DATA SYSTEMS—"DATA-PHONE"® SERVICE ON DIRECT DISTANCE DIALING NETWORK— OVERALL FIELD FORCE MAINTENANCE PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section describes the general maintenance procedures to be followed by the craft employee when handling DATA-PHONE service complaints. It also includes the Overall Maintenance Plan for DATA-PHONE service so that the role of the employee may be seen more clearly in the overall effort to rapidly restore customer service when trouble occurs.

DESCRIPTION OF OVERALL MAINTENANCE PLAN

1.02 The complexity of data systems requires the cooperation of several groups to ensure the prompt restoral of customer service. The Overall Maintenance Plan is designed to show the individual role of each group and at what point within the plan each group accepts the responsibility of continuing the procedure. The following groups are involved in the Plan:

- Plant service center (PSC) (see note)
- Data test center (DTC)
- Toll testboard
- Customer and/or business machine representative

Note: The PSC is that organization designated locally to receive DATA-PHONE service reports whether it be local repair service, special service reports center, data test center, etc. It will be responsible for handling, controlling, and clearing of all trouble reports, but will often find it necessary and advantageous to

request the assistance of other, more specialized groups, such as toll testboards, Direct Distance Dialing (DDD) service bureaus, etc, in locating, sectionalizing, and clearing data troubles.

1.03 The Plan is divided into the following phases to provide a systematic approach to the location and clearance of a trouble condition:

- Phase I—Trouble Reporting and Investigating —Near-End
- Phase II—Trouble Investigating—Far-End
- Phase III—Data Set and Local Loop Trouble Clearing
- Phase IV—Dynamic Data Testing and Transmission Testing of Local Loop
- Phase V—Trouble Investigating—DDD Network

Note: A sequence of activities described by a phase, or part of a phase, is entered from a decision point only when the analysis of the trouble indicates the need to investigate that portion of the data circuit. A sequence may progress through several decision points before reaching one of the following end points; (1) restoral of service, (2) reference to another phase of the Plan, (3) referral of the trouble to management, or (4) referral of the trouble to the customer. The activities required to reach the respective end points for some sequences are similar in part.

1.04 The craft employee is a member of the PSC and is responsible for maintaining DATA-PHONE apparatus and for clearing or assisting in clearing apparatus or loop trouble at the customer premise.

DATA-PHONE SERVICE

1.05 DATA-PHONE service (Fig. 1) provides a means of transmitting data by using local and DDD switching facilities. Calls are completed in the same manner as regular telephone calls. DATA-PHONE service permits the customer to dial the desired number; the called party answers and the calling party states he is ready to send or receive data. Both parties can change the mode of operation from voice to data by operating pushbuttons or keys, built into or associated with the data set. Upon completion of transmission, both parties may either hang up or return to voice mode.

1.06 An unattended operation feature is available which permits the calling party to receive a tone over the circuit. When the tone is received, the distant-end data set is in an unattended mode and ready to receive or transmit data. At the end of the transmission, the distant-end data set is automatically disconnected.

1.07 An automatic calling feature is also available which permits the business machine and data apparatus to automatically dial a number, recognize the answer tone, and transfer to the data mode.

1.08 DATA-PHONE data sets may be used with customer-owned business machines or telephone company provided terminals.

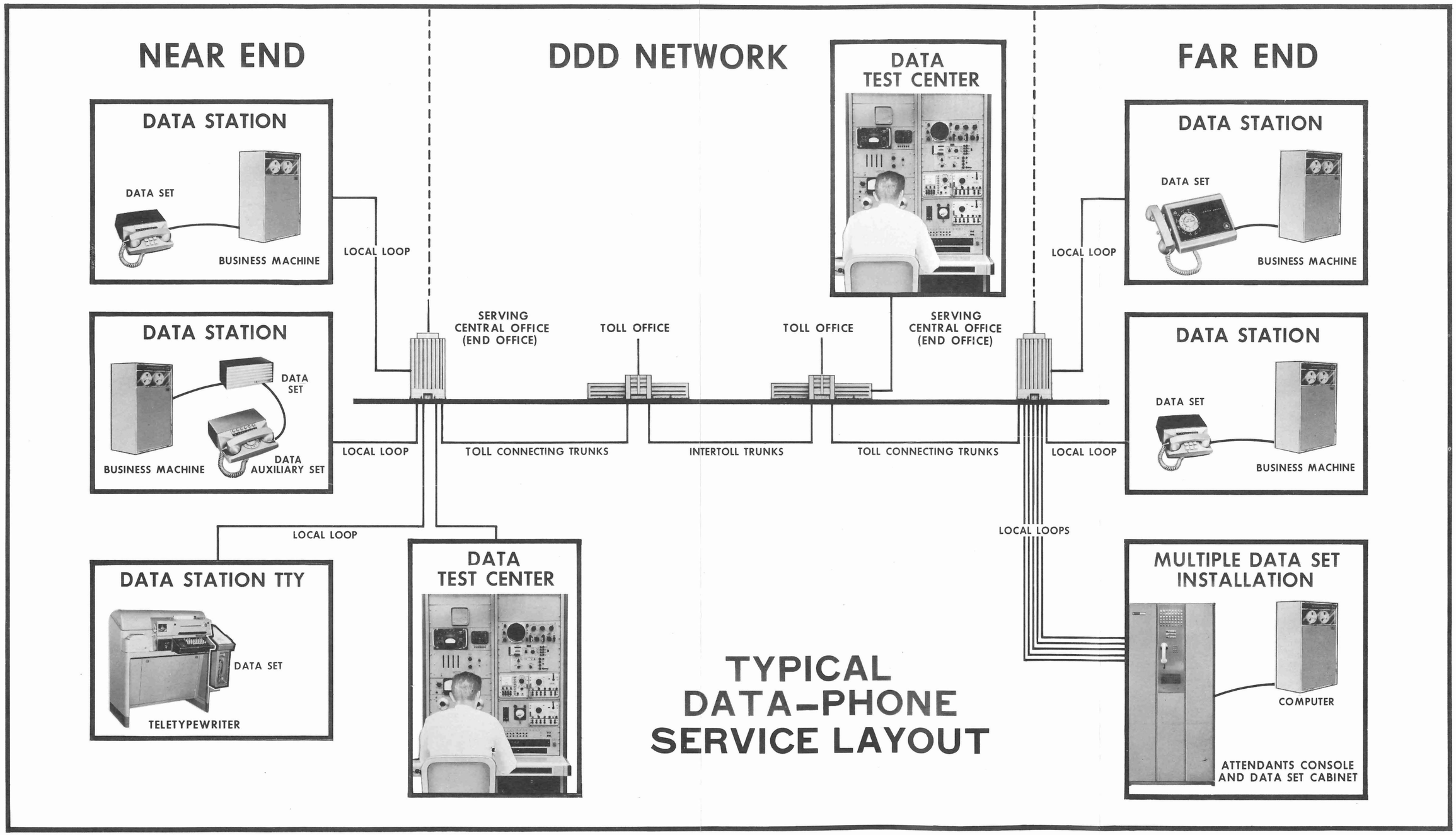
1.09 Except for sets of early manufacture, data sets are equipped with a loop-back test feature which permits a test, with the assistance of the customer, to the interface (demarcation) between the company data set and the customer business machine. This provides a conclusive means for testing the operational capabilities of the data set without dispatching a telephone company employee. Company-owned terminals, such as DATASPEED* equipment or teletypewriters, can be remotely tested with the assistance of the customer which permits sectionalizing trouble between the data set and the terminal equipment. No means are provided for the testing of the customer-owned equipment.

* Service mark of the American Telephone and Telegraph Company.

2. DATA-PHONE SERVICE OVERALL MAINTENANCE PLAN

GENERAL

2.01 DATA-PHONE services must be maintained in a manner which will reduce the out-of-service time to a minimum to exempt the customer from great expense and inconvenience. Each party involved must utilize all available testing capabilities



TYPICAL DATA–PHONE SERVICE LAYOUT

Fig. 1—Typical DATA-PHONE Service Layout

in order to systematically gather the information required for trouble identification. Time-consuming and costly actions such as dispatching repair forces, testing transmission facilities, or actions by the business machine representative, must not be attempted unless a careful analysis of available information and test results indicates that such efforts will probably clear the trouble.

DATA COMMUNICATION MAINTENANCE

2.02 The major components usually involved in data communications consist of business machines, data apparatus and network switching facilities, and personnel operating the business machines and data apparatus. The business machine is furnished by its manufacturer, the data apparatus and facilities by the telephone company, and the personnel by the customer. A malfunction of either of the three components could create a problem condition in data communications. The responsibility of maintaining each component belongs to the party that furnishes the component. However, close cooperation among the three parties is essential to accomplish the desired maintenance of data communications.

2.03 The customer is normally the first party to recognize the existence of a trouble condition. After ensuring that the trouble is not his responsibility, the customer determines the most probable cause and notifies either the telephone or business machine company (see Fig. 2). Both companies have designed ***most*** of their equipment so that a quick, reliable test (referred to as ***LOOP-BACK*** test by the telephone company and local test by business machine manufacturers) can be performed. Satisfactory results of the loop-back test is considered to provide a confidence level of 90% of the data set. At this point, it is recommended that, to keep from entering expensive investigating efforts (to gain 100 percent confidence), the company request the customer to notify the other company, state the test results, and request the other company to perform tests on their equipment. When both companies have reached a high level confidence in the performance of their equipment, they will contact each other in order to analyze the trouble. The companies must decide whether one company, or both, should perform more extensive tests, or whether their respective staffs should be notified to request the assistance of data specialists.

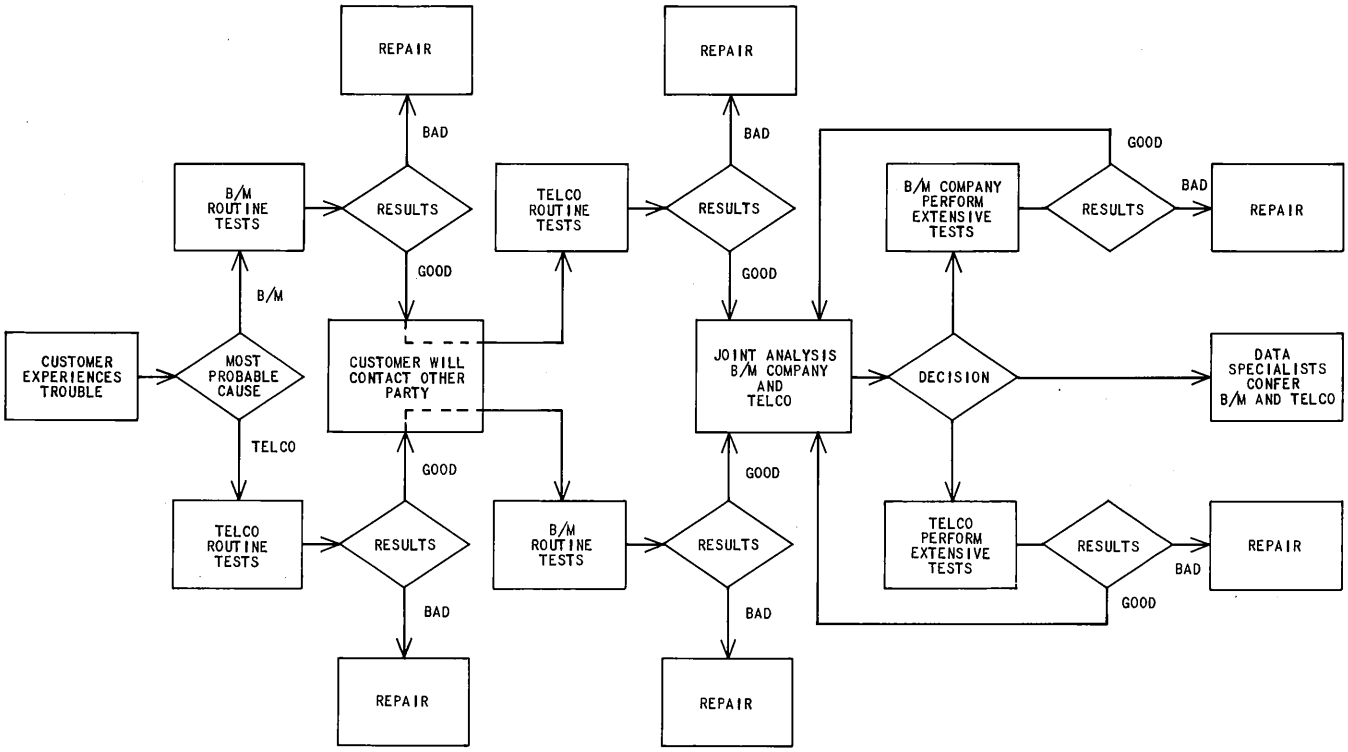


Fig. 2—Data Communications Maintenance

OVERALL MAINTENANCE PLAN

2.04 There are seven basic components of data communications. The components are identified in Fig. 3 and pictorially shown in various forms in Fig. 1. Five of the components are the maintenance responsibility of the telephone company. It can readily be seen that due to the equipment and circuitry involved, a large number of troubles could occur in DATA-PHONE service connections, making it virtually impossible to cover every conceivable problem in writing. Therefore, locating a data trouble requires a systematic elimination of the most likely problem areas. Good judgment, experience, and close cooperation between the various organizations involved are essential.

