



**Bell  
Communications  
Research**

**Bellcore Practice  
BR 314-410-311  
Issue 2, August 1987**

---

**LOCAL AREA DATA CHANNELS  
MAINTENANCE PROCEDURES**

**RECEIVED**

DEC 14 1987

**NETWORK INFORMATION CENTER**

**PROPRIETARY – BELLCORE AND AUTHORIZED CLIENTS ONLY**

This document contains proprietary information that shall be distributed or routed only within Bell Communications Research (Bellcore) and its authorized clients, except with written permission of Bellcore.

**BR-314-410-311**  
**Issue 2, August 1987**

**Prepared by the Information Management Services Division,  
Bell Communications Research, Inc., August 1987.**

**Produced under Project Number 422241**

**Copyright © 1987 Bell Communications Research, Inc.  
All rights reserved.**

**LOCAL AREA DATA CHANNELS  
MAINTENANCE PROCEDURES**

**CONTENTS**

1. GENERAL . . . . .	1
A. Purpose . . . . .	1
2. MAINTENANCE . . . . .	2
A. Routine Maintenance . . . . .	2
B. Trouble Conditions . . . . .	2
3. CHANNEL PROTECTION UNIT . . . . .	2
4. TROUBLE CLEARING PROCEDURES . . . . .	3
5. TESTING . . . . .	4
6. REFERENCES . . . . .	8

**LIST OF FIGURES**

Figure 1. Local Area Data Channels -- Trouble Clearing Procedures . . . . .	6
---	---

**LIST OF TABLES**

Table A. OVERALL CHANNEL TESTS . . . . .	5
--	---

## 1. GENERAL

### A. Purpose

1.01 This practice describes the maintenance considerations and procedures used to locate trouble conditions on the metallic pairs that make up a Local Area Data Channel (LADC). These channels provide for baseband transmission of data signals between two end-user terminal locations within a single serving wire center area.

*Note:* The term "pair" or "loop" as used in this practice denotes the circuit facility used to implement the channel service. It is not necessarily the circuit facility between an end-user and the telephone company central office.

1.02 This practice is reissued to conform to the changes in Part 68 of the Code of Federal Regulations that governs the terms and conditions for connecting customer premise equipment to the telephone network. This reissue also reflects a change in language that was generated by divestiture of the Bell Operating Companies.

1.03 The LADCs use nonloaded metallic facilities exclusively with limited amounts of bridged tap. The facilities may reside entirely within the end-user premises or may be through the Serving Central Office (SCO). When the facilities are routed through a central office, some testing may be accomplished by Mechanized Loop Testing (MLT) at a Maintenance Center (MC). If the channel is not routed through the SCO, a dispatch may be necessary when a trouble is reported.

1.04 The LADCs are provided as either 2-wire or 4-wire channels with corresponding 2-wire or 4-wire interfaces to the modem. Channels are specified in lengths ranging from 1 mile to 6 miles in 1-mile increments. Channel length is determined by the overall length of the facilities used to furnish the particular channel service and is measured from end-user to end-user.

1.05 The LADCs are generally treated as a Special Service. The Test Center (TC) responsible for the territory involved is normally the office that the customer is instructed to call in case of trouble. The TC is responsible for coordinating all maintenance activities and for requesting the MC at the SCO to perform any required testing. In the absence of a TC, the local organization that normally receives trouble reports may be designated as the Control Office.

1.06 Trouble analysis procedures and information given in this practice are based on the results of tests made under the following conditions:

- (a) SELF-TESTS made by the customer (when possible). These tests make use of the self-test capabilities of the modems connected to the LADCs. Generally, the results of these tests should indicate the source of the trouble.
- (b) ONE (1) EMPLOYEE TESTS made at the SCO or another convenient test access midpoint. These tests are DC tests made toward either end of the circuit for the purpose of trouble analysis. If the modems are telephone company provided, they remain connected to the circuit.
- (c) END-TO-END TESTING of the circuit. These tests are AC and DC tests made at the end-user interface with the modems disconnected from the circuit. These tests are performed during installation (benchmarks) or for the purpose of detailed trouble analysis.

