

844 B

## LINE CONCENTRATOR NO. 1A PREINSTALLATION TESTS AND TESTS AND INSPECTIONS AT TIME OF INSTALLATION

### 1. GENERAL

**1.01** This is one of a group of sections pertaining to line concentrator No. 1A. The tests in this section are for testing with a 100-line remote unit. When testing with combinations of 50-line and/or single groups in 100-line remote units, the same procedures may be used, but care must be taken to ensure that tests are performed in the proper group and that all option strapping has been done in accordance with SD-96536-01, SD-96537-01, and SD-95957-01.

**1.02** This section is reissued to include new requirements for signal lead interference and minor changes in testing procedures based on field experience.

**1.03** The tests covered in this section are as follows:

- A. *Visual Inspection of Equipment*
- B. *Test of Line and Cutoff Relays*
- C. *Power*
- D. *Ground Return Resistance*
- E. *Insulation Resistance of Signaling Leads*
- F. *Interference on Signaling Leads*
- G. *Line Insulation*
- H. *Alarm Circuits*
- I. *Circuit Operation, and Line and Trunk Call Through Tests*
- J. *Trunk Verification*
- K. *Trunk Transmission, Overflow Tone, Trunk Disconnect Sequence, and Trunk Load Control*
- L. *Service Denial Call*
- M. *Dial Tone Speed Register*
- N. *Trunk Group Usage Recorder*

### 2. APPARATUS AND REFERENCE MATERIALS REQUIRED

**2.01** Apparatus (See Table A).

**2.02** The following reference material must be used with this section:

- CD- and SD-96536-01 — Common Systems, Line Concentrator No. 1A, Control Unit, 100 Line Capacity.
- CD- and SD-96537-01 — Common Systems, Line Concentrator No. 1A, Remote Unit, 100 Line Capacity.
- CD- and SD-95957-01 — Common Systems, Line Concentrator No. 1A, Remote Unit, 50 Line Capacity.
- 067-105-502 — Line Concentrator No. 1A, System Tests.
- 067-105-301 — Line Concentrator No. 1A, Trouble Analysis.
- 067-105-201 — Line Concentrator No. 1A, Cutover Procedures and Addition of Lines.
- 167-285-301 — Line Concentrator No. 1A, KS-15917, List 3 Battery Supply.
- 639-060-201 — Terminating Concentrator Stub Cable in Cross-Connecting Terminals.

### 3. PREPARATION

**3.01** A portion of the tests in this section will require testing at both the control unit and the remote unit simultaneously.

**3.02** A talking circuit will be required between units to coordinate testing. If possible, the talking circuit should use facilities other than those assigned for concentrator use.

**TABLE A**  
**APPARATUS REQUIRED FOR TESTING**

| APPARATUS   | TESTS |   |   |   |   |   |   |   |   |   |   |   |   |   | NEEDED AT   |              |
|---|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|-------------|--------------|
|   | A     | B | C | D | E | F | G | H | I | J | K | L | M | N | REMOTE UNIT | CONTROL UNIT |
| KS-14510 Volt-Ohm-Milliammeter*                     |       | X | X | X | X | X | X |   |   | X |   |   |   |   | X           | X            |
| High-Resistance Test Receiver or 1011-type Hand Set |       |   |   |   |   |   |   |   | X |   | X | X |   |   | X           |              |
| Dummy Fuse (See Fig. 1)                             |       |   | X |   |   |   |   |   |   |   |   |   |   |   | X           |              |
| 4.5-Volt DC Dry Battery                             |       | X |   |   |   |   |   |   |   |   |   |   |   |   | X           | X            |
| 1015A Spare Parts and Tool Kit                      | †     | † | † | † | † | † | † | † | † | † | † | † | † | † | X           |              |
| Six 624B Tools                                      |       |   |   |   |   |   |   |   | X |   | X |   |   |   |             | X            |
| Three 1W13A Cords‡                                  |       |   |   |   |   |   |   |   | X |   | X |   |   |   |             | X            |
| Two W1AP Cords                                      |       |   |   |   |   |   |   |   | X |   |   |   |   |   |             | X            |

\* Or equivalent 20,000 ohms-per-volt meter.

† The 1015A spare parts and tool kit is required only if replacement of parts is required. In addition, a soldering copper may be required.

‡ Number 893 cord, 3 feet long, equipped with 360 tools at each end.

**3.03** For procedure covering preinstallation tests, this section assumes that cable assignments for signaling leads have been made.

**3.04** For all procedures, except preinstallation tests, this section assumes that:

- All cable assignments have been made for trunks and signal leads.
- Bridge taps on trunk and signal pairs have been removed.
- The control unit has been installed and that cross connections have been placed

and terminated between the terminal blocks on the frame and on the control unit.

- The remote unit has been installed and that the stub cable was placed in accordance with Sections 639-300-200 and 639-060-201.

**Note:** When a 50-line remote unit is installed as Group 1, designation strip Forms E-4873-1 and E-4873-2 should be placed on the 65B1 terminal strip to designate lines 50-99 and trunks 10-19.

## 4. PRECAUTIONS

### GENERAL

**4.01** When working at the remote unit in temperatures below freezing, use a handkerchief or other form of face mask to prevent breath from condensing on any portion of the equipment. Condensation on the equipment may cause malfunctions. Section 081-310-116 covers the use of the D cabinet tent, which should be used during inclement weather.



