PART II

TOOLS, GAUGES, TEST EQUIPMENT, MISCELLANECUS METHODS AND EQUIPMENT

DIAL HAND TEST SET
QSE4A AND QSE4B TYPE HANDSETS
DESCRIPTION, OPERATION AND MAINTENANCE

1. GENERAL

1.01 This practice covers the description, operation and maintenance of the QSE4A (CTS #74-54-070-0) and QSE4B (CTS #74-54-071-8) handsets (dial hand test set).

1.02 The primary application of these handsets is to originate test calls in dial system equipment to test switching, continuity, and talking features of the circuit. In the maintenance of equipment they may also be used to locate trouble in the various portions of the circuit. The types of equipment with which these handsets are used are shown in Table A.

1.03 These handsets are intended for indoor use, and are available in the standard green (-51) color.

1.04 Each type of handset is provided with a "Monitor-Talk" switch to provide a means of monitoring the line under test to determine if it is in use.

1.05 The QSE4A and QSE4B type handsets are equipped with a pushbutton switch which, when depressed, will facilitate dialing over very long loops.

NOTE: QSE4A2 and QSE4B2 handsets provide an arrangement whereby a basic coded handset can be adapted, by means of plug-in cords, to all central office tests requiring the use of a handset.

1.06 If these handsets are accidentally connected directly across 48 volts with the "Monitor-Talk" switch in the talk position, the circuit design is such that minimum damage results.

NOTE: When this condition occurs, the QHP99A inductor located on PC2 (P0500416 or P0500417) is subjected to excessive power dissipation for approximately 10 seconds, at which time the thermistor limits the current to a safe level.

1.07 Conversion Parts: Parts are available to modify QSE4A type handsets in service to QSE4B types, in order to provide the additional features shown in Table B. For installation of these conversion kits, refer to paragraph 4.10.

2. DESCRIPTION

2.01 The QSE4A1 and QSE4B1 type handsets consist of a plastic handset equipped with a

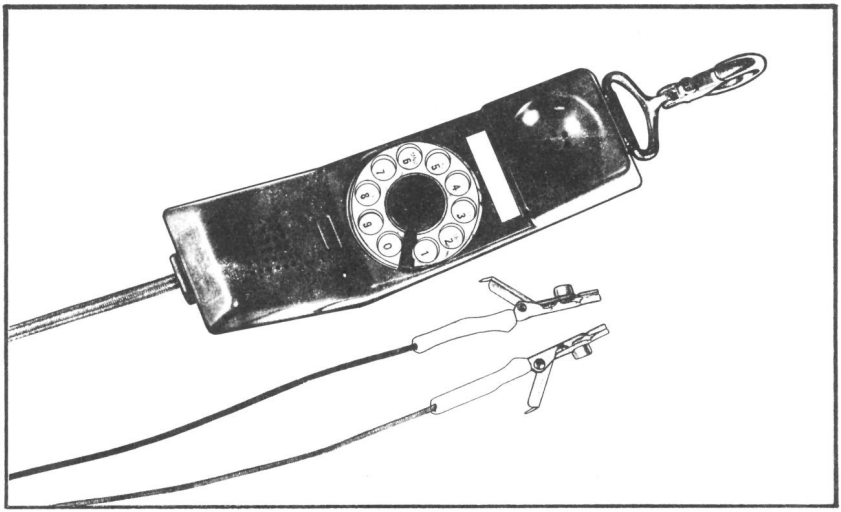

FIGURE 1. QSE4A1 Handset

TABLE A

Handset Code	Identification Dial Center Insert	Features	Primary Application	Cord Code	Cord Termination	See Note
QSE4A1	Red	Medium Impedance Monitor	Outside Plant	W2QK	Test Clips Q4100- L1	
QSE4B1	Yellow	High Impedance Data—Manual Return-to-Monitor				
QSE4A2	Red	Medium Impedance Monitor	General Use	H2QB	346A Plug	1
QSE4B2	Yellow	High Impedance Data—Manual Return-to-Monitor				

10QA type dial in the center of the housing, a T1 Transmitter Unit, a U1 Receiver Unit, and a cord provided with test clips. See Figure 1.

2.02 The QSE4A1 and QSE4B1 handsets differ in their operational features and circuitry, as shown in Table A and Figures 2 and 3 (foldouts).

2.03 The QSE4A2 and QSE4B2 handsets are the same as the QSE4A1 and QSE4B1 types respectively, except that they use a cord equipped with a 346A plug. This plug-ended cord provides an arrangement whereby a basic coded handset can be adapted, by means of plug-in cords, to all central office tests requiring the use of a handset. See Figure 4.

2.04 The QSE4A type handsets are for use where data transmission facilities are not provided, and it is only necessary to bridge the line under test with a medium impedance of 1000Ω in the "Monitor" position, as indicated on the rocker switch when the red face is hidden. In the "Talk" position the red face on the switch is visible and the DC resistance is approximately 130Ω . The use of the pushbutton is described in paragraph 3.01, d.

2.05 The QSE4B handsets are designed for use in areas where local plant involves data circuits, and it is essential to monitor lines before test with a high impedance bridging the line. This high impedance is approximately 100,000Ω in the "Monitor" position and will not disrupt data transmission which may be under way. The change from "Monitor" to "Talk" is accomplished by a rocker switch, after ensuring that the line is not in use. This switch must be in the "Monitor" position before using the handset to test the line. The use of the pushbutton switch is described in paragraph 3.02, d.

2.06 Equipment features of the different types of handsets are shown in Table A.

2.07 Schematic and wiring diagrams of the handsets are shown in Figures 2 and 3.

2.08 Figure 5 (foldout) shows the schematic diagrams of the accessory cords available for use with the QSE4A2 and QSE4B2 handsets.

2.09 All handsets are equipped with a snap hook to allow the handset to be carried on a tool belt. The hook is positioned in such a manner as to allow the handset to hang and follow the contour of the body, thus affording protection to the face of the handset as shown in Figure 6.

2.10 When the handset is not in use, the cord should be wrapped as shown in Figure 7.

TABLE B

CONVERT FROM	CONVERT TO	PART NUMBER
QSE4A- Medium Impedance Monitor (Non-Data)	QSE4B- High Impedance Monitor Manual (Data-Manual)	P0500416

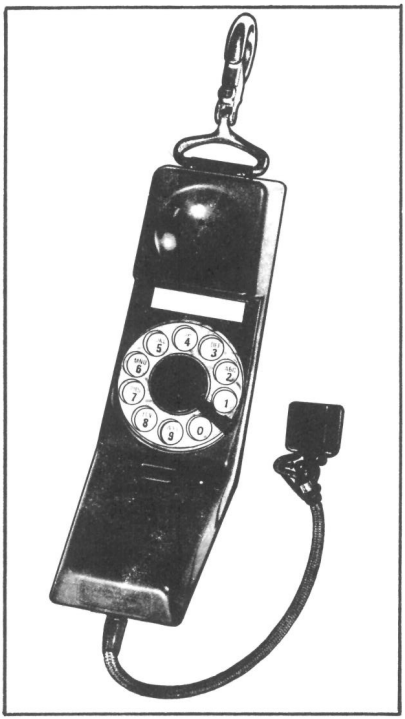

FIGURE 4. QSE4B2 Handset

3. OPERATIONAL PROCEDURE

3.01 QSE4A Type Handsets:

a. Make certain that the test clips make electrical contact with only one circuit at a time.

b. To bridge the line under test, the rocker switch should be in the "Monitor" position, which is indicated by the red face of the switch being hidden. In this mode, the handset has an impedance of approximately 1000 Ω.

c. Dialing can be accomplished in the normal manner; however, since the handset resistance is slightly higher than the resistance of a 500 type telephone set, difficulty could be encountered when dialing over a very long line.

d. If dialing difficulty is experienced, it can be overcome by keeping the pushbutton depressed while dialing. This procedure allows the handset to operate on any line which permits operation of a 500 type telephone set.

e. If talking is necessary, the rocker switch must be placed in the "Talk" position, which is indicated by the red face of the switch being visible, to establish the talking circuit.

f. Checking for the presence of 48 volts on the line should be done with the rocker switch in the "Talk" position (red face showing). Clicks will be produced in the receiver each time 48 volts is present on the test clips.

3.02 QSE4B Type Handsets:

a. Make certain that the test clips make electrical contact with only one circuit at a time.

b. To bridge the line under test, the rocker switch should be in the "Monitor" position, which is indicated by the red face of the switch being hidden. In this mode, the handset presents a very high impedance to the line, which ensures minimum loading of the line under test and thus can be used on circuits where data is present.

c. If talking is necessary, the rocker switch must be placed in the "Talk" position, which is indicated by the red face of the switch being visible, to establish the talking circuit.

d. Dialing can be accomplished in the normal manner; however, since the handset resistance is slightly higher than the resistance of a 500 type telephone set, difficulty could be encountered when dialing over very long lines. This dialing difficulty can be overcome by keeping the pushbutton depressed while dialing.

e. Checking for the presence of 48 volts on the line should be done with the rocker switch in the "Talk" position (red face showing). Clicks will be produced in the receiver each time 48 volts is present on the test clips.

4. MAINTENANCE

4.01 Normal maintenance may involve replacement of the dial, transmitter unit, receiver unit, or the cord.

NOTE: Dial maintenance consists only of determining if the dial is defective. Do not attempt adjustments of the dial in the field.

4.02 Disassembly of handset (see Figures 8 and 9 foldouts) (circled numbers refer to Figure 9 foldout):

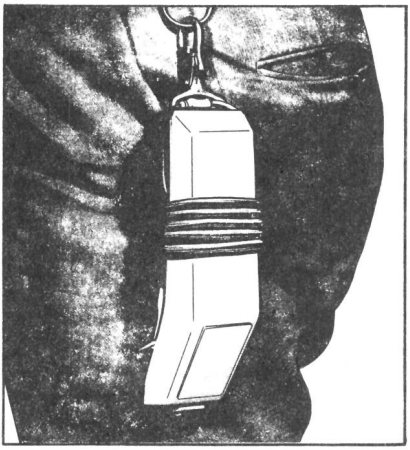

FIGURE 6. Wearing of Handset on Tool Belts

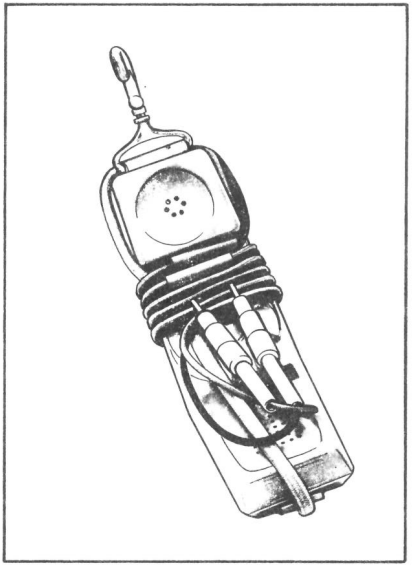

FIGURE 7. Method of Wrapping Cord When Handset is Not in Use

a. To remove the card retainer window (13), insert the tip of a 16750 L3 releaser (a paper clip may be used) into the small slotted hole at the edge of the window. Ensure that the tip does not enter the hole by more than one-eighth of an inch, as an underlying screw may hinder the lateral motion of the releaser. Apply a slight lateral pressure to the handle of the releaser. The housing projection provides a fulcrum and this will bow the window upward so that its edges may be grasped with the fingertips of the other hand to spring it out.

b. Remove the handset line cord grommet (27) and (28), by turning the handset face down and pushing the cord into the grommet to release the pressure on the inside of the grommet, then exerting a lateral pressure toward the rocker switch and an upward pressure (while retaining the lateral pressure) until the grommet comes out of the housing (see Figure 8). This grommet is in two pieces.

c. Once the grommet has been withdrawn, two screws (3) are exposed. Loosen these two screws by about three-sixteenths of an inch only, as it is not desirable or necessary to remove them.

d. Free (do not remove) the two captive screws (2) in the card retainer well. Loosen the receiver end, then slide the smooth (back) half of the handset housing back to release this section from the slotted screw holes.

4.03 To Replace Dial:

a. See paragraph 4.02 for instructions on opening the handset.

b. Remove the dial leads from the terminals.

c. Remove the four mounting screws (1) and loosen rocker switch.

d. Replace dial.

e. See paragraph 4.09 for instructions on reassembly of handset.

4.04 To Replace Transmitter:

a. See paragraph 4.02 for instructions on opening the handset.

b. Remove the two screws (3) holding the transmitter cup (TB2) and loosen the rocker switch retainer bracket (11).

c. Lift out transmitter cup and replace transmitter (MK1).

d. See paragraph 4.09 for instructions on

reassembly of handset.

4.05 To Replace Receiver:

a. See paragraph 4.02 for instructions on opening the handset.

b. Remove the three screws (1) holding the receiver cup (TB1).

c. Slide the cup along the leads.

d. Disconnect and replace the receiver units.

e. See paragraph 4.09 for instructions on reassembly of handset.

4.06 Fingerwheel: Should the fingerwheel require replacement, replace the complete dial as fingerwheel replacement in the field may result in permanent damage to the dial.

4.07 To Replace Line Cord:

a. See paragraph 4.02 for instructions on opening the handset.

b. Disconnect and replace the line cord, ensuring that the cord is properly dressed in the housing (see Figure 10 foldout).

4.08 To Replace Hook:

a. See paragraph 4.02 for instructions on opening the handset.

b. Remove the four screws (5) and remove the two hook plate retainers (15) and the hookstop (14).

c. Replace the hook, ensuring that the four mounting screws are properly positioned in the two hook plate retainers and that the hookstop is properly positioned between the hook and the cover.

d. See paragraph 4.09 for instructions on a reassembly of handset.

4.09 Reassembly of Handset:

a. Align the jacketed portion of the handset line cord (29) or (30) into the handset so that it will fit into the channel in the transmitter cup (TB2).

b. Slide the two handset sections together so that the two slots at the grommet end slide over the two screws (3) in the instrument section (22B).

c. Carefully align the two sections so that the two screws (2) in the card holder well will engage the tapped post holes in the back cover (23B).

d. Tighten the two screws (3) in the grommet cut-out and the two screws (2) in the card holder well.

CAUTION: Do not use undue force when tightening these screws.

e. Slide the grommet (27) and (28) into the rectangular hole in the end of the handset housing, with the side ribs of the grommet sliding into place on the inside face of the cover. Then pull the line cord to ensure that the grommet is securely in place.

f. Insert the card and retainer window into the well in the handset.

4.10 To convert QSE4A Type to QSE4B Type (see Figures 9 and 10 Foldouts):

a. Open handset as described in paragraph 4.02.

b. Remove the two screws (6) which fasten the line cord leads and the red and orange leads to the transmitter cup terminals. Fold the red and orange leads to the sides of the handset.

c. Remove slate-red lead from under dial plate screw (1), the white lead connected to terminal C of PC2, the yellow-slate lead from under terminal R on the transmitter cup (TB2) and the red and blue leads from (TB2) to (S3).

d. Remove original PC2 (P0500417).

e. Insert slate-red lead into terminal B and white lead into terminal C on the new PC2 (P0500416).

f. Carefully place new PC2 (P0500416) into position and ensure that the yellow-slate lead is dressed between the transformer on PC2 and the transmitter cup (TB2) and that the transformer bobbin rests on the raised portion of the instrument section housing between the dial and pushbutton (S1). The bracket of the transformer should now be located over the pushbutton.

g. Connect the yellow-slate lead from PC2 to terminal "R" of the transmitter cup with the existing yellow-slate lead on that terminal.

h. Insert the two screws (6) through the mounting holes in PC2 and into the terminal screw holes in the transmitter cup.

i. Ensure that the line cord is passed through the cord hole in the handset back cover (23B).

j. Connect the red lead, which was moved to one side of the handset in paragraph b. above, and the red lead of the line cord, to the terminal immediately above terminal "R" on the transmitter cup (see Figure 10). Tighten this connection.

k. Connect the orange lead which was moved to one side of the handset in paragraph b. above, and the black line cord lead to the other PC2 mounting terminal (rocker switch side) and tighten the mounting screw (see Figure 10).

l. Dress leads and line cord as shown in Figure 10.

m. Replace handset back cover, line cord grommet and card retainer window as instructed in paragraph 4.09.

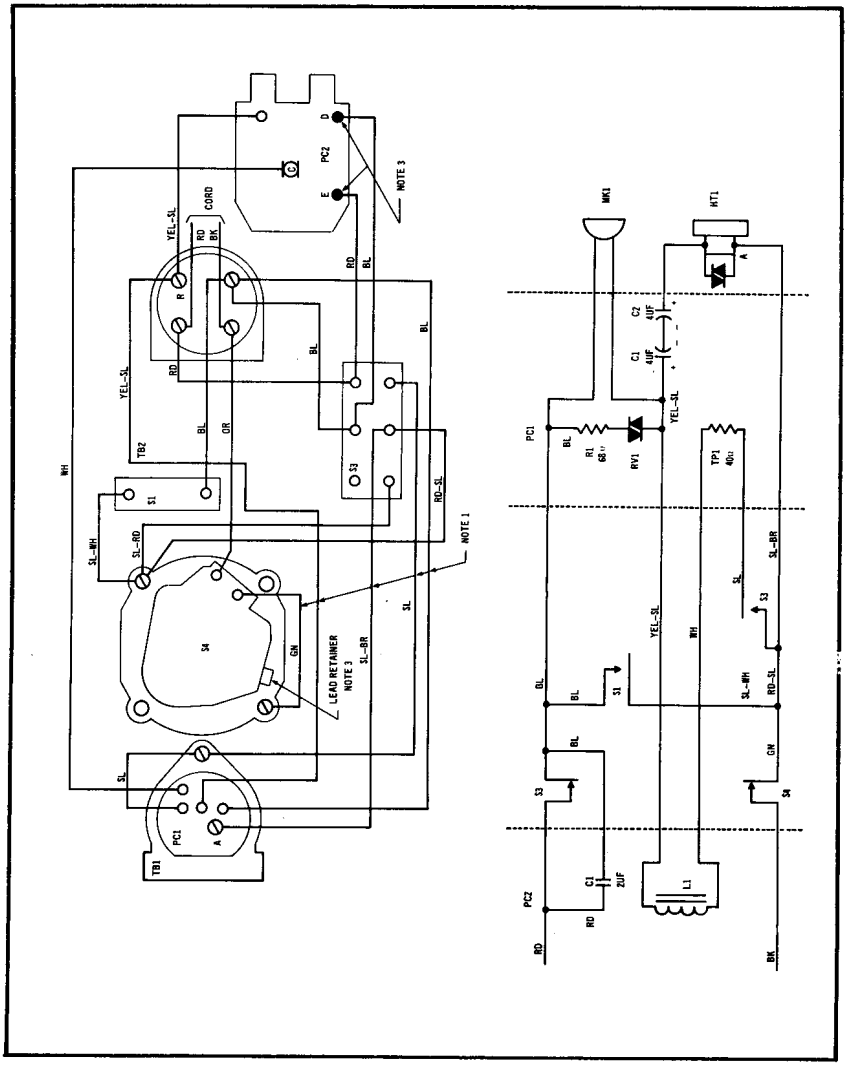

FIGURE 2. QSE4A Handset Schematic and Wiring

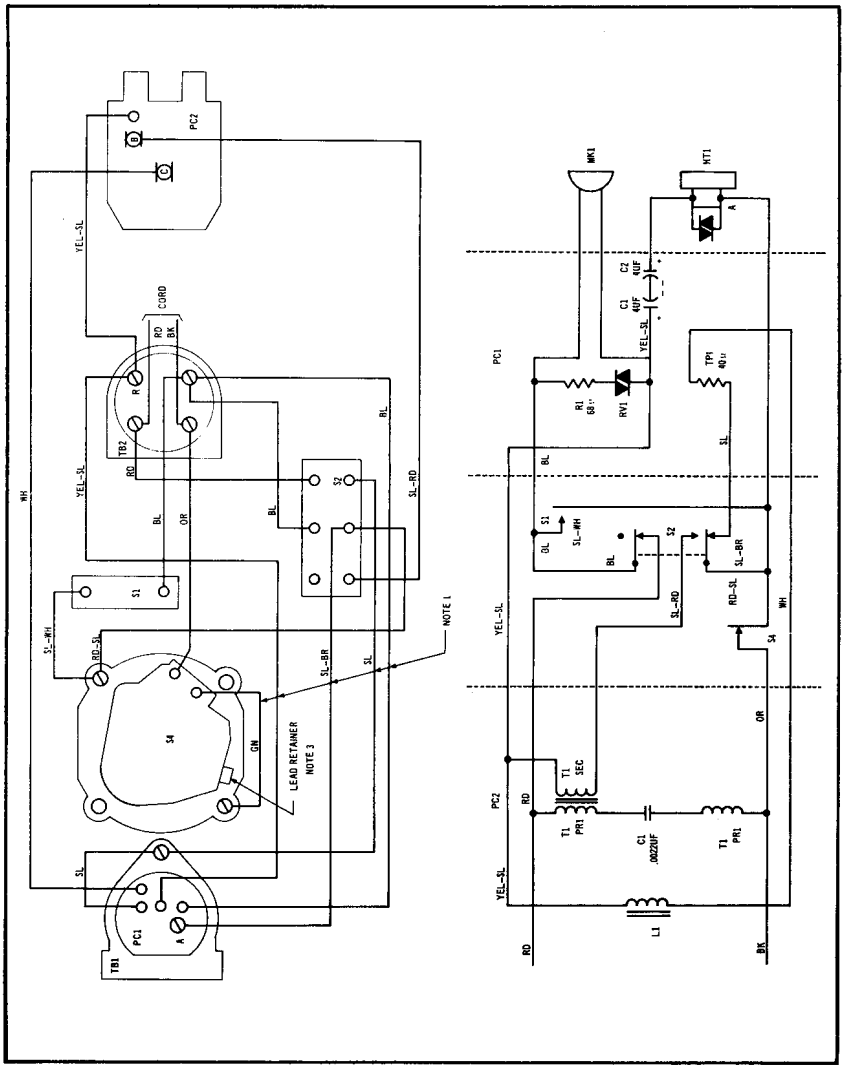

FIGURE 3. QSE4B Handset Schematic and Wiring

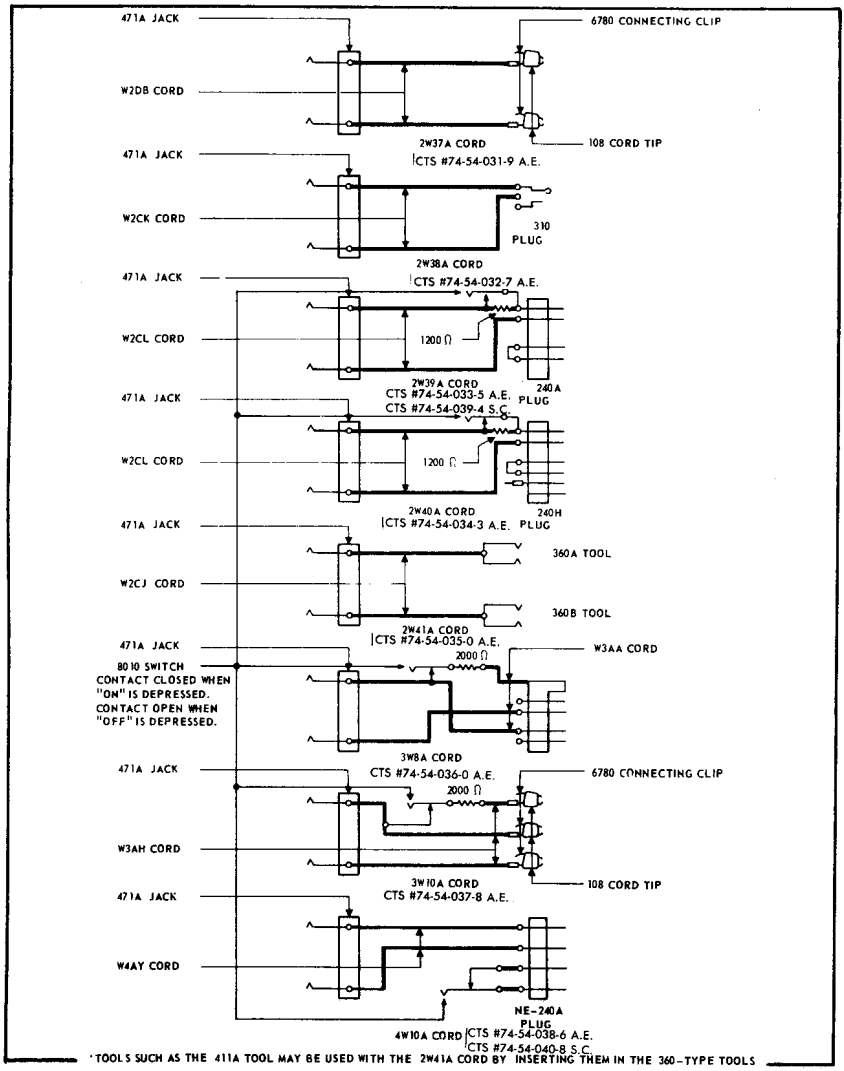

FIGURE 5. Schematics of Accessory Cords for QSE4A2 and QSE4B2 Handsets

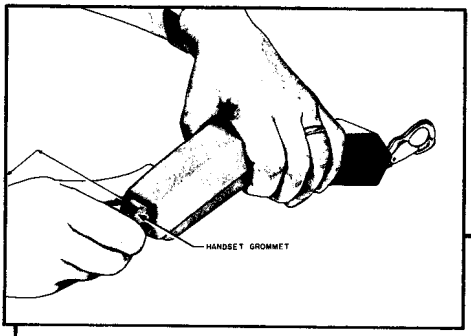

FIGURE 8. Removal of Handset Grommet

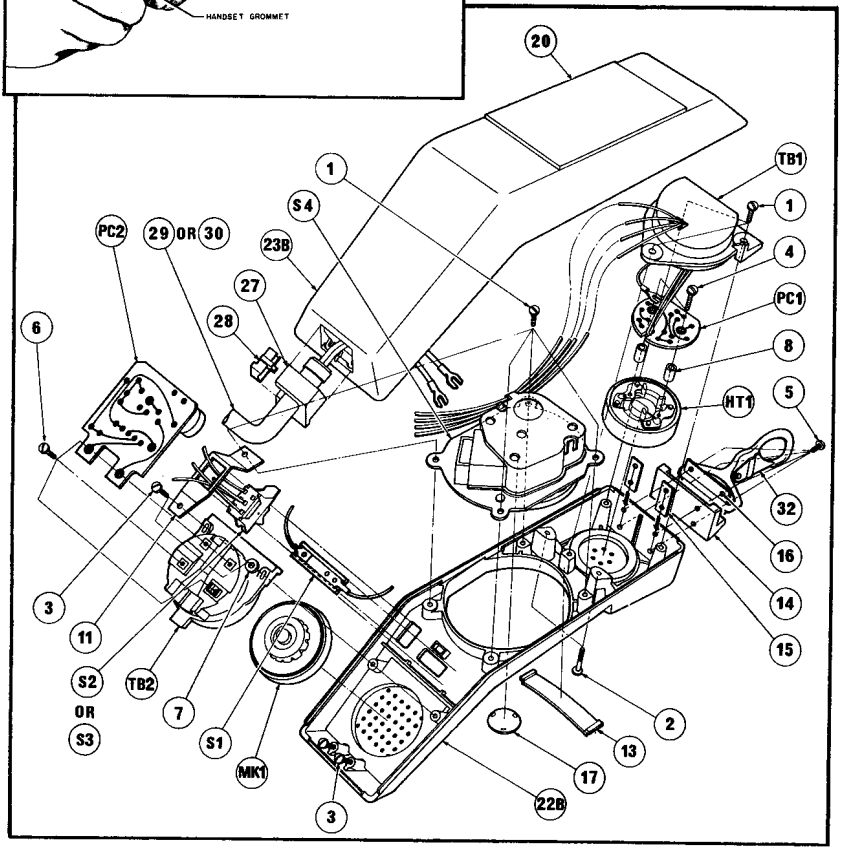

FIGURE 9. QSE4 Type Handsets—Assembly of Parts

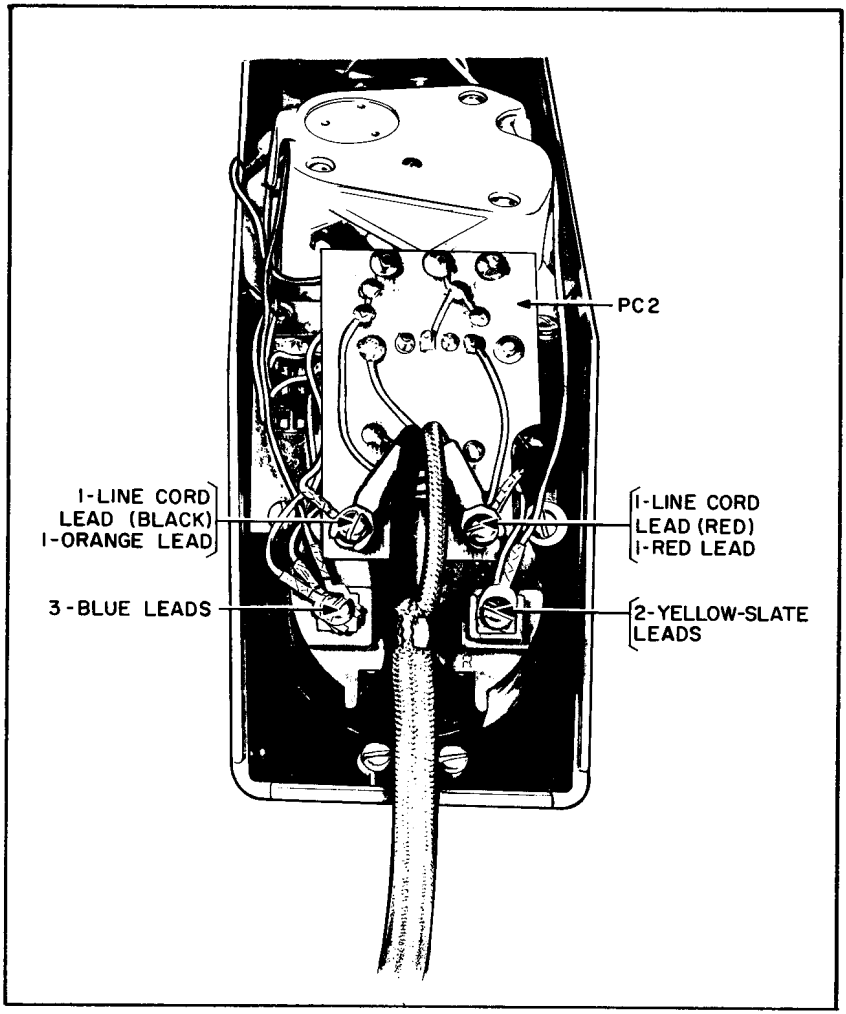

FIGURE 10. QSE4 Type handset—Cover Removed—Showing Connection of Line Cord and Assembly of PC2 (P0500416) For Conversion Purposes

TRIPLETT MODEL 310C VOLT-OHM-MILLIAMMETER

1. GENERAL

1.01 This addendum is issued to correct meter range information in paragraph 3.02, c.

1.02 With red pencil or ink, make the changes specified in paragraph 2 of this addendum, and file the addendum in front of CTSP 405-110-301.

2. CORRECTION

2.01 Change paragraph 3.02, c, to read as follows:

c. The 0-600 range is read on the 0-60 scale by adding one zero to the reading; e.g., a meter reading of 40 would equal 400 volts.

TRIPLETT MODEL 310C VOLT-OHM-MILLIAMMETER

1. GENERAL

1.01 This practice provides the description and operation of the Triplett Model 310C Volt-Ohm-Milliammeter (V.O.M.). Maintenance instructions are also included in this practice.

2. DESCRIPTION

2.01 Figure 1 shows the operational features on the Triplett 310C V.O.M.

2.02 The DC voltage ranges have sensitivities of 20,000Ω per volt. The AC voltage ranges have sensitivities of 15,000Ω per volt.

2.03 Directly under the zero adjust control located on the side of the meter case, in the upper left-hand corner, is a polarity reversing switch for the DC voltage and current ranges. This switch has no effect on the AC volts or ohms ranges. The positive battery of the ohmmeter circuit is connected to the positive V.O.M. terminal.

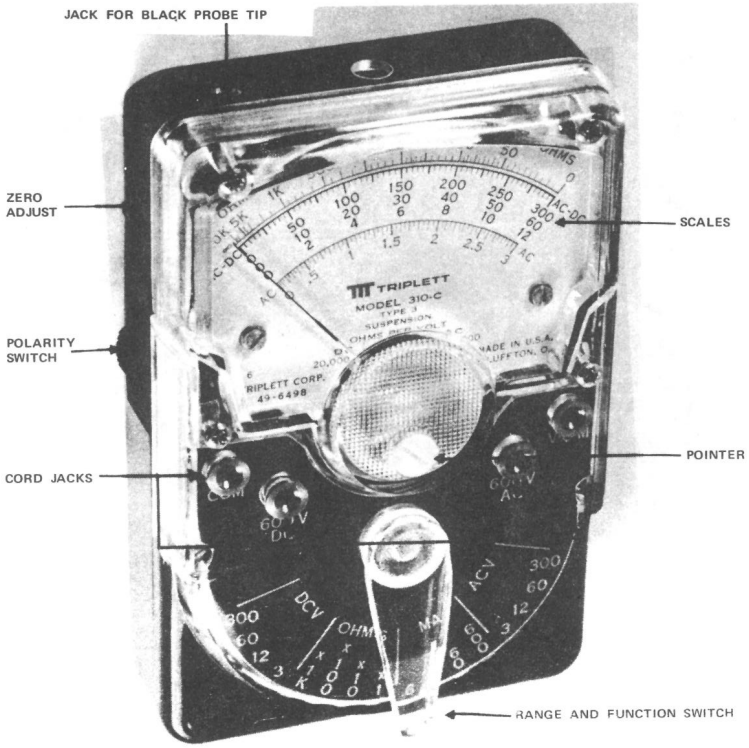

FIGURE 1. Triplett Model 310C V.O.M.

Distribution A B C D E F

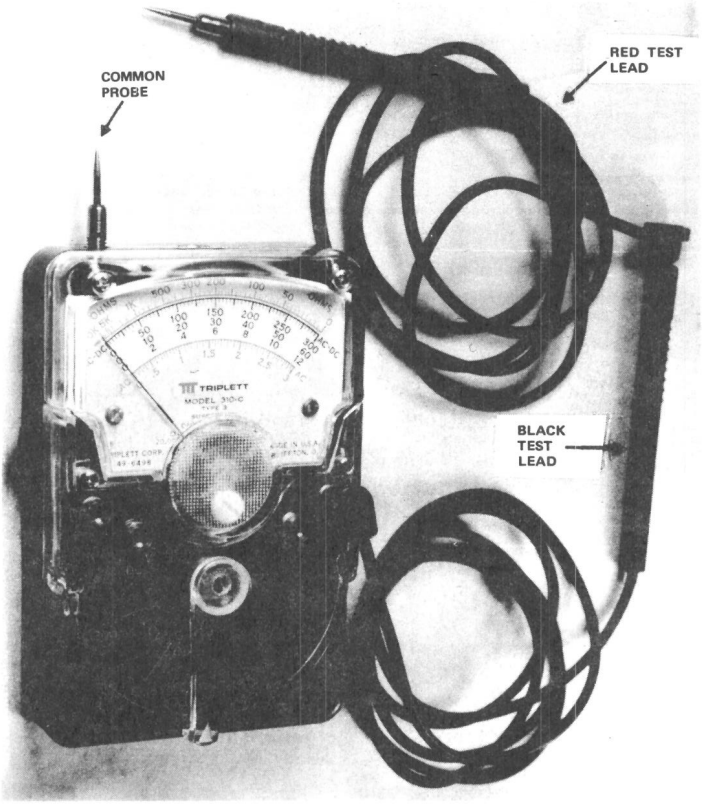

FIGURE 2

2.04 To avoid the necessity of handling the meter and two test cords with probes, unscrew the tip from the black test lead probe and insert it in the jack on the top of the meter. By doing this, the meter can be held in one hand and used as the common probe. With the red test lead connected to the V.O.M. jack, the other hand is free to operate the red test lead. The two leads can be connected together if a long lead is necessary. This can be accomplished by removing the black probe tip and inserting the red lead plug end into the cavity of the black probe. See Figure 2.

3. OPERATING PROCEDURES

3.01 The volt-ohmmeter is designed to measure resistance, AC and DC voltage and DC current. The resistance is in four ranges, i.e., 0-20,000 Ω, 0-200,000 Ω, 0-2 MΩ, and 0-20 MΩ. All four ranges may be used without changing the positions of the test leads. This is done as follows:

a. To measure **resistance from 0 to 20,000Ω,** move the range switch lever to position X1.

b. To measure **resistance from 0 to 200,000Ω,** move the range switch lever to position X10.

c. To measure **from 0 to 2 MΩ**, move the range switch lever to X100.

d. To measure **from 0 to 20 MΩ**, move the range switch lever to X1K.

e. To make all the above measurements, connect the black test lead to the COM jack and the red test lead to V.O.M. jack. See Figure 3.

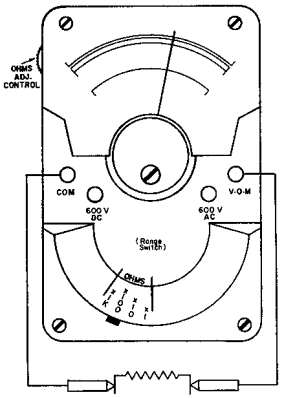

FIGURE 3. Resistance

CAUTION: Before making Ω readings, place the range switch lever in the proper position. With the black test cord in the COM jack and the red test cord in the V.O.M. jack, short the test cord together and adjust the OHMS Adjust control so the pointer will rest on 0 of the Ω scale, which is the top scale.

3.02 The DC voltage ranges are 0-3, 12, 60, 300 and 600 volts and are read as follows (see Figure 4):

a. Read all DC volts on the black scales. The 0-3 volt range is read on the 0-300 scale. Divide the reading by 100; therefore, if the meter reads 250, this would be 2.50 volts.

b. The 0-12, 0-60, and 0-300 ranges are read directly on the corresponding scales.

c. The 0-1200 range is read on the 0-12 scale by adding two zeros to the reading. A meter reading of 8 would be 800 volts.

d. To make readings on 3, 12, 60 and 300 ranges, connect the black test lead to the COM jack and the red test lead to the V.O.M. jack, with the range switch lever at the position of the scale to be used.

e. To make a reading on the 600 volt range, move the red test lead to the 600 VDC jack and set the range switch lever to the 300 DCV position.

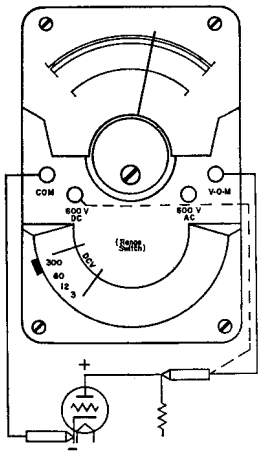

FIGURE 4. DC Voltage

CAUTION: Always place the range switch in the position you intend to use before making contact with the test leads to any equipment. If approximate voltage is unknown, place the range switch in the highest DC position.

3.03 The AC voltage ranges are 0-3, 12, 60, 300 and 600 and are read as follows (see Figure 5):

a. Read all AC volts on the red scale. For greater accuracy, a separate scale is provided for 0-3 volts.

b. The 0-12, 0-60, and 0-300 ranges are read on the corresponding scales.

c. The 0-600 range is read on the 0-60 scale by adding one zero to the reading. A meter reading of 40 would be 400 volts.

d. To make readings on 3, 12, 60 and 300 ranges, connect the black test lead to the COM jack and the red test lead to the V.O.M. jack, with the range switch lever on the position of the scale to be used.

e. To make a reading on the 600 volt range, move the red test lead to the 600 VAC jack and set the range switch lever to the 300 ACV position.

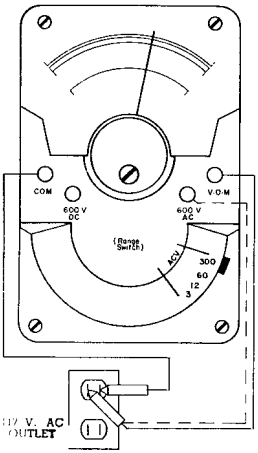

FIGURE 5. AC Voltage

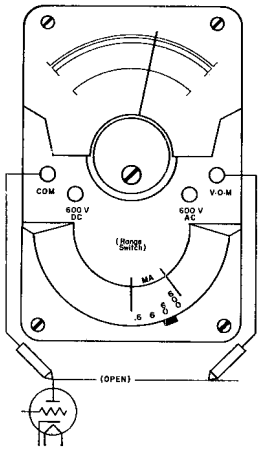

FIGURE 6. DC Current

TABLE A

OPERATION CHART

To Measure	Set Range Switch	Leads Connections Black Lead "COM" Red Lead Listed Below	Read on Scale	Each Scale Div. Equals
DC Volts				
0-3	DCV 3	V-O-M	300÷100	.05 Volt
0-12	DCV 12	V-O-M	12	.20 Volt
0-60	DCV 60	V-O-M	60	1 Volt
0-300	DCV 300	V-O-M	300	5 Volt
0-600	DCV 300	600 V DC	60x10	10 Volt
AC Volts				
0-3	ACV 3	V-O-M	3 AC	.05 Volt
0-12	ACV 12	V-O-M	12	.20 Volt
0-60	ACV 60	V-O-M	60	1 Volt
0-300	ACV 300	V-O-M	300	5 Volt
0-600	ACV 300	600 V AC	60x10	10 Volt
OHMS				
0-20,000	Ω X1	V-O-M	0-20K	
0-200,000	Ω X10	V-O-M	0-20Kx10	
0-2 Meg.	Ω X100	V-O-M	0-20Kx100	
0-20 Meg.	Ω X1K	V-O-M	0-20Kx1000	
DC Mil.				
0-.6	MA .6	V-O-M	60÷100	.01 Mil.
0-6	MA 6	V-O-M	60÷10	.1 Mil.
0-60	MA 60	V-O-M	60	1 Mil.
0-600	MA 600	V-O-M	60x10	10 Mil.
				* Polarity switch at + position

CAUTION: Always place the range switch in the position you intend to use before making contact with the test leads to any equipment. If approximate voltage is unknown, place the range switch in the highest AC position.

3.04 The four DC current ranges are 0-.6, 0-6, 0-60, and 0-600 milliamperes. All four ranges are read on the 0-60 DC scale as follows (see Figure 6):

a. On the 0-.6 range, divide the reading by 100; on the 0-6 range, divide by 10; on the 0-60 range, read the scale directly; on the 0-600 range, multiply the reading by 100 or add one zero to the reading.

b. All current readings are made with the black test cord in the COM jack, the red cord in the V.O.M. jack, and the range switch lever in the range position to be used.

c. Connect the meter in series with the circuit to be measured. Do not test directly across any potential circuit as this may harm the meter. Where polarity is difficult to determine and the meter reads reversed, exchange the probe end of the test leads.

3.05 Table A is a reference chart for lead hookup, range switch setting, scale readings and what each division on the scale equals.

4. MAINTENANCE

4.01 To adjust the pointer so that it will rest on "0", use a small screwdriver placed in the adjusting screw located on the front of the meter.

4.02 When the ohms ranges X1, X10 and X100 will not zero with the ohms adjust control, the 1.5V battery should be replaced. If the X1K range will not zero, then replace the 15 volt battery. To replace either battery, remove the small panel on the back of the meter.

CAUTION: Watch polarity when replacing batteries.

4.03 The plastic window has been treated to dissipate static charges. If cleaning is necessary, use cotton dipped in a solution of common household detergent and water. After cleaning, allow the solution to dry without rubbing; the resultant detergent film will effectively dissipate static charges.

CAUTION: Solvents may crack or scar the plastic window if applied to it.

STROMBERG-CARLSON WIRE CHIEF'S TEST SET—TYPE B 419086-018 AND 419086-028 DESCRIPTION

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1. GENERAL

1.01 This practice provides the description of the S-C Wire Chief's Test Set, Type B, which is used to assist in the testing and troubleshooting of inside and outside plant equipment associated with a dial office. See Figure 1.

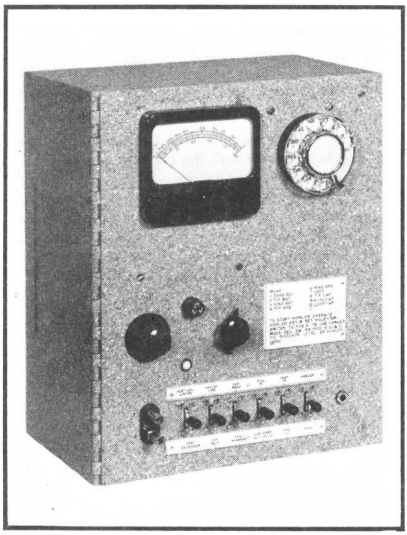


FIGURE 1. Wire Chief's Test Set, Type B

1.02 Also included in this practice are procedures for the installation, maintenance, and calibration of the Type B test set.

1.03 There are two models of the Type B test set:

a. S-C Part No. 419086-018 is supplied for use with a CDO (community dial office) test selector and is wired in accordance with Figures 1, 3, and 7 of circuit diagram S-419086 (see Figure 2, Sheets 1 and 2, foldouts).

b. S-C Part No. 419086-028 is used with an MDO (main dial office) test selector and is wired as shown in Figures 1, 2, and 3 of circuit diagram S-419086 (see Figure 2, Sheets 1 and 2, foldouts).

NOTE: Other FIG. numbers shown on the circuit diagram are for optional equipment wiring. All options are not included in any particular test set but options are selected to suit the requirements of the office in which the test set is to be installed.

1.04 An Equipment Specification may accompany the equipment. If instructions in the Equipment Specification differ from those in this practice, follow the Equipment Specification.

1.05 Refer to CTSP 405-110-728 (S-C switching series) for test procedures using the Type B test set.

2. DESCRIPTION

2.01 System Application: A block diagram of the application of the test set in a typical dial central office is shown in Figure 3 and described as follows:

a. Test Telephone Switching Equipment: When an external telephone set is connected to the test set, the telephone is assigned a station number and functions as a station telephone. The test set uses this number and the dial equipment associated with it to receive and originate calls through the central office equipment.

b. Test Train Switching Equipment: The test switchtrain consists of a test selector and a test connector. The test switchtrain is seized directly from the test set. Normally, there is only one test switchtrain in an office, but a local demand or future expansion may require an additional switchtrain.

c. Test Shoe: The test set is provided with a test shoe circuit. The test shoe permits the testing

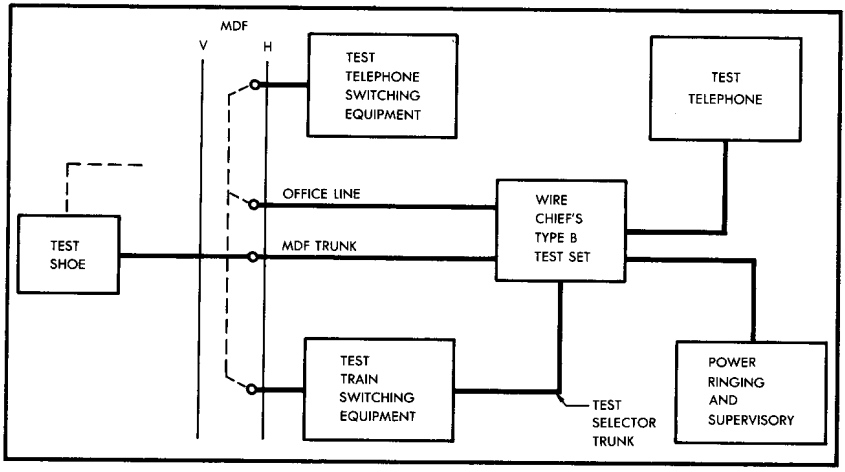


FIGURE 3. Typical Application for Type B Test Set

(without going through the dial equipment) of all lines and trunks that terminate on the protector blocks of the MDF (main distributing frame). The test shoe must be inserted manually into the protector of the line or trunk to be tested.

2.02 Capabilities: The individual requirements and specifications of the office in which the test set is to be used determine the functional circuits incorporated into the unit. Testing facilities for the following principal functions are available:

a. Tip, ring, and loop capacitance.

b. Tip, ring, and loop ground.

c. Loop resistance.

d. Tip and ring battery.

e. Positive booster voltage (+60 volt) on tip.

f. Single frequency, five-frequency, code, or superimposed ringing.

g. Howler with automatic cut-off and restoration of service.

h. Access to inside and outside plant by way of MDF protectors.

i. Reversal of test leads.

j. Dial pulsing.

k. Talking path.

l. Access to inside and outside plant by way of the test selector.

m. Monitoring at MDF heat coils.

n. Permanently held line condition (MDO type test set only).

2.03 Physical Characteristics: The test set is housed in a wooden cabinet with the controls mounted on a hinged metal front panel (see Figure 1), and the assembly is finished with a stone gray multicolored lacquer. Mounting holes drilled in the cabinet rear panel allow for mounting on the end of a main distributing frame, in an equipment bay, or on a wall. Dimensions of the test set are:

a. Height: 14-1/2 inches.

b. Width: 12 inches.

c. Depth: 8-1/2 inches.

d. Weight: 20 pounds (approximately).

2.04 Technical Characteristics:

a. Operating requirements:

(1) Battery voltage: 44 to 54 VDC.

(2) Dial characteristics:

(a) Percent make: 38.5 ±2%.

(b) Speed: 8 to 12 pps.

(c) Ringing voltage: As required.

b. Volt-ohmmeter:

(1) Full scale deflection current: 0.00075 ampere.

(2) Internal resistance: 200Ω maximum.

(3) Scales:

(a) DC voltage (lower scale): 0 to 150.

(b) Ω (upper scale): 0 to infinity.

3. CIRCUIT DESCRIPTION

3.01 This circuit description applies to the Type B test set used in MDO's or CDO's. Operation of the circuit is the same for both models except for the test selector train (see paragraphs 3.09 and 3.10). Each test set provides a means of applying various test circuits and potentials to the tip and ring conductors of a line under test.

3.02 Line Connection: This circuit provides three separate means of accessing a line under test:

a. Binding Post: The T and R binding posts are provided to connect external test equipment to the test set circuit.

b. MDF Test Shoe: The MDF test shoe can be inserted into the protector strip to provide three separate points of access:

(1) The T-IN and R-IN leads are the T and R leads to the line equipment.

(2) The heat coil tip (HCT) and heat coil ring (HCR) leads provide access through the heat coils to the customer's line.

(3) The T-OUT and R-OUT leads provide direct access to the customer's line, bypassing the heat coils.

c. Test Selector: The test selector trunk provides access to a customer's line by way of the test selector and test connector. A metallic path may be established to the line for ringing or meter measurements.

3.03 Receiving and Transmitting: Use a hand test telephone or a regular telephone with this circuit to provide a means of listening and talking.

a. Where a hand test telephone is plugged into the TEST TEL jack mounted in the face of the unit or when the handset of the station test telephone is lifted, a circuit is closed to relay CB.

b. Relay CB operating switches the test pair away from the meter, ringing, and howler circuits and couples the test pair to the test telephone.

c. Operation of the HEAT COIL LISTEN-TEST SELECTOR switch to the HEAT COIL LISTEN position will extend the transmission path from the line through the heat coils to the test pair. If the line is accessed by way of the test selector trunk, operation of this switch to the TEST SELECTOR position extends the transmission path to the test pair.

d. To talk with someone on the line, transmission battery is furnished to the line by operating the OFFICE LINE-OUT TALK switch to the OUT TALK position. This switch short circuits the transmission capacitors, so that relay CB furnishes transmission battery to both the testman and the person on the line under test.

3.04 Office Line Connection: Provision is made in this test unit to connect to a regular exchange line circuit. An external extension ringer may be connected to provide a means of signaling on incoming calls. Operation of the OFFICE LINE-OUT TALK switch to the OUT TALK position connects the test telephone to the exchange line circuit to permit origination or termination of a call in the usual manner.

