

MIL-STD-1664A(EC)

19 August 1981

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MILITARY STANDARD

CONNECTION, ELECTRICAL
CLIP TERMINATION



FSC 5935

MIL-STD-1664A(EC)
19 August 1981

DEPARTMENT OF DEFENSE
Washington, D.C. 20301

Connection, Electrical Clip Termination
MIL-STD-1664A(EC)

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1. SCOPE

1.1 Scope. This standard establishes the requirements for producing a mechanically and electrically stable electrical clip termination made with stranded or solid wire and appropriately designed terminal posts. This standard includes:

- a. Inspection procedure for electrical clip termination.
- b. Requirements and test methods for assuring reliable electrical terminations.

2. REFERENCED DOCUMENTS.

2.1 Government documents. The following documents form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-B-750 Bronze, Phosphor, Bar, Plate, Rod, Sheet, Strips, Flat Wire, and Structural and Special Shaped Sections.

QQ-W-343 Wire, Electrical (Uninsulated).

MILITARY

MIL-T-10727 Tin Plating, Electrodeposited or Hot-dipped, for Ferrous and Nonferrous Metals.

MIL-W-16878 Wire, Electrical, Insulated, High Temperature.

MIL-G-45204 Gold Plating, Electrodeposited.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Terms. The following is a list of key terms used in this standard: (See figure 1.

3.1.1 Electrical clip termination. Consists of a length of wire, automatically stripped, compressed, wiped along the terminal post during the termination process and held in place by a metal clip. The process is accomplished by either hand tool application or by automatic point to point wiring machines.

3.1.2 Insulation support. The pre-formed area of the electrical clip which holds the insulation securely for the purpose of preventing creep between the wire and insulation to insure that the wire is not under stress where it enters the clip.

3.1.3 Contact area. The stripped area of the wire which is in intimate contact with the terminal post.

3.1.4 Gas tight area. The area between the terminal post and stripped wire which due to the compression of the wire against the terminal post by means of the electrical clip will exclude gas fumes.

3.1.5 Strain relief. Outward flange of the electrical clip designed to prevent conductor nicking.

3.1.6 Crown. Outward embossing of the electrical clip web to correctly position the conductor and bundle the stranded wire during application.

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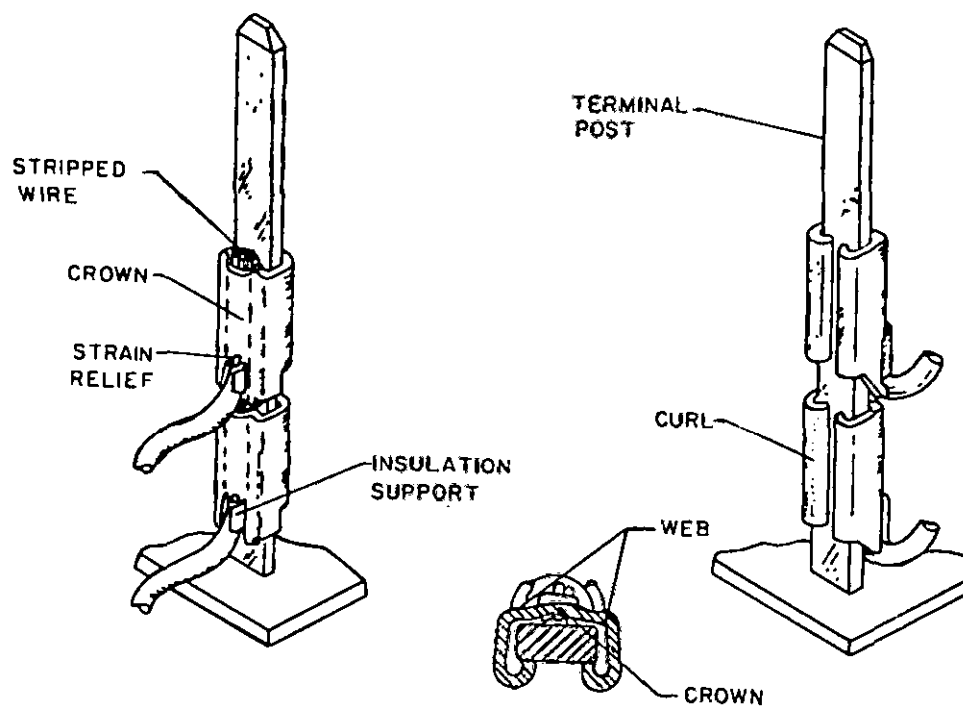


FIGURE 1. Terminology for electrical clip terminations.

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3.1.7 Web. The body of the electrical clip which presses the stripped wire against the terminal post.

3.1.8 Serrations. Internal cross scoring at the crown to prevent wire slippage relative to the electrical clip during application and to provide electrical redundancy.

3.1.9 Curl. Pre-formed area of electrical clip in contact with the terminal post.

4. GENERAL REQUIREMENTS.

4.1 Description. Electrical clip terminations are designed to provide a reliable electrical and mechanical termination for use with stranded and solid conductors in ranges from 30 through 22 AWG. These terminations are achieved for using the appropriate clip, tool, terminal post combination and selected wire types.

