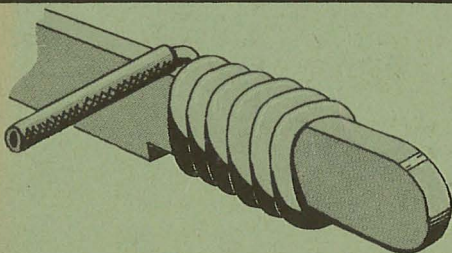


WIRE  
WRAPPED  
CONNECTIONS



Western Electric



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ISSUED BY  
ENGINEER OF INSTALLATION

### PREFACE

This pamphlet has been prepared to provide a condensed and comprehensive introduction to wire wrapped connections. Part I covers WIRE WRAPPING TECHNIQUE and Part II CHECKING WIRE WRAPPING BITS. A GUIDE TO GOOD WORKMANSHIP has been provided on the inside of the rear cover.

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## INTRODUCTION TO WIRE WRAPPING

### PART 1

#### WIRE WRAPPING TECHNIQUE

##### 1. GENERAL

1.1 Wire wrapping is the process of coiling a bare wire or the skinned portion of a lead around a terminal specifically designed for a wire wrapped connection. Figure 1 shows a completed wire wrapped connection.

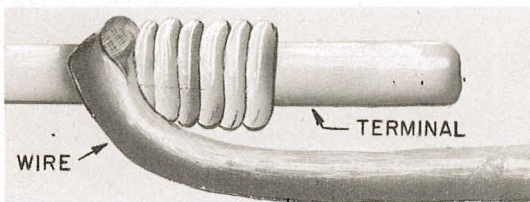


FIG. 1 COMPLETED WIRE WRAPPED  
CONNECTION (PAR. 1.1)

1.2 There are two types of wire wrapped connections, solderless and soldered.

1.21 A solderless wrapped connection is one which (a) meets certain physical characteristics, (b) contains at least a specific number of complete turns, (c) grasps the terminal with sufficient tightness and (d) is applied with the expectation that it will not be necessary to solder the completed connection. Only 22 and 24 gauge wire may be used for a solderless wrapped connection and the terminal on which the connection is to be applied must be of an approved design.

Refer to Handbook 9, Section 314 for the specific codes of apparatus on which solderless wrapped connections may be applied.

1.22 A soldered wrapped connection is one which is applied on a terminal knowing that it must be soldered in order to complete the connection. Any connection made with 20 gauge wire or larger must be soldered. Under certain conditions, which are described later, it may also be necessary to solder wrapped connections of 22 or 24 gauge wire.

## 2. SHINER LENGTH

2.1 To make a satisfactory wrapped connection it is necessary to use a fixed length of bare wire. This length of wire is called "Shiner Length" and determines the number of turns that will be in a wrapped connection.

2.2 In general, a shiner length of 1-5/8 inches will provide sufficient wire for a solderless wrapped connection with 22 or 24 gauge wire.

2.3 On 286, 287, AF, AG and AJ type relays, a shiner length of 1-1/4 inches should be used. When a larger shiner is used it produces more than the required number of turns and will not allow a second solderless connection to be applied.

2.4 A shiner length of 3/4 inches will usually provide enough wire for 3 turns, which is desirable for a soldered wrapped connection. Less than 3 turns are satisfactory under conditions described later.

## 3. SKINNING WIRES

3.1 A number of different tools are available for removing the plastic or textile insulation from switchboard, bulk and cross connection wire ends in preparation for wrapped connections.



3.2 The R-3300 Combo Cutter and R-3305 Combination Cutting and Skinning Pliers are general purpose skinning tools, best suited to skinning plastic wire. The R-3300 can also be used for skinning textile insulated wire. Both tools are adaptable to most skinning locations and automatically provide the proper shiner length.

3.21 The R-3300 tool will cut and strip 22 or 24 gauge wire and provide either a 1-5/8" or 1-1/4" shiner length. See Figure 2.