2.05 The procedures outlined in the overall maintenance plan provide a general systematic approach to locating troubles. It is intended that ingenuity, common sense, and the practical experience of the personnel directly responsible for the service be coupled with the general procedures. ***At any point in the procedures, facts may become apparent which definitely indicate the direction that the investigation should take, or on close examination, could reveal the source of the trouble.*** The Plan is intended to assist the PSC, the DTC, and other investigators in developing and recognizing these facts.

2.06 It is essential that a clear understanding of the problem is obtained at the outset of the investigation. Thorough questioning of the customer along with an examination of all records and reports should be accomplished early in the investigation. From this preliminary analysis, it should be possible to determine if more than one location is experiencing trouble, the type of trouble experienced, the time of occurrence, and the particular days involved. If there are indications that one or more of the locations or components are causing most of the difficulties, attention should be directed at these points initially.

2.07 The sequence of elimination of potential trouble causes begins with the data apparatus at the reporting customer location (near-end, Fig. 3), continues with the data apparatus to which the near-end customer was connected (far-end), and ends with the DDD network. Potential trouble causes fall into the following general areas:

- Business machine trouble
- Data set trouble
- Local loop trouble
- DDD network trouble.

2.08 The Maintenance Plan consists of five different phases. Each phase presents a suggested procedure for investigating and isolating trouble within one or more components of the data system. See Table A for the phase number that pertains to each component. The five phases are listed in (a) through (e).

(a) Trouble Reporting and Investigating—Near-End

(b) Trouble Investigating—Far-End

(c) Data Set and Local Loop Trouble Clearing

(d) Dynamic Data Testing and Transmission Testing of Local Loop

(e) Trouble Investigating—DDD Network.

2.09 The general activities of the responsible groups in each phase are described in succeeding paragraphs. The detailed responsibilities for each of the groups are included in the following sections:

- 314-205-300—Central Office Toll Personnel
- 660-101-305—Plant Service Center Personnel
- 668-010-300—Data Test Center Personnel

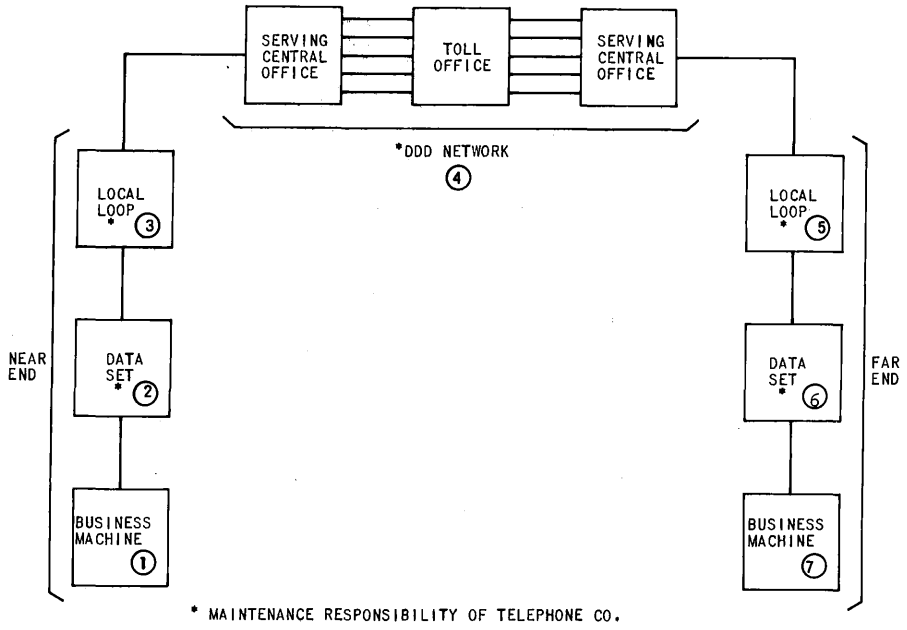


Fig. 3—Basic Components of Data Communications

TABLE A

COMPONENT PHASE NUMBER

NO.	COMPONENT TITLE		MAINTENANCE PHASE NUMBER
1	Near End	Business Machine	1
2		Data Set	1, 3, 4
3		Local Loop	1, 3, 4
4	DDD Network		5
5	Far End	Local Loop	2, 3, 4
6		Data Set	2, 3, 4
7		Business Machine	2

A. Phase I—Trouble Reporting and Investigating—Near-End

2.10 The DATA-PHONE service customer is instructed to call the PSC when trouble is experienced in DATA-PHONE service. Phase I begins with the PSC recognizing, by examination of the line card or comments of the customer, that the report is associated with DATA-PHONE service. The activities in Phase I are intended to determine that a data transmission problem exists and to gather the basic information required to isolate and clear the trouble at the near end.

2.11 The sequence of activities in Phase I is illustrated in Fig. 4 and is described in the following procedure.

Note: The step numbers correspond to the activity numbers in the illustration.

STEP	PROCEDURE
1	The customer calls the PSC to report a trouble condition.
2	The PSC determines, from conversation with the customer, if the trouble is mechanical (broken or frayed cord, physical damage to the equipment, etc), is in the telephone components (cannot dial, receive voice call, talk, etc), or is associated with the transmission of data.
3	If the customer comments indicate telephone or mechanical trouble, the PSC will handle the report in the normal manner except that repairs will be expedited to minimize data service interruption.
4	If the customer report indicates local loop trouble, the PSC will advise him that he will be informed when service will be restored, or telephone company employees responsible for data service will contact him if further information is needed to clear the trouble condition. The PSC will then perform the normal dc tests on the local loop to confirm or eliminate trouble such as opens, shorts, crosses, etc.
5	If the results of the loop test are not satisfactory, the PSC will arrange for repairing or changing the loop. The PSC will verify that new assignments are identical in layout to the old ones. The possibility of additional bridged taps will be checked carefully. If the loop make-up is different, advice will be obtained from the group responsible for DATA-PHONE loop design. Transmission and data tests will be performed on the new loop.
6	After the necessary repairs have been made and checked, the customer will be contacted and requested to verify that service has been restored satisfactorily.
7	When service is restored satisfactorily, the trouble report will be closed. If the customer is not satisfied with the service and there is no evidence of additional trouble as covered in the following steps, the problem will be referred to local management and through lines of organization to the responsible staff personnel.
8	If the customer report indicates data set trouble or if the loop meets dc test requirements, the PSC will immediately notify the DTC serving the area. The DTC will be provided with the line card information (customer number, type of data set, type of data auxiliary sets, options installed, etc) and any other information which will help in analyzing the trouble (history of trouble, details of the customer report, etc).

STEP	PROCEDURE
	Note 1: If the local loop has not been tested, the PSC will advise the customer that he will be informed when service will be restored, or telephone company employees responsible for data service will contact him if further information is needed to clear the trouble condition. ***Note 2:*** In case of telephone company provided terminal equipment, the PSC will refer to 10-type teletype testboard or the DTC, respectively, depending upon whether trouble is in the terminal equipment or in the DATA-PHONE portion of the data station.
9	The DTC will contact the customer and request assistance. The customer will be questioned carefully for as much information as possible concerning the symptoms and circumstances relating to the trouble. In many instances, the information gained during the conversation with the customer will provide clues to permit rapid diagnosis and clearance of the trouble. The DTC will also verify that the equipment is being operated properly.
10	After the DTC has obtained as much information as possible, it will analyze the information to determine the most probable cause of trouble.
11	If the suspected trouble is in the far-end station, the DTC will proceed with Phase II activities.
12	If data trouble is suspected or the information is inconclusive as to the cause of trouble, the DTC will test the data set.
13	If the data set tests defective, the DTC will inform the PSC of the test results.
14	The PSC will proceed with trouble clearing activities for suspected data set trouble (Phase III).
15	If the attempt by the DTC to test the data set is inconclusive (the data set does not respond to test signals, etc), or if the data set is not equipped for remote testing (201-type), the DTC will inform the customer of this, tell him that further testing will be performed, and that he will be informed of the results. The DTC will then notify the PSC of the situation.
16	The PSC will proceed with trouble investigating activities for undetermined trouble source (Phase IV).
17	If the results of the data set test are satisfactory, the DTC will contact the customer and request him to have the business machine tested.
18	If the business machine tests defective, refer the trouble to the customer.
19	The DTC will notify the PSC of the test results and request the PSC to close the trouble report.
20	If the results of the business machine test are satisfactory, the DTC will analyze the situation to determine if the most probable cause of trouble is the far-end data station or the DDD network.

STEP	PROCEDURE
	Note: It may be advantageous at this time to request the staff data specialists to assist in the analysis of the trouble before proceeding to further tests.
21	If the trouble is suspected to be in the far-end data station, the DTC will proceed with far-end investigating (Phase II).
22	If the trouble is suspected to be in the DDD network, the DTC will notify the PSC of the situation.
23	The PSC will proceed with network trouble investigating (Phase V).
24	If the business machine cannot be tested, the DTC must analyze the situation to determine whether the most probable cause of trouble is the telephone company equipment or the customer business machine.
25	If the trouble is suspected to be in the telephone company equipment, the DTC will proceed with investigating the far-end data station (Phase II).
	Note: If at this point in the investigation the far-end data set has already been tested, request the staff data specialist to assist in the analysis of the trouble before proceeding with network trouble investigating (Phase V).
26	If the trouble is suspected to be in the business machine, the DTC will again contact the customer and request that he notify the business machine representative.
27	If the customer agrees to contact his business machine representative, the DTC will notify the PSC of the situation and request the PSC to close the trouble report.
28	If the customer refuses to contact his business machine representative and the evidence is convincing that the trouble is more probably in the business machine, the DTC will notify the PSC to either proceed with Phase IV investigation to prove that the telephone company's equipment is operating satisfactorily, or to contact sales personnel and furnish them with all pertinent test results and information so that a customer contact can be made before proceeding with further investigation.

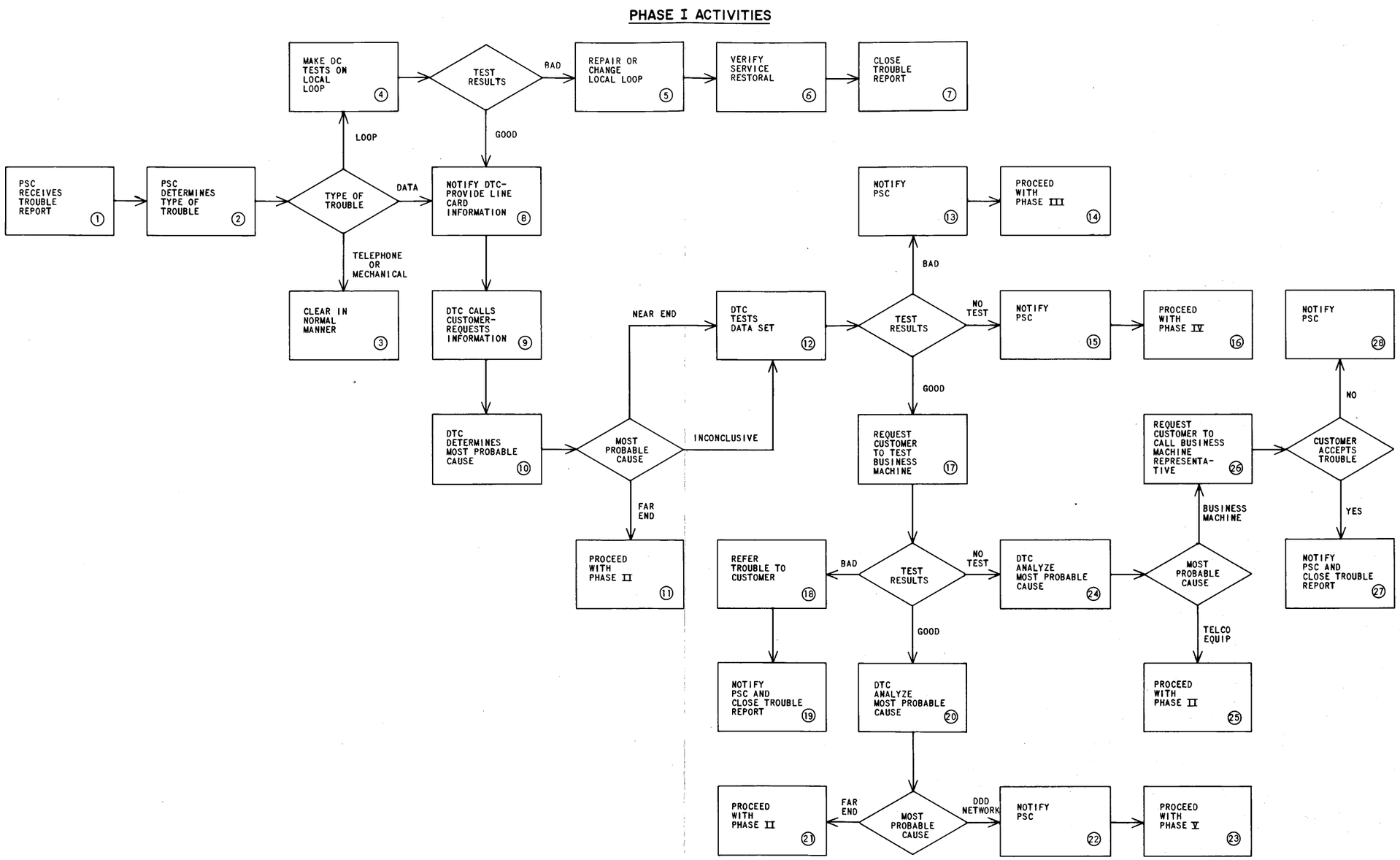


Fig. 4—Trouble Reporting and Investigating—Near End

B. Phase II—Trouble Investigating—Far-End

2.12 If the source of the trouble is not apparent from the tests and information obtained in Phase I, further investigation is necessary to identify the section of the overall data system (including the customer business machine) which is malfunctioning. The activities in Phase II are intended to isolate the trouble to the business machine, data set, and local loop at the far-end station, or to transmission facilities.