4.1.1 Plating. Electrical clips and terminal post shall be either tin, gold or tin nickel plated.

4.2 Post size and spacing. Electrical clips are designed to accommodate the wire size and insulation diameters listed. Terminal post spacing is also tabulated.

TABLE I. Post size, spacing and military wire specifications.

Post size	Wire size AWG		Insulation dia.		Spacing Min	Military wire MIL-W-16878 Slash sheet	Specification Type
	Min	Max	Min	Max			
.022 x .036 (0.55x0.91mm)	30	28	.018 (0.45 mm)	.029 (0.73 mm)	.100 (2.54 mm)	/6	ET
.031 x .062 (0.78x1.57mm)	28	22	.022 (0.55mm)	.065 (1.65 mm)	.125 (3.17 mm)	/4 /5 /6	E EE ET

5. DETAILED REQUIREMENTS

5.1 Wire.

5.1.1 Conductor. The wire to be terminated may be either stranded or solid conductor within the appropriate or permissible wire range. Stranded wire shall comply with MIL-W-16878 and QQ-W-343 for solid conductors.

5.2 Electrical clip.

5.2.1 Clip material. Electrical clips shall be manufactured from phosphor bronze conforming to QQ-B-750.

5.2.2 Clip finish. Tin plating shall conform to MIL-T-10727. Gold plating shall conform to MIL-G-45204. Tin nickel shall be nominally 60 percent tin and 40 percent nickel.

5.3 Terminal post.

5.3.1 Terminal post geometry. Unless specified in the applicable procurement document, the terminal post shall be either 0.031 x 0.062 inch nominal (0.78 x 1.57 mm), or 0.022 x 0.036 inch nominal (0.55 x 0.91 mm). Post edge radius shall not exceed 0.003 inch (0.07 mm) on .022 inch x .036 inch posts and .005 inch on .031 inch x .062 inch posts, edge burrs shall be 0.0015 inch (0.050 mm) maximum.

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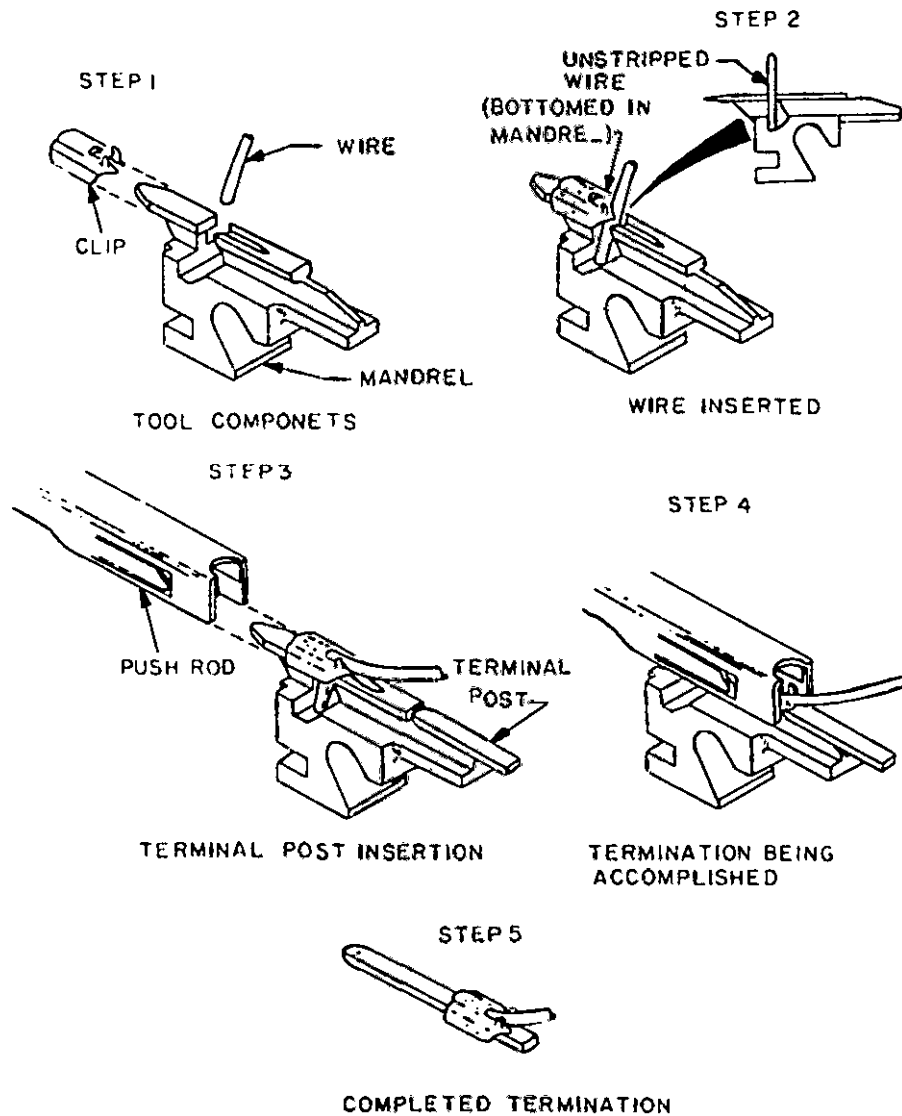


FIGURE 2. Application process.

