

**DROP AND BLOCK WIRING  
TESTING AND FAULT LOCATING**

**1. GENERAL**

- 1.01 In locating trouble in the drop and block wire plant, time and effort can be saved by analysis and systematic procedure by the workmen. Certain types of trouble are apparent and can be detected by a visual inspection; other types show very little external evidence of their existence and require electrical tests to locate them.
- 1.02 Knowledge of plant conditions throughout the territory involved greatly assists a workman in locating trouble.
- 1.03 Knowing the location of foreign construction operations which might interfere with the telephone plant will assist in many instances in locating the cause of trouble. Consultation with the people in charge of the construction, before they have progressed to a point where the telephone plant is endangered, will frequently prevent interference with the telephone service. When it is noted that the telephone plant will interfere with the progress of building operations or other construction work, the condition should be reported or corrected in accordance with local procedures.
- 1.04 In order that the workman may proceed efficiently to locate the cause of trouble, he should have the following information:
  - a. Telephone number.
  - b. Name and address of customer, given in sufficient detail.
  - c. Cable numbers, pair numbers, and terminals. Where terminals are not stenciled or otherwise marked, use binding post identification.
  - d. Number of pole on which drop or drops terminate (on other than cable lines), if available.
  - e. Nature of trouble as diagnosed by test or from report.
  - f. Whether or not station is out of service.
  - g. Other items of special information as:
    - (1) Any indications (such as the operation of protective equipment) that there may be foreign current on the line.
    - (2) Special effort is necessary to restore service quickly such as to hospitals, doctors' offices, etc.
    - (3) Trouble is such that the entire line from the terminal to the station should be inspected.
- 1.05 After securing the necessary information, the workman should proceed as follows:
  - a. If the line is not out of service, the workman should inform the customer that the line is being repaired. When party lines are involved, the work forces must monitor all working lines before opening, short circuiting, crossing, grounding, placing trouble clearing equipment or applying tone for identification.

- b. When the line is out of service, the workman should begin by visiting the points where trouble conditions are known to exist. If the fault is not found at these points and subsequent tests reveal that the trouble is in drop or block wire, the investigation should be continued in accordance with the methods given in paragraphs 3, 4, 5, and 6.
  - c. After the troubles have been cleared, the customer should be informed by the work forces that the work has been completed and that the line is back to normal.
  - d. Each workman should be familiar with CTSP 400-300-019, Monitoring of Working Lines.
- 1.06 Hand test sets can ordinarily be used on common battery circuits to make the necessary electrical tests on the line to locate faults. These sets should be used so that a trouble may be located quickly without making unnecessary tests. Proper use of the test set enables the repairman to locate many troubles without the aid of the test deskman or the operator. Test sets used should be provided with leads ending with approved type clips equipped with test points so that contacts may be made with conductors by piercing the insulation with these points. No other method of establishing contacts with conductors through the wire insulation should be used. When making tests which depend on a click being heard in the receiver of the test set, be sure that the click is heard both upon the make and the break of the contact.
- 1.07 When it is necessary in locating a fault in drop or block wire to open the line at various points for the testing purposes, first select points where disconnections can readily be made such as binding posts, bridging connectors, etc. In general, no wires should be cut until tests have isolated the fault between two adjacent points. After an inspection has been made and further tests are required to locate the fault, one conductor of the wire may be cut to make the test.
- 1.08 Before leaving a worked on or repaired line, suitable tests should be made in accordance with local procedures to determine that the line is in good working condition.
- 1.09 Whenever there is any indication (such as the operation of protective equipment) of the presence of foreign current on a line, suitable precautions should be taken to prevent the possibility of electric shock.
- 1.10 The detailed procedures to be employed to locate the various types of faults in the drop and block wire plant are outlined in the following paragraphs.