2.13 The sequence of activities in Phase II is illustrated in Fig. 5 and described in the following procedure.

STEP	PROCEDURE
1	The near-end DTC calls the far-end customer, informs him of the situation, requests any information which he may be able to provide, and requests his assistance in any tests which may have to be performed. The DTC will analyze the information.
2	If data set trouble is suspected, the DTC will test the far-end data set. If the results of the data set test are satisfactory, the DTC will proceed to Step 10.
3	If the data set tests defective, the DTC will notify the far-end DTC which should be provided with all available information concerning the trouble.
4	The far-end DTC will analyze the information and decide whether to accept the test of the near-end DTC or to retest the data set.
5	If the far-end DTC accepts the trouble, it will notify the far-end PSC which will proceed with trouble clearing activities for suspected data set trouble (Phase III). The near-end DTC will inform the near-end PSC which, in turn, will notify the customer and close the trouble report.
6	If the far-end DTC decides that a retest is needed, it will call the far-end customer and perform remote tests on the data set.
7	If the results of the data set test are satisfactory on retest, the far-end DTC will notify the near-end DTC which will proceed as if the data set tested satisfactorily in Step 2 (proceed with Step 10).
8	If the attempt by the far-end DTC to test the data set is inconclusive (the data set does not respond to test signals, etc), or if the data set is not equipped for remote testing, the far-end DTC will notify the far-end PSC to proceed with trouble investigating activities for the data set and local loop (Phase IV).
9	If the far-end DTC tests indicate that the data set is defective, the far-end DTC will inform the far-end PSC to proceed with trouble clearing activities for suspected data set trouble (Phase III).
10	If the results of the far-end data set test are satisfactory, the near-end DTC will request the far-end customer to make a test of his business machine.

STEP	PROCEDURE
11	If the business machine tests prove that the business machine is the cause of the trouble, the DTC will refer the trouble to the far-end customer.
12	The DTC will notify the near-end PSC that the trouble has been referred to the far-end customer, the PSC will inform the near-end customer of the situation and then close the trouble report.
13	If the results of the business machine test are satisfactory, the DTC will analyze the situation to determine if the most probable cause of trouble is the near-end data station or the DDD network. ***Note:*** If at this point in the investigation, the near-end data set has already been tested, request the responsible staff personnel to assist in the analysis of the trouble before proceeding with network trouble investigating (Phase V).
14	If the DTC suspects that the DDD network is the most probable cause of the trouble, it will notify the near-end PSC which will proceed with network trouble investigating activities (Phase V).
15	If the suspected trouble is in the near-end data station, the DTC will proceed with near-end investigating (Step 12, Phase I).
16	If the business machine cannot be tested, the DTC must analyze the situation to determine whether the most probable cause of trouble is the telephone company equipment or the customer business machine.
17	If the trouble is suspected to be in the telephone company equipment, the DTC will proceed with investigating the near-end data station (Step 12, Phase I). ***Note:*** If at this point in the investigation, the near-end data set has already been tested, request that the responsible staff personnel assist in the analysis of the trouble before proceeding with network trouble investigating (Phase V).
18	If the trouble is suspected to be in the business machine, the DTC will again contact the customer and request that he notify the business machine representative.
19	If the customer agrees to contact his business machine representative, the DTC will notify the PSC of the situation and request the PSC to close the trouble report.
20	If the customer refuses to contact his business machine representative and the evidence is convincing that the trouble is more probably in the business machine, the DTC will either notify the PSC to proceed with Phase IV investigation to prove that the telephone company equipment is operating satisfactorily, or will contact sales personnel and furnish them with all pertinent test results and information so that a customer contact can be made before proceeding with further investigation.

PHASE II ACTIVITIES

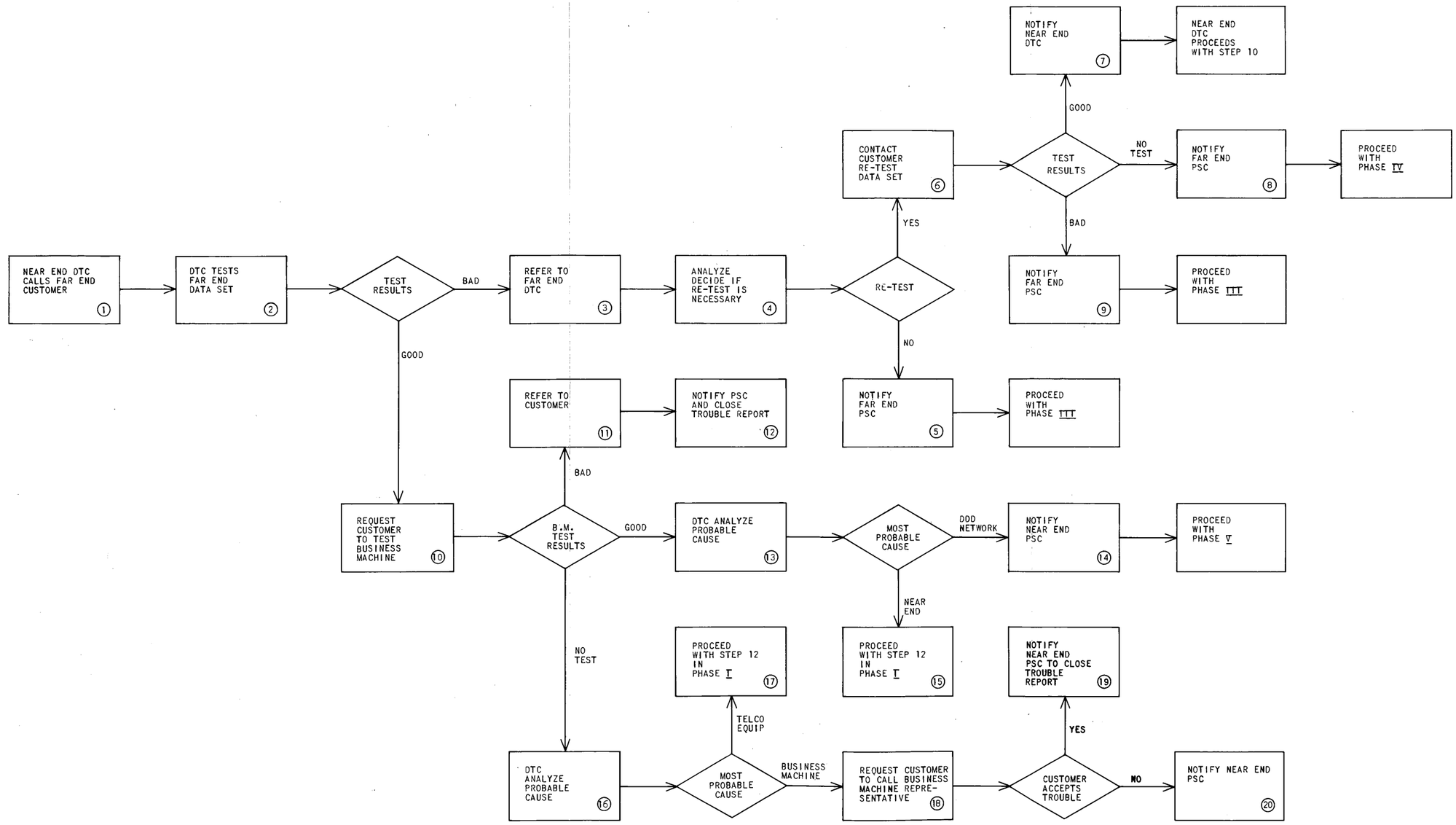


Fig. 5—Trouble Investigating—Far End

C. Phase III—Data Set and Local Loop Trouble Clearing

2.14 Phase III outlines the activities required to effect the necessary repairs when the data set or local loop is the suspected trouble source.

2.15 The suggested sequence of Phase III activities is illustrated in Fig. 6 and is described in the following procedure.

STEP	PROCEDURE
1	The PSC responsible for maintaining the data set, which is not operating properly, will be requested by the serving DTC to initiate the efforts required to restore service.
2	The PSC will inform the craft employee of the test results and information obtained from the DTC. The PSC will ensure that the employee is familiar with the defective data set and the test sets which will be used, and that the employee has the necessary Bell System Practices, tools, and spare parts for repair. It must not be overlooked that other components of the system, in addition to the data set, may require attention.
3	When the craft employee is properly equipped and informed, the employee will visit the customer and repair or replace the data set as indicated by the information and analysis of symptoms. The employee will ensure that the proper options are wired into the data set, and also check the installation for other possible trouble causes.
4	After the data set has been repaired or replaced, the employee will contact the DTC serving that area and request a retest of the data set. The DTC will be informed of the circumstances.
5	If the results of the data set test are satisfactory, the employee will inform the customer that the trouble has been cleared and request the customer to verify service restoral by exchanging data with the station or stations that caused him to report the trouble.
6	When the customer is satisfied that service has been restored, the employee will notify the PSC to close the trouble report. If other customers have been involved in the investigation, they will be informed that repairs have been made and that service is normal. If the customer is not satisfied with the service and there is no evidence of additional trouble, the problem will be referred to local management and through lines of organization to responsible staff personnel.
7	If the results of the data set test are not satisfactory, the craft employee will perform a complete transmission test of the local loop. The employee will require assistance from the PSC for portions of this test.
8	If the results of the loop test are not satisfactory, the PSC will arrange for repairing or changing the loop. The PSC will retest it and verify that the new assignment is identical in layout to the old one. The possibility of additional bridged taps will be checked carefully. If the loop make-up is different, advice will be obtained from the group responsible for DATA-PHONE loop design.
9	When the loop repairs have been completed and checked, the customer will be requested to verify that service has been restored satisfactorily.

STEP	PROCEDURE
10	When the customer is satisfied with the service, the craft employee will notify the PSC to close the trouble report. If the customer is not satisfied with the service and there is no evidence of additional trouble, the problem will be referred to local management and through lines of organization to the responsible staff personnel.
11	If the results of the loop test are satisfactory and the retest of the data set with the DTC is not satisfactory, the craft employee will continue the repair efforts, under the direction of the DTC, until it is apparent that causes other than the data set are involved. In these cases, the employee will notify the PSC of the situation, and then refer the problem to local management and through lines of organization to the responsible staff personnel.

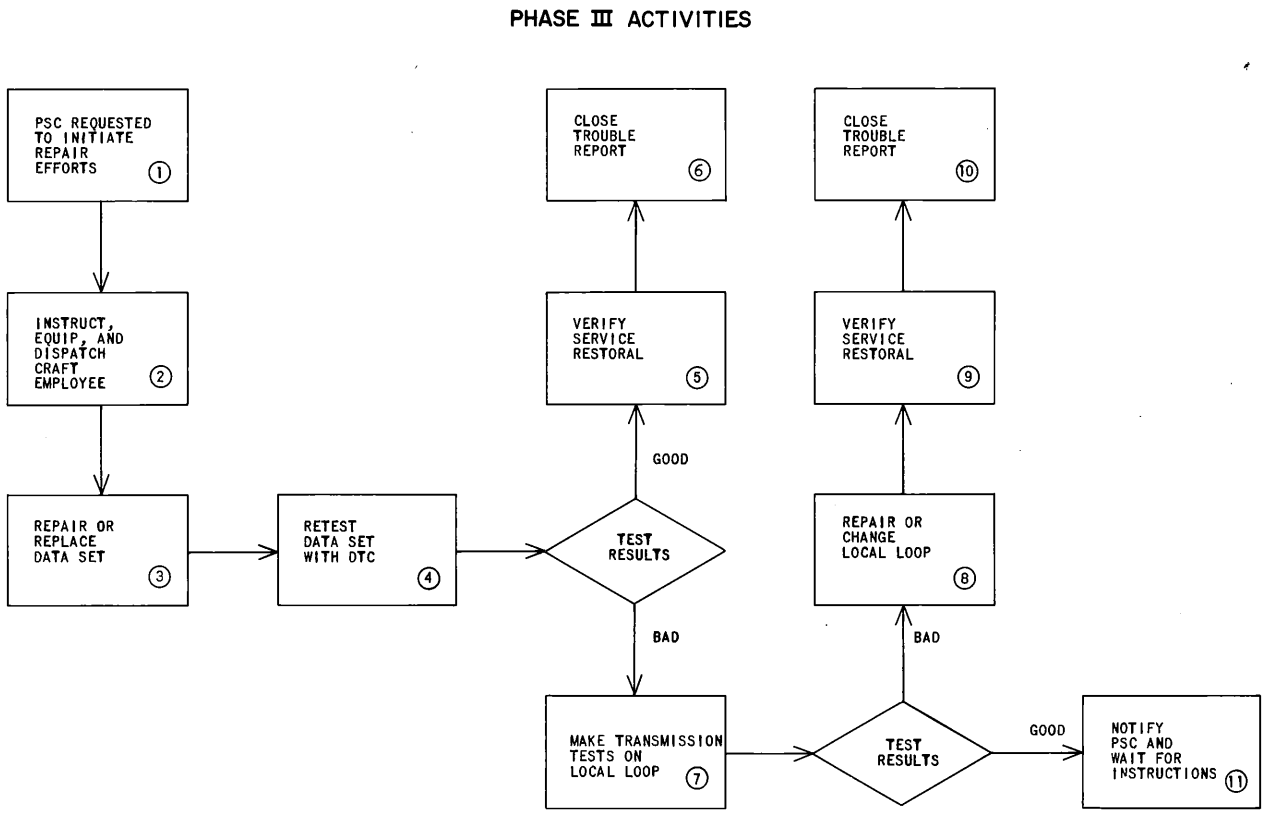


Fig. 6—Data Set and Local Loop Trouble Clearing

D. Phase IV—Dynamic Data Testing and Transmission Testing of Local Loop

2.16 Phase IV outlines the activities required when remote tests of the data set cannot be made and trouble with the data set or local loop is suspected, or when it is necessary to prove that the data equipment is operating properly and trouble is suspected in the business machine.