1.07 The various tests to be performed on LADCs are outlined in Part 5 of this practice. The step-by-step procedures for performing these tests and the test requirements are given in BR 314-410-312.

PROPRIETARY - BELLCORE AND AUTHORIZED CLIENTS ONLY

See proprietary restrictions on title page.

1.08 In the event that a cable pair must be replaced for any reason, (e.g., due to a fault on the pair), replacement pair(s) must still meet all of the design requirements and the installation test requirements for the particular channel length provided.

## **2. MAINTENANCE**

### **A. Routine Maintenance**

2.01 No routine maintenance is required on the cable pair(s) used to implement a LADC. Test results obtained during the LADC installation should be recorded to serve as benchmarks in case of trouble conditions on the channel.

### **B. Trouble Conditions**

2.02 Cable pair faults are not alarmed. A trouble condition will normally be detected and reported to the telephone company by the customer. The telephone company will then investigate the trouble condition.

2.03 The basic intent of a trouble investigation should be to avoid dispatching repair people to both ends of the circuit, except as a last resort. Initial sectionalization to the telephone company facilities should be performed by the customer. Testing by the telephone company should then be performed to isolate and clear the trouble, if necessary.

2.04 When a trouble report is received from the customer, telephone company craft employees should perform the required tests as outlined in Part 5 of this practice, based on the analysis procedures in Part 4. Not all tests will be required in most cases of trouble. The analysis procedures given in Part 4 of this practice should be followed to trace the most likely cause of the trouble condition and the tests to be performed.

## **3. CHANNEL PROTECTION UNIT**

3.01 Part 68 of the Code of Federal Regulations governs the terms and conditions for connecting customer premise equipment (CPE) to the telephone network. The rules were conceived to protect the integrity of the network, without requiring that each piece of equipment be connected to a protective coupler. The Part 68 notification program began as a reasonable precaution to ensure that only registered CPE was connected to the network. The FCC has issued notice of proposed rulemaking to reduce unnecessary regulatory burdens generated by these rules. The Commission's order made the following changes that affect LADCs:

- the public notice period for registration number assignment has been shortened to five (5) days from twenty (20) days;
- mandatory reporting of requirements to telephone carriers by customers prior to connection of terminal equipment has been eliminated;
- the requirement of a telephone subscriber having to notify the telephone company before connection or final disconnection of CPE and to provide the telephone company with the FCC Registration and Ringer Equivalence Numbers (REN) has been eliminated; instructions to the subscriber required by Section 68.218 (b)(1) of the rules should include, where applicable, complete information concerning the importance of compliance with REN limitations. Customers must now supply the carrier registration information only upon a carrier's request.
- specifications for equipment to equipment connections have been eliminated.

**PROPRIETARY - BELLCORE AND AUTHORIZED CLIENTS ONLY**

See proprietary restrictions on title page.

3.02 Separate Channel Protection Units are not required if the customer provided modems used on the LADC meet the terms and conditions as set forth in the applicable, 1986, Part 68 section of The Code of Federal Regulations. If the LADC under test is equipped with a channel protection unit, due to earlier connection to unregistered terminal equipment, the previous options for AC and/or DC operation should be continued until such time as the connected terminal equipment fully complies with Part 68 of the federal rules.

3.03 The presence of 500Z Channel Protection Units should only be taken into account during testing and trouble isolation when the telephone company has knowledge that such devices exist on the circuit. Where applicable, the losses on these units have been included in the insertion loss limits specified for the specific LADC.

#### 4. TROUBLE CLEARING PROCEDURES

4.01 This part outlines the analysis procedures coordinated by the TC, shown in Figure 1, that should be used to isolate and clear trouble on the metallic pairs that make up an LADC. The detailed tests and requirements are listed in BR 314-410-312.

4.02 The procedures begin when the TC receives a trouble report from the customer. The TC should then determine from conversation with the customer if the trouble is the telephone company's responsibility. Generally, the modems used with LADCs will have some self-testing capabilities that should enable the customer to isolate the trouble to a particular modem or the metallic facilities. Customers are expected to use all of the modem testing features before reporting any trouble and should be encouraged to do so.