3.05 Ringing: There are various ways of applying ringing to a line as shown in the following paragraphs a. through g. (see schematic diagram, Figure 2.). One of the methods shown applies to a particular office and other methods may be ignored once the proper method has been determined. Ringing is applied to a line by way of the test shoe or the test train by positioning the selector switch to the proper position and then operating the HOWLER-RING switch to the RING position. If the test shoe is used, the TEST IN-TEST OUT switch must also be placed in the TEST OUT position. Ringing is coded by the appropriate operation of the HOWLER-RING switch since this unit supplies noninterrupted ringing. In all cases, the selector switch position number corresponds to the number of the party on the line.

a. Five Frequency Harmonic Ringing (see FIG. B on Figure 2, sheet 3):

GENERATOR	SIDE OF LINE	SELECTOR SWITCH POSITION
1	R	1
2	R	2
3	R	3
4	R	4
5	R	5
1	T	6
2	T	7
3	T	8
4	T	9
5	T	10

b. Five Frequency Harmonic Ringing Odd and Even (see FIG. E on Figure 2, sheet 3):

GENERATOR	SIDE OF LINE	SELECTOR SWITCH POSITION
1	T	1
1	R	2
2	T	3
2	R	4
3	T	5
3	R	6
4	T	7
4	R	8
5	T	9
5	R	10

c. Five Frequency Ringing Odd and Even (see FIG. L on Figure 2, sheet 3):

GENERATOR	SIDE OF LINE	SELECTOR SWITCH POSITION
1	R	1
2	T	2
3	R	3
4	T	4
5	R	5
1	T	6
2	R	7
3	T	8
4	R	9
5	T	10

d. Five Frequency Harmonic Ringing On Ring Lead (see FIG. G or K on Figure 2, sheet 3):

GENERATOR	SIDE OF LINE	SELECTOR SWITCH POSITION
1	R	5
2	R	4
3	R	3
4	R	2
5	R	1
1	R	10
2	R	9
3	R	8
4	R	7
5	R	6

e. Four Frequency Ringing (see FIG. J on Figure 2, sheet 3):

GENERATOR	SIDE OF LINE	SELECTOR SWITCH POSITION
1	R	1
2	R	2
3	R	3
4	R	4
1	T	5
2	T	6
3	T	7
4	T	8

f. Single Frequency Code Ringing (see FIG. C on Figure 2, sheet 3):

SIDE OF LINE	SELECTOR SWITCH POSITION
R	1
T	2
R	3
T	4
R	5
T	6
R	7
T	8
R	9
T	10

g. Superimposed Ringing (see FIG. D on Figure 2, sheet 3):

POLARITY OF SUPERIMPOSED BATTERY	SIDE OF LINE	SELECTOR SWITCH POSITION
Neg.	R	1
Neg.	T	2
Pos.	R	3
Pos.	T	4
Neg.	R	5
Neg.	T	6
Pos.	R	7
Pos.	T	8

3.06 Howler: With the HOWLER-RING switch in the normal position, the tip and ring conductors under test are extended into the testboard for connection to the test telephone.

a. To apply the HOWLER, the test telephone must be on-hook.

b. When a connection to the line is made by way of the test shoe, the TEST IN-TEST OUT switch must be operated to the TEST OUT position. See FIG. 3 on Figure 2, sheet 2, and FIG. H on Figure 2, sheet 3.

c. Operation of the TEST IN-TEST OUT switch to the TEST OUT position disconnects the customer's line T-OUT and R-OUT leads from the exchange line circuit T-IN and R-IN leads. This opens the loop to allow the held line circuit to restore to normal and extends the customer's line T-OUT and R-OUT leads through normal contacts of the TEST REVERSE switch and normal contacts of relay CB to control of relay HL contacts.

d. After operation of the TEST IN-TEST OUT switch to the TEST OUT position with the selector switch positioned to 8 (TIP CAP), operation of the HOWLER-RING switch to the HOWLER position closes a circuit to the B-D winding of relay HL from ground through normal contacts of relay HL and prepares an alternate holding loop for relay HL.

e. Operation of relay HL grounds the HST lead, causing activation of the external howler circuit. This disconnects the T-OUT and R-OUT leads from control of the HOWLER-RING switch and closes a holding loop circuit to itself by way of operated contacts of the HOWLER switch section, its own operated contacts, normal relay CB contacts, normal TEST REVERSE-CAP READ switch contacts, operated TEST OUT section of the TEST IN-TEST OUT switch contacts, the T-OUT and R-OUT leads, and the customer's telephone hookswitch.

f. The selector switch is now set to the OFF position. This opens the operating loop circuit for relay HL and places it under control of the customer's telephone on the T-OUT and R-OUT leads.

g. External howler tone, capacitor coupled in parallel with the windings of relay HL by way of the HT and HR leads, is applied through the holding path for relay HL (as described above) to the customer's telephone receiver. This provides an audible indication that the telephone is off-hook.

h. If a graduated howler is used, the tone is increased automatically, in steps, to its maximum.

i. When the telephone handset has been properly restored on the hookswitch, the T and R loop is opened to the windings of relay H.

j. Release of relay HL removes ground from the HST lead, deactivates the external howler circuit, disconnects the T-OUT and R-OUT leads from the output of the external howler circuit, and connects the customer's exchange line circuit T-IN and R-IN leads to the customer's line T-OUT and R-OUT leads by way of operated contacts of the HOWLER-RING and TEST IN-TEST OUT switches.

k. With the exchange line circuit reconnected, the customer's telephone is available for normal service.

l. After applying the howler tone for a desired time, the TEST IN-TEST OUT switch must be restored to normal before operating the HEAT COIL LISTEN-TEST SELECTOR switch to the HEAT COIL LISTEN position; then remove the telephone from the hookswitch to monitor the line.

m. Restoration of the TEST IN-TEST OUT switch reconnects the T-OUT and R-OUT leads through normal contacts of the TEST IN switch section to maintain the connection with the exchange line circuit by way of the T-IN and R-IN leads. It also disconnects the test out leads from control of the HOWLER section of the HOWLER-RING switch and relay HL.

n. The line can be monitored as described in paragraph 3.03 and resistance measurements made of the line loop (paragraph 3.07 f.) to determine if the condition has been corrected.

3.07 Meter Connections: Connection to the line is established by way of the test selector switchtrain or the MDF test shoe. When the test shoe is used, the TEST IN-TEST OUT switch must be placed in the TEST OUT position. If the test train is used, the HEAT COIL LISTEN-TEST SELECTOR switch must be placed in the TEST SELECTOR position, and the TEST IN-TEST OUT switch must be left in the normal position. Before making each resistance measurement test, the meter should be calibrated as instructed in paragraph 3.07 b. (4).

NOTE: When making meter measurements, the test telephone must be on-hook.

a. The Selector Switch: The selector switch is a twelve terminal point switch with terminal 1 not wired and referred to as the OFF position. On FIG. 1 of the schematic diagram (Figure 2, sheet 1), terminal 12 is shown as brush wiper connections on each bank A, B, C, D, E, F, and G. The test function of each terminal position of the selector switch is shown in Table A of the schematic diagram (Figure 2, sheet 1).

b. Zero Adjust: Turn the selector switch to position 1.

(1) The ground present on the C brush wiper (relay HL normal) is conducted by way of the strap to terminal 1 (C and F gang), F brush wiper to the positive (+) side of the meter.

(2) Negative battery potential is conducted by way of the resistance network composed of resistors RH1, R2 center tapped, RH2, normal

DIAL IN-LOW OHMS switch, terminal 1, G brush wiper through the winding of relay MS to the negative side of the meter.

(3) Excessive current will operate relay MS which shunts the meter, thereby protecting the meter.

(4) To set the meter needle to 0 Ω, operate the ZERO ADJUST rheostat to RH1.

c. Negative Potential Measurement: Turn the selector switch to position 2.

(1) Tip battery voltage—TEST REVERSE-CAP READ switch normal.

(a) The meter circuit is returned to ground by way of the F wiper and the tip side of the line is connected to the other side of the meter circuit.

(b) Ground is applied by way of the diode and F wiper through the meter and relay MS in series with the G wiper position 2, resistors RH3 and R3, D wiper, normal contacts of the HOWLER-RING switch, normal contacts of relays HL and CB, and normal contacts of the TEST REVERSE-CAP READ switch to the tip side of the line under test.

(c) Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit by way of the T-OUT lead of the MDF test protector shoe to the tip of the line under test.

(2) Ring battery voltage—TEST REVERSE-CAP READ switch in the TEST REVERSE position.

(a) The meter circuit is returned to ground by way of the F wiper. The ring side of the line is connected to the other side of the meter through operated contacts of the TEST REVERSE section of the TEST REVERSE-CAP READ switch.

(b) Ground is applied by way of the diode and F wiper position 2, through the meter and relay MS in series with the G wiper position 2, resistors RH3 and R3, D wiper, normal contacts of the HOWLER-RING switch, normal contacts of relays HL and CB, and operated contacts of the TEST REVERSE section of the TEST REVERSE-CAP READ switch to the ring side of the line under test (test telephone on-hook).

(c) Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit by way of the R-OUT lead of the MDF test protector shoe to the ring side of the line under test.

(d) The meter is connected as a voltmeter and will indicate the reading of negative battery voltage of the ring conductor under test.

d. Positive Booster Voltage Measurement: Turn the selector switch to position 3.

(1) The meter circuit is returned to ground by way of the G wiper; the tip side of the line is connected to the other side of the meter circuit.

(2) Ground is applied by way of the G wiper position 3, relay MS and meter in series, the F wiper position 3, resistors RH3 and R3, D wiper, normal contacts of the HOWLER-RING switch, normal contacts of relays HL and CB, and normal contacts of the TEST REVERSE-CAP READ switch to the tip side of the line under test (test telephone on-hook).

(3) Operation of the TEST IN-TEST OUT switch to the TEST IN position connects the meter circuit by way of the T-IN lead to the tip conductor of either line adapter circuit.

(4) The meter is connected as a voltmeter and will indicate a reading of positive booster voltage (+60) on the tip conductor under test.

e. Line Battery Measurement: Turn the selector switch to position 4.

CAUTION: During this test, if the meter needle moves to the left (negative on tip) or moves very quickly to the right (voltage more than 150 volts), release the TEST IN-TEST OUT switch immediately.

(1) The positive side of the meter is connected to the tip side of the line under test by way of the F wiper and F gang terminal 4, normal contacts of the HOWLER-RING switch, normal contacts of relays HL and CB, and normal contacts of the TEST REVERSE switch.

(2) With the selector switch in position 4, the negative side of the meter is connected to the ring side of the line under test by way of relay MS, the G wiper and G gang terminal 4, strap to G gang terminal 2, resistors RH3 and R3, strap from D gang terminal 2, E gang terminal 4, the E wiper, normal contacts of the HOWLER-RING switch, normal contacts of

relays HL and CB, and normal contacts of the TEST REVERSE switch.

(3) Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit across the T-OUT and R-OUT leads of the MDF test protector shoe to the tip and ring conductors of the line under test.

(4) The meter is connected as a voltmeter and will indicate any extraneous or foreign DC voltage that may be connected across the line.

(5) Operation of the TEST IN-TEST OUT switch to the TEST IN position connects the meter circuit across the T-IN and R-IN leads of the MDF test protector shoe to the tip and ring leads of the line equipment under test. This provides a meter indication of the exchange battery voltage, unless + booster voltage is used on that line. Subtract the + booster voltage (see paragraph d.) to determine the exchange battery voltage.

f. Resistance Measurements: The meter center scale deflection indicates 50,000 Ω . When the DIAL IN-LOW OHMS switch is operated to the LOW OHMS position, the meter scale indication is one hundredth of the high Ω indication (center scale deflection is 500 Ω).

(1) Tip Resistance to Ground Meter Scale Reading—Selector switch in position 5.

(a) With the resistance ground on tip, ground is applied on wiper C, conducted by the straps on terminals 1 and 5 of gang C; then strap to terminal 1 of gang F, furnishing ground to the resistor network composed of R4, R11, R2, and RH1.

(b) The negative battery potential is conducted by way of resistor RH1 to the center tap of resistor R2, to rheostat RH2, normal contacts of the LOW OHMS switch, terminal 5 of gang C, wiper G of the selector switch through relay MS and meter in series, through F gang terminal 5, strap to gang D terminal 5, wiper D, normal contacts of the HOWLER-RING switch, relays HL and CB and normal contacts of the TEST REVERSE switch, to the tip side of the line under test.

(c) Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit by way of the T-OUT lead of the MDF test protector shoe to the tip of the line under test (test telephone on-hook).

(d) The meter connected to battery through high resistance of resistor RH2, in series with the line, indicates the resistance in Ω of the tip conductor.

(2) Tip Resistance to Ground (Low Meter Scale Reading)—Selector switch in position 5.

(a) With the resistance ground on tip and the DIAL IN-LOW OHMS switch operated to the LOW OHMS position, the battery feed of the meter is transferred from high resistance to a low resistance network formed by resistors RH1, R2, R11 center tapped and R5.

(b) The meter reading multiplied by 0.01 will indicate the resistance in Ω of the tip conductor under test.

(3) Ring Resistance to Ground (Normal Meter Scale Reading)—Selector switch in position 6.

(a) With the selector switch in position 6 and the DIAL IN-LOW OHMS switch in normal position, the negative battery is fed by way of resistors RH1 to the center tap R2, RH2, normal contacts of the LOW OHMS switch, G gang terminal 6, G wiper, relay MS and meter in series, the F wiper, F gang terminal 6, strap to F gang terminal 5, D gang terminal 5, E gang terminal 6, E wiper, normal contacts of the HOWLER-RING switch, normal contacts of relays HL and CB and the TEST REVERSE switch, to the ring side of the line under test.

(b) Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit by way of the R-OUT lead of the MDF test shoe to the ring of the line under test (test telephone on-hook).

(c) The meter connected to battery through high resistance RH2 in series with the line indicates the resistance in Ω of the ring conductor.

(4) Ring Resistance to Ground (Low Meter Scale Reading)—Selector switch in position 6.

(a) With the selector in position 6 and the DIAL IN-LOW OHMS switch operated to the LOW OHMS position, the battery feed of the meter is transferred to low resistance formed by resistor network RH1, R2, center tap R11 and R5.

(b) The meter reading multiplied by 0.01 will indicate the resistance in Ω of the ring conductor under test.

(5) **Loop Leakage Resistance**—Selector switch in position 7.

(a) With the selector switch in position 7 and the DIAL IN-LOW OHMS switch normal, the ring side of the line under test is connected to battery by way of the TEST REVERSE switch, relays CB and HL, the HOWLER-RING switch, E wiper, E gang terminal 7, strap to E gang terminal 6, strap to D gang terminal 5, strap to F gang terminals 5, 6, and 7, wiper F to the meter and relay MS in series, wiper G, G gang terminal 7 to the normal LOW OHMS switch, resistor RH2 center tap resistor R2, and resistor RH1. The tip conductor of the line under test is grounded at D gang terminal 7 by way of the normal contacts of the TEST REVERSE switch, relays CB and HL, the HOWLER-RING switch, and the D wiper.

(b) **Normal Meter Scale Deflection**—Operation of the TEST IN-TEST OUT switch to the TEST OUT position connects the meter circuit by way of the R-OUT lead onto the ring side of the line under test. Also, ground is placed on the tip of the line by way of the T-OUT lead for testing leakage resistance between the tip and ring conductors. With a customer's telephone handset on-hook, the leakage resistance is measured between tip and ring. The meter will indicate the high scale leakage resistance in Ω of the line under test. The center scale deflection indicates 50,000 Ω.

(c) **Low Scale Deflection**—Operation of the DIAL IN-LOW OHMS position transfers the meter circuit to low resistance. The meter will indicate in Ω the low scale leakage resistance of the line under test. The center scale deflection is 500 Ω.

(6) **Line Loop Resistance**—The circuit description is the same as that described for the loop leakage resistance in paragraph (5) above.

(a) **Normal Meter Scale Deflection**—With the customer's telephone handset off-hook and the DIAL IN-LOW OHMS switch normal, the line loop resistance measured includes the telephone resistance.

(b) **Low Meter Scale Deflection**—With the customer's telephone handset off-hook and the DIAL IN-LOW OHMS switch operated to the LOW OHMS position, a low scale line loop resistance is measured which includes the telephone resistance.

g. Capacitance Measurement: The tip, ring, or loop capacitance of a line under test can be determined by operating the TEST REVERSE-CAP READ switch to the CAP READ position, with the selector switch placed in the appropriate position. The observed meter deflections are interpreted by using Table A.

NOTE: The TEST REVERSE-CAP READ switch should be operated repeatedly to the CAP READ position to obtain an average reading.

(1) **Tip Capacitance**—With the selector switch in position 8, high resistance battery is extended to the relay side of the meter by way of resistor R1 and the G wiper. The other side of the meter is connected through the F wiper and the normal contacts of the TEST REVERSE switch to D gang terminal 10 wiper D, normal contacts of the HOWLER-RING switch, relays HL and CB normal contacts of the TEST REVERSE switch to the tip side of the line under test. Operating the TEST IN-TEST

TABLE A. Conversion of Meter Deflection to Capacity Value

DEFLECTION (in volts)	CAPACITY (in μf)	DEFLECTION (in volts)	CAPACITY (in μf)	DEFLECTION (in volts)	CAPACITY (in μf)
19	0.5	36	1.0	110	6.0
22	0.6	62	2.0	116	7.0
26	0.7	78	3.0	122	8.0
30	0.8	94	4.0	128	9.0
32	0.9	102	5.0	132	10.0

OUT switch to the TEST OUT position connects the meter circuit by way of the T-OUT lead to the tip of the line under test. When the TEST REVERSE-CAP READ switch is operated to the CAP READ position, the tip conductor is grounded. On release of the switch, the tip conductor is connected to the meter and the meter is returned to battery, so that the capacitance is charged in series with the meter. This results in a meter deflection which is proportionate to the capacitance. Refer to Table A for approximate values.

(2) Ring Capacitance—Turn the selector switch to position 9. The ring capacitance is determined in a manner similar to that used to determine tip capacitance except for the position of the selector switch. This measurement is made with the selector switch in position 9. The ring lead of the line under test is connected to the meter by way of the E wiper and E gang terminal 9.

(3) Loop Capacitance—The loop capacitance is determined in a manner similar to that used to determine tip capacitance except for the position of the selector switch. This measurement is made with the selector switch in position 10. The meter circuit is connected to the tip lead of the line under test by way of the D wiper, D gang terminal 10; the ring lead of the line under test is grounded by way of the E wiper and the E gang terminal 10. With the TEST IN-TEST OUT switch in the TEST OUT position, operation of the TEST REVERSE-CAP READ switch to the CAP READ position connects the tip and ring conductors to ground, which provides a metallic shunt, discharging the total line capacitance. When the TEST REVERSE-CAP READ switch is returned to normal position, the tip lead is connected to the meter and the meter is returned to battery potential so that the total line capacitance is charged in series with the meter. This results in a meter deflection which is proportionate to the loop capacitance. Refer to Table A for approximate values.

3.08 Testing Office Equipment (Using the Test Shoe): Connect the test shoe to the line to be tested at the MDF. To perform tests on the customer's line equipment inside the office, place the selector switch in the OFF position and proceed as follows:

a. To check the customer's office equipment, the Wire Chief's test telephone must be off-hook. If the line is free and the associated line circuit furnishes ground on the tip side (T-IN) lead, operate the DIAL IN-LOW OHMS switch to the DIAL IN position. A loop is placed across the T-IN and R-IN leads, seizing the line circuit; dial tone will be returned to the Wire Chief's test telephone.

b. Use the dial on the test telephone to dial any connection served by the exchange to check the functional operation of the exchange equipment for the line circuit under test.

c. If the line is free, but the associated line circuit does not furnish ground on the tip side (T-IN) of the line (which is common on circuits associated with PABX combination trunks), connect a ground to the R binding post and operate the DIAL IN-LOW OHMS switch to the DIAL IN position. This connects a loop across the T-IN and R-IN leads but will not operate the line relay in that circuit.

d. The line circuit is seized when the TEST IN-TEST OUT switch is placed to the TEST IN position. This places the R binding post ground on the R-IN lead which seizes the line circuit, initiating a linefinder action. When the exchange equipment finds the line, dial tone will be returned to the wire chief's test telephone.

e. When dial tone is heard, operate the TEST IN-TEST OUT switch to the TEST OUT position. Ground is removed from the test telephone dial impulse springs.

f. The testman may now use the test set dial to dial any connection served by the exchange to check the functional operation of the inside equipment for the office line.

3.09 Testing Line Equipment, Using the CDO Test Train: The CDO test train control circuits are described in the following paragraphs. See FIG. 7 of the schematic diagram (sheet 2 of Figure 2) for wiring details.

a. Supervisory Lamp: The supervisory (SR) lamp, mounted on the front panel of the test set, serves as a combined busy and supervisory lamp for the test selector. When the HEAT COIL LISTEN-TEST SELECTOR switch is in the normal position and the SR lamp is illuminated, it indicates that the test selector is busy. The HEAT COIL LISTEN-TEST SELECTOR switch should not be operated to the TEST SELECTOR position unless the SR lamp is extinguished.

b. Test Selector Seizure: To reach a line by way of the switchtrain, place the HEAT COIL LISTEN-TEST SELECTOR switch to the TEST SELECTOR position and dial the last four digits of the line number, using the position dial shown in FIG. 7 (sheet 2 of Figure 2). If the line is busy, the SR

lamp will be illuminated and conversation may be heard on the Wire Chief's telephone. If the line is idle, the testman can make meter measurements or other tests on that line.

c. Meter Measurements, Ringing or Placing Howler on Line Under Test: Placing the HEAT COIL LISTEN-TEST SELECTOR switch to the TEST SELECTOR position connects the test T and R leads of the test position (see FIG. 1 on sheet 1 of Figure 2) to the TTS and TRS leads of the test selector circuit (see FIG. 7 on sheet 2 of Figure 2). The TTS and TRS leads are extended on a metallic basis through to the test selector and test connector circuits as the line number is dialed. Upon connection to an idle circuit, the test selector causes operation of the cut-off relay CO in that line circuit which frees the associated line of attachments, allowing meter measurements (see paragraph 3.07), application of ringing (see paragraph 3.05), or connection of the howler to the line (see paragraph 3.06).

d. Testing Lines In Same Test Connector Bank Level: To test the next consecutive line in the same connector bank level, dial the digit 1 using the test set dial (see FIG. 7 on sheet 2 of Figure 2). The test selector then steps the associated test connector to the next wire bank position.

e. Release of Test Switchtrain: To seize a line in a different level or to seize a different test connector, the HEAT COIL LISTEN-TEST SELECTOR switch (see FIG. 7 on sheet 2 of Figure 2) must be returned to the neutral position, releasing the test selector and test connector circuit.

3.10 Testing Line Equipment, Using the MDO Test Train: The MDO test train control circuits are described in the following paragraphs. (Refer to FIG. 2 on sheet 1 of Figure 2) for wiring details.

a. Supervisory Lamp: The supervisory lamp (SR), mounted on the front panel of the test set, serves as a combined busy and supervisory lamp for the test selector. When the HEAT COIL LISTEN-TEST SELECTOR switch (see FIG. 2 on sheet 1 of Figure 2) is in the normal position and the SR lamp is illuminated, it indicates that the test selector is busy. The HEAT COIL LISTEN-TEST SELECTOR switch should not be operated to the TEST SELECTOR position unless the SR lamp is extinguished.

b. Test Selector: Placing the HEAT COIL LISTEN-TEST SELECTOR switch (see FIG. 2 on sheet 1 of Figure 2) to the TEST SELECTOR position causes the following functions:

(1) Connects the A-C winding of relay BY across the T and R leads to the test selector.

(2) This loop across the T and R leads seizes the test selector.

(3) The test selector returns ground on the S lead to operate relay BY through the B-D winding.

(4) Operation of relay BY connects ground to light the supervisory lamp, indicating that the selector is available for dialing.

c. Dialing: Operation of the test set dial causes the following functions:

(1) When the dial is moved off normal, ground is forwarded from the operated off-normal springs to operate relay DA through the A-C winding.

(2) Operation of relay DA connects ground to operate relay DB.

(3) Operation of relay DB connects the dial impulse springs across the T and R leads to the test selector, disconnects the A-C winding of relay BY from the dialing loop (to prevent impulse distortion), and disconnects resistance ground from the HS lead to the test selector.

(4) While the dial is returning to normal, the impulse springs open and close the loop on the T and R leads to the test selector, causing the test selector to step in accordance with the digit dialed.

(5) When the dial has returned to normal, the following functions occur:

(a) The impulse springs remain closed, holding the loop to the seized test selector.

(b) The off-normal spring open, causing relay DA to release.

(c) Release of relay DA reconnects ground on the HS lead and opens the circuit to slow release relay DB.

(d) Release of relay DB transfers the T and R leads from the dial to the loop provided by the A-C winding of relay BY.

(6) The dialing sequence is repeated until sufficient digits have been dialed to reach the line to be tested.

d. Idle Line Connection: When the test selector trunk connects to an idle line, battery is returned on the HS lead to operate relay SA. Operation of relay SA connects ground (from the CONN RLS switch) to operate relay SB. Operation of relay SB causes the following functions:

(1) Removes ground from the supervisory lamp, causing the lamp to extinguish.

(2) Disconnects the A-C winding of relay BY from across the T and R leads.

(3) Extends the T and R leads from the test selector to the testing circuits in the test set.

(4) Provides a locking path for relay SB to ground at the CONN RLS switch.

(5) Ground pulses received on the HS lead from the test connector cause relays SA and SB to operate and light the supervisory lamp in accordance with the line conditions detected by the test connector as follows:

LAMP INDICATION	LINE CONDITION
120 IPM flashing	Line busy
1 flash	Battery on line
2 flashes	Ground on line
3 flashes	Low loop leakage resistance
4 flashes	No fault on line

e. Additional Digit Dialing: After a line has been seized through the test selector trunk, dialing an additional digit 1 at the test set dial causes the test connector wipers to step to the next consecutive line on the test connector bank. This function is performed by the regular operation of the dialing circuit, with the test connector operating under control of the loop provided by the dial impulse springs.

f. Busy Conditions: When the test train from the test selector trunk detects a busy condition, the supervisory lamp on the test set gives a busy indication as follows:

(1) **Test Connector Busy**—When a busy test connector is detected, ground is applied to the S lead of the test selector and the HS lead becomes open (instead of having battery applied). Relay BY remains operated but relays SA and SB will not operate, causing any further dial pulses to be ineffective. On completion of dialing, the supervisory lamp remains lighted (from the ground on the BY relay contacts) to give a visual indication of the busy condition.

(2) **Line Busy**—When the test connector is stepped to a busy line, 120 IPM battery pulses are forwarded on the HS lead to pulse the SA and SB relays, causing the supervisory lamp to flash at 120 IPM.

(3) **Monitoring a Busy Line**—Placing the DIAL IN-LOW OHMS switch to the DIAL IN position, and the TEST OUT-TEST IN switch to the TEST IN position removes transmission battery from the T and R leads of the TEST TEL jack on the test set and connects these leads to the test selector. The line can then be monitored through capacitors in the test selector circuit from a hand test telephone plugged into the TEST TEL jack.

g. Releasing a Permanently Held Line Circuit: Placing the IN TEST-RELS PERM switch to the RELS PERM position releases any battery feed relay held by a faulty condition (loop more than 50 Ω) on the line circuit. The RELS PERM switch connects low resistance battery on the test selector S lead, in place of the high resistance battery from the B-D winding of the BY relay. This low resistance battery causes the test selector to apply ground on the tip conductor and low potential battery on the ring conductor of the line. These conditions cause the battery feed relay to release.

h. Releasing CO Relay on Regular Line Circuit: Operation of the IN TEST-RELS PERM switch to the IN TEST position and the CO CONTROL-CONN RELEASE switch to the CO CONTROL position causes release of the CO relay of the line circuit selected by the test selector test train. It is necessary to release the CO relay so that tests may be performed on the line equipment inside the office. The release sequence is:

(1) Place the IN TEST-RELS PERM switch to the IN TEST position which applies ground to operate relay DB.

(2) Operation of relay DB connects the T and R leads from the test selector to the dial impulse springs.

(3) Place the CO CONTROL-CONN RELEASE switch to the CO CONTROL position to shunt the B-D winding of relay SB which applies low resistance ground to the HS lead of the test selector.

(4) The test selector removes ground from the sleeve lead of the line circuit, causing release of relay CO in the line circuit.

(5) Release of relay CO transfers the line circuit LR relay to control of the loop provided by the test set dial impulse springs.

(6) The line circuit can now be pulsed from the test set dial.

i. Connecting the Hand Test Telephone to the Test Train: When the hand test telephone (in the off-hook condition) is connected to the TEST TEL jack on the test set, the telephone may be

connected to the line accessed by the test connector in the following manner:

(1) Place the DIAL IN-LOW OHMS switch to the DIAL IN position and the TEST IN-TEST OUT switch to the TEST IN position to connect the T and R leads of the telephone to the test selector trunk circuit. The T and R leads are then extended through the operated contacts of the TEST SELECTOR switch and relay SB to the open contacts on relay DB.

(2) Restore the IN TEST-RELS PERM switch to its normal position which removes ground from relay DB. Relay DB releases, connecting the T and R leads of the test selector train to the leads of the test telephone.

(3) Place the OFFICE LINE-OUT TALK switch to the OUT TALK position which connects battery and ground from the CB relay to the T and R leads of the line. This energizes the transmitters of the telephones on the line so that conversation is possible between the test set operator and the called party.

j. **Disconnecting the Hand Test Telephone from the Line Being Tested:** The hand test telephone is restored on-hook before the operated CO CONTROL switch is restored to normal.

(1) When the hand test telephone is restored on-hook, the T and R loop is opened which releases the line circuit under test.

(2) When the CO CONTROL switch is restored to normal, the shunt is removed from the B-D winding of relay SB. This causes high resistance ground to be applied to the HS lead of the test selector. The test selector then applies ground on the S lead of the line circuit, reoperating the CO relay. Operation of the CO relay causes the test selector train T and R leads to be connected to the outside line equipment (and disconnected from the office equipment) of the line under test.

k. **Releasing the Test Selector Trunk:** The testing train from the test selector trunk can be released by releasing the test connector only, or by releasing both the test selector and the test connector.

l. **Releasing the Test Connector:** The test connector is released in the following manner:

(1) Operate the CO CONTROL-CONN RELEASE switch to the CONN RELEASE position to perform the following:

(a) Remove ground from the A-C winding of relay SB.

(b) Disconnect the T lead from FIG. 1.

(c) Connect a holding battery through R12 to the T lead of the test selector.

(d) Disconnect high resistance ground from the HS lead, causing release of the line relay of the test selector.

(e) Open the loop for A-C winding of relay BY to prevent connection across the T and R leads of the test selector after release of relay SB.

(2) Release of relay SB performs the following:

(a) Connects ground from operated BY relay contacts to light the supervisory lamp.

(b) Opens the path to the A-C winding of relay BY.

(c) Opens the R lead to the test selector, releasing the pulse control relay in the test selector which releases the associated test connector.

(3) Restoring the CO CONTROL-CONN RELEASE switch to normal performs the following:

(a) Reinstates high resistance ground through relays SA and SB to the HS lead.

(b) Reconnects ground to operate relay SB.

(c) Reconnects the A-C winding of relay BY across the test selector T and R leads and removes resistance battery from the tip lead, causing reseizure of the test connector.

m. **Test Selector and Test Connector Release:** The entire test selector train is released by restoring the HEAT COIL LISTEN-TEST SELECTOR switch to normal. Restoring the switch to normal performs the following:

(1) Disconnects the holding ground from relay SB.

(2) Opens the HS lead.

(3) Opens the loop across the T and R leads, causing release of the test selector and test connector.

(4) Release of the test selector removes ground from the S lead to the B-D winding of relay BY.

(5) Release of relay BY emoves ground from

the supervisory lamp, causing the lamp to extinguish.

3.11 Heat Coil Test: To test the protectors, go off-hook with the test telephone and turn the selector switch to the OFF position. Operating the HEAT COIL LISTEN-TEST SELECTOR switch to the HEAT COIL LISTEN position will capacitor couple the line under test to the test telephone. If the line is free, operation of the TEST IN-TEST OUT switch to the TEST OUT position will capacitor couple the customer's line T-OUT and R-OUT leads to the test telephone. This disconnects the associated line circuit T-IN and R-IN leads, transferring seizure of the line circuit under test to the control of a loop circuit composed of the test telephone, the OUT TALK section of the OFFICE LINE-OUT TALK switch, and the test shoe connected to the coils. Operation of the OFFICE LINE-OUT TALK switch to the OUT TALK position shunts the transmission capacitors, closing a T and R loop, seizing the line circuit under test by way of the HC-TIP and HC-RING conductors through the heat coils. Seizure of the line circuit initiates an allotter linefinder action, returning dial tone if the coils are not open.

3.12 Test Lead Reversal: To reverse the conductors under test into the test set, operate the TEST REVERSE-CAP READ switch to the TEST REVERSE position. The T and R leads are transposed from the test set access through the springs of the TEST REVERSE switch. The TEST REVERSE switch is used in conjunction with position 2 of the selector switch to test for battery on the ring lead of a line or trunk.

3.13 Use of External Test Equipment: With the TEST IN-TEST OUT switch in the TEST OUT position, the selector switch in the OFF position and the test telephone on-hook, the T-OUT and R-OUT pair from the test shoe are connected to the T and R binding posts on the front panel of the test set. Equipment such as a Wheatstone bridge or a dial speed and percent make test set may be connected to the binding posts for making tests from the customer's line. If the test selector circuit is used, the external test equipment connected to the binding posts is connected to the line under test when the HEAT COIL LISTEN-TEST SELECTOR switch is placed in the TEST SELECTOR position.

3.14 Generator Ground Cut-Off:

a. When the selector switch is placed to the position for the desired frequency selection, and the DIAL IN-LOW OHMS switch is placed to the LOW OHMS position, ground is removed from the GEN GRD leads of FIGS. B, C, D, E, G, J, K, or L (sheet 3 of Figure 2). This function is called **generator ground cut-off** and is used on lines with subsets that do not remove ringers from the line when the telephone is off-hook; or on lines having telephones equipped with varistors connected across the receiver.

b. The **howler** would not be effective for signaling a customer who had left the handset off-hook on these lines. When the testman places the DIAL IN-LOW OHMS switch to the LOW OHMS position, ground is removed from the line, removing the shunt from the ringers on both the tip and ring (due to the off-hook subset). When applied, ringing current will not short circuit or damage the receiver of the off-hook telephone.

c. Operation of the HOWLER-RING switch to the RING position applies the desired ringing current to the line and rings the parties on both the tip and ring, with ringers connected from one side of the line to ground when both parties are rung normally with the same frequency on separate sides of the line (divided circuit ringing). This is due to the off-hook telephone bridging both the tip and ring of the line.

4. INSTALLATION PROCEDURES

4.01 Mounting Instructions: The test set can be mounted in a relay rack, on a wall, or on the end of the MDF. Figure 4 shows the typical methods of mounting the test set and the location of the required mounting holes to be drilled. When mounting on a wall, all four mounting holes in the corners of the base should be used. For MDF mounting, the installer must drill the cross channel for the two top mounting holes and use suitable screws for securing the test set. When the test set is to be mounted in a relay rack, the installer should drill the base as shown in FIG. B (sheet 3 of Figure 2), and the unit mounted on the brackets supplied as shown in FIG. A of Figure 4.

4.02 Wiring Instructions: A cable entry hole should be drilled in the test set base or top to permit the cabling to be run to the MDF, local telephone, supervisory terminal block, etc. (refer to the equipment specification for details of cable runs required). These cables are terminated on the terminal block inside the test set. Remove the terminal block mounting nuts and turn the block on its side to facilitate wiring. Wire as shown in FIG. A of Figure 2 (sheet 3), then replace the terminal block after all connections have been completed.

5. MAINTENANCE PROCEDURES

5.01 Performance Routine: The performance routine checks in the following paragraphs should be

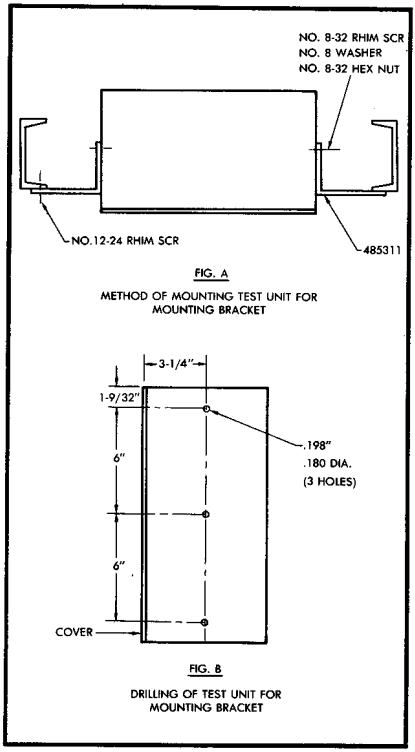


FIGURE 4. Wire Chief's Test Set, Type B, Mounting Details

periodically applied to the Type B Wire Chief's test set. Refer to paragraph 6 for ordering information for any replacement parts required.

a. Material Required: The following materials are required to perform routine checks on the Type B Wire Chief's test set:

(1) Single conductor test cords with an alligator clip at each end of the cord (two cords are required).

(2) 510 Ω resistor (1-watt, carbon, ±5%), Stromberg-Carlson No. 554003-511, or equivalent.

(3) 5100Ω resistor (1 watt, carbon, ±5%), Stromberg-Carlson No. 554003-512, or equivalent.

(4) 2 μf capacitor (+38%, -0%, 200-watt VDC), Stromberg-Carlson No. 202886-865, or equivalent.

b. Preliminary Procedures:

(1) Restore all switches to normal on the test set.

(2) Assign a convenient local telephone as a test telephone.

c. ZERO ADJ Check:

(1) Rotate the selector switch to position 1 (ZERO ADJ).

(2) Rotate the ZERO ADJ control in each direction in turn. Check that the meter needle moves freely in each direction as the control is rotated.

(3) Use the ZERO ADJ control to set the meter indication at 0 on the upper meter scale.

d. Resistance Check:

(1) Connect the 510Ω resistor to the test set T and R binding posts.

(2) Operate the DIAL IN-LOW OHMS key to the LOW OHMS position.

(3) Rotate the test selector switch to position 7 (LOOP).

(4) The meter should indicate 51 K.

(5) Disconnect the 510Ω resistor from the binding posts.

(6) Connect the 5100Ω resistor across the binding posts.

(7) The meter needle should indicate approximately 500 K.

(8) Restore the DIAL IN-LOW OHMS key to normal.

(9) The meter should indicate 5.1 K.

(10) Disconnect the 5100Ω resistor from the T and R binding posts.

e. TIP GRD, RING GRD, TEST REVERSE Check:

(1) Rotate the test set selector switch to position 5 (TIP GRD).

(2) Connect one end of the 5100Ω resistor to the T binding post and the other end to ground.

(3) Check that the meter indicates 5.1 K.

(4) Rotate the test set selector switch to position 6 (RING GRD). The meter should indicate infinity on the upper scale.

(5) Operate the TEST REVERSE-CAP READ key to the TEST REVERSE position. The meter should indicate 5.1 K.

(6) Disconnect both test leads and restore the TEST REVERSE-CAP READ key to normal.

f. Voltmeter, TIP BAT, RING BAT Check:

(1) Rotate the selector switch to position 2 (BAT ON TIP).

(2) Connect the test lead from the battery to the T binding post on the test set. The test set meter should indicate the same voltage as the meter on the powerboard.

(3) Operate the TEST REVERSE key. The test meter should indicate zero.

(4) Disconnect test lead T from the binding post and connect to the R binding post on the test set. The test set meter should indicate the same voltage as in (2) above.

(5) Restore the TEST REVERSE key. The test set meter should indicate zero.

(6) Disconnect the test lead from the R binding post and battery.

g. Capacitance Check:

(1) Rotate the selector switch to position 8 (TIP CAP).

(2) Connect the test lead from the T binding post to one lug of a 2 μf capacitor.

(3) Connect the test lead from ground to the other lug of a 2 μf capacitor.

(4) Rapidly operate and restore the CAP READ-TEST REVERSE key from CAP READ to the normal position several times.

(5) The maximum reading on the meter should be approximately 62.

(6) Disconnect the test lead from the T binding post and connect it to the R binding post.

(7) Rotate the selector switch to position 9 (RING CAP).

(8) Repeat steps (4) and (5) above.

(9) Disconnect the test lead from ground and connect it to the T binding post.

(10) Rotate the selector switch to position 10 (LOOP CAP).

(11) Repeat steps (4) and (5) above.

(12) Disconnect the test leads.

h. OFFICE LINE Key and Test Set Dial Check:

(1) Insert a hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(2) Operate the OFFICE LINE-OUT TALK key to the OFFICE LINE position.

(3) Use the test set dial to dial the test telephone number assigned in paragraph 5.01 c. (2).

(4) The circuit is operating correctly if conversation can take place when the called party answers.

(5) Restore the OFFICE LINE-OUT TALK key to normal and remove the hand test telephone from the TEST TEL jack on the test set.

i. TEST SELECTOR and RING Keys Check (CDO Model Test Set):

(1) From a convenient local telephone, dial the test telephone number assigned in paragraph 5.01 c. (2).

(2) When the called party answers, instruct him to monitor the line while a test is performed from the Wire Chief's test set.

(3) Leave the handset off-hook on the telephone used to dial the test number.

(4) At the Wire Chief's turret, operate the HEAT COIL LISTEN-TEST SELECTOR key to the TEST SELECTOR position.

(5) The SR supervisory lamp lights.

(6) Use the test set dial to dial the last four digits used in step (1).

(7) Insert the hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(8) Operate the OFFICE LINE-OUT TALK key to the OUT TALK position.

(9) Check that conversation is possible with the party at the telephone in step (2) above; then instruct that party to replace the receiver of the handset.

(10) Replace the receiver of the handset of the local telephone used in step (1) above.

(11) Restore the OFFICE LINE-OUT TALK key to normal; remove the test telephone from the TEST TEL jack on the test set.

(12) Restore the HEAT COIL LISTEN-TEST SELECTOR key to normal.

(13) Repeat steps (4), (5), and (6) above.

(14) Position the test set selector switch on the position corresponding to the ringing digit for the telephone used in step (6) above.

(15) Operate the HOWLER-RING key to the RING position for 2 or 3 seconds.

(16) Insert the hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(17) Operate the OFFICE LINE-OUT TALK key to the OUT TALK position.

(18) Check that conversation is possible with the party at the telephone extension dialed in step (6) above; then instruct the party to replace the receiver of the handset.

(19) Restore the OFFICE LINE-OUT TALK and HEAT COIL LISTEN-TEST SELECTOR keys to normal.

(20) Remove the hand test telephone from the TEST TEL jack.

(21) Restore the test set selector switch to the OFF position.

j. TEST SELECTOR, CONN RLS, and RING Key Check:

(1) From a convenient local telephone, dial the test telephone number assigned in paragraph 5.01 c. (2).

(2) When the called party answers, instruct him to monitor the line while a test is performed from the Wire Chief's test set.

(3) Leave the handset off-hook on the telephone used to dial the test number.

(4) At the Wire Chief's turret, operate the HEAT COIL LISTEN-TEST SELECTOR key to the TEST SELECTOR position.

(5) The SR supervisory lamp lights.

(6) Use the test set dial to dial the same digits as in step (1) above.

(7) The supervisory lamp flashes at 120 IPM.

(8) Insert the hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(9) Operate the OFFICE LINE-OUT TALK key to the OUT TALK position.

(10) Check that conversation is possible with the party at the telephone used in step (2) above; then instruct the party to replace the receiver on the handset.

(11) Replace the receiver of the handset of the local telephone used in step (1) above.

(12) Restore the OFFICE LINE-OUT TALK key to normal; remove the hand test telephone from the TEST TEL jack on the test set.

NOTE: Perform the following steps (13) through (19) only when testing the MDO model test set.

(13) Operate the CO CONTROL-CONN RLS key to the CONN RLS position for 2 or 3 seconds; then restore the key to normal.

(14) Use the test set dial to dial the last two digits of the number used in step (1) above.

(15) Position the test set selector switch on the position corresponding to the ringing digit for the phone used in paragraph 5.01 c. (2).

(16) Operate the HOWLER-RING key to the RING position for 2 or 3 seconds.

(17) Insert the hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(18) Operate the OFFICE LINE-OUT TALK key to the OUT TALK position.

(19) Check that conversation can take place with the called party.

(20) Restore all keys on the test set to normal and remove the hand test telephone from the test set jack.

k. Test Shoe Check:

(1) Restore all keys on the test set to normal and rotate the selector switch to the OFF position.

(2) Insert the test shoe into the MDF protector block of the local telephone line assigned as the test number in paragraph 5.01 c. (2).

(3) Insert the plug of the hand test telephone (with the switch in the center position) into the TEST TEL jack on the test set.

(4) Operate the HEAT COIL LISTEN-TEST SELECTOR key to the HEAT COIL LISTEN position. Monitor the line to see if it is in use.

(5) If the line is not in use, restore the HEAT COIL LISTEN-TEST SELECTOR key to normal.

(6) Remove the hand test telephone from the test set jack.

(7) **TEST IN-TEST OUT Key Check—**

(a) Operate the TEST IN-TEST OUT key to the TEST IN position.

(b) Rotate the selector switch on the test set to position 2 (RING BAT). Operate the TEST REVERSE-CAP READ key to the TEST REVERSE position. The test set meter should indicate approximately 48 volts.

(c) Restore the TEST REVERSE-CAP READ key to normal.

(d) Rotate the selector switch to position 5 (TIP GRD). The meter should give full scale deflection to the right.

(e) Operate the TEST IN-TEST OUT key to the TEST OUT position.

(f) Rotate the selector switch to position 10 (LOOP CAP).

(g) Operate and restore the CAP READ-TEST REVERSE key from CAP READ to normal two or three times. The meter should indicate above 10 on the lower scale.

(h) Restore the selector switch to the OFF position.

(8) **DIAL IN Key Check—**

(a) Insert the hand test telephone (with the switch in the center position) into the test jack.

(b) Operate the DIAL IN-LOW OHMS key to the DIAL IN position. Dial tone is heard.

(c) Dial the digits of the number assigned as the test number in paragraph 5.01 c. (2). Busy tone (60 IPM) is heard in the hand test telephone receiver.

(d) Restore the DIAL IN-LOW OHMS key to normal; remove the hand test telephone plug from the test set jack.

(9) **HOWLER-RING and OUT TALK Keys Check—**

(a) Operate the TEST IN-TEST OUT key to the TEST OUT position.

(b) Rotate the selector switch to position 8 (HOWLER START).

(c) Operate the HOWLER-RING key to the RING position for 2 or 3 seconds.

(d) The local test telephone ringer sounds.

(e) Insert the hand test telephone (with the switch in the center position) into the test set jack.

(f) Operate the OFFICE LINE-OUT TALK key to the OUT TALK position.

(g) Instruct the party answering the test telephone to leave the handset off-hook for a few seconds for the howler test, and to replace the handset on-hook after the howler tone reaches maximum volume.

(h) Restore the OFFICE LINE-OUT TALK key to normal and operate the C switch of the hand test telephone.

(i) Operate the HOWLER-RING key to the HOWLER position.

(j) Rotate the selector switch on the test set from position 7 (HOWLER START) to positions 8, 9, and 10. At position 8, howler tone is heard in the test telephone receiver used in step (g) above. In positions 9 and 10, the level of the howler tone is increased progressively.

(k) When the test telephone is placed on-hook, the howler tone is cut off.

(l) Restore the HOWLER-RING and TEST IN-TEST OUT switches to normal and rotate the selector switch to the OFF position.

(m) Remove the hand test telephone from the test set jack.

(10) Remove the test shoe from the MDF protector block.

l. Positive (+) Booster Battery on Tip:

(1) Rotate the selector switch to position 3 (+BOOSTER VOLTAGE ON TIP).

(2) Connect a +60V battery supply to the T binding post. The test set meter should indicate 60 volts.

(3) Remove the +60V battery connection.

(4) Restore the selector switch to the OFF position.

5.02 Repair and Replacement:

a. Access is gained to the components in the test set by loosening the captive screws in the right-hand upper and lower corners of the front panel and swinging the panel open.

b. The test set components consist of standard relays, capacitors, resistors, and switches. Repair and replacement procedures should be performed in accordance with good basic maintenance practices. Refer to paragraph 6 for identification and part numbers of components and for method of mounting replacement components.

c. When required, relay adjustments should be made to conform with the specifications in Table B. The column headings in Table B indicate the following:

(1) The **RELAY** column lists the relays in each circuit by their functional designations. For example, the designation HL means **howler**; BY means **busy**, etc.

(2) The **BLOCK OR INSULATE** column provides necessary instructions for preparing the relay for testing. For example, when checking the electrical operation, it may be necessary to block another relay (hold it nonoperated) or to insulate between a pair of contacts.

(a) Where the notation (NO) appears in this column, block relay DB (hold it nonoperated) by inserting a toothpick between the core and the armature. Be sure to remove toothpicks when testing is completed.

(b) Where the notation SA (1,2) appears in this column, insulate contact 1 from contact 2 on the SA relay by inserting a piece of bond paper between them. Be sure to remove the paper after testing is completed.

(3) The **TEST WITH** column provides reference to one or more of the following notes:

(a) Positive battery through the test set to the point indicated.

(b) Test set across the points indicated.

(4) The **TEST SET POINT** column lists the relay terminals to which alligator clips of the test cords are connected.

TABLE B. Relay Adjustment for Wire Chief's Type B Test Set Circuit (S-419086)

RELAY	BLOCK OR INSULATE	TEST WITH	TEST SET POINT	RESID (Inch)	TEST WDG	TEST FOR	READJ MA	TEST MA	REMARKS
CB		1	CB (B)	0.006	B-D	O NO	36.0 30.0	40.0 27.0	FIG. 1
HL		1	HL (B)	0.004	B-D	O H R	13.0 8.0 6.8	14.0 8.8 6.4	
MS		2	MS (A+, C-)	0.004	A-C	O NO	9.0 6.5	10.0 6.0	Disconnect wires from terminal MS (A)
DA	DB (NO)	1	DA (A)	0.004	A-C	O NO	11.0 9.0	12.0 8.0	FIG. 2 Disconnect wires from terminal DA (A)
DB		1	DB (A)	0.004	A-C	O NO	37.0 30.0	41.0 27.0	
BY		1	BY (B)	0.004	A-C	O NO	9.5 6.5	10.5 6.0	Disconnect wires from terminal BY (B)
SA		2	SA (A+, C-)	0.006	A-C	O NO R	24.0 20.0 9.5	26.0 18.0 8.5	
SB	SA (1,2)	1	SB (A)	0.004	A-C	O NO	13.0 10.0	14.0 9.0	

(a) If one point is specified, the alligator clip is attached to that terminal only. For example, if the notation CB (B) appears, this means that the alligator clip is attached to terminal B of relay CB.

(b) If two points are specified, one alligator clip is attached to each of the two terminals noted. For example, if the notations MS (A,C) appears, one alligator clip is attached to terminal A and the other to terminal C on relay MS.

(5) The **RESID** (Inch) column lists the minimum operated air gap for each relay. The air gap is determined by the projection of the residual screw.

(6) The **TEST WDG** column designates the winding through which current flows during the test.

(7) The **TEST FOR** column lists relay response for a particular test. Designations appearing in this column are: O (operate); NO (nonoperate); H (hold); R (release). Each designation is associated with current values in the **READJ MA** (milliamperes) and **TEST MA** columns. The designations relate to the current values in the **TEST MA** column as follows:

(a) When the indicated value of current for NO (nonoperate) is flowing through the winding (before operation), the relay should not operate.

(b) When the indicated value of current for O (operate) is flowing through the winding, the relay should operate.

(c) When the indicated value of current for H (hold) is flowing through the winding (after current has been reduced from operate value), the relay should remain operated.

(d) When the indicated value of current for R (release) is flowing through the winding (after the current value has been reduced from the operate value), the relay should release.

(8) The **READJ MA** column indicates the value of current to which the relay must be adjusted if the relay does not meet the requirements in the **TEST MA** column.

(9) The **REMARKS** column lists any pertinent information not listed in the other columns.

d. A relay current flow test set is used to check the relays with respect to the requirements specified in Table B. The procedures for making these tests are:

NOTE: It is not necessary to remove the relay from the test set for the electrical test.

(1) Ensure that battery and ground are connected to the test set.

(2) Ensure that all switches on the test set are in the normal position.

(3) Test the relay with the test current specified.

(4) Check the electrical requirements in the relay adjustment tables. If the mechanical adjustment is correct, the relay should function properly in the circuit.

(5) If the relay does not operate properly on the **TEST MA** column values, readjust the relay to meet the **READJ MA** column values specified.

(6) If the relay does not meet readjust values, check the mechanical adjustments.

e. If required, make mechanical adjustments in the following manner:

(1) If the relay operates on the nonoperated value, increase the tension on the force springs.

(2) If the relay fails to operate on the operate value, decrease the tension on the force springs.

(3) If adjustments cannot be made by adjusting the tension of the force springs, carefully adjust the tension of the movable springs.

(4) If hold or release adjustments cannot be made by adjusting the springs, the setting of the residual screw may be changed; however, residual projection must be perceptible at all times.