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5.3.2 Post material. Terminal posts shall be made of copper-base alloys in accordance with the applicable drawings.

5.3.3 Post finish. Gold plating shall be in accordance with MIL-G-45204, Type II, Grade C, Class 1, except that silver underplating shall not be used.

5.3.4 Parallelism. Terminal posts shall be straight and parallel within 0.005 inch per inch (0.12 mm).

5.3.5 Tip configuration. The tip of the terminal post shall terminate in a radius or bevel.

5.4 Application process. The termination technique is illustrated on figure 2.

5.5 Inspection process. Electrical clip terminations shall be made with either hand held or machine tools capable of applying the clips which conform to the requirements of this standard.

5.5.1 Visual inspection. The following steps shall be used to assure proper termination procedure. (See figures 3 and 4 for visual inspection standards).

- a. Stripped wire shall be visible at the back end of the electrical clip (see figure 3).
- b. Clip curls shall grip terminal post in correct manner.
- c. Clips shall not override one another.
- d. The first clip applied shall not bottom on panel and shall not rest on chamfer (if present - See figures 3 and 4) of terminal posts.
- e. The minimum distance between the clip and panel shall be at least equal to the wire insulation diameter of the terminated wire.

5.5.2 Mechanical inspection. Any termination selected at random shall be capable of meeting the requirement for clip retention as specified in 5.7.1.

5.6 Field service process. To free the wire from the terminal post the technique for removal and positioning of an electrical clip termination shall be performed as follows: (See figure 6).

5.6.1 Removal.

- a. Hold electrical clip extraction tool parallel to terminal post and hook extraction tool tip under the curl of the electrical clip.
- b. Close handles and twist extraction tool away from the open portion of the electrical clip.
- c. Remove electrical clip from the extraction tool and discard.

5.6.2 Positioning.

- a. Push existing electrical clips, if necessary, one at a time, to the desired position on the terminal post using the electrical clip positioning tool.
- b. A new electrical clip termination may be applied if desired on the remaining terminal post.

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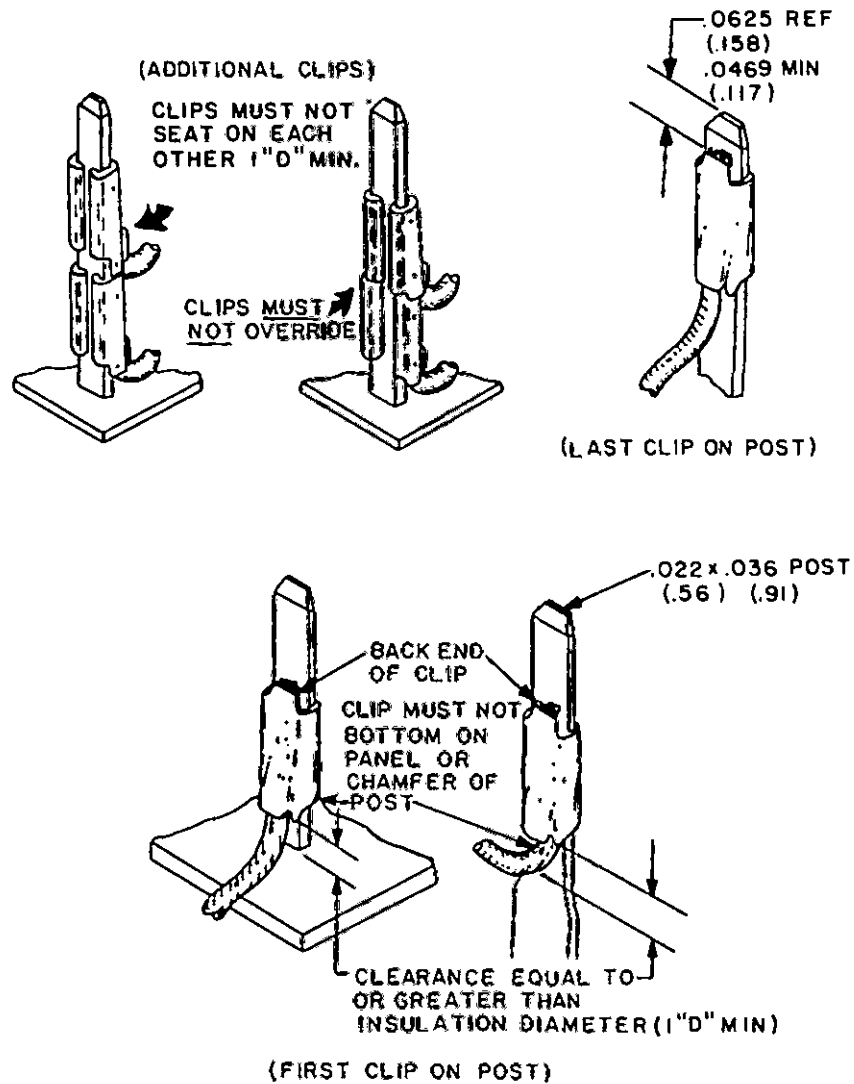