2.17 The suggested sequence of Phase IV activities is illustrated in Fig. 7 and is described in the following procedures.

STEP	PROCEDURE
1	The PSC will inform the craft employee of the circumstances, provide a list of test equipment required for both loop and data set testing, and verify that the employee has the necessary Bell System Practices.
2	When equipped and instructed properly, the craft employee will proceed to the customer location immediately. The employee will briefly explain the circumstances to the customer and perform the appropriate tests of the data set.
3	If the results of the data set test are not satisfactory, the employee will repair or replace the data set, and check that the proper options have been wired. The employee will then retest the data set to ensure that all necessary repairs have been made.
4	After the data set trouble has been cleared, the customer will be requested to verify that service has been restored satisfactorily. If the customer is not satisfied and there is no evidence of additional trouble, the problem will be referred to local management and through lines of organization to the responsible staff personnel.
5	When the customer is satisfied with the service, the craft employee will notify the PSC to close the trouble report.
6	If the results of the data set test are satisfactory, the craft employee will perform a complete transmission test of the local loop. The employee will require assistance from the PSC for portions of this test. ***Note:*** If the data set tests included testing with the DTC, it is not necessary to test the local loop and the employee will proceed to Step 10.
7	If the results of the loop test are not satisfactory, the PSC will arrange for repairing or changing the loop. The loop should be retested. The PSC will verify that a new assignment is identical in layout to the old one. The possibility of additional bridged taps will be checked carefully. If the loop make-up is different, advice will be obtained from the group responsible for DATA-PHONE loop design.
8	When the repairs have been completed and checked, the customer will be requested to verify that service has been restored satisfactorily.
9	When the customer is satisfied, the trouble report will be closed. If the customer is not satisfied with the service and there is no evidence of additional trouble, the problem will be referred to local management and through lines of organization to the responsible staff personnel.

STEP	PROCEDURE
10	If the transmission characteristics of the loop are satisfactory, the craft employee will notify the PSC and wait for further instruction.
11	The PSC will notify the DTC of the test results and request continuance of the investigation.

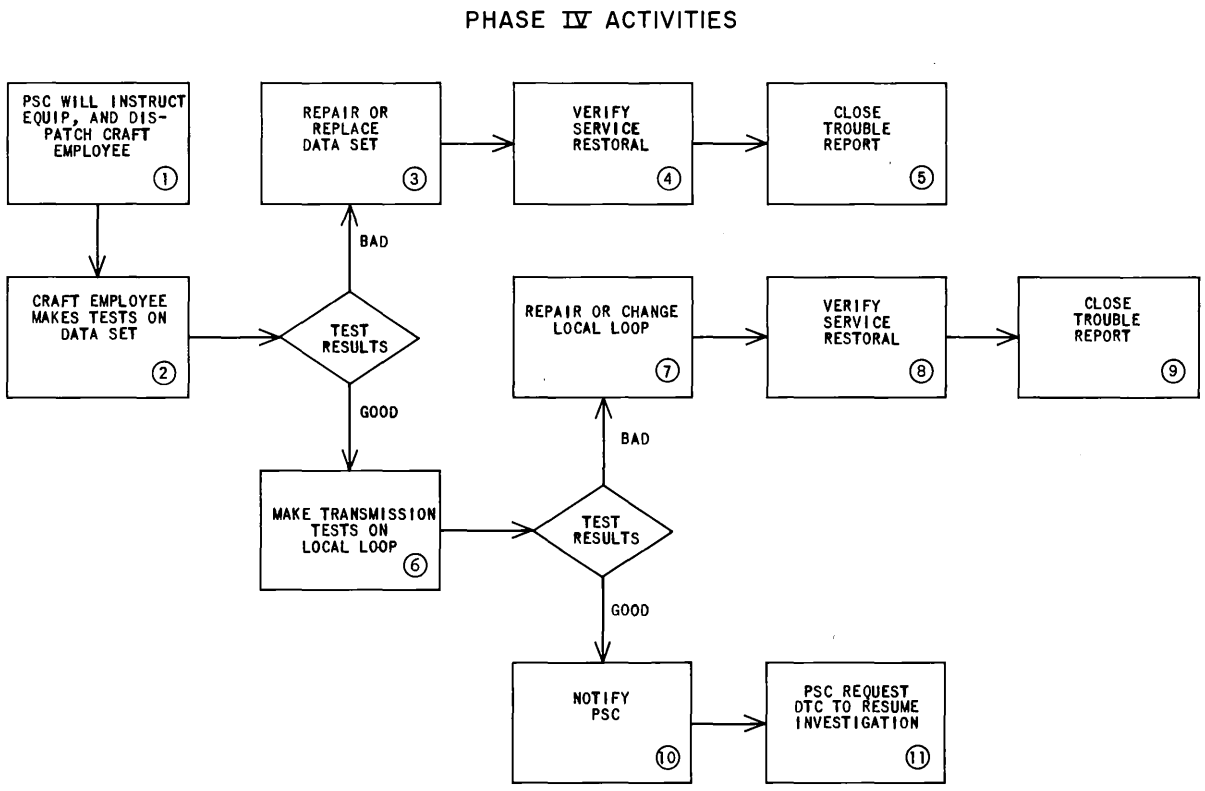


Fig. 7—Dynamic Data Testing and Transmission Testing of Local Loop

E. Phase V—Trouble Investigating—DDD Network

2.18 Phase V outlines the activities required to isolate trouble to the DDD network, or to show that two or more components in the system are contributing to the trouble and thereby causing the overall system to operate improperly.

2.19 Phase V presents three different methods of testing; end office to end office, end-to-DTC, and end-to-end. The method, or combination of methods, selected for any particular data problem will depend upon the analysis of the investigation up to this point.

2.20 ***End Office to End Office Testing:*** The advantages of this method of testing and the circumstances indicating its use are as follows:

(a) Advantages are:

- Releases customer service rapidly. If the trouble is a particular trunk that is frequently encountered due to traffic selection, normal service can be resumed.
- Saves dispatching employees to both ends.
- Customer will not be aware of coordination problems in getting employees dispatched to both ends simultaneously. Avoids appearance of one employee doing nothing while waiting for employee at other end.
- Transmission test equipment may be more readily available in central offices.

(b) End office to end office testing will be used when:

- The customer sometimes gets good performance.
- The trouble occurs at specific times.
- The customer has trouble with only one station in a multipoint system.
- Noise or other effects not present when customer makes local calls.
- The trouble occurs only when one end dials the connection.

2.21 ***End-to-DTC and End-to-End Testing:*** The advantages of these two methods of testing and the circumstances indicating their usage are similar and are listed in (a) and (b). However, it is suggested that end-to-DTC testing be used when it is more evident that trouble is in one of the two ends, or when end-to-end testing is desired and trouble is encountered getting an employee at each end at the same time.

(a) Advantages are:

- Local loops can be transmission tested for impulse noise, slope, etc.
- Error runs can be made to aid in isolating the trouble to the business machine.
- The craft employee may pick up installation troubles such as faulty grounding, or operation troubles caused by inexperienced personnel.
- The customer may feel that he is getting personal attention.

(b) End-to-DTC or end-to-end testing will be used when:

- There is no pattern to the trouble.
- The trouble occurs in one direction only and normal conversation can take place.
- There has been recent local cable work or a possibility of poor local transmission due to storms, etc.
- A belligerent attitude on the part of the customer and/or business machine representative that demands proof that the telephone company equipment is operating properly.

Note: Prior to performing activities in Phase V, it may be advantageous to contact the DDD service bureau who may be able to provide information concerning existing conditions which may affect data transmission over certain routes.

2.22 The suggested sequence of Phase V activities is illustrated in Fig. 8 and is described in the following procedure.

STEP	PROCEDURE
1	The PSC, under the direction of the DTC, will make preparations for end office to end office tests, end-to-DTC tests, or end-to-end transmission tests, depending on the type of trouble being experienced.
2	If it is decided that end office to end office tests would be more effective in clearing the trouble, the PSC will contact the customer and request that he hold the connection the next time he experiences trouble, and notify the PSC. The PSC will arrange to have the connection held at both ends and will determine if additional trunks are defective by requesting the customer to place another call. All defective connections will be held at both ends and the customer lines will be released.
3	The PSC will request local central office personnel to perform transmission tests on the held connections as outlined in Part 3 of Section 314-205-300. The parameters to be tested are: 1000-Hz loss, 2750-Hz loss, PAR reading, message circuit noise, and impulse noise.
4	If the results of the transmission tests are satisfactory, notify the PSC who will refer the problem to local management and through lines of organization to the responsible staff personnel.
5	If the results of the transmission test are not satisfactory, the defective trunks will be located and repaired as outlined in Section 314-205-300. Notify the PSC of the repair efforts.
6	The PSC will request the customer to verify service restoral by exchanging data with the station or stations that caused him to report the trouble.
7	When the customer is satisfied that service has been restored, the PSC will close the trouble report. If the customer is not satisfied with the service and there is no evidence of additional trouble, the problem will be referred to responsible staff personnel.
8	If it is decided that end-to-DTC tests would be more effective in clearing the trouble, the PSC will instruct, equip, and dispatch a craft employee.
9	The employee will contact the DTC and request an error test on the data station.
10	If the results of the error test are satisfactory, the employee will notify the PSC to refer the trouble to the customer and request that his business machine be tested.
11	If the results of the error test are not satisfactory, the employee will repair or replace the data set.
12	After repairs, the employee will retest the data set with the DTC.
13	If the results of the retest are satisfactory, the employee will request the customer to verify service restoral by exchanging data with another station.
14	When the customer is satisfied that service has been restored, the employee will notify the PSC to close the trouble report.

STEP	PROCEDURE
15	If the results of the retest are not satisfactory, the employee will test the local loop.
16	If the results of the local loop test are satisfactory, the employee will notify the PSC of the situation and then refer the problem through local management to staff personnel.
17	If the results of the local loop test are not satisfactory, the employee will arrange to have the loop repaired or changed.
18	After repairing the local loop, the employee will request the customer to verify service restoral by exchanging data with another customer.
19	When the customer is satisfied that service has been restored, the employee will notify the PSC to close the trouble report.
20	If it is decided that end-to-end tests would be more effective in clearing the trouble, the PSC will instruct, equip, and dispatch a craft employee to each customer location (near-end and far-end). ***Note:*** To minimize coordination problems and to maintain a good customer image, it is suggested that a particular time of arrival be specified to the craft employees.
21	The employees will make error runs from end to end.
22	If the results of the error test are satisfactory, the employees will notify the PSC to request the customer(s) to have the business machine(s) tested.
23	If the results of the error test are not satisfactory, the employees will make end-to-end transmission tests (gain frequency test, message circuit noise test, impulse noise test, PAR test, etc.).
24	If the results of the transmission test are satisfactory, the employees will, to the extent possible, test the data sets at each end.
25	If a data set is found defective, the employee will repair or replace it.
26	After repairing the data set, the employee will request the customer to verify service restoral by exchanging data with another customer.
27	When the customer is satisfied that service has been restored, the employee will notify the PSC to close the trouble report.
28	If the results of the transmission test are not satisfactory, the employees will test the local loop at each end.
29	If the results of the loop tests are satisfactory, the employee will notify the PSC which will prepare for end office to end office tests.
30	If a local loop is found defective, the employee will arrange to have the loop repaired or changed.

STEP	PROCEDURE
31	After the loop is repaired the employee will request the customer to verify service restoral by exchanging data with another station.
32	When the customer is satisfied that service has been restored, the employee will notify the PSC to close the trouble report.

3. ACTIVITIES OF CRAFT EMPLOYEE

3.01 ***It is very important that all trouble reports be given special handling in order to effect prompt restoration of service.*** Since many trouble reports cannot be cleared without dispatching a craft employee to the customer location, the employee has the important role of completing the investigation and clearing the trouble.

3.02 The functions of the employee, outlined in Part 2, are further expanded in Part 3. This is to inform the employee of definite procedures to be followed, test sets and other equipment required, and Bell System Practice documentation which provides guidelines of measurements and limits to be met within specific data systems.

3.03 The employee must be properly trained, experienced in data service, and familiar with the overall maintenance plan in order to adequately apply efforts in clearing a trouble condition.