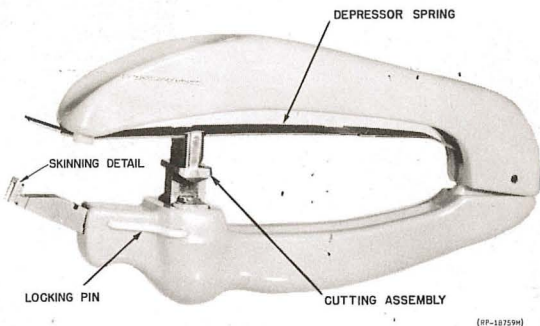


FIG. 2 R-3300 COMBO Cutter  
(PAR. 3.21)

3.22 For maximum operating efficiency the R-3300 should be held as shown in Figure 3. After selecting a wire the tool should be positioned with the wire resting in the V notch of the skinning detail at the skinning point and the wire end guided into the cutting slot. Squeezing the tool handle cuts the wire and pulling the tool away from the wire removes the insulation.

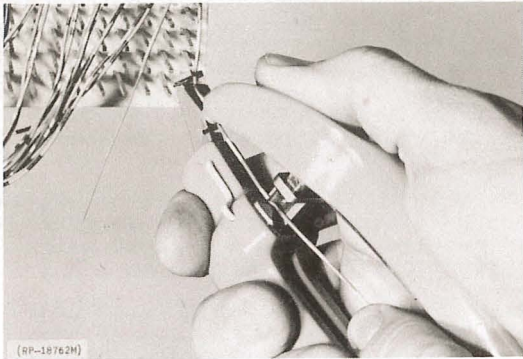


FIG. 3 R-3300 WITH WIRE IN POSITION  
TO BE CUT AND SKINNED  
(PAR. 3.22)

3.23 The R-3305 tool will cut and  
skin 24 gauge wire and pro-  
vide a 1-5/8" shiner length. See Fig-  
ure 4.

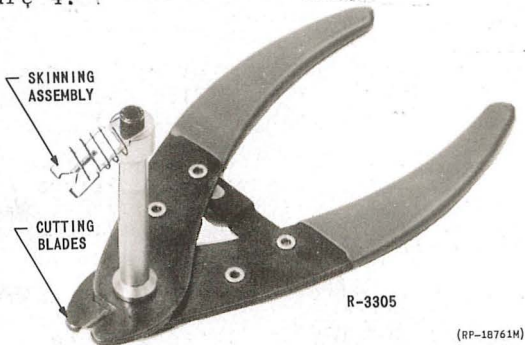


FIG. 4 R-3305 COMBINATION CUTTING  
AND SKINNING PLIERS  
(PAR. 3.23)

3.24 Figure 5 illustrates the skinning position for the R-3305 and the position of the hand when using it. The tool is positioned so that the wire rests in the V of the skinning blade at the skinning point with the wire end passing between the tool's cutting blades. The wire is then cut and the tool pulled back to remove the insulation.

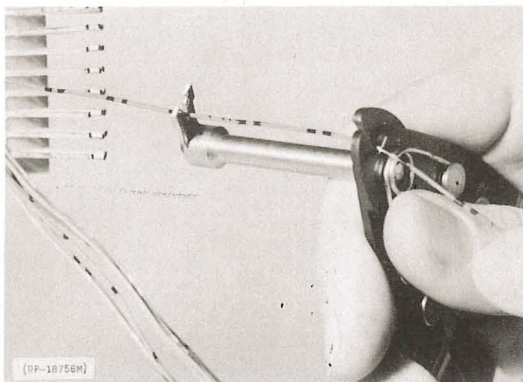


FIG. 5 SKINNING POSITION FOR R-3305 COMBINATION CUTTING AND SKINNING PLIERS (PAR. 3.24)

3.3 The R-3088 Wire Skinning Tool and R-2291 Short Nose Pliers can be used in cases where the R-3300 and R-3305 do not prove satisfactory due to wire gauge or insulation.

