

**UNSIGNED HARDCOPY
NOT CONTROLLED**



Instruction
Hardware Engineering

No. LMS 11-2

SUBJECT: Solderless Wrapped Electrical Connections

APPROVED BY Manager, Hardware Engineering

STATUS Maintenance Revision

PURPOSE Establishes the requirements for mechanically and electrically stable, solderless-wrapped, electrical connections made with single solid, round-wire, and appropriately designed square and rectangular terminals. L-3 Communications Corporation, Link Simulation & Training Division (hereafter referred to as Link) personnel shall follow the requirements of this instruction whenever solderless wrapped electrical connectors are required on items.

AFFECTED FUNCTIONS Hardware Engineering
Manufacturing

REFERENCES IPC-A-610 Acceptability of Electronic Assemblies- Solderless Wrap

DEFINITIONS Class 3 (solderless wrapped electrical connection) preferred method for military programs. This connection consists of a helix of continuous, solid, uninsulated wire tightly wrapped around the wrap post of a solderless wrapped contact to produce a mechanically and electrically stable connection. The number of turns required will depend on the AWG of wire used. (See Table I.) In addition to the length of uninsulated wire wrapped around the wrap post, an additional minimum half turn of insulated wire shall be wrapped around the wrap post to help insure better vibration characteristics. To accomplish a half turn, the wire must be in contact with at least three corners of the wrap post. (See Figure 1.)

Class 2 (conventional solderless wrapped electrical connection). This connection is the preferred method for programs using commercial standards.

End tail. An end tail is the end of the last turn of wire of a solderless wrapped connection which may extend in a tangential direction instead of resting against the wrap post. (See Figure 1.)

A turn of wire. A turn of wire shall consist of one complete, single helical ring of wire wrapped 360 degrees around the wrap post. For the purpose

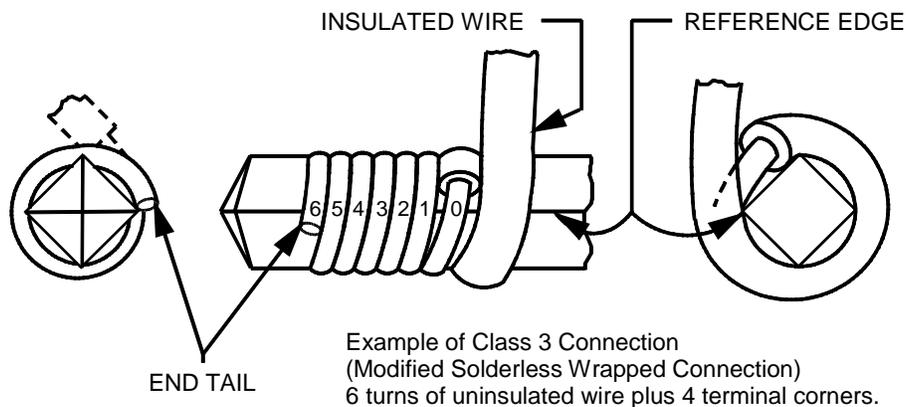
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of counting turns, the number of times the wrapped wire passes and intercepts the reference edge of the wrap post after the first intercept of uninsulated wire and wrap post shall constitute the number of turns of uninsulated wire in the connection.

Reference corner. The corner of a wrap post at which the first turn of uninsulated wire intercepts is the reference corner.



NOTE : For Commercial programs, Class 2 connections may be used.

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Figure 1 Solderless Wrapped Electrical Connection