3.04 The employee shall primarily be responsible for:

(a) Repairing, replacing, and performing various diagnostic tests of the data set and local loop.

(b) Testing the interface between data set and business machine.

(c) Providing assistance to other groups when dynamic tests of the data system and overall circuit are required.

MANDATORY REPORTING PROCEDURE

3.05 It is important that data service trouble be cleared as quickly as possible because in many cases expensive computers or business machines are standing idle due to data service trouble. Often a critical operation such as payrolls, inventories, and management reports are delayed by the trouble. Therefore, judgment needs to be exercised as to the proper action to be taken depending upon the circumstances that may prevail such as:

(a) If circuit or equipment design problems are apparent or when business machine company has dispatched engineering personnel to the customer location, the trouble should be referred to engineering immediately.

(b) If operational problems are encountered, traffic should be notified immediately so that customer training or retraining can be initiated.

(c) If the customer needs more accessory equipment or system changes, marketing should be notified immediately so that a customer contact can be made.

(d) If a trouble has been definitely located and it has been determined that parts or apparatus are needed and supply difficulties are being encountered, the appropriate plant staff should be notified immediately so that expedited action can be taken.

(e) However, if recommended trouble clearing procedures have been employed and the source of trouble has not been found, or if difficulties have been encountered in obtaining cooperation from other groups, it is imperative that the trouble be forwarded through the appropriate lines of organization for technical assistance or management support.

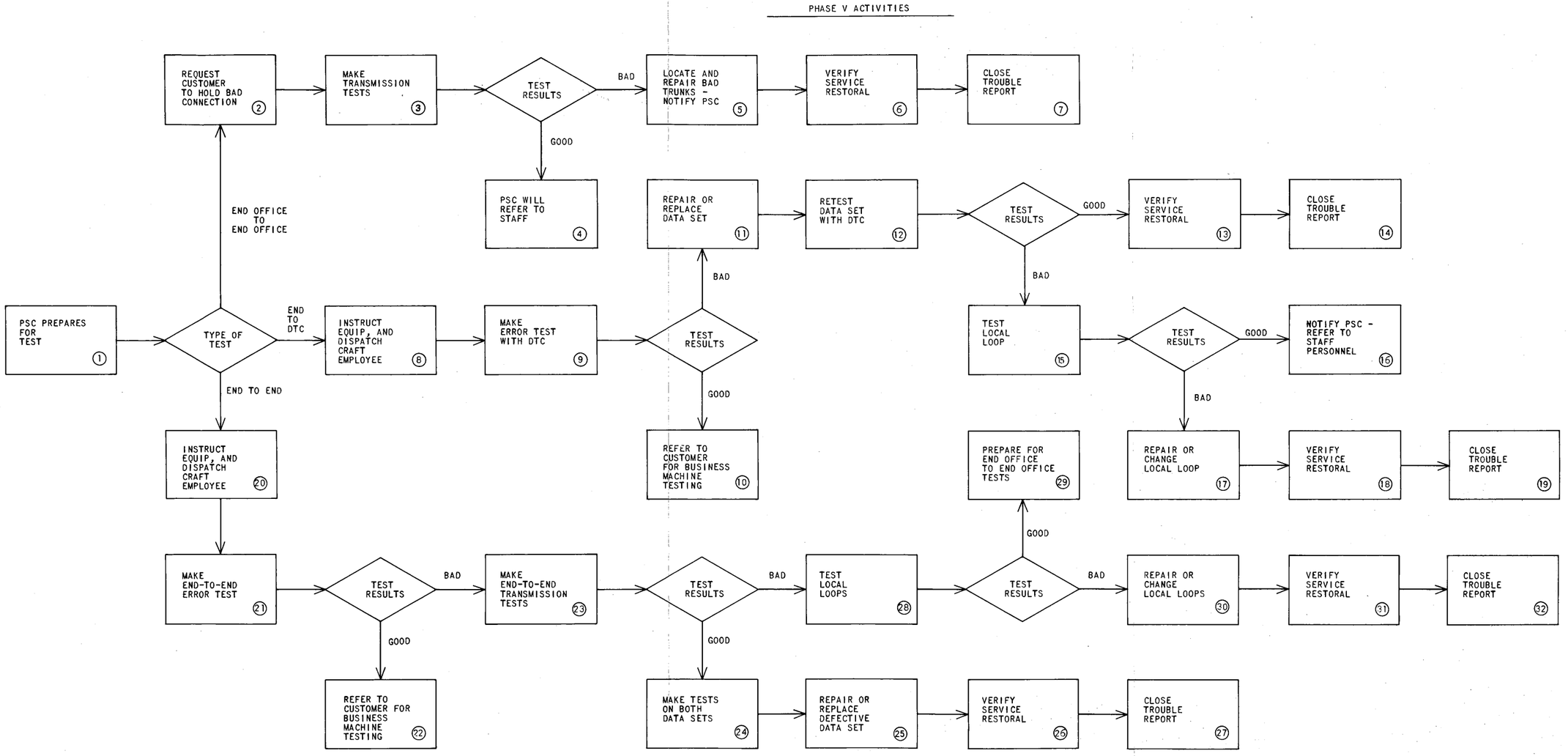


Fig. 8—Trouble Investigating—DDD Network

3.06 To ensure maximum support from supervision and specialized personnel, it is recommended that a ***mandatory reporting procedure*** be established locally. This procedure would dictate levels of supervision, staff, and specialized personnel, which must be notified within specific periods of time from receipt of the trouble report until the trouble is cleared.

3.07 The craft employee must keep the PSC and his supervisor informed of the current repair status; especially, when the trouble cannot be located, or when the trouble has been located and the extent of repairs or lack of spare parts will cause a delay in restoring the service.

SPARE PARTS INVENTORY

3.08 It is recommended that each local operating area (district, sub-district, etc) maintain a spare parts inventory equal to approximately five percent of the data apparatus in service. This inventory is required to ensure prompt restoral of service and will eliminate an unnecessary delay should parts have to be ordered. When service experience indicates that five percent is insufficient to maintain certain types of apparatus, the inventory should be adjusted accordingly. Appropriate Bell System Practices for all data apparatus will indicate the recommended number of spares for each component of that particular apparatus.

TEST EQUIPMENT

3.09 The craft employee must be qualified to use the various test sets available (see Table B) for testing data systems. The following is a list of standard test sets, test set usage, and references to Bell System Practices outlining the methods of calibration and operation:

(a) ***J94003A (3A) Noise Measuring Set:*** The 3A noise measuring set is used to measure the message circuit noise existing on a voice-frequency circuit. The set is equipped with plug-in networks to provide frequency weighting, when required, for testing a particular circuit. Refer to Section 103-611-110.

(b) ***Model TTS-4A Transmission Test Set:*** The 4A transmission test set is used to make transmission measurements (sending and receiving) over telephone circuits. The set can be used on local exchange or PBX circuits as well as on toll and program circuits. The set contains a talking circuit, switchhook control, a neon bulb to indicate incoming ringing in the "on-hook" condition, and a talk battery. A connector is provided for connecting external frequency-determining networks. With accessories, the set duplicates the functions of a subscriber dial set. Refer to Section 103-204-100.

(c) ***6-Type Impulse Counter:*** The 6-type impulse counter is used to count the number of impulse noise peaks during a measured time period that occur on a voice-frequency facility. The counter will register only the peaks which exceed a preset amplitude and which are separated by approximately 150 milliseconds or more. Refer to Section 103-620-100 for 6A counter.

(d) ***J94025A (25A) Voiceband Gain and Delay Measuring Set:*** The 25A voiceband gain and delay measuring set is used for measuring gain and relative envelope delay distortion on voice-frequency circuits. The normal frequency range is from 300 to 3500 Hz. An external frequency counter can be used if precise frequency measurements are required. The set is a single unit containing a transmitter and a receiver. Holding and dialing features are provided for setting up a trunk prior to making measurements, and a switching arrangement permits the interchange of sending and receiving test lines without loss of the connection. Refer to Section 103-115-100.

(e) ***J94027A and B PAR Meter Generator and Receiver:*** The PAR (Peak-to-Average Ratio) meter consists of two separate units; a generator and a receiver. The meter is used to provide a single-number rating of the principal distortions in a transmission facility which affect voiceband data signals. The rating is a measure of the combined amplitude and envelope delay distortions in the facility under test. The generator provides a test signal and the receiver measures the ratio of the peak value of the test signal to its average value. It compares this ratio to that of an undistorted test signal, and indicates the results on a percentage basis. Refer to Section 103-110-110.

(f) ***901B Data Test Set:***

Note: The 901A Data Test Set is limited to tests of certain early model data sets. The 901B set can be used anywhere the 901A is specified.

The 901B Data Test Set (refer to Section 107-100-100) is used to provide access to interface leads of the data set and to provide connectors for connecting to external test apparatus. An interface adapter, which provides access to the interface pins, is furnished as part of the test set cover to permit ***in-service*** (business machine connected and data set on line) or ***not-in-service*** (business machine not connected and data set on or off line) type tests. The test set permits simulation of unattended or attended operation of data sets. Connectors on the test set provide for the following:

(1) 1011-type handset, volt-ohmmeter, or similar test apparatus for testing dc paths and levels of data set signals.

(2) 902-type Data Test Set (distortion measuring and error checking tests).

(3) 903-type Data Test Set (63-bit serial word generator for transmission and receiving tests).

(g) ***902-Type Data Test Set:*** The 902-type Data Test Set works in conjunction with other test sets, such as 901- and 903-type, but never by itself. The test set is used to measure peak distortion and the error rate of the data system. The test set synchronizes and then compares the transmitted data from one test set with data produced at the receiving end by another set to determine the errors. Distortion is found by measuring the time displacement of the change in polarity occurring at the beginning or end of a bit, from the average-time interval of a bit. Refer to Section 107-300-100.

(h) ***903-Type Data Test Set:***

(1) The 903-type Data Test Set is a signal generator used to produce two different serial test signals. One is a 63-bit random word, and the other is a bipolar square wave called a dotting pattern.

(2) The random signal is a 63-bit word which is transmitted continuously in a repetitive sequence to simulate various combinations of bits similar to what a station business machine would send over the transmission network. When the 63-bit signal is utilized, a 902-type test set is used to synchronize the signal with that of a second 63-bit generator, to count the number of errors in the test signal.

(3) The dotting pattern is used to check the symmetry of signals through a data transmitter and receiver and associated telephone circuitry. An oscilloscope or bias test circuit may be used to test with the dotting pattern. Refer to Section 107-200-100.

(i) ***913A Data Test Set:*** The 913A Data Test Set is a parallel adapter which permits the testing of medium speed parallel data sets using the 902- and 903-type serial test sets. The test set converts parallel data signals to single serial data signals and vice versa. The set also tests all interface functions of parallel data sets. Refer to Section 107-401-100.

(j) ***1011-Type Handset:*** The 1011-type handset is used for originating test calls on dial system apparatus for testing the switching, continuity, and talking features of the circuit. The handset can also be used to hold the circuit for other test equipment when locating trouble. A toggle switch is provided on the handset for monitoring or talking. Refer to Section 100-120-101.

(k) ***KS-14510 Meter:*** The KS-14510 meter, or equivalent such as Triplett 310, is a multipurpose instrument used to make various operational tests after data set installations or when clearing trouble. The KS-14510 meter is used for the measurement of ac and dc voltages, dc current, and resistance. Refer to Section 100-520-101.

(l) ***Type 422 Tektronix Oscilloscope:*** The 422 oscilloscope, or equivalent such as Model 180A Hewlett Packard, is a general purpose oscilloscope used for monitoring signals, testing and adjusting work, and trouble analysis while maintaining data systems. The 422 is a portable, dual-trace, ac/dc oscilloscope. Refer to the manual of the manufacturer for methods of calibration and operation.

TABLE B

TEST SETS REQUIRED FOR SPECIFIC TESTS

TYPE OF TEST	TYPE OF TEST SET											
	3A NMS	4A TMS	6-TYPE NMS	25A DELAY SET	PAR METER	901-TYPE DTS	902-TYPE DTS	903-TYPE DTS	913A DTS	1011-TYPE HANDSET	KS-14510 VOM	*TYPE 422 TEKTRONIX OSCILLOSCOPE
Local Loop	•	•	•		•					•	•	
Transmission	•	•	•	•	•							•
Error Run						•	•	•	•			
Interface			•			•			•	•	•	

* Required for special conditions

TROUBLE CLEARING PROCEDURES

3.10 When a trouble condition exists, the primary duty of the craft employee is to clear apparent trouble or to locate the cause of trouble by repairing, replacing, or testing the data apparatus at the customer location.

3.11 The employee will be dispatched when test results and analysis of trouble by the DTC warrants the visit. The repairing and testing activities required by the employee, the corresponding phase numbers of the Overall Maintenance Plan, and the basic investigating efforts which lead to each activity are shown in Fig. 9.

3.12 Before visiting the customer location, the craft employee must properly equip himself with information, spare parts, calibrated test equipment, Bell System Practice documentation, etc, that may be required for repairing or testing efforts. Refer to Section 660-101-305 for description of activities required by the employee prior to visiting the customer.

3.13 The visit of the employee to the customer must always be conducted in an efficient, courteous, and business-like manner. A customer reporting trouble or unsatisfactory conditions is apt to be in a critical or dissatisfied frame of mind. A well-conducted visit will result in a more friendly and favorable customer relationship.

