERING SCHEME**. The following part numbering example for fuses will typically apply:

FM08A125V1/2A*

Where:

FM08 is the fuse style.
A OR B is the characteristic.
125V is the voltage rating.
1/2A is the current rating.
* indicates an optional finish.

71. **DEFINITIONS AND DESCRIPTIONS.**

a. Fuse Types and Styles. Fuse types and styles refer to the construction (physical makeup and material) and dimensions of fuses. For example, cartridge fuse mountings may be either knife blade or ferrule type, and the fuse link may be bead, bridge, or some other type of construction. The body of the fuse can be made of glass, ceramic, fiber, or other non–conducting material. To distinguish one type or style from another, the manufacturer usually stamps each fuse with a specific type or style designation. Some common commercial fuse–type designations are MKB, ACX, 3AG, and 3AB; and a few typical military fuse–style designations are F02, F03, and FM09. Each fuse type or fuse style designation denotes a given construction and dimension.

b. Dimensions. Dimensions refer to the length and width (or diameter) of a fuse. The fuse selected for replacement purposes should be one that properly fits into the fuse holder. However, selection of a fuse should not be limited to physical size because it may differ in current, voltage, or blowtime characteristics.

c. Current Rating. The current rating is the most commonly used fuse rating. Current ratings are always designated in terms of amperes and may range from 0.002 ampere for sensitive instruments to 600 amperes for high power applications. The current rating indicates the highest value of current that the fuse can carry indefinitely without blowing. Because fuses are the ”Safety–Valves of electrical circuits”, it is important to replace a blown fuse with a fuse that has identical fuse current ratings or those required by the design of the equipment.

d. Blowtime Characteristics (General). Time and current are the important factors in the operation of a fuse. There is a time and current relationship at which a fuse will operate satisfactorily and will not blow, and still another time and current relationship at which the fuse will blow. The length of time that a fuse carries a quantity of current above its rated value before blowing is known as the blowtime characteristic. Some fuses are designed to blow rapidly at certain percent–ages of overloads; other fuses are designed to carry slight overloads for hours without blowing. Still others are designed to handle large surges of current for short periods of time without blowing, and yet protect equipment against excessive current resulting from short circuits or continued overloads. The blowtime characteristics are extremely important. Slow blow fuses will not be substituted for fast blow fuses. Temporary substitution of fast blow fuses for slow blow fuses is allowed.

(1) Blowtime Characteristics (Commercial). Most commercial fuses fall into one of the following basic types of blowtime characteristics: fast blowing, medium blowing, or slow blowing. Other commercial trade names are as follows:

Fast–Blowing	Medium–Blowing	Slow–Blowing
Quick–Blowing	Medium–Acting	Slow–Acting
Instant–Blowing	Medium–Lag	Time–Delay
Fast–Acting		

NOTE

Basic Construction (see Figure ???, views A, B, and C).

(2) Blowtime Characteristics (Military). The blowtime characteristics of military fuses are classified on the basis of the amount of current (above that of the actual current rating) that they can safely interrupt, and on their ability to withstand momentary surges of current. All military fuses (fuses manufactured under Military Specification) fall into one of the blowtime characteristics in Table 18–1. Notice that in addition to blowtime characteristics, Table 18–1 lists the characteristic symbols that are stamped on military fuses and the distinguishing properties.

e. Voltage Rating. The fuse voltage rating is the highest voltage at which the fuse can safely interrupt its maxi–mum short circuit current. Since the fuse voltage rating is a design characteristic and is independent of the steady–state, in–circuit voltage, a higher voltage rated fuse may be substituted for a lower voltage rated fuse.

NOTE

It is not permissible to substitute a lower voltage rated fuse for a higher voltage rated fuse. The current rating of the fuse shall not exceed the maximum current rating of the circuit.

72. **FUSES**

73. Fuses used in aircraft are of two types: the cartridge type, installed in the electrical system in an extractor post style fuseholder or in fuse clips; and the enclosed link type (current limiter) installed in a block type fuseholder (seeFigure 18–2). Fuses commonly used in aircraft electrical systems are listed in Table 18–2 by detailed Military Specifications and Military Standard Drawings and in Table 18–3, which lists cross reference from old military designation to new military designation with superseded commercial equivalent.

74. **FUSEHOLDERS**.

75. Extractor post fuseholders in accordance with Military Specification MIL–F–19207 are used in conjunction with cartridge type fuses. Block type fuseholders in accordance with Military Specification MIL–F–5373 are used with enclosed link fuses (see Figure ?).

Table 1. Military Fuse Blowtime Characteristics

Fuse Blowtime Characteristics	Characteristics Symbols	Current–Interrupting Capacity	Distinguishing Properties
Fast Blowing	A	Normal	1. Used in circuits capable of delivering low values of current. Blow instantly at low values of short–circuit current. 2. Intended for general circuit protection.
Time–Lag	B	(Slow–Blow Fuse)	1. These fuses have a built–in delay period. 2. Used in circuits where allowances must be made for momentary surges of current.
Normal–Blowing	C	Very High	1. Used in circuits capable of delivering high values of current. Blow instantly at extremely high values of short circuit current. 2. Intended for general circuit protection