5.03 Calibration Routines:

a. Meter Calibration Operation Check: Although the meter is calibrated before leaving the factory, an operational check is recommended prior to initial use and thereafter as often as it appears necessary. When making resistance measurements, the meter should be set to zero before each measurement to ensure accuracy of the check. See (1), (a), (b), and (c) for zero setting procedures. Office battery and

ground must be connected to the test set by way of the terminal block terminals 54 and 58, respectively. The telephone assigned to the test set office must be on-hook and the hand test telephone plug removed from the jack on the front panel of the test set.

NOTE: A resistance decade box is recommended for use in steps (1), (a), and (b) below. If proper indications for resistance checks are not obtained, calibrate the meter according to instructions in paragraph 5.03 b.

(1) Low Resistance Check—

(a) Place the selector switch to position 1 (ZERO ADJ).

(b) Operate the DIAL IN-LOW OHMS key to the LOW OHMS position.

(c) Adjust the ZERO ADJ control of the 0 indication on the meter.

(d) Connect a 500 Ω resistor (that is known to be accurate) across the T and R binding posts.

(e) Rotate the selector switch to position 7 (LOOP).

(f) A midscale deflection of 50 K should be indicated on the resistance scale of the meter. With the LOW OHMS key operated, the scale indication is divided by 100 to obtain the resistance value (50,000 ÷ 100 = 500 Ω).

(g) Remove the 500 Ω resistor from the T and R binding posts and return the LOW OHMS key to normal. Rotate the selector switch to the OFF position.

(2) High Resistance Check—

(a) Place the selector switch to position 1 (ZERO ADJ).

(b) Check that all test keys are in the normal position.

(c) Adjust the ZERO ADJ control for 0 indication on the meter.

(d) Connect a 50,000 Ω resistor (that is known to be accurate) across the T and R binding posts.

(e) Rotate the selector switch to position 7 (LOOP).

(f) A midscale deflection of 50 K should be indicated on the resistance scale of the meter.

(g) Remove the 50,000 Ω resistor from the T and R binding posts. Rotate the selector switch to the OFF position.

(3) Voltage Check and Calibration—

(a) Check that all test keys are in the normal position.

(b) Connect a vacuum tube voltmeter (VTVM), set to the proper DC scale, across terminal 54 (-48 volts) and terminal 58 (+ ground) of the test set terminal block.

(c) Rotate the selector switch to position 2 (TIP BAT).

(d) Connect a wire between terminal 54 (-48 volts) on the terminal block and the T binding post on the front panel of the test set.

(e) The indications on the test set meter and on the VTVM should be identical. If not, adjust RH3 on the back of the test set panel until the test set meter indication matches that of the VTVM.

(f) Lock the RH3 adjustment with a light touch of Glyptal cement, or equivalent.

NOTE: The above procedures can be modified to use any source of DC voltage up to 150 volts, provided the DC voltage value is known accurately. For example, the VTVM could be deleted in favor of the voltage reading on the powerboard meter. It is recommended that the DC voltage source be in the office battery range, i.e., approximately 50 volts.

b. Calibration of Meter for Resistance Readings: Calibration of the meter should not be necessary unless the operational check requirements in paragraph 5.03 a. cannot be met.

(1) Low Resistance (LOW OHMS) Calibration—

(a) Perform steps (1), (a) through (f) above, except in step (1), (c), adjust the ZERO ADJ control to approximately midposition of its range, regardless of the meter indication.

(b) Check that R11 on the back of the panel is adjusted to midposition of its range. If the factory seal is not disturbed, no adjustment is necessary; if the seal is broken, adjust R11 to midposition.

(c) On the back of the panel, alternately adjust R4 and R5 for 50,000 Ω and 0 Ω

indication, respectively. The selector switch must be in position 7 (LOOP) when adjusting R4, and switched to position 1 (ZERO ADJ) when adjusting R5 for 0 Ω indication on the meter. Repeat the adjustments until both indications are accurate. Lock R4 and R11 with a light touch of Glyptal cement, or equivalent.

(d) Remove the 50,000 Ω resistor from the T and R binding posts. Rotate the selector switch to the OFF position.

(2) High Resistance Calibration—

(a) Perform steps (1), (a) through (g) in paragraph 5.03 a. except in step (1), (c), adjust the ZERO ADJ control to approximately midposition of its range.

(b) On the back of the panel, alternately adjust R2 for 50,000 Ω indication on the meter and RH2 for 0 indication. The selector switch must be in position 7 (LOOP) while adjusting R2, and in position 1 (ZERO ADJ) when adjusting RH2. Repeat the adjustments until both indications are accurate. Lock R2 and RH2 with a light touch of Glyptal cement, or equivalent.

(c) Remove the 50,000 Ω resistor from the T and R binding posts. Rotate the selector switch to the OFF position.

6. PARTS IDENTIFICATION AND PARTS LIST

6.01 Parts Identification: Individual components for the Wire Chief's Type B test set can be identified by locating the part on Figure 5 (foldout) and obtaining the associated part identification item number.

6.02 Parts List: Table C lists the part numbers opposite the item numbers referred to in paragraph 6.01 and gives a brief description of the item. Be certain to include all the information provided on Table C to ensure that you will receive the correct replacement part in the fastest possible time.

TABLE C. Replacement Parts List

ITEM	DESCRIPTION	STOCK NO.
1	Cabinet Assembly	303700-499
3	Bracket Assembly	481936-000
4	Binding Post (Red Top)	209572-000
5	Binding Post (Black Top)	209571-000
6	Mounting Plate (Resistor)	302850-362
7	Spacer	481903-000
8	Insulation Strip	481908-000
9	Insulator (Binding Post)	205794-000
10	Relay (MS)	352258-000
12	Relay (HL)	206267-401
13	Relay (CB)	352262-000
14*	Relay (DA)	352263-000
15*	Relay (DB)	352264-000
16*	Relay (BY)	352265-000
17*	Relay (SA)	352266-000
18*	Relay (SB)	352267-000
19	Key Assembly (172-C)	204964-000
20	Key Assembly (173-N)	802621-000
21*	Key Assembly (172-D)	204965-000
22	Key Assembly (172-E)	802619-000
24	Key Assembly,	211367-000
25	Handle	6541-000
26	Capacitor, 2 x 2 μf (C-1, C-2; C-6, C-7)	42375-000
27	R/C Network, 0.5 μf /150 ohms	202895-213
29	Capacitor Bracket	480793-000
30	Resistor, 200 Ω , 25 W (R-9, R-10)	203618-000
31	Resistor, 68K Ω , 1/2 W (R-1)	554001-683
32	Resistor, 1500 Ω , 25 W, (variable (R-2)	203657-000
33	Resistor, 150K Ω , 1/2 W (R-3)	554001-154
34	Resistor, 25 Ω , 25 W, variable (R-4)	205961-000
35	Resistor, 250 Ω , 25 W, variable (R-5)	149224-000
36	Resistor, 510 Ω , 5 W (R-20)	554554-511
37	Diode, SC827 (CR1)	202852-138
39	Bracket, Standoff	302859-101
40**	Key Blank	204279-000
41	Resistor, 2 Ω , 25 W, variable (R-11)	206789-000
42	Resistor, 300 Ω , 10 W (R-13)	554580-301
43	Rheostat, 350 Ω , 25 W (RH-1)	203675-000
44	Rheostat, 70 K Ω , 4 W (RH-2, RH-3)	204916-000
45	Knob	203955-000
46	Meter	202812-499
47	Selector Switch	208249-000
48	Dial (DE 209)	213084-000
49	Dial Plate	208250-000
50	Terminal Block (6 x 10)	211695-000
51	Lamp Socket (No. 13)	801421-000
52	Lamp (48 C)	42201-000
53	Lamp Cap No. 31-A	801412-000
54	Fuse Holder	128008-000
55	Fuse (1-1/2 amp)	21566-000

*Used on MDO Test Set (419086-028) only. **Used on CDO Test Set (419086-018) only.

TABLE C. Replacement Parts List (cont'd)

ITEM	DESCRIPTION	STOCK NO.
56	Spacer	36787-000
57	Jack Assembly (No. 140)	49907-000
58	Designation Holder	205960-000
59	Designation Card	E-73304-63
60	No. Card Package Assembly	204785-012
61**	Impedance Coil (RE)	36299-000
62	Dial Adapter Ring	16321-000
64	Terminal	540570-021
65	Protector (8-5/8 Inches Long)	E-35275-1
66	Paper Strip (8-5/8 Inches Long)	E-73304-22
67	Paper Strip (8-5/8 Inches Long)	E-73304-23
69*	Resistor, 100 Ω , 25 W (R-16, R-19)	149240-000
70*	Resistor, 1000 Ω , 5 W (R-12), (R-14)	554554-102
72	Cable	202017-094
73	Board, Component	202136-061
74	Terminal	202135-335
75	Clamp	540202-006
77	No. 8-32 x 2-1/2 Inches RHIM Screw	506752-000
78	No. 8-32 x 2-1/4 Inches FHIM Screw	506682-000
80	No. 8-32 x 3/4 Inch BHIM Screw	505872-000
82	No. 8-32 x 5/16 Inch SEMS Fastener	207353-000
83	No. 8-32 x 1/4 Inch RHIMS (SEMS)	35746-000
84	No. 6 x 3/8 Inch RHIW Screw	521012-000
85	No. 4-40 x 1-1/4 Inches BHIM Screw	503273-000
86	No. 4-36 x 3/8 Inch SSBH Screw	515423-000
87	No. 4-36 x 3/16 Inch BHIM Screw	515172-000
88	No. 0 x 1/4 Inch PK Drive Screw	205900-000
89	No. 3-48 x 3/8 Inch PHIM Screw	501472-000
90**	No. 4-48 x 1/4 Inch RHIM Screw	513252-000
91	No. 8 Washer (Insulated)	34987-000
92	Lockwasher, (Shakeproof)	526210-000
95	No. 4 Washer, (Shakeproof)	526281-000
96	No. 3 Washer, flat	525502-000
97	No. 8-32 Hex Nut	525152-000
98	No. 4-40 Hex Nut	525122-000
99	3/8-32 Hex Nut	540417-119
100	Bushing	9927-000
101**	No. 4-48 Hex Nut	525232-000
103	3-48 ESNA Nut	540334-115
105	Instruction Manual	SCP 76-001-10
106	No. 6 Washer, flat	525532-000
107	No. 6-32 Hex Nut	525132-000
108	No. 8-32 Speed Nut	302850-412
109	No. 6-32 Speed Nut	540463-006
110	No. 6-32 x 3/8 Inch RHIMS Screw	503852-000

*Used on MDO Test Set (419086-028) only. **Used on CDO Test Set (419086-018) only.

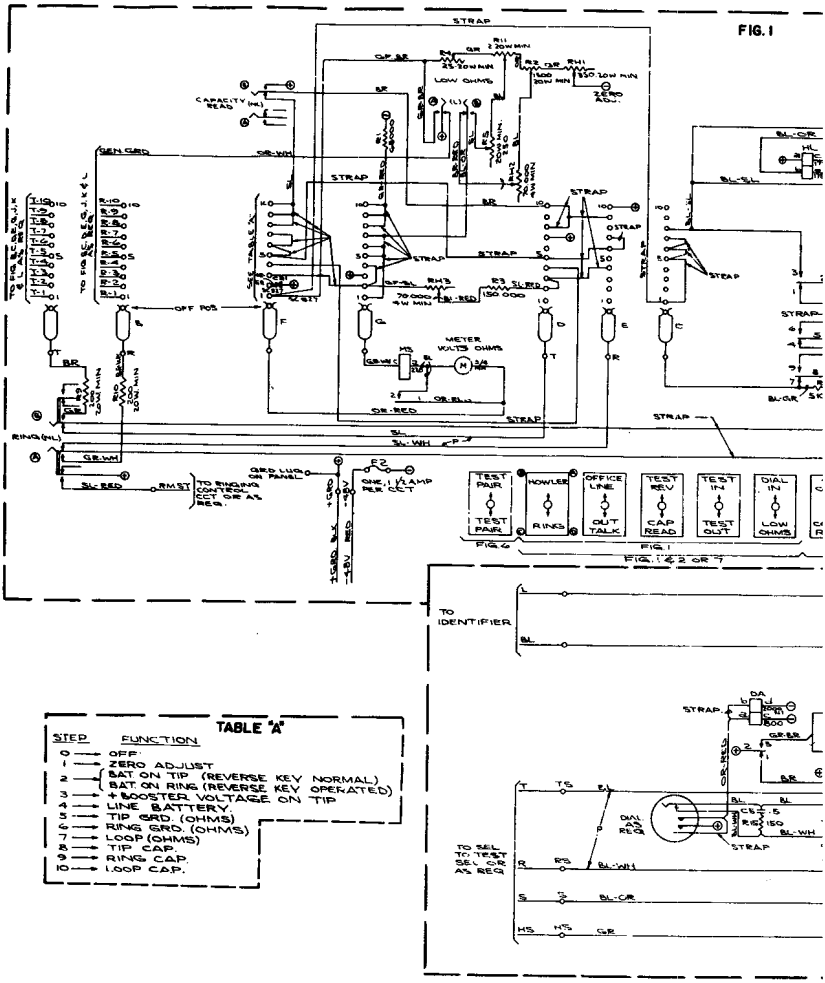


TABLE 'A'

STEP	FUNCTION
0	OFF
1	ZERO ADJUST
2	BAT. ON TIP (REVERSE KEY NORMAL)
2	BAT. ON RING (REVERSE KEY OPERATED)
3	+ BOOSTER VOLTAGE ON TIP
4	LINE BATTERY
5	TIP GRD. (OHMS)
6	RING GRD. (OHMS)
7	LOOP (OHMS)
8	TIP CAP.
9	RING CAP.
10	LOOP CAP.

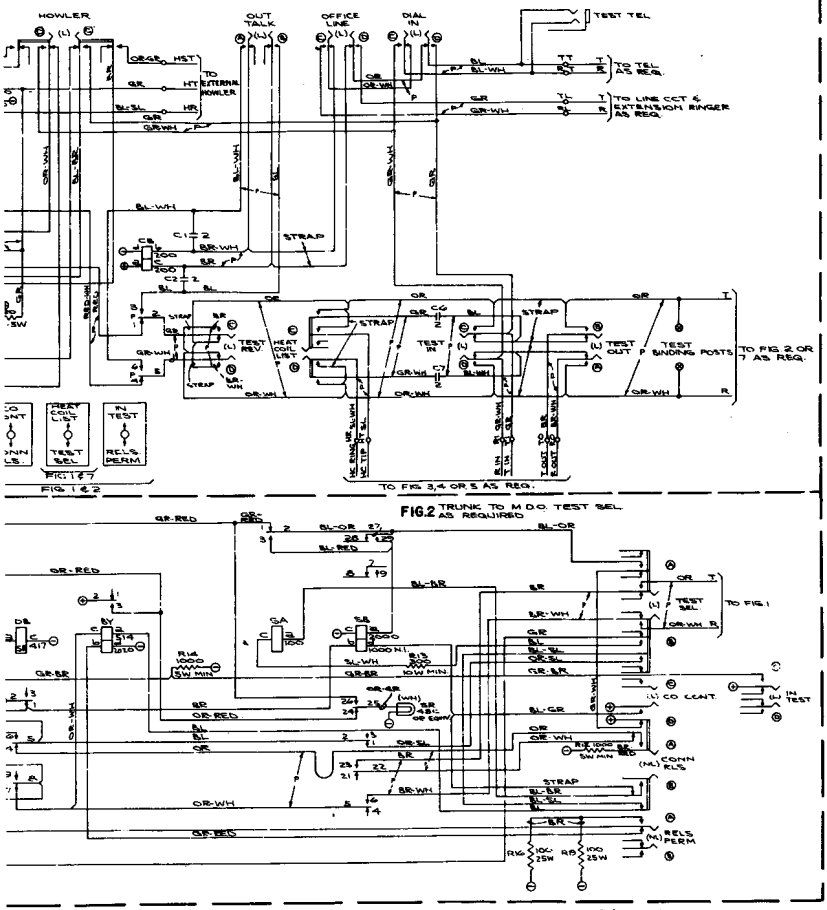


FIGURE 2. Wire Chief's Test Set, Type B, Schematic Diagram (S-419086) (Sheet 1 of 3)

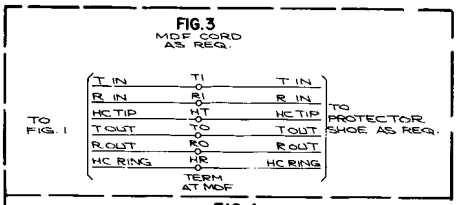


FIG.3
MDF CORD
AS REQ.
T IN
R IN
HC TIP
T OUT
R OUT
HC RING
TERM
AT MDF
TO
FIG. 1
TO
PROTECTOR
SHOE AS REQ.

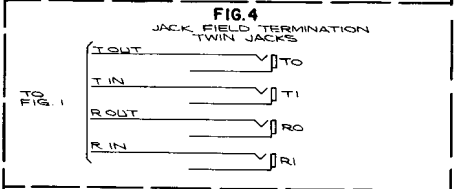


FIG.4
JACK FIELD TERMINATION
TWIN JACKS
T OUT
T IN
R OUT
R IN
TO
FIG. 1
TO
T1
RO
R1

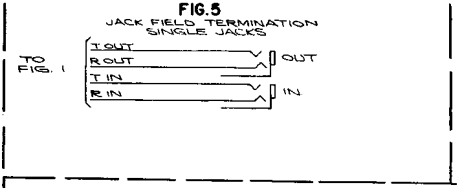


FIG.5
JACK FIELD TERMINATION
SINGLE JACKS
T OUT
R OUT
T IN
R IN
TO
FIG. 1
OUT
IN

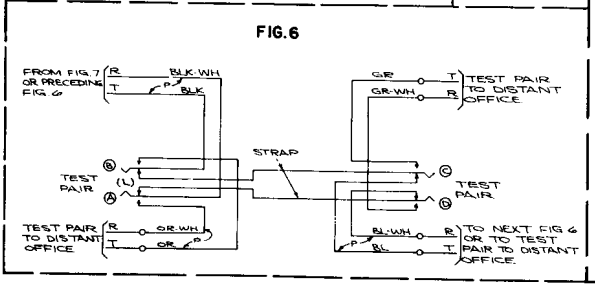


FIG.6
FROM FIG.7
OR PRECEDING
FIG 6
BLK-WH
BLK
TEST
PAIR
TEST PAIR
TO DISTANT
OFFICE
STRAP
TEST
PAIR
TEST PAIR
TO DISTANT
OFFICE
GR
GR-WH
TEST PAIR
TO DISTANT
OFFICE
BL-WH
BL
TO NEXT FIG 6
OR TO TEST
PAIR TO DISTANT
OFFICE

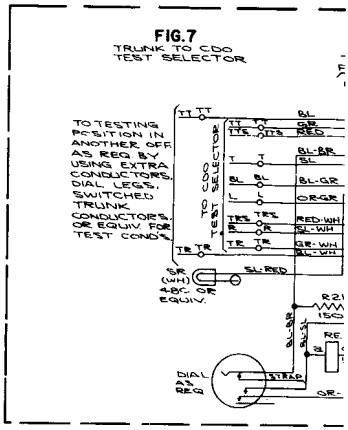
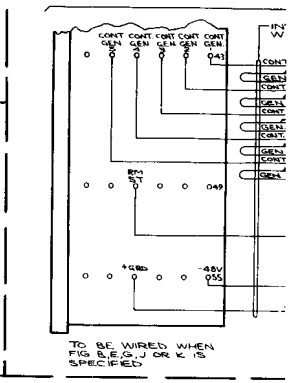


FIG.7
TRUNK TO CDO
TEST SELECTOR
TO TESTING
POSITION IN
ANOTHER OFF.
AS REQ BY
USING EXTRA
CONDUCTORS,
DIAL LEGS,
SWITCHED
TRUNK
CONDUCTORS
OR EQUIV FOR
TEST COND.
TO CDO
TEST SELECTOR
BL-BR
BL-GR
OR-GR
RED-WH
SL-WH
GR-WH
BL-WH
SL-RED
DIAL
AS
REQ
STRAP


CONT
GEN
049
-48V
055
TO BE WIRED WHEN
FIG B, C, J OR K IS
SPECIFIED

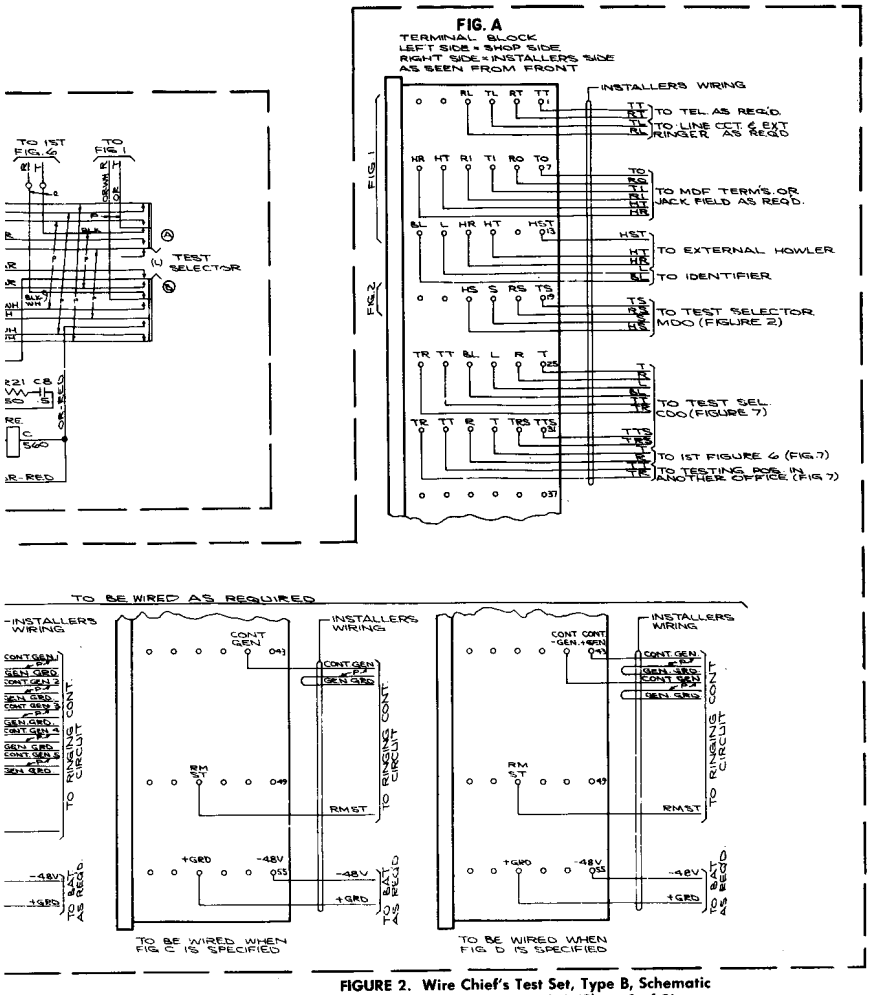


FIGURE 2. Wire Chief's Test Set, Type B, Schematic Diagram (S-419086) (Sheet 2 of 3)

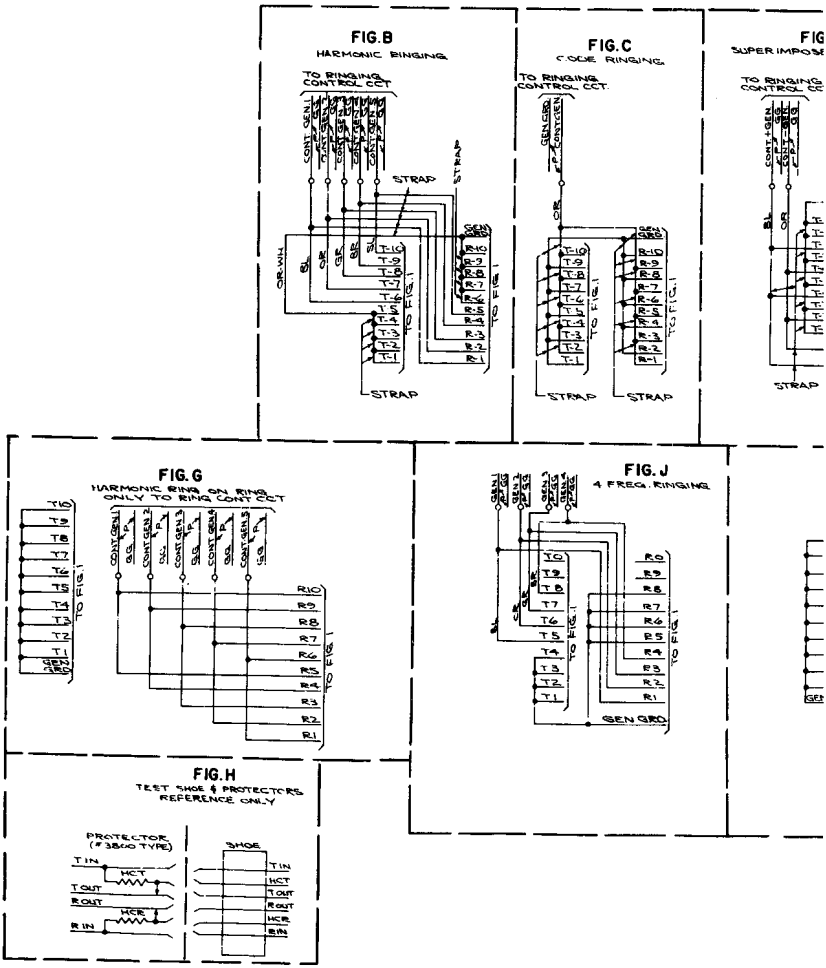


FIG.B
HARMONIC RINGING
TO RINGING CONTROL CCT
STRAP
TO FIG.1
FIG.C
CODE RINGING
TO RINGING CONTROL CCT.
STRAP
FIG.G
HARMONIC RING ON RING ONLY TO RING CONT CCT
TO FIG.1
FIG.J
4 FREQ. RINGING
SEN GRD
FIG.H
TEST SHOE & PROTECTORS REFERENCE ONLY
PROTECTOR (#3600 TYPE)
SHOE
T IN
T OUT
R OUT
R IN
HCT
HCR

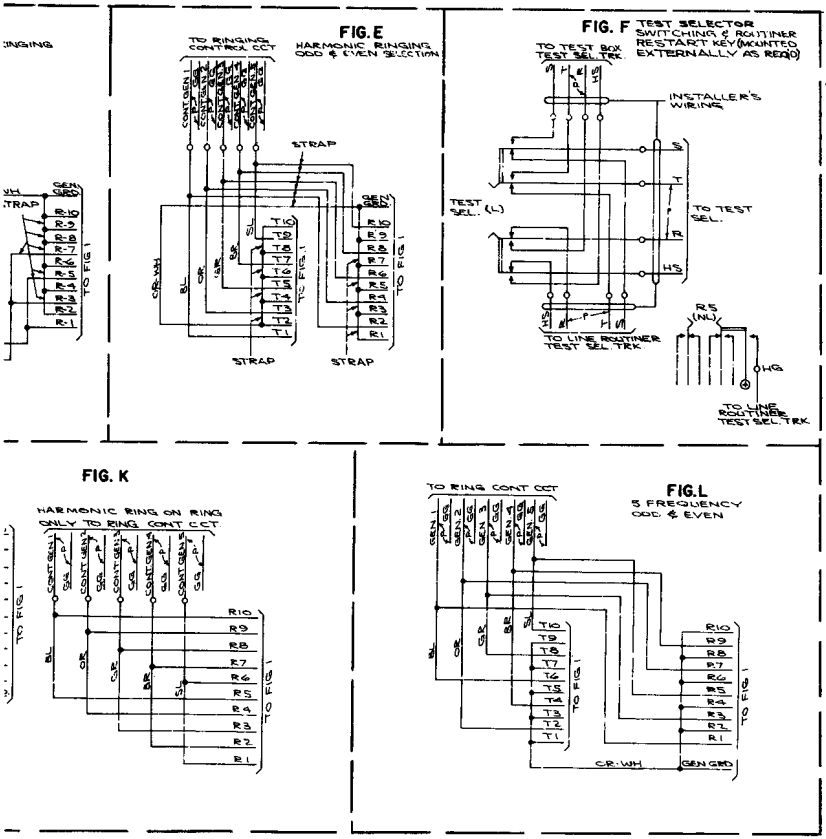
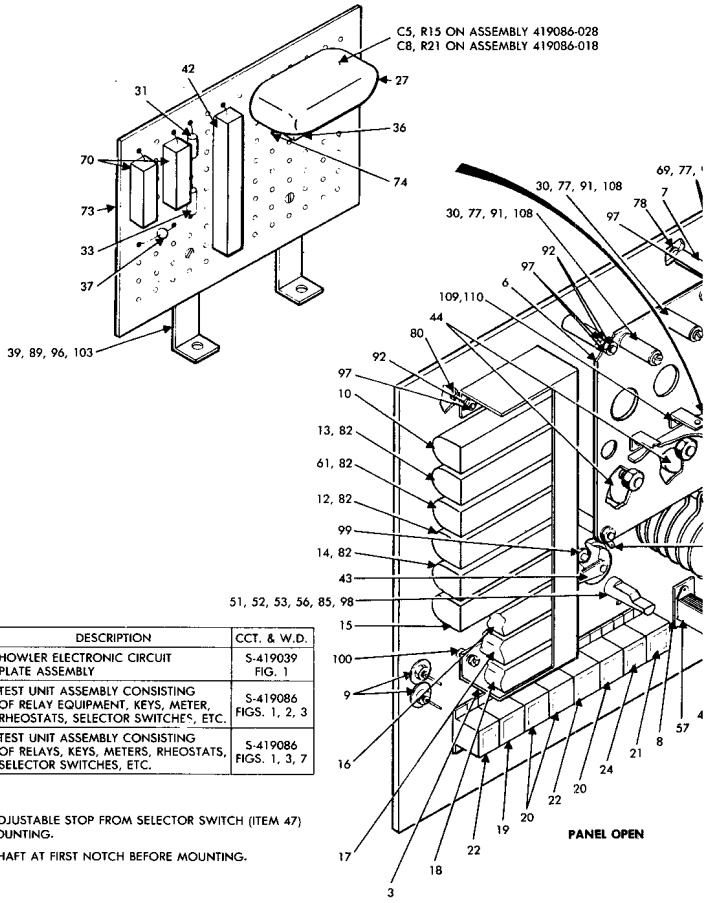


FIGURE 2. Wire Chief's Test Set, Type B, Schematic Diagram (S-419086) (Sheet 3 of 3)



ASSEMBLY	DESCRIPTION	CCT. & W.D.
419039-032	HOWLER ELECTRONIC CIRCUIT PLATE ASSEMBLY	S-419039 FIG. 1
419086-028	TEST UNIT ASSEMBLY CONSISTING OF RELAY EQUIPMENT, KEYS, METER, RHEOSTATS, SELECTOR SWITCHES, ETC.	S-419086 FIGS. 1, 2, 3
419086-018	TEST UNIT ASSEMBLY CONSISTING OF RELAYS, KEYS, METERS, RHEOSTATS, SELECTOR SWITCHES, ETC.	S-419086 FIGS. 1, 3, 7

NOTES:

1 REMOVE ADJUSTABLE STOP FROM SELECTOR SWITCH (ITEM 47) BEFORE MOUNTING.

2 CUT OFF SHAFT AT FIRST NOTCH BEFORE MOUNTING.

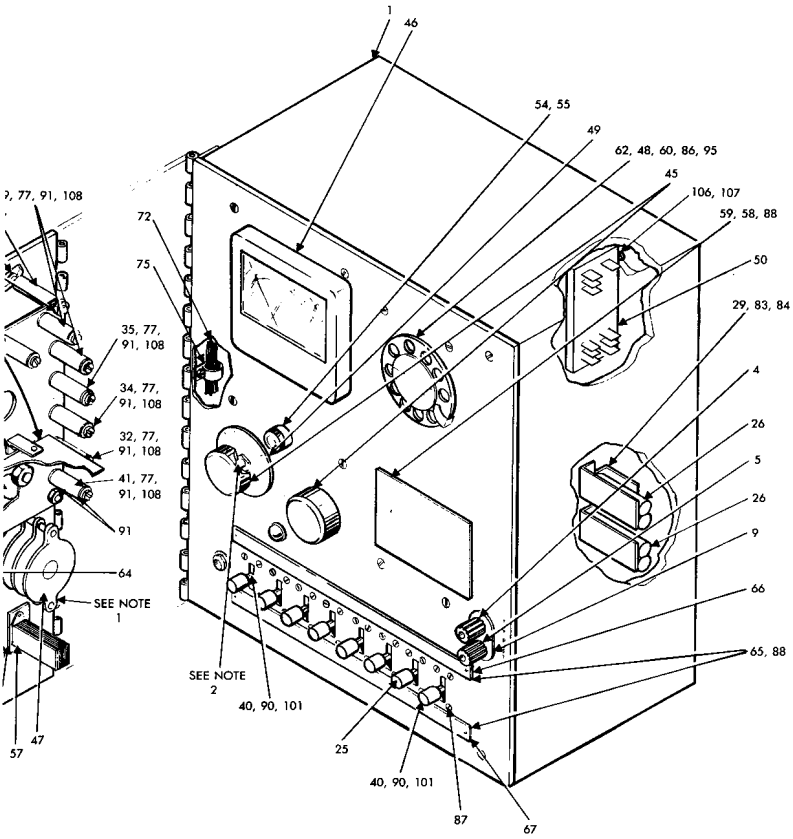


FIGURE 5. Wire Chief's Test Set, Type B, Parts Identification and Modification Details

STROMBERG-CARLSON WIRE CHIEF'S TEST SET—TYPE B 419086-018 AND 419086-028 OPERATION AND TEST PROCEDURES

1. GENERAL

1.01 This practice provides instructions on the operation of and test procedures for the S-C Wire Chief's Test Set, Type B. See Figure 1.

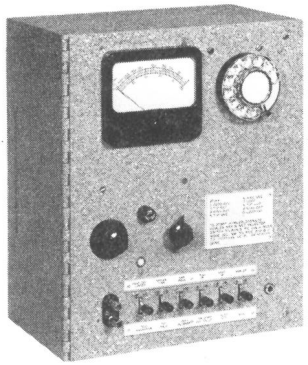


FIGURE 1. Wire Chief's Test Set, Type B

1.02 The test set is used to assist in the testing and troubleshooting of inside and outside plant equipment associated with a dial office.

1.03 An equipment specification may accompany the equipment. If instructions in the equipment specification differ from those in this practice, follow the equipment specification.

1.04 Refer to CTSP 405-110-328 for the description and other information regarding the Type B Wire Chief's test set.

2. TOOLS AND TEST EQUIPMENT

2.01 The following tools and test equipment are required to perform the test procedures in this practice:

a. Hand test telephone, Stromberg-Carlson No. 203685-000, or equivalent.

b. 510Ω resistor (±5%, 1 watt, carbon), Stromberg-Carlson No. 554003-511, or equivalent.

c. 5100Ω resistor (±5%, 1 watt, carbon) Stromberg-Carlson No. 554003-512, or equivalent.

d. 2μf capacitor (+30%, –0%, 200 WVDC), Stromberg-Carlson No. 202886-865, or equivalent.

e. Two test leads, single conductor, terminated in test clips.

3. OPERATING INSTRUCTIONS

3.01 The test set can be connected to the equipment to be tested by one of the following methods:

a. Through a test shoe at the MDF (main distributing frame) protector blocks.

b. By connecting to the binding posts of the test set.

c. By accessing the equipment through a test selector train.

3.02 When using the test set, the selector switch should be in the OFF position unless the operating instructions state otherwise.

3.03 In the test procedures in paragraph 6, the test set is in the **on-hook** condition when the hand test telephone is removed from the TEST TEL jack (or the test telephone C switch is operated) and the test set station telephone handset is resting on the cradle.

CAUTION: If the meter needle deflects to the left when connected to a line to be tested, immediately disconnect from the line (by restoring the last key operated) to prevent damage to the meter.

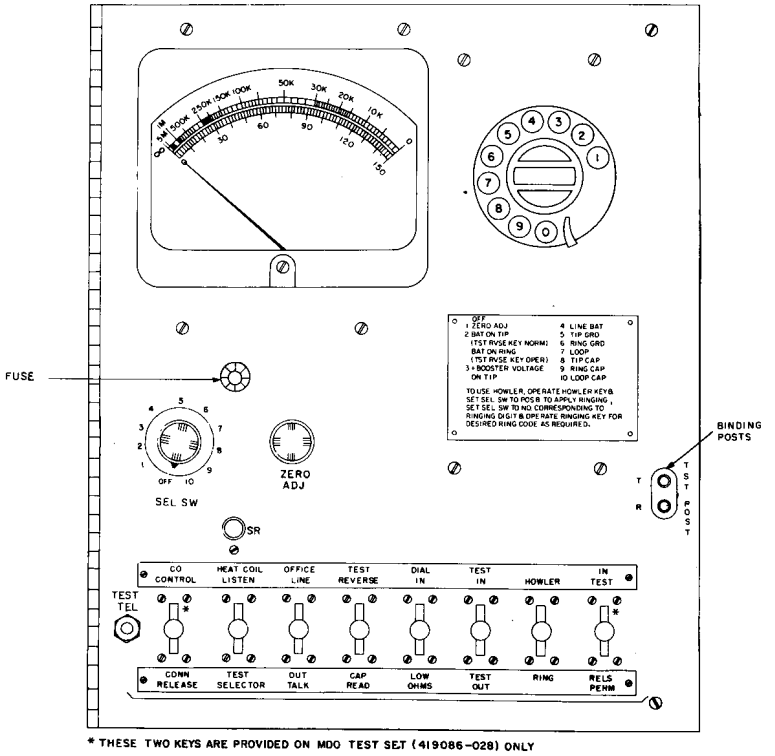
3.04 Controls and Indicators: Tables A through E list the test set controls, indicators, and terminals that are shown in Figure 2 and describe the function of each.

a. Test Keys: Three-position, lever type key switches are used to provide the desired operating condition. The midposition (normal) is off. The operating position is either nonlocking (spring loaded return to midposition upon release), or locking as indicated in Table A.

NOTE: Some positions may not be equipped depending on the model number, options, and whether application is for CDO (community dial office) or MDO (main dial office).

b. Selector Switch: The selector switch is a ganged, seven section, wafer type assembly which can be rotated to any one of eleven positions. The

twelfth terminal of the assembly is for the wiper connection of each section. The first position (extreme counterclockwise) is the OFF position. The other positions of the selector switch are labeled 1 through 10, and the function of each position is listed on the designation card on the front of the test set. When performing the operating procedures in this practice, make certain that the selector switch is in the proper functional position. See Table B.



* THESE TWO KEYS ARE PROVIDED ON MDO TEST SET (419086-028) ONLY

FIGURE 7 Wire Chief's Test Set, Type B, Controls and Indicators

TABLE A. Key Functions

KEY	*FUNCTION*
HEAT COIL LISTEN–TEST SELECTOR	HEAT COIL LISTEN (locking) position–used to test heat coils and to monitor on the MDF trunk circuit. TEST SELECTOR (locking) position–seizes test selector.
OFFICE LINE–OUT TALK	OFFICE LINE (locking) position–connects test telephone jack to line circuit allocated to test set. OUT TALK (locking) position–connects transmission battery to line being tested.
TEST REVERSE–CAP READ	TEST REVERSE (locking) position–reverses tip and ring test set connections to line being tested. CAP READ (nonlocking) position–permits capacitance tests to be made on line being tested.
DIAL IN–LOW OHMS	DIAL IN (locking) position–permits test telephone dial to step XY® dial equipment through test shoe. LOW OHMS (locking) position–permits meter to make low resistance measurements. Also removes generator ground from ringing circuit to permit ringing of some types of station phones when off-hook.
TEST IN–TEST OUT	TEST IN (locking) position–permits testing of inside plant equipment through test shoe. TEST OUT (locking) position–permits testing of outside plant equipment through test shoe.
HOWLER–RING	HOWLER (locking) position–extends howler tone to line being tested. RING (nonlocking) position–applies ringing current to line being tested.
CO CONTROL–CONN RELEASE (MDO ONLY)	CO CONTROL (locking) position–releases CO relay and connects LR relay of line being tested through the test switch train. CONN RELEASE (nonlocking) position–permits release of test connector without releasing test selector.
IN TEST–RLS PERM (MDO ONLY)	IN TEST (locking) position–connects dial to test selector. RELS PERM (locking) position–permits release of a permanently held CO line relay.

c. Indicators: Indicators and their functions are described in Table C.

d. Calibration Controls: The controls described in Table D are used to calibrate the meter. Except for the ZERO ADJ control on the hinged front panel, all others are located on the back of the panel. For more detailed calibration instructions, refer to CTSP 405-110-328, paragraph 5.03.

TABLE B. Selector Switch Functions

CARD DESIGNATION	*SWITCH POSITION*	*FUNCTION*
OFF	OFF	Disconnects meter circuit from testing circuit. [1]
ZERO ADJ	1	Provides circuit for zero set of meter before each resistance measurement.
BAT ON TIP (TST RVSE KEY NORM)	2	Permits testing for battery on tip side of line when TEST REVERSE–CAP READ key is in normal (center) position.
BAT ON RING (TST RVSE KEY OPER)	2	Permits testing for battery on tip side of line when TEST REVERSE–CAP READ key is operated to TEST REVERSE position.
+BOOSTER VOLTAGE ON TIP	3	Permits testing for high voltage (+60 V) on tip side of line.
LINE BAT	4	Permits measurement of potential on line loop.
TIP GRD	5	Permits testing for ground on tip side of line.
RING GRD	6	Permits testing for ground on ring side of line.
LOOP	7	Permits measurement of line loop resistance.
TIP CAP	8	Permits capacitance measurement between tip side of line and ground. Starts operation of howler circuit when HOWLER-RING key is operated to HOWLER position.
RING CAP	9	Permits capacitance measurements between ring side of line and ground.
LOOP CAP	10	Permits measurements of line loop capacitance.
Text	1 thru 10	Connects correct ringing condition for party lines when HOWLER-RING key is operated to RING position.

TABLE C. Indicator Functions

INDICATOR	*FUNCTION*
Volt-Ohmmeter	Upper scale indicates resistance from 0 to infinity. Lower scale indicates DC volts from 0 to 150.
Lamp SR	When lighted, with TEST SELECTOR switch not operated, indicates that test selector is busy and switch should not be operated to TEST SELECTOR position. With switch operated to TEST SELECTOR and last four digits of line number dialed, the condition of the supervisory lamp indicates the following: Lighted steady—line busy (CDO only) 120 IPM flashing—line busy (MDO only) *Note: The following flashing indications are for automatic line test which is a special application. The condition of the supervisory lamp indicates the following:* Lighted steady—line busy. 1 Flash—Battery on line. 2 Flashes—Ground on line. 3 Flashes—Low loop leakage resistance. 4 Flashes—No fault on line.

TABLE D. Calibration Control Functions

CONTROL	*FUNCTION*
ZERO ADJ (RH1)	Used to calibrate meter for 0 ohms before each resistance measurement.
RH2	Used in overall calibrations with RH1 to obtain correct relationship between 0 ohms indication and midscale (50,000 ohms) deflection.
RH3	Used to calibrate meter for 150 volts full scale deflection.
R4, R5, R11	With R11 at midpoint, R4 and R5 are adjusted alternately to obtain 0 ohms (full-scale deflection) and 500 ohms (midscale deflection) when DIAL IN-LOW OHMS key is operated to LOW OHMS position.

e. Terminals, Fuse, and Dial: Table E describes the function of the components listed.

4. OFFICE LINE TEST PROCEDURES

4.01 To place or receive a call on the office line allocated to the test set, the operator can use either a hand test telephone jacked into the test set or the regular station test telephone wired externally to the test set.

TABLE E. Miscellaneous Components

COMPONENT	*FUNCTION*
TST POST, T and R	Test binding posts—permits connection of components to test set for testing purposes. Also permits connection of test equipment (Wheatstone bridge, dial speed test set, etc.) to expand capabilities of test set.
TEST TEL Jack	Switchboard—type jack—permits connection of hand test telephone to test set for answering, monitoring, or placing calls over office line.
Fuse	Protects test set against current overload.
Dial	Permits stepping of test train through test selector trunk.

4.02 Placing a Call with the Hand Test Telephone:

a. Operate the OFFICE LINE key.

b. Insert the plug of the hand test telephone into the TEST TEL jack.

c. Listen to the receiver of the hand test telephone.

d. When dial tone is heard, dial the desired number, using the dial on the hand test telephone.

e. When the call is completed:

(1) To place another call immediately, operate the C button on the hand test telephone; then release the button, listen for dial tone, and dial the desired number.

(2) If further calls are not desired, remove the hand test telephone plug from the TEST TEL jack and restore the OFFICE LINE key to normal.

4.03 Placing a Call Using the Station Test Telephone:

a. Operate the OFFICE LINE key.

b. Remove the handset of the station test telephone and listen to the receiver.

c. When dial tone is heard, dial the desired number, using the dial on the test telephone.

d. When the call is completed:

(1) To place another call immediately, depress the hookswitch on the test telephone. Release the hookswitch, listen for dial tone, and dial the desired number.

(2) If further calls are not desired, restore the handset of the test telephone and restore the OFFICE LINE key to normal.

4.04 Answering An Incoming Call: When the extension ringer sounds, it indicates an incoming call. To answer the call:

a. Operate the OFFICE LINE key.

b. Insert the plug of the hand test telephone into the TEST TEL jack, or remove the handset of the station test telephone and talk to the calling party.

c. When the call is completed:

(1) Restore the OFFICE LINE key.

(2) Remove the plug of the hand test telephone from the TEST TEL jack, or restore the handset of the station test telephone.

5. TEST SHOE TEST PROCEDURES

5.01 Test Connection: Tests can be made from the test set on all lines and trunks that are connected at the protector blocks of the main distributing frame (MDF) by using the test shoe. To connect the test set to a line or trunk, first ensure that all keys on the test set are normal; then insert the test shoe into the protector block of the line or trunk. If the test set MDF trunk is terminated in a jack field instead of a test shoe, the line to be tested must be patched to the jack field.

5.02 Preliminary (Monitoring) Test: Before making any test on a line or trunk, monitor from the test set to determine if the line or trunk is in use, as follows:

a. Go off-hook with the test telephone by inserting the plug of the hand test telephone (with the R switch operated) into the TEST TEL jack; or removing the handset from the station test telephone.

b. Operate the HEAT COIL LISTEN key and listen to the receiver.

c. If the line or trunk is busy, restore the HEAT COIL LISTEN key and go on-hook with the test telephone by removing the hand test telephone from the TEST TEL jack (or operating the C switch); or, if the station telephone was used in this test, replacing the handset on the cradle.

d. If the line or trunk is idle, proceed as instructed in paragraphs 5.03 through 5.10 for the type of test required.

5.03 Testing Outside Plant:

a. Monitor the line as instructed in paragraph 5.02; then go on-hook.

b. Restore the HEAT COIL LISTEN key.

c. Operate the TEST OUT key.

d. Refer to paragraphs 8 through 17 and perform the required tests as instructed.

e. When testing is completed, restore all keys to normal and remove the test shoe.

5.04 Testing Inside Plant Bypassing Heat Coils:

a. Monitor the line as instructed in paragraph 5.02; then go on-hook.

b. Operate the TEST IN key.

c. Refer to paragraphs 8 through 17 and perform the required tests as instructed.

d. When testing is completed, restore all keys to normal and remove the test shoe.

5.05 Testing Inside Plant Through Heat Coils:

a. Monitor the line as instructed in paragraph 5.02; then go on-hook.

b. Refer to paragraphs 8 through 17 and perform the required tests as instructed.

c. When testing is completed, restore all keys to normal and remove the test shoe.

5.06 Outgoing Call Through Outside Plant:

a. Monitor the line as instructed in paragraph 5.02; then go on-hook.

b. Restore the HEAT COIL LISTEN key.

c. Operate the TEST OUT key.

d. Set the selector switch to the number corresponding to the ringing digit of the party to be called.

e. Operate the RING key. (Operate the key momentarily, or operate the key intermittently to produce the desired ringing code.)

f. After about 3 seconds, momentarily reoperate the RING key; or repeat the ringing code.

g. Go off-hook with the test telephone.

h. Operate the HEAT COIL LISTEN key and monitor the line to determine if the called party has answered.

i. When the called party answers, restore the HEAT COIL LISTEN key to normal.

j. On lines that require transmission battery, operate the OUT TALK key.

k. Proceed with the conversation.

l. When the conversation is finished, restore all keys to normal.

m. Go on-hook with the test telephone.

n. Remove the test shoe.

5.07 Originating Calls Through Dial Equipment—Regular Lines or Trunks:

a. Monitor the line as instructed in paragraph 5.02 and stay off-hook.

b. Restore the HEAT COIL LISTEN key.

c. Operate the DIAL IN key.

d. Dial the desired number using the dial on the test telephone.

e. When dialing is completed, the dial equipment rings the called party.

f. When the called party answers, the dial equipment supplies transmission battery to the test set telephone and to the called telephone.

g. Proceed with the conversation.

h. When the conversation is finished, restore all keys to normal.

i. Go on-hook with the test telephone.

j. Remove the test shoe.

5.08 Originating Calls to PBX Lines or Special Lines: When testing a PBX line circuit (or any other circuit that does not furnish ground on the tip side of the line), proceed as follows:

a. Connect ground to the R terminal of the TST POST.

b. Go off-hook with the test telephone.

c. Operate the DIAL IN key.

d. Operate the TEST IN key.

e. When dial tone is heard, restore the TEST IN key to normal.

f. Operate the TEST OUT key.

g. Proceed as instructed in paragraph 5.07, steps d. through j.

h. Remove ground from the R terminal.

5.09 Originating Calls Through Incoming Ringdown Trunks:

a. Monitor the trunk as instructed in paragraph 5.02; then go on-hook.

b. Restore the HEAT COIL LISTEN key.

c. Operate the TEST IN key.

d. Momentarily operate the RING key.

e. Go off-hook with the test telephone.

f. When the switchboard operator answers, proceed with the conversation.

g. When the conversation is finished, restore all keys to normal.

h. Go on-hook with the test telephone.

i. Remove the test shoe.

5.10 Originating Calls Through Incoming Common Battery Trunks:

a. Restore the HEAT COIL LISTEN key.

b. Operate the TEST IN key.

c. Operate the DIAL IN key.

d. When the switchboard operator answers, proceed with the conversation.

e. When the conversation is finished, restore all keys to normal.

f. Go on-hook with the test telephone.

g. Remove the test shoe.

6. TEST SELECTOR—MDO TEST PROCEDURES

6.01 Tests can be made on any line or trunk terminated on selector or connector banks in the MDO by using the test selector trunk from the MDO test set. The supervisory lamp (SR) on the front panel lights when the test selector is seized from the test set or the operator's switchboard. Testing should not be attempted when the test selector is already seized from the operator's switchboard.

6.02 Connecting to the Line:

a. Turn the selector switch to the OFF position.

b. Operate the TEST SELECTOR key. The supervisory lamp lights, indicating that the test selector is ready to receive dial pulses.

c. Use the test set to dial the last four digits of the desired number. If the supervisory lamp flashes at 120 IPM, the line is busy; if the lamp remains lighted, the test connector is busy; if the lamp extinguishes, the line is free for testing.

d. If the line is busy (120 IPM flashes), monitor the line to determine whether conversation is in progress or whether a fault condition is holding the line circuit. Monitor as follows:

(1) Operate the DIAL IN and TEST IN keys.

(2) Go off-hook with the test telephone and listen to the receiver.

e. If the test connector is busy (lamp remains lighted), restore the TEST SELECTOR key and try again later.

f. If the line is idle (supervisory lamp extinguishes), apply tests by operating the appropriate keys on the test set.

6.03 Stepping to the Next Line or Level: After completing the tests on a line, the connector can be stepped to the next line by dialing the digit 1 with the test set dial while the DIAL IN and TEST IN keys are operated.

6.04 Releasing the Test Connector: The test set can be connected for testing on a line within a different level (tens group) by releasing the test connector without releasing the test selector. To do this, operate the CONN RLS key, then dial the last two digits of the desired number. The supervisory lamp indications and test functions are as described in paragraph 6.02. To access lines within a different hundreds connector group, both the test selector and test connector must be released. To do this, restore the TEST SELECTOR key to normal and repeat the procedures described in paragraph 6.02.

6.05 Release Permanent: If the supervisory lamp on the test set is lighted after a line has been restored to normal, momentarily operate the RLS PERM key. This releases the battery feed relay so that tests can be made on the T and R leads.

6.06 Inward Test—Regular Lines and Trunks:

a. Operate the TEST SELECTOR key and use the test set dial to dial the desired number.

b. After the supervisory lamp extinguishes (indicating that the test selector has stepped to the desired line):

(1) Operate the IN TEST key and then the CO CONT key.