*Do not make adjustments to relays or crossbar switches without consulting the section covering the requirements and adjusting procedures for the particular relay or switch.*

**4.02** Other plant forces working in the same cable containing trunk and signaling pairs should be cautioned to avoid all unnecessary contact with these leads.

### DRY-REED RELAYS

**4.03** The cutoff *CO*- relays in the control unit and the line *L*- and cutoff *CO*- relays in the remote unit are of the 302 dry-reed type. Before testing on contacts of these relays or the circuits containing them, refer to Section 040-275-301.

**4.04** Contacts of reed relays may be damaged if test connections are made which cause these contacts to make or break one-half ampere or more of current. A high-resistance telephone test set or headset should be used at the control unit when testing reed-relay contacts and the circuits containing them. A 500-ohm resistor has been connected in series with the test battery terminal in the remote unit; a low-resistance test set, such as the 1011B telephone hand test set, may be used for testing these contacts at the remote unit when this high-resistance battery test terminal is used.

### MERCURY RELAYS

**4.05** The relays in series with the signaling leads in both the remote and control units are of the 303 mercury contact type. Before testing these relays or the circuits containing them, refer to Section 040-263-501.

**4.06** These signaling relays may be permanently damaged if more than 60 ma of current is caused to flow through their windings. A high-resistance telephone set should be used at the control unit when making tests on the signaling leads. At the remote unit, a low-resistance test set, such as the 1011B telephone hand test set, may be used when testing signaling leads when the high-resistance battery test terminal is used.

### MAGNETIC LATCHING CROSSBAR SWITCHES AND REED RELAYS



*The hold magnets and cutoff relays in both units are magnetic latching. These switches or relays should not be operated or released electrically or manually during testing except by normal circuit operation or in strict accordance with approved procedures covered herein. Indiscriminate operation or release of these switches and relays will cause malfunctions of the system.*

### DIODES

**4.07** Before testing diodes or the circuits containing them, refer to Section 032-173-301.

### TROUBLE LOCATION

**4.08** The battery in the remote unit does not have sufficient capacity to allow blocking a major portion of the apparatus used in making a call, or blocking the timing circuit. The proper procedure is to:

- Make repeated tests, observing relay operation.
- Determine condition of *W* and *Z* relays when operation stops.
- Determine condition of *RK2* and *CCK* relays when operation stops.
- On SCs, localize trouble to the area limited by *W*, *Z*, *RK2*, and *CCK* operation.
- On FSs, pinpoint possible troubles.
- On equipment, check for troubles pinpointed by these steps.

**Note:** Sections 067-105-301 and 067-105-502 may be used to assist in locating trouble experienced during application of this section.

## 5. METHOD

**Note 1:** These tests apply to both units except when specific reference is made either to the control unit in the central office or to the remote unit in the field.

**Note 2:** Prior to performing control unit tests, remove PF and 20A fuses from the frame fuse panel in control unit and verify that M fuse has been removed in remote unit.

| STEP                                     | ACTION                            | VERIFICATION   |
|--|-----------------------------------|--|
| <b>A. Visual Inspection of Equipment</b> |                                   |  |
| 1  | Inspect all relays and switches.  | All covers in place and all actuating cards in proper positions (wire-spring types).<br>All make and break springs parallel and in proper positions relative to associated fixed contact (wire-spring type).<br>All mercury relays properly seated in sockets.<br>All crossbar switch select fingers properly in cards.<br>All latching hold magnets in released position. If any hold magnets are in latched position, release manually at this time.<br>All hold magnets are free of filings or other foreign matter that could interfere with proper operation. |
| 2  | Inspect wiring side of equipment. | No solder splashes, wire ends, bent terminals, etc.  |

**B. Test of Line and Cutoff Relays**

*Operate all CO- relays in both units. (Concentrator units are shipped with CO- relays in released condition.) To operate CO- relays, place the (+) and (-) terminals of a 4.5 volt battery on terminals 1 and 6, respectively, of each CO- relay.*

|   |   |  |
|---|---|--|
| 1 | In both units, place an ohmmeter between test terminals 2 and 3, and 4 and 5 of each CO- relay.   | Should read 0 ohms (short). If meter does not show 0 ohms:<br>Place the + terminal of a 4.5-volt battery on terminal 1 of CO- relay.<br>Place the negative terminal of a 4.5-volt battery on terminal 6 of CO- relay.<br><br>Then repeat test. |
| 2 | In remote unit, remove <b>G</b> and <b>D</b> fuses; then place ohmmeter across test terminals 2 and 3, and then 4 and 5 of the following <b>L</b> - relays: 00, 09, 18, 27, 36, 45, 50, 59, 68, 77, 86, 95. | Should read infinite resistance (open).  |