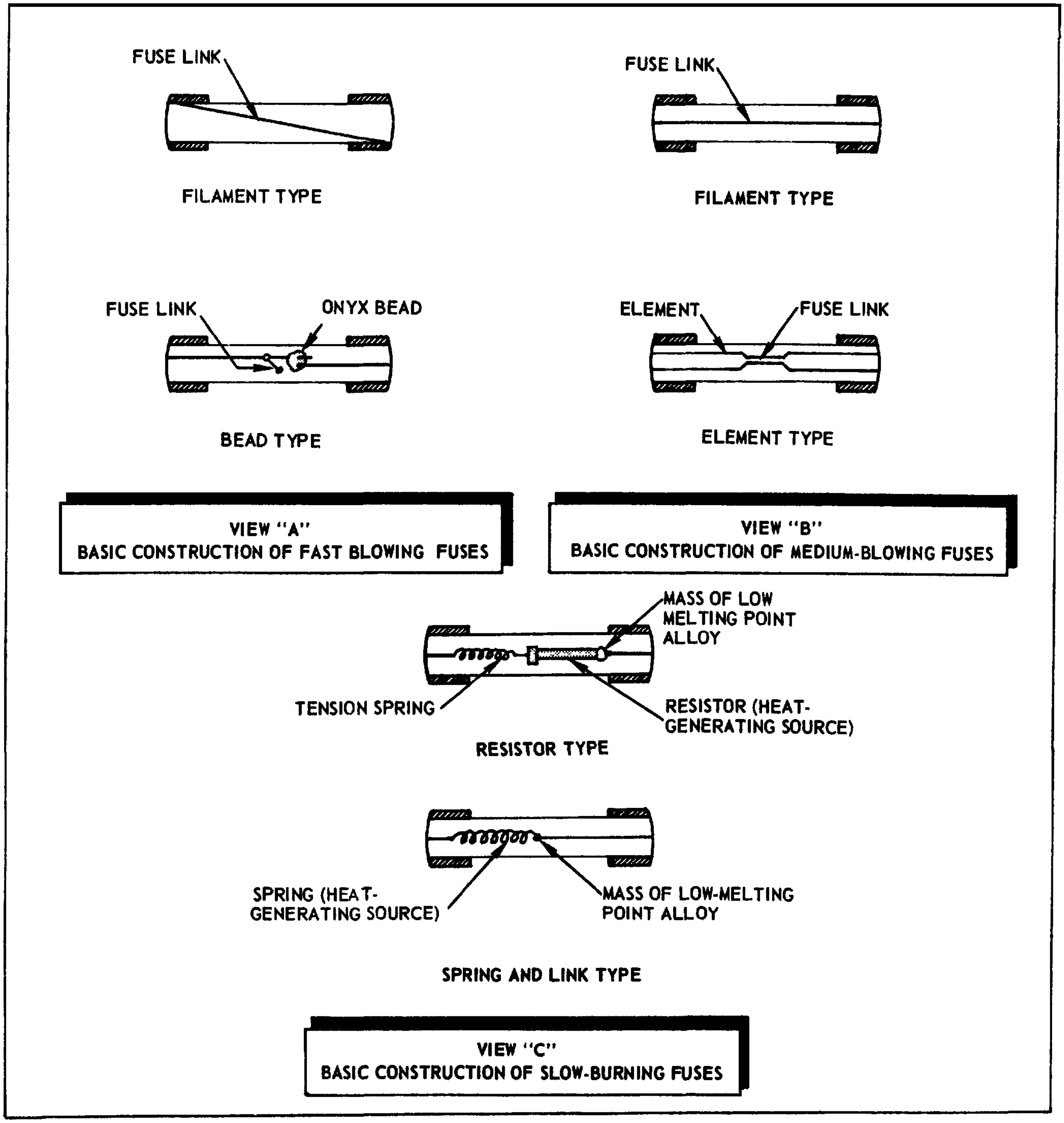

Figure 4. Basic Construction, Views A, B, and C

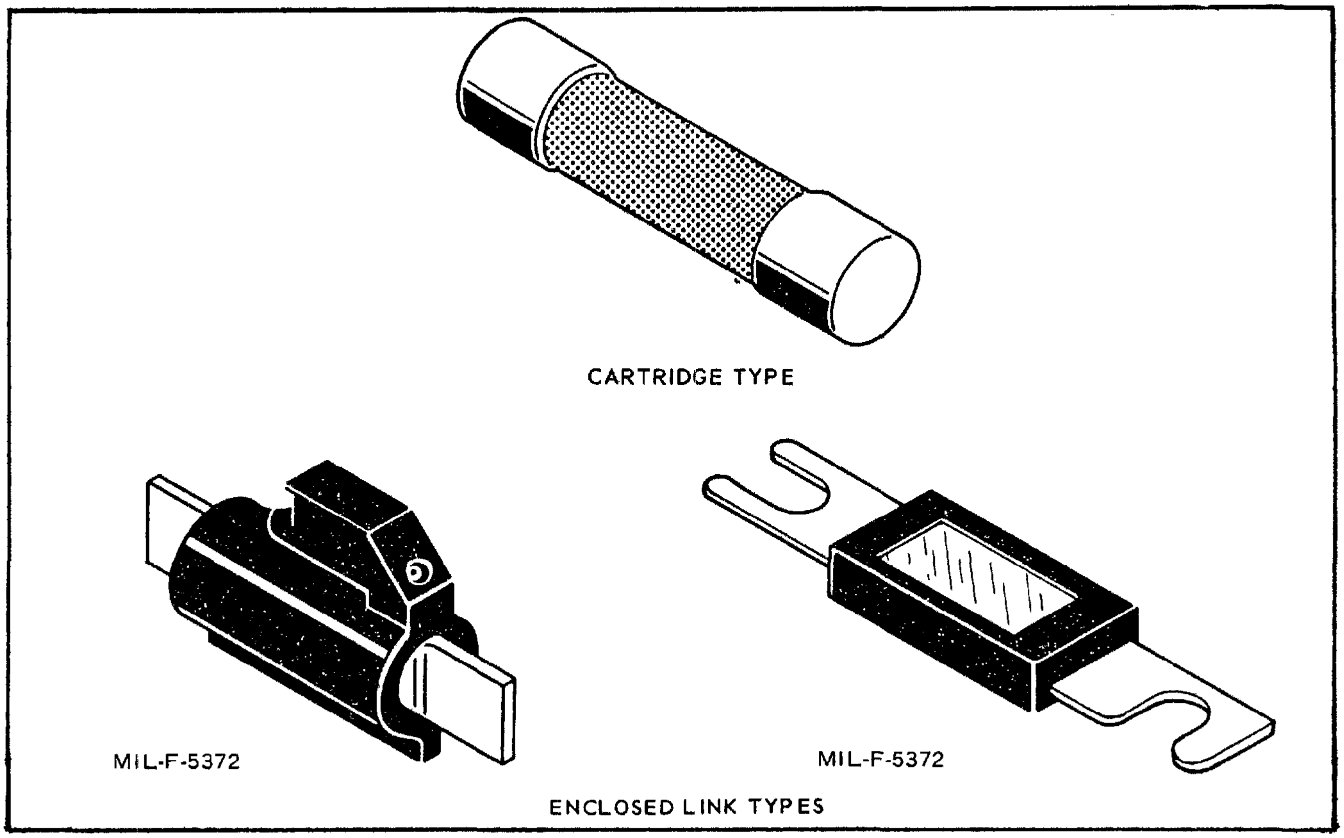

Figure 5. Typical Aircraft Fuses

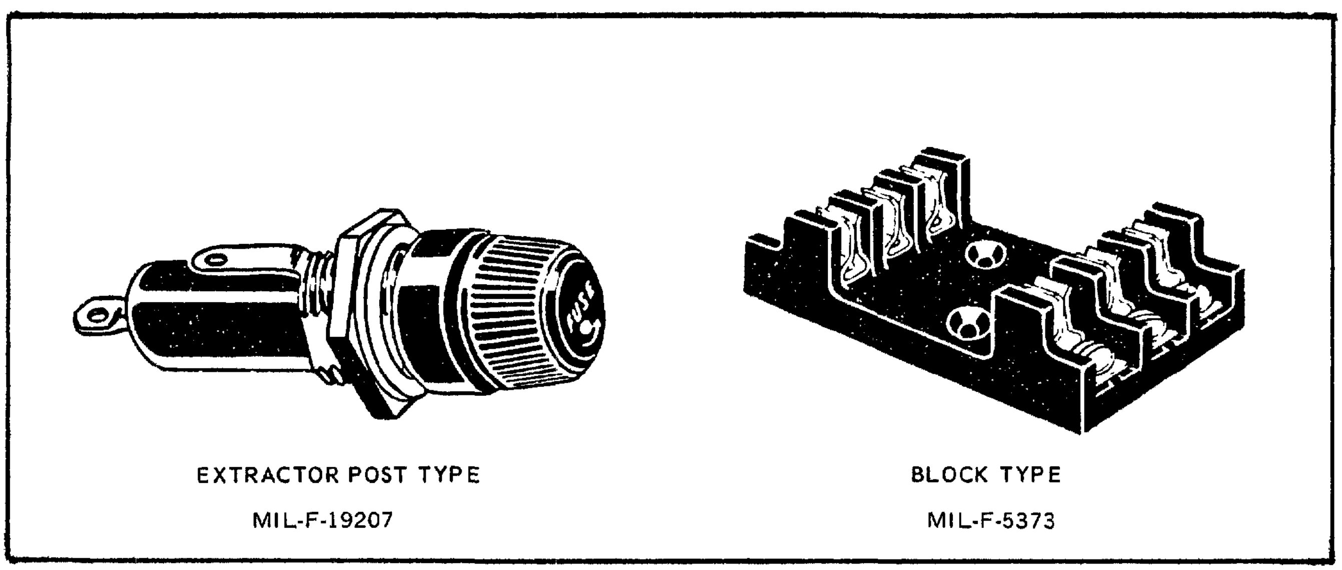

Figure 6. Typical Fuse Holders

Table 2. Fuses Used In Aircraft Electrical Systems

Cartridge Type No.	Style*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
MIL–F–15160/1	FO1 A	250	1/500	90077–1	
	A		1/200	90077–2	
	A		1/100	90077–3	
	A		1/32	90077–4	
	A		1/16	90077–5	
	A		1/10		
	A		1/8	90077–6	
	A		3/16		
	A		2/10		
	A		1/4	90077–7	
	A		3/8	90077–8	
	A		4/10		
	A		1/2	90077–9	
	A	125	6/10		
	A		3/4	90077–10	
	A		8/10		
	A		1	90077–11	
	A		1– 1/4		
	A		1– 1/2	90077–12	
	A		1– 6/10		
	A		2	90077–13	
	A		2– 1/2		
	A		3		
	A		3– 2/10		
	A		4		
	A		5		
	A	32	6		
	A		7		
	A		8		
	A		10		
	A		15		
	A		20		
	A		25		
	A		30		
MIL–F–15160/2	FO2 A, B	250	1/100	90078 – 1–1	90078 – 16–1
	A, B		1/32	– 2–1	– 17–1
	A, B		1/16	– 3–1	– 18–1
	A, B		1/8	– 4–1	– 19–1
	A, B		1/4	– 5–1	– 20–1
	A, B		3/8	– 6–1	– 21–1
	A, B		1/2	– 7–1	– 22–1
	A, B		3/4	– 8–1	– 23–1
	A, B		1	– 10–1	–24–1
	A, B		1 1/2	– 11–1	–
	A, B		2	– 12–1	–
	A		3	– 13–1	–
	A		4	– 14–1	–
	A		5	– 15–1	–
	A		6	–	–