(2) Go off-hook with the test telephone.

(3) Operate the DIAL IN and TEST IN keys.

(4) Restore the IN TEST key to normal.

(5) Dial the desired line number, using the test telephone dial.

c. Operate the appropriate keys for the desired test.

d. To release from the inward test, the following sequence of operation must be observed to prevent locking up the switchtrain connection:

(1) Go on-hook with the test telephone.

(2) Restore the TEST IN key to normal.

(3) Restore the CO CONT key to normal.

6.07 Inward Test—PBX and Special Lines: When testing PBX lines (or any other circuit that does not furnish ground on tip), use the following procedure:

a. Connect ground to the R binding post of the test set.

b. Go off-hook with the test telephone.

c. Operate the DIAL IN and TEST IN keys.

d. Operate the CO CONT key.

e. When dial tone is heard, remove the ground connection from the R binding post.

f. Use the dial on the test telephone to dial the digits of the desired line number.

g. Operate the appropriate keys for the desired test.

h. To release from the test connection, go on-hook with the test telephone; then restore the CO CONT key to the normal position.

7. TEST SELECTOR—CDO TEST PROCEDURES

7.01 Tests can be made on any line or trunk terminated on the selector or connector banks in the CDO by using the test selector trunk from the CDO test set. The supervisory lamp (SR) on the front panel lights when the test selector is seized from the test set or the operator's switchboard. Testing procedures should not be attempted when the test selector is already seized from the operator's switchboard.

7.02 Connection to a Line:

a. Turn the selector switch to the OFF position.

b. Operate the TEST SELECTOR key. The supervisory lamp lights, indicating that the test selector is ready to receive dial pulses.

NOTE: The dial on the test set controls the test train only and should not be used in an attempt to control the regular central office dial equipment for inward tests.

c. Use the test set dial to dial the last four digits of the desired line number. If the supervisory lamp remains lighted, the line is busy; if the supervisory lamp extinguishes, the line is free for testing.

d. If the line is busy, monitor to determine whether conversation is in progress or whether a fault condition is holding the line circuit. Monitor the line as follows:

(1) Operate the DIAL IN and TEST IN keys.

(2) Go off-hook with the test telephone and listen to the receiver.

e. If the line is free, go on-hook with the test telephone and make tests by operating the appropriate keys on the test set.

8. BINDING POSTS TEST PROCEDURES

8.01 The binding posts, designated TST POST T and R (see Figure 2), can be used for two different purposes:

a. Components or equipment to be tested can be connected to the binding posts so that tests may be applied from the test set.

b. External test equipment (e.g., Wheatstone bridge, dial speed test set, etc.) can be connected to the binding posts to increase the capability of the test for testing lines and equipment through the test shoe or test selector train.

8.02 When the test set is used for testing components connected to the binding posts, the following particular type of test condition is applied:

a. Potential Tests:

(1) Connect the equipment to be tested to the binding posts.

(2) Refer to paragraphs 11 through 16 and select the test to be performed.

(3) Disconnect the equipment from the binding posts when testing is completed.

b. Ringing:

(1) Turn the selector switch to the required ringing digit (see paragraph 5.06).

(2) Connect the equipment to be tested to the binding posts.

(3) Operate the RING key to apply the required ringing frequency to the equipment connected to the binding posts.

(4) Restore the RING key to remove the ringing.

(5) Disconnect the equipment from the binding posts when testing is completed.

c. Transmission Battery:

(1) Connect the equipment to be tested to the binding posts.

(2) Go off-hook with the test telephone.

(3) Operate the OUT TALK key to connect battery and ground to the component by way of the R and T binding posts, respectively.

(4) Restore the OUT TALK key to disconnect the transmission battery supply.

(5) When testing is completed, go on-hook with the test telephone.

(6) Disconnect the equipment from the binding posts.

d. Dialing:

(1) Connect the equipment to be dial pulsed to the binding posts.

(2) Go off-hook with the test telephone.

(3) Operate the DIAL IN key.

(4) Operate the TEST IN key.

(5) Dial the desired number on the test telephone dial to apply dial pulses to the equipment connected to the binding posts.

(6) When the pulsing test is completed, go on-hook with the test telephone.

(7) Restore all keys to normal.

(8) Disconnect the equipment from the binding posts.

8.03 Auxiliary test equipment is connected to the binding posts after the preliminary test path has been set up through the test shoe (see paragraph 5) or through the test selector train (see paragraph 6 or 7). When using the test selector train, the TEST OUT key must be operated to connect the auxiliary test equipment to the test train.

9. HEAT COIL TEST PROCEDURES

9.01 To check the condition of the heat coils, proceed as follows:

a. Position the selector switch to the OFF position.

b. Go off-hook with the test telephone.

c. Operate the HEAT COIL LISTEN key and listen to the receiver. If the line is busy, try again later.

d. If there is no conversation on the line, operate the TEST OUT and OUT TALK keys.

e. If dial tone is heard in the receiver, the heat coils are not open.

10. METER CALIBRATION

10.01 Before making a resistance test, zero set the meter in accordance with the following steps to ensure accuracy of the readings. (If the proper indications are not obtained, reter to CTSP 405-110-328, paragraph 5.03 for more detailed calibrating procedures.)

a. Rotate the selector switch to position 1 (ZERO ADJ).

b. If a resistance below 5000Ω is to be measured, operate the LOW OHMS key.

c. Adjust the ZERO ADJ control so that the meter needle indicates 0 on the resistance scale.

11. TESTING FOR NEGATIVE BATTERY ON THE TIP OR RING LEAD

CAUTION: If the meter needle moves off-scale (left) during the following procedures, disconnect immediately from the line being tested.

11.01 Proceed as follows:

a. For testing on the tip lead, rotate the selector switch to position 2. For testing on the ring lead, rotate the selector switch to position 2 and operate the TEST REVERSE key.

b. Connect to the line or trunk by using the test shoe or test selector train. Refer to paragraph 5, 6, or 7.

c. If there is a negative battery potential on the lead, the meter needle will indicate the voltage value on the lower scale of the meter.

d. If the meter needle does not move, the lead is either open or free of battery potential.

e. Upon completion of the test, restore all keys to normal and disconnect the test shoe or test selector train.

12. TESTING FOR + BOOSTER VOLTAGE ON THE TIP

CAUTION: If the meter needle moves off-scale (left) during the following procedures, disconnect immediately from the line being tested.

12.01 Proceed as follows:

a. Rotate the selector switch to position 3.

b. Connect to the line or trunk by using the test shoe or test selector train. Refer to paragraph 5, 6, or 7.

c. If there is a positive battery potential on the tip lead, the meter needle will indicate the voltage value on the lower scale of the meter.

d. If the meter needle does not move, the lead is either open or free of battery potential.

e. Upon completion of the test, restore all keys to normal and disconnect the test shoe or test selector train.

13. MEASURING LINE BATTERY VOLTAGE

13.01 To measure the battery voltage around the T and R loop of a line, rotate the selector switch to position 4 and follow the same testing procedures described in paragraph 12. With the selector switch in position 4, the meter reading shows the battery voltage on the line loop.

14. TESTING FOR GROUND ON TIP OR RING

14.01 Proceed as follows:

a. Zero set the meter as described in paragraph 10.

b. Rotate the selector switch to position 5 for measuring ground on the tip lead, or to position 6 for measuring ground on the ring lead.

c. Connect to the line or trunk by using the test show or test selector train. Refer to paragraph 5, 6, or 7.

d. If there is a ground on the line, the resistance to ground will be indicated on the upper scale of the meter.

e. If the meter needle does not move, it indicates that the lead is either open or not grounded.

f. Upon completion of the test, restore all keys to normal and disconnect the test shoe or test selector train.

15. MEASURING LINE LOOP RESISTANCE AND LEAKAGE

15.01 Proceed as follows:

a. Rotate the selector switch to position 7.

b. Connect to the line or trunk by using the test shoe or test selector train. Refer to paragraph 5, 6, or 7.

c. With the telephone at the far end **on-hook**, the meter reading indicates the leakage resistance of the line.

d. Compare this reading with the resistance shown on the line record card to determine if the line is faulty.

e. With the telephone at the far end **off-hook**, the meter reading indicates the loop resistance of the line. If the meter needle indicates 5000Ω or less, operate the LOW OHMS key and divide the meter indication by 100 to obtain the actual loop resistance.

f. Compare this reading with the resistance shown on the line record card to determine if the line is faulty.

g. Upon completion of the test, restore all keys to normal and disconnect the test shoe or test selector train.

16. MEASURING LINE CAPACITY

16.01 When testing the capacity of a line, the telephone at the far end should be **on-hook**. Proceed as follows:

a. Tip to Ground Capacitance:

(1) Rotate the selector switch to position 8.

(2) Connect to the line or trunk by using the test shoe or test selector train. Refer to paragraph 5, 6, or 7.

(3) Rapidly operate and restore the CAP READ key several times.

(4) While performing step (3), observe the meter needle and record the maximum reading observed on the lower scale of the meter.

(5) Restore the CAP READ key.

(6) Compare the recorded reading with the DEFLECTION column in Table F to obtain the capacitance reading (CAPACITY column).

(7) Upon completion of this test, either proceed with other tests or restore all keys to normal.

b. Ring to Ground Capacitance: The procedures for measuring ring capacitance are identical to those for measuring tip capacitance (a. above), except that the selector switch is turned to position 9 on the test set.

c. Loop Capacitance:

(1) Rotate the selector switch to position 10.

(2) Rapidly operate and restore the CAP READ key several times.

(3) While performing step (2), observe the meter needle and record the maximum reading observed on the lower scale of the meter.

(4) Restore the CAP READ key.

(5) Subtract the tip capacity reading (obtained in paragraph 16.01, a.) from the loop capacitance reading obtained in step (3) above. The result is the loop capacity.

(6) Compare the recorded reading with the DEFLECTION column in Table F to obtain the capacitance reading (CAPACITY column).

(7) Upon completion of this test, either proceed with other tests or restore all keys to normal.

d. Converting Meter Deflections to Capacitance: Table F lists typical readings

TABLE F. Conversion of Meter Deflection to Capacity Value

DEFLECTION (in volts)	*CAPACITY (in μf)*	*DEFLECTION (in volts)*	*CAPACITY (in μf)*	*DEFLECTION (in volts)*	*CAPACITY (in μf)*
19	0.5	36	1.0	110	6.0
22	0.6	62	2.0	116	7.0
26	0.7	78	3.0	122	8.0
30	0.8	94	4.0	128	9.0
32	0.9	102	5.0	132	10.0

obtained on the lower scale of the meter and the approximate capacitance in microfarads to which they are equal.

17. GENERATOR GROUND CUT-OFF

17.01 The test key which controls generator ground cut-off is the same key that controls application of the circuits to obtain LOW OHMS. However, the circuits for each function are different and separate. Generator ground cut-off is used on lines having subsets which do not remove ringers from the line when the phone is off-hook, or on lines having telephones equipped with varistors connected across the receiver.

17.02 To signal a customer who has left his telephone off-hook, the usual howler method would be ineffective. To signal such a customer, the LOW OHMS key is operated and ringing is applied to the line by operation of the RING key. Operation of the LOW OHMS key removes the shunt across the ringer of the off-hook telephone so that the telephone can be rung without ringing current damaging the receiver.

18. HOWLER

18.01 Except as noted in paragraph 17, the howler is used to try to alert a customer whose telephone is off-hook. Either an internal howler or an external howler is supplied. Generally, the internal howler is adequate for smaller offices, and the external howler is used when many lines must be covered. Both howlers are automatic to the extent that the rising and falling tone will continue until the telephone is placed on-hook; then howler operation will cease automatically.

18.02 If the telephone is not placed on-hook, the testman should stop howler operation by restoring the HOWLER key and recheck at a later time.

WILCOM T-136B CIRCUIT TEST SET
DESCRIPTION AND OPERATION

1. GENERAL

1.01 This practice provides the description of and operating procedures for the Wilcom T-136B Circuit Test Set.

1.02 The T-136B circuit test set measures circuit loss (dbm), transmitter current (ma), power influence (dbrnC) [equivalent to **noise to ground**] and circuit noise (dbrnC) [equivalent to **noise metallic**]. This compact, portable test set is capable of measuring the significant transmission characteristics of a subscriber loop.

1.03 The test set has a color coded scale which facilitates **go, no-go** testing and decision making.

1.04 The input impedance (terminating) is 735 Ω, which is the geometric mean between 600 and 900 Ω. The set indicates correctly on either 600 or 900 Ω circuits.

2. DESCRIPTION

2.01 The operation of the test set is controlled by a single function switch located in the center of the front panel. See Figure 1.

a. A dialing and hold arrangement makes it possible to dial a remote test line when the function switch is in the DIAL & LINE MA position, and to hold the connection in all measurement positions of the function switch. Square posts are provided for connecting a dial telephone handset to the test set. The hold coil provides a DC resistance of about 225 Ω with an AC impedance high enough to have no significant effect on the measurements.

b. The type of measurement is selected by the function switch. The DC line current may be measured when the function switch is in the DIAL & LINE MA position. The meter includes a scale calibrated from 0 to 100 ma in 5 ma increments.

c. The next position is CKT LOSS which provides a means for measuring (on a terminated basis) the level of a tone received from a 1 mw reference tone source over a level range of -15 dbm to +3 dbm on a color segmented meter scale. Measurements may be made at frequencies other than 1 kHz as the CKT LOSS response characteristic is flat from 300 Hz to 15 kHz; 60 Hz is attenuated more than 30 db.

d. The next position of the function switch is designated CKT NOISE which provides additional sensitivity for measuring noise metallic on a C-message weighted basis. The color segmented meter scale for this measurement extends from 33 dbrnC to 15 dbrnC.

e. The third position of the function switch is designated PWR INFL (power influence) which provides a means for measuring noise voltages between a circuit and ground on a C-message weighted basis. The input circuit in this position has an impedance of about 200,000 Ω between the input terminals and over 100,000 Ω between either input terminal and ground. The noise to ground level is measured on the same color segmented scale as CKT NOISE, but the range of measured noise is now arranged for the normal range of power influence measurements. The scale extends from 93 dbrnC to 75 dbrnC.

f. In most conventional noise measuring sets, 40 db is added to the noise to ground measurements to take into account the difference between noise metallic and noise to ground measurement circuits. The PWR INFL scale on the meter is calibrated to provide the absolute value; therefore, it is not necessary to add 40 db to the measurement.

g. A nonlocking pushbutton switch is provided to add 20 db attenuation to the input signal, if the signal level is sufficient to cause the meter to read off scale. In most cases, operation of the switch will bring the meter pointer back on scale; consequently, the T-136B test set has a range of measurement of about 35 db.

h. A phone jack is provided to enable the tester to listen to the signals being measured without interfering with the measurements. The jack accepts the standard 310 type plug, the normal termination of the 723A receiver, and W2FS cord.

i. Three 4-foot leads, equipped with clips and colored green for tip, red for ring, and yellow for ground, are permanently attached to the set.

j. A nonlocking pushbutton switch is used to supply power to the measuring circuits from two small 9-volt batteries. No current is supplied by the batteries until the switch is depressed to take a

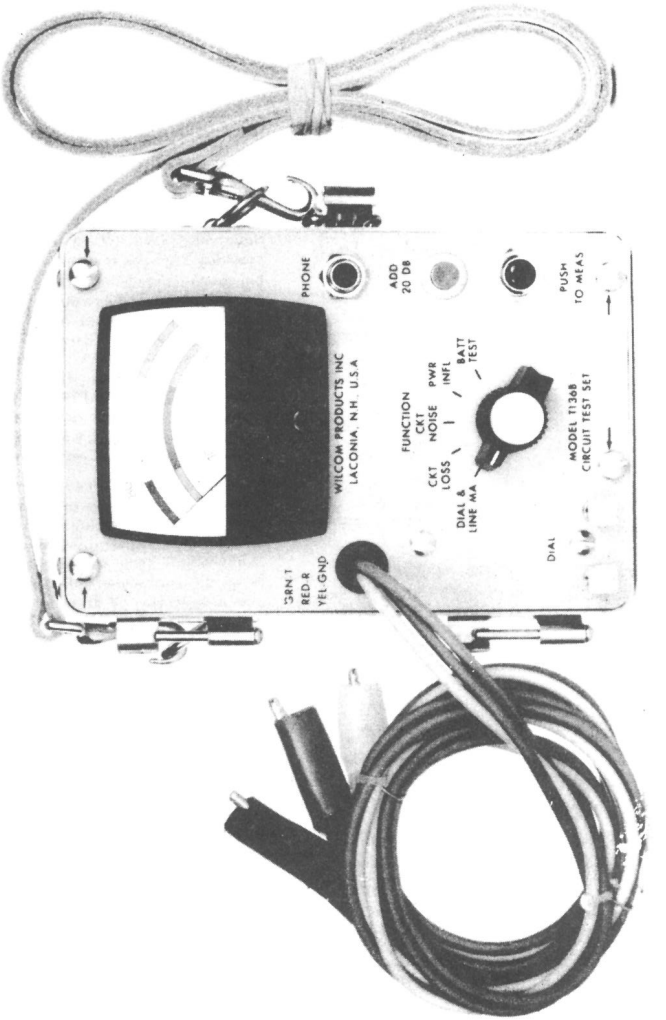

PHONE
ADD
20 DB
PUSH
TO MEAS
WILCOM PRODUCTS INC
LACONIA N.H. U.S.A.
FUNCTION
CKT
NOISE
PWR
INFL
BATT
TEST
CKT
LOSS
DIAL &
LINE MA
MODEL T1368
CIRCUIT TEST SET
DIAL
GRN-T
RED-R
YEL-GND

FIGURE 1.

reading. Therefore, the useful life of the batteries approaches shelf life as the ON period is usually very short. The set cannot be left ON inadvertently.

k. The physical dimensions of the test set are 4-3/8 inches wide by 6-3/8 inches long by 4-7/8 inches high. The weight is 3 pounds.

3. CHARACTERISTICS

3.01 The response of the T-136B test set in the CKT LOSS function is flat from 300 Hz to 15,000 Hz; 60 Hz is attenuated more than 30 db.

3.02 When measuring PWR INFL or CKT NOISE, the test set exhibits the C-message weighting characteristic.

3.03 Figure 2 shows a block diagram of the T-136B test set.

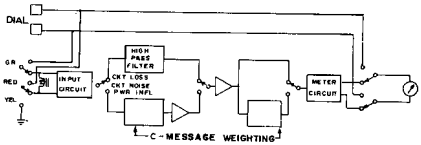


FIGURE 2. Block Diagram

3.04 A schematic of the input circuit for the three modes of the test set are shown in Figures 3, 4, and 5.

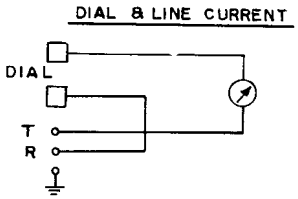


FIGURE 3. Input Circuit

3.05 A schematic of the T-136B test set is shown in Figure 6 (fold-out).

4. TEST SET OPERATION

4.01 The measurement ranges of the T-136B test set are designed to be within the normally acceptable limits of circuit loss, noise metallic, and noise to ground. The colored segments of the meter scale indicate the degree of performance acceptability when direct readings are made on the meter, i.e., when it is not necessary to press the ADD 20 DB pushbutton switch. The significance of each color is:

a. Green: Acceptable performance.[1]

b. Yellow: Marginal performance: investigation should be made.

c. Red: Unacceptable performance; corrective action required.

4.02 The T-136B test set terminates the circuit in the proper impedance when it is across the line during a measurement. The **green, red,** and **yellow** leads of the set are connected to the **tip, ring** and **ground,** respectively. A low resistance ground is not required. When available, an earth ground is preferred.

4.03 After connecting the test set to the circuit to be tested, proceed as follows:

a. Place the function switch in the DIAL & LINE MA position. Line current may be measured on the MA scale before dialing.

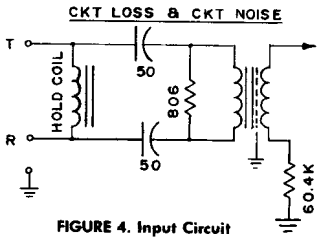


FIGURE 4. Input Circuit

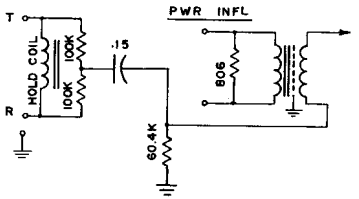


FIGURE 5.

b. Dial the number of the milliwatt generator in the central office. When connection is established, the line current may be checked again. Turn the function switch to the CKT LOSS position and press the PUSH TO MEAS button. This turns on the set and must be held in place until the measurement has been made. Readings are made on the CKT LOSS scale of the meter which is calibrated from 0 to -10 dbm in divisions of 1 db. The -15 dbm point is the last marking on the scale.

NOTE: Release the central office connection.

c. Noise measurements are made by dialing the number of the quiet (or balance) termination in the central office. The function switch must be in the DIAL & LINE MA position. When a connection is made, turn the function switch to the CKT NOISE position and press the PUSH TO MEAS button. The reading on the CKT NOISE scale on the meter is the noise metallic on the line. If the meter should read off scale, press the ADD 20 DB pushbutton switch; this should bring the meter pointer within the measuring scale of the meter unless the noise is excessively high. If it is necessary to push the ADD 20 DB button, add 20 db to the meter reading to get the exact value of circuit noise (or noise metallic).

d. PWR INFL (or noise to ground measurements) are made while connected to the quiet termination at the central office by turning the function switch to the PWR INFL position and reading the top scale on the meter. The PWR INFL scale is calibrated to read the noise to ground directly; it takes into account the 40 db addition usually required for the attenuation in the input circuit in noise measuring sets. If the meter should read off scale, press the ADD 20 DB pushbutton switch; this should bring the meter pointer within the measuring scale of the meter unless the noise is excessively high. If it is necessary to push the ADD 20 DB button, add 20 db to the meter reading to get the exact value of power influence (or noise to ground).

e. Circuit balance can be determined from the CKT NOISE and PWR INFL measurements made with the T-136B test set.

Balance (db) = PWR INFL—CKT NOISE

The balance of a circuit will determine how susceptible it is to induced noise. The following values provide a guide for evaluating balance:

BALANCE	CONDITION
Over 70	Excellent
60—70	Good
50—60	Fair
Under 50 db	Poor

NOTE: Refer to Figure 7 for a graphic solution of the balance equation.

5. MAINTENANCE

5.01 The T-136B test set requires very little maintenance except for replacement of the battery. The battery is replaced by removing the screws identified by an arrow on the faceplate of the set. If maintenance is necessary, the unit should be sent to the local storeroom for return to the manufacturer: Wilcom Products Inc., Box 508, 109 Court St., Laconia, New Hampshire 03246.

6. CALIBRATION

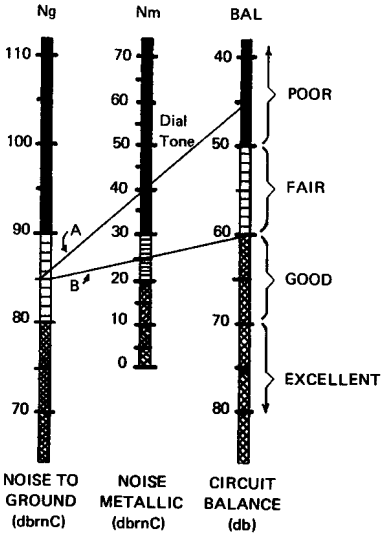
6.01 The calibration of the T-136B test set is checked by the manufacturer. However, a test line equipped with an attenuator and potentiometer will facilitate periodic checks of the test set at the -10 dbm CKT LOSS point and 20 ma transmitter current point. As these are the decision points for these parameters, the test set should be checked there. Test sets which do not indicate accurately at these points should have a calibration chart attached (inside the cover) to indicate the correction (+ or -). If the deviation is more than 5 ma or 1 db, the set should be returned to the manufacturer for maintenance. The PWR INFL and CKT NOISE scales are accurate (+ or -1/4 db).

NOMOGRAPH FOR SOLVING CIRCUIT BALANCE EQUATION

(CIRCUIT BALANCE = NOISE TO GROUND–NOISE METALLIC)

EXAMPLE

	VERY NOISY CIRCUIT (A)	SAME CIRCUIT AFTER BALANCE IMPROVEMENT (B)
Ng	85	85
Nm	40	25
BAL	45	60



SUBSCRIBER LOOP ACCEPTABILITY CRITERIA:

- ACCEPTABLE PERFORMANCE
- MARGINAL PERFORMANCE; INVESTIGATION OF POTENTIAL TROUBLES SHOULD BE INITIATED
- UNACCEPTABLE PERFORMANCE; CORRECTIVE ACTION REQUIRED

FIGURE 7.

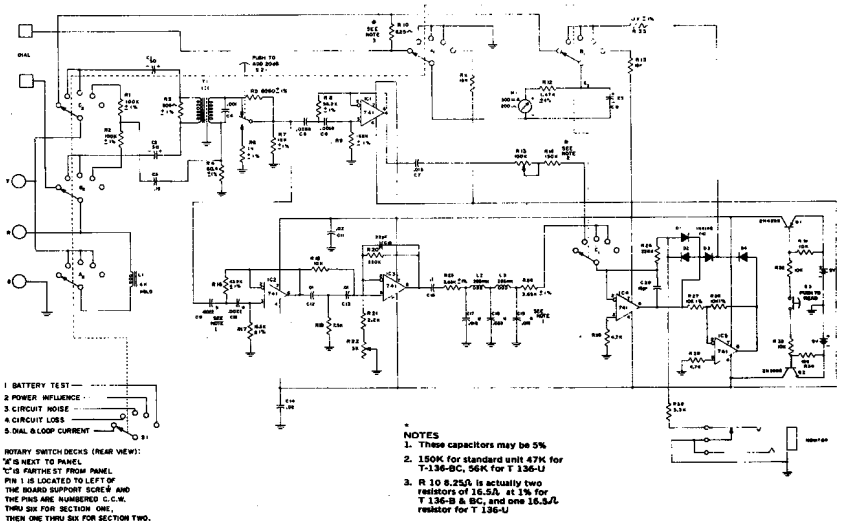

1 BATTERY TEST
2 POWER INFLUENCE
3 CIRCUIT NOISE
4 CIRCUIT LOSS
5 DIAL & LOOP CURRENT
S1
ROTARY SWITCH DECKS (REAR VIEW):
"A" IS NEXT TO PANEL
"C" IS FARTHEST FROM PANEL
PIN 1 IS LOCATED TO LEFT OF THE BOARD SUPPORT SCREW AND THE PINS ARE NUMBERED C.C.W. THRU SIX FOR SECTION ONE, THEN ONE THRU SIX FOR SECTION TWO.
NOTES
1. These capacitors may be 5%
2. 150K for standard unit 47K for T-136-BC, 56K for T 136-U
3. R 10 8.25Ω is actually two resistors of 16.5Ω at 1% for T 136-B & BC, and one 16.5/1 resistor for T 136-U

FIGURE 6.

B VOLTAGE TESTER
DESCRIPTION

CONTENTS

1. GENERAL

1.01 This practice provides the description of the B Voltage Tester, CTS #74-94-310-3, (Figure 1) and accessories:

a. B Temporary Bond, CTS #74-88-011-0, (Figure 2).

b. B Shunting Capacitor, CTS #74-88-012-8, (Figure 3).

c. B Voltage Tester Carrying Case, CTS #74-94-327-8, (Figure 4).

d. B Voltage Plug, CTS #74-94-295-4.

1.02 This practice also includes information on field repairs that may be required on the tester.

2. DESCRIPTION OF B VOLTAGE TESTER

2.01 The B Voltage Tester is designed to detect the presence of voltages from 60 to 7600 volts. It consists of an indicator assembly which contains a small neon glow unit and reflector, and a plastic insulated probe equipped with a toothed metal disc on one end for making contact with the conductor, conduit, or street light fixture to be tested. The probe is designed to limit the amount of current which can pass through the device. The probe, indicator assembly, and an insulated clip are connected by insulated cord. See Figure 1.

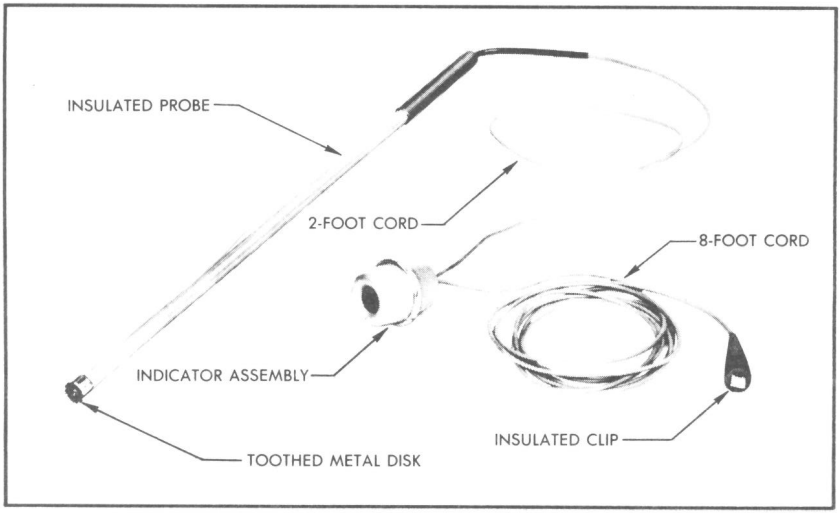


FIGURE 1. B Voltage Tester CTS #74-94-310-3

2.02 At 60 to 70 volts the indicator of the B voltage tester glows dimly. Higher voltages will produce a brighter glow. Higher voltages can damage the tester (7200 volts will burn it out in approximately one minute), it should be touched to the facility being tested **only long enough to determine whether or not the indicator glows.**

3. VOLTAGE PLUG

3.01 A voltage plug, to be made up locally (Figure 5), is designed to provide a safe and convenient means for checking the operation of the B voltage tester. When plugged into any standard 110 to 120 volt convenience outlet, it provides a source of voltage in series with a current limiting resistor. As shown in Figure 5, the resistor is connected to only one prong of the plug and this prong must be plugged into the **hot** side of the outlet. Generally, the **hot** side is the smaller of the two parallel slots in the outlet.

a. Voltage plug, CTS #74-94-295-4, designed for checking the B voltage tester can be ordered from the Test Equipment catalog. When the voltage plug is inserted into a standard 110-120 AC outlet, an electrical source will be provided that is controlled by a current limiting resistor.

b. The insulated clip of the B voltage tester is attached to a ground (as recommended in paragraph 6.02, c.) and the probe of the tester is inserted into the exposed end of the voltage plug so that the toothed metallic disc makes contact with the metal spiral in the plug.

c. If the indicator on the B voltage tester glows dim when contact is made, the tester is operating properly. If not, reverse the plug in the outlet. If there is still no glow, the B voltage tester is defective and should not be used.

4. B TEMPORARY BOND

4.01 The B Temporary Bond is a 5-foot length of stranded copper, rubber covered cord with battery clips at each end. The B Temporary Bond is used to prevent electrical shock to craftsmen by temporarily grounding to cable strand and can be used with the B Voltage Tester and the B Shunting Capacitor to prevent false indication on the B Voltage Tester.

5. SHUNTING CAPACITOR

5.01 The B Shunting Capacitor (Figure 3) is used to distinguish dangerously energized street light fixtures from weakly energized fixtures which are not dangerous. For further information, refer to CTSP 490-050-106.

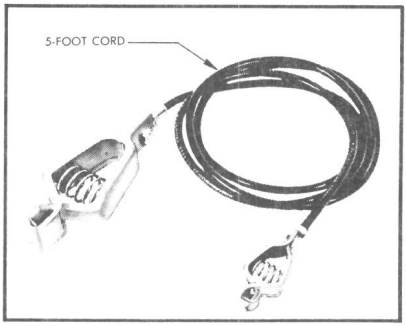


FIGURE 2. B Temporary Bond CTS #74-88-011-0

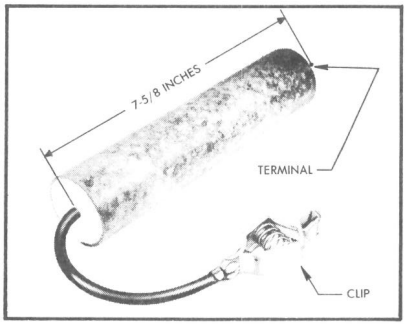


FIGURE 3. B Shunting Capacitor CTS #74-88-012-8

5.02 Because the B Voltage Tester is extremely sensitive and operates with very small currents, street light fixtures may cause the indicator to glow even though they are energized only by leakage across damp cobwebs or induction between the fixture and its wiring.

5.03 The B Shunting Capacitor will drain off harmless voltages such as those described in paragraph 5.02. It will not interfere with the operation of the B Voltage Tester if the fixture is dangerously energized (as it would be if the wiring insulation in the fixture broke down).

5.04 The B Shunting Capacitor should not be used in making other tests except as specifically authorized by local instructions.

5.05 The B Shunting Capacitor should not be dropped and should be kept reasonably clean and dry. It does not require testing or any special maintenance.

6. TESTING THE B VOLTAGE TESTER

6.01 The B Voltage Tester should be tested weekly to ensure that it is operating satisfactorily.

6.02 The method of testing the B Voltage Tester is:

a. Locate a standard 110 to 120 volt convenience outlet which is energized. This may be checked with an extension cord and lamp.

b. Insert the voltage plug into the outlet; first choose the smaller of the two slots in the outlet to insert the prong connected to the resistor.

c. Attach the insulated clip of the voltage tester to a ground such as a water pipe, radiator, metallic power conduit, etc. If none of these are available, lay the B temporary bond, uncoiled, on concrete floor and attach to one of its clips.

d. Touch the toothed metal disc of the probe to the metal spiral of the voltage plug. The indicator should glow faintly. If the indicator does not glow, release the tension in the wire, but keep the probe in contact with the voltage plug. If the indicator glows after the tension has been released, the wire is broken under the insulation and the tester should be disposed of.

e. If the indicator does not glow, reverse the voltage plug in the outlet by removing it, turning a half turn and inserting again into the outlet. Repeat the test.

f. If the indicator still does not glow and it is known that the convenience outlet is not defective, then the voltage tester must be defective and should be disposed of.

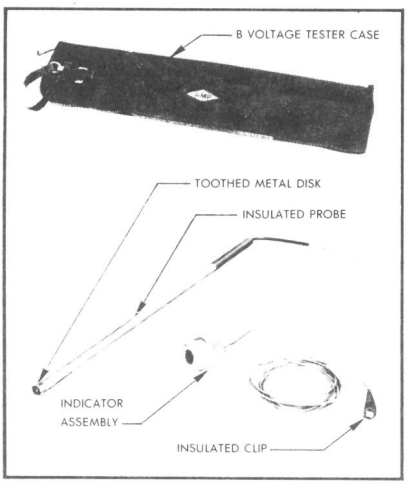


FIGURE 4. B Voltage Tester and Case CTS #74-94-327-8

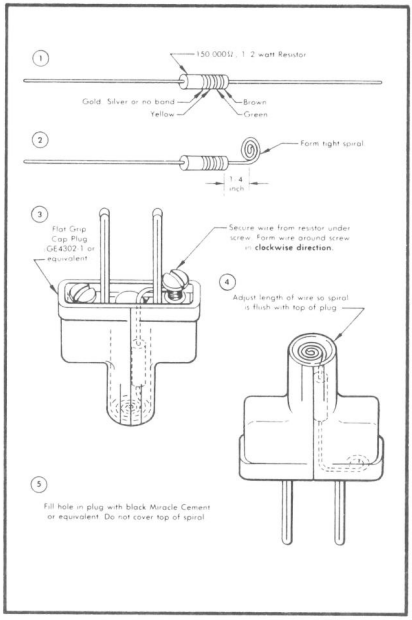


FIGURE 5

7. FIELD REPAIR OF B VOLTAGE TESTER

7.01 Certain limited field repairs to the B Voltage Tester will be required. Testers which cannot be repaired by using the methods described in this practice should be disposed of in accordance with local instructions.

7.02 The wire or cord of the B Voltage Tester may be spliced under the following conditions:

a. Between the probe and the indicator assembly, a maximum of two splices are permitted. Do not attempt to splice wire if the break is within 4 inches of either the indicator assembly or the grip of the probe.

b. Between the indicator assembly and the grounding clip, a maximum of three splices is permitted. No attempt should be made to splice wire breaks within 4 inches of the indicator assembly. No attempt should be made to splice wire breaks if the overall length of the cord between the clip and the indicator assembly will be less than 7 feet 6 inches. Each splice will reduce the length of the cord about 2 inches.

7.03 To splice broken cords (Figure 6):

a. Strip 2 inches of insulation from the wire on each side of the break using the wire stripping hole of the standard 6-inch diagonal pliers.

b. Clean the insulation of the wire adjacent to the break for a distance of at least 1 inch to remove mud, grease, etc.

c. Tie a square knot in the middle of the exposed wire so the ends will lie parallel and extend approximately to the beginning of the insulation.

d. Tape the joint with 3/4-inch vinyl tape or friction tape. Start the tape at about a 45-degree angle beginning at the knot and continue until about 1/2-inch of the rubber insulation has been covered. Continue taping until the splice has two layers. End the tape in the middle of the splice.

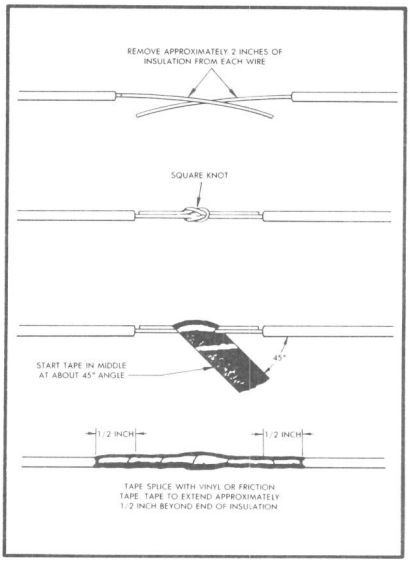


FIGURE 6. Repairing Broken Cord

8. CARE AND STORAGE

8.01 In placing the tester in the case, place the toothed metal disc first. The capacitor and bond should be carried in the lower pocket of the case.

8.02 The B Voltage Tester should be handled and stored with reasonable care. Remove any dampness or dirt with a clean cloth before using or storing. Keep the instrument free of grease or oil to prevent deterioration of insulation.

8.03 Avoid exposing the instrument to excessive heat as the plastic rod may become deformed under high temperatures.

8.04 The instrument should be **carried down and lowered** from poles, **not dropped,** as the impact may short-circuit the elements in the neon glow unit of the indicator.

FABRIC BODY BELTS AND SAFETY STRAPS DESCRIPTION, USE AND MAINTENANCE

1. GENERAL

1.01 This addendum is to add safety precautions in connection with fabric body belts and safety straps.

1.02 With red pencil or ink, make the changes and additions specified in paragraph 2 of this addendum and file in front of CTSP 405-601-303. In the margin of subject paragraphs write the words "See Addendum".

2. CHANGES AND ADDITIONS

2.01 Change paragraph 3.06 to read:

3.06 Body belts should not be worn while working on the ground. For example, do not use body belt to assist in piking poles. If the pike pole should slip down between the belt and the craftsman's body, serious injury could result.

2.02 Add paragraph 3.11 k. which reads:

k. Do not place any metal such as rivets on the body side of a belt.

2.03 Change paragraph 5.02 to read:

5.02 When a body belt and/or safety strap are received, they should be inspected carefully by the employee. At least once each day thereafter, the belt and strap should be examined for any defects that may have developed.

2.04 Change paragraph 5.03 to read:

5.03 The employee's immediate supervisor will inspect all body belts and safety straps monthly.

FABRIC BODY BELTS AND SAFETY STRAPS DESCRIPTION, USE, AND MAINTENANCE

1. GENERAL

1.01 This practice replaces CTSP 405-600-100, CTSP 405-600-603 and CTSP 405-600-604 and is issued to update information on the description, use, and maintenance of fabric (nylon) body belts and safety straps.

1.02 In accordance with the Company's established routine, all body belts or safety straps that have major defects will be *tagged defective,* withdrawn from service immediately, and returned to the storeroom. To prevent reissue or reuse, defective belts and/or straps must be destroyed by being cut into small pieces.

2. DESCRIPTION

2.01 *Body Belt:* The body belt (lineman's tool belt) is fitted with a knife snap, tape thong, ring for utility pouch, four suspension rings, and five leather loops for tools.

2.02 *Safety Strap:* The safety strap is a red centered impregnated nylon strap, 1-3/4 inches wide. It is equipped with pointed drop forged round nose snap hooks and a tongue type buckle. The safety strap is available in two lengths, 7 feet and 9 feet, and is adjustable at 1-inch and 1-1/2-inch increments.

NOTE: Exposure of the red center ply by wear indicates that the strap should be removed from service, as instructed in paragraph 1.02.

3. SAFETY PRECAUTIONS

3.01 When working aloft, a body belt and safety strap shall be worn at all times. They shall be worn when working on poles, cable cars, aerial platforms, truck ladder platforms (when chains are not used), other ladder platforms, and ladders lashed to strand.

3.02 When in use, the safety strap should be adjusted as short as possible to minimize potential falling distance.

3.03 Before climbing a pole, make sure that the tongue of the buckle is properly seated in the desired hole in the safety strap.

3.04 Do not allow a fabric body belt or safety strap to be run over by trucks, trailers, reels, or other heavy equipment.

3.05 Never attach two or more safety straps together for additional length. If one safety strap cannot be lengthened sufficiently, the method of doing the work shall be changed. If tree pruning operations are involved, only a rope sling shall be used.

3.06 Body belts should not be worn while working on the ground. For example, do not use a body belt to assist in piking poles. If the pike pole should slip down between the belt and the craftman's body, serious injury could result.

3.07 Security may be increased by placing the safety strap around the pole at a point directly above a crossarm, strand, pole step, or other secure attachment that will remain in place while work is being performed. Do not place a strap around an insulator pin, bolt, or other insecure attachment. Do not place a strap around a pole within one foot of the top of the pole unless there is a crossarm or cable attachment on the pole *above the strap.*

NOTE: Electric light, power and foreign signal circuit attachments shall never be used as supports for safety straps.

3.08 When either the snap hook or buckle of the safety strap is likely to contact the cable sheath, provision should be made to protect the sheath from damage. This protection may be provided by slipping a cable guard over the cable or by wrapping the cable with muslin or friction tape at the place of contact. See Figure 1.

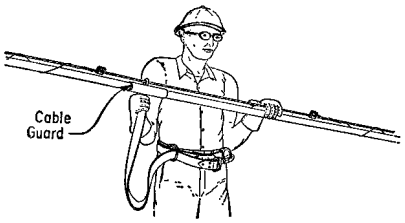


FIGURE 1.

3.09 When a safety strap is placed around a pole, strand, or other support, never engage both snap hooks of the safety strap in the same D ring of the body belt.

NOTE: The body belt buckle and tongue are not designed to carry a craftsman's weight; both D rings must be engaged.

3.10 Make sure that the snap hook and D ring are properly engaged. Do not rely on the feel or the click of the keeper in the snap hook; look and know that the snap hook is properly engaged before placing weight on the safety strap. When engaged in the D ring, the keeper of the snap hook on the safety strap must always be away from the body, as shown in Figure 2.

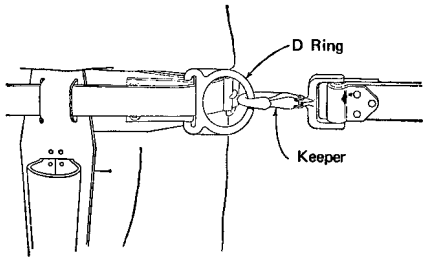


FIGURE 2. View of Craftsman's Right Side

3.11 Additional safety precautions are:

a. Never use an improvised substitute of rope, wire, etc., as a safety strap.

b. Do not punch extra holes in a safety strap.

c. A safety strap should never be used as a means of riding suspension strand.

d. While wearing a safety strap that is not in use, both ends should be snapped into the same D ring. When climbing poles, be very careful that the strap does not catch on pole steps and other attachments.

e. When working aloft, be very careful that the keeper of the snap hook is not accidentally depressed by contact with wires, strand, crossarm braces, guys, and other attachments, or by crossarms, guard arms, cable cars, etc., that may be supported on the safety strap while certain work operations are being performed.

f. When climbing past another employee who has his safety strap in place around a pole, be very careful not to drag climber gaffs over his strap.

g. Avoid swinging rapidly around a pole while wearing a safety strap.

h. Never throw or drop a body belt or safety strap.

i. Do not allow a body belt or safety strap to come in contact with heat by being placed near a furnace, pot of hot solder, torch, or hot soldering copper.

j. Do not stand near a fire while wearing a body belt or safety strap.

[k. Do not place any metal such as rivets on the body side of the belt.]

3.12 Never place or carry tools or materials in the D rings of a body belt; they may prevent the snap hooks from engaging properly or give false indication that they are properly engaged. These items should be carried in holsters or other approved carriers.

3.13 When climbing or working on a pole, do not fasten an uncoiled handline directly to the body belt or to tools carried in the belt. With the handline fastened to the belt, the craftsman could be pulled off the pole if the handline should catch either on an obstruction or a passing vehicle. To allow the handline to pull free of the belt if it should be caught, use one of the following methods to carry or support a handline aloft:

a. Form the end of the handline into a loop and place the loop in the handline carrier.

b. Form the end of the handline into a bight and tuck the bight up under the body belt.

4. USE

4.01 When working on a pole, the following method shall be used to secure the body belt and safety strap:

a. Attach one snap hook to a D ring.

b. Pass the free end of the safety strap around the pole so that the strap rests flat against the pole surface, without turns or twists.

c. Engage the snap hook in the other D ring, making certain that the hooks point outward.

4.02 When working from an extension ladder that is securely lashed to a suspension strand or other support, use one of the following methods to secure the body belt and safety strap. Attach one snap hook to a D ring and either:

a. Pass the free end of the safety strap between two rungs and around one side rail, and engage the snap hook in the other D ring, or

b. Pass the free end of the safety strap around a rung and engage the snap hook in the other D ring, or

c. Pass the free end of the safety strap over the suspension strand so as to loop the strand, and engage the snap hook in the other D ring.

4.03 When working from an extension ladder which is properly placed on the strand but *not lashed,* the following method shall be used to secure the body belt and safety strap:

a. Attach one snap hook to a D ring.

b. Pass the free end of the safety strap around the strand and side rail, between two rungs.

c. Engage the snap hook in the other D ring.

4.04 When working from an aerial platform that is supported by a suspension strand or other support, the following method shall be used to secure the body belt and safety strap:

a. Attach one snap hook to a D ring.

b. Pass the free end across the front of the body, through the other D ring.

c. Engage the other snap hook on the suspension strand. See Figure 3.

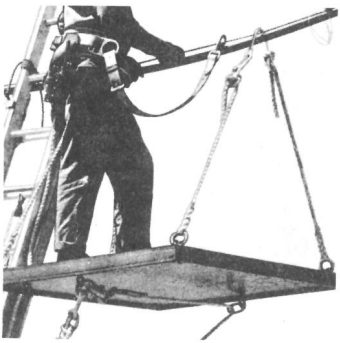


FIGURE 3. Method of Using Safety Strap When Working from Aerial Platform

4.05 When working from a truck platform ladder, the safety strap shall be looped through the platform framework, unless the platform is equipped with safety chains. If safety chains are provided, the chains shall be attached to the D rings of the body belt.

5. INSPECTION AND MAINTENANCE

5.01 It is the responsibility of each employee to determine that his body belt and safety strap are in good condition at all times.

5.02 **When a body belt and/or safety strap are received, they should be inspected carefully by the employee. At least once each day thereafter, the belt and strap should be examined for any defects that may have developed.**

5.03 **The employee's immediate supervisor should inspect all body belts and safety straps monthly.**

5.04 Examine the body belt and safety strap visually. If any of the conditions listed in paragraph 5.05 exist, or if the condition of the belt or strap is such that there is any doubt as to its safety, it should be exchanged immediately. (See paragraph 1.02.) A fabric body belt or safety strap should never be subjected to proof load tests.

5.05 *Visual Inspection of Body Belts and Safety Straps:*

a. The important conditions to look for when inspecting a body belt are:

(1) The condition of the steel reinforcing plates holding the D rings.

(2) The condition of the nylon, especially at the reinforcing plates; determine whether the nylon is worn through or crushed sufficiently to affect its strength.

(3) Loose or broken rivets, particularly those in the loops holding the D rings.

(4) Broken or rotted threads in the stitching.

(5) Cuts that would tend to cause the nylon to tear or affect its strength.

(6) Broken or defective buckle.

b. The important conditions to look for when inspecting a safety strap are:

(1) Worn fabric, as indicated by the ply color. When two outer layers of fabric are worn through, the red ply can be seen and the strap should be removed from service.

(2) Cuts, nicks, punctures, etc., that would affect the strength of the strap. The edges should be carefully inspected.

(3) Loose, broken, or missing rivets; or rivets showing excessive wear.

(4) Broken or badly worn steel guard on the ends.

(5) Defective buckle or snap hook, and poor action of the keeper on the snap hook. The keeper should work freely without excessive side play and should close securely under the spring tension.

(6) If holes for the tongue of the buckle are excessively enlarged, remove the strap from service.

(7) Check for acid burns; a strap that has been in contact with acid shall be removed from service.

(8) Charred spots on the surface of the fabric that might have been caused by flames, contact with hot solder pots, furnaces, hot soldering copper, or heated ducts and pipes. If burns are on the flat surfaces and two or more outer layers are burned through (or the red ply is visible), remove the strap from service. If burns are on the edges of the strap and more than 1/8 inch deep, remove the strap from service.

(9) Broken inner fibers. Defects are usually found in the section at which an injury occurred. Breakage of the inner fibers is indicated by limpness and flexibility of the strap. The strap should be examined in short sections and if a soft, flexible section is found, the strap should not be used.

6. CLEANING

6.01 Remove creosote, paint, oil, grease, tar, etc., from body belts and safety straps using RP-6021 waterless hand cleaner applied directly to the straps; then wipe with a clean, dry cloth.

7. STORING

7.01 The following precautions shall be observed when storing body belts and safety straps, or when they are not in use:

a. Keep the belts and straps away from radiators, stoves, steam pipes, fires, and other places where the fabric would be subjected to excessive heat.

b. A damp or wet strap or belt should not be packed in a locker, tool box, grip, or other container. The belt and/or strap should be wiped with a dry cloth and allowed to dry completely before being stored or packed.

c. A body belt or safety strap should never be stored with tools unless the tools are equipped with satisfactory guards. When body belts, safety straps, and climbers are kept in the same container, the climbers shall be fitted with gaff guards to avoid cutting or puncturing the belt or strap.

d. Store body belts and safety straps in a location free from excessive humidity to prevent mildew.

CLIMBERS
DESCRIPTION, USE AND MAINTENANCE

1. GENERAL

1.01 This addendum is issued to correct references to minimum gaff lengths in paragraphs 5.04 a. (5) and 6.02 f.

1.02 This addendum also provides instructions for measuring gaff length.

1.03 With red pencil or ink, make the changes specified in paragraph 2 of this addendum, or file the addendum in front of CTSP 405-601-310.

SPECIAL NOTE TO ALL I & R FOREMEN OR SUPERVISORS: Please notify all holders of Station Installation manuals of the changes covered in this addendum. Refer to Part I, General Information, to make the changes.

2. CHANGES AND CORRECTIONS

2.01 In paragraph 5.04 a. (5), change the minimum safe length of the gaff from 1-1/8 inches to 1-1/4 inches.

2.02 In paragraph 6.02 f., change the minimum safe length of the gaff from 1-1/8 inches to 1-1/4 inches, and change the paragraph to read:

f. Some gauges are marked to indicate minimum safe length of the gaff (1-1/4 inches). If the gauge is not marked, measure the gaff with a ruler. Gaffs that do not meet this requirement shall be replaced.

NOTE: The difference in the length of gaffs for the same pair of climbers shall not vary more than 1/8 inch.

CLIMBERS
DESCRIPTION, USE AND MAINTENANCE

1. GENERAL

1.01 This practice provides updated information on linemen's climbers, and includes the description, use, maintenance, and safety procedures for climbers and associated items such as pads, straps, gaffs, and gaff guards.

1.02 This practice replaces and incorporates information contained in CTSP 405-600-101 and CTSP 405-600-606, and is numbered to place it in the proper Plant Practice subdivision.

1.03 **Climbers are used for ascending, descending, and maintaining the working position on poles when no other means of support is available.**

2. ADJUSTABLE CLIMBERS–DESCRIPTION

2.01 Climbers that are supplied with the 7-3/16-inch sleeve will adjust from 14-3/4 inches to 18-1/2 inches. A longer sleeve (10-3/16 inches), is also available that will allow adjustment up to 21-1/2 inches. See Figures 1 and 2.

