FORMING, GROUNDING, SPLICING, AND TERMINATING SHIELDED WIRING AND COAXIAL AND TWIN-CONDUCTOR SHIELDED OFFICE CABLE GENERAL EQUIPMENT REQUIREMENTS

CONTENTS PAGE

1. GENERAL

1.01 This section covers the general equipment requirements for forming, grounding, splicing, and terminating shielded wire and coaxial and twin-conductor shielded office cable.

1.02 This section is reissued to make the changes listed under **REASONS FOR REISSUE** at the end of this document.

1.03 The requirements covered in this section are supplemented by the requirements and procedures specified on drawings ED-92524-10 through -21 covering methods of terminating shielded wire and coaxial and twin-conductor shielded office cables. The requirements of this section as well as those specified on the ED-92524-( ) drawings shall be followed except where otherwise specified on applicable drawings or specifications.

1.04 Except where otherwise specified, sewing of shielded wire and cable forms shall be in accordance with Section 800-612-153 covering forming, fanning, sewing, and skinning wiring and cabling.

1.05 The following list shows abbreviations for the insulation on wires referred to in this section.

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IPvc—Irradiated Polyvinyl Chloride
Pe—Polyethylene
PvcCBL—Polyvinyl Chloride, Cotton Braid, Lacquered
TFE or PTFE—Polytetrafluoroethylene.

1.06 The sections listed below contain wiring and cabling requirements that supplement the requirements of this section and, where applicable, are referred to in other parts of this section.

800-610-152—Gauge and Insulation of Wire
800-612-150—Specific Requirements for Electronic-Type Equipment
800-612-151—Design of Cable Forms
800-612-153—Forming, Fanning, Sewing, and Skinning Wire and Cable
800-612-154—Connecting and Soldering Individual Conductors
800-612-156—Placing, Securing, and Supporting Cable Forms
800-612-157—Protection of Cable Forms and Skinners
800-612-162—Selection of Switchboard Cables
800-614-152—Switchboard, Power, and Local Power Cable Installation

1.07 ***Coaxial office cable*** consists of an insulated conductor enclosed in a single or double covering of braided wire shielding and an outer jacket that covers the shield. This cable will be referred to as coaxial cable.

1.08 ***Twin-conductor shielded office cable*** consists of a twisted pair of insulated conductors within a double covering of braided wire shielding and an outer jacket that covers the shield. The insulated conductors of cables such as the 754E are filled to circular cross section with an additional layer of insulation between the conductors and shield. On cables such as the 761A type, the insulated conductors are covered directly with the shield. These cables, which will be called twin-conductor office cables, are sometimes called balanced-pair transmission cables.

1.09 ***Shielded wire*** consists of one or more insulated conductors enclosed in a single covering of braided wire shielding and an outer jacket that covers the shield. Shielded wire refers to coded shielded wire, such as types BF; DL; P; KS-13385 shielded per KS-13587; KS-19195 L2; KS-21238; KS-22247 L2; and shielded pairs in cables, such as the 750A and 763A types.

1.10 The exposed shield and ground wire of shielded wire or cable terminations shall be protected wherever the shield or ground wire might come in contact with foreign grounds, other potentials, or apparatus terminals; or wherever the exposed shield might rest against the insulation of other wiring.

1.11 ***Where protection is required,*** shield terminations may be covered with an overlapping layer of tape (see paragraph 1.14) extended approximately 1/4 inch beyond the exposed conductors. On shielded wire or cable having TFE- or PTFE-insulated center conductors, the shield termination may be covered with polyolefin heat-shrinkable tubing per MS-59074, L3 or L5, or an approved equivalent extended approximately 1/4 inch beyond exposed conductors. Heat-shrinkable tubing may also be used on Pe-, IPvc-, or PvcCBL-insulated wire or cable where a barrier such as the KS-7851 sleeving is provided under the shield braid as shown in Fig 5C (see paragraphs 1.12 and 3.03). Protection is not required on crimp-type terminations made with insulated outer sleeves.

1.12 ***On connections protected with heat-shrinkable tubing,*** there shall be no visible discoloration or distortion of the center conductor insulation or of the outer jacket of the shielded wire or cable; nor shall the tubing be scorched or discolored to such an extent as to obscure inspection of the connection.

1.13 Protection is not required for 750-type (except 754-type) or 479R cables run within the ducts of duct-type bays. In this case, the bare shields need not be protected from touching the inside of ducts, unless drawings specify otherwise. ***Where protection is required,*** it shall be provided in accordance with Section 800-612-157 covering protection of cable forms.

1.14 Where taping is specified in this section, use gray friction tape per RM-591127 or gray plastic tape per KS-14090, R-3359, or R-3428.

1.15 The descriptions of various shielded wires and cables are shown in Table A. The symbols used for coded shielded wire and cable are as follows:

CU—Coaxial cable such as 724, 730, KS-19224, and KS-21112 types

EU—Shielded PTFE-, TFE-, IPvc-, or Pe-insulated wire such as KS-19414; KS-19195 L2; KS-21238; KS-22247 L2; P5-, BF-, or DL-type wire; and shielded pairs in 750-type (except 754-), 763-type, and 479R cables

RU—Twin-conductor office cable such as 754-, 760-, and 761-type cables and 761A-type pairs of cables

U—Shielded PvcCBL-insulated wire such as KS-13385 shielded per KS-13587.

TABLE A

SHIELDED WIRE AND COAXIAL AND TWIN-CONDUCTOR SHIELDED OFFICE CABLE DESCRIPTION*

SYMBOL	CODE	COND	OD	COND INSL	INSIDE BENDING RADIUS (IN INCHES)		GA	OHMS IMP	REPRESENTATIVE USE AND REMARKS
					REG	MIN†			
CU	724 or 724B	2	0.312 Max	Pe	3	1-1/2	20	75	Coaxial cable, double shield
CU	727A	2	0.312 Max	Pe	3	1-1/2	20	75	Coaxial cable (corona free), double shield—L3 carrier systems
CU	728A or 728B	2	0.312 Max	Pe	3	1-1/2	0.0311	75	Coaxial cable (corona free), double shield—TD-2 and TH radio relay and T-multiplex systems
CU	730A or 730B	2	0.260	Pe	2	1	23	75	Coaxial cable, double shield—L multiplex and radio systems
CU	731A or 731B	2	0.260 Max	Pe	2	1	23	75	Coaxial cable, double shield, good return-loss characteristic—radio systems
RU	754E	2	0.425	Pe	3	2	19	124	Balanced pair, double shield—video systems
RU	760A	2	0.315 Max	Pe	3	1-1/2	22	124	Balanced pair, double shield—TJ radio relay systems
RU	761A Type	2	0.225 Max	Pe		1/2	24	110	Balanced pair, double shield—134 multiplex systems
RU	762A	20	0.64 by 0.81	Pe	4 Flat 4 Edge		24	110	Consists of ten 761A-type cables

*For more detailed description, see Sections 800-610-152 and 800-612-162.

†The minimum bending radius of the Pe- and IPvc-insulated coaxial cables is permissible only if bend is made after the connection has cooled or if no heat is to be applied within 3 inches of the bend. Formed fiber snap-on details (P-188058 for 180° bends and P-188059 for 90° bends) may be used to maintain a 2-inch bending radius in 724 cable where the weight of the cable (as in ducts) or where presence of framework or pressure from other cables might adversely affect the bending radius.