FIGURE 3. Visual inspection process .022 x .036 posts

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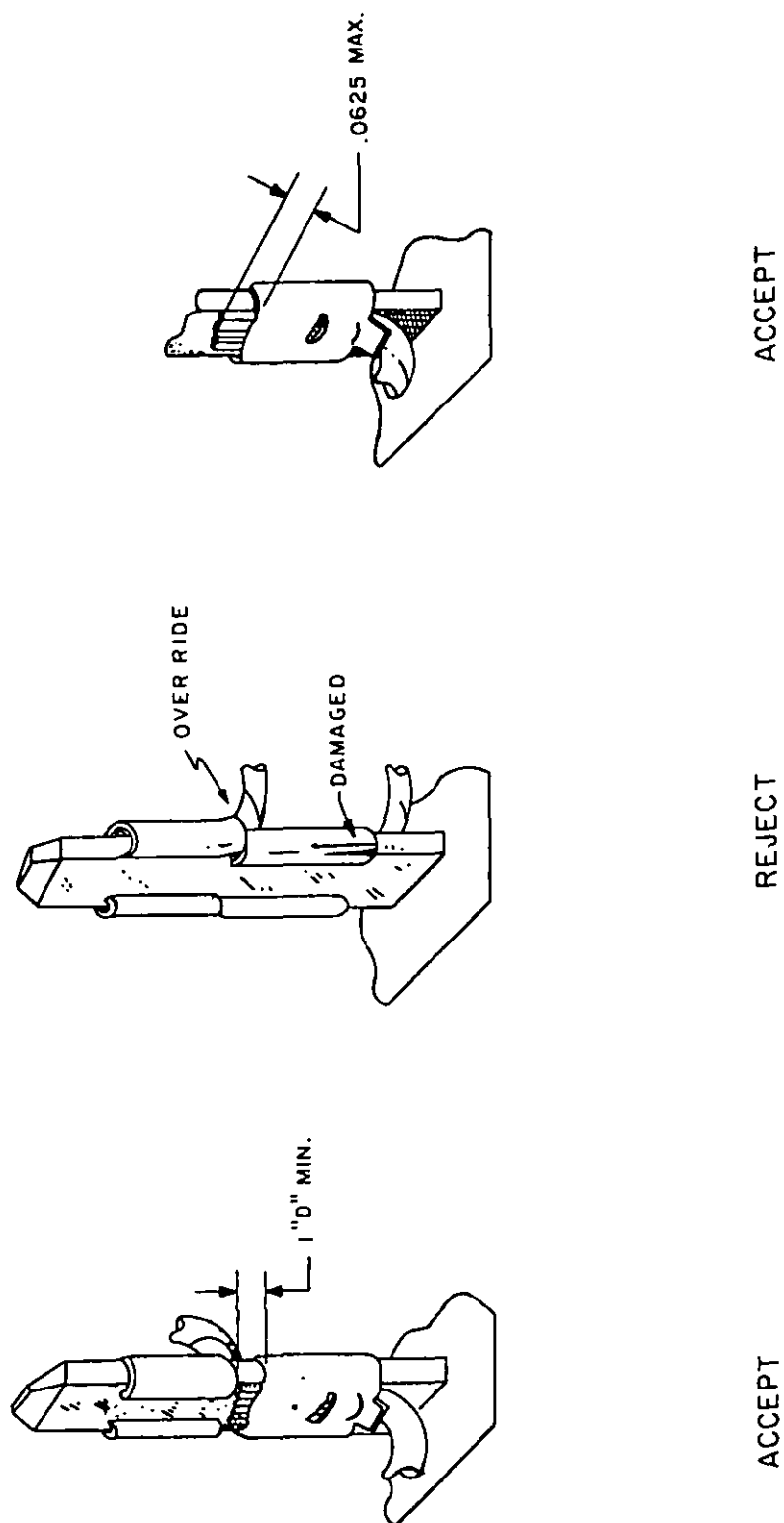


FIGURE 3. Visual inspection process .022 x .036 posts - Continued.