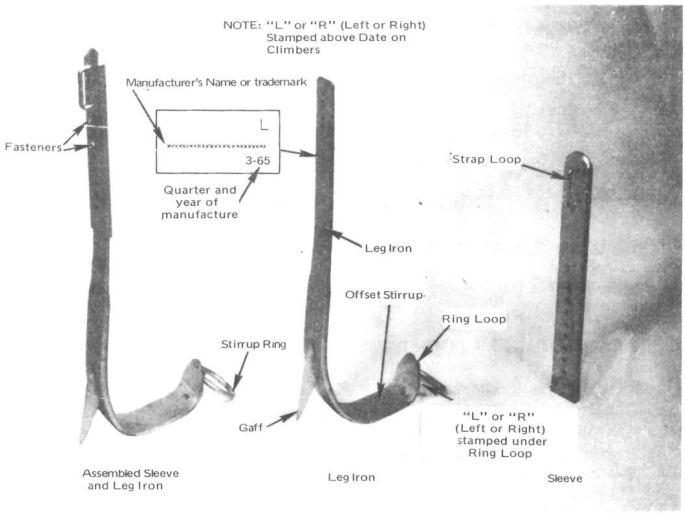


FIGURE 1. Climber

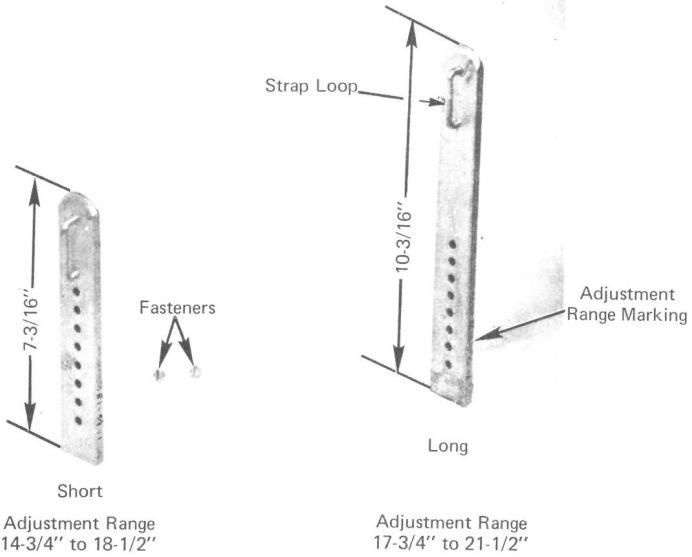


FIGURE 2. Sleeves for Adjustable Climbers

2.02 Adjustments of the sleeve on the shank may be made in increments of 1/4 inch.

2.03 Adjustable climbers are not furnished with straps, pads, or gaff guards; these items must be ordered separately.

3 FITTING ADJUSTABLE CLIMBERS

3.01 Adjustable climbers should be fitted to the legs at the longest comfortable length. Measure the distance from the lower edge of the projecting knee bone to the underside of the shoe at the arch; then subtract 1/2 to 1 inch. See Figure 3.

3.02 After measuring as directed in paragraph 3.01 and Figure 3, assemble the climber by:

a. Sliding the sleeve over the shank and adjusting to the required length.

b. Inserting the locking device from the stirrup side of the shank to secure positioning of the sleeve; then fasten.

NOTE: Shanks shall not be bent to obtain a comfortable fit; use cushion pads. See Figures 4 and 5.

FIGURE 3. Measuring for Climber Length

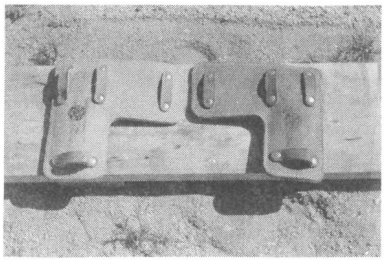


FIGURE 4. Climber Pad

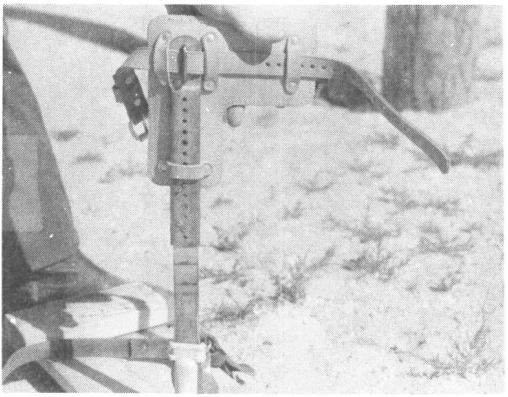


FIGURE 5. Left Leg Climber Pad Installed

4. SAFETY PRECAUTIONS

4.01 The following precautions must be observed when using climbers:

a. When climbing past another employee who has his safety strap in place around the pole, special care should be taken not to gaff him, his safety strap, or other equipment.

b. When climbing past attachments on poles, do not drag climbers or feet against these attachments.

c. Do not use the gaff as a pry.

d. When climbing, do not place the gaff in or near a crack, knot, nail, or tack, etc.

e. Inspect climbers in accordance with paragraph 5.

4.02 Do not wear climbers for work when they are not required, e.g., when walking between poles, when working on the ground, a ladder, a stepped pole where the work can be performed safely from the pole steps, or while traveling in a motor vehicle or any other type of conveyance.

4.03 In cold weather, remove climbers as frequently as work will permit. The metal shanks retain the cold and the straps restrict blood circulation.

4.04 When climbers are not in use, are being transported, or are stored in tool boxes or other storage spaces, they should be equipped with gaff guards. See Figure 6. The gaff guards protect the craftsman, as well as the gaff tips and cutting edges. Guards also prevent damage to safety straps and body belts when stored in the same compartments.

FIGURE 6. Gaff Guard Installed

5. INSPECTION OF CLIMBERS

5.01 Upon receipt of climbers, and at least once a week thereafter, each employee shall inspect his climbers and associated items in accordance with paragraph 5.04.

5.02 Each employee shall make a daily inspection of the climber gaffs to detect nicks or dulled cutting edges. To ensure that climber gaffs are in good condition, they should be tested according to the procedures outlined in paragraph 6.

5.03 Supervisors shall make a periodic inspection of craftsmen's climbers (once a month is recommended).

5.04 Procedures to be followed when inspecting climbers are:

a. If any of the following conditions exist, the climbers shall be tagged defective, returned to the storeroom (for disposal as described in paragraph 8), and exchanged for a pair in good condition:

(1) Fractured gaff or hairline crack.

(2) Loose gaff.

(3) Nicks and depressions in gaff due to impact with a hard object.

(4) Ridge of gaff not straight.

(5) Gaff dull beyond restoration by means of honing or filing; or less than the minimum safe length, i.e., 1-1/4 inches.

(6) Broken or distorted gaff point.

(7) Broken stirrup ring or broken or loose ring loop.

(8) Fractured shank or start of a fracture.

b. If any of the following conditions exist, the defective item shall be replaced:

(1) Fractured sleeve or start of a fracture.

(2) Broken or loose sleeve strap loop.

(3) One layer of fabric worn through on straps; or cuts in straps or enlarged buckle holes that would affect their strength.

(4) Broken or otherwise defective strap buckle.

(5) Broken or otherwise defective clip on foot strap.

(6) Broken or loose rivets on straps or pads.

(7) Broken or torn loop on strap or pad.

(8) Chipped or cracked plastic on gaff guard.

(9) Loose screw or rivet on sleeve.

5.05 Figure 7 shows the ridge of a properly shaped gaff; the ridge is straight.

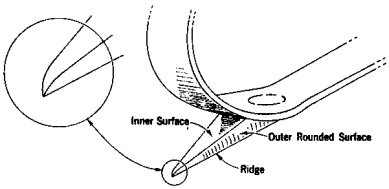


FIGURE 7. Gaff Profile and Point

5.06 Figure 8 shows the properly rounded contour of the outer surfaces on a gaff.

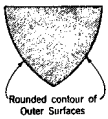


FIGURE 8. Outer Surfaces

5.07 Figure 9 shows that insufficient penetration of the pole will result from a dull gaff.

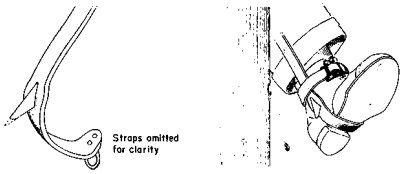


FIGURE 9. Dull Gaff

5.08 Figure 10 shows that ineffective penetration of the pole will result from the ridge not being straight.

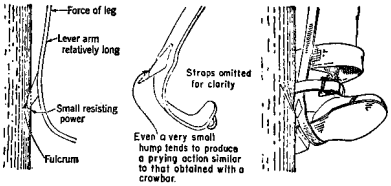


FIGURE 10. Ridge Not Straight

6. TESTING CLIMBER GAFFS

6.01 Climber gaffs shall be tested when received and at least once a week thereafter to ensure that they are properly shaped and sharpened. (Anytime there is doubt about the condition of the gaffs, they should be tested.)

6.02 Use a gaff gauge (see Figure 11) to measure the thickness, width, and length of gaffs:

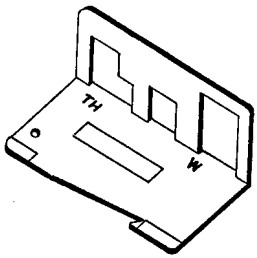


FIGURE 11. Gaff Gauge

a. Insert the gaff as far as possible through the large slot marked TH. The point of the gaff should fall within the line as shown in Figure 12A. This ensures the proper thickness of the gaff approximately 1 inch from the point.

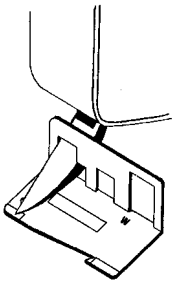


FIGURE 12A.

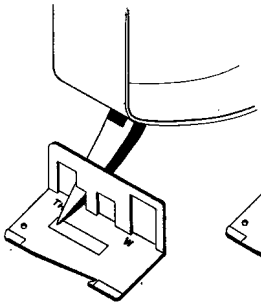


FIGURE 12B.

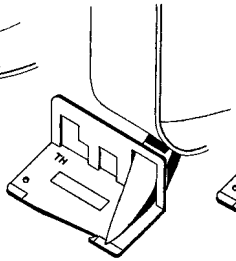


FIGURE 12C.

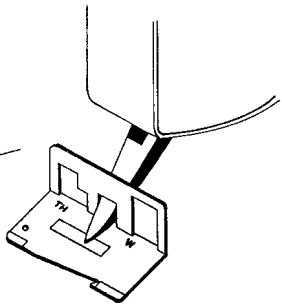


FIGURE 12D.

b. Insert the gaff as far as possible through the small slot marked TH. The point should fall within the two center lines as shown in Figure 12B. This ensures the proper thickness of the gaff 1/2 inch from the point.

c. Insert the gaff as far as possible through the large slot marked W. The point should fall within the line as shown in Figure 12C. This ensures the proper width of the gaff approximately 1 inch from the point.

d. Insert the gaff as far as possible through the small slot marked W. The point should fall within the two center lines as shown in Figure 12D. This ensures the proper width of the gaff approximately 1/2 inch from the point.

e. The small hole in the gauge is used to measure the length of the gaff point. When inserted in this hole, the point should be flush with the other side of the gauge.

f. The gauge is marked to indicate minimum safe length of the gaff (1-1/4 inches). Gaffs that do not meet this requirement shall be replaced.

NOTE: The difference in the length of gaffs for the same pair of climbers shall not vary more than 1/8 inch.

6.03 Gaffs shall also be tested at regular intervals to determine if they are dull or properly sharpened. There are two types of tests:

a. *Cutout Test of Climber Gaffs:*

(1) Place the climber on the leg and fasten the foot strap in the usual manner. Do not fasten the leg strap.

(2) Remove the gaff guard and put on gloves. Place the hand between the leg and the climber pad, palm facing the pole. Place the other hand around the pole for balance. With the leg at about a 30° angle (the normal climbing angle), aim the gaff toward the center of the pole about one foot above the ground line. Lightly jab the gaff in the pole so that it penetrates the wood about 1/4 inch. See Figure 13. Do this at a location where the pole surface is free of cuts.

FIGURE 13. Jabbing Gaff in Pole

(3) Keeping just enough pressure on the stirrup to keep the gaff in the pole (but not enough to cause the gaff to penetrate any deeper), push the climber and hand toward the pole by moving the knee until the strap loop of the sleeve is against the pole as shown in Figure 14.

FIGURE 14. Climber Holding

(4) Make sure the strap loop is held against the pole with pressure from the leg, and *gradually* exert full pressure straight down on the stirrup/ without raising the other foot off the ground (this will maintain balance if the gaff does not hold).

(5) A gaff which is correctly shaped and sharpened will cut into the pole and hold in a distance of 2 inches or less. Measure the cut from the point where the gaff enters the pole to the bottom of the cut at the surface of the pole. See Figure 15. A gaff that is properly shaped but dull or burred will cut in and hold; however, the length of the cut will be more than 2 inches. A gaff that is very dull or deformed in some way will cut out of the pole or plow through the wood for a distance greater than 2 inches. Do not use climbers that cut out or plow through the wood for a distance greater than 2 inches. If the climber gaff is dull, sharpen as directed in paragraph 7.01; then repeat the cutout test.

FIGURE 15. Measuring Gaff Cut

b. *Plane Test of Climber Gaffs:*

(1) Place the climber on a soft pine or cedar board as shown in Figure 16, with the point of the gaff and the loop strap resting against the wood surface. Hold the stirrup of the climber in a vertical position, without exerting any downward pressure, and slide the climber along the wood by pushing forward on the leg iron. If the climber is properly sharpened, it will dig into the wood and begin to hold within a distance of approximately one inch.

(2) If the climber gaff slides along the surface of the wood without cutting and leaves only a line or mark on the wood as shown in Figure 17, the point has not been properly sharpened or the outer surface of the gaff is deformed.

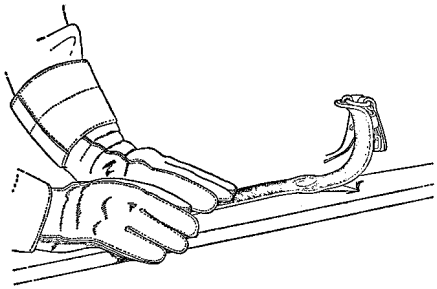


FIGURE 16.

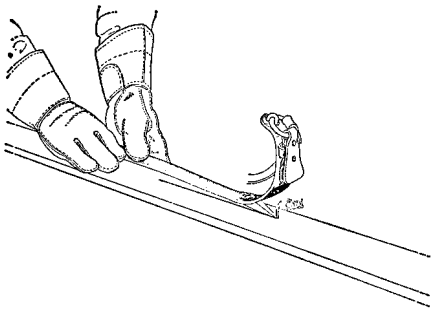


FIGURE 17.

7. MAINTENANCE OF CLIMBERS

7.01 Climber gaffs shall be maintained in a sharpened condition at all times. Use the following procedure for sharpening gaffs:

a. Place the climber in a bench vise with the point of the gaff facing outward and the outer ridge facing downward. Protect the shank by placing wooden blocks between the vise jaws and the shank.

b. Use an approved mill file and work with short strokes. File from the heel toward the point to sharpen the cutting edges. The point of the gaff should then be rounded back approximately 1/4 of an inch. See Figure 18.

NOTE: The straight outer ridge of the gaff is not a cutting edge and should not be filed.

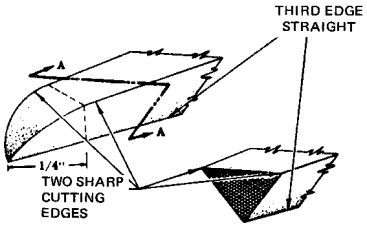


FIGURE 18. Rounding Off Gaff Point

c. If it is necessary to remove any of the outside of the gaff, file from the heel to the point down the sides to retain the original shape. See Figure 19.

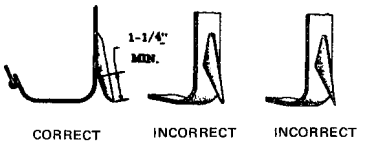


FIGURE 19. Correct and Incorrect Filing of Gaff Point

d. A sharper edge can be obtained on each of the two cutting edges by using a honing stone instead of a file.

NOTE: While using a honing stone, keep the stone well oiled with light machine oil to prevent clogging the stone.

e. If there are any small burrs along the cutting edge, remove them first by holding the stone against the side of the gaff and *carefully following the edge around to the tip.*

f. Hone the inner surface of the gaff by starting the stroke near the shank and continuing over the rounded curve of the tip. To prevent dulling the tip, stop the honing stroke before the stone slides off the end of the gaff. About 20 to 25 strokes of the stone should be sufficient. *Do not attempt to reshape the tip of the gaff.*

7.02 Pads should be maintained clean and pliable for maximum comfort. The following procedures are recommended:

a. About every three months clean the pads with a damp sponge, using a neutral handsoap.

b. With the sponge and clean water, work up a lather using a good grade of saddle soap. Work the lather well into the pad and place the pad in the shade to dry. When the pad is almost dry, rub the leather vigorously with a soft cloth.

c. About every six months, instead of dressing the pads with saddle soap as described in b., clean as in a., and while the leather is still damp apply about 1/2 teaspoon of neat's-foot oil on the loop side of the pad. Apply oil gradually with the hands, using long light strokes to work it into the leather. After oiling, allow the pads to dry overnight and then rub vigorously with a soft cloth to remove any excess oil.

8. DISPOSAL OF DEFECTIVE CLIMBERS

8.01 Under no circumstances shall climbers that have been returned marked *defective* be placed where they might be reissued or reused.

8.02 Prior to disposal of defective climbers, storeroom personnel shall make them useless by *cutting the stirrups in two pieces.*

LEATHER BODY BELTS AND SAFETY STRAPS CARE AND MAINTENANCE

CONTENTS

1. GENERAL

1.01 This practice is reissued to provide additional information on the inspection of body belts and safety straps. It also provides information on maintenance, storing, testing and fitting. **Remove from the file and destroy all copies of CTSP 405-601-601, Issue 1, 1971.**

1.02 The portions of this practice enclosed in brackets [ ] indicate additions and/or revisions.

1.03 Refer to CTSP 405-601-303 for the description, use and maintenance of fabric body belts and safety straps.

1.04 In accordance with the Company's established procedure, all body belts or safety straps that have major defects will be **tagged defective,** withdrawn from service immediately, and returned to the storeroom. To prevent reissue or reuse, defective belts and/or straps must be destroyed.

2. INSPECTION

2.01 It is the responsibility of each employee to determine that his body belt and safety strap are in good condition at all times.

2.02 When a body belt and/or safety strap are received, they should be inspected carefully by the employee. At least once each day thereafter, the belt and strap should be examined for any defects that may have developed.

2.03 The employee's immediate supervisor will inspect all safety straps and body belts monthly.

2.04 Visually examine the safety strap and body belt. If any of the conditions in paragraph 2.05 exist, or if the condition of the strap or belt indicates a safety hazard, it should be exchanged immediately (see paragraph 1.04).

2.05 Visual Inspection of Safety Straps and Body Belts: The important conditions to observe when inspecting a leather safety strap and/or leather body belt are:

a. Cracks, cuts or nicks (particularly cuts or tears on the edges of the straps) that would tend to cause the leather to tear or that might affect the strength of the straps.

[**CAUTION: No extra holes should be punched into the tongue of the body belt or safety strap.**]

b. Broken or rotted threads in the stitching.

c. Broken or defective buckle.

d. Broken or badly worn steel guard on ends of a safety strap.

e. Broken wrench keeper on a body belt.

f. Loose or broken rivets on leather tool holster.

g. Loose or broken rivets, particularly those in the loops holding the D rings.

h. Broken or rotted threads in the stitching of the loops holding the D rings.

[**i.** Metal, such as rivets, exposed on body side of belt.]

j. Poor action of keeper on the snap hook. (The keeper should work freely without excessive side play and should close securely under the spring tension.)

k. Hard or dry leather. (If all the strap requires is oiling, the leather should be treated as instructed in paragraph 3.04.)

l. Burnt leather (see paragraph 2.06).

[**m.** Leather worn thin. If none of the above conditions exist in the strap, it may be used until it is worn to a thickness of not less than 1/8 inch in any portion. Figure 1 indicates a method of measuring the thickness of leather.]

[**n.** Modifications of belt or strap such as the addition of wire hooks.]

2.06 Leather with hard spots, a curved set, or a burnt streak across the face may have become burnt or cooked by being subjected to excessive heat. This may have occurred as a result of:

a. Placing the belt against or near hot steam pipes, radiators, or heaters.

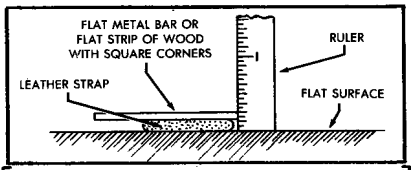


FIGURE 1. Method of Measuring Thickness of Leather

b. Placing the belt near a pot of hot solder, hot soldering copper, or a splicer's furnace.

c. Standing near a fire with the safety strap suspended from the body belt.

NOTE: Burn marks, hard spots, crystallized or brittle leather, or a curved set to the belt, are visual indications that a body belt has been subjected to excessive heat.

3. MAINTENANCE

3.01 Leather body belts should be cleaned and dressed at 3-month intervals. If a belt has been wet frequently from rain or perspiration, or has been in contact with wet paint, clean at shorter intervals. Leather body belts should be cleaned as follows:

a. Remove surface dirt with a sponge dampened (not wet) with water. Do not use gasoline or petroleum products; they will cause the leather to become dry.

b. Rinse the sponge in clear water and squeeze partly dry. Work up a thick lather using a neutral soap, such as castile or white toilet soap (free from alkali).

c. Thoroughly wash the entire length of the belt with a lathered sponge to remove embedded dirt and perspiration, and wipe with a cloth to remove excessive moisture.

d. Repeat step b. using a good grade of saddle soap.

e. Work the saddle soap lather well into all parts of the belt and place it in the shade to dry.

f. When the leather is almost dry, rub vigorously with a soft cloth.

3.02 Paint ingredients have a harmful effect on leather. Therefore, wet paint must be promptly removed from body belts with a dry cloth.

3.03 Creosote is not harmful to leather, but to avoid clothing stains it should be removed from the body belt as soon as possible.

3.04 Oiling: Treating the leather in body belts with saddle soap (paragraph 3.01) will normally keep the belt soft and pliable. However, to keep the leather from drying out and becoming brittle, leather body belts should be oiled approximately every 6 months as follows:

a. Clean the leather with a neutral soap as instructed in paragraph 3.01 b. Oil applied to dry or dirty leather has a harmful effect on the leather.

b. While the leather is still damp, use about 1/4 ounce (two teaspoonsful) of neat's-foot oil and apply the oil gradually with the hands, using long light strokes to work it into the leather. A light, even distribution of the oil is desired.

c. After oiling, the belt should be set aside in a dry, shady place for about 24 hours to permit the leather to dry slowly. When the leather is dry, vigorously rub the belt with a soft cloth to remove excess oil.

NOTE: Do not use mineral oils or greases such as machine oil or vaseline. Leather should never look or feel greasy; this is an indication that too much oil is being used. Leather with too much oil will stretch and is likely to pick up sand or grit which may injure the leather.

4. STORING

NOTE: If a body belt with insufficient oil is received, it should be oiled as instructed in paragraph 3.04.

4.01 When not in use, body belts should be oiled at least once every 6 months. The belt should be oiled 3 months after it has been received for stock, and at intervals no longer than 6 months thereafter as long as it remains in stock.

4.02 Never store or place body belts near radiators, stoves, steam pipes, or in places where the leather would be subjected to excessive heat or dampness. Belts that have become wet should be oiled and then set aside in a dry, shady place and allowed to dry slowly.

5. BENDING TEST

5.01 The bending test should be made on body belts only when the leather is clean and well oiled. The leather should show no cracks other than slight surface cracks when the test is applied. If well defined cracks appear, the belt must not be used, but should be taken out of service.

5.02 Do not make the bending test if the temperature of the leather is below 32°F.; at low temperatures the leather may be damaged by bending it around the test mandrel.

5.03 The bending test should be made as follows:

a. Leather should be bent with the grain (smooth) side out, over a mandrel that is not less than 3/4 inch in diameter. (A 3/4-inch guy rod may be used.) In making this test, pull the leather taut, and wrap it halfway around the mandrel, keeping the leather under tension while the bend is being made. **Do not loop the leather first and then pull it over the mandrel.** This procedure brings the leather into firm contact with the mandrel while the bend is being made, and thus avoids bending the leather too sharply.

NOTE: Do not make the bend test at a buckle hole.

b. Body belts shall be subjected to the bending test at points where it is possible to bend them, such as under the leather tool loops and at the tongue strap.

5.04 If a body belt is subjected to an excessively severe test, such as bending it too sharply (without a mandrel or over too small a mandrel) with the grain side out, the leather may crack because of the excessive strain placed on the grain layer.

6. FITTING BODY BELTS

6.01 The degree of comfort and satisfactory service an employee obtains from a body belt depends, to a large extent, on the location of the D-rings with respect to the prominent portions of the hip bones. Most workers prefer to have the D-rings located slightly in front of the prominent portions of the hip bones. To obtain a properly fitting belt, measure the distance across the back to the desired locations of the D-rings, and order a belt of the size that comes nearest to this dimension. See CTSP 490-025-110, paragraph 2.03.

WOOD BORING BITS AND DRILLS
USE AND MAINTENANCE

1. GENERAL

1.01 This practice replaces CTSP 405-600-605 and provides instructions for the use and maintenance of standard wood boring bits and drills. This practice includes safety precautions to be observed in the use of wood boring bits and drills.

2. STANDARD WOOD BORING BITS

2.01 The standard wood boring bits for telephone use are *auger* bits, *ship auger* bits, *insulator pin* bits and *expansive* bits. The sizes are shown in the following paragraphs. Although a complete list of bits is covered, it is suggested that each employee select only those that have been approved for use in the area and which are required for use in his work. The size of a bit can be readily selected from a kit of bits by the "number" impressed in the shank of the bit. This number indicates the diameter of the bit in sixteenths of an inch. Number "3" indicates a 3/16-inch diameter bit.

2.02 *Auger Bit:* This bit consists of a solid center twist provided with a head containing a single cutter, a single spur, and a lead screw, the threads of which are 14 per inch on the three smaller sizes and 12 per inch on the remaining sizes. See Figure 1.

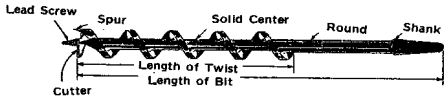


FIGURE 1. Auger Bit.

2.03 Fifteen sizes of *auger bits* are covered, ranging in size from 1/4-inch to 1-inch diameters in increments of 1/16-inch, and from 1-inch to 1-1/4-inch diameters in increments of 1/8-inch. The overall lengths range from 7-1/2-inches to 9-1/4-inches in increments of 1/8-inch. These bits are intended for general use in boring all kinds of wood where the hole depth does not exceed 4 inches for the smaller sizes of bits or 5 inches for the larger sizes of bits. In addition, the bits listed have the following specific uses:

TOOL	OVERALL LENGTH (INCHES)	DESIGNATING NUMBER	SPECIFIC USES
1/4-Inch Auger Bit	7-1/2	4	Inside wiring and installation work.
3/8-Inch Auger Bit	7-3/4	6	Inside wiring, installation work and boring holes in cedar and similar wood poles for pole steps. Also for boring holes when testing poles for hollow heart.
7/16-Inch Auger Bit	7-7/8	7	Boring holes for 3/8-inch bolts used in attaching braces to terminal boxes and crossarms.

Distribution C D E F

TOOL	OVERALL LENGTH (INCHES)	DESIGNATING NUMBER	SPECIFIC USES
1/2-Inch Auger Bit	8	8	Boring holes in chestnut, creosoted pine and similar wood poles for pole steps.
9/16-Inch Auger Bit	8-1/8	9	Boring holes for 1/2-inch bolts used in attaching back braces and vertical braces to crossarms and for 1/2-inch guy rods where the maximum thickness of the pole does not exceed 5 inches.
5/16-Inch Auger Bit	7-5/8	5	
5/8-Inch Auger Bit	8-1/4	10	
11/16-Inch Auger Bit	8-3/8	11	
3/4-Inch Auger Bit	8-1/2	12	
13/16-Inch Auger Bit	8-5/8	13	For general use where
7/8-Inch Auger Bit	8-3/4	14	there is occasional need
15/16-Inch Auger Bit	8-7/8	15	for bits of these sizes.
1-Inch Auger Bit	9	16	
1-1/8-Inch Auger Bit	9-1/8	18	
1-1/4-Inch Auger Bit	9-1/4	20	

NOTE: Number indicates the diameter of a bit in sixteenths of an inch.

2.04 *Ship Auger Bit*—This bit consists of either a solid center or a hollow center twist provided with a head containing a single cutter, a single spur and a lead screw having 12 threads per inch. The solid center twist type of construction bit is similar in design to the auger bit. Figure 2 illustrates the hollow center type.

2.05 Nine sizes of *ship auger bits* are covered ranging from 3/8-inch to 1-5/16-inches in diameter, being available in lengths of 12 inches and 18 inches which are suitable for boring holes to depths of approximately 8 inches and 12 inches respectively. These bits are intended for boring holes through poles, stubbing, building beams, etc.

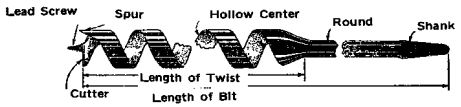


FIGURE 2. Ship Auger Bit.

TOOL	DESIGNATING NUMBER	SPECIFIC USES
3/8-Inch X (*) Inch (**) Center Ship Auger Bit	6	For boring holes through wood for a pair of inside wires. Where practicable a bell hanger bit should be used for holes of this diameter.
1/2-Inch X (*) Inch (**) Center Ship Auger Bit	8	For boring holes through wood for two pairs of inside wires.
11/16-Inch X (*) Inch (**) Center Ship Auger Bit	11	For boring holes through poles for standard 5/8-inch bolts (crossarm, stubbing, cable suspension, eye and machine bolts for deadending strand) and 5/8-inch guy rods.
3/4-Inch X (*) Inch (**) Center Ship Auger Bit	12	For boring holes through wood to a depth of 9-1/2 inches for deadending strand.
13/16-Inch X (*) Inch (**) Center Ship Auger Bit	13	For boring holes through poles for standard 3/4-inch eye bolts and machine bolts for deadending strand and for boring for 3/4-inch guy rods.
7/8-Inch X (*) Inch (**) Center Ship Auger Bit	14	For boring holes through wood to a depth of 10-1/2 inches for cable suspension.
1-1/16-Inch X (*) Inch (**) Center Ship Auger Bit	17	For boring holes through poles for standard 1-inch eye bolts and machine bolts for deadending strand and for boring for 1-inch guy rods. Also for boring holes for loading coil case supports.
1-1/4-Inch X (*) Inch (**) Center Ship Auger Bit	20	For boring holes through wood to a depth of 11-1/2 inches through building beams, etc.
1-5/16-Inch X (*) Inch (**) Center Ship Auger Bit	21	For boring holes through poles for 1-1/4-inch guy rods.

*NOTE: * 12 or 18 depending on the length desired.*
***Hollow or solid depending on the type adopted by the company.*
Designation number indicates the diameter of a bit in sixteenths of an inch.

2.06 The *ship auger bits* are tempered the entire length to prevent the bits being bent when side pressure is applied. The twists are ground and polished to the required dimensions to permit the chips to travel out through the spiral groove without turning and wedging

between the outer edges of the bit and the side of the hole, which would cause the chips beyond that point to pile up and clog the groove of the bit. The cutter of the bit is diametrically opposite the spur, which facilitates sharpening the bit.

2.07 *Insulator Pin Bit:* This bit consists of a solid center twist provided with a head containing a single cutter, a single spur and lead screw having 12 threads per inch. The length of the bit has been limited to 6-7/8 inches to permit operating the brace between crossarms having standard spacing. See Figure 3.

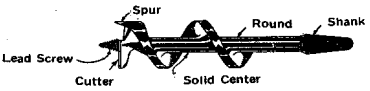


FIGURE 3. Insulator Pin Bit.

2.08 There are two sizes of bits which are intended for the following uses:

TOOL	DESIGNATING NUMBER	SPECIFIC USES
11/16-Inch Insulator Pin Bit	11	Intended for boring holes in crossarms for steel insulator pins and 5/8-inch bolts used in attaching break irons
1-1/4-Inch Insulator Pin Bit	20	Intended for boring holes in crossarms for respacing wooden insulator pins

NOTE: Designation number indicates the diameter of a bit in sixteenths of an inch.

2.09 *Expansive Bit*—This bit consists of a bit shank and round, terminating in a slotted head having a lead screw. The threads are 18 per inch and are provided with a cutter secured to the head with an adjusting clamp and screw. It is available in two sizes, large and small. Each size is furnished with a large and small adjustable cutter, both of which carry scales graduated in 1/32 of an inch to furnish adjustment to 1/16 of an inch on the diameter. The overall lengths of the large and small bits are 9-1/4 inches and 7-5/8 inches, respectively. The small bit has a 1/2-inch diameter head and bores holes from 1/2 inch to 7/8 inch, and 7/8 inch to 1-1/2 inches in diameter depending on whether it is equipped with a small or large cutter. The large bit has a 7/8-inch diameter head and bores holes from 7/8 inch to 1-3/4 inches, and 1-3/4 inches to 3 inches in diameter depending on whether it is equipped with a small or large cutter. See Figure 4.

2.10 Expansive bits are intended for boring holes through boards, where it is desired to cover a wide range of hole diameters with a minimum number of bits (an example of which is boring holes through terminal boxes for cable entrances).

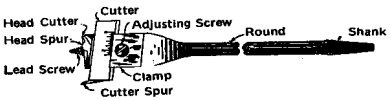


FIGURE 4. Expansive Bit.

FIGURE 5. Installer's Drill. (Bell Hanger Bit)

3. STANDARD INSTALLER'S DRILLS (BELL HANGER BITS)

3.01 The installer's drill (Figure 5) consists of a bit stock shank and long round provided with a short twist drill. The drill point is ground at an angle suitable for drilling in wood in which nails, screws, sheet metal or metal lath may be encountered as well as drilling through plaster walls. It is available in 5 sizes ranging by 1/8 of an inch from 1/4 inch to 3/4 inch in diameter. In general, the size of the drill is impressed on the round in thirty-seconds of an inch. All sizes, as listed below, are intended for boring holes where a variety of conditions may be encountered in connection with inside wiring and installation work.

TOOLS	DESIGNATING NUMBER
1/4-Inch by (*) Inch Bell Hanger Bit	8
3/8-Inch by (*) Inch Bell Hanger Bit	12
1/2-Inch by 18-Inch Bell Hanger Bit	16
5/8-Inch by 18-Inch Bell Hanger Bit	20
3/4-Inch by 18-Inch Bell Hanger Bit	24

*NOTE: *18, 24, or 30 depending on the length desired.*
Designating number indicates the diameter of the drill in thirty-seconds of an inch.

3.02 All installer's drills are provided with a hole through the web of the drill to facilitate fishing wires through the bored hole at the time it is withdrawn.

4. USING BITS AND DRILLS

4.01 Bits and drills will give the best service if they are kept in good repair. If a bit or drill requires pushing on the brace head to cut the wood, the indications are that it is in need of repair. *Never strike the brace with a hammer to start boring with a bit or drill.*

4.02 With bits, the appearance of the chip is an indication of the cutting edge and outlining spur condition. A clean-cut chip means a sharp cutter. A mangled or shredded chip usually means a dull cutter. A bit which does not feed itself properly may be in need of screw point repairs. A bent bit turns hard and ultimately binds, preventing further entrance in the hole. If the chips pile up in the hole, clearance may be too great or the bit may be covered with gummy material or rust. Difficulty of this nature may, however, be experienced when boring cedar poles especially those containing either pipe rot or checks. These conditions are similar to striking another hole, which permits the chips to drop and turn in the spiral groove. As a result, some of the chips tend to wedge between the outer edges of the bit and the side of the hole causing the chips beyond this point to pile up and clog the opening of the twist. There appears to be no way of overcoming this trouble so it will be necessary for employees working on cedar poles to clear the holes during the boring operation when required.

4.03 Before boring through siding, clapboard, panels, thin boards, etc., particularly if the hole is to be located near the end of the board, drill a lead hole in a diameter slightly less than the diameter of the lead screw with the standard automatic drill as a means of reducing the possibility of splitting the wood.

4.04 In general, a hole can be bored completely through the wood without cleaning the hole. After the bit has passed completely through the hole, clear the hole by hitting the head of the brace with the palm of the hand until the bit passes through for three or more inches. Then remove the bit by turning it counterclockwise and pulling on the head until

it is all the way out. Pulling the bit without turning it out may cause the loss of balance and result in an accident. If the bit turns hard making it necessary to clear the hole before completing the boring operation, back the bit out until the screw point is loose and then pull on the head of the brace and at the same time turn the brace clockwise until most of the chips have worked their way out of the hole.

4.05 If a nail or other piece of metal is encountered while boring with a bit, immediately back the tool out to clear the metal and then clean as described above. If the size of the hole permits, remove the obstruction with a cold chisel, and then proceed with the boring. Obstructions in small diameter holes will necessarily have to be bored through with an installer's drill.

4.06 Bits, particularly the expansive bits, have a tendency to break out the wood around the bottom of the hole when completing the boring operations. This can be overcome by firmly backing up the location of the hole with a small block of wood until the bit has passed completely through the hole being bored. This practice should be followed wherever practicable.

4.07 If the cutting edges of an installer's drill are dull, the boring will be difficult. If the edges are not of equal length, a hole larger in diameter than desired is obtained. If the cutting edges do not form a uniform angle with the axis of the drill, only one side will do the cutting. If the cutting edges of the drill have not been backed off sufficiently to provide the proper clearance or the web is too thick, considerable pressure will be required on the brace head to remove only a small amount of wood. When using an installer's drill in solid wood, the hole should be cleared of chips every 10 to 15 turns.

4.08 Bits or drills should not be placed or left on a highway, sidewalk, or property accessible to the public where they or vehicles may be damaged, or where they may constitute a potential hazard to persons or livestock.

4.09 When carrying a bit or drill, always direct the point away from the body and hands.

4.10 Before boring a hole, make certain that there is no obstruction (gas, water, or soil pipe) in the bit or drill path and that it does not come in contact with foreign wires or fixtures. Observe the direction of the lag bolts holding foreign wire pole attachments and obtaining clearance for the through bolt. Bear in mind that walls or other locations may conceal wires, pipes, or sliding doors.

4.11 When stationed on the opposite side of a partition, pole, etc., observe where the bit or drill is coming through. Assume a safe position so there is no chance of injury from the bit or drill suddenly projecting through the wall, pole, etc.

4.12 When boring a deep hole, sight along the bit after it has been started to determine if it will terminate at the desired location.

5. TRANSPORTING AND STORING BITS AND DRILLS

5.01 At all times, take proper care of bits and drills so that they will give satisfactory service and that injury or damage will not result from an exposed point or cutting edge. Bits and drills should be placed in tool rolls, racks or pockets of trucks or tool chests provided for protection purposes.

5.02 New bits and drills should be left in the original container until required for use. If the container is broken and it appears advisable to remove either the bits or drills from the

container or if bits or drills are returned from the field for storage, they should be placed on the shelves with the points facing the back of the shelf.

6. INSPECTION ROUTINE

6.01 Each employee should at all times assume the responsibility for determining that the bits and drills in his possession are in good condition.

7. INSPECTION OF WOOD BORING BITS AND DRILLS

7.01 Bits and drills should be examined to determine their condition as suggested below. In connection with the inspection of bits, the important conditions to look for are:

a. *Auger Bits, Ship Auger Bits and Insulator Pin Bits.*

(1) Broken screw point or threads badly marred.

(2) Dull spur or edge badly nicked or bent.

(3) Spur lower than cutting edge.

(4) Dull or badly nicked cutting edge.

(5) Twist of bit bent.

(6) Round of bit bent.

(7) Shank marred or rounded.

b. *Expansive Bits.*

(1) Broken screw point or threads badly marred.

(2) Dull or bent spur or edge badly nicked.

(3) Spur lower than cutting edge of head.

(4) Dull cutter spur or edge badly nicked.

(5) Top of cutter spur lower than cutting edge of cutter.

(6) Dull or badly nicked cutting edge of head.

(7) Dull or badly nicked cutting edge of cutters.

(8) Round of bit bent.

(9) Shank marred or rounded.

(10) Threads of adjusting screw stripped and slot badly marred.

c. *Installer's Drills (Bell Hanger Bits).*

(1) Dull cutting edges or edges badly nicked.

(2) Cutting edges of unequal length and angle formed with the axis of the drill not uniform.

(3) Insufficient clearance back of cutting edge.

(4) Twist broken, bent or less than 2 inches in length.

(5) Round of drill bent or broken.

(6) Shank marred or rounded.

7.02 If tools for repairing bits and drills have not been provided for that purpose and any of the above conditions are found to exist or if the condition of the bits and drills is such that they do not appear satisfactory from a safety standpoint, they should be exchanged at once for bits and drills in good condition.

7.03 If tools have been provided for repairing bits and drills and if any of the above conditions that warrant repairing are found to exist, they should be maintained in accordance with paragraphs 9 and 10.

8. TOOLS REQUIRED FOR MAINTAINING WOOD BORING BITS AND INSTALLER'S DRILLS (BELL HANGER BITS)

8.01 The following tools are required for maintenance of bits and drills as covered in this practice.

TOOL	USE
File, Auger Bit, 7-Inch	For use in sharpening screw point spur and cutter.
File, Lineman's	For use in dressing shank.
File, Round, Second Cut, 5-Inch	For use in thinning web of drill.
Hammer, Claw, 1-1/2 lb.	For use only in straightening the round of a drill or bit.
Hammer, Riveting, 7 oz.	For use in straightening the outlining spur.
Mallet, Wooden	For use in straightening the round and the twist of a drill or bit.
Paper, Abrasive, Fine	For use in polishing bad rust spots on the shank, center and twist of bits or drills.
Rag, Oily	For treating bits and drills to prevent rusting.
Rule, 2 ft. or 6 ft.	For use in determining the angle of the cutting edge of the drill.

9. MAINTAINING WOOD BORING BITS

9.01 The following maintenance methods have been found satisfactory for use by field forces. The illustrations cover the position for a right-handed man.

a. *Maintaining auger bits, ship auger bits, and insulator pin bits.*

(1) *Resharpening Screw Point*—The threads of the screw point should not be resharpened unless very dull or badly marred. To restore the threads, rest the bit on the edge of a supporting wood surface with the screw pointing upwards. Place an edge of auger bit file on the bottom of the thread near the cutting edge. Revolve the bit slowly and at the same time file the thread using short, light strokes. Continue this until the point of the screw is reached. See Figure 6. A screw point with the initial threads badly marred or broken off should be repointed with a file. If too blunt a point is obtained to take a hold in the wood, the bit is to be returned for a new one.

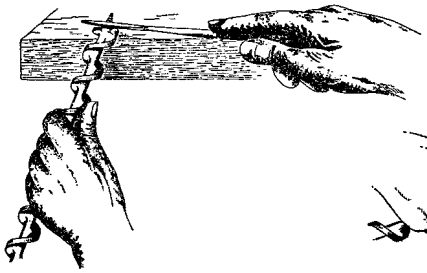


FIGURE 6.

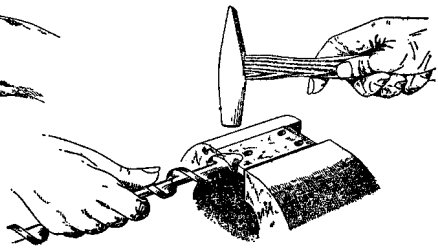


FIGURE 7.

(2) *Restoring Bent Spur*—If the spur of a bit has been bent, it should be straightened with a light hammer such as a riveting hammer as shown in Figure 7. If after straightening the spur the cutting edge appears to be jagged or rolled, the outside surface near the cutting edge may be "touched up" with a file.

(3) *Resharpening Spur*—Hold the bit against a wood support with the point up and then place an auger bit file on the inside of the spur on the front edge which performs the cutting. Sharpen this cutting edge by pressing lightly on the file and keeping it at an angle that will limit the amount of metal removed. See Figure 8. Except for "touching up", never file the outside of the spur as this destroys the clearance and causes the bit to bind or stick. The foremost edge of the outlining spur must extend beyond the cutting edge for efficient boring. If such is not the case, the bit should be returned for a new one.

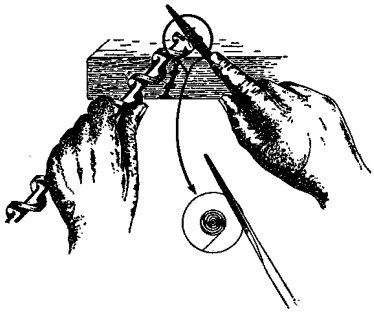


FIGURE 8.

(4) *Resharpening Cutter*–Hold the bit in the left hand with the point down, resting the top of the screw point against the edge of a bench or other suitable support so that the cutting edge is parallel with the edge of the bench or other support. Using light strokes, sharpen the cutting edge to a straight line with an auger bit file, keeping the bevel practically the same as it was when the bit was new. See Figure 9.

(5) *Straightening Bit*–To straighten a bit, bore a hole to the depth of the bend in a solid timber that has a direction opposite to the bend of the bit until the distance traveled is sufficient to remove the bend. If available, a vise may be used for holding the bit. The bit should be protected from injury by placing solid pieces of wood between the sides of the bit and vise jaws. If the bit remains slightly bent, it may be straightened by placing it on a solid, flat, wooden surface and tapping it lightly with a smooth faced wooden mallet or a hammer on the side opposite the bend. This method should also be used for sprung or slightly bent bits. See Figure 10. A badly bent bit that cannot be straightened by these methods in a reasonable time should be exchanged for one satisfactory for use. To determine whether a bit is straight, lay it on a flat surface, then roll it. If it rolls evenly it is straight.

(6) *Squaring Shanks*–Shanks with slightly rounded edges may be squared by filing the flat faces with a lineman's file. See Figure 11. If the shank bit edges are rounded to the extent that the brace chuck will not hold the bit after being filed, it should be exchanged for one satisfactory for use.

b. *Maintaining Expansive Bit.*

(1) *Resharpening Screw Point*–Maintain in accordance with paragraph 9.01 a. (1).

(2) *Restoring Bent Spur*–Maintain in accordance with paragraph 9.01 a. (2).

(3) *Resharpening Head and Cutter Spur*–Maintain in acordance with paragraph 9.01 a. (3).

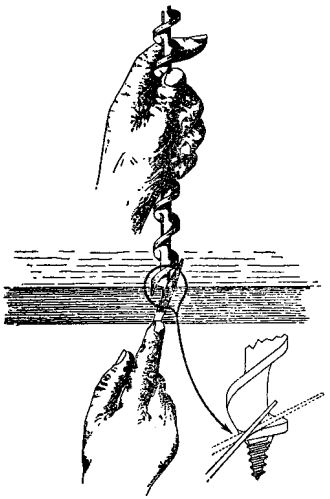


FIGURE 9.

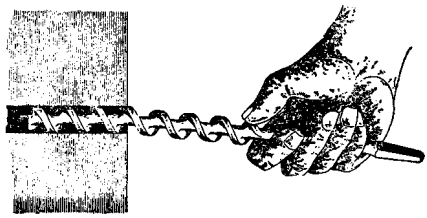


FIGURE 10.

(4) *Resharpening Head Cutter*–Hold the bit with the left hand resting on a solid surface as shown in Figure 12. With an auger bit file, sharpen the cutting edge to a straight line keeping the bevel the same as it was when new.

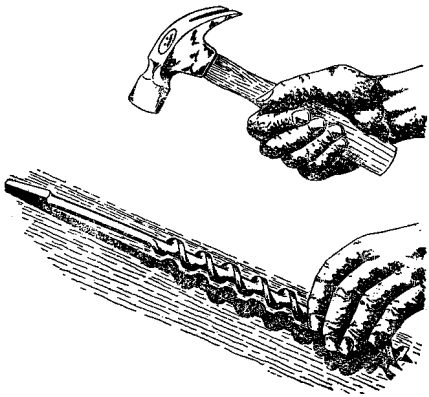


FIGURE 11.

(5) *Resharpening Edge of Cutter*–Move the cutter out to the maximum size hole that the bit is used for. Hold the bit in the left hand with the point up and back of the cutter, resting on a solid support as shown in Figure 13. With an auger bit file, sharpen the cutting edge using light strokes keeping the bevel the same as it was when new. Test the edge by drawing a small stick of wood across the cutting edge. If a sliver of wood is easily removed, the cutting edge is satisfactory for use.

(6) *Squaring Shank*–Maintain in accordance with paragraph 9.01 a. (6).

9.02 Moisture from the hand, as well as that found at seashores and in foggy territories or sap from green timber, etc., may occasionally cause rust spots to appear on a bit. To prevent this, the bit should be wiped with an oily rag. Fine abrasive paper may be used to polish bad spots on the shank, round or twist of bits. Such material, however, should not be applied to any cutting edge, spur, or screw.

10. MAINTAINING INSTALLER'S DRILL (BELL HANGER BITS)

10.01 In general, drills should be returned to the storeroom for resharpening where the work is performed on an abrasive wheel.

10.02 *Straightening Round of Drill*–Maintain in accordance with paragraph 9.01 a. (5).

10.03 *Squaring Shank*–Maintain in accordance with paragraph 9.01 a. (6).

10.04 *Removing Rust*–Maintain in accordance with paragraph 9.02.

10.05 A correctly ground drill should:

a. Provide the cutting edges with a uniform angle with the axis of the drill.

b. Obtain cutting edges with exactly equal length.

c. Obtain sufficient clearance behind the cutting edge.

d. Obtain sufficient groove depth.

11. SAFETY PRECAUTIONS

11.01 Take care and observe the following precautions when handling bits and drills:

a. Bits and drills should not be placed or left on highway, sidewalk or property accessible to the public.

b. Bits should be raised aloft on a pole by means of a canvas bucket or a handline. Bit should not be assembled in a brace to be raised aloft in a canvas bucket.

c. When placing bits and drills on shelves, the points should face the back of shelves.

d. Never transport bits and drills loose in tool boxes or compartments. (See paragraph 5.01.) Tools being returned for junking are exceptions.

e. Do not pull either a bit or a drill from a completed hole; back it out by turning. See paragraph 4.04.

f. Place the bit or drill in brace so that the jaws catch the edges of the shank.

g. When finished with bits and drills, place them in the receptacle provided for the purpose of protection.

h. When stationed on the opposite side of partition, pole, etc., observe where a bit or drill is coming through and assume a position so there is no likelihood of being injured if the bit or drill is suddenly projected through the wall, pole, etc.

12. STANDARD REPAIRS

12.01 The employees in the field, if furnished with maintenance tools, should maintain bits and drills in accordance with the instructions in this practice. All bits and drills requiring other repairs should be returned.

13. DISPOSITION OF WOOD BORING BITS AND INSTALLER'S DRILLS (BELL HANGER BITS)

13.01 Bits and drills found to be defective should be tagged "defective" or "N.G." and returned in accordance with the company's established procedure.

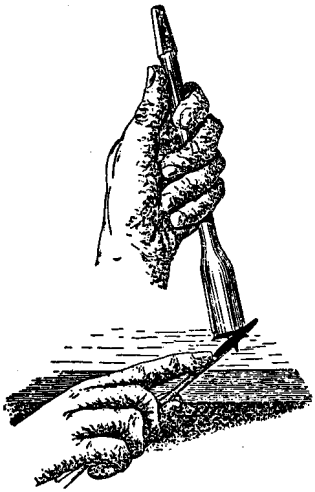


FIGURE 12.

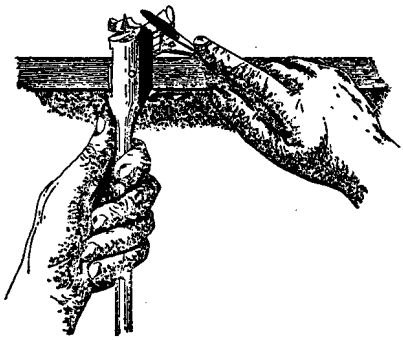


FIGURE 13.

MASONRY DRILLS AND DRILL HOLDERS
DESCRIPTION AND USE

1. GENERAL

1.01 This practice provides the description of masonry drills and drill holders which are used to drill holes in masonry for the anchoring devices that secure the various building attachments associated with drop and block wiring, house and block cables, and underground cables.