Table 2. Fuses Used In Aircraft Electrical Systems (Cont)

Cartridge Type No.	Style*Characteristic		Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
		B	125	5	–	–
		A		10	–	–
		A, B	32	10	–	–
		A, B		15	–	–
		A, B		20	–	–
		B	32	8	–	–
MIL–F–15160/3	FO3	A, B	250	1	90079 – 1–1	90079 – 20–1
		A, B		3	– 2–1	–
		A		5	– 3–1	–
		A		8	– 4–1	–
		A		10	– 5–1	–
		A		12	– 6–1	–
		A		15	– 7–1	–
		B	250	1/100	–	90079– 10–1
		B		1/32	–	– 11–1
		B		1/16	–	– 12–1
		B		1/8	–	– 13–1
		B		15/100	–	– 14–1
		B		3/16	–	– 15–1
		B		1/4	–	– 16–1
		B		3/8	–	– 17–1
		B		1/2	–	– 18–1
		B		3/4	–	– 19–1
		B		2 1/2	–	–
		A	125	20	90079 – 8–1	
		A		30	– 9–1	
		B		5		
		B		8		
		B		10		
		B		12		
		B	125	15		
		B		20		
		B		30		
MIL–F–15160/6	FO6	A	250	1	90082 – 1	
		A		2	– 2	
		A		3	– 3	
		A		5	– 4	
		A		10	– 5	
		A		15	– 6	

Table 2. Fuses Used In Aircraft Electrical Systems (Cont)

Cartridge Type No.	Style*Characteristic		Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
MIL–F–15160/7	FO7	A	250	1		
		A		2		
		A		3		
		B	125	1		
		B		2		
		B		3		
		A, B	32	5	90083 –1	90083 –10
		A, B		10	–2	–11
		A, B		15	–3	–12
		A, B		20	–4	–13
		A, B		30	–5	–14
MIL–F–15160/9	FO9	B	250	1/10		90085–36
		B		15/100		90085–37
		B		2/10		90085–38
		B		3/10		90085–39
		B		4/10		90085–40
		B		1/2		90085–41
		B		6/10		90085–42
		B		8/10		90085–43
		A, B		1	90085–9	90085–44
		B		1– 1/8		90085–45
		B		1– 1/4		90085–46
		B		1– 4/10		90085–47
		B		1– 6/10		90085–48
		B		1– 8/10		90085–49
		A, B		2	90085–15	90085–50
		B		2– 1/4		90085–51
		B		2– 1/2		90085–52
		B		2– 8/10		90085–53
		A		3	90085–19	
		B		3– 2/10		90085–55
		A, B		3– 1/2	90085–21	90085–56
		A, B		4	90085–22	90085–57
		B		4– 1/2		90085–58
		A, B		5	90085–24	90085–59
		B		5 6/10		90085–60
		A		5	90085–26	
		A, B		6– 1/4	90085–27	90085–62
		A, B		7	90085–28	90085–63
		A, B		8	90085–29	90085–64
		B		9		90085–65
		A, B		10	90085–31	90085–66
		A		15	90085–32	
		A		20	90085–33	
		A		25	90085–34	
		A		30	90085–35	

Table 2. Fuses Used In Aircraft Electrical Systems (Cont)

Cartridge Type No.	Style	*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
		B	125	12		
		B		15		90085–67
		B	32	20		90085–68
		B		25		90085–69
		B		30		90085–70
MIL–F–15160/10	F10	B	250	1/10		
		B		15/100		
		B		2/10		
		B		3/10		
		B		4/10		
		B		1/2		
		B		6/10		
		B		8/10		
		A, B		1	15453–1	
MIL–F–15160/10	F10	B	250	1– 1/4		
		A, B		2	15453–2	
		B		2– 1/2		
		A, B		3	15453–3	
		B		3– 2/10		
		A, B		4	15453–4	
		A, B		5	15453–5	
		B		5– 6/10		
		A		6	15453–6	
		B		8 1/4		
		A		10	15453–7	
		A	125	12	15453–8	
		A		15	15453–9	
		A		2	15453–10	
		A, B		2– 1/2		
		B		3	15453–3	
		A, B		3– 2/10		
		B		4	15453–4	
		A, B		5	15453–5	
		A, B		5– 6/10		
		B		6	15453–6	
		A		6– 1/4		
		A		8	15453–7	
		A		10	15453–8	
		A		12	15453–9	
		A		15	15453–10	
		B	125	7		
		B		8		
		B		10		
		A		20	15453–11	
		A		25		
		A		30		
MIL–F–23419/9	FM09	A, B	250	1/100		
		A, B		1/32		
		B		1/16		
		A, B		1/10		

Table 2. Fuses Used In Aircraft Electrical Systems (Cont)

Cartridge Type No.	Style	*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
		B		1/8		
		B		15/100		
		A, B		3/16		
		B		1/4		
		A, B		3/10		
		A, B		3/8		
		B		1/2		
		A, B		6/10		
		A, B		3/4		
		B		8/10		
		A, B		1		
		A, B		1– 1/4		
		A, B		1– 1/2		
		B		1– 6/10		
		A, B		2		
		B		2– 1/2		
		B		2– 8/10		
		A, B		3		
		B		3– 2/10		
		A		4		
		A		5		
		A		6		
		A		8		
		A		10		
		A		12		
		A		15		
MIL–F–23419/9	FMO9	B	125	4		
		B		8		
		B		10		
		B		12		
		A, B		15		
		A, B		20		
		A, B		25		
				30		

*A Normal (normal interrupting capacity); for general circuit protection

*B Time Lag; for circuits containing motors, and circuits where provision must be made for momentary surges.

2. Enclosed Link Type

MS Part No.		Voltage Rating		Current Rating		
MS28937	–5	115/200 VAC,	28 VDC	5 Amps	24124–5,	24125–5
	–10			10 Amps	–10	–10
	–20			20 Amps	–20	–20
	–30			30 Amps	–30	–30
	–40			40 Amps	–40	–40
	–50			50 Amps	–50	–50
	–60			60 Amps	–60	–60

Table 3. Cross Reference of Military and Commercial Fuse Designations

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
(Military New)	81349	96906	71400	71400	75915	75915	75915	98997
F01A250V1/500A [1]	FO1GR002A [1]	M590077–1 [2]	AGX1/500	8AG1/500	361.002		364.002	
F01A250V1/200A	F01GR005A	M590077–2	AGX1/200	8AG1/200	361.005		364.005	
F01A250V1/100A	F01GR010A	M590077–3	AGX1/100	8AG1/100	361.010		364.010	
F01A250V1/32A	F01GR031A	M590077–4	AGX1/32	8AG1/32	361.031		364.031	
F01A250V1/16A	F01GR062A	M590077–5	AGX1/16	8AG1/16	361.062		364.062	8AG1/16
F01A250V1/10A	F01GR100A		AGX1/10	8AG1/10	361.100		364.100	8AG1/10
F01A250V1/8A	F01GR125A	M590077–6	AGX1/8	8AG1/8	361.125	362.125	364.125	8AG1/8
F01A250V3/16A			AGX3/16	8AG3/16	361.187		364.187	8AG3/16
F01A250V2/10A			AGX2/10	8AG2/10	361.200		364.200	8AG2/10
F01A250V1/4A	F01GR250A	M590077–7	AGX1/4	8AG1/4	361.250	362.250	364.250	8AG1/4
F01A250V3/8A	F01GR375A	M590077–8	AGX3/8	8AG3/8	361.375	362.375	364.375	8AG3/8
F01A250V4/10A			AGX4/10	8AG4/10	361.400		364.400	8AG4/0
F01A250V1/2A	F01GR500A	M590077–9	AGX1/2	8AG1/2	361.500	362.500	364.500	8AG1/2
F01Al25V6/10A			AGX6/10	8AG6/10				8AG6/10
F01Al25V3/4A	F01GR750A [3]	M590077–10 [3]	AGX3/4 [3]	8AG3/4 [3]	361.750 [3]	362.750 [3]	364.750 [3]	8AG3/4 [3]
F01Al25V8/10A			AGX8/10 [3]	8AG8/10 [3]				8AG8/10 [3]
F01Al25V1A	F01G1R00A [3]	M590077–11 [3]	AGX1 [3]	8AG1 [3]	361.001 [3]	362001 [3]	364001 [3]	8AG1 [3]
F01Al25V11/4A				8AG11/4 [3]				8AG11/4 [3]
F01Al25V11/2	F01G1R50A [3]	M590077–12 [3]	AGX11/2 [3]	8AG11/2 [3]	36101.5 [3]	36201.5 [3]	36401.5 [3]	8AG11/2 [3]
F01Al25V16/10A				8AG16/10 [3]				8AG16/10 [3]
F01Al25V2A	F01G2R00A [3]	M590077–13 [3]	AGX2 [3]	8AG2 [3]	361002 [3]	362002 [3]	364002 [3]	8AG2 [3]
F01Al25V21/2A			AGX2 1/2					
F01Al25V3A			AGX3		361003	362003 [3]		
F01Al25V31/2A			AGX3 1/2					
F01Al25V4A			AGX4		361004			
F01Al25V5A			AGX5		361005	362005		
F01A32V6A			AGX6			362006		
F01A32V7A			AGX7					
F01A32V8A			AGX8			362008		
F01A32V10A			AGX10			362010		
F01A32V15A			AGX15			362015		
F01A32V20A			AGX20			362020		
F01A32V25A			AGX25			362025		
F01A32V30A			AGX30			362030		