3.14 When the employee or customer is required to make a call for testing purposes during any of the repairing or testing activities, the employee must ensure that the proper procedure for crediting charges are followed. Refer to Section 010-250-001.

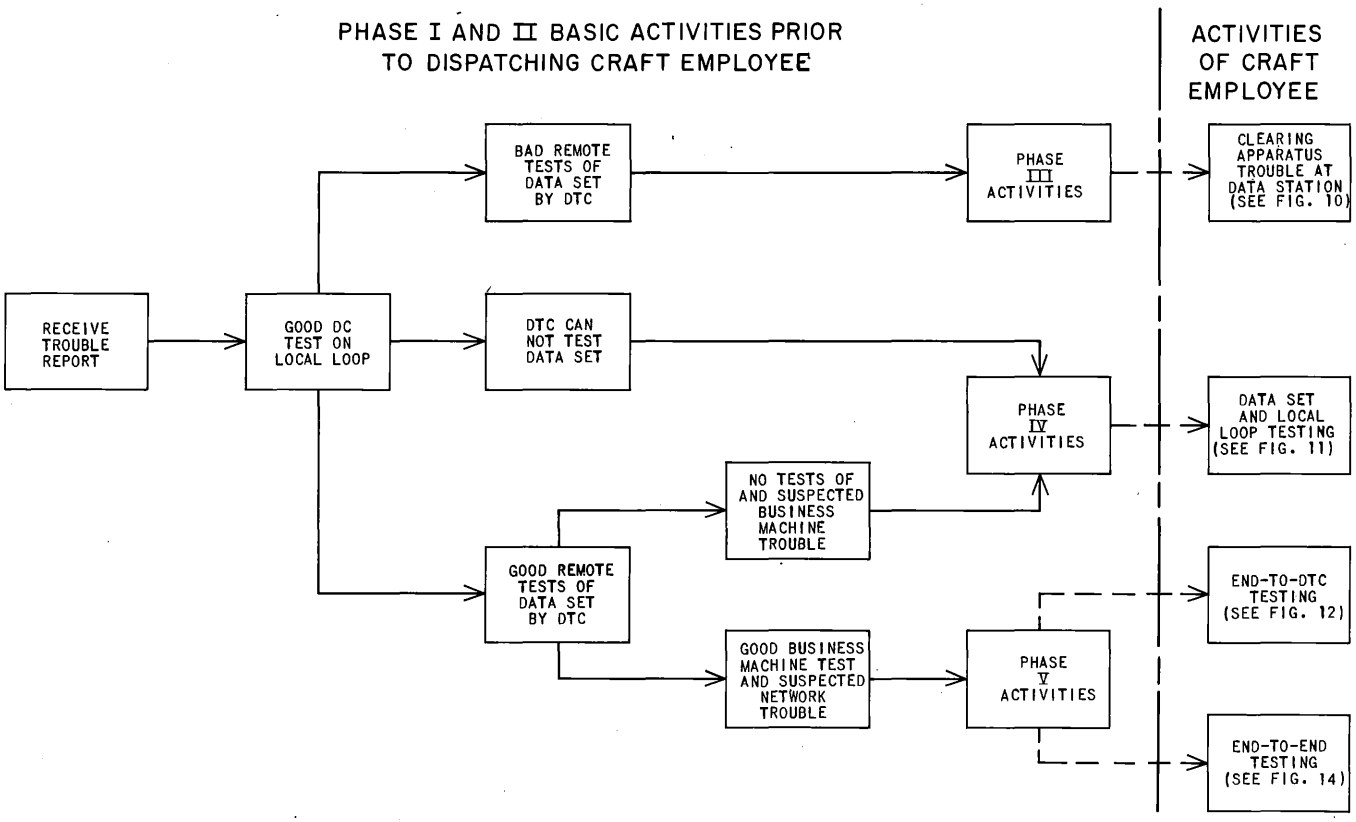


Fig. 9—Basic Activities of Craft Employee

A. Data Set Repair Activities

3.15 The craft employee must be prepared to repair or replace the data apparatus at the customer premise when informed by the PSC that the following trouble conditions exist:

(a) When the station apparatus is inoperative due to physical damage or mechanical trouble of components in either the data set or the telephone set.

(b) When the apparent trouble is in the data set, based on trouble analysis and confirmed with remote test of data set by the DTC.

3.16 The suggested sequence of activities when repairing or replacing the data set is illustrated in Fig. 10 and described in the following procedure which is an expansion of Phase III of the Overall Maintenance Plan.

STEP	PROCEDURE
1	The craft employee must properly equip himself with information, spare parts, calibrated test equipment, Bell System Practices documentation, etc, that may be required to effect the repairs requested by the PSC. After arriving at the customer location, the employee will verify that the trouble exists as it was reported. Physical damage or mechanical breakage will be apparent; however, if the trouble is in the circuitry of the station equipment, the employee will make only the repairs as outlined in the Section on the data set involved.
2	Based on the trouble analysis, the employee will either make all necessary repairs or replacement of damaged or inoperative components, or replace the data set with one known to be operating properly. If it is apparent that the repair effort will require an excessive length of time, the employee will replace the data set. Refer to the appropriate Section for the installation and connection procedures when replacing the data set. Ensure that the proper options are wired into the set.
3	After repairing or replacing the data set, the employee will perform a complete visual inspection of the station installation. Make sure all connectors are properly engaged. Check mechanical linkages. Look for broken or frayed wiring or cords. Check for any other possible trouble causes. Repair or replace any component found bad or marginal during check of installation.
4	After the station apparatus appears satisfactory, the employee will prepare the data station for appropriate tests with the DTC. Connect the 900-type test sets as outlined in the Section associated with the data set under test. Contact and inform the DTC that this is the data station which was previously tested with the customer and the nature of repairs that were made. Request a test of the data set and assist with the testing as required.
5	If the results of the test with the DTC are satisfactory, the employee will inform the customer that the trouble has been cleared. Request the customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
6	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report. If for any reason the customer is ***not*** satisfied with the service and the employee is unable to locate additional trouble, the employee will refer the problem to the PSC and request further instructions.
7	If the results of the data set test are ***not*** satisfactory, the DTC will analyze the results and determine if the trouble is in the data set or the local loop. The DTC will then instruct the employee accordingly. The following may be helpful when making the decision: (a) When some frequency checks are within requirements and some are not, the probable trouble is in the data set and not the local loop. (b) When majority of the frequency checks fail to meet the requirements and if a new data set has been installed, the probable trouble is in the local loop. (c) Some data sets are so equipped that the employee may perform a back-to-back test to determine the condition of the data set.

STEP	PROCEDURE
8	If analysis of the tests indicate that the probable trouble is in the transmission capabilities of the local loop, the employee will perform a complete transmission test of the local loop. Refer to Section 314-205-501 for requirements and test sets needed for testing. The employee will require assistance from the serving central office for portions of this test.
9	If the results of the loop test are satisfactory, the employee, under the direction of the DTC, will continue the repair effort until it is apparent that causes other than the data set are involved. In these cases, the employee will also notify the PSC and responsible staff personnel of the problem condition.
10	If the results of the loop test are ***not*** satisfactory, the employee will arrange to have the loop repaired or changed. If the loop is changed, the PSC will verify that the new assignment is identical in layout with the old. The possibility of additional bridged taps will be carefully checked. If for any reason the loop make-up is different, advice should be obtained from the group responsible for DATA-PHONE loop design. The employee will test the repaired or changed loop per requirements outlined in Section 314-205-501.
11	After the repaired or changed loop has been tested, the employee will prepare the data station for test with the DTC. The employee will contact the DTC and state that this is the data station previously tested and the nature of repairs that have been made. Request a retest of the data set and assist with the testing as required.
12	If the results of the data set retest are satisfactory, the employee will request the customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
13	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report. If for any reason the customer is ***not*** satisfied with the service and the employee is unable to locate additional trouble, the employee will refer the problem to the DTC and request further instructions.
14	If the results of the data set retest are ***not*** satisfactory, the employee, under the direction of the DTC, will continue the repair effort until it is apparent that causes other than the data set are involved. In these cases, the employee will also notify the PSC and responsible staff personnel of the problem condition.
15	If the analysis of the test indicate that the probable trouble is in the data set, the employee will continue the repair efforts based on whether the data set was repaired or replaced initially.
16	If the data set was replaced during the initial repair effort, the employee, under the direction of the DTC, will continue the repair effort until it is apparent that causes other than the data set are involved. In these cases, the employee will also notify the PSC and the responsible staff personnel of the problem condition.
17	If the data set was ***not*** replaced during the initial repair effort, the employee will replace the data set with one known to be operating properly. Refer to the appropriate Section for the installation and connections of the data set. Ensure that the proper options are wired in the new set.

STEP	PROCEDURE
18	After replacing the data set, the employee will prepare the data station for appropriate tests, contact the DTC, and request a test of the new data set.
19	If the results of the data set test are satisfactory, the employee will request the customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
20	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report. If for any reason the customer is ***not*** satisfied with the service and the employee is unable to locate additional trouble, the employee will refer the problem to the DTC and request further instructions.
21	If the results of the data set test are ***not*** satisfactory, the employee under the direction of the DTC, will continue the repair effort until it is apparent that causes other than the data set are involved. In these cases, the employee will notify the PSC and responsible staff personnel of the problem condition.

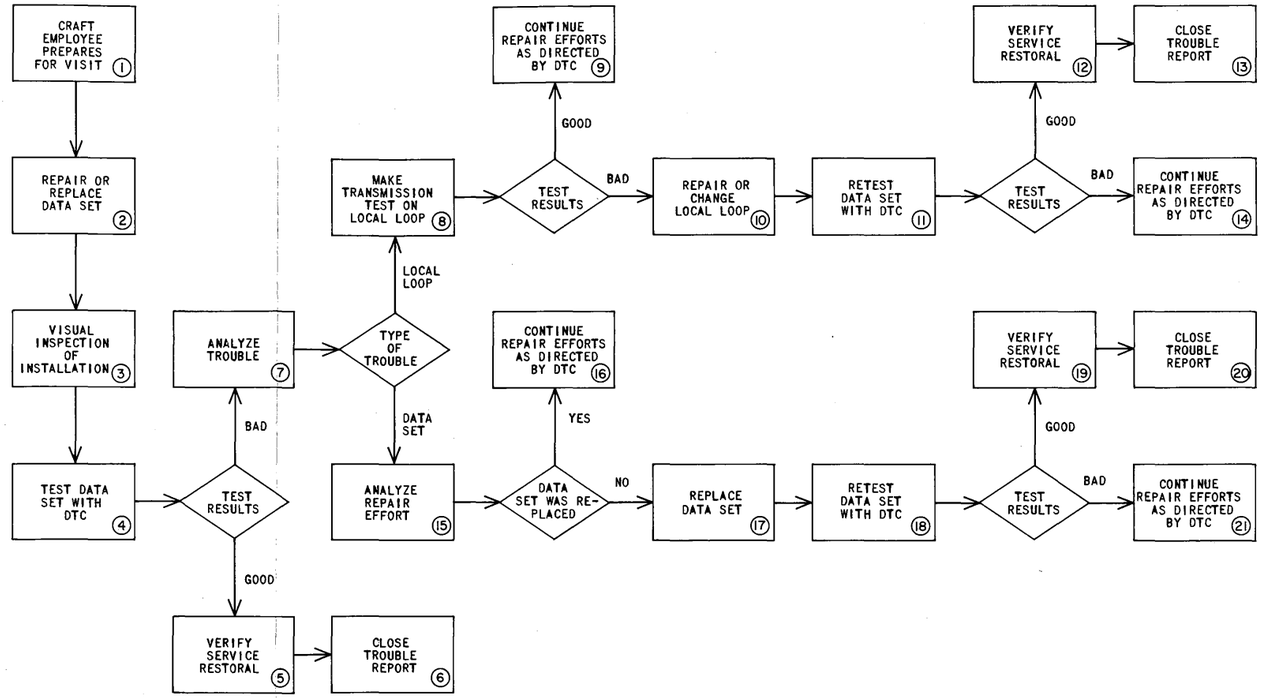


Fig. 10—Activities for Clearing Apparatus Trouble at Data Station

B. Troubleshooting Activities

3.17 The craft employee must be prepared to visit the customer to assist in locating cause of trouble and in making the necessary repairs. These visits will require the employee to perform various types of tests in attempt to isolate the problem to one or more components of the data system. Analysis of the trouble by the DTC will determine the activities to be performed by the employee. The troubleshooting activities (Phase IV and V) are divided into three different tests and the conditions for each are outlined below:

(a) ***Data Set and Local Loop Testing (Fig. 11):*** Required when trouble is suspected in the data station (data set, local loop, or business machine), and the DTC cannot confirm that the data set is operating properly (remote tests of the data set are inconclusive or cannot be performed).

(b) ***End-to-DTC Dynamic Testing of Data Systems (Fig. 12):*** Required when trouble is suspected in business machine and the customer cannot test the business machine, when the customer and/or business machine representative insist on visit to prove that the data set is operating properly, or as a substitute for end-to-end testing when trouble is encountered obtaining a craft employee to assist with the testing at the far-end station.

Note: When used as a substitute for end-to-end testing, it is recommended that the employee utilize the DTC nearest to the far-end station.

(c) ***End-to-End Dynamic Testing of Data Systems and Transmission Testing of the Facilities (Fig. 14):*** Required when trouble is suspected in the facilities, when station apparatus tested marginally, or when there is no definite pattern to the trouble.