2. DESCRIPTION

2.01 The drill holder consists of a length of round tool steel with a tapered socket in one end to accommodate the drill shank and a beveled striking head on the other end. A soft rubber grip is molded around the holder to facilitate holding and turning during the hand drilling operations. An elongated hole located in the socket end is for inserting the ejector to remove the drill from the socket. See Figure 1.

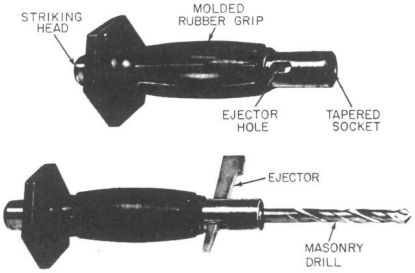


FIGURE 1. Drill Holder

2.02 The masonry drill has a spiral fluting similar to that in twist drills used for drilling metal. The shank of the drill is tapered to fit the socket of the drill holder. See Figure 2.

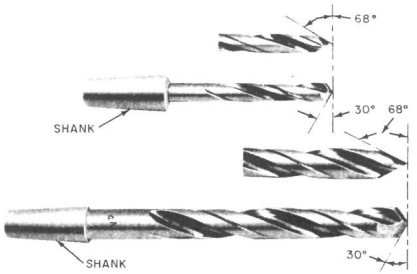


FIGURE 2. Masonry Drills

3. PRECAUTIONS

3.01 Eye protection must be worn during drilling operations in masonry to protect the eyes from flying chips.

3.02 Protective gloves should be worn to protect the hands from flying particles of metal or masonry caused by the drilling.

3.03 Before performing any drilling operations in manholes, the procedures outlined in CTSP 490-150-100 must be performed.

3.04 Do not use a drill holder with a badly mushroomed head. Refer to paragraph 5 to correct this condition.

4. USE

4.01 When drilling in masonry walls, apply light hammer blows and turn the drill slightly between blows for best result. This procedure will require less physical effort and results in faster and cleaner hole drilling.

4.02 Masonry drills give best results when in good condition. If cutting edges are dull, the drilling will be slow and laborious. If cutting edges are not of equal length or the point is off center, the drill will jam and produce a hole larger than the drill size.

4.03 Masonry drills clean the holes while drilling and when removed, the anchors or expansion shields can be inserted.

4.04 To remove a masonry drill from the drill holder, insert the small end of the ejector into the elongated hole at the socket end of the holder so the flat side is in contact with the end of the drill. Push the ejector into the hole until it is seated handtight against the shank of the drill in the socket. A sharp tap with the drilling hammer is usually sufficient to unseat the drill in the socket for easy removal. Direct the point of the drill downward to prevent injury in case the drill is ejected too sharply.

5. MAINTENANCE

5.01 Each craftsman should assume responsibility for the working condition of the drill holder and drills assigned to him.

5.02 The striking head of the drill holder is made purposely softer than the head of the drilling hammer; therefore, with continued use it will spread over or mushroom. When this occurs, the mushroomed edges may be removed and the head redressed on an electric grinder.

CAUTION: Eye protection must be worn when using an electric grinder.

5.03 When the mushrooming begins to shown signs of cracking, the holder is considered unsafe for further use and should be replaced.

5.04 The following defects impair the drilling efficiency of masonry drills:

a. Dull or badly nicked cutting edges.

b. Cutting edges of unequal length and the angle formed with the axis of the drill not uniform.

c. Bent drills.

d. Broken points.

e. Diameter reduced by wear to the point where the drilled hole is too small for anchor.

5.05 Dull or unequal length cutting edges may be restored to efficiency on an electric grinder. Maintain the same angle on the point as originally sharpened. See Figure 2. For all other defects, the drills should be replaced in accordance with local procedures.

ELECTRIC SOLDERING IRON
100, 200, AND 300 WATT COPPER TIP

1. GENERAL

1.01 This practice provides information on the description and use of soldering irons used for central office, PBX and PABX installations.

2. DESCRIPTION

2.01 As shown in Figure 1, the electric soldering irons covered in this practice consist of a molded handle, 2-conductor cord and plug, a 100, 200, or 300 watt heat element within the casing assembly, an air gap insulator safety shield, a replaceable nickled copper tip and two set screws.

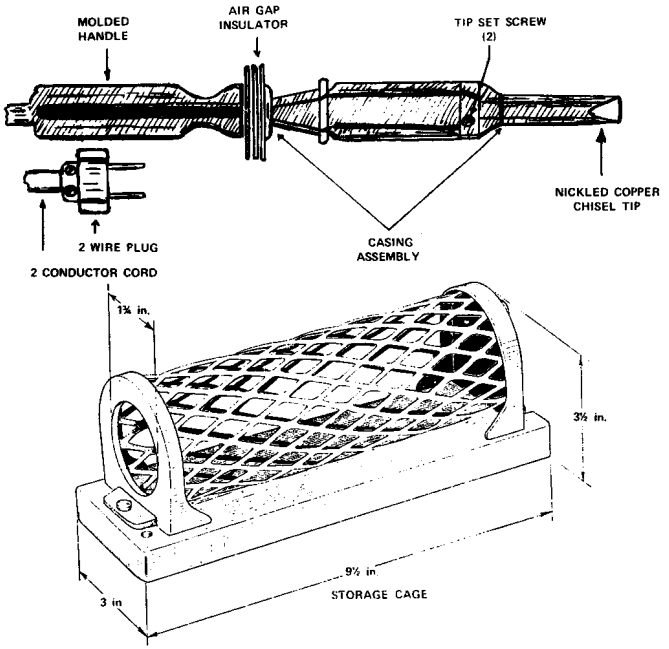


Figure 1.

2.02 These irons have been designed to operate on 115 volt house current or that supplied by a portable generator.

3. USE

3.01 The 100, 200, and 300 watt soldering irons as medium duty tools, will be utilized for soldering a number of cross connections, strapping DTA's and similar work which requires a more constant heat than the light weight iron (described in practice 405-700-001) furnishes.

3.02 New soldering tips will have to be tinned before initial use. To tin a tip proceed as follows:

a. Scruff flat surfaces of (chisel) tip lightly with a file.

b. Obtain working temperature of point.

c. Using rosin core solder, apply a light coat of solder to the working surfaces of the iron. A wiping cloth may be required during this process to wipe excess solder off tip. Only a slight glaze (coat) of solder is required.

3.03 When soldering proceed as follows:

a. Place the tinned tip of the iron upon the wire or connection.

b. Place rosin core solder on the wire or connection until the rosin flows.

c. The rosin will clean the oxides from the metals to be soldered and allow the solder to run smoothly on the connection.

d. A heavy film of solder between the working face of the tip and the joint being soldered eliminates the need for pressure as the solder conducts heat from the tip to the work.

e. Solder should be applied to the joint and should flow onto the metal and into the joint.

f. Do not use excess solder. Slide the iron from the work, do not lift it. This insures an even soldered surface.

g. Avoid a fracture in the joint by preventing movement of the connection until the metal is cooled below the freezing point of the solder.

h. The finished connection should be bright and free of pits.

4. MAINTENANCE

4.01 For maximum efficiency, be sure that the tip is clean at all times. A tip containing foreign residue will not heat properly.

4.02 The soldering iron tip will generally require an occasional touchup with a wiping cloth at working temperature.

4.03 As the tip is used it will become pitted and solder buildup will generally be heavier and require more frequent cleanings.

4.04 It may also be necessary to file away excess solder (cold tip) between periods of use.

4.05 After filing tip, re-tin as outlined in paragraph 3.02.

4.06 If an iron is not functioning properly, check tip for cleaning or replacement. If this does not solve the problem, return the unit to the storeroom.

4.07 When not in use, the soldering iron shall be stored in its associated cage (Figure 1) with the cord wrapped around and firmly secured to the handle.

4.08 The iron should be stored in the workman's truck in such a manner that it will not come in contact with any other hard object that would rupture the cord insulation.

5. SAFETY PRECAUTIONS

5.01 During a work operation, the hot iron shall always be placed in the cage (Figure 1) when not in use, and the complete unit kept clear of any combustible material.

5.02 In checking the iron for heat, never use fingers or hand. Check tip of iron for heat with solder.

WIRE-WRAP TOOLS
DESCRIPTION AND USE

1. GENERAL

1.01 This practice covers the description and use of electric, spring, and hand operated wire-wrap tools.

1.02 Wire-wrapped connections shall be made only on terminals designed for wire-wrapping.

2. WIRE-WRAPPING TOOLS

2.01 The wire-wrapping tools recommended for use are:

a. Electric Wire-Wrap Tool No. 14B1-A (wire gauge capacity 20 through 32).

b. Spring Operated Wire-Wrap Tool No. 14H-1C (wire gauge capacity 20 through 26).

c. Hand Operated Wire-Wrap Tool No. 20557-23 (wire gauge capacity 24 through 26).

d. Hand Operated Wire-Wrap Tool No. 20557-14 (wire gauge capacity 22).

e. Hand Unwrapping Tool No. A-31478-(LH) (wire gauge capacity 20 through 26).

f. Wrapping Bit No. 500131 (wire gauge capacity 22).

g. Wrapping Bit No. 17612-2 (wire gauge capacity 24).

h. Sleeve No. 18840 (wire gauge capacity 22).

i. Sleeve No. 17611-2 (wire gauge capacity 24).

3. DESCRIPTION

3.01 A wire-wrapping tool is basically a metal rod containing two longitudinal holes. The skinned portion of a wire is inserted into the smaller hole and the larger hole is placed over the terminal. See Figures 1 through 4.

3.02 The wire-wrap tools No. 14B1-A and No. 14H-1C are pistol shaped. The No. 14B1-A is electrically driven and the No. 14H-1C is hand driven and is equipped with a spring which restores the tool to normal.

3.03 Wrapping bits and sleeves are provided in different sizes to accommodate the various wire sizes. The bits and sleeves are inserted into the nose assemblies of the wire-wrapping tools. The wire sizes are shown in Part 2.

3.04 The wire-wrapping bit has an axial hole in one end which fits over the terminal on which a wrapped connection is to be made. In the same end near the outer edge is a smaller hole which is the wire feed slot. (See Figure 5.)

3.05 The sleeve has two wire anchoring notches located opposite each other for holding the insulated portion of the lead. This prevents the insulated portion of the wire from wrapping around the terminal. On the same end is a funnel-shaped flare which guides the skinned portion of the wire into the feed slot of the wrapping bit (Figure 5).

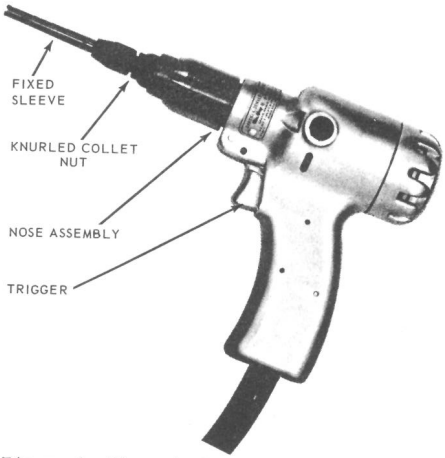


Figure 1. Electric Powered Wire-Wrap Tool

Figure 2. Hand Operated Wire-Wrap Tool

Figure 3. Hand Wrapping Tool.

Figure 4. Hand Unwrapping Tool.

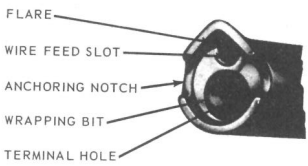


Figure 5. Wire Wrapping Tool Equipped with Associated Bit and Sleeve.

4. PREPARATION

4.01 The gauge of the wire-wrap tool, bit and sleeve shall match the gauge of the wire which is to be used.

4.02 To equip the tool for operation, unscrew the knurled collet nut (see Figure 1) and insert the bit and then the sleeve into the nose piece. Tighten the knurled collet nut by hand. Operate the trigger several times to verify that the wire feed slot stops in line with the flare. If the wire feed slot fails to stop in line with the flare, loosen the knurled collet nut and reposition the sleeve. Failure of the wire feed slot to line up with the flare after repositioning may indicate that the wrapping tool or bit is defective. In this case the wrapping tool and bit should be returned for inspection and repair.

4.03 To remove the sleeve, loosen knurled collet nut and pull sleeve straight out from the wrapping tool.

4.04 To remove the bit, pull it straight out from the wrapping tool until it stops and is free to rotate. Rotate the bit 180° and pull straight out.

5. WRAPPED CONNECTIONS

5.01 *Solderless Wrapped Connections:* The minimum number of turns around the terminal shall be six complete turns for 24 gauge wire, and five complete turns for 22 gauge wire. A skinned length of 1 5/8 inches should be sufficient for 22 and 24 gauge wire to permit the required number of turns around the terminal. More than the required number of turns is permissible (see Figure 6). In order to ascertain that satisfactory connections are being obtained, check them periodically.

5.02 *Soldered Wrapped Connections:* A minimum of three complete turns around the terminal shall be made for soldered wrapped connections. A skinned length of 3/4 inch should be sufficient to permit the required number of turns around the terminal. More than the required number of turns is permissible (see Figure 6).

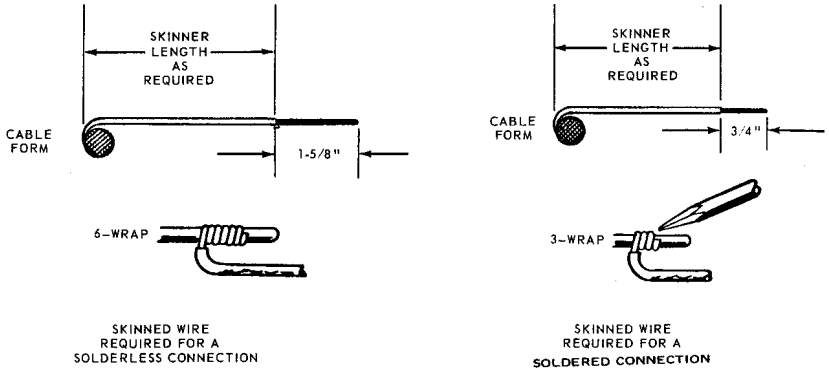


Figure 6. Skinned Lengths Required for Solderless and Soldered Wire Wraps.

5.03 *Skinning Leads:* Care should be used when skinning leads for wrapped connections as it is important that the leads not be nicked or flattened. The wires should not be bent as this makes it difficult to introduce the wire ends into the wire feed slot of the bit.

NOTE: *Before skinning cable conductors on the apparatus side of terminal strips, the wires shall be in their final position.*

5.04 *Wrapping Leads:* Wrap leads as follows:

a. Insert the skinned portion of the lead into the feed slot of the wrapping bit, care being taken to insure that no bare wire is showing. Bond the insulated portion of the lead into the anchoring notch as illustrated in Figure 7. Push the tool onto the terminal while holding the wire taut in the anchoring notch. Use of the left or right anchoring notch is determined by direction of approach, i.e., a lead dressed to the left of the terminal is placed in the left anchoring notch; if dressed to the right, it is placed in the right anchoring notch.

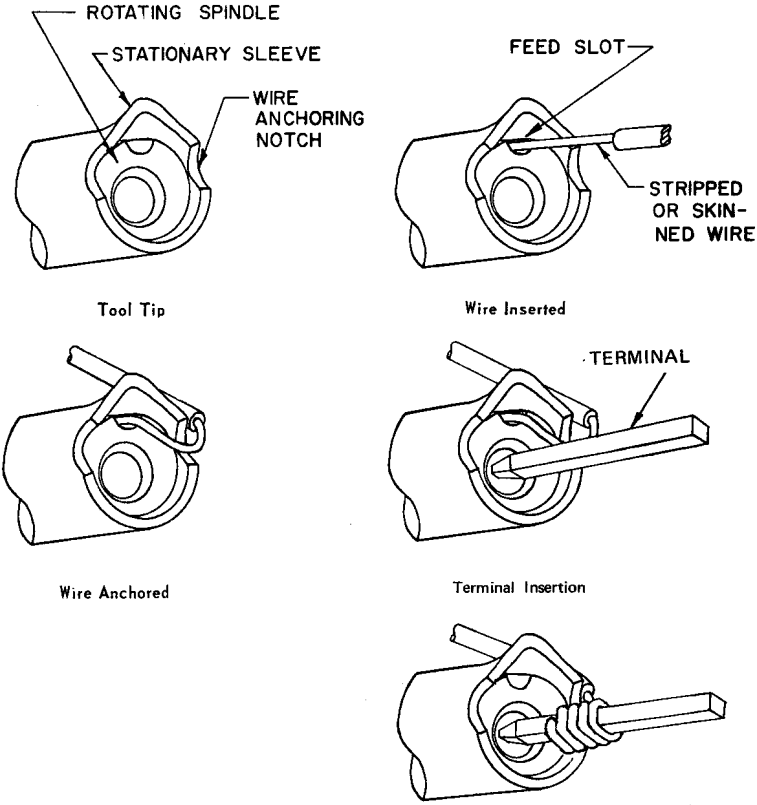


Figure 7. Solderless Wrapped Connection Process.

NOTE: *If the wire is not inserted up to the insulation, a "shiner" may result. A "shiner" shall not be longer than 1/8 inch. A longer length "shiner" is a potential trouble.*

b. The tool shall be inserted over the terminal as far as it will go without touching the terminal moulding.

c. The tool shall be in a direct line with the terminal before operation.

d. Operation of the trigger will wrap the wire on the terminal. The tool will automatically recede as the wire coils on the terminal, producing a finished connection.

e. Insufficient pressure on the tool when wrapping may cause separation between turns. Complete turns may be separated, provided the spaces between inside wraps are no more than .005 inch as gauged by eye. (Figure 8)

Figure 8. Separated Turns Resulting From Insufficient Pressure.

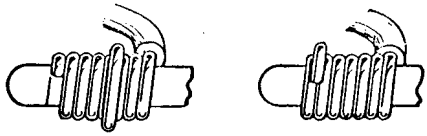


Figure 9. Overriding Turns Resulting From Excessive Pressure.

f. Excessive pressure on the tool when wrapping can cause overriding turns. (Figure 9) Overriding turns are not permissible.

g. It ~~is not~~ required that the wire end be flat against the terminal but a 1/64 inch clearance between the wire end and adjacent terminal must be maintained.

h. If the clearance between the wire end and the adjacent terminal is less than 1/64 inch, and solderless connections are involved, the wire end can be wrapped by placing the tool lightly against the connection and operating the tool.

5.05 *More than one wire per terminal:*

a. Where more than one connection per terminal is necessary, the method of wrapping the second or third connection is determined by the remaining terminal length after the first connection has been made. Each 6 turn connection takes approximately 1/4 inch of the terminal. In order to make a second or third connection, at least 1/4 inch or 1/2 inch of the terminal must be available. (Figure 10 A)

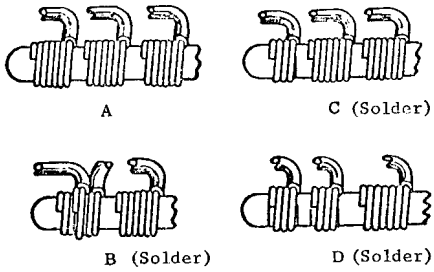


Figure 10. More than One Wire Per Terminal.

b. If there is not sufficient terminal length available for solderless connecting, 1 1/4 to 3 turn connection may be made but must be soldered. (Figure 10 C & D)

c. If there is not sufficient terminal length for a 1 1/4 inch turn connections, wrap the lead over the previous connection and solder. (Figure 10 B)

d. Where it is decided on an installation that it is not practical to apply solderless wire-wrapped connections on terminal strips, the soldering operation can be facilitated if the wrapping tool is not placed on the terminal as far as it will go. A depth guide as shown in Figure 11 and used as illustrated in Figure 12 will position the wrapping tool so as to leave sufficient space for three connections of three turns each. After the first horizontal row of connections has been made on a group of terminal strips, the remaining terminals can be gauged by eye rather than repositioning the guide on each succeeding row of terminals.

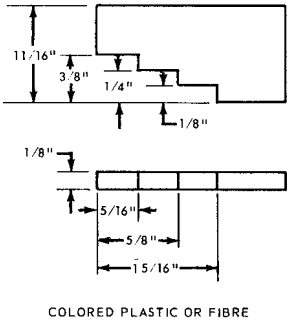


Figure 11. Depth Guide for Soldered Connections on Terminal Strips.

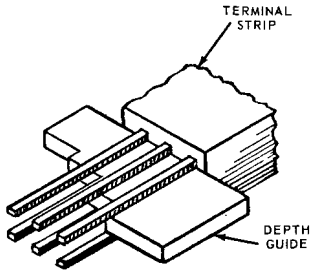


Figure 12. Method of Using Depth Guide for Soldered Connections on Terminal Strips.

5.06 *Soldering Wrapped Connections:*

a. When a terminal contains solder, either on an existing connection or resulting from a previously soldered connection, all connections added to this terminal shall be soldered.

b. When soldering a wrapped connection, a minimum of two adjacent turns of the connection shall be soldered.

c. Where a connection requiring solder is added to a terminal, all connections on that terminal shall be soldered.

5.07 *Removing Wrapped Connections:*

a. The spiral may be unwound with an unwrapping tool or pliers (Figure 13) or, if there is sufficient slack, by hand.

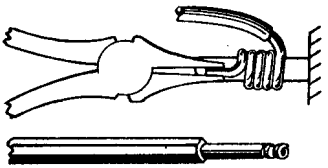


Figure 13. Removing Wrapped Connection.

b. Where a connection has been soldered, a soldering iron should be applied to the connection and the spiral unwound with pliers or by hand. *Do not use the unwrapping tool.*

c. No attempt shall be made to pull the wrap from the terminal by pulling on the lead. This may break the wire and make the wrap difficult to remove.

d. If, for any reason, a wrap must be removed and then reconnected, proceed as follows:

(1) When there is sufficient slack in the lead to obtain the proper skinned length, cut the previously connected lead back, skin and reconnect. Do not rewrap a previously wrapped skinned length as the strength of the wire is reduced by the first connection.

(2) Where there is insufficient slack to make a normal connection, skin 1/4 inch of insulation from the lead and wrap at least 1 1/4 turn of wire, using the wrapping tool or pliers. This wrap shall be soldered.

NOTE: *This does not apply to jumpers. If there is not enough slack, replace the jumper.*

(3) Rewrapped connections made on a terminal that was not previously soldered do not require soldering.

6. PRECAUTIONS

6.01 The bit of the wire-wrapping tool rotates in a thin walled sleeve and, *due to the close tolerance between the two parts, bumping or dropping the tool may result in the bit failing to turn or the wire feed slot failing to line up with the flare on sleeve.*

6.02 When the wrapping tool is not in use, it should be placed in a secure, out-of-the-way location.

6.03 When working on ladders, normal safety practices, such as securing the tool to the ladder with a cord, should be followed to protect both equipment and personnel.

6.04 Since the case of the 14B1-A tool is grounded, care should be taken when connecting terminals associated with working equipment. The appropriate supervisor shall be contacted to have working equipment released if possible. If equipment cannot be released, the connections shall be hand wrapped, using the hand operated wire-wrap tools to complete the connections.

6.05 When it is necessary to connect 20 gauge wire and the 20 gauge wrapping bit and sleeve are not available, the lead should not be wrapped with pliers. The lead should be wrapped around a square or rectangular test terminal, removed, placed on the equipment terminal and soldered. A nail or other object of suitable diameter could be substituted for a test terminal. The described method of wrapping on a test terminal or nail can also be used for 14 gauge wire. All connections made with 20 through 14 gauge wire must be soldered.

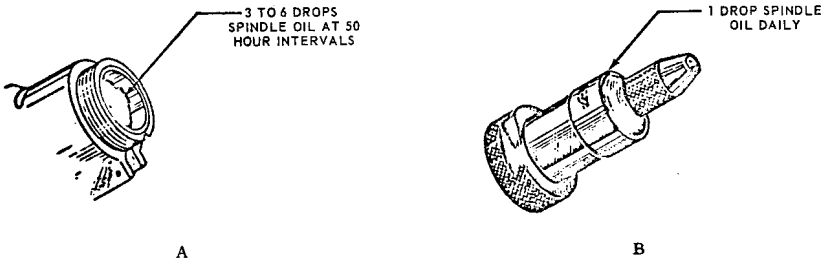
6.06 When solderless connections have been applied, care shall be taken that no testing fixture (either push-on or spring clip type) comes in contact with the connection.

7. LUBRICATION

7.01 The wire wrap tool is assembled at the factory with a light coating of oil on all moving parts. This provides initial lubrication for approximately 50 hours running time. Beyond this, additional lubrication is necessary to maintain top performance.

7.02 At 50 hour intervals, remove the nose assembly and add 3 to 6 drops of spindle oil to the upper clutch block and spindle, as illustrated in Figure 14 A. Replace the nose assembly and run the tool for one or two minutes before starting production.

7.03 The STOP PAWL located under the sleeve on the nose assembly must be lubricated DAILY. Apply 1 drop of spindle oil between the sleeve and guide sleeve assembly (Figure 14 B).



A B

Figure 14. Lubrication Points of Wire Wrap Tool.

8. ORDERING INFORMATION

8.01 The Wire-Wrap tools listed in Paragraph 2.01 are manufactured by the Gardner-Denver Company, Quincy, Illinois.

SCREWDRIVERS
DESCRIPTION, USE, AND MAINTENANCE

1. GENERAL

1.01 This practice covers the description, use and maintenance of screwdrivers and appropriate safety precautions.

1.02 The screwdrivers provided for field use are high grade tools with heat-treated blades. The ends of the blades are ground to fit the screws ordinarily found in telephone work.

1.03 Screwdrivers are furnished in two types: blade type and Phillips. The heavy duty blade type screwdriver is designed for general use with large size wood and machine screws. The light duty blade type screwdriver is for light work with small screws used primarily in apparatus assembly and repair. The Phillips screwdriver is used in any application employing Phillips recessed slot screw-heads.

1.04 The following precautions shall be observed when handling screwdrivers.

a. *Do not use* screwdrivers as drills, chisels, scrapers, or pinch bars.

b. *Do not* carry screwdrivers in pockets where injury to persons or damage to property may result from the exposure of the blade tip.

c. Screwdrivers with broken, chipped or rounded points *shall not* be used.

d. *Always* work in such a position that if the screwdriver should slip it will not cause injury, particularly to the hands or face. If it is necessary to hold small objects, the hand should be kept away from the back of the object so that it will not be struck if the screwdriver slips. This can usually be accomplished by placing the object against some supporting surface. *Avoid holding small objects in the palm of the hand.*

2. DESCRIPTION

2.01 Figure 1 shows screwdriver types and sizes.

2.02 Figure 2 shows the results of improper use and maintenance of blade screwdrivers. Such conditions cause accidents and unsatisfactory workmanship.

2.03 Always use the proper size screwdriver with each size of screw.

3. USE

3.01 In general, a pilot hole will not be required for starting the smaller sizes of screws in soft wood. Pilot holes of the *following* sizes shall be made for the larger sizes of screws where such holes are not already available.

SIZE OF WOOD SCREW

HARD WOOD	SOFT WOOD	SIZE OF DRILL POINT
	No. 6	1/16 Inch
No. 6	No. 8 to No. 10	3/32 Inch
No. 8 to No. 10	No. 12 to No. 14	1/8 Inch
No. 12 to No. 18	No. 18	11/64 Inch

See Figure 1 on following page.

3.02 Before starting screws in metal, be sure the proper size hole has been predrilled and, where necessary, tapped and threaded in the metal.

3.03 After the pilot hole has been drilled, insert the screw. Use both hands when starting screws, one on the handle of the screwdriver and the other on the blade to steady it on the screw. Turn the screw, keeping the centerline of the screwdriver in line with the centerline of the screw. (See Figure 3)

3.04 If it is difficult to turn the screw into the wood, lubricate the threads with a small amount of soap or wax. Be sure the lubricant does not get into the screw slot or on the tip of the screwdriver. If lubricant gets on either of these points, it should be removed to prevent accidents when the screw is being turned.

4. INSPECTION

4.01 Look for the following conditions when inspecting screwdrivers:

a. Point of tip chipped, worn, bent, or improperly shaped.

b. Soft tip (temper destroyed).

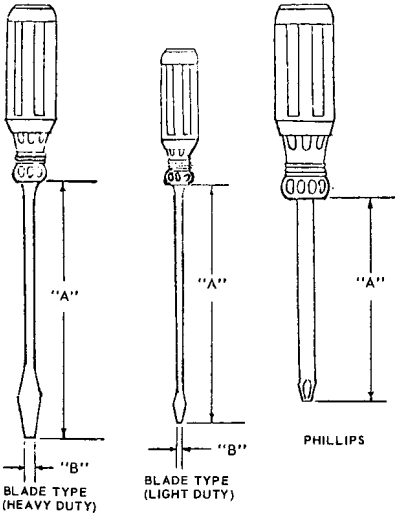
c. Shank bent or loose in handle.

d. Handle broken, split or butt end mushroomed or rough.

4.02 If any of the above conditions are found and cannot be repaired in the field, mark the screwdriver defective and exchange it for one in good condition in accordance with local practices.

4.03 Each employee is responsible for examining his screwdrivers at frequent intervals to determine that they are safe and in good condition.

4.04 Screwdrivers shall be inspected during the periodic tool inspections and employees performing this work shall see that all instructions contained in this practice are followed.



HEAVY DUTY		LIGHT DUTY		PHILLIPS		
"A"	"B"	"A"	"B"	"A"	POINT SIZE	SCREW SIZE *
4"	1/4"	3"	3/16"	3"	1	2-3-4
6"	5/16"	6"	3/16"	4"	2	5-6-7-8-9
8"	3/8"	8"	3/16"	4"	3	10-12-14-16

* ALWAYS USE CORRECT POINT SIZE WITH CORRESPONDING SCREW SIZES.

Figure 1. Screwdriver Sizes

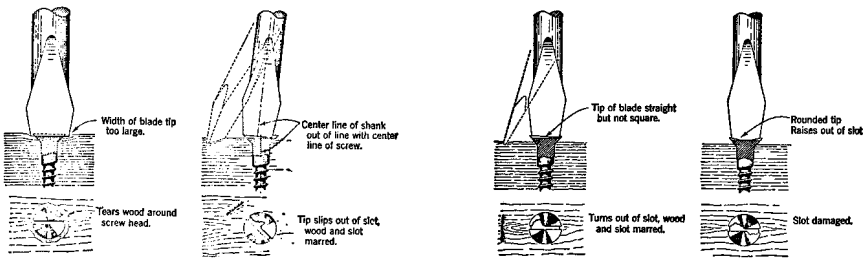


Figure 2.

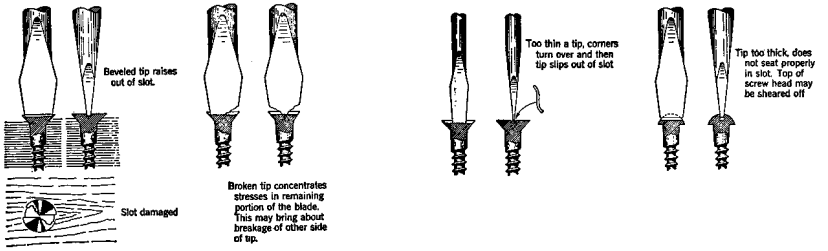


Figure 2

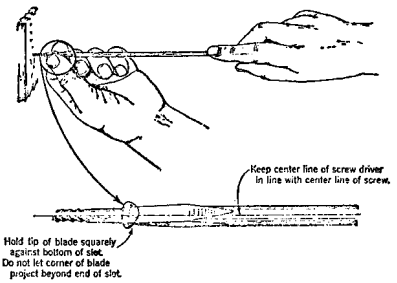


Figure 3

5. MAINTENANCE

5.01 The following method shall be used for repointing blade type screwdriver tips:

a. Select a file designed for sharpening tools. If the teeth of the file are clogged, clean them with the standard file card brush.

b. Select a location that is steady and at approximately the height of the elbows. The surface should be flat so that it can be used as a guide for pushing the file straight across the tip of the screwdriver.

c. Hold the screwdriver blade perpendicular to the flat surface and use the index finger to steady it.

d. Grasp the file securely so that its movements can always be controlled. Place the file on the tip of the screwdriver, parallel with the flat surface and apply sufficient pressure for the teeth to grasp the metal. Move the file forward and parallel to the surface of the tip of the screwdriver (see Figure 4). On the return stroke, the file should be lifted slightly above the surface being filed to avoid dulling the cutting teeth. Continue this process until the desired shape has been obtained.

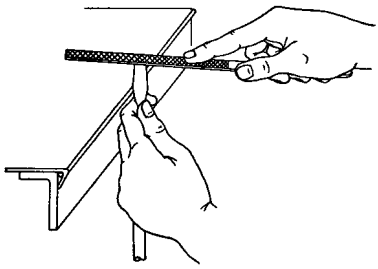


Figure 4. Filing Tip of Screwdriver

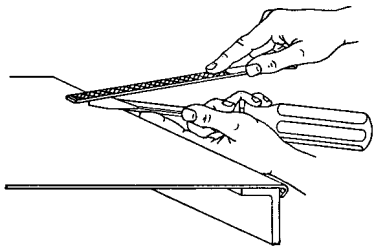


Figure 5. Restoring Tip of Screwdriver

e. Restore the width of the tip as close to its original size as possible with the file (see Figure 5).

f. To restore the thickness of the tip, the entire broad face of the tip should be filed as shown in figure 6.

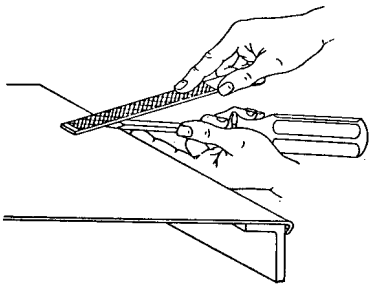


Figure 6. Restoring Thickness of Tip

5.02 *An emery wheel shall not be used for repointing a screwdriver blade.*

5.03 To straighten a bent screwdriver blade, place the bent portion on a solid flat surface with the tip and the shank near the handle resting on the flat surface. Strike the bent section with a mallet or hammer. Start near the handle and continue striking, each blow a little ahead of the last blow, until the tip is reached. This operation should be repeated until the shank is straight. Light blows should be used in order to avoid damage to the shank surface. If a vise is available it may be used by placing the blade of the tool in the vise and applying leverage as required to straighten the shank.

5.04 *Phillips screwdrivers shall not be repointed or filed down.* If the head of the screwdriver is damaged in any way, the screwdriver shall be replaced by a new one.

WOOD EXTENSION LADDERS AND ATTACHMENTS

CONTENTS

1. GENERAL

1.01 This practice is reissued to change the title and to specify that the description and procedures apply to **wood** extension ladders and attachments. Due to the major revision of this practice, brackets indicating changes and/or additions are deleted. **Remove from the file and destroy all copies of CTSP 405-700-320, Issue 1, 1971.**

1.02 This practice provides the proper and safe procedures for handling the various types of wood extension ladders and attachments presently used in the Continental Telephone System. Figure 1 shows a standard wood extension ladder.

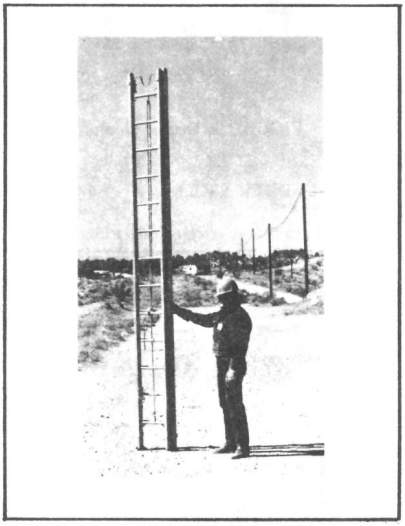


FIGURE 1. Standard Wood Extension Ladder

1.03 The information in paragraphs 4, 10, 11, 12 13, 14, 15, and 16 of this practice also applies to fiberglass ladders. Refer to CTSP 405-700-619 for information on the care and maintenance of fiberglass ladders.

1.04 It is the responsibility of craftsmen to check ladders and attachments to ensure that the equipment is in good working condition.

2. DESCRIPTION

2.01 All ladders referred to in this practice are of the treated wood type. Extension ladders are provided in sizes of 24 feet, 28 feet, and 32 feet. They are equipped with duo safety shoes on the side rails to prevent slipping, and are furnished with strand hooks. Two automatic locks are attached to the side rails of the top section and clasp over the rungs of the bottom section. The top section of the ladder is raised by means of a 3/8-inch manila or synthetic fiber rope. See Figures 2, 3, and 4.

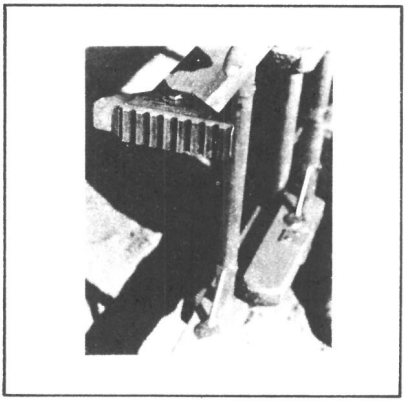


FIGURE 2. Duo Safety Shoes

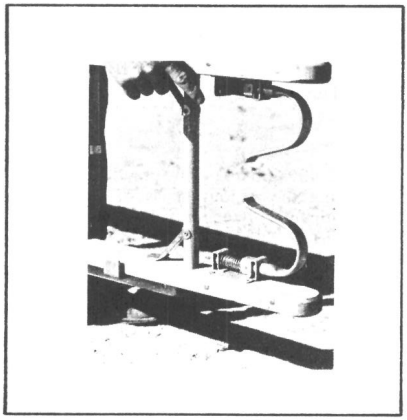


FIGURE 3. Strand Hooks

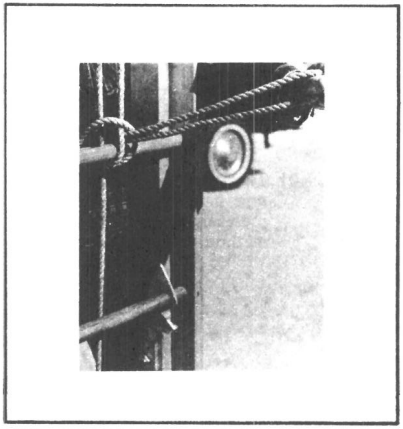


FIGURE 4. Automatic Locks

3. SELECTION OF PROPER SIZE OF WOOD LADDER

3.01 The maximum working length of an extension ladder is from 3 to 4 feet less than the ladder size, depending upon the maximum overlap. See Table A for maximum working lengths of the ladders.

TABLE A

Ladder Size (Feet)	Maximum Working Length (Feet)	Minimum Overlap (Feet)
24	21	3
28	25	3
32	29	3

3.02 Depending upon local conditions, the 24-foot extension ladder will usually meet most requirements for installation and maintenance work. The 28-foot or 32-foot ladders will meet the requirements for construction and splicing operations.

3.03 Always select a ladder of sufficient length for the work to be done. The ladder should be long enough so that the work can be performed when standing no higher than on the fourth rung from the top so that the side rails may be grasped conveniently and safely. Figure 5 shows a ladder of the right length.

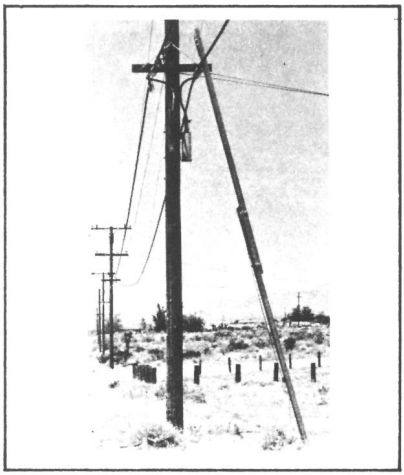


FIGURE 5.

4. SAFETY PRECAUTIONS

4.01 Use only **standard** extension ladders (Figure 1). **Do not use ladders with broken or missing rungs, broken side rails, broken locks, or defective ladder ropes.**

4.02 Do not place ladders on boxes, barrels, or other objects to obtain additional height; use a ladder of sufficient length for the job at hand.

4.03 When the surface on which the base of the ladder is resting is such that the ladder may have a tendency to slip, follow the instructions given in paragraph 11.02.

4.04 Do not place a ladder inside or opposite an angle formed by wires or cables where loosening of the wire or cable attachments might cause the ladder to move or fall.

4.05 In areas exposed to vehicular traffic, place the ladder on the strand from the field side of the cable whenever possible to avoid danger from passing vehicles. If vehicular traffic is not a problem, the ladder may be placed against the strand from the street side of the cable.

4.06 If a ladder must be placed at a work location where it could be struck by passing vehicles and a Company vehicle is available, the truck should be parked with brakes set to provide maximum protection for the ladder without obstructing traffic. In addition, warning signs, flags, traffic cones, or flashing signals should be placed to divert the flow of traffic from the work area, as instructed in CTSP 490-050-101. See Figure 6.

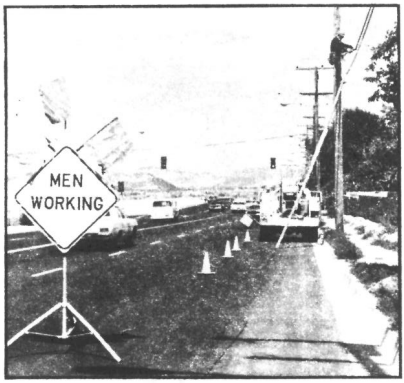


FIGURE 6.

4.07 When raising or lowering the top section of an extension ladder, keep hands and feet off the rungs. When the top section is being lowered, stand clear so that it will not strike the feet. See Figure 7.

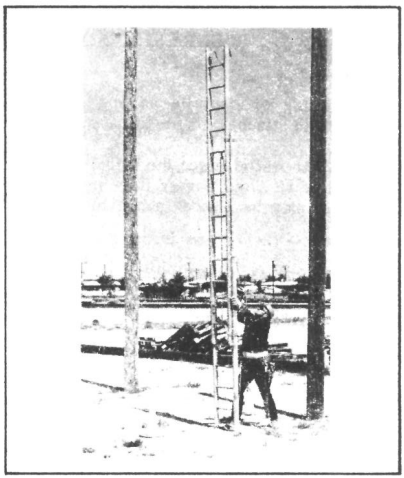


FIGURE 7.

4.08 Avoid spilling or spattering paraffin on a ladder as wood coated with paraffin is very slippery and this could cause an accident.

4.09 Before climbing an extension ladder, make certain that the ladder locks are properly engaged and the ladder rope is securely tied to one of the rungs of the bottom section. See Figure 8.

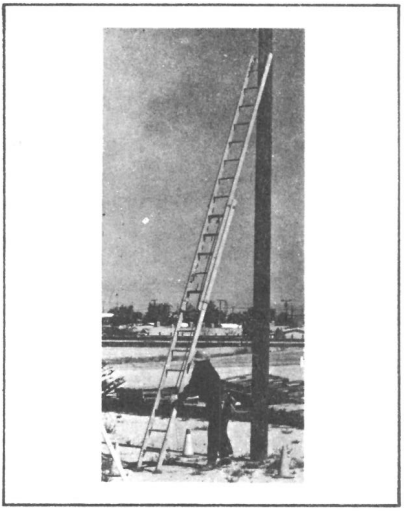


FIGURE 8.

4.10 When the ladder is to be used on aerial cable, turn the hooks to the working position before the ladder is raised. Ladder hooks should be placed on the cable strand as shown in Figure 9, unless the ladder is to be lashed to the strand as covered in paragraph 13.

4.11 Do not hurry when going up or down a ladder; take one step at a time and always face the ladder, being sure to have both hands free to hold the sides of the ladder. See Figure 10. Be especially careful when going up or down ladders in wet or icy weather.

4.12 Do not climb a ladder while wearing climbers.

4.13 Only one person at a time is permitted on a ladder.

4.14 The craftsman should always remember to first make the ladder secure, and then make himself secure on the ladder, so that he will not fall if he slips, loses his balance, or something unexpected occurs. The manner in which the craftsman secures himself to the ladder will depend on the security of the ladder, and the nature of the work to be done.

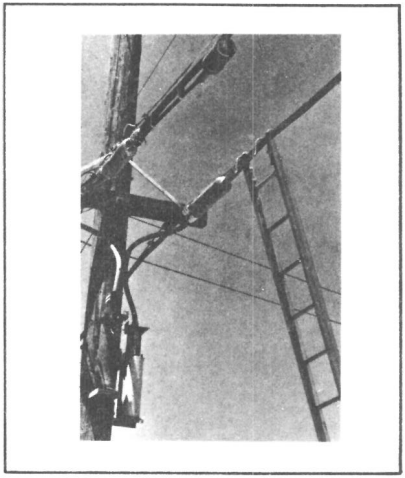


FIGURE 9. Ladder Hooks on Cable Strand

FIGURE 10.

4.15 If the ladder is lashed to the pole, the craftsman may increase his safety by passing his

safety strap around one rung of the ladder, then around the pole and the opposite outer side rail of the ladder and into the D ring of the safety strap. See Figure 11.

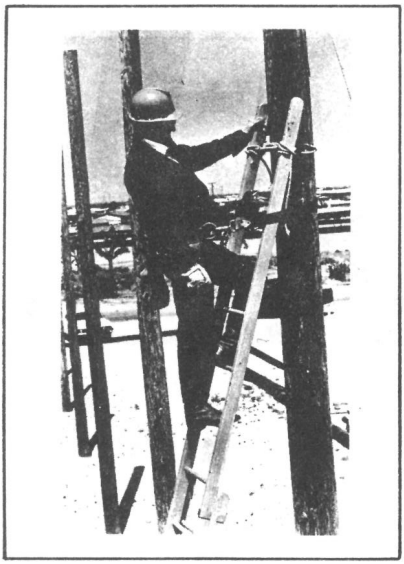


FIGURE 11.

4.16 If the ladder is attached to strand, pass the safety strap around one outer side rail of the ladder, over the strand, under and over the rung of the ladder, over the strand again and around the opposite outer side rail of the ladder and into the D ring of the safety strap.

4.17 When a ladder is lashed, or otherwise secured so that it cannot fall, the craftsman may increase his security by placing one leg between two rungs of the ladder.

4.18 Do not throw tools or materials to a craftsman working on a ladder: raise them by means of a handline. See Figure 12. Be careful that tools or materials being used aloft cannot fall on persons passing below.

4.19 When working on a ladder, do not attempt to lean so far to the side that the outside shoulder is more than 12 inches beyond the side rail. Loss of footing in this position may cause loss of balance and

FIGURE 12.

the weight being shifted to one side of the ladder may cause it to slip at the top. Descend and move the ladder to the proper location.

4.20 When working from ladders, **do not allow drop wires, lashing wires, handlines, or ladder ropes to dangle to the ground where they may be struck by passing vehicles.** A wire or rope caught on a passing vehicle may pull the ladder and cause it to fall, or it may pull the craftsman off the ladder. When not in use, the handline shall be tied to the lower portion of the ladder or pulled aloft.

4.21 Do not slide down an extension ladder.

4.22 Never carry an extension ladder from one location to another while it is extended. First lower the ladder and secure the ladder rope, then extend it again at the new location.

4.23 When carrying a ladder on the shoulder, point the safety shoes forward and downward.

4.24 When carrying or removing a ladder from a vehicle, avoid swinging it into the path of passing vehicles or pedestrians.

4.25 Do not place ladders where they may come in contact with power lines.

4.26 Do not tie drop wires or pulling lines to ladders.

4.27 Do not use a ladder in a horizontal position as a platform, runway, or scaffold.

4.28 Do not place a ladder against a suspension strand which is held under tension by a strand puller only.

5. ROUTINE INSPECTION OF WOOD LADDERS

5.01 Each time a ladder is used, the employee shall determine that it is in good condition and that there is no indication of deterioration or damage that may affect its strength. **Ladders not in storage shall be examined visually once each week.**

5.02 Every 6 months (or if a ladder has been dropped or otherwise abused or damaged), all sections of a ladder shall be examined according to the procedures in paragraph 6.

5.03 Definitions of terms used in ladder inspection are:

a. Cracks are fractures across the lengthwise fibers of the wood, usually resulting from mechanical stresses.

b. Decay is disintegration of the wood due to action of wood-destroying fungi.

c. Splits are lengthwise separations of the wood extending in the direction of the grain.

d. Delamination is separation of ply in the laminated side rails of extension ladders.

5.04 Paragraph 7 describes defects in side rails that can be detected visually.

5.05 Extension ladders shall be inspected when the wood is dry as absorption of considerable moisture causes swelling which tends to conceal defects.

5.06 Every 2 months the supervisor shall inspect the ladders used by his forces. Inspection under dead weight load may be omitted.

5.07 The supervisor shall ensure that the craftsmen comply with the inspection routine.

6. METHOD OF INSPECTING WOOD EXTENSION LADDERS

6.01 Examine the ladder to determine the condition of all parts. To facilitate careful inspection, place the ladder at a convenient height in a well lighted area. **If any defects are found that cannot be taken care of by the craftsman, or if the condition is such that there is doubt about the ladder being safe to use, it should be tagged DEFECTIVE and exchanged at once for a ladder in good condition, in accordance with local routine.**

6.02 Separate the ladder sections and place **one section at a time** on two supports located a few inches from the ends of the side rails. These supports should be high enough to permit the craftsman to examine the underside of each rail thoroughly.

6.03 Place a weight of approximately 100 pounds at a point approximately 2 feet from one end support. The weight should be supported evenly by the two side rails. Examine the under edges and the faces of each rail carefully for signs of any defects. Particular attention should be given to the points where the rungs are joined to the side rails, as these are points where fractures are most likely to occur.

6.04 Repeat the procedure in paragraph 6.03 with the weight placed at the midpoint of the ladder section. See Figure 13.

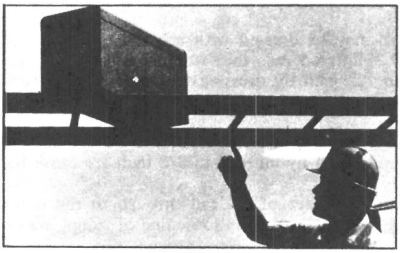


FIGURE 13.

6.05 Turn the section over and repeat the inspections described in paragraphs 6.03 and 6.04. **The suggested loading is not a strength test of the section, but rather a means for disclosing defects and therefore is of no significance unless a careful visual examination is made while the section is under load.** Under no circumstances shall an **extended** ladder be inspected in this manner, nor shall a weight appreciably in excess of the 100 pounds (such as the weight of a person) be applied to a ladder section being inspected.

7. VISUAL INSPECTION OF WOOD EXTENSION LADDER SIDE RAILS

7.01 Look for damage to the side rails which may appear as a fine crack, as a fold or crease in the wood fibers, or as a splintering of the wood fibers. Such defects are usually caused by overloading the ladder or subjecting it to a hard blow by dropping it or through some other accident and may subsequently result in failure of the ladder under normal load. Cracks or fine wrinkles (compression failure) in the wood fibers are most likely to occur at rung positions; a very careful inspection is usually required to detect them. In most instances the wrinkles or creases appear alone, but in some cases there may also be some splintering of the wood fibers in the opposite side of the rail. See Figure 14.

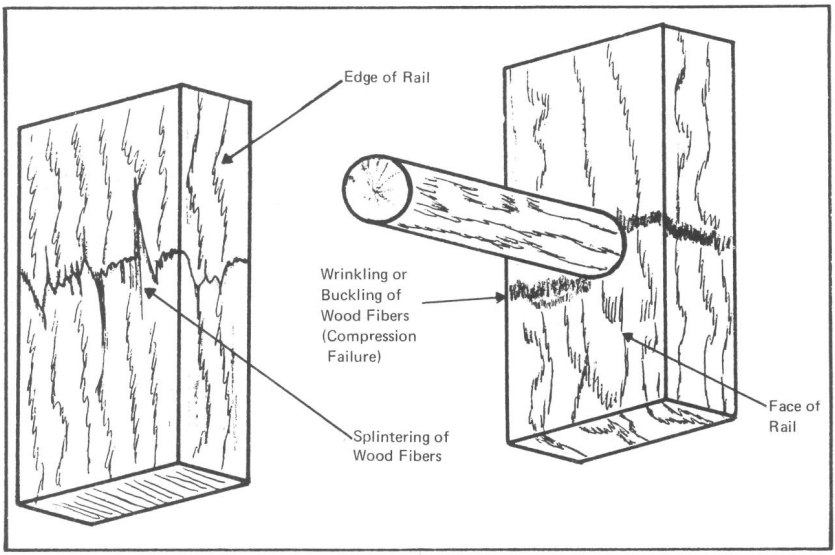


FIGURE 14.

7.02 Slightly splintered rails may be dressed with a wood rasp, file, knife, sandpaper, or other suitable means. Badly splintered rails that would require the original width of the rail to be reduced more than 1/2 inch by dressing to remove the projecting fibers are cause for rejection.