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED						
(Military New)	81349	81349	96906	71400	71400	75915	75915	75915	98997
F02A250V1/100A [1]	F02GR010A [1]	F02CR010 [1]	MS90078–1 [2]	AGC1/100		311.010	312.010	392.010	3AG1/100
F02A250V1/32A	F02GR031A	F02CR031	M590078–2	AGC1/32		311.031	312.031	392.031	3AG1/32
F02A250V1/16A	F02GR062A	F02CR062	M590078–3	AGC1/16	MGB1/16	311.062	312.062	392.062	3AG1/16
F02A250V1/8A	F02GR125A	F02CR125	MS90078–4	AGC1/8	MGB1/8	311.125	312.125	392.125	3AG1/8
F02A250V15/100A				AGC15/100		311.150	312.150	392.150	3AG15/100
F02A250V175/1000A				AGC175/1000		311.175	312.175	392.175	3AG175/1000
F02A250V3/16A				AGC3/16		311.187	312.187	392.187	3AG3/16
F02A250V2/10A				AGC2/10		311.200	312.200	392.200	3AG2/10
F02A250V1/4A	F02GR250A	F02CR250	M590078–5	AGC1/4		311.250	312.250	392.250	3AG1/4
F02A250V3/10A				AGC3/10		311.300	312.300	392.300	3AG3/10
F02A250V3/8A	F02GR375A	F02CR375	M590078–6	AGC3/8		311.375	312.375	392.375	3AG3/8
F02A250V1/2A	F02GR500A	F02CR500	M590078–7	AGC1/2		311.500	312.500	392.500	3AG1/2
F02A250V6/10A				AGC6/10		311.600	312.600	392.600	3AG6/10
F02A250V3/4A	F02GR750A	F02CR750	M590078–8	AGC3/4		311.750	312.750	392.750	3AG3/4
F02A250V1A	F02G1R00A	F02C1R00	M590078–9	AGC1		311001	312001	392001	3AG1
F02A250V0/ 1/4A				AGC1 1/4		3111.25	3121.25	3921.25	3AG1 1/4
F02A250V1/ 1/2A	F02G1R50A	F02C1R50	M590078–10	AGC1 1/2		3111.50	3121.50	3921.50	3AG1 1/2
F02A250V16/10A				AGC16/10		3111.60	3121.60	3921.60	3AG16/10
F02A250V2A	F02G2R00A	F02C2R00	M590078–11	AGC2		311002	312002	392002	3AG2
F02A250V2 1/2A				AGC2 1/2		31102.5	31202.5	39202.5	3AG2 1/2
F02A250V3A	F02G3R00A	F02C3R00	M590078–12	AGC3		311003	312003	392003	3AG3
F02A250V4A	F02G4R00A	F02C4R00	M590078–13	AGC4	MTH4	311004	312004	392004	3AG4
F02A250V5A	F02G5R00A	F02C5R00	M590078–14	AGC5	MTH5	311005	312005	392005	3AG5
F02A250V6A	F02G6R00A	F02C6R00	M590078–15	AGC6	MTH6	311006	312006	392006	3AG6
F02Al25V8A	F02A32V8A	F02D8R00		AGC8	GLH8				
F02Al25V10A	F02A32V10A	F02D10R0		AGC10	GLH10				
F02A32V15A		F02A15R0		AGC15					
F02A32V20A		F02A20R0		AGC20					
F02A32V25A		F02A25R0		AGC25					
F02A32V30A		F02A30R0		AGC30					

See Footnotes at the end of Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED			
	81349	81349	71400	75915	75915	98997
F02B250V 1/100A [1]	F02GR010B [1]	MS90078–16 [2]	MDL 1/100	393.010	313.010	3AGTL 1/100 A–250V
F02B250V 1/32 A	F02GR031B	M590078–17	MDL 1/32	393.031	313.031	3AGTL 1/32 A–250V
F02B250V 1/16 A	F02GR062B	M590078–18	MDL 1/16	393.062	313.062	3AGTL 1/16 A–250V
F02B250V 1/10 A			MDL 1/10		313.100	3AGTL 1/10 A–250V
F02B250V 1/8 A	F02GR125B	M590078–19	MDL 1/8	393.125	313.125	3AGTL 1/8 A–250V
F02B250V 15/100A			MDL 15/100		313.150	3AGTL 15/100A–250V
F02B250V 3/16 A			MDL 3/16		313.187	3AGTL 3/16 A–250V
F02B250V 2/10 A			MDL 2/10		313.200	3AGTL 2/10 A–250V
F02B250V 1/4 A	F02GR250B	M590078–20	MDL 1/4	393.250	313.250	3AGTL 1/4 A–250V
F02B250V 3/10A			MDL 3/10		313.300	3AGTL 3/10 A–250V
F02B250V 3/8 A	F02GR375B	M590078–21	MDL 3/8	393.375	313.375	3AGTL 3/8 A–250V
F02B250V 4/10 A			MDL 4/10		313.400	3AGTL 4/10 A–250V
F02B250V 1/2 A	F02GR500B	M590078–22	MDL 1/2	393.500	313.500	3AGTL 1/2 A–250V
F02B250V 6/10 A			MDL 6/10		313.600	3AGTL 6/10 A–250V
F02B250V 7/10 A			MDL 7/10		313.700	3AGTL 7/10 A–250V
F02B250V 3/4 A	F02GR750B	M590078–23	MDL 3/4	393.750	313.750	3AGTL 3/4 A–250V
F02B250V 8/10 A			MDL 8/10		313.800	3AGTL 8/10 A–250V
F02B250V 1 A	F02G1R00B	M590078–24	MDL 1	393.001	313001	3AGTL 1 A–250V
F02B250V 1 1/4 A			MDL 1 1/4		3131.25	3AGTL 1 1/4 A–250V
F02B250V 1 1/2 A	F02D1R50B	M590078–25	MDL 1 1/2		31301.5	3AGTL 1 1/2 A–250V
F02B250V 1 6/10A			MDL 1 6/10		31301.6	3AGTL 1 6/10A–250V
F02B250V 2 A	F02D2R00B	N590078–26	MDL 2		313002	3AGTL 2 A–250V
F02B250V 2 1/2 A			MDL 2 1/2		31302.5	3AGTL 2 1/2 A–250V
F02B250V 2 8/10A			MDL 2 8/10		31302.8	3AGTL 2 8/10A–250V
F02B250V 3 A	F02D3R00B	M590078–27	MDL 3		313003	3AGTL 3 A–250V
F02B250V 3 2/10A			MDL 3 2/10		31303.2	3AGTL 3 2/10A–250V
F02B125V 4 A			MDX 4		313004 [3]	3AGTL 4 A–250V [3]
F02B125V 5 A			MDX 5		313005 [3]	3AGTL 5 A–250V [3]
F02B125V 6 1/4 A			MDX 6 1/4		3136.25	
F02B25V 7 A			MDX 7		313007	
F02B32V 8 A			MDL 8		313008	3AGTL 8 A32V
F02B32V 10 A			MDL 10		313010	3AGTL 10 A32V
F02B32V 12 A			MDL 12		313012	3AGTL 12 A32V
F02B32V 15 A			MDL 15		313015	
F02B32V 20 A			MDL 20		313020	3AGTL 20 A32V
F02B32V 25 A			MDL 25		313025	
F02B32V 30 A			MDL 30		313030	