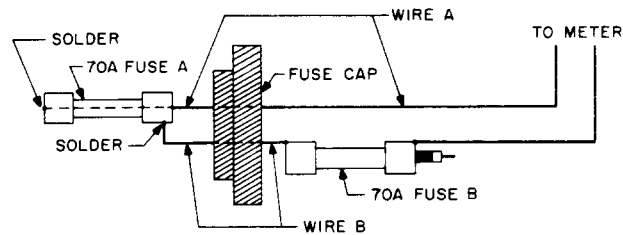
| STEP            | ACTION   | VERIFICATION  |
|-----------------|--|---|
| Γ 3a            | <p>If control unit is provided with option ZC (SD-96536-01, Issue 9 or earlier) —</p> <p>In the control unit, remove <b>L</b> and <b>M</b> fuses, then place ohmmeter across contacts <b>5M</b> and <b>5F</b>, and then contacts <b>4M</b> and <b>4F</b> of the following even numbered <b>SL</b>- relays and contacts <b>9M</b> and <b>9F</b>, and then contacts <b>8M</b> and <b>8F</b> of the following odd numbered relays:</p> <p>00, 18, 36, 50, 68, 86,<br/>09, 27, 45, 59, 77, 95</p>                | Should read infinite resistance (open).   |
| 4b              | <p>If control unit is provided with option ZD (SD-96536-01, Issue 10 or later) —</p> <p>In the control unit, remove <b>L</b> and <b>M</b> fuses, remove AL lamp, then place ohmmeter across contacts <b>5M</b> and <b>5F</b>, and then contacts <b>4M</b> and <b>4F</b> of the following even numbered <b>SL</b>- relays and contacts <b>9M</b> and <b>9F</b>, and then contacts <b>8M</b> and <b>8F</b> of the following odd numbered relays:</p> <p>00, 18, 36, 50, 68, 86,<br/>09, 27, 45, 59, 77, 95</p> | Should read infinite resistance (open).   |
| ↳ 5b            | Replace AL lamp.   |   |
| <b>C. Power</b> |  |   |
| 1               | Replace all fuses in fuse panel on control unit frame.   | Determine that all fuses are of proper rating and that caps are tight.  |
| → 2             | Inspect.   | <p>If the control unit is equipped with option R —</p> <p>Determine that only the TM1 relay operates. If the control unit is equipped with options S and ZD —</p> <p>Determine that SAL and TM1 relays operate, and AL lamp lights.</p> |
| 3               | Measure battery supply at control unit.  | Minimum of 45 volts dc. (Measure between terminals 79 through 88 GRD, and 100 through 112 and 119 battery, on CAD 6.)   |
| 4               | Inspect and test remote unit battery in accordance with Section 167-285-301.   |   |
| 5               | At remote unit, place all fuses in proper positions in fuse panel.   | Determine that all fuses are of proper rating and that caps are tight.  |
| 6               | Inspect.   | Determine that no switches or relays are operated.  |

| STEP | ACTION   | VERIFICATION   |
|------|--|--|
| 7    | Measure battery supply at remote unit.   | Minimum 23 volts dc. (Measure at battery.)   |
|      | <i>Note:</i> If 22 spare cable pairs (2 groups of 12 pairs for 50-line remote units) are available and assigned, proceed as follows. If sufficient spare cable pairs are not available, proceed in accordance with Section 067-105-201 covering cutover procedures.  |  |
| 8    | In control unit, make busy trunks 06, 07, 08, 09, 16, 17, 18, and 19.  |  |
|      | <i>Note:</i> A talking trunk (00-19) is made busy by blocking operated the associated A and C hold magnets in the control unit.  |  |
| 9    | Cross connect the 20 talking trunks between the concentrator terminal strip and the feeder cable appearance on the distribution frame per SD-96536-01, CADs 11 and 12.   |  |
| 10   | Cross connect the 20 talking trunk stub cable pairs to feeder cable pairs at cross-connecting terminal at remote unit per Section 639-060-201.   |  |
| 11   | Measure charging current at remote unit. Insert dummy fuse (see Fig. 1) into CHG fuse position in remote unit to measure current. Refer to SD-96536-01-D1, Circuit Note 307 for strapping instructions in control unit.  | <p><b>100-Line Unit:</b> Near but not exceeding 140 ma with 8 trunks in cut-through or made busy condition.</p> <p><b>50-Line Unit:</b> As close as possible to 80 ma with 4 trunks in cut-through or made busy condition. (In some cases this may be over 100 ma, but in no case shall the charge current exceed 140 ma.)</p> |
|      | <i>Note:</i> The current measuring capacity of the KS-14510 meter is 120 ma. If a higher range milliammeter is not available, the following procedure may be used:   |  |
|      | <ol style="list-style-type: none"> <li>1. Connect a 1-ohm resistor (106A, 107A, 145A, or 146A) across the leads of the KS-14510 VOM.</li> <li>2. Set meter scale to 0.3 volt dc.</li> <li>3. Insert meter (with 1-ohm resistor) into circuit per Fig. 1.</li> <li>4. Adjust strapping for 0.14-volt reading. (The 0.14-volt drop across the 1-ohm resistor indicates a current flow of 140 ma.)</li> </ol> |  |

## STEP

## ACTION

## VERIFICATION



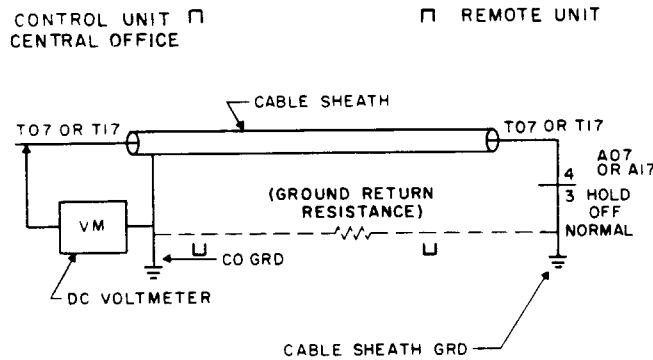
## Steps in Construction:

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Unsolder fuse element of 70A fuse A. Remove element, spring, cap, plastic tip, etc.</li> <li>2. Replace fuse element with wire connections as shown.</li> </ol> | <ol style="list-style-type: none"> <li>3. Thread wire through fuse cap.</li> <li>4. Solder 70A fuse B into circuit with wire B.</li> <li>5. Tape bare parts of fuse B.</li> </ol> |
|---|---|

**Fig. 1 — Construction of Dummy Fuse for Charge Current Measurements**

#### D. Ground Return Resistance

- |   |  |   |
|---|--|---|
| 1 | If ground return resistance measurement is made as part of this test and inspection procedure, proceed as specified in Fig. 2. | Ground return resistance not more than 23 ohms. |
| 2 | If ground return resistance measurement is made prior to installation of equipment, proceed as specified in Fig. 3.            | Ground return resistance not more than 23 ohms. |



Procedure:

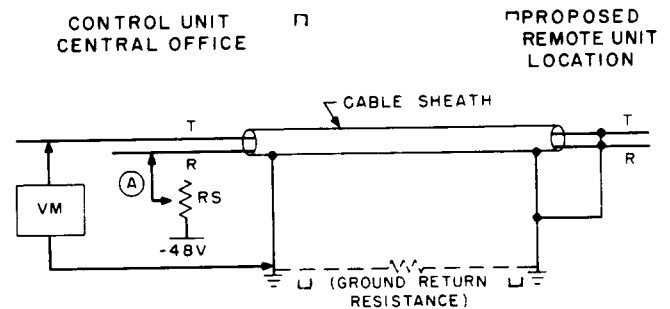
1. Remove charge fuse in remote unit.
2. Measure voltage at control unit as shown with no charging current flowing ( $E_1$ ). Determine polarity of voltage relative to ground, plus (+) for positive, minus (-) for negative.
3. Measure charging current (I) using the dummy fuse (Fig. 1) in the charging fuse holder at the remote unit.
4. Measure voltage again as shown above but with charging current flowing ( $E_2$ ). Determine polarity as shown in Step 2.
5. Remove dummy fuse and replace charging fuse.
6. Resistance of ground return (approximate) = 
$$\frac{\pm E_2 - (\pm E_1)}{I}$$

Example:

$E_1 = +0.4V$  (Step 2)  
 $E_2 = +3.2V$  (Step 4)  
 $I = 0.140A$  (Step 3)

Ground return resistance = 
$$\frac{+3.2 - 0.4}{0.140} = 20 \text{ ohms (Step 6)}$$

Fig. 2 - Measurement of Ground Return Resistance



Procedure:

1. Establish a cable pair between the central office and proposed remote unit location for test purposes.
2. At the remote location, ground the tip and ring leads of the test pair to cable sheath ground.
3. At central office, measure dc voltage  $E_1$  from tip lead to building ground. Determine polarity of voltage, relative to ground, plus (+) for positive and minus (-) for negative.
4. At central office, connect 48 volts to ring lead in series with sufficient resistance to maintain current between 40 and 140 ma. (Wattage rating of (RS) should be equal to  $I^2R = (0.140)^2 (RS) = 0.0196 (RS)$  watts.) Measure current (I).
5. At central office, measure dc voltage  $E_2$  from tip lead to building ground with ring lead current flowing (determine polarity as in Step 3).
6. Resistance of ground return (approximate) = 
$$\frac{\pm E_2 - (\pm E_1)}{I} \text{ ohms.}$$

Fig. 3 - Measurement of Ground Return Resistance Prior to Installation

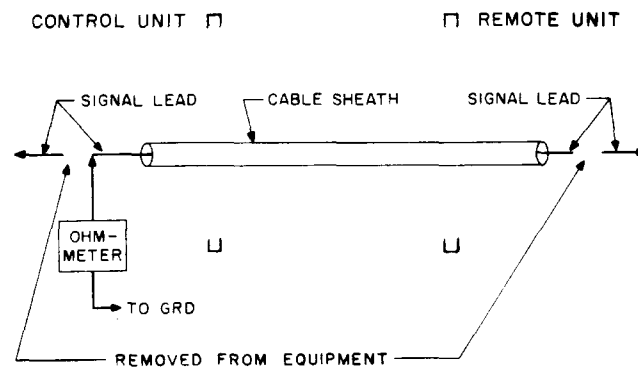
|      |        |              |
|------|--------|--------------|
| STEP | ACTION | VERIFICATION |
|------|--------|--------------|

**E. Insulation Resistance of Signaling Leads**

1. At the distribution frame, cross connect signaling leads between the concentrator terminal strip and the feeder cable pairs assigned as signaling leads per SD-96536-01, CADs 11 and 12.