## 2. GROUNDS

- 2.01 Two types of grounds are commonly encountered in the drop and block wire plant:
- a. *Low resistance grounds*—This type of ground is usually the result of a complete breakdown of the insulation on a conductor due to deterioration or abrasion and contact with grounded objects such as guys, suspension strand, ground wires, rain spouts, conduit, etc., establishing a low resistance path to ground.
  - b. *High resistance grounds*—This type of ground may be caused by complete or partial breakdown of the insulation on a conductor and the establishment of a poor contact with grounded objects so that the path to ground is of high resistance, except in wet weather. It may also be caused by complete breakdown of the insulation on a conductor and contact with objects such as wood poles, trees, buildings, etc., that do not afford a low resistance path to ground. Troubles of the latter class are frequently of varying intensity, appearing usually during wet weather, and usually must be located either under wet weather conditions or by a visual inspection for the point where the insulation is faulty.

### 3. COMMON BATTERY CIRCUITS – LOCATING GROUNDS IN THE DROP AND BLOCK WIRE PLANT

3.01 *Low resistance grounds*—Information as to which side of the line is grounded is important. This is especially true if the cause of the fault is not found by visual inspection and tests must be made to more accurately determine its location. This information, if it is available, should be obtained when the trouble is referred for clearing. If it is not available, the side that is grounded should be determined during the tests that are necessary to isolate trouble to a drop or block wire.

3.02 The drop or block wire in which the fault is located should be found by the following test:

- a. Disconnect all drop, block, or bridle wires bridged to the grounded line from the binding posts in the cable terminal, placing the wires so that they may be reconnected in their original position upon test completion. (If it is known which side of the line is grounded, it is necessary to disconnect only the wires on the grounded side of the line.)
- b. Connect one clip of the test set to a suitable ground such as the metal terminal case or suspension strand and touch the other clip to the binding post on which battery normally should be found. See Figure 1. If no battery click is heard in the receiver, touch the other binding post. (If battery click is still not heard, there is other trouble on the line which must be corrected before proceeding with trouble location in the drop or block wire.)

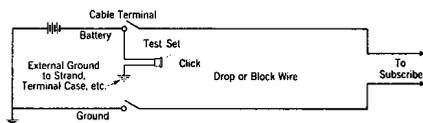


FIGURE 1. Test to Determine Battery Side of Line

3.03 When a battery click is heard, connect the clip to the binding post carrying battery and remove the other clip from the external ground. Touch this clip to the conductors of the drop wire. A battery click will be heard in the receiver when the grounded wire is touched. See Figures 2 and 3.

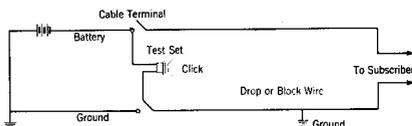


FIGURE 2. Ground Side Grounded

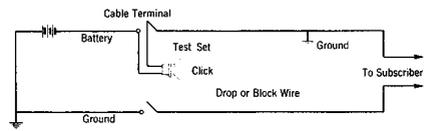


FIGURE 3. Battery Side Grounded

Note whether or not the insulation on the grounded wire carries a tracer. This knowledge will be helpful if subsequent tests at other points are necessary (unless an intervening splice has been made in a nonstandard manner and the tracer reversed). Before reconnecting the wires disconnected to make this test, be sure to test every wire separately to determine whether or not it is clear.

- 3.04 After the fault has been isolated to a particular drop or block wire, a careful inspection for the conditions causing the ground should be made before testing at other points to further isolate the fault. This is desirable as low resistance grounds in the drop and block wire plant are usually caused by conditions that are readily discovered by visual inspection.
- 3.05 If a visual inspection of the wire that is grounded does not disclose the fault, further tests are necessary to definitely locate the source of the trouble. In making these tests, if the ground is on the battery side of the line:
- Open that side of the line.
  - Then attach one clip of the test set to the binding post or wire end on the central office side of the open.
  - Touch the end of the wire that leads away from the central office with the other clip. See Figure 4.