3.4 Care must be exercised in skinning leads for wrapped connections as nicking or flattening the wires will lower the quality of the connections. In severe cases the wire may break during the connecting or dressing operation.

3.5 Care should be exercised not to distort the skinned portion of the wire as a bent wire is difficult to slide into the wire feed slot of the wrapping bit. A bent wire also causes excessive wear on the wrapping bit and sleeve resulting in reduced wrapping bit life and scored sleeve, which often prevents the wrapping bit from indexing and in time will prevent the making of a satisfactory wrapped connection.

3.6 Refer to Handbook 9, Sections 300 and 301 for additional skinning information.

#### 4. WRAPPING A LEAD

4.1 The coiling of a wire around a terminal is accomplished with the wire wrapping tools. The wrapping bits of the R-3060 (shown in Figure 6) and R-3263 Wrapping Tools are motor driven and are actuated by pulling the trigger. The wrapping bit of the R-3278 Wrapping Tool is hand driven and is operated by depressing the movable front handle. The bit has a hole which fits over the apparatus terminal and a slot (wire feed slot) which receives the wire. The sleeve is always stationary and has two anchoring notches located opposite each other to prevent the wire from being pulled around the terminal when the bit rotates. On the same end as the anchoring notches is a funnel shaped flare which guides the wire into the wire feed slot. See Figure 6.

NOTE 1: Three sizes of wrapping bits (20, 22 and 24) are available. Each size bit is used to wrap the corresponding size wire. It is permissible to wrap 20 gauge wire with a 22 gauge bit, but the 20 gauge connections must be soldered.

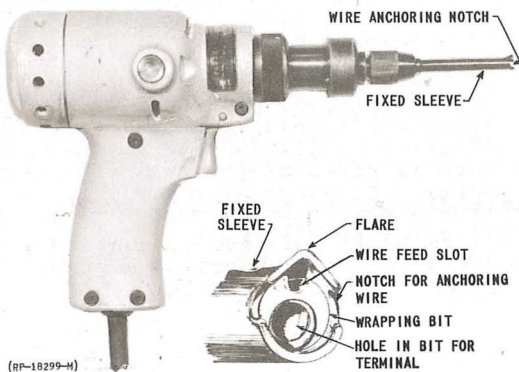


NOTE 2: In cases where the terminals have a tendency to twist out of shape when a connection is made (such as on the thin terminals of crossbar switches), the wire should be wrapped around a square or rectangular test terminal, removed, placed on the apparatus terminal and soldered. A nail of suitable size may be used in place of the test terminal. 14 gauge wire or larger should be wrapped around a test terminal or nail prior to applying it to a terminal.

NOTE 3: After a solderless wrapped connection has been made with the wire wrapping tool equipped with the proper bit and associated sleeve the connection should not be disturbed. Care shall be exercised that no tool or testing fixture (either push-on or spring clip type) touches or comes in contact with the connection.

CAUTION: Since motor driven wrapping tool cases are grounded these tools should not be used on terminals associated with working equipment. Use the R-3278 hand wrapping tool when wrapping connections on working equipment. When use of a wrapping tool is not feasible, plier wrap connections as covered in Note 2.

Dropping or severely jarring the wire wrapping tool may damage the bit or sleeve. If damage to the bit is suspected a verification check of the bits, as outlined in Handbook 9, should be performed.



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FIG. 6 WIRE WRAPPING TOOL WITH BIT AND SLEEVE (PAR. 4.1)

4.2 Wrap a lead as covered in the left half (photographs) of Figure 7. The sketches on the right half of the figure point out conditions which can easily result in an unsatisfactory connection.

4.21 The wire may be held taught in the anchoring notch by holding between the fingers and pulling slightly toward the back end of the tool or by holding against the sleeve immediately in front of the collet nut.

4.22 Either the right or left anchoring notch is used depending on the approach of the wire to the terminal.

4.23 Applying insufficient pressure when wrapping can cause excessive separation between turns, excessive pressure on the tool can cause overriding turns.