| STEP | ACTION   | VERIFICATION   |
|------|--|--|
| 2    | At the remote unit cross-connecting terminal, cross connect stub cable, signaling leads to assigned feeder cable pairs per Section 639-060-201.  | At both units, mercury relays <i>S2</i> and <i>S4</i> operate. In addition, relays <i>S2A</i> and <i>S4A</i> operate in the control unit. (If <i>S</i> option is provided, <i>TMI</i> relay operates and <i>RL1</i> and <i>RL2</i> relays release. Operation of <i>AR</i> key will release <i>SAL</i> relay and <i>AL</i> lamp.) No other relays or switches should operate. |
| 3    | If insulation resistance test is applied as part of this test and inspection procedure, measure insulation resistance of signaling leads following procedure specified in Fig. 4.  | Minimum insulation resistance of 30,000 ohms to GRD or other conductor of pair.  |
| 4    | If insulation resistance test is applied to cable pair to be used for signaling leads prior to installation of equipment, measure insulation resistance of proposed signaling pairs in accordance with standard practices. | Minimum insulation resistance of 30,000 ohms to GRD or other conductor of pair.  |



## Procedure:

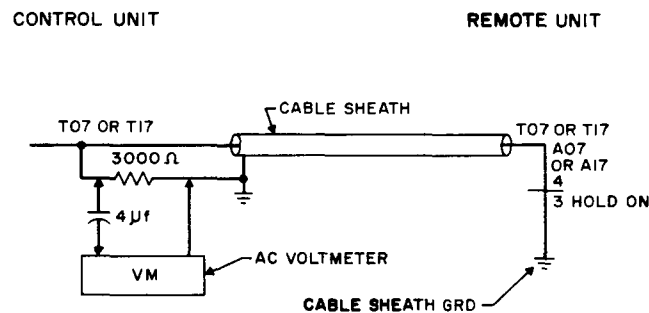
1. Insulate *10* of *Z1* in the control unit.  
100-Line Remote: Insulate 1 and 8 of *Z1*  
50-Line Remote: Insulate 1 of *Z1*
2. Measure leakage of *TS0* at CAD 6, terminal 70.
3. Insulate *9* of *Z1* in control unit.  
100-Line Remote: Insulate 3 and 11 of *Z1A*  
50-Line Remote: Insulate 3 of *Z1*
4. Measure leakage of *RS0* at CAD 6, terminal 60.
5. Remove *M* relay in remote unit.
6. Measure leakage of *TS1* at CAD 6, terminal 71.
7. Remove *RS1* lead from screw terminal in remote unit.
8. Measure leakage of *RS1* at CAD 6, terminal 61.
9. Correct any leakage found less than 30,000 ohms.
10. Replace *M* relay and *RS1* lead. Remove insulating material from all previously insulated contacts.

Fig. 4 – Measurement of Signal Lead Insulation Resistance

| STEP | ACTION | VERIFICATION |
|------|--------|--------------|
|------|--------|--------------|

### F. Interference on Signaling Leads

- |   |   |              |
|---|---|--------------|
| 1 | If interference test is applied as part of this test and inspection procedure, measure ac and dc interference on signaling leads following procedure specified in Fig. 5.   | See Table B. |
| 2 | If interference test is applied to cable pair to be used for signaling leads prior to installation of equipment, ground one lead of proposed signaling pair at the proposed remote location. Using this lead, apply the test procedure specified in Fig. 5. In the calculations, assume 0.140-amp charging current. | See Table B. |



#### Procedure:

1. Terminate tip of trunk 07 (trunk 17 if group 1 on 50-line remote unit) to ground with 3000 ohms as shown.
2. Measure ac voltage across 3000 ohms. A 4-uf capacitor should be placed in series with the voltmeter leads as shown above.
3. Calculate dc voltage as shown in following example:

Maximum dc charging current  
(obtained in Test C) = 0.140 amp

Signaling current = 0.100 amp (for all cases)

Ground return resistance  
(obtained in Test D) = 20 ohms

DC voltage =  $(0.140 + 0.100) \times 20 = 4.8$  volts

**Note:** Limits are shown in Table B. If limits are exceeded, sheath bonding and grounding should be verified.

Fig. 5 – Measurement of Interference on Signal Leads

TABLE B

## SIGNAL LEAD INTERFERENCE LIMITS

| FOR SYSTEMS WITHOUT 60-CYCLE FILTERS ON SIGNAL LEADS IN CONTROL AND REMOTE UNITS |  | FOR SYSTEMS EQUIPPED WITH 60-CYCLE FILTERS ON SIGNAL LEADS IN CONTROL AND REMOTE UNITS |  |
|--|--|--|--|
| When DC Interference (Step 3) Is:  | AC Interference (Step 2) May Not Exceed: | When DC Interference (Step 3) Is:  | AC Interference (Step 2) May Not Exceed: |
| volts  | volts rms                                | volts  | volts rms                                |
| 10   | 0  | 10   | 0  |
| 9.5  | 0.4                                      | 9.5  | 1.4                                      |
| 9.0  | 0.7                                      | 9.0  | 2.9                                      |
| 8.5  | 1.1                                      | 8.5  | 4.3                                      |
| 8.0  | 1.4                                      | 8.0  | 5.7                                      |
| 7.5  | 1.8                                      | 7.5  | 7.1                                      |
| 7.0  | 2.1                                      | 7.0  | 8.6                                      |
| 6.5  | 2.5                                      | 6.5  | 10.0                                     |
| 6.0  | 2.8                                      | 6.0  | 11.4                                     |
| 5.5  | 3.2                                      | 5.5  | 12.8                                     |
| 5.0  | 3.6                                      | 5.0  | 14.3                                     |
| 4.5  | 3.9                                      | 4.5  | 15.7                                     |
| 4.0  | 4.3                                      | 4.0  | 17.2                                     |
| 3.5  | 4.6                                      | 3.5  | 18.6                                     |
| 3.0 or less  | 5.0                                      | 3.0 or less  | 20.0                                     |