4.03 The following questions are intended as a guide for the TC to use when discussing a trouble with a customer. All questions are not expected to be applicable in every case.

- Describe the trouble – occasional errors, or does not work at all?
- Are modem power indicators ON?
- Are modems plugged in?
- Are modems properly connected to the circuit?
- Have the self-testing features, if any, been exercised. What was the outcome?
- How often does the trouble occur?
- Any particular time of day that the trouble symptoms are usually bad?
- Is the trouble in one direction or both directions of transmission?
- Has this trouble been experienced before? If so, what was the outcome?
- Have changes been made to the system lately (e.g., new equipment, new program, new operator, etc.)?
- Any other pertinent information?

4.04 All available information collected from the customer should be analyzed to locate the most probable cause of trouble. If results of this analysis indicate trouble in the CPE, the customer should be advised. The defective (CPE) modem should be replaced by the customer. If channel trouble is suspected, the procedures outlined below apply.

4.05 The TC determines from the Circuit Record, or equivalent, whether any channel testing can be done from the MC at the SCO (or from another convenient test access midpoint). If there is no test access, proceed to paragraph 4.09.

4.06 If there is no test access to the circuit, the TC should request the SCO (or equivalent) to perform DC Tests A, B, and C that are listed in Table A. The tests are performed toward each end-user interface location for the purpose of trouble isolation. Test access from the MC is obtained at the Main Distribution Frame (MDF) via patch cords to the MC test trunk.

4.07 If the results of Tests A, B, and C toward both end-user interfaces meet requirements, check the cross-connections and then restore the circuit continuity. Request the customer to retest the data communications system to make certain that the trouble condition still exists before dispatching any personnel (refer to paragraph 4.09).

4.08 If the results of Tests A, B, and C fail to meet requirements, isolate the trouble and repair or replace the cable pair(s), if required. Make certain that all of the test requirements, for the particular channel length, are met before returning service to the customer.

4.09 Dispatch the employee(s) to the end-user location(s) to perform end-to-end testing. Prior to dispatch, advise the customer of possible maintenance service charge if the trouble is located in the CPE. Table A lists the tests and the test equipment required. These tests are to be performed during channel installation and on trouble cases, as required. Procedures for the tests are given in BR 314-410-312.

*Note:* The employees should be equipped with the test equipment listed in Table A, or equivalent.

4.10 If any of the tests fail to meet requirements, isolate the trouble and repair or replace the cable pair(s), if required. Make certain that all the test requirements for the channel length are met before returning service to the customer.

4.11 If the channel test results meet requirements, return the service to the customer.

4.12 If the channel tests are successful, the channel trouble has been cleared and the service can be returned to the customer. If the channel tests continue to fail, request the aid of the Network Technical Support organization. See BR 010-523-100.

## 5. TESTING

5.01 This part describes each test to be performed on LADCs. The testing procedures and requirements are given in BR 314-410-312.

5.02 The tests listed in Table A consist of DC and AC measurements performed between the two end-user interfaces. The DC measurement may also be performed between a network interface (NI) and the MC when the channel is routed through the SCO. All the tests listed in Table A should be performed during installation. For maintenance purposes, the tests are performed as required.

### Apparatus Required

5.03 The following is a list of apparatus required for performing these tests on an end-to-end basis:

- Two Noise Measuring Sets (NMS) with C-message network
- Two Transmission Measuring Sets (TMS) for level and loss
- One multimeter

PROPRIETARY - BELLCORE AND AUTHORIZED CLIENTS ONLY

See proprietary restrictions on title page.

- Two 135-ohm resistors per wire pair.

5.04 The following information is required before starting the tests:

- Determine from the records if the facility is 2-wire or 4-wire;
  - If 2-wire, only the T, R leads are tested.
  - If 4-wire, both the T, R and T1, R1 leads are tested.
- The cable pair(s) loop resistance, measured during initial installation tests and recorded on the circuit record or equivalent. [If the measurement result is not available, measure the loop resistance (Test C) and record those results on the circuit record.]
- The end-to-end Expected Measured Loss (EML) value expressed for the initial installation or Actual Measured Loss (AML), if earlier testing was performed for trouble analysis. [If EML/AML values are available on the circuit record, measure the loss and record those results.]