TABLE A (Contd)

SHIELDED WIRE AND COAXIAL AND TWIN-CONDUCTOR SHIELDED OFFICE CABLE DESCRIPTION*

SYMBOL	CODE	COND	OD	COND INSL	INSIDE BENDING RADIUS (IN INCHES)		GA	OHMS IMP	REPRESENTATIVE USE AND REMARKS
					REG	MIN†			
RU	763A	24	0.69	Pe	4		24		Consists of twelve single shielded pairs—L multiplex systems
RU	764A	16		Pe	4 Flat 4 Edge		24	110	Consists of eight 761A-type cables
U	KS-13385**	1,2		Pe	See par 2.01		16		Shielded single or pair—power equipment
CU	KS-13730 or RG-63B/U	2	0.495	Pe	4	3	22	125	Coaxial cable, single shield
EU	KS-19195 L2	‡		TFE	See par 2.01		16 to 26		High temperature applications
CU	KS-19224 L1	2	0.096	TFE	1/2	1/4	29	75	Coaxial cable, single shield—L multiplex systems
CU	KS-19224 L2	2	0.116	TFE	3/4	3/8	29	75	Coaxial cable, double shield—T and L multiplex systems
EU	KS-19414	2	0.160	TFE	1/2	1/4	24		Shielded pair—L multiplex systems
CU	KS-21112 L1, L3	1	0.075	PTFE		1/2	30	75	Coaxial cable, single shield—No. 4 ESS, 1A processor, and M12 multiplex
CU	KS-21112 L2	1	1.100	PTFE		1/2	30	100	
EU	KS-21238	1,2	0.047 max 0.090 max	PTFE			28	95	Shielded single or pair—No. 4 ESS and 1A processor
EU	KS-22247 L2	1		TFE			16 to 26		High temperature applications
CU	RG-213/U	2	0.405	Pe	4	3	0.089	50	Coaxial cable, stranded, single shield
CU	RG-59B/U	2	0.242	Pe	2	1	23	75	Coaxial cable, single shield

*For more detailed description, see Sections 800-610-152 and 800-612-162.

†The minimum bending radius of the Pe- and IPvc-insulated coaxial cables is permissible only if bend is made after the connection has cooled or if no heat is to be applied within 3 inches of the bend. Formed fiber snap-on details (P-188058 for 180° bends and P-188059 for 90° bends) may be used to maintain a 2-inch bending radius in 724 cable where the weight of the cable (as in ducts) or where presence of framework or pressure from other cables might adversely affect the bending radius.

**Shielded per KS-13587.

‡See KS-19195.

TABLE A (Contd)

SHIELDED WIRE AND COAXIAL AND TWIN-CONDUCTOR SHIELDED OFFICE CABLE DESCRIPTION*

SYMBOL	CODE	COND	OD	COND INSL	INSIDE BENDING RADIUS (IN INCHES)		GA	OHMS IMP	REPRESENTATIVE USE AND REMARKS	
					REG	MIN†				
EU	750A	4	0.35 by 0.22	Pe	1 Flat 2 Edge		22	110	2 Pair	Pe-insulated conductors twisted into pairs. Each pair is covered with a braided shield
	751A	6	0.43		2	1			3 Pair	
	752A	12	0.57		3	2			6 Pair	
	753A	24	0.68		4	3			12 Pair	
	758A	8	0.48		3	2			4 Pair	
	759A	16	0.62		4	3			8 Pair	
EU	755A	4	0.37 by 0.23	Pe	1 Flat 2 Edge		19	100	2 Pair	
	756A	16	0.71		4	3			8 Pair	
	757A	20	0.74		4	3			10 Pair	
EU	479R	8	0.49	IPvc	2	1	22		Four shielded pairs	
EU	P5-Type Wire	1,2,3		IPvc	See par 2.01		20, 22 & 24		Shielded single, pair, or triple	
EU	BF-Type Wire	1,2,3		Pe	See par 2.01		22	110	Shielded single, pair, or triple	
EU	BF- or DL-Type Wire	2	0.180	Pe	See par 2.01		24	110	Shielded-pair-type DL has silver-coated shield	

*For more detailed description, see Sections 800-610-152 and 800-612-162.

†The minimum bending radius of the Pe- and IPvc-insulated coaxial cables is permissible only if bend is made after the connection has cooled or if no heat is to be applied within 3 inches of the bend. Formed fiber snap-on details (P-188058 for 180° bends and P-188059 for 90° bends) may be used to maintain a 2-inch bending radius in 724 cable where the weight of the cable (as in ducts) or where presence of framework or pressure from other cables might adversely affect the bending radius.

2. FORMING

GENERAL REQUIREMENTS

2.01 Except where otherwise specified, forming of shielded wire and coaxial and twin-conductor shielded office cable shall be in accordance with the requirements for forming wiring and cabling specified in Section 800-612-153 and as specified in Part 2 of this section. In forming shielded wire and cable, the bending radii shown in Table A shall be maintained. For shielded wire and cable not covered in Table A, a bending radius of not less than five times the diameter of the shielded wire or cable is recommended.

Note: Care should be exercised in forming miniature coaxial cable and small-diameter shielded wiring to avoid drawing the cable or wire tightly on forming boards or other wiring devices, since this may cause stretching and possible breakage of the conductors of the cable or wire.

SHIELDED WIRE

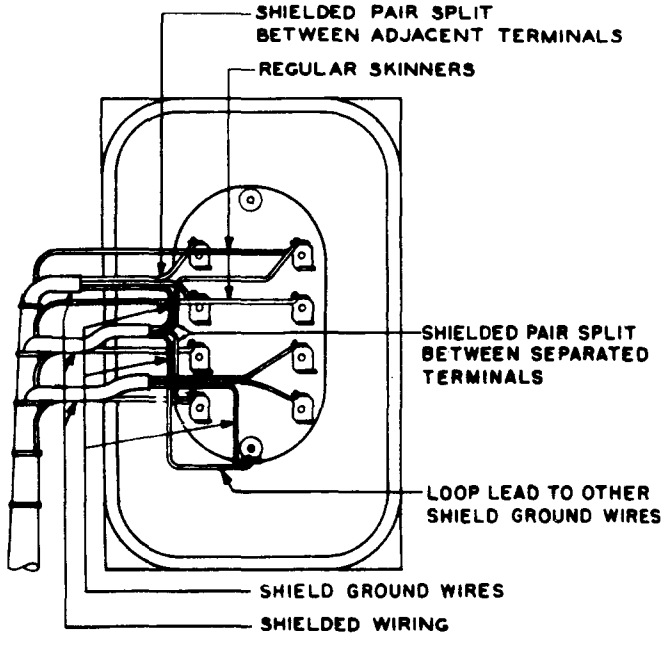
2.02 ***Where a shielded pair is split between two terminals on the same piece of apparatus for which the skinners normally break out at one stitch,*** both leads of the pair shall be dressed straight to the terminals from the end of the shield, as shown in Fig 1.

2.03 ***Where a shielded pair is split between two separated terminals on one piece of apparatus to which the regular skinners break out at separate stitches,*** the shielding shall be terminated at a point approximately midway between the terminals, and the conductors shall run directly from there to the respective terminals, as shown in Fig 1.

2.04 ***Where a shielded pair is split between terminals on adjacent pieces of apparatus for which the skinners normally break out at one stitch*** (such as may be the case with 18-type resistors or 441-type capacitors), the shielding shall be terminated at a point approximately midway between the terminals, and the conductors shall run directly from there to the respective terminals.

2.05 ***Where a shielded pair is split between two pieces of apparatus, so separated that the skinners would break out at different stitches,*** the shielding shall be terminated in the form at the point where the first conductor leaves the pair. The second conductor shall be sewed into the form and brought out with the regular skinners to the second piece of apparatus. However, consideration shall be given in the design information as to whether or not the omission of the shielding and pairing of the second conductor can be tolerated.

2.06 ***Unequipped, spare, and unused shielded cable pairs*** shall be treated in the same manner as unshielded cables per Section 800-612-153, except that at terminal strips with fanning strips they shall be disposed of by enclosing them in rigid polyvinyl chloride tubes per Section 800-612-156 and by tying them to the fanned portion of the fanned form.