**Note 1:** The ac voltage component must be 5 volts rms or less on systems not equipped with 60-cycle filters on *each* end. Systems equipped with these ac filters (SD-96536-01, Fig. 11, Control Unit; SD-95957-01 Option "V," 50-Line Remote Unit; SD-96537-01, Fig. 6, 100-Line Remote Unit) at each end will tolerate up to 20 volts rms ac interference.

**Note 2:** If interference limits are exceeded, use separate cable pairs to extend central office battery and ground to the signaling circuit at the remote unit in accordance with SD-96537-01 or SD-95957-01, using Table C. Test for interference as in Step 2 by using both leads of a cable pair shorted together at the remote location and with one lead grounded at the central office.

**Note 3:** Signaling lead interference may vary through a 24-hour period. It may be necessary to make measurements at different intervals to ensure requirements are met. If possible, make measurements over a 24-hour period using a recording voltmeter.

| STEP | ACTION  | VERIFICATION |
|------|---|--------------|
| 3    | Strap proper punchings on the control unit (see the appropriate CAD in SD-96536-01). Provide total signaling lead cable resistance plus inserted artificial resistance as close to 800 ohms maximum (at maximum temperature) as possible. (See Note 2.) |              |

**Note 1:** Determine cable resistance at 68 F based on cable pair make-up. Using the following equation, determine the predicted maximum cable resistance based on the maximum temperature, the various lengths of cable, whether underground or aerial, and the type and gauge of cable.

$$R_c = \frac{395 + T_m}{463} \cdot R_{68F} \text{ ohms}$$

$R_c$  = Maximum cable resistance (at maximum cable temperature)

$T_m$  = Maximum predicted pair temperature

$R_{68F}$  = Pair resistance at 68 F

Required artificial resistance equals:

$$R_a = 800 - R_c$$

Insert resistance to come as close to this value without exceeding it as the strapping arrangement will allow.

**Note 2:** If no interference is measured in Test F or if battery and ground are being furnished to the remote unit via cable pairs per Table C, the concentrator remote unit may be placed at a greater distance from the central office. In this case, the total signaling lead resistance should be adjusted to as close to 1000 ohms maximum as the strapping permits.

**TABLE C**  
**SIGNALING LEAD RESISTANCE**

| LEAD DESIGNATION | NUMBER OF LEADS REQUIRED FOR FOLLOWING OHM RANGES<br>(SEE STEP 3, NOTE 1) |          |          |           |
|------------------|---|----------|----------|-----------|
|                  | 0-575*  | 576-765† | 766-860† | 861-1000† |
| T22 or T12       | 1   | 1        | 1        | 1         |
| R22 or R12       | 1   | 1        | 1        | 1         |
| T23 or T13       | 1   | 2        | 3        | 4         |
| R23 or R13       | 1   | 2        | 3        | 4         |


\* The sum of the loop resistance and the compensating resistance (C0-C15 in control unit) adjusted to as near as possible to but not less than 750 ohms at 68 F.

† Strap all compensating resistance (C0-C15 in control unit) out.

| STEP                      | ACTION   | VERIFICATION   |
|---------------------------|--|--|
| <b>G. Line Insulation</b> |  |  |
| 1                         | This test may be omitted if customer facilities between remote unit and customer are the same as those used before concentrator installation and are trouble free. |  |
| 2                         | Measure assigned customer line insulation with ohmmeter at remote unit cross-connecting terminal.  | Minimum insulation resistance 15,000 ohms.   |
| <b>H. Alarm Circuits</b>  |  |  |
| 1                         | Test uncompleted call alarm. At control unit, block <i>CCK</i> relay nonoperated. Initiate call from remote unit.  | Alarm relay <i>CAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.                           |
| 2                         | Unblock <i>CCK</i> relay. Operate alarm release <i>AR</i> key.   | Relay <i>CAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired.                           |
| 3                         | Block <i>RK2</i> relay nonoperated. Initiate call.   | Alarm relay <i>RAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.                           |
| 4                         | Unblock <i>RK2</i> relay. Operate alarm release <i>AR</i> key.   | Relay <i>RAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired.                           |
| 5                         | Block both <i>CCK</i> and <i>RK2</i> relays nonoperated. Initiate call.  | Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.                           |
| 6                         | Unblock both <i>CCK</i> and <i>RK2</i> relays. Operate alarm release <i>AR</i> key.  | Relay <i>SAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired.                           |
| 7                         | Block both <i>CCK</i> and <i>RK2</i> relays operated. Initiate call.   | Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.                           |
| 8                         | Unblock both <i>CCK</i> and <i>RK2</i> relays. Operate alarm release <i>AR</i> key.  | Relay <i>SAL</i> releases. <i>AL</i> lamp extinguishes. Central office alarms retire.                            |
| 9                         | Block <i>S2A</i> relay released. Initiate call. When <i>S</i> option is provided, a call should not be initiated.  | Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.                           |
| 10                        | Unblock <i>S2A</i> relay. Operate alarm release <i>AR</i> key.   | Relay <i>SAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retire.                            |
| 11                        | Repeat Steps 9 and 10 for <i>S4A</i> relay. When <i>S</i> option is provided, a call should not be initiated.  |  |
| 12                        | Test control unit fuse alarm. Insert an operated fuse in each fuse location, one at a time.  | Alarm relay <i>FA</i> operates. <i>FA</i> lamp lights. Central office alarms operate.                            |
| 13                        | Test charging circuit alarm. Insert an operated fuse into CHG fuse holder at remote unit. Trunk 00 must be idle and released.                                      | Alarm relay <i>RAL</i> operates, <i>CF</i> relay operates. <i>AL</i> lamp lights. Central office alarms operate. |