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
	81349	96906	71400	71400	75915	75915	75915	98997
F03A250V1–4A [1]			ABC1/4	MB01/4	394.250	314.250	3AB 1/4	3AB 1/4
F03A250V1–2A			ABC1/2	MB01/2	394.500	314.500	3AB1/2	3AB 1/2
F03A250V1A			ABC1	MB01	394001	314001	3AB1	3AB1
F03A250V1–1/4A	F03G1R00A [1]	MS90079–1 [2]	ABC11/4	MB011/4	3941.25	3141.25	3AB11/4	3AB11/4
F03A250V1–1/2A			ABC11/2	MB011/2	39401.5	31401.5	3AB1 1/2	3AB11/2
F03A250V2A			ABC2	MB02	394002	314002	3AB2	3AB2
F03A250V3A	F03G3R00A	MS90079–2	ABC3	MB03	394003	314003	3AB3	3AB3
F03A250V4A			ABC4	MB04	394004	314004	3AB4	3AB4
F03A250V5A	F03G5R00A	MS90079–3	ABC5	MB05	394005	314005	3AB5	3AB5
F03A250V6A			ABC6	MB06	394006	314006	3AB6	3AB6
F03A250V8A	F03G8R00A	MS90079–4	ABC8	MB08	394008	314008	3AB8	3AB8
F03A250V10A	F03G10R0A	MS90079–5	ABC10	MB010	394010	314010	3AB10	3AB10
F03A250V12A	F03G12R0A	MS90079–6	ABC12	MB012	394012	314012	3AB12	3AB12
F03A250V15A	F03G15R0A	MS90079–7	ABC15	MB015	394015	314015	3AB15	3AB15
F03Al25V20A	F03D20R0A	MS90079–8	ABC20	MB020	394020	314020	3AB20	3AB20
F03Al25V25A			ABC25	MB025	394025	314025	3AB25	3AB25
F03Al25V30A	F03D30R0A	MS90079–9	ABC30	MB030	394030	314030	3AB30	3AB30
F03B250V1/100A	F03GR010B	MS90079–10	MDA1/100	MDF1/100	390.010	323.010		3ABTL1/100
F03B250V1/32A	F03GR031B	MS90079–11	MDA1/32	MDF1/32	390.031	323.031		3ABTL1/32
F03B250V1/16A	F03GR062B	MS90079–12	MDA1/16	MDF1/16	390.062	323.062		3ABTL1/16
F03B250V1/8A	F03GR125B	MS90079–13	MDA1/8	MDF1/8	390.125	323.125		3ABTL1/8
F03B250V15/100A	F03GR150B	MS90079–14	MDA15/100	MDF15/100	390.150	323.150		3ABTL15/100
F03B250V3/16A	F03GR187B	MS90079–15	MDA3/16	MDF3/16	390.187	323.187		3ABTL3/16
F03B250V1/4A	F03GR250B	MS90079–16	MDA1/4	MDF1/4	390.250	323.250		3ABTL1/4
F03B250V3/10A			MDA3/10	MDF3/10	390.300	323.300		3ABTL3/10
F03B250V3/8A	F03GR375B	MS90079–17	MDA3/8	MDF3/8	390.375	323.375		3ABTL3/8
F03B250V1/2A	F03GR500B	MS90079–18	MDA1/2	MDF1/2	390.500	323.500		3ABTL1/2
F03B250V6/10A			MDA6/10	MDF6/10	390.600	323.600		3ABTL6/10
F03B250V3/4A	F03GR750B	MS90079–19	MDA3/4	MDF3/4	390.750	323.750		3ABTL3/4
F03B250V8/10A			MDA8/10	MDF8/10	390.800	323.800		3ABTL8/10
F03B250V1A	F03G1R00B	MS90079–20	MDA1	MDF1	390001	323001		3ABTL1
F03B250V1 1/4A			MDA11/4	MDF11/4	390.250	3231.25		3ABTL11/4

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
	81349	96906	71400	71400	75915	75915	75915	98997
F03B250V1 1/2A			MDA11/2	MDF11/2	390.500	32301.5		3ASTL11/2
F03B250V1 6/10A			MDA16/10	MDF16/10	390.600	32301.6		3ABTL16/10
F03B250V2A	F03B125V2A		MDA2	MDF2	390002	323002		3ABTL2
F03B250V2 1/2A	F03B125V21/2A		MDA21/2	MDF21/2	39002.5	32302.5		3ABTL21/2
F03B250V2 8/10A	F03B125V28/10A		MDA28/10	MDF28/1 0	39002.8	32302.8		3ABTL28/10
F03B250V3A [1]	F03GR00B [1]	MS90079–21 [2]	MDA3	MDF3	390003	323003		3ABTL3
	F03B125V3A							
F03B250V3–2/10A	F03B125V32/10A		MDA32/10	MDF32/1 0	39003.2	32303.2		3ABTL32/10
F03B125V4A			MDA4 [3]	MDF4 [3]	390004	323004		3ABTL4
F03B125V5A	F03G5R00B [3]	MS90079–22 [3]	MIDA5 [3]	MDF5 [3]	390005	323005		3ABTL5
	F03D5R00B							
	F03B32V5A							
F03B125V61/4 A [1]	F03B32V6–1/4A[1]		MDF6 1/4	MDA6 1/4	3906.25	3236.25		3ABTL6 1/4
F03B125V7A	F03B32V7A		MDF7	MDA7	390007	323007		3ABTL7
F03B125V8A	F03G8R00B [3]	MS90079–23 [2]	MDF8	MDA8	390008	323008		3ABTL8
	F03B32V8A							
F03B125V10A	F03G10R0B [3]	MS90079–24	MDF10 [3]	MDA10 [3]	390010	323010		3ABTL10
	F03B32V10A							
F03B125V12A	F03G12R0B [3]	M590079–25	MDF12 [3]	MDAl2 [3]	390012	323012		3ABTL12
	F03B32V12A							
F03B125V15A	F03G15R0B [3]	M590079–26	MDF15 [3]	MDA15 [3]	390015	323015		3ABTL15
	F03B32V15A							
F03B125V20A	F03D20R0B	M590079–27	MDF20 [3]	MDA20 [3]	390020	323020		3ABTL20
	F03B32V20A							
F03B125V25A	F03D25R0B		MDF25	MDA25	390025	323025		3ABTL25
	F03B32V25A							
F03B125V30A	F03D30R0B	M590079–28	MDF30	MDA30	390030	323030		3ABTL30
	F03B32V30A							

Footnotes

[1] A letter S following the part number signifies silver plating.

[2] A second dash number (–1) signifies silver plating.