TERMINATION OF SEVERAL SHIELDED PAIRS AT APPARATUS

Fig 1—Method of Forming Shielded Wire

COAXIAL AND TWIN-CONDUCTOR SHIELDED OFFICE CABLE

2.07 Forms of coaxial and twin-conductor shielded office cable shall be sewn, when required, in accordance with Section 800-612-153.

Note: Shielded cables which are provided with a foam-type dielectric, such as the KS-21112 type, and those which are provided with a semisolid-type dielectric, such as the KS-19689 type, are easily deformed when sewn. Therefore, taping instead of sewing may be required. The taping of such cables is covered in Section 800-612-153.

(a) Forms consisting entirely of coaxial cable shall not be sewn, tied, or taped so tightly as to disturb the circular cross section of the coaxial cables.

(b) Where only a few coaxial cables are to be sewn into a form with other wiring, the coaxial cables shall be, where practicable, imbedded in the form so that the sewing twine will not come in contact with the cables.

3. GROUNDING

GENERAL REQUIREMENTS

3.01 ***Where CU, EU, U, RU, or other shielded wiring or cable*** is specified on the schematic, the shields shall be grounded on one end, both ends, or not at all, as specified on the schematic. If the shields are to be grounded or several shields are to be bonded together, the schematic will show the points at which the ground or other connecting leads are attached. Care shall be taken that ungrounded shields not come in contact with ground or any other conductor. (See paragraphs 1.10 through 1.13.)

3.02 Where a lead for shield ground connection is required, use No. 22 gauge solid switchboard wire unless special considerations require the use of a heavier gauge wire (such as when extremely low impedance to ground is a requirement). A lighter gauge ground lead wire may be specified for use with smaller size cables where low impedance to ground is not critical. To achieve the lowest possible impedance and thus provide optimum transmission characteristics, the ground lead wire shall not be any longer than necessary to reach the grounding terminal to which it is to be connected; nor shall it be so short as to require pulling or stretching to make it reach the terminal. For terminating the ground lead wire to equipment or apparatus terminals refer to Section 800-612-154.

Note: Care should be exercised in using crimp-type connections with ground lead wires which are larger in diameter than No. 22 gauge since this may result in collapse of the inner sleeve.

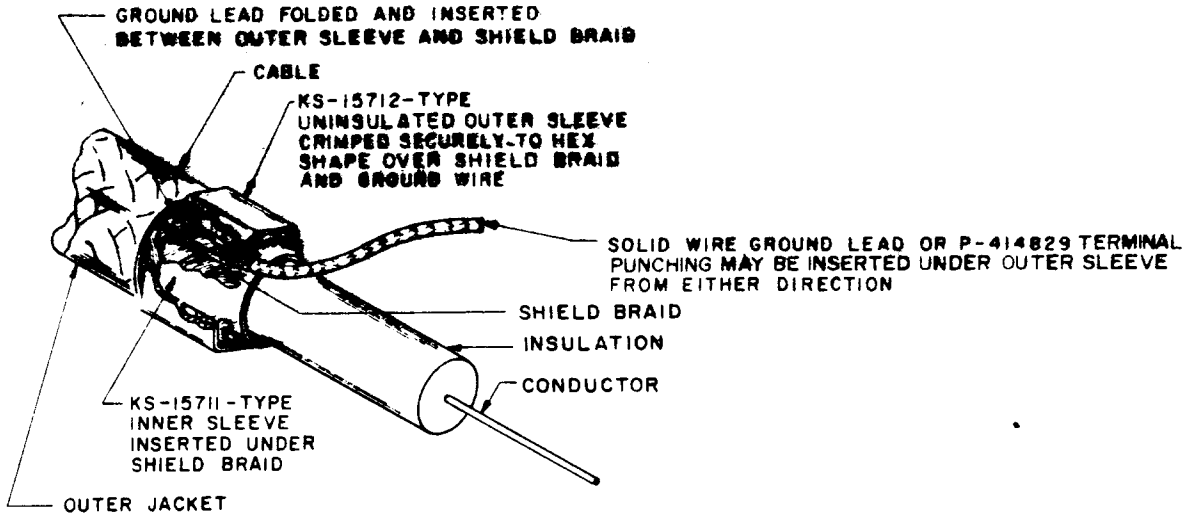
3.03 Care shall be exercised in the application of heat for soldering, for applying heat-shrinkable tubing, or for making shield sleeve terminations on the shield of wire or cable having Pe- or IPvc-insulated center conductors. Such heat applications may cause damage to the insulation and possible shorting between the shield braid wires and center conductors if the insulation is not properly protected with sleeving, or if tools or procedures other than those approved are used to make the terminations.

3.04 Care shall be taken in preparing cable ends for terminating and grounding to avoid any circumferential groove in the insulation resulting from cutting the shielding. It is desirable that no damage be done to the inner dielectric, but a very slight scoring of the dielectric is permissible.

3.05 ***Where no connections are made to the shield,*** the shield and outer covering shall be cut flush at the point of butt and covered with an overlapping layer of tape extended approximately 3/8 inch (1/4 inch for cable of 0.160 diameter or smaller) on each side of the butt. On shielded wire or cable having TFE- or PTFE-insulated center conductors, the butt may be covered with polyolefin heat-shrinkable tubing per MS-59074, L3 or L5, or an approved equivalent extended approximately 3/8 inch (1/4 inch for cable of 0.160 diameter or smaller) on each side of the butt. (See paragraphs 1.11 and 3.03.)

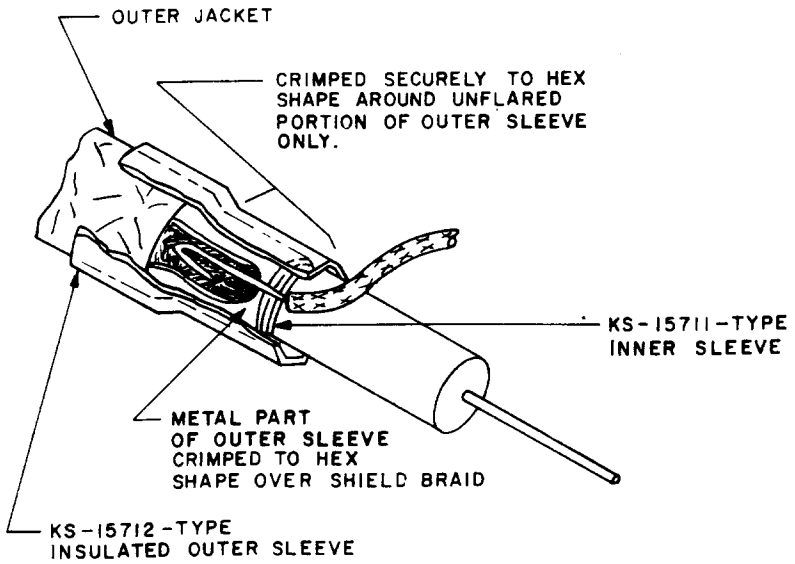
SPECIFIC REQUIREMENTS

3.06 Connection of a ground lead to the shield on the open end of a shielded wire or cable shall be made using the crimp-type, the wrap-soldered-type, or shield-sleeve-type connection as indicated in paragraphs 3.07 through 3.13. The aluminum sheath of ABAM, ABMM, and similar type cable shall be terminated in accordance with ED-97270-10.



NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH-21, FIG 66 OR 67.

METHOD A



NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH-21, FIG 81 OR 82.