CAUTION: If In Doubt - Solder It

To qualify as a good connection a solderless wrapped connection must be made correctly the first time.

Do not "doctor up" an unqualified wrapped connection by reapplying the wrapping tool, or otherwise disturbing the connection, in an attempt to make it look like a qualified solderless wrapped connection. While wrapped connections must be soldered in such cases, and in certain other instances mentioned later, it is expected that, normally, connections made on approved apparatus terminals with approved tools will be solderless wrapped. Solder connections are more difficult to remove for modifications or maintenance reasons, and where plastic wire is used the heat of the iron may damage the wire insulation.

If at all possible, where the skinner length permits, an unqualified connection should be removed, the wire reskinned and a new connection made.

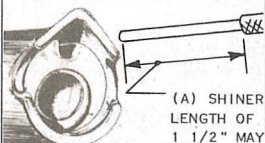
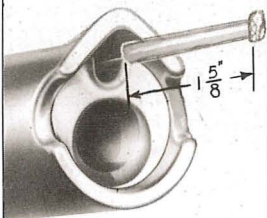
# WRAPPING A LEAD

## STEP BY STEP PROCEDURE

### CORRECT

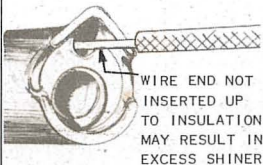
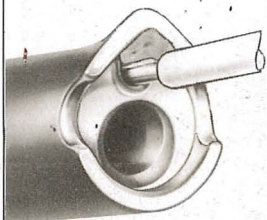
### INCORRECT

#### PRIOR TO INSERTING SKINNED WIRE END



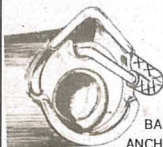
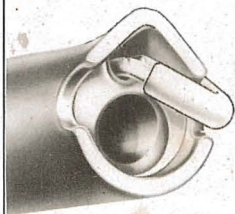
RESULT IN INSUFFICIENT NUMBER OF TURNS  
(B) SHINER LENGTH MORE THAN 1 3/4" MAY RESULT IN INSUFFICIENT TERMINAL LENGTH FOR NUMBER OF CONNECTIONS REQUIRED.

#### INSERTING WIRE END IN WIRE FEED SLOT



(BARE WIRE BETWEEN INSULATION AND TERMINAL) AND/OR INSUFFICIENT NUMBER OF TURNS.

#### WIRE POSITIONED IN ANCHORING NOTCH



RATHER THAN INSULATION MAY RESULT IN EXCESS SHINER AND/OR INSUFFICIENT NUMBER OF TURNS.

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FIG. 7 WRAPPING A LEAD  
(PAR. 4)



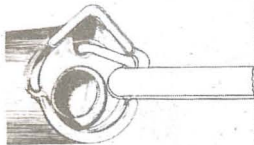
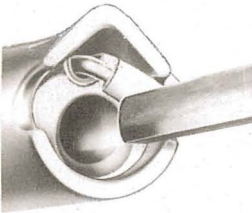
# WRAPPING A LEAD

## STEP BY STEP PROCEDURE

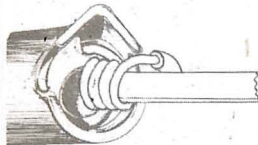
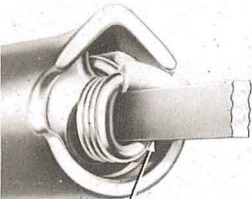
### CORRECT

### INCORRECT

#### BIT PRIOR TO PLACEMENT ON TERMINAL

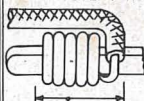
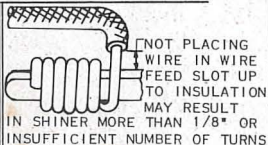
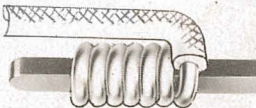


#### CONNECTION PARTIALLY MADE - TOOL RECEDING



BIT PLACED ON  
TERMINAL AS FAR AS IT WILL  
GO OR PULLED BACK SLIGHTLY  
IF IT WILL HIT THE SHOULDER  
OR TERMINAL STRIP PILE-UP