**Table A. OVERALL CHANNEL TESTS**

NAME OF TEST	TEST APPARATUS REQUIRED (NOTE)	PROBABLE CAUSE OF TEST FAILURE
A. Foreign Voltage	Multimeter or MLT	Short circuit to another cable pair
B. Insulation Resistance	Multimeter or MLT	Short or ground in cable pairs
C. Loop Resistance	Multimeter or MLT	Open/short in cable pairs, or splicing errors
D. Insertion Loss	2 Transmission Test Sets	inaccurate cable records load coils, excessive BT
E. Noise	2 Noise Measurement Sets (NMS) 2 135-ohm Resistors	pair imbalance or crosstalk
F. Impulse Noise	2 Noise Measurement Sets (NMS) 2 135-ohm Resistors	pair imbalance or crosstalk

*Note* : The test equipment used should meet the specifications outlined in IEEE Standard 743-1984.



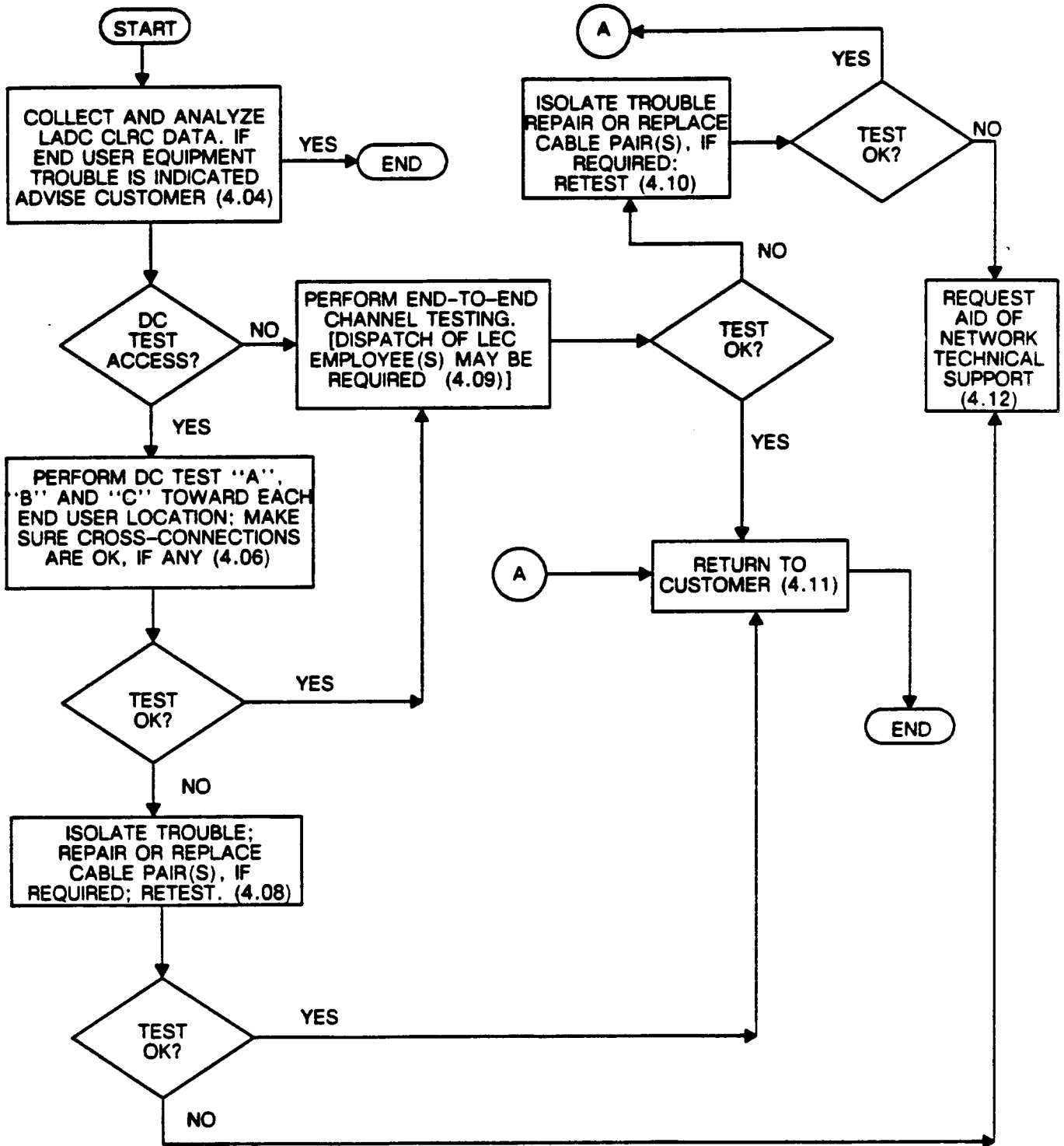


Figure 1. Local Area Data Channels - Trouble Clearing Procedures

PROPRIETARY - BELLCORE AND AUTHORIZED CLIENTS ONLY  
 See proprietary restrictions on title page.

## DC TESTS

### Test A - Foreign Voltage

5.05 This test is made to check that no foreign voltage is present on the channel pairs. A foreign voltage may indicate that a cable fault could exist. (In some cases the foreign voltage could be caused by the modem or other sources at one end of the circuit.)

5.06 The test is made between the following leads: T to R (T1 to R1); and T, R (T1, R1) to ground. There should be no significant voltage reading (less than 1 volt) between any of these leads.

### Test B - Insulation Resistance

5.07 This test is made to ensure adequate isolation between the conductors and ground. The test measures the insulation resistance between the channel conductors as follows.

- T and R; R and R1
- T and T1; R and T1
- T1 and R1; T and R1
- T and GND; R and GND
- T1 and GND; R1 and GND

### Test C - Loop Resistance

5.08 The loop resistance measurement checks the DC resistance of the transmit and receive cable pairs while each is shorted at one end of the circuit. The measurement reading is taken at the other (nonshorted) end. If this is an installation test, the DC resistance for the cable pairs under test, between the SCO and each end-user interface (or between end-user interfaces), should be recorded on the records for future reference.