METHOD B
OTHERWISE SAME AS METHOD A

Fig 5A—Crimp-Type Ground Lead Connection to Shields of Shielded Wire and Coaxial and Twin-Conductor Office Cable (Coaxial Cable Shown)

A. Crimp-Type Ground Lead Connections

3.07 ***The crimp-type ground lead connection*** (Fig 5A) is made with a 2-piece compression-type connector consisting of a tubular inner sleeve and an insulated or uninsulated tubular outer sleeve. The inner sleeve is inserted either under or over the shield. When inserted under the shield, the inner sleeve is positioned so that the cut ends of the shield braid will not come in contact with the insulation on the center conductor. When inserted over the shield, the cut ends of the shield braid are folded back over the inner sleeve to permit the outer sleeve to cover the braid adequately. A solid ground lead conductor or a P-414829 terminal punching may be positioned between the shield braid and outer sleeve. The outer sleeve is then crimped on with a crimping tool (equipped with the required die) to secure the braid and ground lead between the inner and outer sleeves. The sleeves and crimping tool are covered in the following specifications:

(a) KS-22214 Crimping Tool (With Interchangeable Die Sets)

(b) KS-15711 Shield Connector (Inner Sleeve)

(c) KS-15712 Shield Connector (Outer Sleeve).

Note: The operation of the crimping tool should be checked periodically to ensure that the dies of each die set are in contact with each other when the tool is in the fully closed position and that the tool does not release, when making the crimp, until the fully closed position of the dies is achieved.

3.08 Crimp-type ground lead connections shown in Fig 5A shall be made in accordance with the applicable requirements and procedures specified on ED-92524-10 through -21 and shall also meet the following requirements.

Note: It is important that care be exercised in the relative positioning of the inner sleeve, shield braid, ground lead wire, and outer sleeve to ensure that the shield braid and ground lead wire are fully sandwiched between the inner and outer sleeves when making the crimp.

(a) No portion of the outer covering of the wire or cable shall be crimped under the outer sleeve.

(b) The crimped portion of the outer sleeve shall be 1/4 inch minimum measured along the axial dimension of the sleeve.

(c) The crimped outer sleeve shall exhibit six approximately flat surfaces with no fins or excessive rounding at the 60-degree corner bends.

(d) The crimped outer sleeve shall show no evidence of double crimping (a double crease at the corners of the outer sleeve).

(e) The crimped outer sleeve shall be free of cracks or fractures.

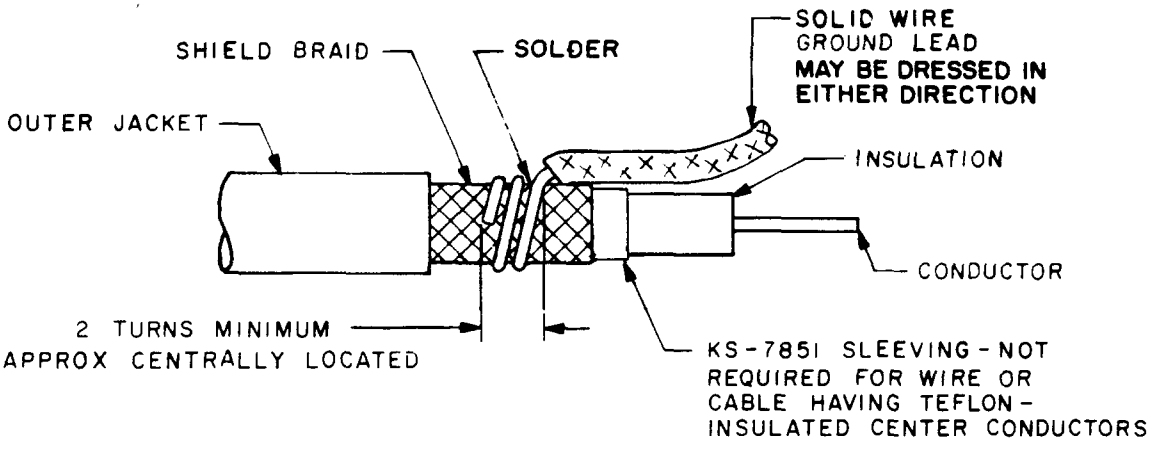
(f) The inner sleeve of the crimped termination shall not be deformed other than being slightly out of round.

(g) The crimped ground lead connection shall be capable of withstanding a pull force of 6 pounds applied to the ground wire in a direction parallel to the axis of the crimped sleeve and away from where the wire exits the sleeve. This requirement may be considered met if no movement of the ground wire, shield braid, or outer sleeve occurs at the termination.

3.09 Where there is a possibility of damaging or breaking the terminated end of a ground lead at the crimped connection, such as when shield ground leads smaller in diameter than No. 22 gauge are provided, the ground wire should be secured to the shielded wire or cable with twine or tape at a point adjacent to the crimped outer sleeve. Tying is not necessary where the connection is protected with tape or tubing.

B. Wrap-Soldered-Type Ground Lead Connections

3.10 The wrap-soldered-type ground lead connection to the shield of shielded wire or cable is shown in Fig 5C. When this method is used for ground lead terminations on wire or cable having TFE- or PTFE-insulated center conductors (such as KS-19195 and KS-19224 types), the KS-7851 sleeving shown in the figure is not required. However, the KS-7851 sleeving shall be provided under the shield braid for all other types of wires prior to making the soldered connection.



NOTE:

FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH -21, FIG 53 OR 103, WHICHEVER IS APPLICABLE.

Fig 5C—Wrap-Soldered-Type Ground Lead Connection to Shields of Shielded Wire or Cable (Coaxial Cable Shown)

3.11 Wrap-soldered ground lead connections to the shield of shielded wire or cable shall be made in accordance with the requirements and procedures specified on ED-92524-10 through -21 and shall also meet the following requirement.

(a) The soldered ground lead connection shall be capable of withstanding a pull force of 6 pounds applied to the ground wire in a direction parallel to the axis of the shielded wire or cable and away from the point at which the soldered connection is made. This requirement may be considered met if no movement between the shield braid and ground lead wire occurs at the connection.

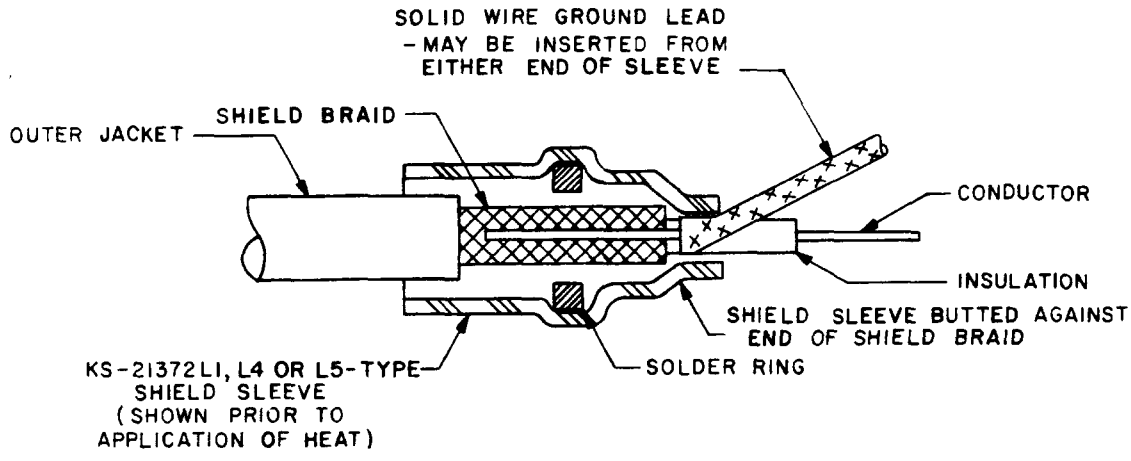
C. Shield-Sleeve-Type Ground Lead Connections

3.12 The KS-21372 shield sleeves shown in Fig 5D and 5E consist of a heat-shrinkable-type tubing and a ring of solder positioned within the → tubing. The L21 through L36 sleeves (Fig 5E) also include a sleeve-type barrier which is positioned → under the shield braid to prevent damage to the in- → sulation on the center conductors of the cable during heat application. Using approved tools, heat is applied to the assembly to make the soldered connection and simultaneously shrink the tubing.

3.13 KS-21372 shield sleeve terminations shall be made in accordance with the requirements and procedures specified on ED-92524-10 through -21 and shall also meet the following requirements.