#### TOOL REMOVED - COMPLETED CONNECTION



NOT PLACING  
WIRE IN WIRE  
FEED SLOT UP  
TO INSULATION  
MAY RESULT  
IN SHINER MORE THAN 1/8" OR  
INSUFFICIENT NUMBER OF TURNS

SHINER LENGTH OF  
1 1/2" OR LESS MAY RESULT IN  
INSUFFICIENT NUMBER OF TURNS

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FIG. 7 WRAPPING A LEAD (Cont'd)  
(PAR. 4)

4.3 A minimum of 6 consecutive non-overriding turns in contact with the terminal for 24 gauge wire and 5 consecutive nonoverriding turns in contact with the terminal for 22 gauge wire is required for a solderless wrapped connection. See Figure 8.

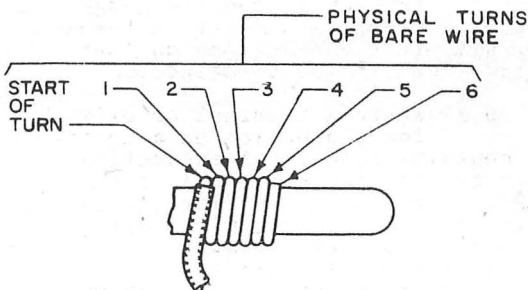


FIG. 8 A SOLDERLESS WRAPPED CONNECTION (PAR. 4.3)

4.4 Complete turns may be separated provided four of the spaces between turns (not necessarily adjacent), as viewed from any one side, do not exceed .005" each (gauged by eye) at the closest point. See Figure 9.

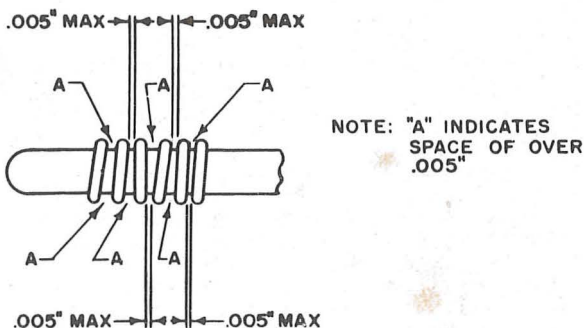


FIG. 9 A SOLDERLESS WRAPPED CONNECTION WITH SEPARATED TURNS (PAR. 4.4)

## 5. SOLDERING WRAPPED CONNECTIONS

5.1 The following conditions are some which require soldering of wrapped connections. For additional information see Handbook 9, Section 310.

5.11 Where a connection required to be soldered (20 gauge wire or larger) is added to a terminal, all other connections on that terminal shall also be soldered.

5.12 Where a terminal or existing connection on a terminal contains solder all connections added to the terminal shall be soldered. Exceptions are distributing frame terminal strips (wire wrap type) where soldered straps are placed on the base portion of the terminal. Wrapped 22 or 24 gauge connections need not be soldered on these terminals.

5.13 Where black, enameled or stranded wire is used all connections must be soldered.

5.14 Where nontinned wire is used for central office installations. (This does not apply for PBX installations).

5.15 Where a connection does not have the required number of turns, has overriding turns and lacks the required complete turns, or has excessive separation between adjacent turns.

5.2 Due to the close proximity of wrapped connections use the midget soldering copper R-3007 or the R-2733 Soldering Copper equipped with an R-2789 Adapter and an R-2889 Tip when required to solder wrapped connections. A minimum of any two adjacent turns of a connection shall be soldered.

5.3 Exercise caution to prevent dropping solder and to prevent the barrel of the copper from burning skinner insulation. The terminal and wrapped connection are small, requiring only an instant to reach soldering temperature.