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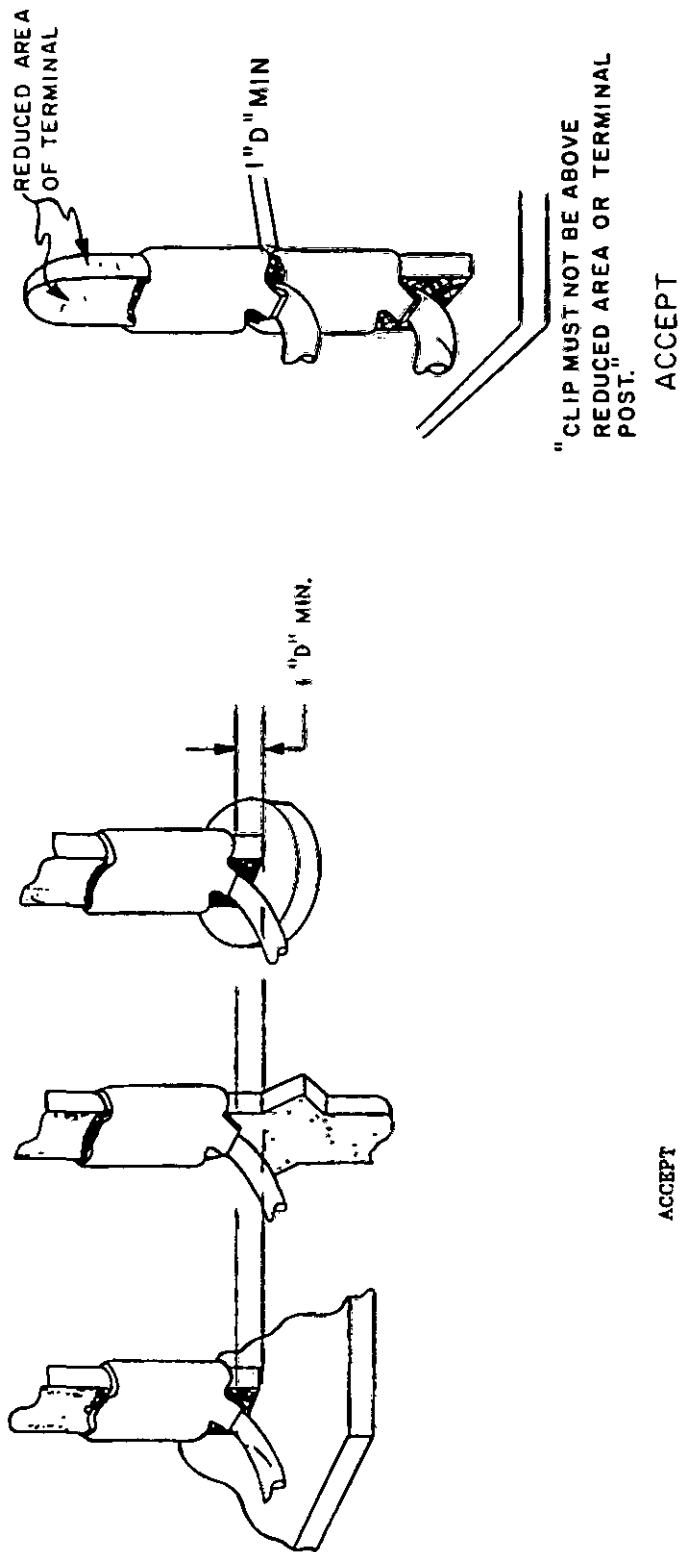
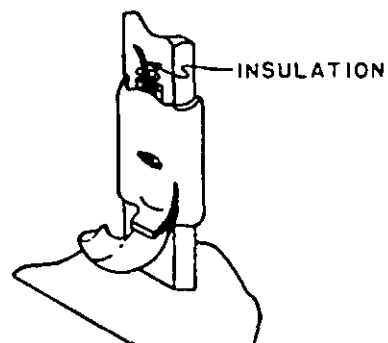


FIGURE 3. Visual inspection process .022 x .036 post - Continued.

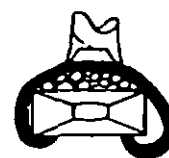
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FIGURE 3. Visual inspection process .022 x .036 posts - Continued.