**Note 1:** When this test is made on a 50-line remote unit or on 1/2 of a 100-line remote unit used as group 1, trunk 10 must be idle.

**Note 2:** To release a trunk, operate *DP0* or *DP1* relay until trunk releases.

| STEP   | ACTION   | VERIFICATION  |
|--|--|---|
| <b>I. Circuit Operation, and Line and Trunk Call-Through Tests</b>   |  |   |
| 1  | In control unit, remove blocks for hold magnets for trunks 06, 07, 08, 09, 16, 17, 18, and 19.   | Hold magnets on switches A and C for trunks 06, 07, 08, 09, 16, 17, 18, and 19 will release.    |
| 2  | In control unit, cross connect terminals 3 and 7 of the <i>TLCO</i> relays and terminals 3 and 7 of the <i>TLC1</i> relay using two W1AP cords.  |   |
| 3  | Activate one directory number and associated line equipment for use as a <i>temporary</i> test line.   |   |
| <i>Note:</i> In addition, a telephone set which can be used to terminate calls to the temporary test line should be available at the control unit location. The spare telephone jack on the control unit may be cross connected to a line equipment at the concentrator spare jack terminal block on the distributing frame and used for this purpose. |  |   |
| 4  | On the distributing frame, cross connect the temporary test line equipment to concentrator line terminal 00 on the concentrator terminal strip.  |   |
| 5  | At remote unit, place dial hand test set across concentrator screw terminals for line terminal 00.   |   |
| 6  | At remote unit, place dial hand test set in an off-hook condition.   | Receive dial tone.  |
| 7  | At remote unit, dial one or two digits.  | Break dial tone.  |
| 8  | At remote unit, return test set to an on-hook condition and observe that the call disconnects.   | Crosspoints should release and the <i>CO-</i> relay in both units should operate. (See Test B.) |
| 9  | At control unit, dial the temporary test line directory number.  | Hear ringing at both units.   |
| 10   | At control unit, release test call and observe that the call disconnects.  | Crosspoints should release and the <i>CO-</i> relay in both units should operate. (See Test B.) |
|   | <i>This test assures that the line is capable of completing a call to one trunk. Calls using another trunk may fail due to bent select fingers, crosspoints not closing correctly (mechanical or dirt), or crosses in the vertical pile-up. Therefore, it seems desirable to use additional testing efforts which would assure the completion of calls from each line to each trunk.</i> |   |
| <i>Caution: If any CO- relay is found released at the start of a test, the cause should be found. It may be necessary to reoperate the CO- relay and make all the previous operational tests and observe after each test whether this CO- relay will release due to a call on a line not associated with the CO- relay.</i>                            |  |   |
| 11   | At remote unit, move dial hand test set to line terminal 01.   |   |

| STEP | ACTION | VERIFICATION |
|------|--------|--------------|
|------|--------|--------------|

- |    |   |  |
|----|---|--|
| 12 | At control unit, remove cross connections between the frame terminal strip and control unit terminal strip for line 00. Temporarily cross connect T, R, and S of line 00 to T, R, and S of line 01 on the frame terminal strip, using 1W13 test cords equipped with 360 and 624B tools. |  |
|----|---|--|

**Note:** Frame terminal strip to control unit terminal strip cross connections should only be removed for line 00; the other lines are open at the distributing frame concentrator terminal strip.

- |    |  |  |
|----|--|--|
| 13 | Repeat Steps 6 through 12 until all lines in each group, except lines 49 and 99, have been tested with all trunks in that group. |  |
|----|--|--|

**Note:** See Section 067-105-502, System Tests, for method of testing lines 49 and 99 for originating service. From control unit, measure for 33,000 ohms between tip and ring. Terminating requests can be made as above.

- |    |   |             |
|----|---|-------------|
| 14 | Check that all <b>CO</b> - relays are operated.   | See Test B. |
| 15 | At the control unit on the frame terminal strip, remove cross connections between line terminals 00 and last line tested. |             |

#### J. Trunk Verification

- |   |   |   |
|---|---|---|
| 1 | At control unit, determine that all trunks are released.  |   |
| 2 | Place dc voltmeter between tip lead of each trunk and ground. Make test connections on frame terminal strip (SD-96536-01, CAD 3) to test trunk 00 or trunks 00 and 10 when two remote units are associated with one control unit. Remove the <b>K</b> fuse in the control unit. | Read 0 volts provided there is no ground potential. |

**Note:** To test trunk 08 or 09, block A08 or A09 hold-off-normal contact in the remote unit operated. With option **Z**, this refers to trunks 09 and 19.