## 6. MORE THAN ONE WIRE ON A TERMINAL

6.1 The type of second and/or third connection which is applied on a terminal depends on the amount of terminal length remaining after the first connection has been made. Each 6 turn wrapped connection takes approximately  $1/4$  inch of terminal length. Therefore, in order to apply a 6 turn second and third connection  $1/4$  or  $1/2$  inch respectively of terminal length must be available.

6.2 If there is not  $1/4$  or  $1/2$  inch of space available 3 or  $1-1/4$  turn wrapped connections should be applied depending on the remaining space.

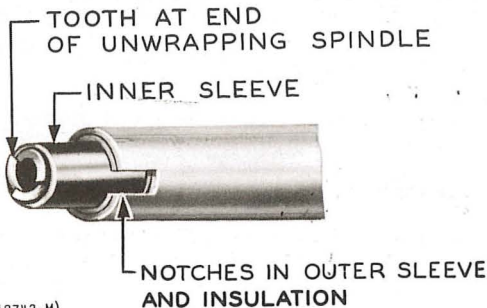
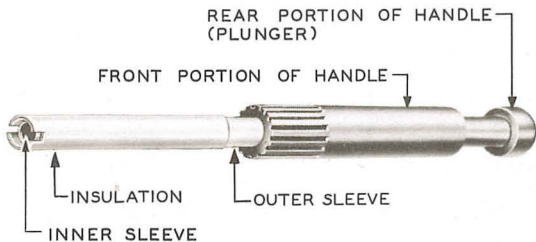
6.3 Where there is insufficient length for  $1-1/4$  turn connections wrap the lead over the previous connection and solder.

## 7. REMOVING WRAPPED CONNECTIONS

7.1 Solderless wrapped connections may be removed by unwinding the helix with the R-3328 wire unwrapping tool. Figure 10 shows the tool and a detailed end view.

7.2 To unwrap a connection place the R-3328 on the terminal so that one of the notches in the outer sleeve engages the lead of the connection. In this position the inner sleeve will completely cover the wrapped connection and the unwrapping spindle will engage the first turn of the connection. See Figure 11.





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FIG. 10 R-3328 WIRE UNWRAPPING TOOL  
AND DETAILED END VIEW  
(PAR. 7.1)

7.3 Maintaining light pressure on tool toward the terminal, slowly rotate the tool counterclockwise until the connection is loose.

7.31 If the teeth of the unwrapping spindle do not engage the first turn of the connection push the rear portion of the handle forward until contact is made.

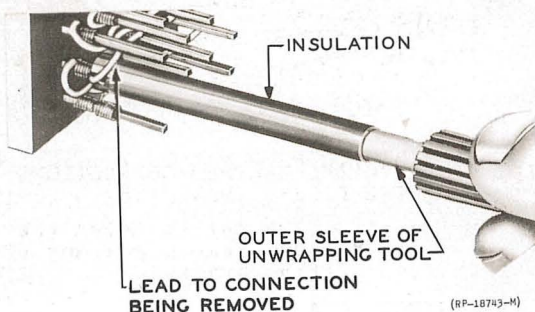


FIG. 11 R-3328 IN POSITION TO UNWRAP  
A CONNECTION (PAR. 7.2)

7.4 Remove the tool and the connection from the terminal. Eject the turns by pushing in the rear portion of the handle or by rotating the tool clockwise.

CAUTION: To keep control of the connection while ejecting it from the tool, hold the lead to the connection with the fingers.

7.5 If the R-3328 is not available the helix may be unwound with pliers, as shown in Figure 12 or with the fingers by grasping the skinner.

7.6 Where a wrapped connection has been soldered the soldering copper shall be applied to the connection and the helix unwound as covered in Paragraph 7.5. Unwrap the wire carefully so as to avoid splashing solder.

7.7 Do not attempt to pull the connection from the terminal by pulling on the skinner. The wire may break and leave the helix on the terminal, making it more difficult to remove.