(a) There shall be good solder wetting of the ground lead wire and shield braid and a minimum 1/4-inch long fillet of solder along each side of the wire. The solder ring shall not be discernible when the termination is completed.

(b) The soldered ground lead connection shall be capable of withstanding a pull force of 6 pounds applied to the ground wire in a direction parallel to the axis of the shielded wire or cable and away from the point at which the soldered connection is made. This requirement may be



NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH -21, FIG 128

Fig 5D—KS-21372 Shield-Sleeve-Type Ground Lead Connection to Shield of TFE- or PTFE-Insulated Shielded Wires and Cables (Coaxial Cable Shown)

considered met if no movement between the shield braid and ground lead wire occurs at the connection.

(c) There shall be no visible discoloration or distortion of the insulation on the center conductor, or of the outer jacket of the shielded wire or cable.

(d) Except for the blue-colored shield sleeves used with TFE- or PTFE-insulated wire or cable (such as KS-19195 and KS-19224, etc), the portion of the shield sleeve butted against the cut end of the shield braid shall not be recovered (shrunk).

(e) The shield sleeve shall completely cover the terminated shield conductors.

(f) The shield sleeve shall not be scorched or discolored to such an extent that the soldered connection cannot be inspected.

(g) The bare ground wire shall not overlap the cable jacket, and the insulated portion of the ground wire shall not overlap the end of the shield.

(h) Unless otherwise specified, the completed ground lead termination shall be capable of meeting a 500-volt ac breakdown test per specification X-38, supplement C, or a 750-volt dc ← breakdown test per supplement E. The voltage shall be applied between the center conductor of the shielded wire or cable and the exposed end of the ground lead wire. For shielded pairs, the test shall be made between each of the conductors in the pair and the ground lead wire. Tests shall not be performed on wire or cable assemblies connected in circuitry with other electrical components.

D. Flag-Type Shield Connections

3.14 Flag-type shield connectors (shown in Fig 6A) are crimp-type connections provided with brackets for securing the terminated shield to apparatus or to the mounting plate, panel, or other parts of the equipment. The terminating procedures for flag-type connectors are similar to those specified for the crimp-type ground lead connectors. Flag-type shield connections shall be made in accordance with the applicable requirements and procedures specified on ED-92524-10 through -21 and shall also meet the requirements of paragraph 3.08 (a) through (f).

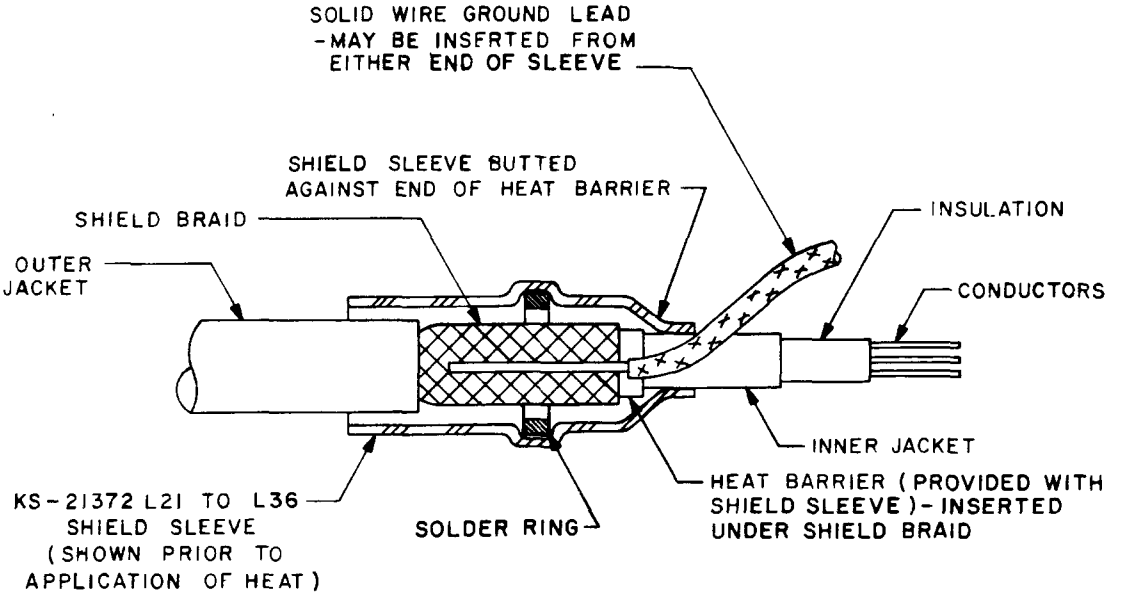


Fig 5E—KS-21372 Shield-Sleeve-Type Ground Lead Connection to Shield of Shielded Wires or Cables Not Provided With TFE- or PTFE-Insulated Conductors (Shielded Pair Shown)

E. Shield-to-Shield Connections

3.15 Where the shields of several shielded wires or cables are to be connected together and not grounded (Fig 7A), the termination is made by connecting a ground lead wire to each of the shields as shown in Fig 5A, 5C, 5D, or 5E and then splicing the ground wires together. Where manufacture is facilitated, a single ground lead wire may be used to connect the shields, thus eliminating splicing. These terminations shall be made in accordance with the requirements and procedures specified on ED-92524-10 through -21 and shall meet the requirements of paragraphs 3.08 and 3.09.

F. Terminating Several Cables at the Same Point

3.16 ***Shield-ground connections of several cables at the same point*** may be made, where applicable, using spacers and flag-type shield connectors as shown in Fig 8A. These connections shall be made in accordance with the requirements and procedures specified on ED-92524-10 through -21 and shall also meet the applicable requirements of this section [see paragraph 3.08 (a) through (f)].

4. SPLICING

GENERAL REQUIREMENTS

4.01 ***Television Systems:*** No splices shall be made in any coaxial or twin-conductor office cable in the initial installation. One splice may be made in coaxial or twin-conductor office cable when circuits are later reassigned or rerouted. The distance between splices in adjacent cables shall not be less than 9 inches, center to center.

4.02 ***TD and Other Microwave Radio Systems:*** No splices shall be made in any coaxial cables except as specified on applicable drawings or specifications. No splices shall be made in twin-conductor office cable on the initial installation except as specified on applicable drawings or specifications. One splice may be made in twin-conductor office cable when circuits are later reassigned or rerouted. The distance between splices in adjacent cables shall not be less than 9 inches, center to center.

NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH-21, FIG 54A AND 54B.