3.18 The suggested sequence of troubleshooting activities for data set and local loop testing is illustrated in Fig. 11 and is described in the following procedure which is an expansion of Phase IV of the Overall Maintenance Plan.

STEP	PROCEDURE
1	Before visiting customer location, the craft employee must be properly equipped for locating trouble within the data station. Refer to Section 660-101-305 for a description of activities required prior to visiting the customer.
2	The employee will explain the circumstances to the customer upon arrival and proceed to perform a visual inspection of the installation. Look for disconnected, broken, or frayed cords. Check for broken components or any other possible trouble causes.
3	If any component is found defective or marginal during check of the installation, the employee will repair or replace the component.
4	After making the necessary repairs, request the customer to verify service restoral by exchanging data with the station or stations that caused him to report the trouble.
5	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.
6	If the customer cannot exchange data or is not satisfied with the service, the employee will proceed with the investigation (Step 7).

STEP	PROCEDURE
7	If the installation appears to be in order after visual inspection, the employee will prepare to make appropriate tests of the data set. Refer to the appropriate Section for the required test equipment and procedures for making the tests.
8	Perform the tests of the data set as outlined in the Section on test procedures. If the design of the data set does not provide for making tests, replace the data set with a new set.
9	If the results of the data set tests are ***not*** satisfactory, the employee will replace the data set with one known to be operating properly. Refer to the appropriate Sections for installation and connection of the new data set. Ensure that the proper options are wired into the new set.
10	After the data set has been replaced, the employee will repeat the tests outlined in the Section on the new set.
11	If the results of the new data set test are ***not*** satisfactory, the employee will contact the DTC and request instructions before continuing investigating efforts.
12	If the results of the new data set test are satisfactory, the employee will ensure that all wiring and cords are properly connected and then request customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
13	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.
14	If the customer cannot exchange data, the employee must continue the investigation to locate additional trouble. Proceed to Step 15.
15	If the results of the data set test are satisfactory or when replacement of data set does not restore service, the employee will disconnect the data set and prepare the test equipment for a complete transmission test of the local loop.
16	Refer to Section 314-205-501 for requirements, and perform transmission test on the local loop.
17	If the results of the loop test are satisfactory, the employee will notify the DTC that the results of the data set and local loop tests are satisfactory and will wait for further instructions. ***Note:*** The preceding investigation has eliminated the data set and local loop as possible trouble; therefore, attention must be directed to the business machine or facilities. The DTC will notify the employee if further investigation is required at this time.
18	If the results of the loop test are ***not*** satisfactory, the employee will arrange to have the loop repaired or changed. If the loop is changed, the PSC will verify that the new assignment is identical in layout with the old. The possibility of additional bridged taps

STEP	PROCEDURE
	will be carefully checked. If for any reason the loop make-up is different, advice should be obtained from the group responsible for DATA-PHONE loop design. The employee will test the repaired or changed loop per requirements outlined in Section 314-205-501.
19	After changing the defective loop, the employee will make the necessary connections to the data set. Employee will then request customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
20	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.
21	If the customer cannot exchange data or is not satisfied with the service, trouble may still exist in another component of the system or in the business machine, and further investigation must be pursued. The employee will notify the DTC of the repair work that has been completed and wait for further instructions.

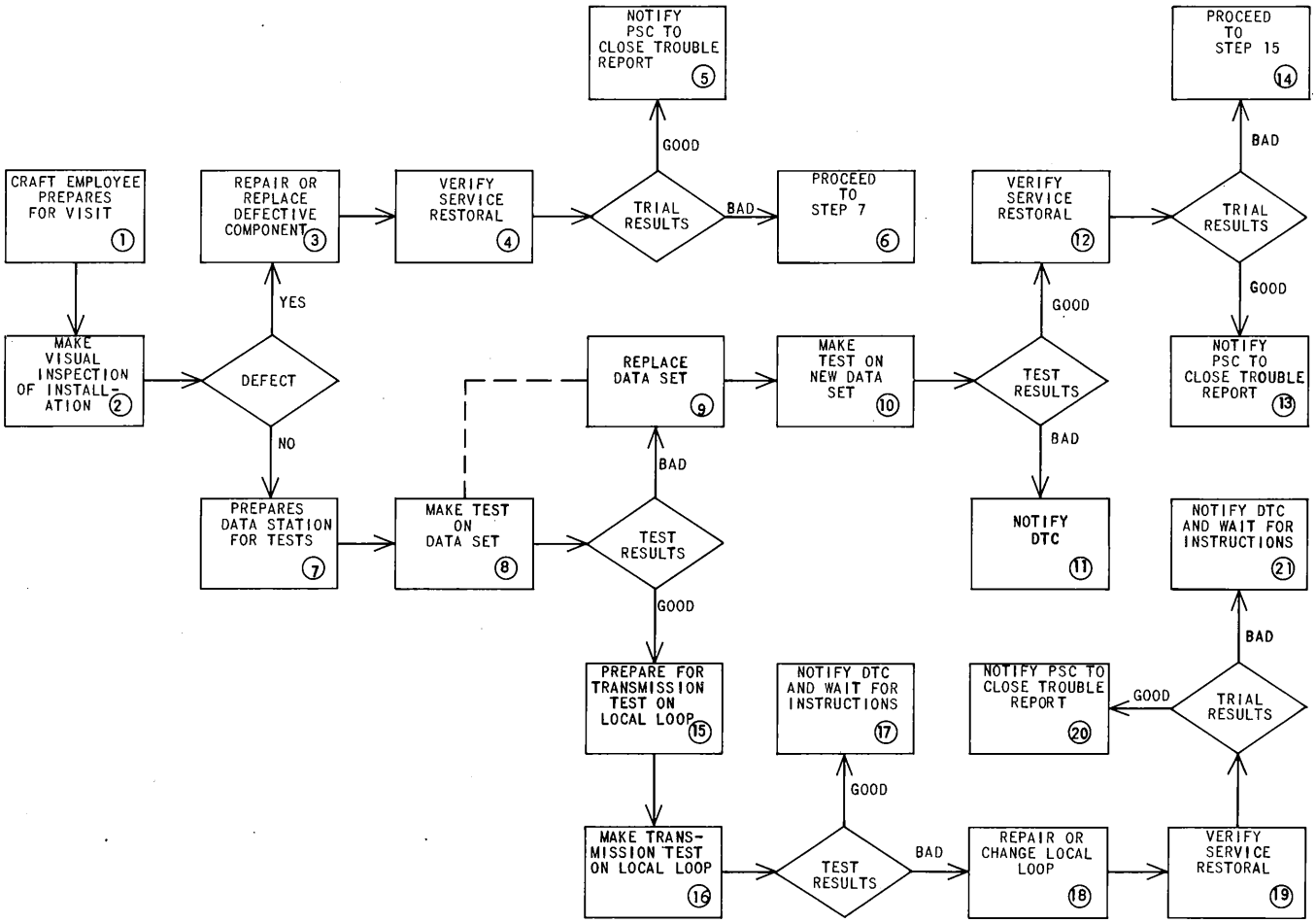


Fig. 11—Troubleshooting Activities for Data Set and Local Loop Testing

3.19 The suggested sequence of the troubleshooting activities for end-to-DTC testing is illustrated in Fig. 12, and is described in the following procedure which is a partial expansion of Phase V of the Overall Maintenance Plan.

STEP	PROCEDURE
1	When trouble is thought to be in the business machine and the customer will not accept the trouble or cannot test his machine, the employee will be requested to visit the customer and prepare the data station for an end-to-DTC dynamic or error rate testing. The employee must be properly equipped for performing the tests. Prior to visiting the customer, refer to Section 660-101-305 for a description of required activities.
2	After arriving at customer location, the employee will explain the circumstances to the customer and that tests are to be made on the data set. The employee will connect the test equipment as outlined in the Section on test procedure for the data set to be tested. The employee will then notify the DTC that the data station is ready for the test and will assist as required during testing.
3	If the results of the data set error rate or dynamic test are satisfactory, the employee and the DTC will determine the operating margin of the system in both directions by repeating the tests made in Step 2 with the transmit level lowered 4 dB. The 914 data test set has provisions for inserting this loss. If the 914 is not used, a 4-dB pad and a holding and signaling bypass arrangement must be inserted in the transmit path as shown in Fig. 13. ***Note:*** If the design of the data set does not provide a transmitter and a receiver, the marginal test can ***only*** be made in one direction.
4	If the results of the dynamic and marginal tests are satisfactory, indications are that the probable trouble is in the customer business machine. The employee will request the customer to have the business machine representative check the business machine. The employee will then notify the PSC to close the trouble report. ***Note:*** If the end-to-DTC testing was entered from a condition other than suspected business machine trouble (suspected facilities, etc), the employee will notify the DTC and request instructions for further investigation.
5	If the results of the error rate, dynamic, or marginal test are ***not*** satisfactory, the employee will replace the data set. Refer to appropriate Sections for the installation and connections of the new data set. Ensure that the proper options are wired into the new data set.
6	After the data set has been replaced, the employee will contact the DTC and request a repeat of the tests performed in Steps 2 and 3.
7	If the results of the new data set tests are satisfactory, the employee will ensure that all wiring and cords are properly connected and then request the customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
8	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.

STEP	PROCEDURE
9	If the customer cannot exchange data, the probable trouble is in the business machine since the results of the new data set tests were satisfactory. The employee will request the customer to have the business machine representative check the business machine. ***Note:*** See Note in Step 4.
10	If the results of the new data set tests are ***not*** satisfactory, the employee will disconnect the data set and prepare the test equipment for a complete transmission test of the local loop. Refer to Section 314-205-501 for requirements, and perform a transmission test on the local loop.
11	If the results of the local loop test are satisfactory, the employee will notify the DTC and request further instructions. ***Note:*** Further analysis of the trouble must be considered at this time before the investigation can continue. There are several possible approaches: the employee could be requested to replace the data set the second time, to assist in testing the facilities, or to check the possibility of faulty test equipment.
12	If the results of the local loop test are ***not*** satisfactory, the employee will arrange to have the loop repaired or changed. If the loop is changed, the PSC will verify that the new assignment is identical in layout with the old. The possibility of additional bridged taps will be carefully checked. If for any reason the loop make-up is different, advice should be obtained from the group responsible for DATA-PHONE loop design. The employee will test the repaired or changed loop per requirements outlined in Section 314-205-501.
13	After changing the defective loop, the employee will reconnect the data set, connect the appropriate test equipment, and contact the DTC. The employee will request the DTC to retest the data set.
14	If the results of the data set retest are satisfactory, the employee will proceed to Step 7.
15	If the results of the data set retest are ***not*** satisfactory, the employee will request analytical assistance from the DTC before continuing the investigation. See Note in Step 11.