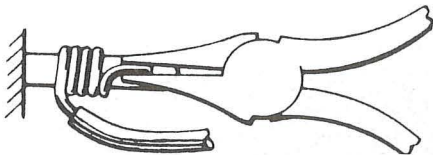


FIG. 12 REMOVING WRAPPED CONNECTIONS WITH PLIERS (PAR. 7.5)

7.8 Exercise care not to twist the terminal when removing a connection from a thin terminal.

## 8. RECONNECTING A WIRE

8.1 Where there is sufficient slack in the lead to obtain the proper shiner,  $3/4$  inch for soldered connections and  $1-5/8$  inches for solderless connections cut the previously connected lead back to the insulation, skin and reconnect as covered in Paragraph 4.1.

8.2 Where there is insufficient slack to make the type of wrapped connection required (3, 5 or 6 turns) skin  $1/4$ " of insulation from the lead and wrap at least  $1-1/4$  turn of wire around the terminal or previous connection where there is insufficient length of terminal left using either the wrapping tool or a pair of pliers and solder the connection.

8.3 Solderless wrapped connections (5 or 6 turns) may be applied on terminals from which solderless wrapped connections have been removed.

8.4 When a connection has been temporarily removed using the R-3328 tool and a solderless wrapped connection can not be used in reconnecting, the helix can be replaced on the terminal, but the connection must be soldered.

CAUTION: Do not attempt to reuse the portion of a wire previously wrapped on a terminal for making a solderless wrapped connection.

## PART 2

## CHECKING WIRE WRAPPING BITS

9. GENERAL

9.1 The process of inserting a wire in a wrapping tool and wrapping a wire around a terminal causes wear on the wrapping bit and, in turn, variations in the tightness of connections made. This makes it necessary to check a wrapping bit periodically, at least once every 3000 connections, to determine whether or not it made satisfactory connections. To determine this fact, a specific number of test connections are wrapped on test terminals with the wrapping bit. The test terminals are held in place by a special terminal holding fixture. Two tests are then performed on the test terminals.

9.2 The first test applied to test connections is called a "STRIP" test and it determines whether or not the test connections are wrapped with sufficient tightness.

9.3 The second test applied is called an "UNWRAP" test and it determines whether or not the test connections are wrapped too tightly.

9.4 The procedures and requirements for the "STRIP" and "UNWRAP" tests are outlined in Handbook 9, Section 313.

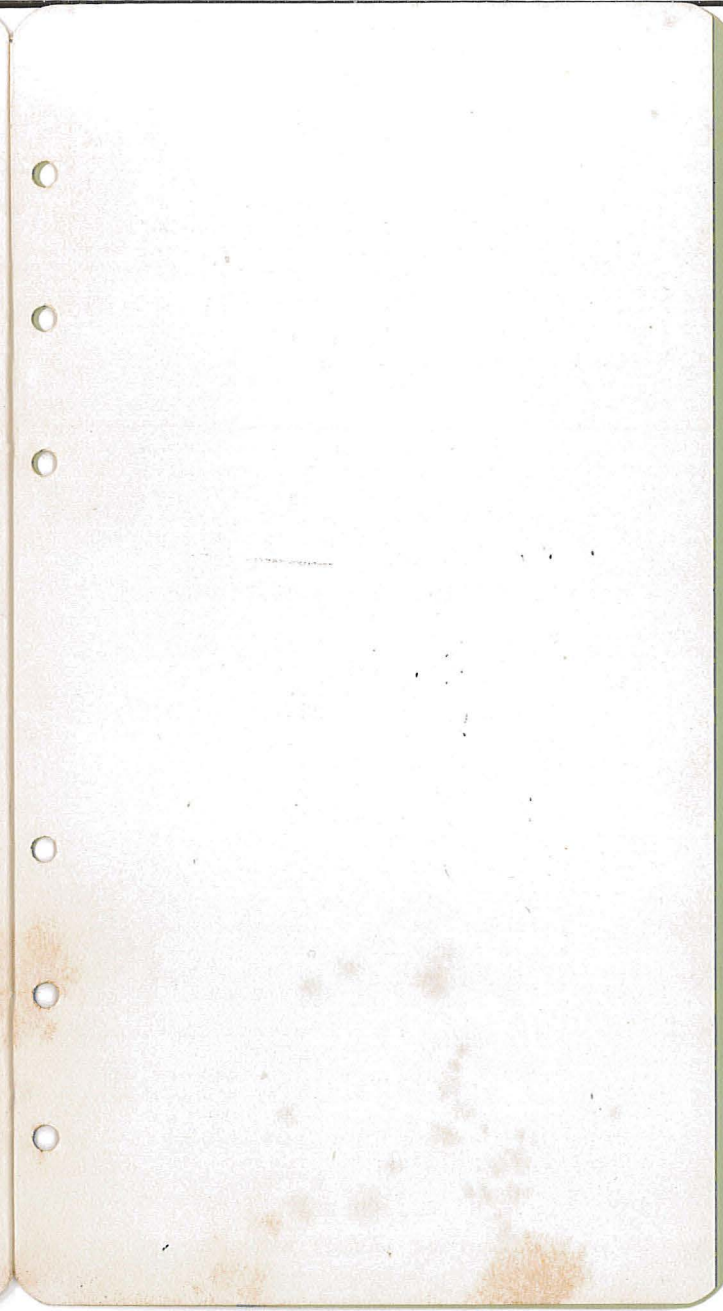
9.5 In addition to a lot check after every 3000 connections, a bit should be checked prior to use on the job and also if damage is suspected.