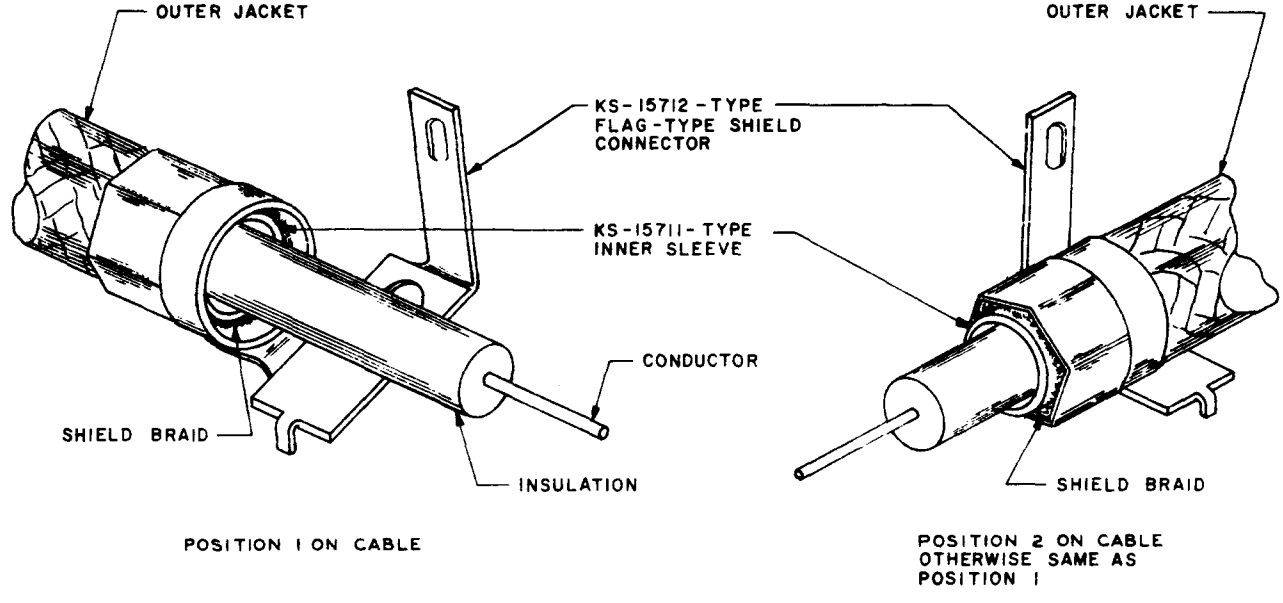


Fig 6A—Flag-Type Shield Connector for Use on Coaxial and Twin-Conductor Office Cable (Coaxial Cable Shown)

4.03 ***L Multiplex Systems:*** No splices shall be made in any coaxial cable except as specified on applicable drawings or specifications.

4.04 ***Other System:*** No splices shall be made in running lengths in coaxial cable except in runs over 100 feet, in which case not more than one splice may be made. (This does not apply to pigtail terminal splices.) Not more than one splice may be made in any twin-conductor office cable when equipment is initially installed. The distance between splices in adjacent cables shall not be less than 9 inches, center to center. Spliced cable ends shall not be shorter than 2 feet.

SPECIFIC REQUIREMENTS

4.05 ***Splices in coaxial cable (except RG-59B/U cable)*** shall be made using 219-type connectors as specified on ED-92524-20. ***Splices in twin-conductor office cable and RG-59B/U coaxial cable*** shall be made as specified on ED-92774-11. The crimped shield connections of the splice shall meet the requirements for crimped shield connections specified in paragraphs 5.12 through 5.14. The soldered center conductor connections of the splice shall meet the requirements for soldering center conductors specified in paragraph 5.18.

4.06 Three resistors connected in a pi configuration (pi pad cartridge) per ED-92731-31 may be used to splice a coaxial cable when a fixed amount of transmission loss is desired. The cable ends are attached to the pad cartridge in accordance with ED-92731-10. Four resistors connected in a square configuration (square pad cartridge) per ED-92839-30 are used for twin-conductor office cable, and the cable ends are attached to the square pad cartridge in accordance with ED-92839-10.

4.07 The spliced cables shall not be pulled along cable racks or within the wiring ducts of frames.

4.08 Where a connector, such as the 219-type, is used for terminating KS-19224 miniature

coaxial cable to any larger size coaxial cable, the connector should be located, where practicable, so that it will be entirely supported by the larger cable. Where this is not practicable, the larger cable should be supported so as to eliminate any strain on the terminated end of the miniature coaxial cable.

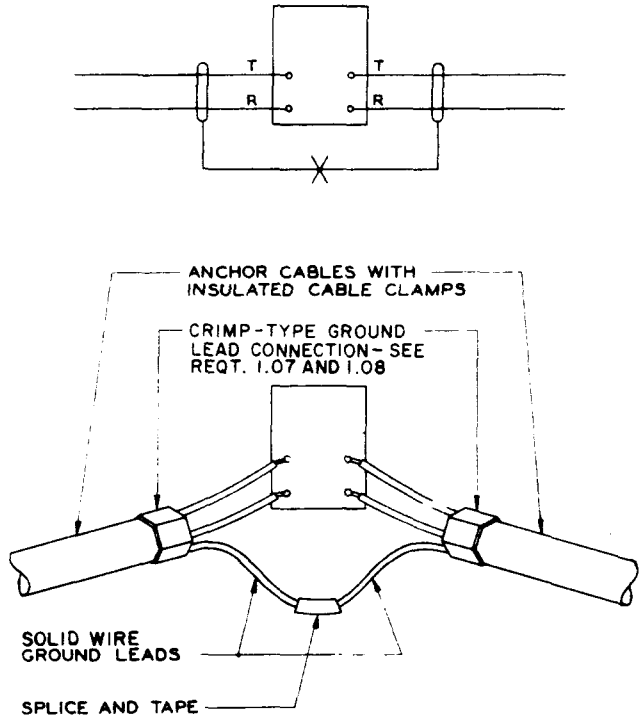


Fig 7A—Method of Connecting Ungrounded Shields of Two Twin-Conductor Office Cables (Crimp-Type Ground Lead Connection Shown)

4.09 ***Splices in shielded wire*** should be avoided wherever possible. However, where necessary, splices may be made with crimp-type connectors as shown in Fig 15. Splicing shall be as specified on ED-92524-10 through -21, and the crimped shield connection shall meet the requirements of paragraph 3.08.

5. TERMINATING AND CONNECTING

SHIELDED WIRE

5.01 Except where otherwise specified, ***the shield of shielded wire*** shall be terminated approximately 1-1/2 inches from the terminals of apparatus, whether or not the ends of the shield are grounded. Termination of the shield shall be in accordance with Part 3 of this section or as shown in Fig 17. Crimped shield connections per Fig 17 shall be made in accordance with the requirements and procedures specified on ED-92524-10 through -21 and shall also meet the requirements of paragraph 3.08 (a) through (e).

5.02 ***At terminal strips with fanning strips,*** the shield shall be terminated as closely as practicable to the fanning strip.

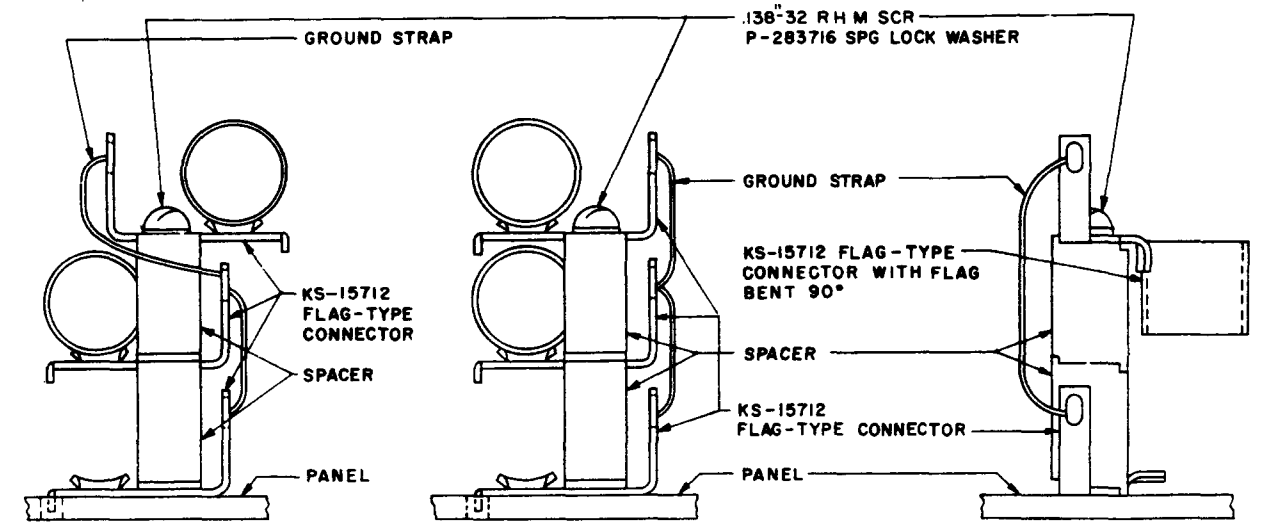
5.03 ***At 224-type (well-type) terminal strips,*** where the shielded wire is connected to the front (apparatus side) of the terminal strip, the shield of the shielded conductors shall be terminated just back of the grommet in the mounting plate on which the terminal strips are mounted.