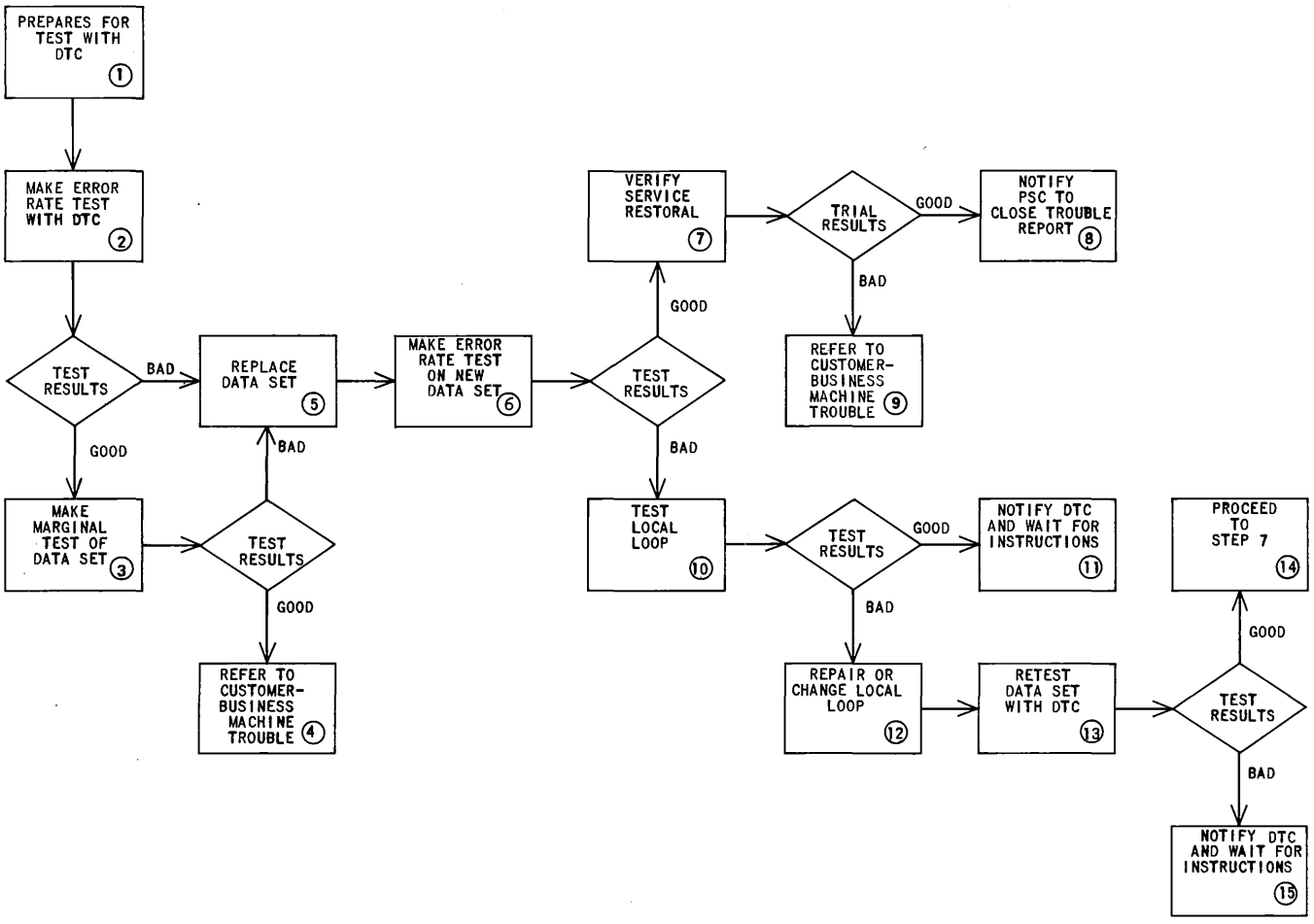


Fig. 12—Troubleshooting Activities for End-to-DTC Testing

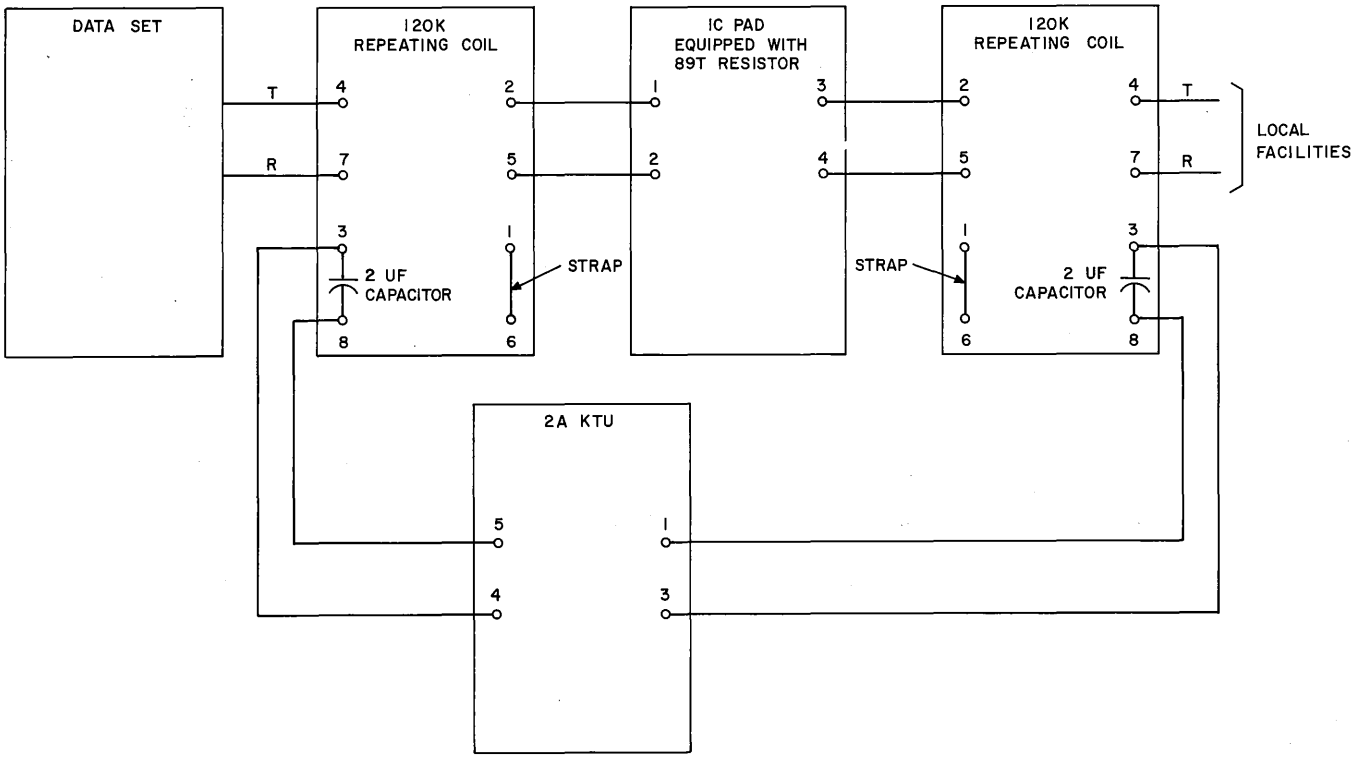


Fig. 13—Holding and Signaling Bypass Arrangement

3.20 The suggested sequence of the troubleshooting activities for end-to-end testing is illustrated in Fig. 14, and is described in the following procedure which is a partial expansion of Phase V of the Overall Maintenance Plan:

STEP	PROCEDURE
1	When the trouble is thought to be in the facilities, the craft employee may be requested to visit the customer and perform end-to-end dynamic testing of the data system or transmission testing of the facilities. The employee must be properly equipped for performing the tests and making repairs. Prior to visiting the customer, refer to Section 660-101-305 for description of activities required. ***Note:*** To minimize coordination problems created by end-to-end testing, the employee must make every effort to arrive at the customer location at the time specified by the PSC.
2	After arriving at customer location, the employee will explain to the customer that tests are to be made to check the data set at each end and also the facilities. The employee will connect the test equipment as outlined in the test procedures section for the data set to be tested. The employee will then contact the employee at the far-end and state that the data station is ready for test. When both stations are ready, the employees will perform the tests as indicated in the test section.
3	If the results of the end-to-end dynamic test are satisfactory, the employees will determine the operating margin of the system in both directions by repeating the tests made in Step 2 with the transmit level lowered 4 dB. The 914 data test set has provisions for inserting this loss. If the 914 set is not used, a 4-dB pad and a holding and signaling bypass arrangement must be inserted in the transmit path as shown in Fig. 13. ***Note:*** If the design of the data set does not provide a transmitter and a receiver, the marginal test can ***only*** be made in one direction.
4	If the end-to-end dynamic or margin test is ***not*** satisfactory, the employee will disconnect the test equipment and data set at each end, and prepare to make end-to-end transmission tests. The following transmission measurements will be made in both directions within the system. (a) Make a PAR reading by using the J94027A and B PAR meter generator and receiver. Refer to Section 314-205-500 for PAR rating objectives. (b) If the PAR reading is low (or was not made), make a message circuit noise test by using a 3A noise measuring set. Refer to Section 314-205-500 for overall limits. (c) Make a frequency run at 200-Hz intervals from 500 to 2750 Hz, using a 4A transmission test set. Refer to Section 314-205-500 for end-to-end requirements. Inspect the results for ripples or other irregularities.

STEP	PROCEDURE
	(d) If the PAR reading made in (a) was low and no trouble was found in (b) and (c), the problem is probably relative envelope delay distortion. Check the envelope delay with a 25-type delay measuring set. Refer to Section 314-205-500 for requirements. (e) Make an impulse noise test by using the 6-type impulse counter. Refer to Section 314-205-500 for objectives.
5	If the results of the end-to-end transmission tests are ***not*** satisfactory, the employee at the near-end will request the PSC to hold the existing connection. The employees will then perform a complete transmission test of the local loop at each end. Refer to Section 314-205-501 for requirements.
6	If the results of the local loop test are satisfactory, the employee at the near-end will notify the PSC to proceed with an end office to end office transmission test on the held connection. Release customer connection on both ends. The employee will then prepare the test equipment and data set on each end to make an end-to-end dynamic test on another connection to determine whether the trouble is peculiar to an individual trunk or may be common to a routing. If the results of the test are ***not*** satisfactory on the new connection, measure the parameter that was out-of-limits on the first connection. If the same parameter is out-of-limits, the trouble is probably in a trunk group. Release the second connection. Notify the PSC of the test results and wait for further instructions.
7	If the results of the local loop test are ***not*** satisfactory, the employee will arrange to have the loop repaired or changed. If the loop is changed, the PSC will verify that the new assignment is identical in layout with the old. The possibility of additional bridged taps will be carefully checked. If for any reason the loop make-up is different, advice should be obtained from the group responsible for DATA-PHONE loop design. The employee will test the repaired or changed loop per requirements outlined in Section 314-205-501.
8	After changing the defective loop, the employee will ensure that all wiring and cords are properly connected, and then request the customer to verify service by exchanging data with the station or stations that caused him to report the trouble.
9	When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.
10	If the customer cannot exchange data, the employee will notify the DTC of the circumstances and request further instructions.
11	If the results of the end-to-end transmission test are satisfactory, the employee at each end will connect the required test equipment and prepare to make end-to-DTC dynamic tests as outlined in the test procedure section for the data set under test. Each employee will then contact his serving DTC and request the tests. The employee will assist the DTC as required during tests.
12	The employee will replace the data set found defective during tests with the DTC. Refer to appropriate Sections for the installation and connections of the new data set. Ensure that the proper options are wired into the new data set.

STEP	PROCEDURE
13	After the data set has been replaced, the employee will contact the DTC and request a repeat of the tests performed in Step 11.
14	If the results of the new data set test are satisfactory, the employee will proceed to Step 8.
15	If the results of the new data set test are ***not*** satisfactory, the employee will request further instructions from the DTC.
16	If the results of the end-to-end dynamic and margin tests are satisfactory, each employee will remove the test equipment, ensure that all cords are properly connected, and then request the customers to verify service by exchanging data.
17	If the customers do not experience trouble when exchanging data, the employee will inform the near-end customer that the tests indicate that the telephone station equipment at both ends is operating properly and suspected trouble is in the network facilities. Request the customer to hold the next connection that fails, so that the telephone company can test the connection through the facilities.
18	If the customers cannot exchange data, the employee will notify the DTC of the circumstances and request further instructions.

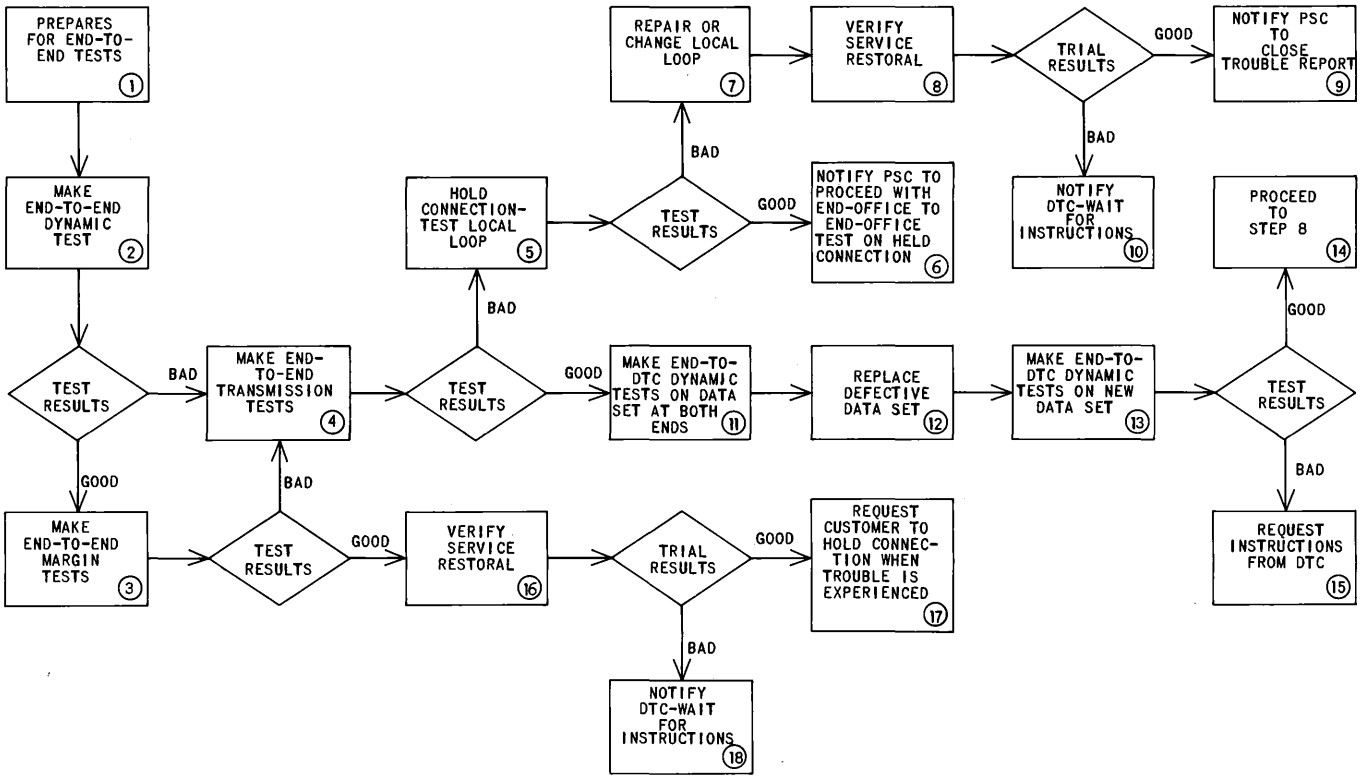


Fig. 14—Troubleshooting Activities for End-to-End Testing