9.6 If a bit fails to pass the requirements for satisfactory "STRIP" and "UNWRAP" tests it should be withdrawn from service immediately. Tag the bit as defective and return to Installation Stockkeeping.

R. E. RAHMES

Engineer of Installation







## A GUIDE TO GOOD WORKMANSHIP

A minimum of 6 consecutive turns in contact with the terminal required for 24 gauge wire and 5 consecutive turns in contact with the terminal for 22 gauge wire for a solderless wrapped connection. (An overriding turn cannot be counted as a satisfactory turn.)

Adjacent turns may be separated provided four of the spaces between turns on the same side of the connection do not exceed .005" each (gauge by eye) at the closest point as viewed from one side.

A minimum of  $1/64$ " between the wire end and an adjacent connection.

Smallest possible shiner maintained (distance between insulation and terminal). Maximum allowable shiner  $1/8$ ".

All connections not having the required number of turns soldered.

All connections of 20 gauge or larger wire soldered.

All connections made with black enameled wire soldered.

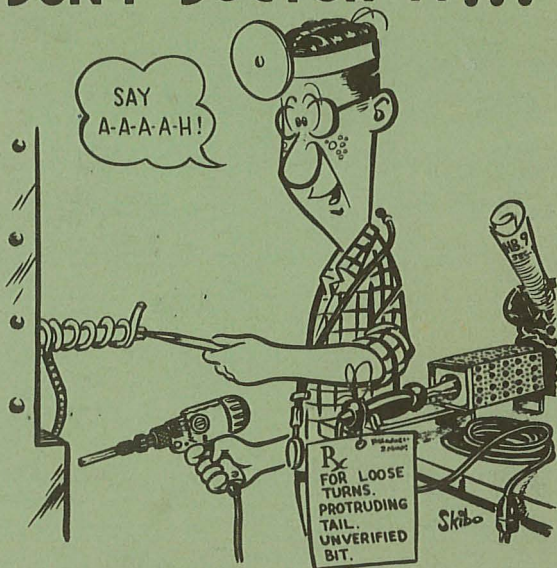
Terminals containing solder, on an existing connection, or from a previously soldered connection, all connections added shall be soldered. (See exception in HB 9 for wire wrapped distributing frame terminal strips).

When a connection requiring solder is added to a terminal, all connections on the terminal shall be soldered.

On all wrapped connections requiring solder, a minimum of any two adjacent turns shall be soldered.

Unqualified connections soldered.

# DON'T "DOCTOR" IT...



# SOLDER IT !!

*Wilbur Wire Wrapper*