- |   |  |                                  |
|---|--|----------------------------------|
| 3 | On C switch at control unit, block operated hold magnet for trunk 00.  |                                  |
| 4 | Place voltmeter between ring lead for trunk 00 and ground.   | Should read more than -26 volts. |
| 5 | Unblock hold magnet for trunk 00. Manually release if necessary.   |                                  |
| 6 | Repeat Steps 3, 4, and 5 for all trunks.   |                                  |
| 7 | At control unit, assure that all hold magnets are unblocked and released, then remove jumpers from <b>TLC0</b> and <b>TLC1</b> relays. |                                  |

| STEP   | ACTION   | VERIFICATION  |
|--|--|---|
| <b>K. Trunk Transmission, Overflow Tone, Trunk Disconnect Sequence, and Trunk Load Control</b> |  |   |
| 1  | At the control unit, temporarily cross connect line terminal 00 from frame terminal block to control unit terminal block using 1W13 test cords equipped with 360 and 624B tools. |   |
| 2  | At remote unit, place the test set across line terminals 00, simulating an on-hook condition.  |   |
| 3  | At the control unit, dial the temporary test line directory number.  | Receive ringing at both ends. Trunk 00 will be selected and connected.  |
| 4  | At the control unit, block the <i>TB00</i> relay operated.   |   |
| 5  | At the remote unit, when ringing is received, place the test set in an off-hook condition.   | By means of conversation, verify talking path and transmission.   |
| 6  | Place receivers at both locations on hook.   |   |
| 7  | At control unit, remove temporary test cord cross connections between frame and control unit terminal strips for line 00.  |   |
| 8  | Using test cords on the frame terminal strip, temporarily cross connect line terminals 00 and 01.  |   |
| 9  | At remote unit, remove dial hand test set from line terminal 00 and place on line terminal 01.   |   |
| 10   | Repeat Steps 3 through 9 for lines 01 through 09.  | <i>TB</i> relays 00 through 09 should be blocked operated, and trunks 00 through 09 should be connected to lines 00 through 09. Trunks are selected in order from 00 to 09. |
| 11   | Repeat Steps 7 and 8 for line 10.  |   |
| 12   | At the control unit, place a terminating call to line 10.  | Terminating call receives overflow tone.  |
| 13   | Block <i>DP0</i> relay nonoperated.  |   |
| 14   | Remove blocks from <i>TB</i> relays 00 through 09.   |   |
| 15   | Remove block from <i>DP0</i> relay.  | Observe that trunks 00 through 05 or 06 disconnect and that they disconnect in order from zero up. One disconnect occurs about every 6 seconds.                             |



| STEP | ACTION  | VERIFICATION  |
|------|---|---|
| 16   | Repeat Steps 1 through 12 for lines 50 through 60 (group 1). Cross connection in Step 1 shall be between line terminals 00 and 50 on frame terminal strip, then between 00 and 51, etc. |   |
| 17   | Repeat Steps 13 through 15 using <i>DPI</i> relays and <i>TB</i> - relays 10 through 19.  | Observe that trunks 10 through 15 or 16 disconnect and that they disconnect in order from 10 up. One disconnect occurs about every 6 seconds. |
| 18   | Remove all temporary test lead cross connections. Replace regular cross connections between frame and control unit terminal strips for line 00.   |   |

#### L. Service Denial Call

*Note:* This is only a test procedure. Service denial calls should be placed in accordance with Section 067-105-502 Line Concentrator No. 1A, System Tests.

|   |   |                                     |
|---|---|-------------------------------------|
| 1 | In control unit, cross connect terminal A69 of the control unit terminal block to terminal 3 of a <i>CO</i> - relay in group 0. |                                     |
| 2 | Operate TO key. Release key as soon as COK lamp lights.   |                                     |
| 3 | Remove cross connection between <i>CO</i> - relay and terminal A69.   |                                     |
| 4 | From the remote unit, place a call from the line which has been denied service.   | Service request will not be served. |
| 5 | Place terminating call to the line denied service to restore cutoff relay.  |                                     |
| 6 | Repeat Steps 1 through 5 for any line in group 1.   |                                     |

#### M. Dial Tone Speed Register

*Note:* The central office dial tone speed register circuit must be operating when performing step 1 or 3. Block relays only as long as required for this test. Traffic should be notified of the number of registrations because of this test.

|   |   |  |
|---|---|--|
| 1 | Block <i>TGB0</i> relay operated in control unit. | One registration on meter associated with group 0. |
| 2 | Unblock <i>TGB0</i> relay.                        |  |
| 3 | Block <i>TGB1</i> relay operated in control unit. | One registration on meter associated with group 1. |
| 4 | Unblock <i>TGB1</i> relay.                        |  |

#### N. Trunk Group Usage Recorder

*Note:* For procedures to follow when performing Test N refer to Section covering Concentrator Trunk Usage Recorder SD-96549-01, Tests.

## 6. SUMMATION

- 6.01 After completion of all test and inspections, both control and remote units should be in normal operating condition.