7.03 Splits that extend to an edge of a side rail and cannot be removed by dressing without reducing the original rail width by more than 3/8 inch are cause for rejection.

7.04 Splits that extend from one face of the rail through to the opposite face and are more than 24 inches in length, or that result in loosening of rungs, are cause for rejection.

7.05 Worn, crushed, or excessively indented rails are cause for rejection. (Top or bottom edge of narrow side worn or depressed 3/8 inch or less is permitted.)

7.06 Decay, particularly where rungs join side rails, is cause for rejection.

7.07 Loose rungs and rung braces will cause excessive longitudinal play in side rails, i.e., more than 3/4 inch. This may be checked and measured as shown in Figures 15 and 16. Longitudinal play in excess of 3/4 inch is cause for rejection.

7.08 Check for protruding nails. These shall be driven flush and set with a nail set.

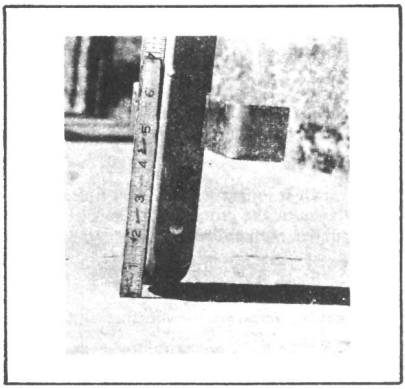


FIGURE 15.

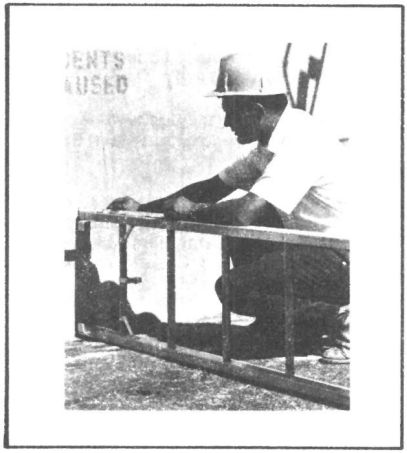


FIGURE 16.

8. VISUAL INSPECTION OF WOOD EXTENSION LADDER RUNGS AND FITTINGS

8.01 Excessively worn rungs, severely bent rungs, loose or missing rungs, are cause for rejection.

8.02 Check for cracked, split, badly splintered, or decayed wooden rungs. Sometimes a break will occur in the portion inside the side rail. Such a defect is not visible but may be detected by rapping the rung with a hammer handle near each side rail and comparing the sound with that obtained from striking other rails. Do not strike rungs with the hammer head.

8.03 The following defects on ladder fittings are cause for rejection:

a. **Broken, badly bent, or cracked guide irons.**

b. **Loose rivets.**

c. **Broken locks or improper action of locks.** (The spring shall function to keep the hook in position to engage the rung.)

d. **Excessively worn, seriously frayed, or rotted ladder rope.** Replace the rope, attaching it to the ladder by means of a rope eye splice.

e. **Broken, cracked, or badly distorted ladder hooks.**

f. **Broken, badly worn, or otherwise defective shoes.**

g. **Broken or defective braces.**

h. **Broken or defective pulley** (the pulley sheave shall revolve freely).

i. **Broken or defective pulley shackle** (never use wire as a substitute for the shackle).

9. CARE OF WOOD LADDERS

9.01 If properly handled and cared for, a ladder can be used for a considerable time without repairs or replacement. Craftsmen using extension ladders shall maintain them in accordance with the instructions given in this practice. Extension ladders that require repairs which cannot be made on the job shall be returned to the storeroom as instructed in paragraph 6.01.

9.02 When lowering the top section of a ladder, check its downward movement with the extension rope to ensure that the top section does not strike the ground or pavement sharply.

9.03 A craftsman shall not attempt to lower a ladder which is longer than 32 feet unless he has assistance. Dropping a ladder for even a short distance to the ground may damage the side rails and subsequently result in the rails breaking under normal loads.

9.04 Never use a ladder as a skid.

9.05 Keep ladder rails free from splinters. Splinters may be removed by dressing with a rasp, knife, sandpaper, or other suitable means (see paragraph 7.02).

10. CARE OF LOCKS AND PULLEYS ON EXTENSION LADDERS

10.01 Keep locks, springs, and pulleys on extension ladders lubricated by applying oil sparingly on the movable parts at least once a month. This will make them operate easier and add to their service life. Ensure that locks are securely fastened to the side rails. Test each spring to see that it is capable of returning the catch to position. Examine the keeper to see that it operates properly. See that the pulley is held securely at the middle of the rung.

10.02 One type of lock with which standard extension ladders are equipped is shown in Figure 17.

11. LADDER FOOTING

11.01 Use care in positioning ladders before climbing them. Place the foot of the ladder on the ground or other firm support so that distance A (as shown in Figures 18 and 19) is approximately 1/4 of distance B. If distance A is greater than 1/4 of distance B, there is danger of imposing excessive

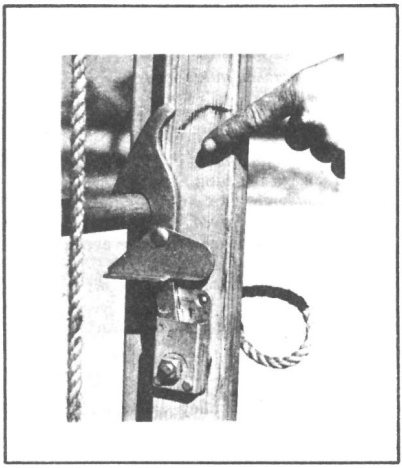


FIGURE 17.

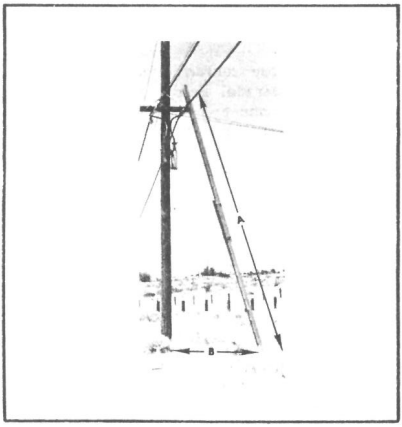


FIGURE 18.

stresses on the ladder. If distance A is considerably less then 1/4 of distance B,the ladder will be pitched so steeply that the work cannot be done safely. In any case, if the base of the ladder is likely to slip, the ladder shall be braced, fastened, or securely held.

11.02 Set a ladder only on secure footing. Set both feet of the ladder at the same level and on a line

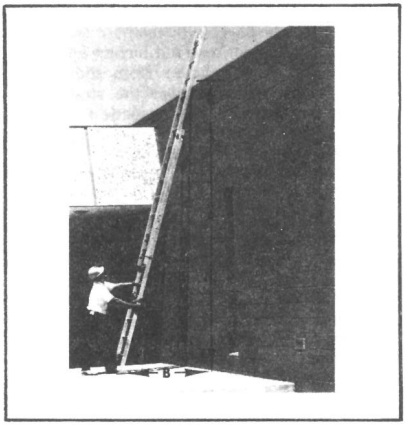


FIGURE 19.

parallel to the surface on which the top of the ladder rests. If necessary, remove earth from beneath the high side to bring it to the level of the lower side. **Never increase the length of a side rail by nailing a board to it.** If a ladder leans to either the right or the left, it is not properly placed. If the ladder cannot be leveled, select another location. Always place an extension ladder with the top section to the front. A well placed ladder is shown in Figure 20.

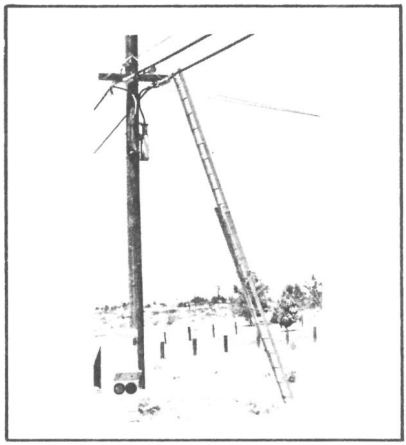


FIGURE 20.

11.03 When it is impossible to avoid placing the base of the ladder on the surface where it might slip, such as on wet or oily pavement, a smooth floor, or icy or metal surfaces, tie the base of the ladder securely in place. If this is impractical, the ladder must be held by another craftsman. The person holding the ladder shall be on the alert at all times to protect the person on the ladder and anyone passing below him. Never leave a raised ladder unattended under these conditions. The ladder might slip and cause injury, damage, or both.

11.04 Avoid placing a ladder in front of a doorway, especially where the door opens toward the ladder. Avoid placing a ladder near passageways, near moving machinery, or at locations where vehicles or pedestrians may strike or displace it. When these conditions cannot be avoided, or when a door cannot be secured in the open position or locked with no possibility of its being opened inadvertently, make arrangements to have the ladder guarded by another craftsman. Also, use warning devices to alert people to activity beyond a closed door.

12. SUPPORTING THE TOP OF EXTENSION LADDERS

12.01 Objects against which the top of the ladder will be placed shall be sufficiently rigid and have ample strength to support the ladder and the craftsman on it. Certain work operations performed from a ladder (for example, moving a cable manually) will increase the load on the ladder; this shall be taken into account when judging the strength of the upper support for the ladder.

12.02 Before placing a ladder against suspension strand, test the strength of the suspension strand and its supports. See CTSP 490-360-700.

12.03 When using a ladder on a strand having a fairly steep slope, secure the ladder with rope to prevent the top of the ladder from sliding along the strand. Before raising the ladder, throw or place a handline over the strand and secure one end on the handline to the second rung from the top of the section of the ladder.

12.04 After placing the ladder on the strand, pull the other end of the handline taut and secure it to an adequate support on the uphill side of the ladder, such as a pile, tree, or digging bar firmly placed in the ground. If no such anchorage can be obtained, the ladder may be secured to the cable and strand by throwing or placing the handline over the strand again (so that the rope passes twice around the cable and strand), and then tying the rope securely to a rung on the lower section of the ladder.

12.05 When a ladder is placed against the strand and heavy work such as pulling or lifting is to be done, lash the ladder to the strand with a short length of rope. Where the cable is supported in rings, pass the lashing rope around the strand only; where the cable is lashed, pass the lashing rope around the strand and cable. **Do not move the base of the ladder after the upper end has been secured to the strand.**

NOTE: When pushing or pulling heavy loads from a working position on a ladder, take care not to place undue stress on the ladder.

12.06 When using a ladder on a suspension strand that is attached to a building wall, wherever possible, place the ladder so that it will tend to push the wall attachment against rather than away from the building wall.

12.07 When placing a ladder against a tree, select the tree trunk or its larger limbs for support. When it is necessary to place a ladder so the top rung rests against a tree trunk or similar object, a handline may be thrown or placed with a wire raising tool or tree pruner handle over a tree limb, tied to the top rung of the ladder, and used to assist in raising the ladder. After the ladder has been placed, tie the free end of the handline to one of the lower rungs, thereby holding the ladder until a more secure lashing is made. The ladder shall be lashed securely at one or two points in a manner which will prevent the ladder from twisting or sliding when the craftsman's weight is put on one side. The lashing can be performed in the following manner with a second rope.

a. Make a slip noose about 15 feet from the free end of the rope so that the noose will tighten when the free end of the rope is pulled.

b. Place the slip noose over the top end of one side rail.

c. Pass the free end of the rope down behind and under the top rung, then toward the front of the ladder, around the rail, and then to the back of the tree or pole.

d. Make two complete wraps around the **tree** or **pole**, then pass the rope twice around the opposite rail below the first rung, and then up behind the rung.

e. Reverse the direction of wrapping and make two half-hitches on the rail so that the ladder is lashed tightly to the **tree** or **pole.** See Figure 21.

NOTE: Never place an extension ladder against a window sash. If it is not possible to avoid placing a ladder in front of a window, lash a board to the

FIGURE 21.

ladder to provide support on each side of the window frame.

13. LADDER HOOKS

13.01 The ladder hooks provided on extension ladders are shown in Figure 22.

13.02 When not in use, turn the hooks in between the rails. To rotate a hook, push it toward the lower end of the ladder, turn it 90°, then release it. The coil spring locks the hook in either of two positions. Turn ladder hooks in between the rails when the ladder is to be placed against a building wall or other flat surface.

13.03 Ladder hooks on extension ladders should be used on lashed, ring-supported, and self-supporting cable when the ladder is not lashed to the strand.

CAUTION: When using ladder hooks on aerial cable, make certain the ladder is placed on firm and level footing to prevent the ladder from twisting or sliding along the strand.

13.04 When using a ladder (even if the ladder is lashed to the strand), and especially when placing and removing the ladder, a greater margin of safety is provided with the hooks in the working position.

14. TRANSPORTING LADDERS ON MOTOR VEHICLES

14.01 When transporting ladders on trucks or other motor vehicles, always fasten them securely in their proper position, using the straps or other devices provided for the purpose. Never use wire for securing a ladder to the brackets of a truck. A ladder hanging loosely on the brackets of a truck will soon be marred, cracked, and weakened by road shocks.

15. ONE-MAN METHOD OF CARRYING A LADDER

15.01 Carry extension ladders in the closed position with the shoes pointed downward and to the front and the ladder hooks turned in between the side rails. Secure the end of the ladder rope by tying it with a clove hitch around one rung of the top section and the adjacent rung of the bottom section.

15.02 To carry an extension ladder, first place it in the vertical position with the side rails of the bottom section on the outer side. Tilt the ladder until the bottom section side rail rests against the chest and shoulder; then lift the ladder to the shoulder until the exact point of balance is obtained. The proper carrying method is shown in Figure 23.

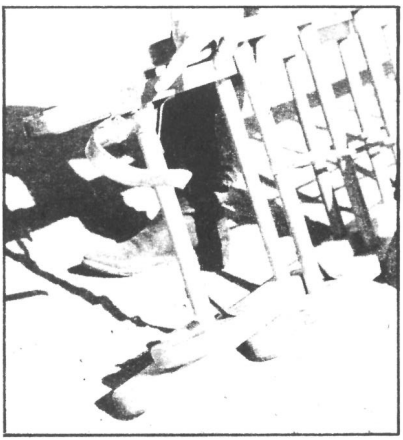


FIGURE 22.

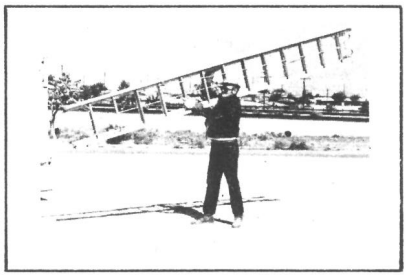


FIGURE 23.

15.03 Do not lift or carry a ladder by grasping the ladder rope.

16. TWO-MAN METHOD OF CARRYING A LADDER

16.01 First, secure the free end of the ladder rope with a clove hitch around one rung of the top section and the adjacent rung of the bottom section, and turn the ladder hooks in between the side rails.

16.02 To pick up a ladder, the two men take positions at opposite ends and, lifting together, lift the ladder as shown in Figure 24. Carry the ladder with the shoes forward.

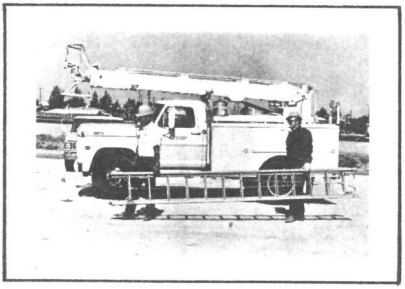


FIGURE 24.

17. METHOD OF RAISING AND LOWERING WOOD EXTENSION LADDERS

17.01 The following is a one-man method of raising a 24-foot or 28-foot ladder to suspension strand. (When two craftsmen are available, this method may also be used for raising longer ladders to the strand.) This method of handling ladders keeps the ladder under control at all times and provides a temporary lashing to the strand before climbing.

17.02 Where ground conditions allow, place the ladder on the ground at a right angle to the suspension strand, with the base of the ladder directly under the location of the work.

17.03 While they are lying on the ground, 24-foot and 28-foot ladders can be extended to within a few feet of the vertical height of the strand before raising the ladder.

NOTE: Ladders of greater length should be extended only two rungs.

17.04 Where ground conditions do not permit placing the ladder as described above (for example, where the end of the ladder would interfere with traffic on a road or street), the base of the ladder can be moved back from its position under the work location as required. It can also be placed parallel to the suspension strand, with the base directly under the work location. In either of these positions, extend the ladder only two rungs.

17.05 Throw a handline over the strand at the location where the ladder is to be supported. If there is a possibility of the handline becoming involved with tree branches, power wires, etc., place the handline over the strand with tree pruner handles, taking care to avoid contact with power wires. In doing this, take care that the free end of the handline does not interfere with passing vehicles.

17.06 Tie the near end of the handline to the bottom rung of the ladder, using a clove hitch and two half-hitches. Take the other end of the handline to the top of the ladder. Check the handline where it passes over the strand to be sure it does not cross over itself, and pass the free end behind the second rung from the top, and then out on the top side of the ladder. See Figure 25.

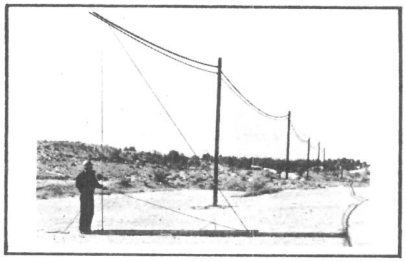


FIGURE 25.

17.07 Pull the handline hand over hand. As the top end of the ladder is raised off the ground, keep both feet in position to block any movement of the base of the ladder to the rear. See Figure 26.

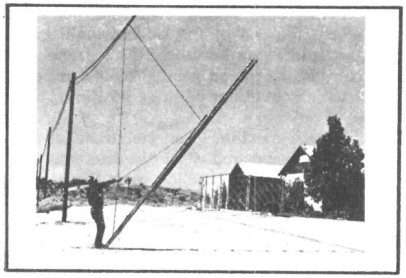


FIGURE 26.

17.08 Continue pulling the free end of the handline until the ladder is in a vertical position under the strand as shown in Figure 27.

17.09 As mentioned in paragraph 17.04, if the ladder base was not placed under the strand, the base should be moved directly under the strand. To do this, tie the free end of the handline to a ladder rung with a clove hitch and two half-hitches and move the base of the ladder in position under the strand. Untie the free end of the handline and pull on the handline until the ladder is vertical as shown in Figure 27.

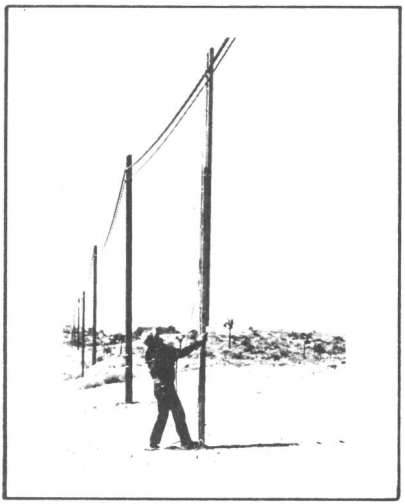


FIGURE 27.

17.10 With the ladder positioned vertically under the strand, hold the ladder in this position with one hand on the side rail. Allow about 1 foot of slack in the free end of the handline, and hold this slack with the same hand on the side rail. Use the other hand to tie the rope around the second or third rung with a clove hitch and two half-hitches. (If desired, the rope may be doubled or the tie may be made around two rungs to avoid having excess rope lying on the ground.) The ladder is secured to the strand and cannot fall as long as the handline is tied to the ladder.

17.11 Untie the ladder extension rope, taking care not to untie the handline. Pull on the ladder extension rope and extend the ladder until the top section is above the strand, perferably with the second rung level with the strand, and engage the ladder locks. See Figure 28.

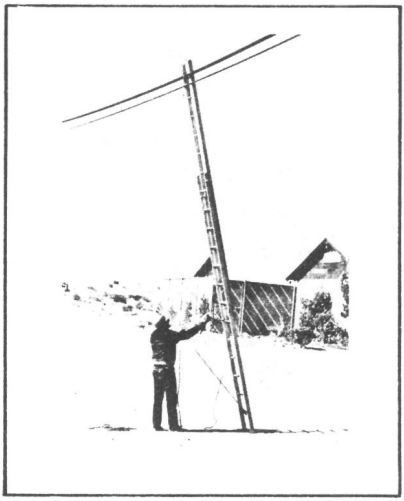


FIGURE 28.

17.12 To lock the top section after it has been raised to the desired height, continue raising it until the ends of the lock hooks are just above the rung to be engaged; then lower the top section until the inside curve of the lock hooks rests directly on the rung. Make sure that both locks are engaged.

17.13 Move the foot of the ladder out to its working position, allowing the top of the ladder to rest on the strand. It should not be necessary to extend the ladder further. However, if necessary to do so, untie the handline, extend the ladder, and retie the handline.

17.14 To lower the ladder, move the foot of the ladder back under the strand. Leaving the handline over the strand tied at both ends, untie the ladder extension rope. Lower the top section until it is extended two rungs above the bottom section and secure the ladder locks. Untie the upper end of the handline and lower the ladder gently to the ground by slowly paying out the handline. If the top end of the ladder tends to swing, move the foot of the ladder back while holding the handline securely.

17.15 A 28-foot extension ladder may be raised or lowered by one man in the manner shown in Figure

29, if the foot of the ladder is securely embedded in earth or is placed against the base of a wall, a pole, or other secure object.

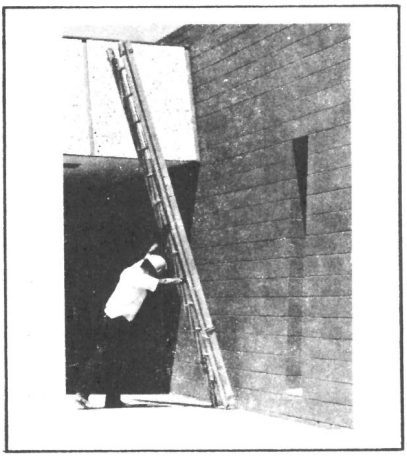


FIGURE 29.

17.16 A 32-foot extension ladder should be raised with the foot of the ladder held securely by one craftsman, while a second craftsman walks the ladder up to a vertical position similar to that shown in Figure 30. As an alternative, if the foot of the ladder can be placed against the base of a wall, one craftsman can raise the ladder as described in paragraph 17.15.

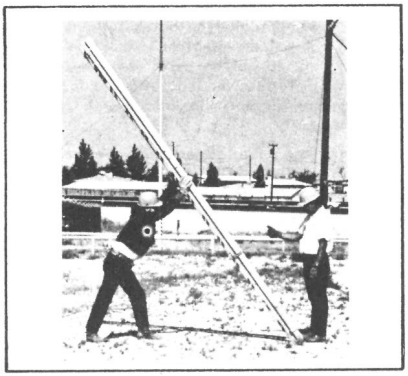


FIGURE 30.

17.17 When raising or lowering extension ladders, it is imperative that the craftsman handling the ladder maintain a secure footing at all times.

17.18 When lowering ladders, follow the reverse of the procedures for raising ladders.

18. HANDLING AND RAISING TOP SECTIONS OF 24-FOOT AND 28-FOOT WOOD LADDERS

18.01 After the ladder has been raised to an upright balanced position, stand in front of the ladder with one foot against the base of the ladder to prevent it from kicking out. Place the other foot in a bracing position to the rear of the ladder to provide a firm stance. See Figure 31. Untie the ladder extension rope and raise the ladder.

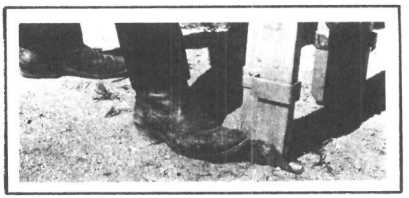


FIGURE 31.

18.02 After locking the top section, allow the top of the ladder to move slowly toward the support. When the ladder is in place against the support, tie the ladder rope securely to one of the rungs of the bottom section with a clove hitch and two half-hitches.

18.03 As an alternate method, after the ladder has been raised to an upright balanced position on a firm footing, balance the ladder with one hand and move behind the ladder in a position to operate the ladder rope with the other hand.

18.04 Pull the ladder rope to raise the top section two or three rungs at a time, engaging the locks after each pull. Take care to prevent the lower guide iron from striking the hand holding the side rail. Lock in place as instructed in paragraph 17.12.

19. LOWERING TOP SECTION OF 24-FOOT AND 28-FOOT WOOD LADDERS

19.01 Stand at the base of the ladder and raise the upper section about 6 inches by means of the ladder rope to release the ladder locks. Allow the upper section to descend slowly by applying the necessary drag on the rope. The drag on the rope should hold the ladder in the balanced position. See Figure 32. Take care to prevent injury to the hand holding the side rail. Do not allow the top section to strike the ground or pavement sharply.

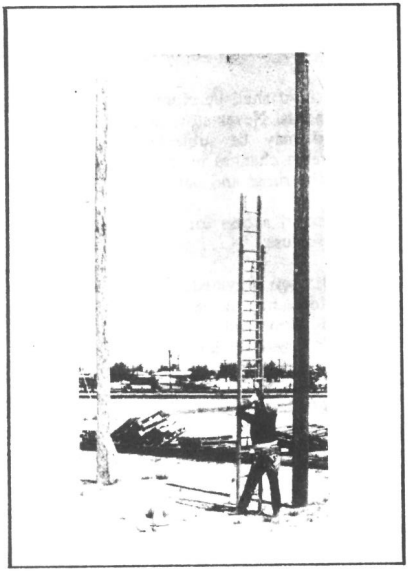


FIGURE 32.

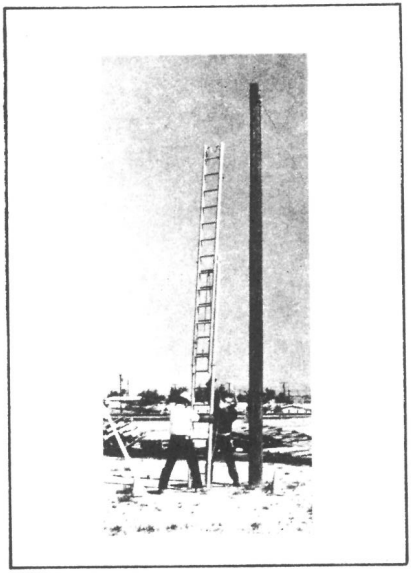


FIGURE 33.

20. RAISING AND/OR LOWERING TOP SECTION OF 32-FOOT WOOD LADDERS

20.01 One craftsman shall hold the side rails of the lower section on the front side of the ladder during the raising and lowering of the upper section by another craftsman. Take care to prevent the ladder guide irons from striking and injuring the hands of the craftsman holding the side rails. The ladder is raised by the second craftsman as described in paragraph 18.04 and shown in Figure 33.

20.02 The craftsman holding the ladder shall keep his feet and legs clear of the side rails and bottom rung of the lower section while the upper section is being lowered. The craftsman lowering the top section shall check its downward movement with the ladder rope so that the top section does not strike the ground or pavement sharply.

21. STORAGE OF WOOD LADDERS

21.01 Ladders that are **not being used** shall be stored in a well-ventilated area, where they will not be exposed to the elements. Never store ladders near radiators, stoves, steampipes, or in places where the wood may be subjected to excessive heat or dampness. Such conditions bring about extreme changes in the moisture content of the wood, causing the wood to split or crack and the rungs and hardware to become loose.

21.02 Store ladders to provide ease of access for inspection and to prevent danger of accident when withdrawing a ladder for use.

21.03 Where ladder racks have not been provided, store ladders in a vertical position. Where this is not practical, lay the ladders in a horizontal position, one on top of the other. Place wooden spacers between the floor and the lower ladder and between ladders to prevent side rails from becoming damaged by guide irons. Do not store ladders in any position where there is a chance of pressure being placed on them that might cause warping or twisting. Not more than six ladders should be placed in one stack. Heavy objects shall not be permitted to rest on ladders in storage.

21.04 Ladders stored in a horizontal position should be supported at a sufficient number of points (at least 3 points for 24-foot ladders and 4 points for the longer ladders) to avoid sagging and permanent set.

INSULATING GLOVES
LEATHER PROTECTORS, FABRIC LINERS
AND GLOVE BAG

1. GENERAL

1.01 This practice covers the description, care, and maintenance of insulating gloves provided for the protection of Continental Telephone Company workmen against electric shock, and the precautions to be followed in their use.

2. TYPES OF INSULATING GLOVES

2.01 All types of insulating gloves are of the gauntlet type and are made in sizes 10, 11, and 12. The size indicates the approximate number of inches around the glove, measured midway between the thumb and finger crotches. The length of each glove, measured from the tip of the second finger to the outer edge of the gauntlet, is approximately 14". See Figure 1.

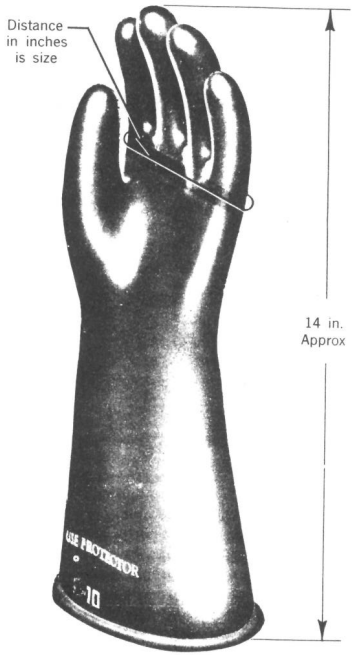


FIGURE 1. Insulating Glove.

3. LEATHER PROTECTOR GLOVES

3.01 Leather protector gloves must always be worn over insulating gloves to prevent mechanical damage to the insulating gloves. Leather protector gloves do not provide protection from electrical shock by themselves and should never be worn except over insulating gloves.

3.02 Leather protector gloves *are not* to be worn as a substitute for work gloves.

3.03 Leather protector gloves are of the gauntlet type. The overall length is about 13" and the cuff is about 4-1/2" wide. See Figure 2.

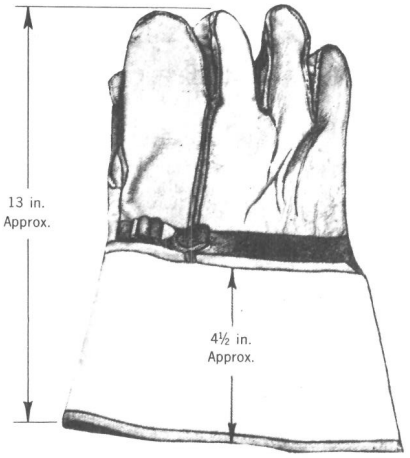


FIGURE 2. Leather Protector Glove.

3.04 Leather protector gloves are made of deerskin using the moccasin style outseam construction (seams sewn outside at the back of the fingers and thumb). These gloves are somewhat more flexible and less bulky.

3.05 Leather protector gloves are made in three sizes for use over insulating gloves of similar size designations.

3.06 Leather protector gloves are to be given reasonable care in their use. Oil, grease, paint, etc., on the palm and finger surfaces of the gloves impairs their usefulness for work operations. All foreign matter should be immediately wiped off the gloves with a soft, dry cloth.

3.07 Inspect leather protector gloves before and after use.

4. FABRIC LINER GLOVES

4.01 Fabric liner gloves are formfitting gloves made of lightweight interlock knit cotton cloth They are equipped with 3" wide rubberized fabric gauntlets. The overall length of the gloves is about 10-3/4". See Figure 3.

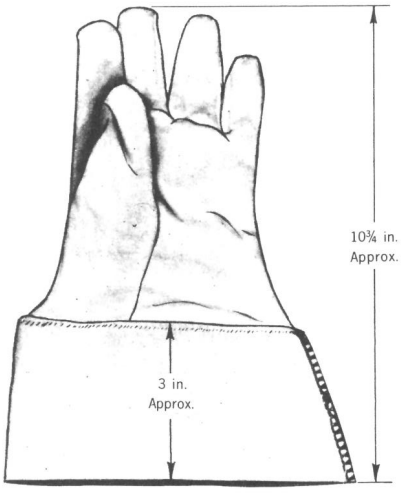


FIGURE 3. Fabric Liner Glove.

4.02 Fabric liner gloves are available in the following sizes:

a. Size 7 for insulating glove size 10.

b. Size 8 for insulating glove sizes 11 and 12.

4.03 Fabric liner gloves may be worn inside all types of insulating gloves for warmth in cold weather and for absorbing perspiration in warm weather.

5. RUBBER GLOVE BAG

5.01 The rubber glove bag is provided for carrying and storing insulating gloves, associated leather protector, and fabric liner gloves.

5.02 The rubber glove bag is made of cotton duck. A snaphook is provided for suspending the bag from the body belt.

6. PRECAUTIONS

6.01 Except in emergencies (such as to prevent serious injury or loss of life), Continental Telephone employees will not handle electric power wires or associated switches, and will arrange to have the work required on these circuits performed by properly qualified employees of the Power Company.

6.02 Continental Telephone employees will not handle telephone wires that are known or suspected to be energized until the contact conditions have been cleared by the Power Company.

6.03 In general, conditions under which insulating gloves should be worn are covered in the CTSP 490-050 Series on various field operations. However, because of the complicated nature of the conditions encountered under which insulated gloves should be worn, it is impractical to provide a complete set of rules covering all of the specific cases in which they are to be used. Therefore, where workmen must handle wires or other objects on which there is any possibility of an abnormal voltage being introduced, insulating gloves are to be worn. Workmen wearing insulating gloves must avoid body contact with wires, poles, vehicles and any other object which might be energized.

6.04 Insulating gloves are inspected and subjected to an electrical test to ensure their insulating value when purchased from the manufacturer and periodically thereafter according to the company's established routine.

6.05 Workmen and storekeepers are to see that insulating gloves receive their periodic electrical tests in accordance with the company's established routine.

6.06 Insulating gloves are never to be worn inside out as this stresses the curved portions of the gloves. Exposure to ozone is more pronounced at points where rubber is stressed, causing these points to be more susceptible to deterioration.

7. INSPECTION OF INSULATING GLOVES

7.01 It is the responsibility of the employee to be certain that his insulating gloves are in good condition.

7.02 Each employee shall inspect his insulating gloves in accordance with this practice as follows:

a. At the time he receives the gloves.

b. Each time before using them.

c. Each time after using them.

d. A minimum of once each month if not used.

7.03 The supervisor is to inspect the insulating gloves periodically and is to see that all instructions contained in this practice are complied with.

7.04 The visual inspection of insulating gloves is to be made to determine their safety. If any of the following conditions exist, the gloves are to be replaced in accordance with the company's established practice:

a. Cracks, cuts, or nicks that would tend to cause the glove to tear. Such defects within 1" of the open end of the gauntlet may be disregarded if of a minor nature.

b. Deterioration or ozone cracking. This is best detected by rolling the surface between the thumb and forefinger and watching for fine surface cracks.

c. Glove worn sufficiently to affect the mechanical strength. This is best detected by stretching the glove as follows:

(1) Grasp the gauntlet end of the glove with one hand and pull on each glove finger with the other hand.

(2) Pull the glove by grasping at both sides.

(3) Pull the fingers apart.

NOTE: Worn spots are indicated by undue stretching or, in severe cases, by tearing of the glove.

(4) Check the date stamped on the gauntlet to ensure that the gloves are being used within the proper dates.

NOTE: The above inspections are to be made on both the inner and outer surfaces of the insulating gloves.

8. AIR TEST OF INSULATING GLOVES

8.01 The air test is to be made before and after each use of the insulating gloves. Make this test as follows: (See Figure 4.)

a. Hold the glove at each side of the edge of the gauntlet.

b. Revolve it about the edge of the gauntlet as on an axis, thus rolling it toward the palm and confining the air to the palm and fingers.

c. Hold the rolled-up gauntlet tightly in one hand.

d. Squeeze the palm of the glove with the other hand so as to place the confined air under pressure.

8.02 If any puncture exists, it is indicated by excaping air and the hole in the glove should be evident.

8.03 If a puncture is found or if the condition of the gloves is such that there is any doubt as to their safety, replace the gloves at once.

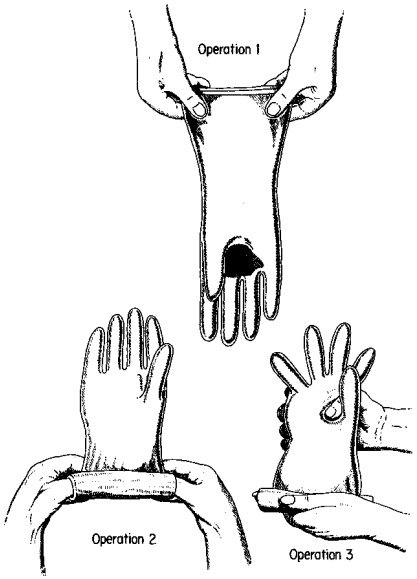


FIGURE 4.

9. CLEANING OF INSULATING GLOVES

9.01 Insulating gloves shall be cleaned when:

a. They become wet from perspiration.

b. They are subjected to contact with dirt, mud, paint, creosote, or any other foreign matter.

9.02 Perspiration, mud, dirt, and other foreign matter that does not adhere firmly to the glove may be removed with clear water.

9.03 Paint and creosote should be removed as soon as possible, because some oils have a deteriorating effect if allowed to remain on the glove.

9.04 The following method has been found satisfactory for removing paint or creosote from the glove:

a. Wipe the gloves with a dry cloth, removing as much wet paint or creosote as possible.

b. Clean the entire glove thoroughly with a cloth moistened with one of the following:

(1) Dry-cleaning fluid.

(2) Petroleum spirits.

(3) Trichloroethylene.

NOTE: *Do not* use an excessive amount of the cleaning fluid and *do not wipe over the test date.*

IMPORTANT: *This cleaning should be done in a well-ventilated location as these materials are either flammable or their vapors constitute a health hazard. As soon as each glove has been cleaned, it should be wiped thoroughly with a dry clean cloth.* **Do not use gasoline to clean insulating rubber gloves.** Gasoline has a very low flash point and its use presents a much more serious fire hazard than the above mentioned cleaning fluids.

9.05 After insulating gloves are used, they should be thoroughly dried so that moisture from the hands does not penetrate and cause the glove to deteriorate. After each use, gloves should be turned inside out and laid flat to dry. After the gloves have been dried, they should be turned right side out and placed in the containers ready for use.

10. STORAGE

10.01 Fabric liner gloves and leather protector gloves should be stored with the insulating gloves so that they will be available for use. All gloves should be dry before being stored.

10.02 Fabric liner gloves, insulating rubber gloves, and leather protector gloves should be separated during storage.

10.03 Insulating gloves deteriorate even when not in use. This deterioration is caused by ozone in the atmosphere reacting with the glove material to produce fine surface cracks. Ozone deterioration will be materially reduced if the gloves are:

a. Laid out flat, right side out without bends or folds.

b. Protected from:

(1) Light.

(2) Edged tools.

(3) Pressure due to heavy objects.

c. Stored in a ventilated room away from ozone producing equipment such as electric motors and generators.

d. Stored away from steam pipes, radiators or places subject to heat.

10.04 For maximum protection of the gloves, one of the following methods of storage should be used:

a. On motor vehicles—Insulating gloves, leather protector, and fabric liner gloves should be kept in the glove bag with the flap secure.

b. With tool bags—Insulating gloves, leather protector, and fabric liner gloves should be kept tightly closed in the glove bag, which should be attached to the tool bag.

NOTE: Care should be taken to attach the glove bag so that it will be flat against the side of the tool bag which is away from the body.

c. When insulating gloves, leather gloves, and fabric liner gloves are being carried for intermittent use, they should be kept in the glove bag.

d. If they are stored in lockers or central offices, the gloves should be kept in the container in which they were returned from electrical testing.

11. DISPOSITION OF INSULATING GLOVES REQUIRING ELECTRICAL TESTING

11.01 Storekeepers are responsible for insulating gloves in the storerooms and workmen are responsible for insulating gloves which they have in the field. The dates of return for tests are stamped inside the glove cuff.

11.02 Workmen are to see that gloves in the field are returned to the storeroom or office prior to the "Return for Test" date. Replacement gloves should be available before returning the gloves to be tested.

11.03 Storekeepers should see that all gloves in their possession are returned for inspection on the dates indicated to the authorized inspection agency. However, if gloves are held beyond this date, they should not be used or issued until retested.

11.04 Before being returned to the authorized agent, all insulating gloves should be given a careful inspection in accordance with paragraph 7 and a careful test in accordance with paragraph 8. Gloves with obvious defects should be disposed of in accordance with paragraph 12.

12. DISPOSITION OF DEFECTIVE INSULATING GLOVES

12.01 Gloves with obvious defects should have the front cut open from the fingers to the top of the gauntlet and should be disposed of as junk in accordance with the company's established routine.

TEST SET 81AW
TEST PROCEDURES

1. GENERAL

1.01 This practice describes the 81AW test set used for conductor identification and continuity tests on inside wire, drop wire, block wires, inside wiring cable, etc.

1.02 Store the test set in a dry location.

2. DESCRIPTION

2.01 The 81AW test set (Figure 1) consists of a buzzer, switch and capacitor which are contained in the top of a plastic case. The bottom of the case houses two type D dry cell batteries.

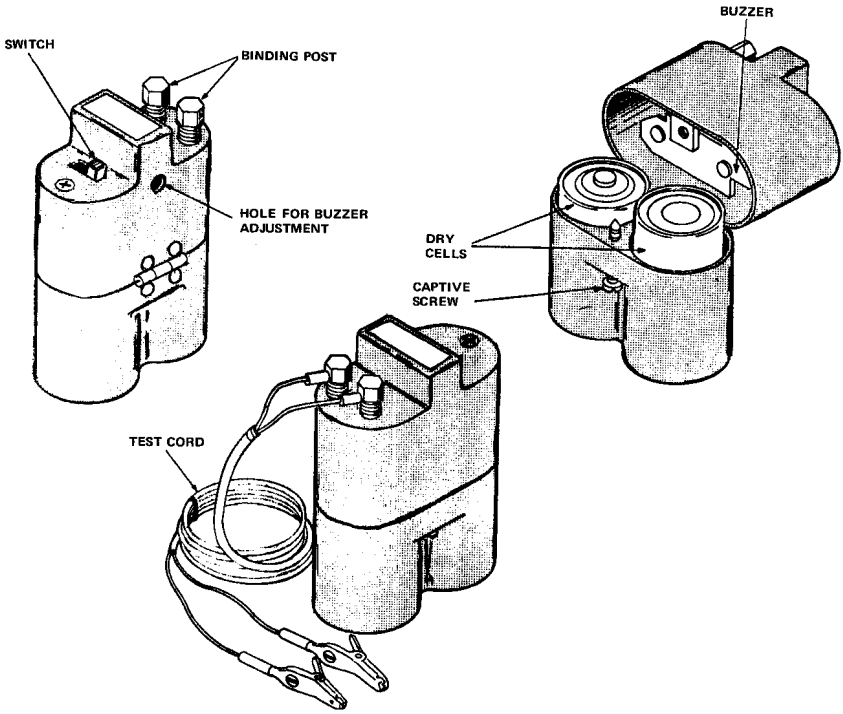


FIGURE 1. 81AW Test Set.

2.02 The switch on top of the case has three positions.

a. OFF

b. C = For DC continuity tests

c. T = For buzzer tone

2.03 A test cord assembly attaches to the binding posts. It consists of cord tips on one end and test clips on the other end.

3. OPERATION

3.01 Care should be exercised when using this test set that foreign potentials, either AC or DC, are not present. Carelessness will result in damage to the buzzer or annoyance to customers.

3.02 The switch must be placed in the OFF position when the set is not in use.

3.03 *Shorted Conductors:* With the switch in the OFF position, connect the test set to the conductors to be tested, either directly or by using the test cord.

3.04 Operate switch to the C position. If the buzzer operates, there is a short across the pair. If the buzzer does not operate, a further test should be made by placing a hand test set in series with the 81AW test set. If there is a click in the receiver, the pair is shorted.

3.05 Connect the 81AW test set across the pair of conductors to be tested, and operate the switch to T to start the buzzer.

3.06 Assuming the locations of both ends of the pair are known, go to the other end with a hand test set and connect it across the pair.

a. If the buzzer tone is heard, the pair is not open.

b. If the buzzer tone is not heard, the pair is open on one side or both sides.

c. Each side can be checked if a good conductor (metallic or ground) is available between the two points.

3.07 Connect the test set between one side of the pair to be tested and the good conductor.

3.08 Connect the hand test set between the side of the pair being tested and the good conductor at the other location.

a. Buzzer tone is an indication the side is not open.

b. No buzzer tone is an indication that the side is open.

3.09 *Tracing Conductors:* Connect the 81AW test set to the pair to be traced, and test to be sure the pair is not shorted.

3.10 Operate the switch to the T position to start the buzzer, and go to the location where it is desired to identify the pair.

3.11 Connect the hand test set (switch in the C, or capacitor position) across each pair of wires until the buzzer tone is heard. If tone cannot be heard on any pair, this indicates the pair to be located does not appear at the point being tested, or one or both sides of the pair are open.

4. MAINTENANCE

4.01 Do not mishandle or drop the test set.

4.02 Replace weak cells immediately. The dry cells must be placed in the test set in series: one right side up and the other upside down. Occasionally it may be necessary to clean the cell contact springs. They are readily removable.

4.03 The upper section of the test set contains a hole to be used for screw driver access to the buzzer for adjustment. The correct adjustment procedures are:

a. Operate the switch to the T position; the buzzer should operate.

b. Set the adjusting screw until the volume and pitch of the tone are highest; then turn the adjusting screw counterclockwise 1/8 turn.

4.04 To test the set:

a. Operate the switch to the T position; the buzzer should operate.

b. Operate the switch to the C position; the buzzer should not operate.

c. With the switch in the C position, short the two terminals; the buzzer should operate.

PROTECTION
PORTABLE ELECTRIC POWER TOOLS
GROUNDING

1. GENERAL

1.01 This addendum is reissued to update the Continental Telephone System standard for portable electric power tool cords (CTSP 405-705-320) and to clarify how equipment shall be marked to indicate double insulation.

1.02 Existing standard catalogs and practices indicate that portable electric drills are equipped with a 3-conductor cord that provides a ground for the drill housing.

1.03 With red pencil or ink make the change specified in paragraph 2 of this addendum and file in front of CTSP 405-705-320. In the margins of the subject paragraphs, write the words "See Addendum".

1.04 Issue 1 of addendum should be removed from file and destroyed. File this addendum directly in front of CTSP 405-705-320.

2. CHANGE

2.01 Change paragraph 1.01 to read as follows:

1.01 This practice describes the procedure for the proper grounding of portable electric power tools and methods of obtaining effective grounds. Portable power tools shall be grounded, unless those tools or appliances are protected by a system of double insulation. Where double insulation is used, the equipment shall be distinctly and permanently marked by the manufacturer to indicate the double insulation.

PORTABLE ELECTRIC POWER TOOLS GROUNDING

1. GENERAL

1.01 This practice describes the procedure for the proper grounding of portable electric power tools and methods of obtaining effective grounds.

1.02 The grounding of portable electric tools protects the operator from electric shock caused by insulation breakdown on current carrying parts within the tool housing. Grounding prevents the presence of voltage on the tool frame.

1.03 Grounding as described in this practice is accomplished by a third conductor used to connect the tool housing to the local power grounding system or to other equivalent grounds, such as a cold water pipe.

1.04 Permission should be obtained from the property owner or an authorized person before connecting the power tool to an outlet receptacle on a customer's premises.

2. PRECAUTIONS

2.01 Use only electric tools provided by the company.

2.02 *Electric power tools must always be adequately grounded.*

2.03 Before connecting a tool to a power supply, check the tool apparatus plate to be certain that the proper voltage and current type (AC or DC) is available.

2.04 Replacement cords should have equal or larger gauge wire than the original cord.

2.05 All cords assembled or repaired locally should be tested for continuity of the grounding conductor before connecting the tool to a power supply.

2.06 Make certain that the grounding connections do not become disengaged while the tool is being operated.

3. PROVISIONS FOR GROUNDING

3.01 The adapters shown in Figure 1 permit connections when the outlet receptacle is not the same type as the plug.

3.02 All electric power tools (except lamps and soldering coppers) should be equipped with a 3-conductor cord which terminates in a 3-blade plug (see Figure 2). Lamps and soldering coppers do not require grounding.

3.03 The 3-blade standard plug supersedes two other types of plugs; 3-blade crowfoot and the 2-blade parallel with an external attached pigtail grounding wire.

3.04 Extension cords are required for connecting power tools to outlet receptacles located away from the work area. This is usually a 50' cord with 16 gauge conductors having a standard plug at one end and a standard connector at the other.

CAUTION: The extension cord (Figure 3) should not be used with portable electric tools where conductors of a larger size are required.

3.05 The pigtail grounding terminal on adapters or attachment plugs should be connected to a suitable conductor as shown in Figure 4.

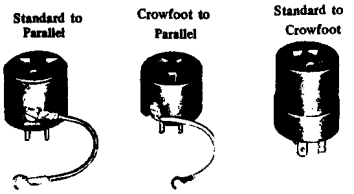


FIGURE 1. Adapters.

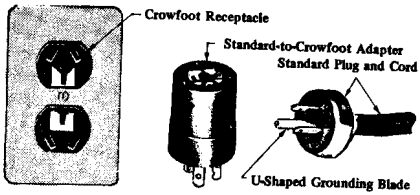


FIGURE 2. Standard-to-crowfoot Adapter.

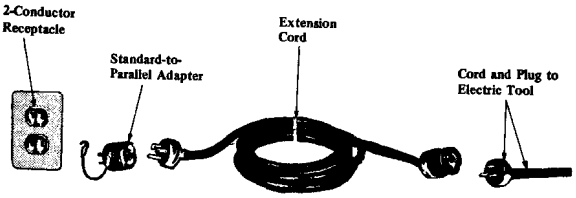


FIGURE 3. Typical Cord Make-up.

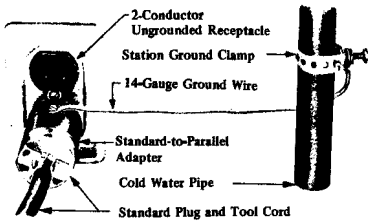


FIGURE 4. Ungrounded 2-conductor Receptacle.

4. METHOD OF GROUNDING

4.01 *3-Wire Grounding Type Receptacles*—The most satisfactory method of providing an effective ground is through the connection of a 3-blade plug to a comparable 3-wire receptacle. See Figure 5.

NOTE: The standard to crowfoot adapter must be used when the receptacle is a crowfoot type and the plug is standard. See Figure 2.

4.02 *2-Wire Receptacles (Ungrounded Outlet Box)*–Where electrical connections are to be made at 2-wire parallel receptacles, proceed as follows:

a. Locate a nearby grounded object (such as a cold water pipe) to which the ground wire or grounding cord may be attached.

b. Attach a ground wire to the green ground terminal on the plug or adapter and to the grounded object selected, making certain a good metallic connection is achieved at both ends. See Figure 4.

c. Insert the adapter or plug into the receptacle for tool operation.

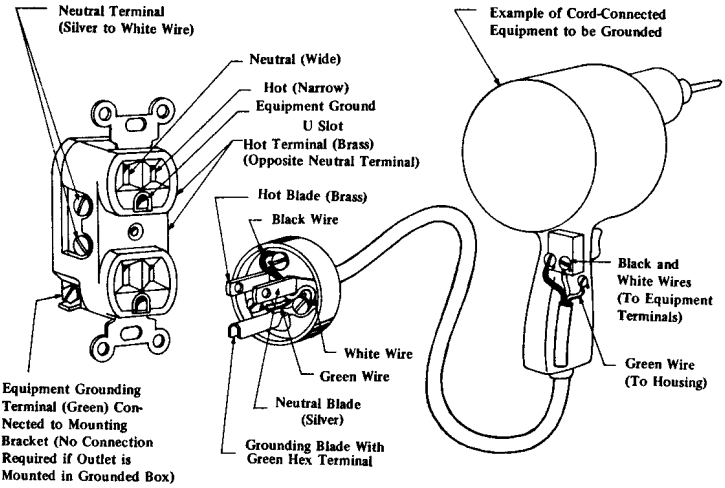


FIGURE 5. Wiring of 125-volt Standard Plug and Receptacle.

4.03 *2-Wire Receptacles (Grounded Outlet Box)*–Where it is known that a building is wired with metallic conduit, armored cable, or nonmetallic sheath cable with a grounding conductor, the outlet boxes may be grounded. Under these conditions and only after it has been found that the boxes are grounded, the grounding pigtail terminal on the adapter or plug may be fastened under the coverplate screw of the receptacle. See Figure 6. In grounding to a 2-conductor receptacle (Figure 6), connect pigtail to coverplate screw before inserting adapter into the receptacle.

NOTE: If grounding cannot be accomplished as outlined in this practice, the electric tool must not be operated. Nonelectric tools should be used to complete the job.