[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	COMMERCIAL SUPERSEDED	
*F04A5R0A	*F02A 250V 5A	MTH or AGC 5	312 3AG 5A 250V
F04A10R0A	F02A 32V 10A	AGC 10	311 3AG 10A 32V
F04A15R0A	F02A 32V 15A	AGC115	311 3AG 15A 32V
F04A20R0A	F02A 32V 20A	AGC 20	311 3AG 20A 32V
F04A5R00B	F02B 32V 5A	MDL 5	
F04A10R0B	F02B 32V 10A	MDL 10	313 3AG 10A 32V
F04A15R0B	F02B 32V 15A	MDL 15	313 3AG 15A 32V
F04A20R0B	F02B 32V 20A	MDL 20	313 3AG 20A 32V
F05A10R0A	F05A 32V 10A	AGS 10	411 4AG 10A 32V
F05A15R0A	F05A 32V 15A	AGS 15	411 4AG 15A 32V
F05A20R0A	F05A 32V 20A	AGS 20	411 4AG 20A 32V
F05A25R0A	F05A 32V 25A	AGS 25	411 4AG 25A 32V
F05A30R0A	F05A 32V 30A	AGS 30	411 4AG 30A 32V
F05A35R0A	NONE	AGS 35	411 4AG 35A 32V
F05A40R0A	NONE	AGS 40	411 4AG 40A 32V
F05A10R0B	F05B 32V 10A	MDM 10	413 4AG 10A 32V
F05A15R0B	F05B 32V 15A	MDM 15	413 4AG 15A 32V
F05A20R0B	F05B 32V 20A	MDM 20	413 4AG 20A 32V
F05A25R0B	F05B 32V 25A	MDM 25	413 4AG 25A 32V
F05A30R0B	F05B 32V 30A	MDM 30	413 4AG 30A 32V
F05A35R0B	NONE	MDM 35	
F05A40R0B	NONE	MDM 40	

* Indicates voltage change from military superseded fuse to superseding number fuse.
military superseded fuse to superseding number fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

Superseding No.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED			
(Military New)	81349	96906	71400	75915	75915	98997
F06A250V1A [1]	F06G1R00A [1]	MS90082–1 [2]	ABS1	494001	414001	4AB1
F06A250V2A	F06G2R00A	MS90082–2	ABS2	494002	414002	4AB2
F06A250V3A	F06G3R00A	MS90082–3	ABS3	494003	414003	4AB3
F06A250V5A	F06G5R00A	MS90082–4	ABS5	494005	414005	4AB5
F06A250V10A	F06G10R00A	MS90082–5	ABS10	494010	414010	4AB10
F06A250V15A	F06G15R00A	MS90082–6	ABS15	494015	414015	4AB15

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations(Cont)

Superseding No. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED		
	81349	96906	71400	75915	75915
F07A250V1A [1]	F07G1R00A [1]		AGU1	590001	512001
F07A250V2A	F07G2R00A		AGU2	590002	512002
F07A250V3A	F07G3R00A		AGU3	590003	512003
F07A32V5A	F07A5R00A	MS90083–1 [2]	AGU5	590005	512005
F07A32V10A	F07A10R0A	MS90083–2	AGU10	590010	512010
F07A32V15A	F07A15R0A	MS90083–3	AGU15	590015	512015
F07A32V20A	F07A20R0A	MS90083–4	AGU20	590020	512020
F07A32V30A	F07A30R0A	MS90083–5	AGU30	590030	512030
F07B125V1A			MDR1		
F07B125V2A			MDR2		
F07B125V3A			MDR3		
F07B32V5A		MS90083–10	MDR5		
F07B32V10A		MS90083–11	MDR10		
F07B32V15A		MS90083–12	MDR15		
F07B32V20A		MS90083–13	MDR20		
F07B32V30A		MS90083–14	MDR30		

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designation (Cont)

Military Superseded	Superseded No. (Military New)	Commerical Superseded	Commerical Superseded
F08G1R00A	F07A 250V 1A	AGU 1	512 5AG 1A 250V
F08G2R00A	F07A 250V 2A	AGU 2	512 5AG 2A 250V
F08G3R00A	F07A 250V 3A	AGU 3	512 5AG 3A 250V
*F08D5R00A	*F09A 250V 5A	BAN or **AGU 5	513 5AG 1A 250V
*F08D10R0A	*F09A 250V 10A	BAN or **AGU 10	513 5AG 2A 250V
*F08D15R0A	*F09A 250V 15A	BAN or **AGU 15	513 5AG 3A 250V [3]
*F08D20R0A	*F09A 250V 20A	BAN or **AGU 20	
*F08D25R0A	*F09A 250V 25A	BAN or **AGU 25	
*F08D30R0A	*F09A 250V 30A	BAN or **AGU 30	
F08G1R00B	F09B 250V 1A	FNM or **MDR 1	
F08G2R00B	F09B 250V 2A	FNM or **MDR 2	

Footnotes
* Indicates voltage change from old to new military replacement.
**Indicates that the commercial fuse is of a lower voltage rating than one or both military fuse replacement.
[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

Military Superseded	Superseded No. (Military New)	Commerical Superseded
*F08G3R00B	*F07B 125V 3A	**MDR 3
F08G5R00B	F09B 250V 5A	FNM or **MDR 5
*F08D10R0B	*F09B 250V 10A	FNM or **MDR 10
F08D15R0B	F09B 125V 15A	FNM or **MDR 15
*F08D20R0B	*F09B 32V 20A	**FNM or **MDR 20
*F08D25R0B	*F09B 32V 25A	**FNM or **MDR 25
*F08D30R0B	*F09B 32V 30A	**FNM or **MDR 30

Footnotes
*Indicates voltage change from old to new military replacement.
**Indicates that the commercial fuse is of a lower voltage rating than one or both military fuse replacement.
[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED				
(Military New)	81349	96906	96906	71400	72076	75915	71424
F09A250V 1A [1]	F09G1R00A [1]	MS90085–9 [2]	MS90084–1 [1]	BAN 1	M0L 1	525001	
F09A250V 2A	F09G2R00A	MS90085–15	MS90084–2	BAN 2	M0L 2	525002	
F09A250V 3A	F09G3R00A	MS90085–19	MS90084–3	BAN 3	M0L 3	525003	
F09A250V 3 1/2A	F09G3R50A	MS90085–21		BAN 3 1/2	M0L 3 1/2	52503.5	
F09A250V 4A	F09G4R00A	MS90085–22		BAN 4	M0L 4	525004	
F09A250V 5A	F09G5R00A	MS90085–24	MS90084–4	BAN 5	M0L 5	525005	
F09A250V 6A	F09G6R00A	MS90085–26		BAN 6	M0L 6	525006	
F09A250V 6 1/4A	F09G6R25A	MS90085–27		BAN 6 1/4	M0L 6 1/4	5256.25	
F09A250V 7A	F09G7R00A	MS90085–28		BAN 7	M0L 7	525007	
F09A250V 8A	F09G8R00A	MS90085–29		BAN 8	M0L 8	525008	
F09A250V 10A	F09G10R0A	MS90085–31	MS90084–5	BAN 10	M0L 10	525010	
F09A250V 15A	F09G15R0A	MS90085–32	MS90084–6	BAN 15	M0L 15	525015	
F09A250V 20A	F09G20R0A	MS90085–33	MS90084–7	BAN 20	M0L 20	525020	
F09A250V 25A	F09G25R0A	MS90085–34	MS90084–8	BAN 25	M0L 25	525025	
F09A250V 30A	F09G30R0A	MS90085–35	MS90084–9	BAN 30	M0L 30	525030	
F09B250V 1/10A	F09GR100B	MS90085–36		FNM 1/10			
F09B250V 15/100A	F09GR150B	MS90085–37		FNM 15/100			
F09B250V 2/10A	F09GR200B	MS90085–38		FNM 2/10			
F09B250V 3/10A	F09GR300B	MS90085–39		FNM 3/10			
F09B250V 4/10A	F09GR400B	MS90085–40		FNM 4/10			
F09B250V 1/2A	F09GR500B	MS90085–41		FNM 1/2			
F09B250V 6/10A	F09GR600B	MS90085–42		FNM 6/10			
F09B250V 8/10A	F09GR800B	MS90085–43		FNM 8/10			
F09B250V 1A	F09G1R00B	MS90085–44	MS90084–10	FNM 1	MEN 1		
F09B250V 11/8A	F09G1R12B	MS90085–45		FNM 11/8	MEN 11/8		
F09B250V 1 1/4A	F09G1R25B	MS90085–46		FNM 1	MEN 1		
F09B250V 14/10A	F09G1R40B	MS90085–47		FNM 14/10	MEN 14/10		
F09B250V 16/10A	F09G1R60B	MS90085–48		FNM 16/10	MEN 16/10		
F09B250V 18/10A	F09G1R80B	MS90085–49		FNM 18/10	MEN 18/10		
F09B250V 2A	F09G2R00B	MS90085–50	MS90084–11	FNM 2	MEN 2		
F09B250V2 1/4A	F09G2R25B	MS90085–51		FNM 2 1/4	MEN 2 1/4		