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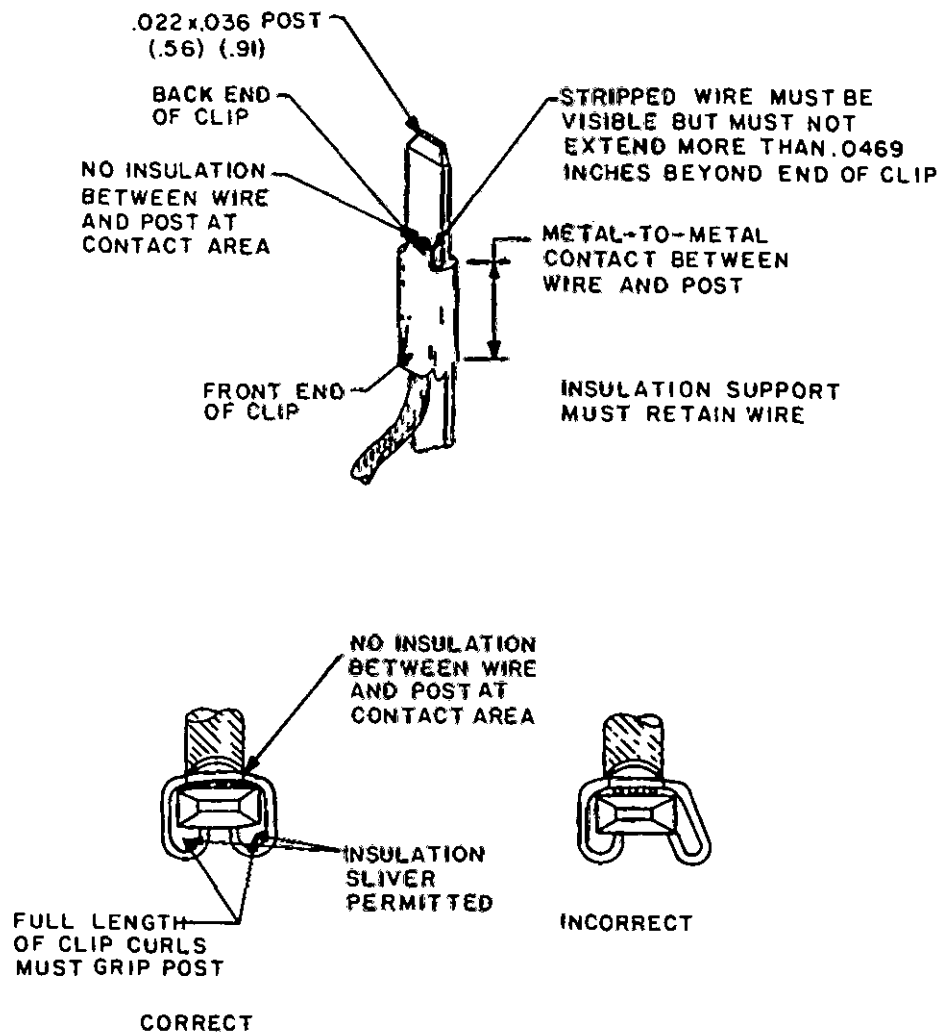


FIGURE 4. Visual inspection process .022 x .036 posts.