5.04 ***At D-type terminal strips,*** where the shielded wire is connected to the front (apparatus side) of the terminal strip, the shield of the shielded conductors shall be terminated just back of the throat of the terminal strip.

5.05 ***In local cables,*** the shield of the shielded conductors may be terminated as near as practicable to the breakout point when the 1-1/2 inch dimension cannot be maintained.

5.06 ***When shields are grounded at the back of a fanning strip of a terminal strip,*** the ground lead shall be run along the back of the fanning strip and brought through the fanning hole opposite the ground terminal on the strip.

5.07 ***Where punchings are provided at the apparatus for grounding,*** the shield ground lead shall be dressed in the same manner as the skinners from the shielded wire itself.



NOTES:
1. THIS FIGURE FOR USE ONLY WHERE INDUCTANCE IN GROUND STRAP CAN BE TOLERATED.
2. FOR MORE DETAILED INFORMATION, SEE ED-92524-10 THROUGH -21, FIG 70.

Fig 8A—Method of Terminating Several Cables at the Same Point

5.08 ***Inner conductors of shielded wire*** shall be terminated in accordance with Section 800-612-154 covering connecting and soldering individual conductors.

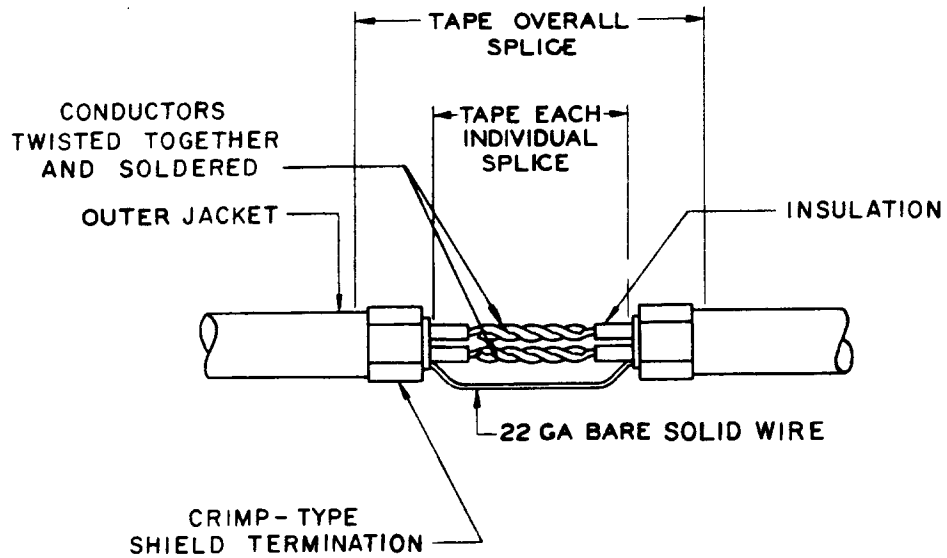
COAXIAL AND TWIN-CONDUCTOR OFFICE CABLE

5.09 Coaxial and twin-conductor office cable (balanced pairs) may be terminated at apparatus by using a flag-type shield connector as indicated in paragraph 3.14 to anchor the cable to the panel before connecting the conductor, or as indicated in paragraph 5.01. Crimped connections per paragraph 5.01 shall meet the requirements of paragraph 3.08 (a) through (f).

5.10 ***Terminations of coaxial and twin-conductor shielded office cables at coaxial-type jacks, plugs, connectors (splice-type etc), and similar-type apparatus*** shall be made in accordance with ED-92524-10 through -21. In addition, the terminations shall meet the applicable requirements of paragraphs 5.11 through 5.19.

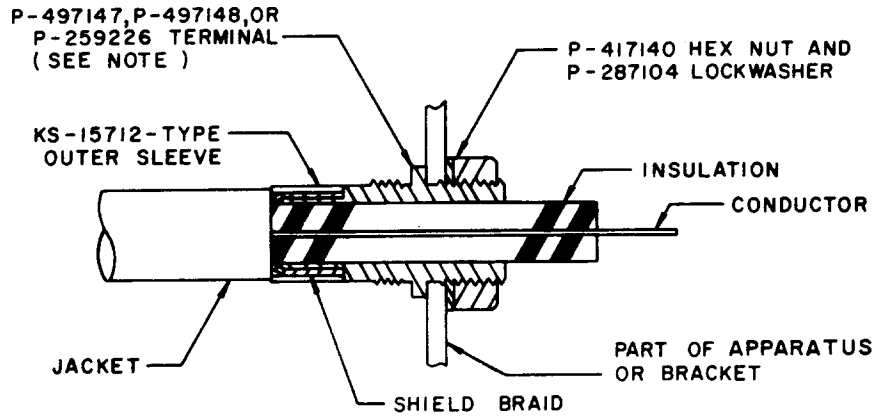
5.11 On coded cord and patchcord assemblies, where cable terminations are made at 466-, 477-, 503-, 552-, 557-, or similar-type jacks, or 358-, 374-, 408-, or similar-type plugs, apply sealing compound (Glyptal Lacquer) per MS-58307 to the screw hole preceding insertion of the screw for final assembly of the shell to the body of the jack or plug.

5.12 ***Crimp-type shield connections to coaxial-type jacks, plugs, connectors, and similar-type apparatus*** shall meet the following requirements:



NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH-21, FIG 63B

Fig 15—Method of Splicing Shielded Wires



NOTE:
FOR DETAILED INFORMATION, SEE ED-92524-10 THROUGH-21, FIG 65.

Fig 17—Method of Terminating Shielded Wire and Coaxial and Twin-Conductor Office Cable at Apparatus

Note 1: It is important that care be exercised in the relative positioning of the shield braid and outer sleeve connector over the sleeve-type terminal of the jack, plug, etc, to ensure that the shield braid is fully sandwiched between the sleeves when making a crimp connection.

Note 2: The operation of the crimping tool should be checked periodically to assure that the dies of each die set are in contact with each other when the tool is in the fully closed position and that the tool does not release, when making the crimp, until the fully closed position of the dies is achieved.

(a) No portion of the outer covering of a cable shall be crimped under the outer sleeve.

(b) The crimped outer sleeve shall be located within 1/32 inch of butting against the jack, plug, etc.

(c) The crimped portion of the outer sleeve shall be 1/4 inch minimum measured along the axial dimension of the sleeve.

(d) The crimped outer sleeve shall exhibit six approximately flat surfaces with no fins or excessive rounding at the 60-degree corner bends.

(e) The crimped outer sleeve shall show no evidence of double crimping (a double crease at the corners of the outer sleeve).

(f) The crimped outer sleeve shall be free of fractures or cracks.

5.13 Crimped shield terminations to connectors, jacks, plugs, etc, shall be capable of meeting the minimum torques specified below. The torque test shall be made with the body of the connector, jack, or plug held stationary and the torque applied to the crimped outer sleeve in either direction. This requirement may be considered met if no movement occurs in the outer sleeve.

DIAMETER OF CRIMPED CABLE (INCHES)	MINIMUM NON-TURNING TORQUE (INCH-POUNDS)
0.100 or Less	1.0
0.101 to 0.200	1.2
0.201 to 0.300	4.0
0.301 or Larger	6.0

5.14 Unless otherwise specified, coaxial cable assemblies shall be capable of meeting a 500-volt ac breakdown test per specification X-38, supplement C, or a 750-volt dc breakdown test per supplement E. The voltage shall be applied between the center conductor terminal and the outer conductor (body) of the jack, plug, or connector. This test shall not be performed on coaxial cable assemblies that are connected in the circuitry with other electrical apparatus or equipment, or cable assemblies that include components such as resistors as a part of their circuitry.