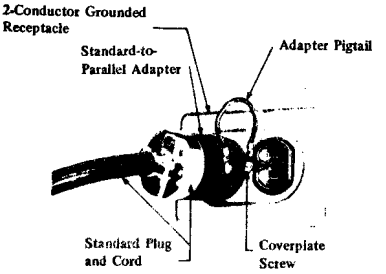


FIGURE 6. Grounded 2-conductor Receptacle.

MILLER FALLS MODEL 185 AUTOMATIC HAND DRILL

1. GENERAL

1.01 This practice covers the description and use of the Miller Falls 185 Automatic Hand Drill, CTS #74-50-061-9. (See Figure 1). This practice is being reissued to reflect the System approved hand drill.

1.02 The Miller Falls 185 automatic hand drill is to be used on wood trim, paneling and siding to drill pilot holes for placing screws (generally used by Outside Installers).

2. DESCRIPTION

2.01 The automatic drill is a push-type drill. It is used with drill points suitable for drilling small holes in light metal or wood. The handle serves as a magazine for ten drill points.

2.02 Drill points furnished with the automatic drill are listed in Table A.

3. OPERATION

3.01 To remove a drill point from the magazine:

a. Hold drill with magazine pointed down. Press spring lock forward and turn magazine cap to the desired drill point size.

b. Remove the desired drill point by tilting the magazine downward.

c. Turn the magazine cap back to its original position.

3.02 To insert a drill point:

a. Grasp the cylinder of the drill in the palm of the hand with the thumb against the back of the chuck sleeve.

b. Slide the chuck sleeve forward past the end of the chuck body.

c. Insert drill point in the chuck and release the chuck body.

d. Rotary action of the drill is created by the forward stroke or push of the handle.

TABLE A. DRILL POINTS

QUANTITY	SIZE INCHES	INTENDED USE	REMARKS
1	1/16	Wood	Straight-fluted carbon steel drills, suitable for drilling wood
1	5/64	Wood	
1	3/32	Wood	
1	7/64	Wood	
1	1/8	Wood	
1	9/64	Wood	
1	5/32	Wood	
1	11/64	Wood	

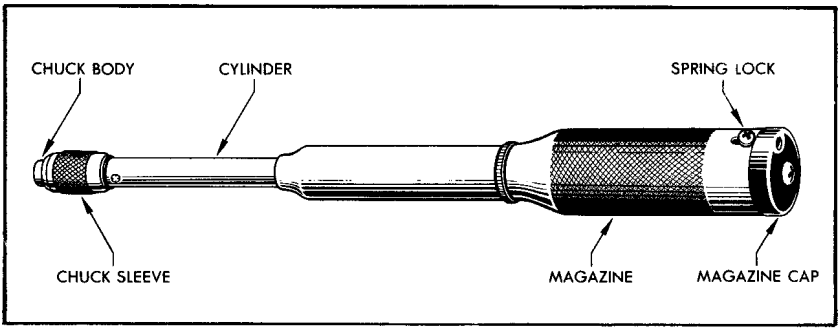


FIGURE 1. Miller Falls 185 Automatic Hand Drill

4. PRECAUTIONARY MEASURES

4.01 Observe the following precautions to prevent accidents and damage to tools or materials:

a. Keep both hands behind the drill point during operation.

b. Use suitable eye protection when the drill is used.

c. Remove the drill point from the chuck when not in use.

d. Do not use drill points that are bent.

e. Mark the location to be drilled and remove the apparatus before drilling holes.

f. Start guide holes with a center punch when metal is being drilled.

g. Use only enough pressure to operate the drill. (This is particularly important when using the small 1/16-inch drill point).

h. Hold the drill at a right angle to the surface being drilled.

UC 250 UTILITY CLAMP
DESCRIPTION AND INSTALLATION

1. GENERAL

1.01 This practice provides description and installation procedures for the UC 250 Utility Clamp.

1.02 The purpose of the UC 250 Utility Clamp is to provide support for wire and cable runs for inside installations.

2. DESCRIPTION

2.01 The UC 250 Utility Clip, Figure 1, is manufactured of spring steel and is so constructed that it may be installed without the use of hardware or tools.

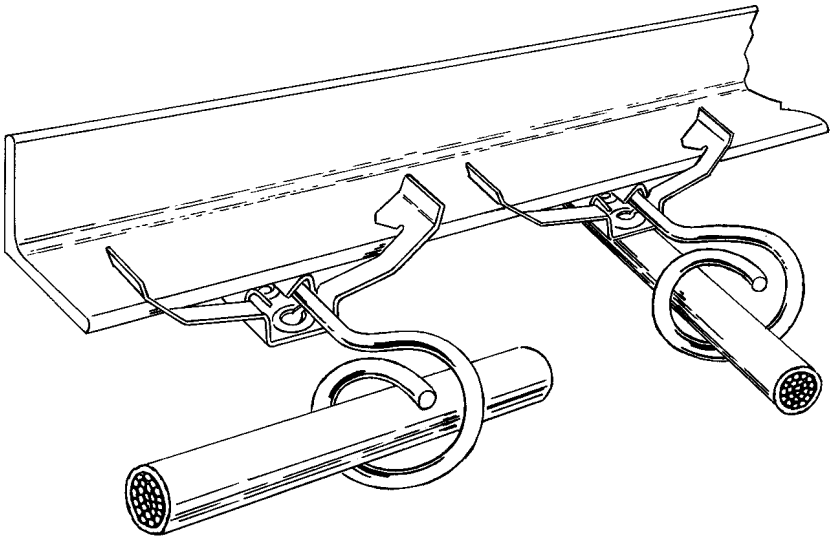


FIGURE 1

2.02 The clip may be attached to structural beam flanges ranging in thickness from 1/8" to 3/8", to wire from 12 through 8 gauge and to suspension rods ranging in diameter from 3/16" through 3/8", see Figures 2 and 3.

2.03 Bridle rings or drive rings may be fitted to the loops located at the center of the assembly, Figure 2, or the loops may accommodate a No. 8 sheet metal screw.

2.04 Two threaded depressions are provided on one side of the clip. One of the depressions accepts a 10-24 machine thread and the other a 1/4-20 machine thread. See Figure 2.

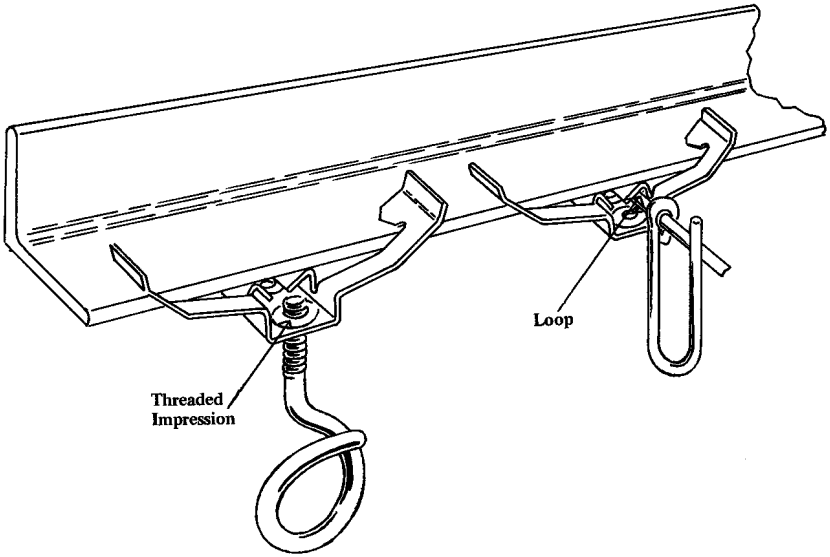


FIGURE 2

3. INSTALLATION

3.01 To install the UC 250 Utility Clip, proceed as follows:

a. Position the open slot of one end of the clip so that the wire, rod or flange rests against the top inside corner of the slot.

b. Support the center section of the clip while performing step c.

c. Apply pressure to the opposite end of the clip until the open slot has clearance with the supporting member.

d. In order to preserve the self supporting feature of the utility clip, apply only that pressure which is necessary to accomplish the installation.

e. Apply pressure in the required direction until the support member rests against the inside corners of both slots. See Figure 3.

f. Attach the appropriate supporting ring or screw to the spring clip.

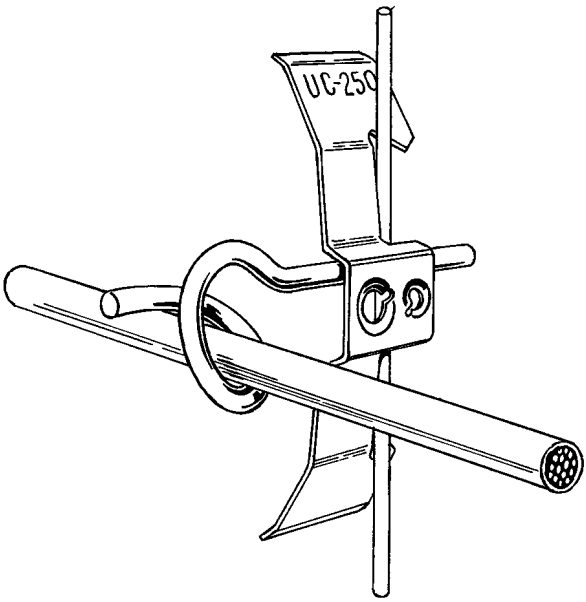


FIGURE 3

HEAD PROTECTION
DESCRIPTION AND USE

CONTENTS

1. GENERAL

1.01 This practice covers the safety requirements for head protection and includes the description, use and care of safety headgear.

1.02 Safety caps are designed to act as both a shield and a shock absorber to protect against head injuries. The headgear is also designed to provide protection against electric shock in case of accidental contact with electrically energized objects.

1.03 The use of safety caps in no way reduces the need for good job planning or the requirements for observing the safety precautions specified in other Continental Telephone System practices.

1.04 The Continental Telephone System standard safety cap meets the Class A and B standards (ANSI-Z-89.2-1971):

a. Insulation Resistance: 20,000 volts (30,000 volts to breakdown).

b. Impact Resistance: Average of 850 to 1,000 lbs.

c. Penetration Resistance: 3/8 inch.

d. Weight: Not to exceed 15.5 ounces.

e. Flammability: 3 inches per minute burn rate.

f. Water Absorption: 0.5% maximum.

2. SAFETY REQUIREMENTS—DESCRIPTION AND USE

2.01 The safety cap consists of a molded, high-impact white plastic shell equipped with detachable suspension which is adjustable to different head sizes. The Continental Telephone logo is embossed on the front; pressure sensitive reflective strips (avocado and orange) are located on the front and back of the shell for night safety visibility and conformance to Company identification. A glare resistant underbrim is furnished. The safety cap is illustrated in Figure 1 and shall be worn by all personnel engaged in outside plant or installation and repair work whenever they are subjected to conditions which could result in (1) head injuries from falling or moving objects or striking against stationary objects or (2) electric shock from accidental contact with electrically energized objects. It is not feasible to cover every situation requiring the use of headgear; however, careful observance of the principles and precautions given below will do much to prevent head injuries and electric shock. The following are the more common work operations and conditions under which the safety cap shall be worn:

a. Performing all kinds of work, i.e., line, splicing, installation, and repair work, from aerial lifts or truck mounted ladders.

b. Performing line work aloft such as from poles, ladders and platforms.

c. Working with, or in the vicinity of construction apparatus and equipment such as derricks, booms, winches, take-up reels, earth boring machines, cable trailers, tractors, trenches, and cable plows.

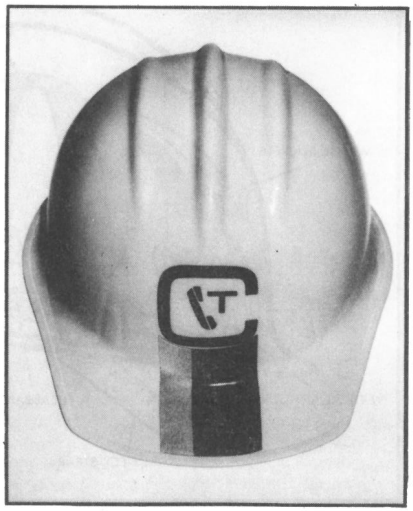


FIGURE 1. Safety Cap

d. When below work being done aloft or when performing overhead work from the ground such as placing cable blocks on strand, raising wire, and pruning trees.

e. All pole placing and removal work.

f. Entering, leaving, and working in manholes.

g. Working in any area or enclosure where headroom is insufficient such as crawl spaces, cellars, and steam tunnels.

h. Working in trenches, splicing pits, or other excavations of three feet or over in depth.

i. When in or near buildings under construction or being demolished.

j. When in an industrial establishment or on other premises.

k. Storm restoration work.

l. Performing blasting operations or when in the vicinity of such operations.

m. At any time there is exposure to high voltage electrical contact.

2.02 The suspension for the safety cap consists of a molded plastic band with a vinyl sweatband and nylon crown straps attached. The crown straps are not adjustable, but are fixed to provide clearance between the top of the head and the inside of the cap shell. The suspension has six points which attach to the cap using delta shaped plastic clips. The sweatband is a moisture absorbing microporite brow pad which is attached in the front of the headband. Sizing buttons are located on either side and are adjustable in increments of 1/16 inch of standard hat sizes. Detailed illustration is shown in Figure 2. Instructions for headband adjustment are:

a. Unsnap sizing buttons and decrease band size.

b. With buttons still unsnapped, put helmet on head.

c. Remove helmet and snap sizing buttons into nearest hole. The suspension is now permanently set to head size.

d. The headband may be raised or lowered front and/or rear by removing hangers from "V"

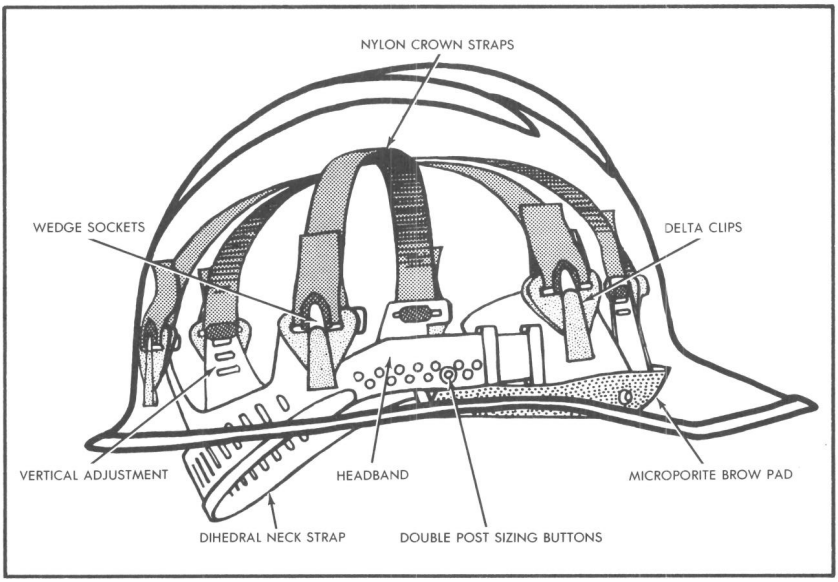


FIGURE 2

slots and repositioning the "L"-shaped plastic key. Be sure to reseat hanger firmly before wearing helmet. The dihedral neck strap may be raised or lowered vertically by separate adjustment.

e. The suspension is shown in Figure 3.

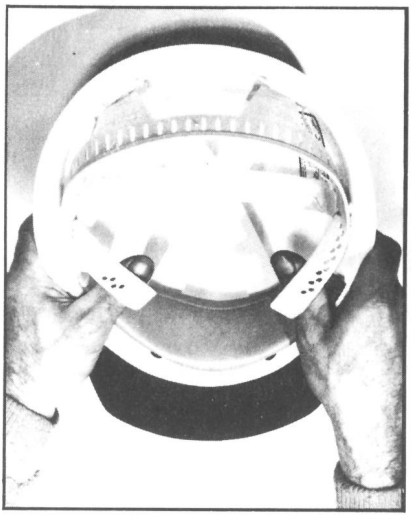


FIGURE 3

2.03 Winter liners with ear flaps for use with safety cap are available as accessory items. The liner is worn with the suspension over the liner as illustrated in Figure 4.

2.04 Chin straps are made of an elastic material, fully adjustable, available as an accessory, and snap into the plastic hangers located on the inside, underbrim portion of the shell. The chin strap is for use during windy weather to prevent the safety cap from falling off.

2.05 When a safety cap is being worn and it is necessary to use a head telephone set, use the following procedure:

a. Hold the safety cap in both hands, inverted, with the front facing away from you. The edge of the brim should rest approximately in the center of the palm of each hand. The position of the hands is such that the thumbs are directly over the center supporting tabs of the sweatband. See Figure 5.

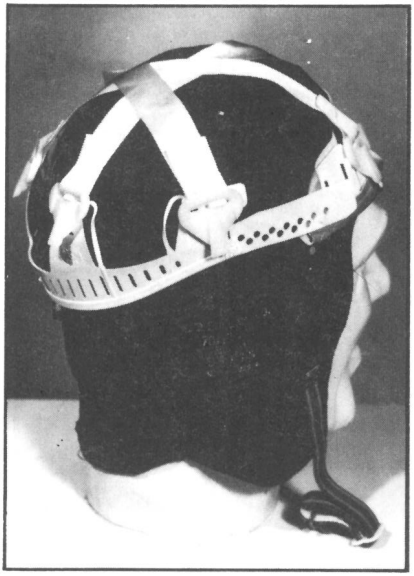


FIGURE 4

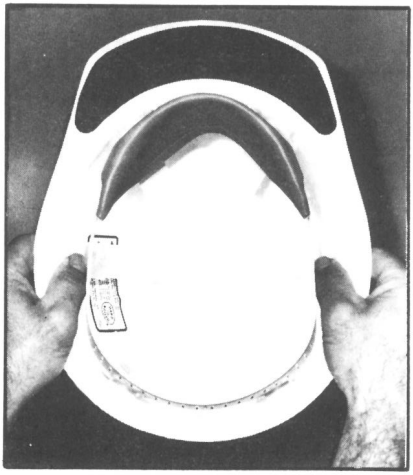


FIGURE 5

b. Slide each thumb down the outside of the sweatband tab attached to the side suspension strap hanger keys to the plastic angle button which holds the suspension to the hanger key. This will snap the buttons out of the slots in the hanger key when a steady pressure is applied, freeing the supporting tabs from the sweatband. See Figure 6.

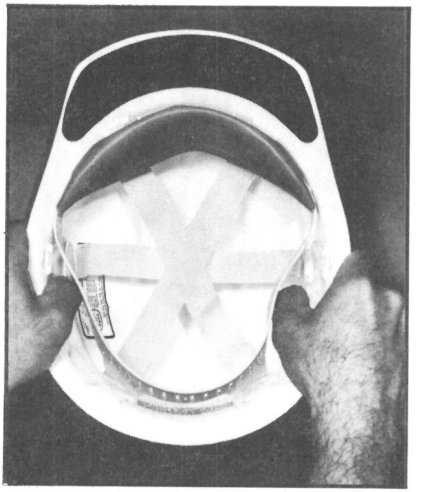


FIGURE 6

c. Remove the angle buttons from the slots in the tabs. The sweatband is now being held in the cap or hat at four points, two in front and two in back. The cap or hat is now ready to have the headset installed. Rotate so the front of the cap or hat faces you. See Figure 7.

d. Place the headset in position by threading the headpiece bracket (from either left or right side depending on which ear the receiver is worn) between the sweatband and the side hanger key, sliding it along the nylon cross strap so the leather pad rides on the strap and the strap is between the bracket supporting wires. Continue to slide the free end under the two long straps and emerge between the sweatband and the side hanger key. The headset is now installed. Hold the headset in this position, spreading the bracket toward the sides of the safety cap. See Figure 8.

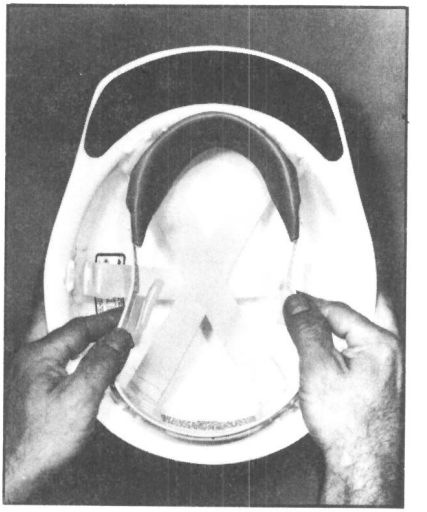


FIGURE 7

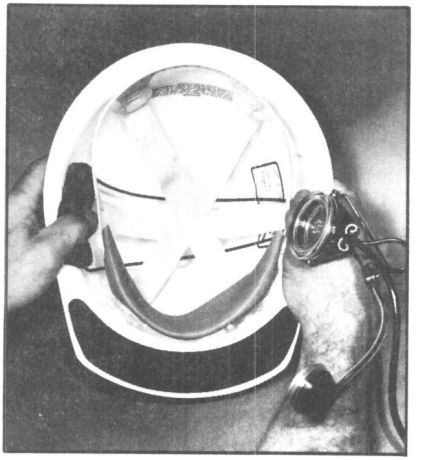


FIGURE 8

e. Place the safety cap on the head and position the receiver on the ear. The cap or hat with the headset installed is now properly worn. The headset bracket being secured between the sets of nylon straps is held in a secure position, regardless of the movement of the head or of the safety cap relative to the head. The receiver can be moved from the ear either forward or back without disturbing the position of the headset bracket on the head. When not needed, the headset can be removed easily from the safety cap.

NOTE: Releasing the two side supports of the suspension does not in any way affect the safety of the safety cap. The six point suspension has not been changed, which is the basic protection. The sweatband merely holds the cap on the head and being attached in four points just as effectively accomplishes this purpose. When the safety cap is not worn with the headset, it is not necessary to reattach the side supports of the sweatband.

2.06 The safety cap can be worn with a dielectric bracket and visor which are accessory items. When used with safety headgear, this combination gives face-eye protection as illustrated in Figures 9 and 10 for protection against impact.

2.07 The safety cap should be stored where it will not be damaged by other tools. Proper storage of the cap is by use of a cap rack, which is available.

CAUTION: Do not store the safety cap on the rear shelf of an automobile as it could be hurled forward in a collision.

3. CARE—CLEANING—INSPECTION AND TESTING

3.01 Maintenance should include all safety caps being initialed or marked in some manner to prevent random exchange among workers. Craft personnel should wipe dust or moisture from the caps before storing them.

3.02 A schedule should be established and maintained for the periodic inspection of all safety caps. Electrical safety caps should be inspected visually each day by the wearer for defects such as cracks, pit marks, or other abrasions that have occurred through use. It is recommended that management arrange for periodic electrical test of such caps. Safety caps should be periodically returned to the supplier or a local accredited test center for dielectric test per ANSI-Z-89.2-1971. The interval between testing shall not exceed one year.

3.03 Caps used primarily for electrical protection must be destroyed when they are found to contain cracks, abrasions, or other physical damage, or when they fail to pass an electrical proof test.

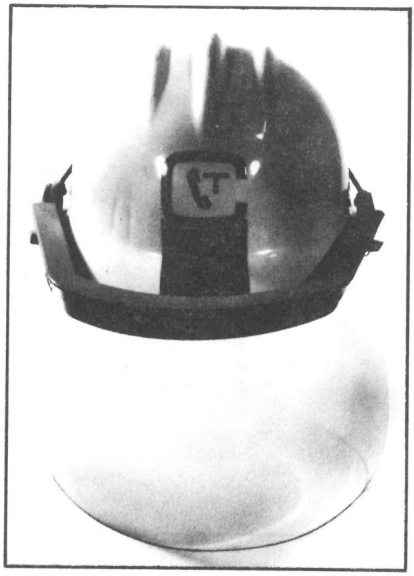


FIGURE 9

3.04 The worker can turn in a cap if it is found to be damaged or in need of a new suspension or sweatband. Caps turned in with sound shells may be transferred to other employees if the shell is thoroughly cleaned, sterilized, and supplied with a new suspension.

3.05 Tars, paints, oils, and other adherent dirt should be removed with nonflammable and nontoxic solvents. Because some solvents can be harmful to dielectric caps, the cap manufacturer should be queried before choosing a solvent.

3.06 A common method of cleaning the shells is to dip them into a tank of hot water, not in excess of 140°F., and containing a good detergent for at least one minute. These hats should then be scrubbed and finally rinsed in clear hot water (maximum temperature 140°F.). (Hats should be dipped using wire baskets to prevent hand and arms burns.) After rinsing, they should be wiped dry and inspected for damage that might show up. If cleansing facilities are unavailable, use a sanitizing spray to clean the shells and wipe dry for inspection. New suspensions

FIGURE 10

should be installed and the entire unit placed in a plastic bag, paper bag, or box to protect it against dust and handling damage.

4. ORDERING INFORMATION (INCLUDING REPLACEMENT ITEMS AND ACCESSORIES)

4.01 The following descriptions and catalog numbers cover the complete safety cap and accessories:

a. Cap, Model No. 302, white with Continental Telephone logo and reflectorized stripes, front and rear—complete with suspension: CTS #74-86-033-0.

b. Yellow dihedral 6 point suspension system, Part #ESDMY: CTS #74-86-052-6.

c. Green underbrim decal for glare prevention pressure sensitive: Part #UBG.

d. Chin strap, Part #ES-42: CTS #74-86-051-8.

e. Liner, winter (available in small, medium and large sizes), Part #EL-33: CTS #74-86-048-8, small; #74-86-053-4, medium, #74-86-050-0, large.

f. Dielectric bracket: Part #300.

g. 8 inch x 15 inch x .040 clear visor for use with #300 dielectric bracket for impact protection to face and eyes: Part #840.

PROTECTOR BLOCKS
RECTANGULAR TYPE

1. GENERAL

1.01 This practice covers the use and maintenance of the protector blocks most commonly used.

1.02 Protector blocks usually consist of a pair of carbon blocks, which, when installed in a protector mounting, provide a small air gap between a line conductor and ground. A low impedance path is provided to ground when abnormally high voltages are applied to the line, which may be caused as a result of lightning or contact between telephone conductors and power lines.

2. TYPES OF PROTECTOR BLOCKS

2.01 The *rectangular type* protector block is shown in Figure 1.

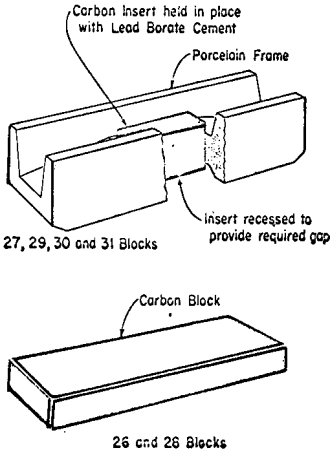


FIGURE 1

2.02 The rectangular protector block may be used in the 83A, 84A, and 87A mounting assemblies and in the 104A and 108A mountings.

2.03 The design of the protector is such that one of the blocks is made of carbon and the other of porcelain with a small carbon insert. When placed in a protector mounting, the carbon block is in contact with the ground electrode; and the carbon insert of the porcelain block is in contact with the line terminal through a protector spring which holds the assembly in place.

2.04 Protector block characteristics are shown in Table 1.

TABLE 1

Code Designation	Gap	60-Cycle R.M.S. Breakdown Voltage	Color Code on Porcelain	Common Use
26*–27	.003 in.	350	White	C.O. and Station Prot.
28*–29	.003 in.	350	White	C.O. Protection
26*–30	.006 in.	700	Blue	Cable Protection
26*–31A	.010 in.	1000	Yellow	Special Applications

2.05 In certain localities where equipment such as phantom repeating coils associated with open wire lines are located outdoors on poles, excessive maintenance is sometimes experienced with 0.006" blocks. In such cases 0.010" blocks are recommended. Where such protection is used it is recommended that a separate set of the 0.010" protector blocks be used on each side of the phantom repeating coil between each open wire conductor and a common ground consisting of two or three ground rods in parallel.

Benefits from the use of 0.010" blocks ahead of the 0.006" blocks may also be obtained where excessive maintenance has been experienced with the 0.006" blocks due to lightning. The use of double protection is not generally recommended but may be found helpful in special cases for circuits in which the avoidance of even occasional service interruptions from standard cable pole protection is desired. Where used, it is desirable to locate the 0.010" blocks about two to four spans ahead of the cable pole with the ground plate connected to about three ground rods in parallel at the base of the pole.

3. PRECAUTIONS

3.01 If there is any indication or reason to believe that a power contact has occurred, make a check from the ground to be certain that safe working conditions exist before performing any work at a protected terminal or protector mounting location.

4. PLACING PROTECTOR BLOCKS

4.01 Rectangular porcelain and carbon blocks will be placed by holding the assembly firmly by hand and pressing into place in the protector mounting so that the protector spring rests squarely against the carbon insert of the porcelain block. Avoid sliding motion between the blocks as any loosened carbon particles are a potential service hazard.

5. INSPECTION AND MAINTENANCE

5.01 Both the porcelain and carbon blocks shall be handled with care and should be kept in the original shipping cartons or in an approved holder such as the 3A type.

5.02 In the event the porcelain and carbon blocks are removed from the protector mounting to clear trouble or for any other reason, they shall be inspected and cleaned as covered in 5.03 to 5.05.

5.03 Porcelain and carbon blocks will be inspected for indications of chips and cracks. Both sides of the carbon block may be used. If one side shows pitting and the other side is satisfactory.

Reject porcelain blocks if subject to any of the following defects:

a. Porcelain blocks which have a chip or crack in the porcelain that extends to the carbon insert.

b. Porcelain blocks that have both walls of the spring groove chipped at the same end.

c. Porcelain blocks that show evidence that the carbon insert has moved.

5.04 Clean porcelain and carbon blocks which pass inspection, outlined in 5.03.

5.05 After cleaning the porcelain and carbon blocks, they shall be inspected for further evidence of defects as follows:

a. Do not reuse any blocks in which the carbon sparking areas are glazed, scratched or cracked, or show signs of soft or unduly roughened spots on those areas.

b. Do not reuse any blocks which cannot be cleaned free of dirt or other foreign matter.

6. OPERATED PROTECTOR BLOCKS

6.01 Ordinarily, lightning discharges will cause an arc across the air gap between the carbon insert and the ground block, but will not heat them sufficiently to melt the cement used for holding the insert in place.

6.02 Protector blocks operated by lightning to the extent of very heavy pitting or blackening indicates that the plant has been exposed to frequent or severe lightning discharges. Such information may be useful in the investigation of cable troubles resulting from lightning.

6.03 A cross with electricity will cause a discharge or repeated discharges of such duration that the heating of the carbon insert will melt the cement holding it and allow the mounting spring to push it into direct contact with the solid carbon block, thus permanently grounding the line.

6.04 Power may be of low voltage and generally is applied for a much longer period of time than lightning. The effect being to make deep pits with whitish deposits or to ground the blocks permanently. Blocks thus damaged by power are usually unfit for further service.

6.05 Protector blocks operated by power are indicative of an irregular plant condition. It is important, therefore, in order to take the necessary action to preclude further trouble, to make a careful inspection for direct or swinging contacts or inadequate separations between telephone and electric plant. Any cases where protector blocks are operated by power for which the cause has not been determined should be reported to the supervisor for further investigation.

6.06 Moisture may also cause deterioration of carbon protector blocks. At damp locations, moisture may accumulate between the protector blocks and establish a high resistance path for current. Electrolytic action will cause the carbon to soften and crumble and small particles of carbon will eventually bridge the gap between the two blocks, placing a permanent ground on the line. A cavity results, rendering the carbon blocks unfit for further service. The associated porcelain block with the carbon insert is not affected and remains serviceable.

SOLDERING METHODS

1. GENERAL

1.01 This practice covers the method of making and removing soldered connections, the use of soldering irons, and safety precautions that must be observed during soldering operations. This practice replaces CTSP 400-300-006.

1.02 Soldering is the process of fusing three metals (wire, terminal, and solder) by the application of molten solder. This bond is made by raising the temperature of the wire and terminal to the melting point of solder. The rosin flux in the solder excludes air during the heating which minimizes oxidation. Before soldering, the terminals and wires must be thoroughly cleaned of all enamel, grease, dirt, and oxides.

1.03 It is essential that the wire is connected so that it is in the proper position and rests firmly against the terminal. A properly soldered connection will have a definite, thin strip of solder on both sides of the wire to form a secure mechanical connection and a good electrical connection. See Figure 1.

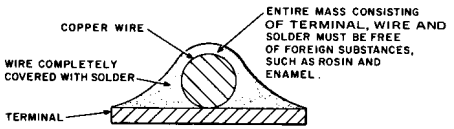


FIGURE 1. Cross Section of a Properly Soldered Connection

1.04 The point of soldering is generally on the right side or on the top of the terminal.

1.05 When soldering neoprene or plastic insulated wire, considerable care shall be taken that the copper soldering tip or other heat source is not applied to the connection any longer than necessary to make a good connection; these materials have a tendency to recede with excessive heating.

1.06 Do not allow neoprene and plastic insulated wire without a textile covering to come in direct contact with another terminal which is being soldered. Special care shall be taken to avoid even momentary contact between the copper soldering tip (or other heat source) and the insulation of these types of wire.

1.07 Methods of holding soldering irons are:

a. The hand grip is generally found applicable on horizontal terminals such as those on the vertical side of a distributing frame. See Figure 2.

b. The pencil grip is generally found applicable on vertical terminals such as those on the horizontal side of a distributing frame. See Figure 3.

FIGURE 2. Hand Grip Method of Holding Soldering Iron

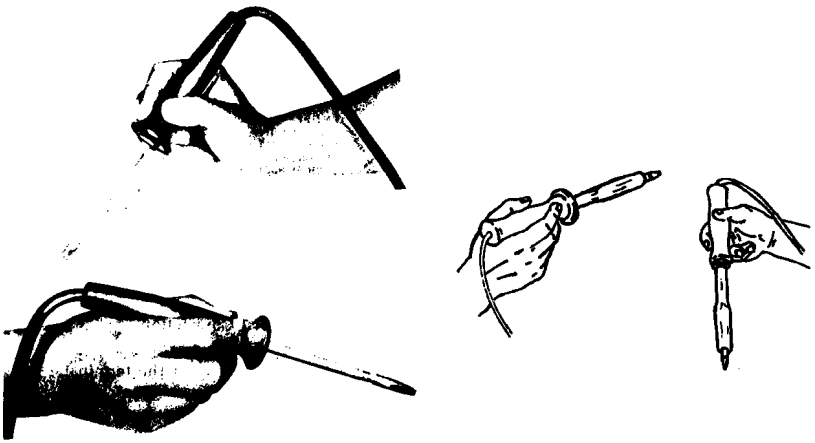


FIGURE 3. Pencil Grip Method of Holding Soldering Iron

2. TOOLS AND MATERIALS

2.01 The following tools and materials are required to perform the soldering procedures outlined in this practice:

a. Soldering iron holder (includes wiping pad).

b. Soldering iron, 100 watts.

c. Soldering iron (Ungar).

d. Orange stick.

e. Spudger.

f. File.

g. Safety goggles or safety glasses, one piece clear plastic lenses.

h. Longnose pliers.

i. Distributing frame bag.

j. Aloxite cloth (emery cloth).

k. Solder, rosin core, 40/60 (40% tin, 60% lead).

3. SAFETY PRECAUTIONS

3.01 Do not *flip* solder from the soldering iron; personal injury or damage to nearby equipment may result.

3.02 Judge the temperature of the soldering iron by applying a piece of solder on the tinned surface of the tip and observing whether or not the solder melts.

CAUTION: Do not test the temperature of the iron by holding it near hands or face; serious burns may result.

3.03 Safety goggles or glasses shall be worn when cleaning terminals and unsoldering wires.

3.04 Do not place a warm or hot soldering iron on the floor, equipment, or in any other place except in the guard or holder or on the rest provided for this purpose.

3.05 Do not remove a soldering iron from its holder to store it (as in a locker) until it has thoroughly cooled.

3.06 Wherever possible, use the distributing frame bag to protect the equipment below.

3.07 When inserting the copper tip into a handle, do not strike the point of the tip forcibly against any surface. This could damage the iron coating, as well as blunt the point.

3.08 It is not possible to do satisfactory work with a dirty or stubby copper tip. Also, it is not possible to properly solder a connection on which either the wire or terminal has not been thoroughly cleaned.

3.09 To avoid causing a poor connection, do not disturb a newly soldered connection until the solder has thoroughly cooled.

3.10 Do not allow a hot soldering iron to come close to semiconductor devices such as transistors, diodes, etc., as they can be damaged by excessive heat.

3.11 Avoid overheating when soldering on pigtail equipment. See paragraph 12.

3.12 When soldering to electron tube contacts, be very careful not to misalign or overheat the contacts. See paragraph 13.

3.13 An electric soldering iron may break down internally in such a way that the metal parts of the iron become crossed with the heating circuit. Also, the insulation of the power cord may become frayed and defective. These conditions could result in personal injury or equipment damage. Refer to paragraph 4 of CTSP 405-700-001 and CTSP 405-700-002 for inspection and maintenance procedures.

4. TYPICAL USES OF SOLDERING IRONS AND SOLDERS

4.01 Typical uses of soldering irons are:

a. The 100 watt soldering iron is standard for general and continuous use.

b. The 74-26-081-2 (Ungar) soldering iron should be used where small size, light weight, and quick heating are desirable. This iron can be equipped with a short shank for general use or a long shank for special use, such as on switchboard multiples. Normally, this iron is equipped with a 1/4-inch wide tip. Heater assemblies with 3/16- and 1/8-inch wide tips are also available.

4.02 Typical uses of solders are:

a. The 40/60 rosin core is generally used to solder wire to terminals.

b. Solders with greater than 40% tin content are used where heat sensitive equipment or insulation is involved, or where the nature of the soldering operation requires a solder with a lower melting point.

5. SHAPING COPPER SOLDERING TIPS

5.01 Plain copper tips may be shaped by filing. Refer to paragraph 4 of CTSP 405-700-002.

NOTE: IRONCLAD TIPS, INCLUDING THOSE COATED WITH A DIELECTRIC, SHOULD NOT BE RESHAPED.

6. TINNING COPPER SOLDERING TIPS

6.01 *Plain copper tips:*

a. File approximately half an inch (3/8" to 5/8") of the surface of one side of the tip until it is bright and clean. See Figure 4.

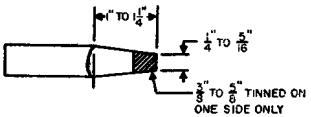


FIGURE 4.

b. Heat the copper tip to soldering temperature; quickly file the side of the tip which was previously cleaned, then apply rosin core solder until the surface is well tinned. Use a wiping pad to remove any excess solder. Only one side of the tip should be tinned. The tinned area may be confined by rubbing the untinned portion of the tip with a rubber eraser or rubber matting.

NOTE: Continuous heating of an idle iron will destroy the tinned area.

6.02 Before replacing a soldering iron in a holder or on a rest, remove any excess solder on the tinned side of the tip. If the tip is reheated, the excess solder will tend to cause pitting. Surplus solder may be removed by wiping the tip on the wiping pad.

6.03 *Ironclad tips:*

a. The ironclad tips are furnished initially with one side of the tip tinned. If the soldering iron is to be idle for an extended period, leave an excess of solder on the tip. To clean the tip, heat the iron and then flow solder over the tip. Rub the tip on the wiping pad to distribute the solder over the tip and to wipe off any excess solder.

NOTE: Do not wipe the tip on anything other than the wiping pad as this may destroy the tinning.

b. After cleaning the ironclad tip, if it is apparent that retinning is necessary, proceed as follows:

(1) While the tip is hot, wipe off as much of the old solder as possible, using the wiping pad. Then allow the tip to cool; otherwise, it cannot be cleaned satisfactorily.

(2) When the tip is cold, rub the surface to be tinned on a piece of emery cloth until the surface is bright. Do *not* use a file to clean the tip. Take care to remove as little of the iron as possible as the iron coating is less than 1/64 inch thick. If the iron coating is penetrated, a short tip life will result.

(3) When the surface is clean heat the tip and apply solder as it is heating. As soon as the rosin begins to melt, spread the rosin over the surface to prevent it from tarnishing before the solder is melted.

(4) As soon as the solder begins to melt, spread the solder over the surface until the desired area is tinned. Rub the tip on the wiping pad to wipe off any excess solder.

7. SOLDERING WIRE TO NOTCHED TERMINALS

7.01 Apply rosin core solder to the tip of a hot soldering iron momentarily, leaving a small amount of molten solder on the tip. Apply the tip to the terminal and wire as shown in Figure 5, Step 1. As the terminal and wire attain proper soldering temperature, the molten solder will spread over the surfaces of the terminal and wire. As this occurs, a small amount of additional solder is immediately applied to the heated joint as shown in Figure 5, Step 2, so the molten rosin will protect the joint as the soldering process is completed.

NOTE: When soldering connections made with wires of gauges larger than those of distributing frame wire (particularly if the wire is untinned), a longer period of time must be allowed for heating the wire and terminal with the soldering iron before the solder is applied to the copper tip. This will permit the melted flux to flow over the heated wire. Experience will give the period of time required for heating the wire sufficiently to take the flux and solder; it should not be so long as to cause excessive oxidation of the surface of the wire. A satisfactory job cannot be done if the solder is run onto a cold or improperly heated terminal, even though the copper tip is sufficiently hot. On the other hand, the connection should be soldered and the copper tip removed from the terminal as quickly as possible to avoid damage to the insulation on the terminal strip.

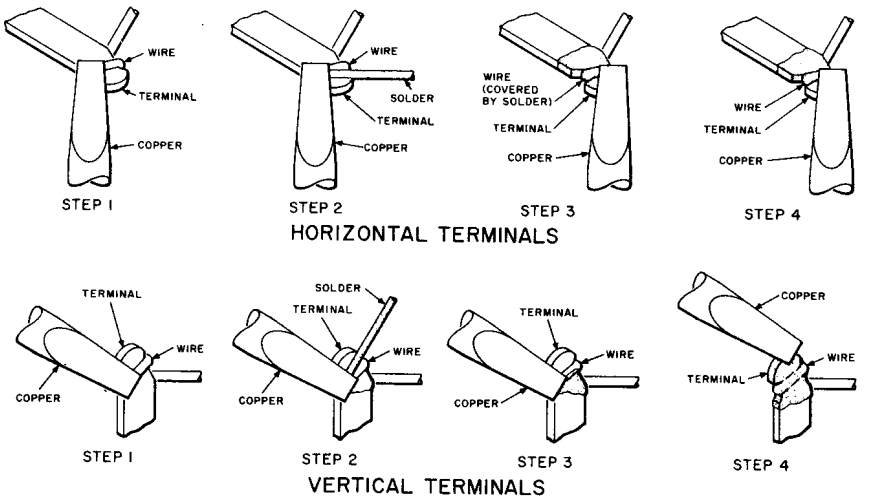


FIGURE 5. Soldering Wire to Notched Terminals

7.02 When the solder has melted and flows freely, bring the copper tip down over the terminal with a forward movement so the solder flows over the wire, completely covering it as shown in Figure 5, Step 3. Draw the copper tip off the terminal, carrying with it any surplus solder to leave a clean, smooth joint as shown in Figure 5, Step 4.

7.03 Only a small amount of solder is needed to make the joint illustrated in Figure 6, which shows a thin coat of solder spread smoothly over the wire, completely covering it. If too much solder is used, a lumpy connection will result which may cause trouble.

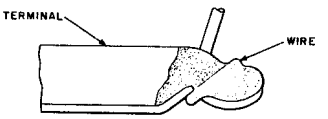


FIGURE 6. Example of Properly Soldered Connection

7.04 Improper soldering technique on vertical terminals may result in a cross or short circuit between adjacent terminals as shown in Figures 7 and 8.

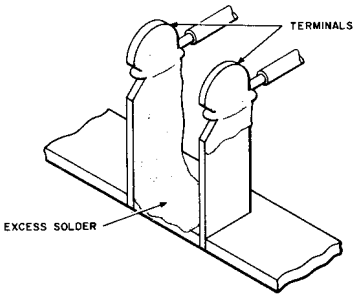


FIGURE 7. Excessive Solder on Vertical Terminals

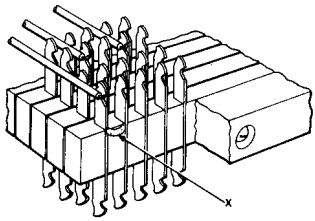


FIGURE 8. Excessive Solder on Terminal Strips

7.05 Figure 9 illustrates an improperly soldered connection; the solder has sweated to the terminal only, while between the solder and the wire there is a layer of rosin which insulates the solder from the wire. A connection of this type is due to one of the following causes:

a. Cold copper soldering tip.

b. Copper soldering tip held on the connection an insufficient length of time.

c. Improper manipulation of soldering iron.

d. Untinned or uncleaned terminal or wire.

8. SOLDERING WIRE TO PERFORATED TERMINALS

8.01 Perforated terminals are those on which the wire is brought through the hole, such as on equipment units, jacks, and lamp sockets. The method of soldering is the same as for notched terminals outlined in paragraph 7. Sufficient solder should be used to fill the hole. This ensures that a good electrical and mechanical connection has been made. See Figure 10.

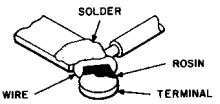


FIGURE 9. Example of Improperly Soldered Connections

9. SOLDERING WRAPPED CONNECTIONS TO WIRE TERMINALS (INCLUDING SQUARE CROSS SECTION) AND PUNCHED TYPE TERMINALS 1/16-INCH OR LESS IN WIDTH

9.01 When soldering wrapped connections to punched and wire type terminals, it is not necessary to cover the entire wrapped end with solder. Ordinarily, all turns of wire will

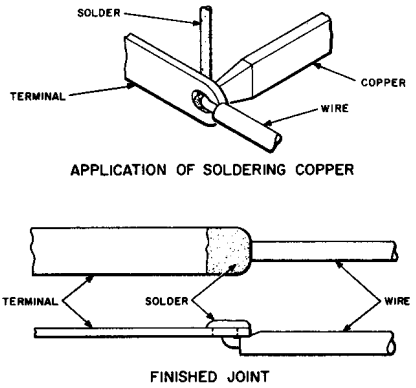


FIGURE 10. Soldering Wire to Perforated Terminals

become covered with solder at the soldered side of the terminals. Where more than two turns have been wrapped, it is necessary to solder only two adjacent turns to the terminal.

10. SOLDERING WIRE TO TUBULAR TERMINALS

10.01 When soldering wire to a tubular terminal, first apply a little solder to the wire with the copper tip. Then, connect and solder the wire to the terminal as outlined in a., b., *or* c.:

a. *Skinned End of Wire Folded Back* (Figure 11): When the connection is made by folding back the skinned end of the wire, the length of bare wire from the skinning point to the fold should be slightly less than the depth of the terminal. Insert the folded wire into the tubular portion of the terminal so the spring effect of the folded wire will hold it in place before soldering. Then hold the copper tip against the side of the terminal until the solder can be flowed into the tube.

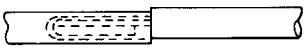


FIGURE 11.

b. *Skinned End Inserted Without Fold* (Figure 12): When soldering connections to *cutaway tubular* terminals such as on U.S. Components Co. plugs and connectors, insert the wire into the tubular portion of the terminal and fill the cutaway portion with solder.

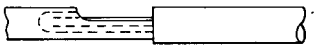


FIGURE 12.

c. *Wire Wrapped Around Terminal* (Figure 13): When the connection is made by wrapping the wire around the terminal, solder the turn nearest the insulation for at least one-half the circumference of the terminal.

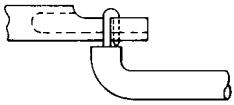


FIGURE 13.

d. Hold the copper tip against the terminal for another instant; then remove the copper tip and hold the wire in place until the solder sets.

11. SOLDERING WIRE TO SPUN-IN, STAND-OFF, AND SIMILAR TYPE TERMINALS

11.01 When soldering connections to spun-in, stand-off, and similar type terminals, completely cover the wire with solder for at least one-half of the circumference of the terminal.

NOTE: When soldering connections to stand-off terminals (terminals insulated from their mounting studs by means of insulating material), take special care to avoid overheating as excessive heat may loosen the terminal from the insulating material.

11.02 *Spun-In Terminals*: These terminals are frequently used for mounting pigtail equipment. Make the connections as follows (see Figure 14):

a. Where the pigtail equipment is located on the side of the panel opposite the terminal, the pigtail leads should be brought through the terminal and bent over the terminal end.

b. Where the pigtail equipment is located on the same side of the panel as the terminal, connect the pigtail leads by wrapping approximately one full turn around the terminal.

c. Connecting wires should be connected in a manner similar to the pigtail leads.

d. Where surface wiring and/or pigtail leads are to be connected and it is necessary to provide for future connections such as installer wiring, connect the surface wiring and/or pigtail leads to the inner end of the terminal.

NOTE: Some spun-in terminals do not have wire retaining ridges. In such cases, connect wires in the same relative locations as described above. On slotted spun-in terminals, connect wires in the same relative locations as described above, except that pigtail connections may be made through the slot in the terminal.

11.03 *Stand-Off and Grooved Type Terminals*: Connect wires as shown in Figure 15, using one full turn of wire.

11.04 See CTSP 410-600-420 for the method of soldering and unsoldering wrapped connections.

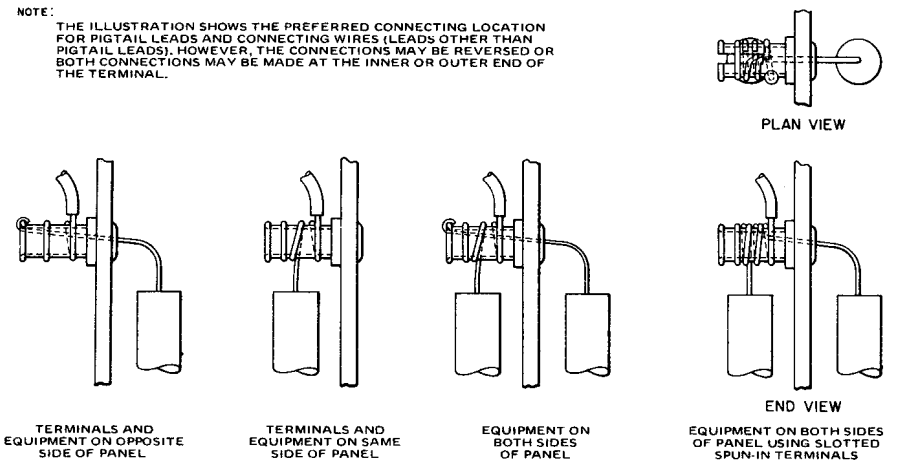


FIGURE 14. Plier Connections to Spun-In Terminals (Solder Not Shown)

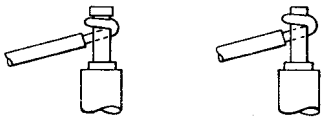


FIGURE 15. Stand-Off and Grooved-Type Terminal (Solder Not Shown)

12. PIGTAIL EQUIPMENT

12.01 Pigtail equipment such as electrolytic capacitors, carbon and composition resistors, thermistors, and diodes are usually mounted by means of their wire terminals. Equipment of this type can be damaged by excessive heat during a soldering operation, either by heat being transferred to the equipment body by conduction through the pigtail or by holding the soldering iron too close to the equipment. When soldering leads closer than one-half inch from the body of the component, a *heat sink* is recommended to restrict the flow of heat into the pigtail equipment. To further aid in keeping the amount of heat to a minimum, use a solder with a high tin content such as the 60-40 percent solder which has a low melting point.

13. ELECTRON-TUBE SOCKETS

13.01 To prevent damage or misalignment of the contacts on electron-tube sockets, and to reduce the possibility of overheating the contacts and body material, use a *heat sink* during wiring and soldering operations.

14. UNSOLDERING CONNECTIONS

14.01 Use a wiping pad to remove all surplus solder from the copper tip. Place the copper tip against the soldered connection and remove as much of the solder as can be drawn off on the copper tip.

14.02 Using a pair of longnose pliers and keeping the hot copper tip on the connection, grasp the wire to be removed a short distance back from the terminal. Apply a light, steady pull to the wire until it becomes unfused from the soldering surface. Then carefully unhook or unwrap the wire to disengage it from the terminal. *Extreme care must be taken not to flip or spatter the solder.*

NOTE: Disconnecting a wire by melting the solder and jerking it free from the terminal may result in personal injury or damage to nearby equipment.

14.03 After removing the wire from the terminal, use the copper soldering tip and an orange stick or spudger to remove all excess solder from the terminal.

14.04 Solder-wrapped connections need not be unsoldered to remove the connections. Cut the wire, unwrap with longnose pliers, and then remove solder as directed in paragraph 14.03.