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

Superseding No.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED				
(Military New)	81349	96906	96906	71400	72076	75915	71424
F09B250V 2 1/2A	F09G2R50B	MS90085–52		FNM 2 1/2	MEN 2 1/2		
F09B250V 28/10A	F09G2R80B	MS90085–53		FNM 28/10	MEN 28/10		
F09B250V 32/10A	F09G3R20B	MS90085–55		FNM 31/10	MEN 31/10		
F09B250V 3 1/2A	F09G3R50B	MS90085–56		FNM 3 1/2	MEN 3 1/2		
F09B250V 4A	F09G4R00B	MS90085–57		FNM 4	MEN 4		
F09B250V 4 1/2A	F09G4R50B	MS90085–58		FNM 4.5	MEN 4 1/2		
F09B250V 5A	F09G5R00B	MS90085–59		FNM 5	MEN 5		
F09B250V 56/10A	F09G5R60B	MS90085–60		FNM 56/10	MEN 56/10		
F09B250V 6 1/4A	F09G6R25B	MS90085–62		FNM 6 1/4	MEN 6 1/4		
F09B250V 7A	F09G7R00B	MS90085–63		FNM 7	MEN 7		
F09B250V 8A	F09G8R00B	MS90085–64		FNM 8	MEN 8		
F09B250V 9A	F09G9R00B	MS90085–65		FNM 9	MEN 9		
F09B250V 10A [1]	F09D10R0B [1]	MS90085–66 [2]	MS90084–14 [1]	FNM 10	MEN 10		
F09B125V 12A	F09D12R0B	– – –	– – –	FNM 12	– – –		
F09B125V 15A	F09D15R0B	MS90085–67	MS90084–15	FNM 15	MEN 15		TRM 15
F09B32V 20A	F09D20R0B	MS90085–68	MS90084–16	FNM 20	MEN 20		TRM 20
F09B32V 25A	F09D25R0B	MS90085–69	MS90084–17	FNM 25	MEN 25		TRM 25
F09B32V 30A	F09D30R0B	MS90085–70	MS90084–18	FNM 30	MEN 30		TRM 30

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED
(Military New)	81349	96906	71400
F10A250V 1A [1]	F10G1R00A [1]	MS15453–1 [2]	MIN 1
F10A250V 2A	F10G2R00A	MS15453–2	MIN 2
F10A250V 3A	F10G3R00A	MS15453–3	MIN 3
F10A250V 4A	F10G4R00A	MS15453–4	MIN 4
F10A250V 5A	F10G5R00A	MS15453–5	MIN 5
F10A250V 6A	F10G6R00A	MS15453–6	MIN 6
F10A250V 8A	F10G8R00A	MS15453–7	MIN 8
F10A250V 10A	F10G10R0A	MS15453–8	MIN 10
F10A250V 12A	F10G12R0A	MS15453–9	MIN 12
F10A250V 15A	F10D15R0A	MS15453–10	MIN 15
F10A125V 20A	F10D20R0A	MS15453–11	MIN 20
F10A125V 25A	F10D25R0A		MIN 25
F10A125V 30A	F10D30R0A		MIN 30
F10B250V 1/10A			FNJ 1/10
F10B250V 15/100A			FNJ 15/100
F10B250V 2/10A			FNJ 2/10
F10B250V 3/10A			FNJ 3/10
F10B250V 4/10A			FNJ 4/10
F10B250V 1/2A			FNJ 1/2
F10B250V 6/10A			FNJ 6/10
F10B250V 8/10A			FNJ 8/10
F10B250V 1A			FNJ 1
F10B250V 1 1/4A			FNJ 1 1/4
F10B250V 2A			FNJ 2
F10B250V 2 1/2A			FNJ 2 1/2
F10B250V 3A			FNJ 3
F10B250V 3 2/10A			FNJ 3 2/10
F10B250V 4A			FNJ 4

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED
(Military New)	81349	96906	71400
F10B250V 5A			FNJ 5
F10B250V 5 6/10A			FNJ 5 6/10
F10B250V 6 1/4A			FNJ 6 1/4
F10B250V 7A	F10G7R00B		FNJ 7
F10B250V 8A	F10G8R00B		FNJ 8
F10B250V 10A	F10G10A08		FNJ 10

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

SUPERSEDING PART NO.	SUPERSEDED PART NO.				
FM02A125V1/500A	FM02–125V–1/500A	FM02–1/500A	FM02125V1/500A	FM021/500A	M23419/2–001
FM02A125V1/200A	FM02–125V–1/200A	FM02–1/200A	FM02125V1/200A	FM021/200A	M23419/2–002
FM02A125V1/100A	FM02–125V–1/100A	FM02–1/100A	FM02125V1/100A	FM021/100A	M23419/2–003
FM02A125V1/64A	FM02–125V–1/64A	FM02–1/64A	FM02125V1/64A	FM021/64A	M23419/2–004
FM02A125V1/32A	FM02–125V–1/32A	FM02–1/32A	FM02125V1/32A	FM021/32A	M23419/2–005
FM02A125V1/16A	FM02–125V–1/16A	FM02–1/16A	FM02125V1/16A	FM021/16A	M23419/2–006
FM02A125V1/10A	FM02–125V–1/10A	FM02–1/10A	FM02125V1/10A	FM021/10A	M23419/2–007
FM02A125V1/8A	FM02–125V–1/8A	FM02–1/8A	FM02125V1/8A	FM021/8A	M23419/2–008
FM02A125V2/10A	FM02–125V–2/10A	FM02–2/10A	FM02125V2/10A	FM022/10A	M23419/2–009
FM02A125V1/4A	FM02–125V–1/4A	FM02–1/4A	FM02125V1/4A	FM021/4A	M23419/2–010
FM02A125V3/10A	FM02–125V–3/10A	FM02–3/10A	FM02125V3/10A	FM023/10A	M23419/2–011
FM02A125V4/10A	FM02–125V–4/10A	FM02–4/10A	FM02125V4/10A	FM024/10A	M23419/2–012
FNI2A125V1/2A	FM02–125V–5/10A	FN02–5/10A	FM02125V5/10A	FM025/10A	M23419/2–013
FM02A125V6/10A	FM02–125V–6/10A	FM02–6/10A	FM02125V6/10A	FM026/10A	M23419/2–014
FM02A125V3/4A	FM02–125V–3/4A	FM02–3/4A	FM02125V3/4A	FM023/4A	M23419/2–015
FM02A125V1A	FM02–125V–1A	FM02–1A	FM02125V1A	FM021A	M23419/2–016
FM02A125V1–1/2A	FM02–125V–1–1/2A	FM02–1–1/2A	FM02125V1–1/2A	FM021–1/2A	M23419/2–017
FNI2A125V2A	FM02–125V–2A	FM02–2A	FM02125V2A	FM022A	M23419/2–018
FM02A125V3A	FM02–125V–3A	FM02–3A	FM02125V3A	FM023A	M23419/2–019
FM02A125V4A	FM02–125V–4A	FM02–4A	FM02125V4A	FM024A	M23419/2–020
FM02A125V5A	FM02–125V–5A	FM02–5A	FM02125V5A	FM025A	M23419/2–021

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	SUPERSEDED COMMERCIAL
FM03A 250V 1/100A	FM09A 250V 1/100A	ABC 1/100A
FM03A 250V 1/32A	FM09A 250V 1/32A	ABC 1/32A
FM03A 250V 1/16A	FM09A 250V 1/16A	ABC 1/16A
FM03A 250V 1/8A	FM09A 250V 1/8A	ABC 1/8A
FM03A 250V 1/4A	FM09A 250V 1/4A	ABC 1/4A
FM03A 250V 3/8A	FM09A 250V 3/8A	ABC 3/8A
FM03A 250V 1/2A	FM09A 250V 1/2A	ABC 1/2A
FM03A 250V 3/4	FM09A 250V 3/4A	ABC 3/4A
FM03A 250V 1A	FM09A 250V 1A	ABC 1A
FM03A 250V 1–1/2A	FM09A 250V 1–1/2A	ABC 1–1/2A
FM03A 250V 2A	FM09A 250V 2A	ABC 2A
FM03A 250V 3A	FM09A 250V 3A	ABC 3A
FM03A 250V 4A	FM09A 250V 4A	ABC 4A
FM03A 250V 5A	FM09A 250V 5A	ABC 5A
FM03A 250V 6A	FM09A 250V 6A	ABC 6A
FM03A 250V 8A	FM09A 250V 8A	ABC 8A
FM03A 250V 10A	FM09A 250V 10A	ABC 10A
FM03A 250V 12A	FM09A 250V 12A	ABC 12A
FM03A 250V 15A	FM09A 250V 15A	ABC 15A
FM03A 250V 20A	FM09A 250V 20A	ABC 20A