5.09 If the DC measurements do not meet the requirements given in BR 314-410-312 and a faulty cable is suspected, the procedures given in AT&T Practice 634-310-501 can be used by the cable repair crew to locate the trouble.

## AC TESTS

### Test D - Insertion Loss

5.10 Insertion loss measurements are made using a test signal at various frequencies. The test is used to determine that the specifications for the particular channel length are being met. It also verifies that the cable pairs and associated bridged taps are not loaded.

5.11 Transmission test sets containing an oscillator at each end of the circuit are used to generate the test signals and to measure the level of the received signals.

5.12 If the insertion loss measurement fails to meet the test requirements based on the EML, the problem may be due to inaccurate cable records, load coils that were not removed, or bridged taps of excessive length.

**Test E - Noise**

5.13 The noise and impulse noise measurements are made on the receive side of the channel at each end of the circuit. Both the transmit and receive sides are terminated with 135-ohm resistors. A noise measuring set (NMS), capable of measuring noise and impulse noise, is connected to the receive side with the Function switch set to the 600-OHM BRIDGING position.

5.14 The instructions for operating the particular NMS to be used should be reviewed before attempting to make noise measurement tests. While noise measurements can be made at any time, it is preferable that they be made during a peak traffic load or busy-hour period.

**Test F - Impulse Noise**

5.15 The impulse noise measurement is normally made after the Noise test is completed and generally uses the noise counter of the NMS. The NMS is set to operate for a period of 15 minutes at a particular threshold value.

**6. REFERENCES**

6.01 The following practices can be referenced for additional information:

<b>PRACTICE</b>	<b>TITLE</b>
BR 314-410-312	Local Area Data Channels - Tests and Requirements
AT&T Practice 880-102-100	Local Area Data Channels - Engineering Guidelines