5.15 Coaxial cable skinner terminations shall be in accordance with the requirements of Section 800-612-154 covering the connecting and soldering of individual conductors. Where a skinner must be bent on such a small radius as to cause stress on the termination (which might be the case where large-diameter coaxial cables are provided), the insulation of the skinner shall be removed and replaced by KS-7851 sleeving prior to making the connection.

5.16 ***On 754-, 760-, and 761-type cables,*** the blue lead of the pair shall be considered ring and the white lead tip, unless otherwise specified.

5.17 ***Where a coaxial cable terminated in a 210A connector is to be connected to a 207A terminal,*** the inner conductor of the cable shall be soldered to the terminal. The shell of the connector shall then be tightened on the terminal and locked with the nut (provided as a loose part with the connector) to prevent rotation of the cable.

SOLDERING

5.18 ***Connecting and soldering of the center conductor of a cable to the center terminal of a connector, jack, plug, or similar-type apparatus*** shall be in accordance with the applicable requirements of Section 800-612-154 and as specified in the rest of this part of this section.

Note: Where a crimped shield connection is to be made to the sleeve-type terminal of the jack, plug, etc, it is recommended, where practicable, that the crimp connection be made prior to soldering the center conductor connection. This will help prevent movement between the center conductor of the cable and the terminal on the apparatus when soldering and thus minimize the possibility of cold solder joints.

(a) For shielded wire or cable not provided with tinned conductors, the skinned conductors shall be solder-coated prior to making the soldered connection.

(b) ***Where the center conductor of a cable is inserted into a tubular-type terminal of a connector, jack, plug, etc, for soldering,*** it shall be visible in at least one-half of the cutaway portion of the terminal prior to soldering. For connectors such as the 219 type, the contour of the center conductor (wire) shall be discernible within the connector terminal after soldering of the center conductor has been completed.

(c) There shall be no solder icicles, solder splashes, or foreign matter in the cavity of the connector, jack, plug, etc, that houses the soldered connection.

5.19 Care must be exercised when soldering center conductors of cable or wire having Pe insulation because of the low melting point of Pe. All soldering should be done with rosin-core solder having a minimum tin content of 40 percent.

6. CHECKING LIST FOR FIGURES

6.01 The figure numbers in this section are referred to in associated instructions and drawings. In order that these references may remain correct, the figure numbers used in this and subsequent issues of this section will not be changed.

6.02 The complete list of all figures used in this issue is as follows:

FIGURE	TITLE
1	Method of Forming Shielded Wire
2,3,4,5,6,7,8, 9,10,11,12,13, 14,16	Discontinued with Issue 2
5A	Crimp-Type Ground Lead Connection to Shields of Shielded Wire and Coaxial and Twin-Conductor Office Cable
5B	Discontinued with Issue 8; Covered in Fig 104 of ED-92524-19
5C	Wrap-Soldered Ground Lead Connection to Shields of Shielded Wire or Cable
5D	KS-21372, Shield-Sleeve-Type Ground Lead Connection to Shield of TFE- or PTFE-Insulated Shielded Wires and Cables
5E	KS-21372, Shield-Sleeve-Type Ground Lead Connection to Shield of Shielded Wires or Cables Not Provided With TFE- or PTFE-Insulated Conductors
6A	Flag-Type Shield Connector for Use on Coaxial and Twin-Conductor Office Cable
6B	Discontinued with Issue 7; covered in Fig 54A and 54B of ED-92524-15
7A	Method of Connecting Ungrounded Shields of Two Twin-Conductor Office Cables
8A	Method of Terminating Several Cables at the Same Point
9A	Discontinued with Issue 7; covered in Tables C and D of ED-92524-16 and -17, respectively
11A	Discontinued with Issue 5D
15	Method of Splicing Shielded Wire
17	Method of Terminating Shielded Wire and Coaxial and Twin-Conductor Office Cable at Apparatus

7. REASONS FOR REISSUE

7.01 To revise paragraph 1.03 to indicate that the requirements of ED-92524-( ) shall be followed except where otherwise specified.

7.02 To add paragraph 1.04 to indicate that sewing of shielded wire and cable forms shall be in accordance with Section 800-612-153.

7.03 To add paragraph 1.05 to include abbreviations for wire insulations.

7.04 To add paragraph 1.06 to include a list of applicable sections which are supplemental to this section.

7.05 To revise paragraph 1.09 (formerly paragraph 1.06) to remove reference to BK wire (rated Mfr Disc) and to include reference to KS-21238 and KS-22247 L2 shielded wires.

7.06 To revise paragraph 1.11 (formerly paragraph 1.08) to indicate that heat-shrinkable tubing may be used to protect Pe-, IPvc-, or PvcCBL-insulated wires if a barrier is provided under the shield braid.

7.07 To revise paragraph 1.14 (formerly 1.11) to include COMCODES for two alternative plastic tapes.

7.08 To revise paragraph 1.15 (formerly 1.12) to include references to KS-21112 coaxial cable for the CU symbol, and to KS-21238, KS-22247 L2, P5, and 479R shielded wire for the EU symbol; also to omit reference to BK-type wire (rated Mfr Disc) and to add reference to KS-13385 wire for the U symbol.

7.09 To revise Table A as follows: to include information for 724B, 728B, 730B, and 731B cables and for KS-13385 and KS-22247 L2 wires; to change the code of 479M wire to 479R and the associated symbol from U to EU; to include information for 20- and 24-gauge P5-type wire, and to change the symbol from U to EU; to change the conductor insulation for the 479- and P-type wires from PvcCL to IPvc to omit reference to AK- and BK-type wires since they are now rated Mfr Disc; and to omit reference to DP wire (shielded per X-17198) since P5-type wire is identical.

7.10 To revise paragraph 2.06 to refer to rigid polyvinyl chloride tubes instead of paper or fiber tubes.

7.11 To revise paragraph 2.07 and to add note on the treatment fo cables such as KS-21112 and KS-19689 types.

7.12 To omit paragraph 2.07(c) concerning protection of coaxial cables at cable brackets since this information is covered in Section 800-612-153 which is now referred to in the note of paragraph 2.07.

7.13 To add to paragraph 3.02, reference to Section 800-612-154 for terminating the ground lead to apparatus terminals.

7.14 To revise paragraph 3.03 to indicate that the application of heat for soldering, or applying heat-shrink tubing or shield sleeves is permissible and that protection with sleeving may be required.

7.15 To revise paragraph 3.06 to omit reference to the cast-soldered ground lead connection because such connections are not being made.

7.16 To revise paragraph 3.07(a) to delete reference to the KS-15710 crimping tool and to include information for the KS-22214 tool.

7.17 To add note to paragraph 3.07 on checking the crimping tool operation.

7.18 To omit from note of paragraph 3.08, checking of crimping tool operation.

7.19 To omit information for cast-soldered ground lead connections (formerly paragraphs 3.10 and 3.11 and Fig 5B) because such connections are not being made.

7.20 To include in paragraph 3.10 (formerly paragraph 3.12) reference to KS-19195 and KS-19224 cables.

7.21 To revise paragraph 3.12 (formerly paragraph 3.14) to change reference for sleeves from L30 to L36.

7.22 To revise Fig 5D and 5E to omit reference to the KS-21372 list numbers in the figure captions and to change these list numbers in the figure callouts.

7.23 To clarify note 2 of paragraph 5.12 on crimping tool operation.

7.24 To revise paragraph 5.15 to indicate that coaxial cable skinner terminations shall be in accordance with Section 800-612-154.

7.25 To add to paragraph 5.16 reference to 761-type cables.

7.26 To add to paragraph 5.18(b) information that the contour of the center conductor (wire) shall be discernible after soldering for connectors such as the 219-type.

7.27 To change 6.02 for clarification.