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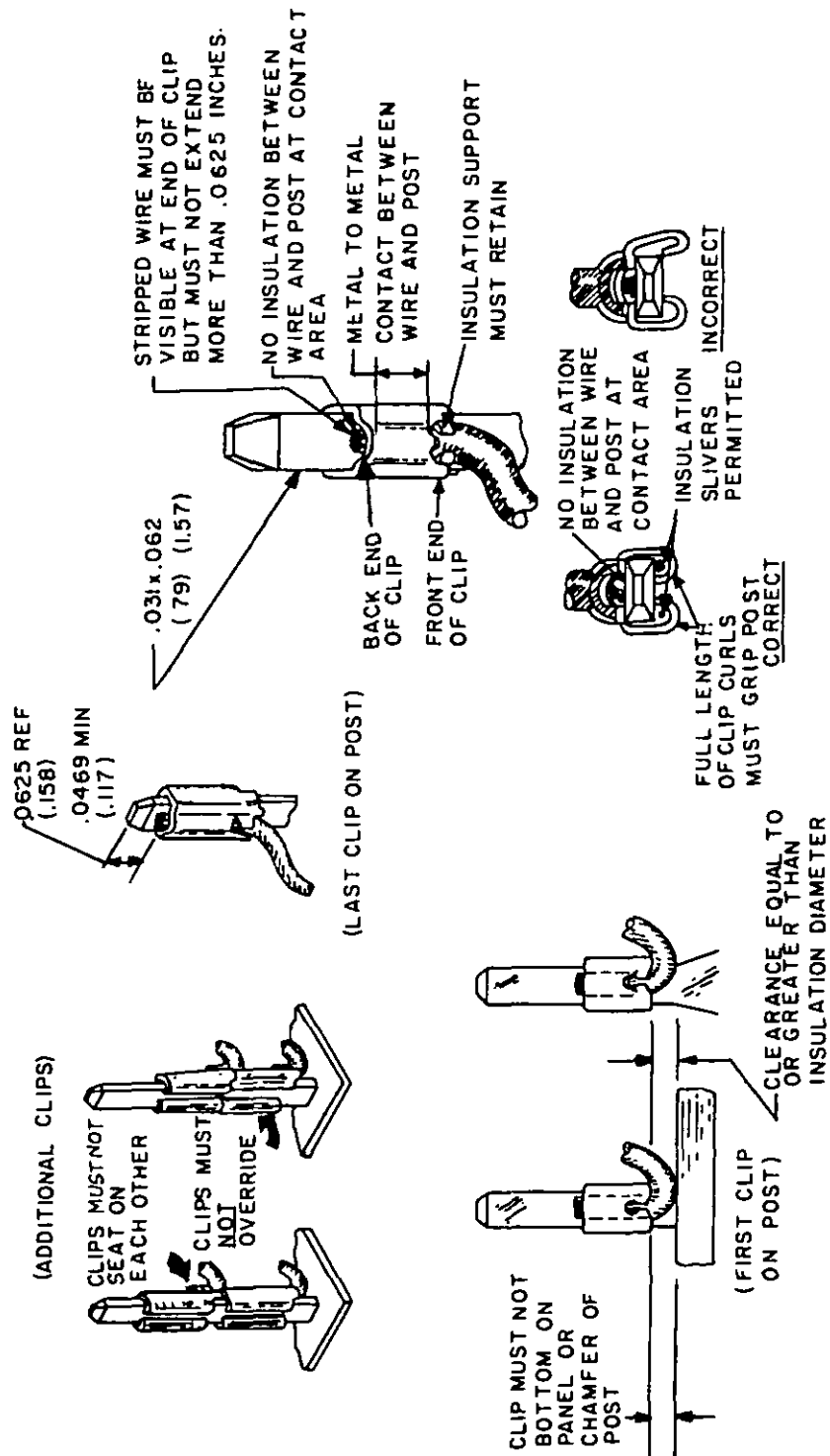
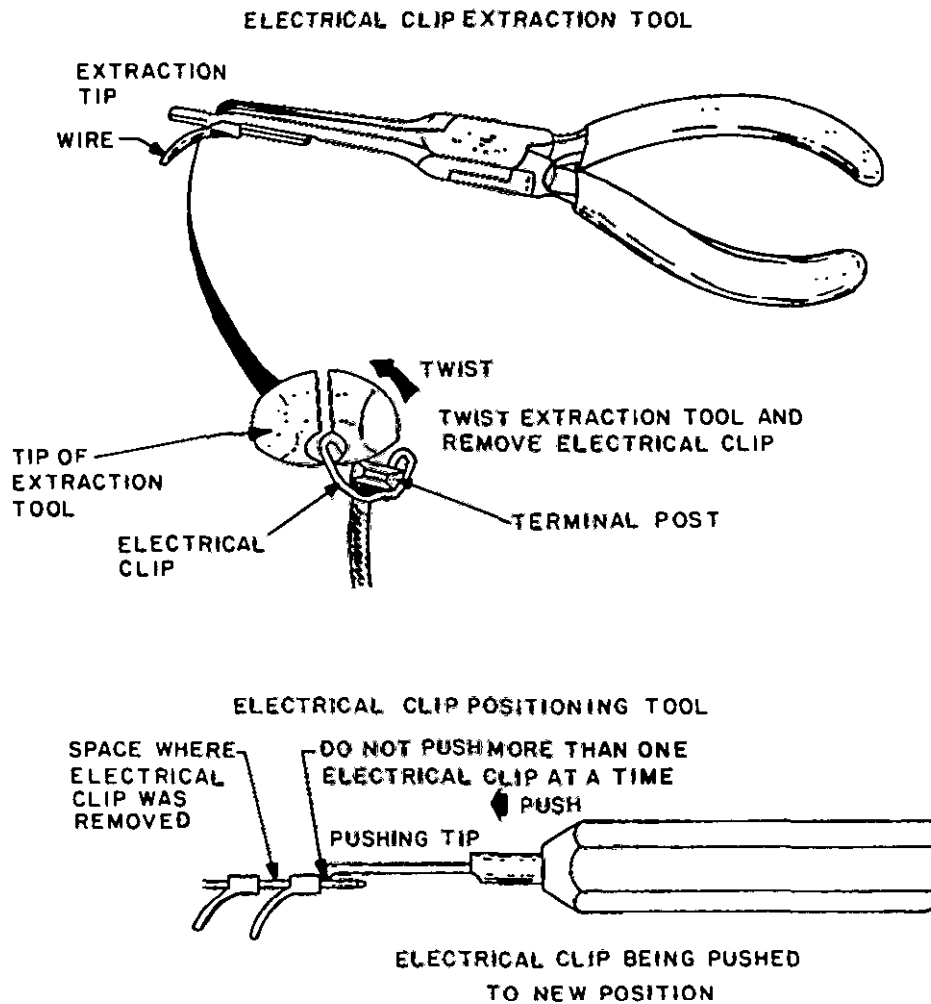


FIGURE 5. Visual inspection process for .031 x .062 posts.

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FIELD SERVICE PROCESS

FIGURE 6. Field service process.

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5.7 Performance requirements of electrical clip terminations.

5.7.1 Clip retention. Clip retention shall be employed as a nondestructive inspection of termination quality. During the test, the clip may move in the lateral direction, or up to one-half the clip length and be considered acceptable, provided a minimum retention force specified in table II is achieved.

5.7.1.1 Method of test. The terminal post shall be held in a fixed position and an axial force shall be applied to the clip with a mechanical force gage. The force shall be applied at an approximate rate of 0.5 inches (12.7 mm) per second. The recommended procedure for attachment of the force gage is illustrated on figure 7.

TABLE II. Clip and wire retention.