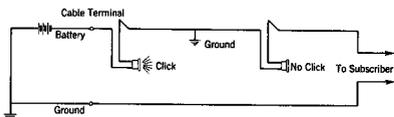


FIGURE 4. Battery Side Grounded

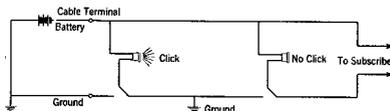


FIGURE 5. Ground Side Grounded

However, if the external ground is on the ground side of the line:

- Open that side.
  - Establish a contact with the battery side of the line by attaching a clip of the test set to a binding post or (if the test is at a point in the wire) by piercing the insulation of the conductor carrying battery with the point of the test set clip.
  - Touch the exposed end of the wire that leads away from the central office with the other clip. See Figure 5.
- The test, if on an individual line will indicate by a click in the receiver that the ground is located toward the station or by absence of a click that it is located in the direction of the central office. On a party line, the click indicates that the ground is located in the portion of the wire that is directly affected by the test and absence of the click indicates that the ground is either toward the central office or in a portion of the wire which is not affected by the test at that particular point.
- 3.06 In locating grounds on party line, it is desirable to start at a point where the circuits to all parties are common and are carried on a single pair of conductors. Then test the wires to each individual party until the wire that is in trouble is found.
- 3.07 *High resistance grounds*—Trouble of this type is frequently of varying intensity and in some instances appears only under severe moisture conditions. Often the trouble is caused by the cumulative effects of lowered insulation at several entirely different points in the drop or block wire plant; this condition is frequently found on party lines. If the resistance of the contact to ground is high, it is difficult to obtain a positive indication by testing with the hand test set under low resistance grounds. In this case, it is advisable to first determine

that the fault is not located toward the central office by disconnecting the drop or block wire at the cable terminals and having the circuit tested from the central office (when testing facilities are available). On a party line if this disconnection reduces the leak to ground but does not entirely clear the line, leave the wires disconnected until similar tests have been made where other wires are bridged to the line so that all the conditions contributing to the leak may be isolated and cleared. On party lines where the disconnection has either cleared the fault or has had no effect on the leak to ground or on individual lines, reconnect the wires immediately after the test has been concluded and the result reported. After the wire or wires which cause or contribute to the leak are determined, the fault usually may be found by making careful visual inspection. If the points of faulty insulation are not found, it is necessary to further isolate them by opening the faulty conductor at various points and having the circuit tested from the central office when testing facilities are available.

NOTE: Where leaks to ground exist at several points due to faulty insulation on different sides of the line, the trouble may be referred to the workman as a short and a ground. This possibility should be understood when starting to clear such a trouble.

#### 4. OPENS

4.01 Opens in the drop and block wire plant are of three classes:

- a. Opens—A complete open in a line is usually due to a break in one or both conductors of a drop or block wire, to a wire disconnected from a binding post or bridging connector, or to an improper or split pair connection at a cable terminal.
- b. Intermittent Opens—The common causes of an open of this type are loose connections at binding posts or bridging connectors, improperly made splices, corroded wires, kinks, etc.
- c. High Resistance Connections—High resistance connections are ordinarily caused by improper cleaning of wires before attaching them to binding posts or bridging connectors; also by the formation of corrosion on wires, binding posts, nuts, and washers.

Opens of the first class are easily recognized and are usually referred to the workman. High resistance connections causing only poor transmission and noise and not causing cutouts are often not identified as opens and therefore are not referred to the workman.

4.02 *Common Battery Circuits—Locating Opens in the Drop and Block Wire Plant*—To locate an open in the drop or block wire plant, isolate the fault by making successive tests at different points in the line with the hand test set. See Figure 6.

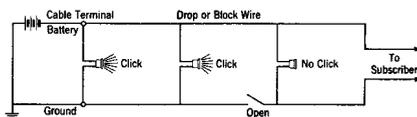


FIGURE 6. Test for Locating an Open

To make the test, bridge the test set across the line. If a battery click is heard in the receiver on the make and on the break of the contact, the open is away from the central office. If these clicks are not heard, it is situated toward the central office. When clicks are

heard on one test and the test at the next point in the line no clicks are heard, the fault is located between the points at which these two tests were made. After the fault has been isolated to one span or section, the wire in this span or section should be carefully examined, if necessary lowering the wire to do so. If the fault cannot be found, it should be eliminated by replacing the wire in that span or section. When locating an open, the test set should be bridged across the line on the *far* side of any wire support on every test. If the trouble is at a wire support, and if procedures in this practice are followed, the direction of the fault is shown. Verification of the fault at the support consists of repeating the test on the near side of the support. During the tests, wires should be shaken as described in paragraph 4.03.