INSTRUCTION

1. Requirements

1.1 General. For military programs, all connections shall be Class 3.

1.2 Connections.

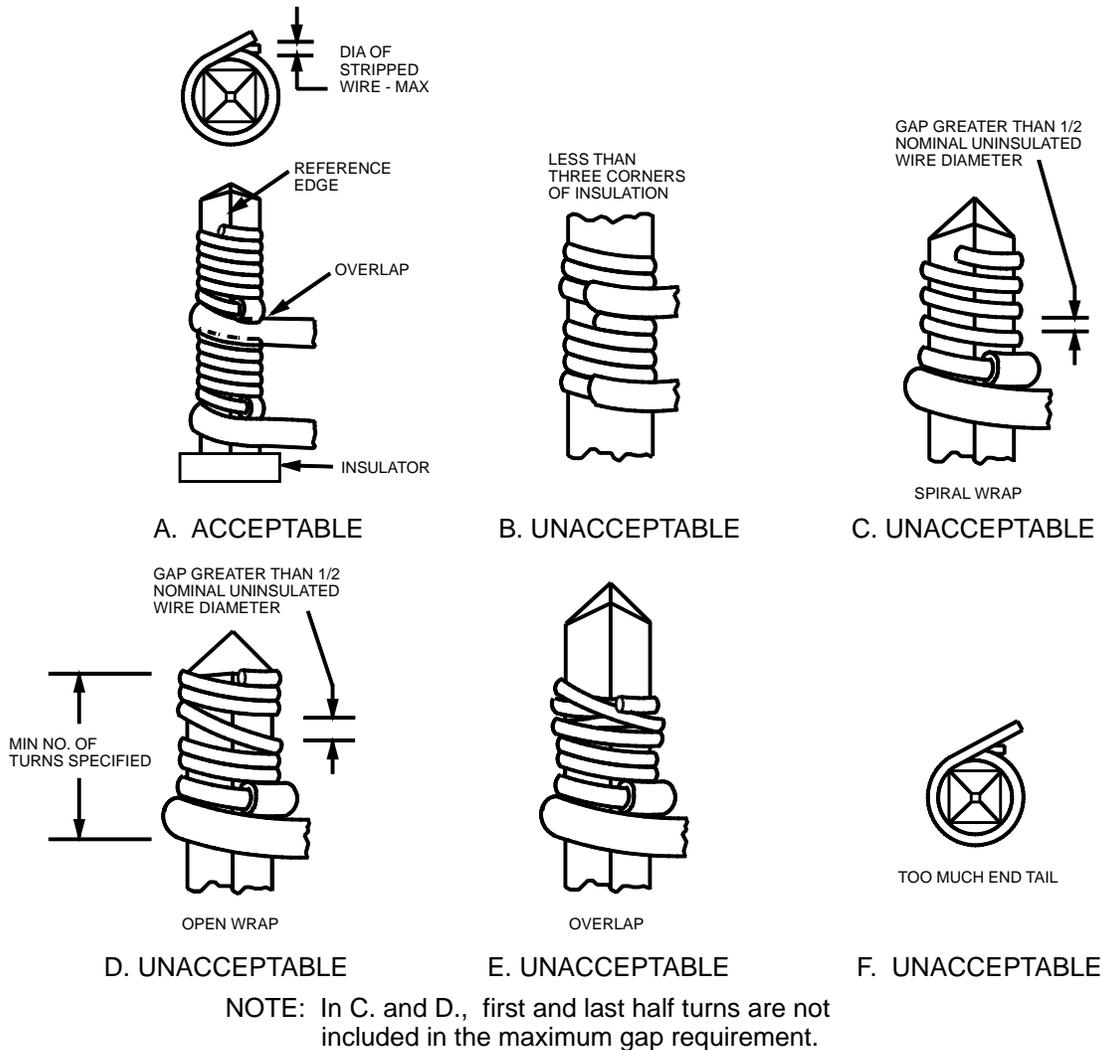
- a. Space between turns of a connection. There shall be no gaps between adjacent turns greater than one-half of the diameter of the uninsulated wire, exclusive of gaps on the first and last turns.
- b. The sum of all gaps (excluding those on the first and last turn) on any side of a connection shall not exceed the diameter of the wire.

NOTE: The previous two statements apply only to the minimum number of turns as specified in Table I.

TABLE I NUMBER OF TURNS

AWG NUMBER	Min No. of Uninsulated Turns
30	7
28	7
26	6
24	5
22	5
20	4
18	4

- c. There shall be no overlapping within the minimum specified number of turns of uninsulated wire except that the first turn of insulated wire in a Class 3 connection may overlap the last turn of uninsulated wire in a connection below it on the same terminal. (See “A” in Figure 2.) Insulation must make contact bite with a minimum of three corners.
- d. The termination of the last turn of a wrapped connection (end tail) shall not extend away from the outside diameter of the stripped wire on the terminal by more than the diameter of the stripped wire. (See Figure 2.) Dressing and clipping of wires must be accomplished so as not to loosen the helix connection.
- e. The minimum number of turns of uninsulated wire per connection shall be as shown in Table I.
- f. The required minimum number of uninsulated turns in a wrapped connection shall not extend beyond the wrapping length of a terminal.
- g. There shall be no visible terminal fracture in a wire-wrapped connection.