Clip size	Minimum retention
.022 x .036 (0.55 x 0.91 mm)	.5 lbs. (.277 Kg)
.031 x .062 (0.78 x 1.57 mm)	2.25 lbs. (1.02 Kg)

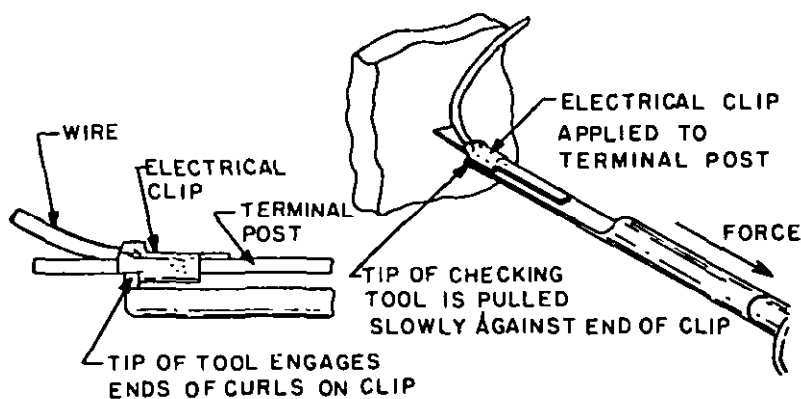


FIGURE 7. CLIP RETENTION

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5.7.2 Wire retention. The terminated wire shall remain intact and shall not pull from the clip when the applicable axial force is applied.

"Minimum wire retention shall be as specified in Table II and the sample shall be discarded after test."

5.7.2.1 Method of test. The terminal post shall be held firmly while an axial force is applied to the wire as illustrated on figure 8. The force shall be applied at an approximate rate of one inch per minute.

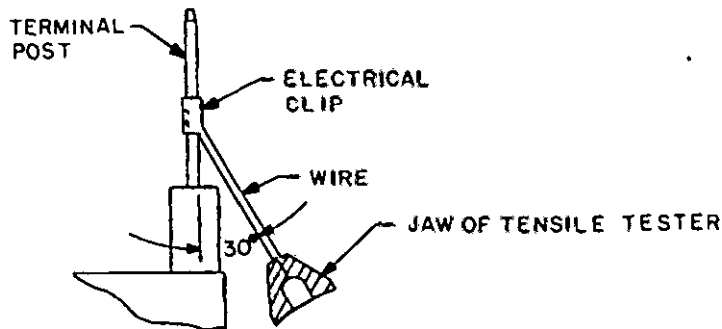


FIGURE 8. WIRE RETENTION

5.7.3 Gas tight area. Area of the electrical clip termination which after gas exposure shall appear bright and in sharp contrast to the discolored area of the terminal post.

5.7.3.1 Method of test. Blacken the electrical clip termination, using the following method (testing to be conducted at room ambient temperature).

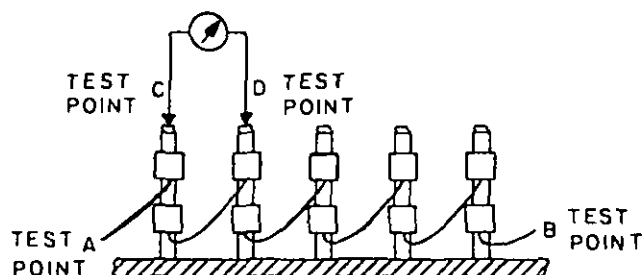
- a. The specimens shall be suspended and corked in a 16 x 150 millimeter (mm) test tube containing approximately 1 to 2 milliliters (ml) of aqua regia solution (1:1 concentrated hydrochloric and nitric acids). The solution shall not touch the specimens. The specimens shall be exposed to the aqua regia fumes for 10 minutes.
- b. The chemically attacked specimens shall be transferred to another 16 x 150 mm test tube containing approximately 1 ml of concentrated ammonium sulphide solution. Suspend the specimens in the test tube so that they will not touch the ammonium sulphide solution. Close the test tube with a cork or rubber stopper and leave the specimens exposed to this atmosphere until they turn black. Copper and gold sulphide color will be developed on all areas exposed to vapor.
- c. Air dry and carefully remove the clip from the terminal post exposing the wire and terminal post.
- d. The gas tight area will appear in bright sharp contrast with the blackened area.

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5.7.4 Low level termination resistance. Termination resistance shall conform to the values of table III when tested as follows:

5.7.4.1 Method of test. Terminations prepared as illustrated on figure 9 shall be energized at points A and B using 50 milliamperes direct current with an open circuit voltage limited to 50 millivolts. Voltage drop measurements shall be taken between points C and D. "L" (Total length of cut wire) dimensions shall be maintained $\pm .016$ inch (0.40 mm). "L" dimension for clip size .031 x .062 inch (0.78 x 1.57 mm) shall be 2 inches (50.8 mm) and for .022 x .036 inch (0.55 x 0.91 mm) shall be 1.25 inches (25.46 mm).



"L" = .0156 WIRE LENGTH "TOTAL LENGTH OF CUT WIRE"

FIGURE 9. LOW LEVEL TERMINATION RESISTANCE

TABLE III. Termination resistance.

AWG Wire size	Resistance * milliohms (max)
30	14.0
28	14.0
26	9.0
24	6.0
22	4.0

*Includes resistance of two electrical clips, the resistance of the included length of terminal post, two wire/post contact resistance and "L" length of wire.

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