4.03 *Intermittent opens*—Intermittent opens in the drop and block wire are frequently difficult to locate and generally require a close inspection. If it is not detected by the inspection, resort to tests to locate the fault. When making a test on the line, the wires toward the central office should be moved at knobs or other supporting fixtures; the wire in the span or section toward the central office should be shaken. A succession of battery clicks or a fluttering noise in the receiver indicates that the open is near to the point of movement, and it ordinarily can then be found by a careful inspection. Check all connections at binding posts, bridging connectors, etc., to be sure that they are tight.

4.04 *High Resistance Connections*—High resistance connections are generally indicated by noise and occasionally by cutouts. Connections may appear tight and in good condition on visual inspection and yet the contact afforded may be so poor that noise is introduced into the circuit. The cause of this type of trouble ordinarily can be located by bridging the test set across the line near the various connections on the side away from the source of battery and listening for noise. Moving the wires at connections or tightening screws or locknuts may clear the trouble; but, to prevent its recurrence, all wires found to be faulty should be removed at the connecting point, and thoroughly cleaned before replacing. Where the trouble is not definitely found at any connection, the wires should be removed, cleaned, and replaced at all binding posts or bridging connectors, etc. When the trouble is at the binding posts of a cable terminal and the nuts and washers are dirty and corroded, the spinning should be removed from the top of the binding post with the binding post cutter and the nuts and washers should be replaced with new ones before re-establishing the connection.

## 5. SHORT CIRCUITS

5.01 Short circuits in drop and block wiring are of two general classes:

- a. *Low Resistance Short Circuits*—These are due to a complete breakdown of the insulation between the two wires and the establishment of a low resistance path from one wire to the other. Frequent causes are injury to or deterioration of insulation at supporting fixtures; abrasion at knobs, rings and at contacts with poles, trees, buildings, etc.; and injury due to interference by foreign workmen, building operations, etc.
- b. *High Resistance Short Circuits*—These are due to the establishment of a high resistance path between the two wires, caused by either a partial breakdown of the insulation or a complete breakdown of the insulation which has resulted in only a poor or high resistance contact between the wires. The usual causes for this type of short circuit are similar to those given for the first type, differing only in that the deterioration of or injury to the insulation is less severe.

5.02 *Common Battery Circuits—Locating Short Circuits in the Drop and Block Wire Plant*—In locating a low resistance short circuit in the drop or block wire plant, first isolate the fault to a particular portion of the wire. To do this, disconnect one side of the line at various

convenient points (such as at binding posts, bridging connectors, or protectors) and connect the test set in the line. See Figure 7.

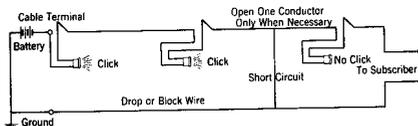


FIGURE 7. Tests to Locate Short Circuits

If a battery click is heard on the make and on the break of the connection, the short circuit is located away from the central office. If no click is heard, it is in the portion of the circuit toward the central office. When the clicks are heard at the point one test is made and are not heard at the point the next test is made, the fault is located between these two points.

- 5.03 After the fault has been isolated on a particular portion of the wire, make an inspection of this section, noting especially the condition of each wire support. Location of the fault is facilitated if, while making this inspection, the test set is bridged across the line near each wire support and the wire is moved at the support and in adjacent spans. If this disturbance of the wire causes the short circuit to shake out even momentarily, this will be indicated by a fluttering noise or a series of clicks in the receiver. Then, by making a careful inspection of the wire near the point it was moved, the fault can usually be found.
  - 5.04 If the short circuit cannot be located by the inspection, it becomes necessary to further isolate it to a particular span or section by repeating at various points the test outlined in paragraph 4.02, cutting one conductor of the wire when necessary to permit testing. After the fault has been isolated to a particular section or span, make a careful inspection of the wire in that section or span, if possible with the wire lowered. If the fault is not found, cut out and replace the wire.
  - 5.05 *High Resistance Short Circuits*—High resistance short circuits often cannot be located by the tests described for low resistance short circuits. In this event it becomes necessary to obtain assistance by having the condition of the circuit observed at the testing equipment in the central office while one side of the line is opened at various points. When a disconnection at one point causes the fault to disappear and a disconnection at an adjacent point does not, the fault is located between the two points at which these tests were made. After the fault has been isolated in this manner to a particular section or span, make a careful inspection of the wire in that section or span (if possible with the wire lowered) and then if the fault is not found, cut out and replace the wire.
6. CROSSES
- 6.01 Crosses in the drop and block wire plant result from the establishment of an electrical contact between one conductor of a drop or block wire and one conductor or binding post of another line. Troubles of this nature are less common than grounds, opens, or short circuits and are to a large extent limited to localities where two or more working block or drop wires are in close proximity. Common causes of crosses in drop and block wiring are:

- a. Breakdown of the insulation on wires in ring runs on poles or buildings due to deterioration, abrasion on rings, or injury from external sources.
- b. Breakdown of insulation on wires in close proximity in building or pole runs due to deterioration, abrasion, or other injury.
- c. Improper dressing and connecting of wires at cable terminals so that wires or ends of wires touch adjacent binding posts of other lines.

6.02 When the trouble to be located is a cross, the work is greatly facilitated if certain information is obtained:

- a. The line number of each of the lines that are crossed together.
- b. The cable number and pair number at crossed lines.
- c. Cable terminal locations—all terminals where drops terminate on either of the crossed lines.
- d. Number of each pole on which drops of either line terminate (on other than cable lines), if available.

6.03 *Common Battery Circuits—Locating Crosses in the Drop and Block Wire Plant*—In isolating a cross to a portion of the plant such as to the drop or block wire plant or to a portion of a drop or block wire, make the following test: See Figure 8.

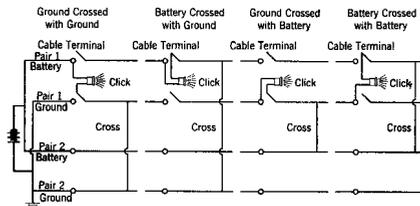


FIGURE 8. Tests to Locate Crosses

- a. Disconnect all wires of one crossed line from the binding posts or bridging connectors, using care to place the wires so that they may be properly reconnected in their original position after testing.
- b. Attach one clip of the test set to one of the pair of binding posts or bridging connectors from which the wires were disconnected. With the other clip, touch in turn each of the wires just disconnected.
- c. If no battery click is heard on the make and break of any of the contacts, transfer the clip on the binding post or bridging connector of the same pair and repeat the test.

If clicks are heard, the wire causing the clicks when touched is crossed with another line. The cross is in the portion of the wire that is affected by the tests at this point. If no clicks are heard on either test, the cross is not located in the portion of the circuit which is affected by the tests at this point. On party lines, this test should be made at every point at which a drop or block wire is bridged to the circuit until the fault is isolated to the line

of a particular party. After it has been determined that the fault is located on the station side of a cable terminal, there is still the possibility that the inside wiring of the station is crossed with another line. Therefore, to determine that the cross is located in the drop or block wire, the above test should be repeated at the protector or connecting block at the customer's premises.

- 6.04 After the fault has been isolated in a drop or block wire, it usually can be found by carefully inspecting the entire length of the wire. If it cannot be found by inspection, it must be further isolated by repeating tests at suitable points, if necessary cutting a conductor to permit testing. If it is necessary to cut a conductor, repairs should be made after testing is complete.

## 7. HIGH RESISTANCE CROSSES

- 7.01 When the cross is of high resistance and the test set cannot successfully be used to locate the fault, request that the condition of the line be observed at the testing equipment in the central office while disconnections are made at various points in the circuit. The fault can be isolated in this manner to a particular portion of the drop or block wire and can then be discovered by visual inspection. In areas where testing equipment suitable for this test is not available at the central office, the operator may be called and requested to talk or ring on one of the crossed lines while the test set is bridged to a suitable disconnected portion of the other circuit. If the ring or the operator's voice is heard in the test set, the cross is in the portion of the circuits under observation and when by suitable repetition of this test the fault is isolated to a sufficiently small section of the drop or block wire, it can be found by visual inspection.