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Figure 2 Examples Of Class 3 Connections

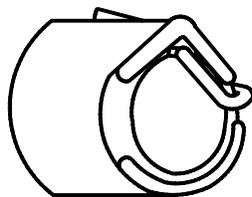
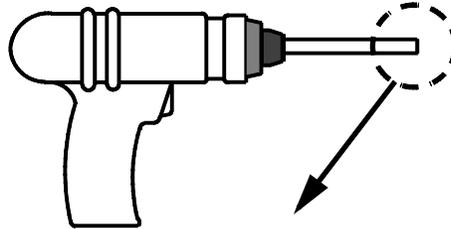
- h. Insulation stripping. The insulation shall be removed by manual or automatic tools. Prior to wrapping, there shall be no exposure of the base metal.
- i. Rewraps. It is not permissible to rewrap the portion of wire that has been previously wrapped on a terminal.

- j. No attempt shall be made to move a wrap on a terminal after the wrap is made. The bond between wire and terminal is destroyed if any adjustments are made after the wrap is completed.
- k. Solderless-wrapped connections and soldered connections may be used on the same terminals, providing the terminal length for the solderless-wrapped connection is free of excess finish coat deposited from the soldering process (not to exceed .0015-inch [0.0038-cm] thickness). The order of placement of solderless-wrapped or soldered connections on the terminal is not important, providing the completed solderless-wrapped connection is not mechanically disturbed.
- l. Assemblies shall be clean and free from wire clippings and other foreign matter.
- m. Wire insulation shall not be cut, torn, frayed, or otherwise damaged away from the post. Small indentations in the insulation .125 inch (0.318 cm) or less from the post, caused by the wire-wrap tool, are acceptable, provided the bare wire is not exposed.

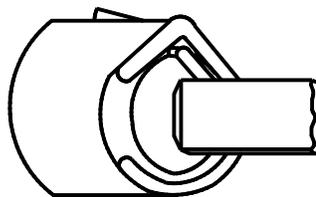
NOTE: For commercial programs, damaged insulation is permissible if there is no danger of exposed wire coming in contact with another conductor.

- n. Insulation cut by a tool during the wrapping operation is acceptable if this cut is included as a portion of the wrap around the terminal.
- o. Wire-wrapping process. Strip the insulation from the wire to a length determined by the gauge and number of turns needed for the connection and perform the following steps:
 - (1) Insert the bare wire into the wire slot of the wrapping bit, butting the insulation of the wire against the bit face. The funnel shape of the sleeve permits easy wire insertion. The wire is then positioned in the notch of the wrapping sleeve. (See Figure 3.)
 - (2) Position the tool with the terminal hole of the wrapping bit over the terminal to be wrapped.

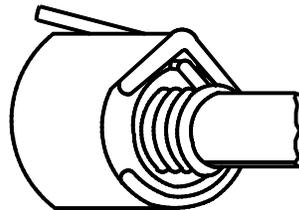
- (3) Squeeze the trigger and apply a slight amount of back force. (Back force is forward pressure applied by the operator, approximately 1.5 pounds (0.68 kg).



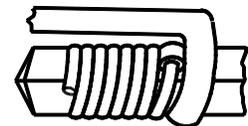
WIRE INSERTION
AND ANCHORING



TERMINAL
INSERTION



WRAPPING



FINISHED
CONNECTION

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Figure 3 Wire Wrapping Process

- p. The wrapping operation shall not twist the terminal perpendicular to its axis more than 15 degrees.
- q. The required minimum number of uninsulated turns in a wrapped connection shall not extend beyond the wrapping length of a terminal. (See “D” in Figure 2.)
- r. Wire dress.
- (1) The wire shall not be routed in any manner which will tend to unwrap the connection.
 - (2) Wiring shall be routed to preclude strain on wire or terminal.
 - (3) A wire routing between terminals of a wire-wrap assembly shall be such that the wire does not interfere with the normal routing of other wires or the removal/testing of mounted components.

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- (4) A wire shall not be dressed tightly around the sharp corners of terminals or other hardware throughout its routing where penetration or damage to the insulation may result.
 - (5) Wires noted “direct run” on the wire list or schematic shall be routed the shortest possible distance between terminals so as to minimize the length of wire. To meet this objective, it may be necessary to use lengths of wire which cannot be automatically wrapped and must be hand wrapped. However, wires shall not be subjected to strain or routed over components.
 - (6) Wires in the same net shall be positioned in that net to prevent excessive wire buildups and to facilitate the addition of terminals, bussing components, or other electrical connections to the pins at the next higher assembly. This information shall be incorporated into the wire-wrap wire lists and wire-wrap programs for subsequent use.
2. Quality Assurance Requirements
 - 2.1 All wire-wrapped connections shall be inspected and tested in accordance with the requirements of this instruction and IPC-A-610.
3. Preparation for Delivery (Not Applicable)
4. Notes (Not Applicable)