Table 3. Cross Reference of Military and Commercial Fuse Designations (Cont)

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	SUPERSEDED COMMERCIAL
FM03A 250V 25A	FM09A 250V 25A	ABC 25A
FM03A 250V 30A	FM09A 250V 30A	ABC 30A
FM06 250V 1/100A	FM09B 250V 1/100A	MDA 1/100A
FM06 250V 1/32A	FM09B 250V 1/32A	MDA 1/32A
FM06 250V 1/16A	FM09B 250V 1/16A	MDA 1/16A
FM06 250V 1/10A	FM09B 250V 1/10A	MDA 1/10A
FM06 250V 1/8A	FM09B 250V 1/8A	MDA 1/8A
FM06 250V 15/100A	FM09B 250V 15/100A	MDA 15/100A
FM06 250V 3/16A	FM09B 250V 3/16A	MDA 3/16A
FM06 250V 2/10A	FM09B 250V 2/10A	MDA 2/10A
FM06 250V 1/4A	FM09B 250V 1/4A	MDA 1/4A
FM06 250V 3/10A	FM09B 250V 3/10A	MDA 3/10A
FM06 250V 3/8A	FM09B 250V 3/8A	MDA 3/8A
FM06 250V 4/10A	FM09B 250V 4/10A	MDA 4/10A
FM06 250V 1/2A	FM09B 250V 1/2A	MDA 1/2A
FM06 250V 6/10A	FM09B 250V 6/10A	MDA 6/10A
FM06 250V 7/10A	FM09B 260V 7/10A	MDA 7/10A
FM06 250V 3/4A	FM09B 250V 3/4A	MDA 3/4A
FM06 250V 1A	FM09B 250V 1A	MDA 1A
FM06 250V 1–1/4A	FM09B 250V 1–1/4A	MDA 1–1/4A
FM06 250V 1–1/2A	FM09B 250V 1–1/2A	MDA 1–1/2A
FM06 250V 1–6/10A	FM09B 250V 1–6/10A	MDA 1–6/10A
FM06 250V 2A	FM09B 250V 2A	MDA 2A
FM06 125V 2–1/2A	FM09B 250V 2–1/24	MDA 2–1/2A
FM06 125V 2–8/10A	FM09B 250V 2–8/10A	MDA 2–8/10A
FM06 125V 3A	FM09B 250V 3A	MDA 3A
FM06 125V 3–2/10A	FM09B 250V 3–2/10A	MDA 3–2/10A
FM06 125V 4A	FM09B 125V 4A	MDA 4A [3]
FM06 125V 5A	FM09B 125V 5A	MDA 5A [3]
FM06 125V 6–1/4A	FM09B 125V 6–1/4A	MDA 6–1/4A [3]
FM06 125V 7A	FM09B 125V 7A	MDA 7A [3]
FM06 125V 8A	FM09B 125V 8A	MDA 8A [3]
FM06 125V 10A	FM09B 125V 10A	MDA 10A [3]
FM06 125V 12A	FM09B 125V 12A	MDA 12A [3]
FM06 125V 15A	FM09B 125V 15A	MDA 15A [3]
FM06 125V 20A	FM09B 125V 20A	MDA 20A [3]
FM06 125V 25A	FM09B 125V 25A	MDA 25A
FM06 125V 30A	FM09B 125V 30A	MDA 30A

Footnotes

[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 4. Voltage Code (Previous)

Voltage Code Letter	Voltage (Volts)
A	32
B	52
C	90
D	125
G	250
H	500
J	1,000
K	2,500
N	5,000
P	10,000

Table 5. Current Code (Previous)

Current Code		Current (Amperes)
R002	.002	= 1/500
R005	.005	= 1/200
R010	.010	= 1/100
R031	.031	= 1/32
R750	.750	= 3/4
1R50	1.50	= 1 1/2

76. AIRCRAFT CURRENT LIMITERS.

77. **GENERAL**. A limiter is a device that responds only to high values of overcurrent and is applied with this criterion in mind. A limiter is designed specifically with a high temperature melting point to provide protection for electric power distribution systems against short-circuit currents.

78. **CLASSIFICATION OF CURRENT LIMITERS**. There are two basic types of aircraft limiters that are used in aircraft electrical power systems. The most widely used limiter is of the knife blade style and Gives visual indication of a blown limiter by a spring activated pin that extends from the limiter body. The other type of limiter is the bolt-on type with an insulating window covering the link for visual inspection.

79. **APPLICATIONS OF CURRENT LIMITERS**. Limiters are usually applied in aircraft as back-up protection for circuit breakers and in multiple cable circuits for isolating faulted cable.

80. **PART NUMBERING SCHEME**. The following part numbering example for current limiters will typically apply:

MS 28937-10

Where:

MS 28937=the military part number
10=amperage rating of the current limiter

81. **GENERAL SIZING**. Aircraft limners are usually sized according to their tine-current characteristics.

82. **CIRCUIT BREAKER BACK-UP PROTECTION**. Where the available short circuit currents exceed the interrupting ruing of a circuit breaker, an aircraft limiter may be used to limit the short-circuit current to within the breaker's capability.

83. **SHORT CIRCUIT PROTECTION**. Where multiple cable runs have been designed into the system, and single cable fault isolation is required, aircraft limiters will be installed at each end of each cable.

WARNING

To prevent electrical shock, ensure electrical power is off before commencing work.

To prevent fire and damage to electrical equipment, do not replace a current limiter with one of a higher amperage rating.

84. **MAINTENANCE**. Periodic inspection of the limiter holding device is recommended to insure adequate pressure on the contact making members. Limiter characteristics do not change with age hence, no maintenance is required for those limiters in storage.

85. IDENTIFICATION.

a. Military Fuse Designations. Military fuse designations differ from commercial fuse designations and are divided into four parts as follows: (1) style, (2) blowtime characteristics, (3) voltage rating, and (4) current rating. To decode old and new military fuse designations (see Table 18–4, views A and B).

b. Commercial Fuse Designations. Designations of various commercial fuses differ according to the manufacturer. However, when decoded, most of these designations provide the same general information, such as fuse type, current rating, voltage rating, and catalog number (see Figure 18–4, views C and D).

86. GENERAL PRECAUTIONS.

87. When replacing fuses in aircraft electrical systems, observe the following precautions:

a. Do not use tools except for fusepullers to remove or insert fuses.

b. Make sure that the new fuse has the same electrical features as the fuse being replaced. The blow time characteristics are extremely important. Slow blow fuses will not be substituted for fast blow fuses. Temporary substitution of fast blow fuses for slow blow fuses is allowed.

c. Make sure that the plating on all metal parts is clean and intact.

d. Make sure that the wire inside the replacement fuse exhibits continuity.

e. Make sure that the replacement fuse has no cracks or breaks.

f. Do not force a fuse into a holder that does not readily accept it; check that a fuse of the correct size is being used.

CAUTION

Cartridge fuses marked F02 and F03 are 1–1/4 inches long and 1/4 inch diameter; fuses marked F05 and F06 are 1–1/4 inches long and 9/32 inch diameter. Do not interchange the two sizes.

g. Inspect fuse holder cap to ensure the rubber grommet is properly installed.

WARNING

Death or injury to personnel and damage to equipment may occur if these instructions are not followed.

h. Panel mounted fuseholder caps of the extractor–post type will be turned by finger pressure only. Use of tools to lock or unlock caps may damage them. The fuseholder cap must retain the fuse when either inserting or removing a fuse. Fuseholder caps which do not securely retain fuses must be discarded and a new fuseholder cap installed.

(1) When installing or removing fuses which are retained in extractor post type fuse holder caps, ensure the fuse remains in the extractor cap.

(2) If the fuse remains in the fuse holder body, the equipment must be disconnected from the power source while attempting to extract the fuse.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

Joel B. Hudson

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0430614

Distribution:
To be distributed in accordance with initial distribution number (IDN) 311333, requirements for TM 1-1500-323-24-1.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	***To***	***Multiply by***	***To change***	***To***	***Multiply by***
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 081991-000