

**CONTROLLED MAINTENANCE PLAN  
GENERAL INFORMATION—OVERALL SYSTEMS  
DIGITAL TRANSMISSION SYSTEMS**

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**NOTICE**

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## 1. GENERAL

**1.01** This section describes the specific plan for the maintenance of Digital Transmission Systems and applies to all central office locations, large and small, responsible for the maintenance of these systems and associated equipment. This plan supplements the Controlled Maintenance Plan for Transmission and Signaling Equipment Serving All Trunks and Special Services found in Section 010-300-010 by providing additional corrective maintenance procedures, specifically for Digital Transmission Systems. This section will take precedence for T-Carrier over any other Controlled Maintenance Plan (CMP) for corrective maintenance procedures. Preventive maintenance procedures will not be changed by this section and will remain as described in Section 010-300-010. It is important that the reader be familiar with Section 010-300-010 before continuing with this document.

**1.02** Whenever this section is reissued, the reason for reissue will be stated in this paragraph. This issue does not affect the Equipment Test List.

**1.03** The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which the figure is referenced.

**1.04** Digital Transmission Systems, also known as T-Carrier, are made up of digital transmission equipment joined together to establish digital facilities. Failure of digital transmission equipment will cause loss of service to customers using a digital facility at the time of failure. In addition, such failures can reduce the call-handling capability in switching machines and create abnormal service loads for testboards, repair desks, and traffic switchboards. The costly nature of these failures dictates that it is most economical to maintain all digital facilities at the design level of performance and reliability.

**1.05** Controlled Maintenance, as described in this section, provides techniques for managing upkeep maintenance on Digital Transmission Systems and equipment. Digital transmission equipment is defined as equipment installed in and between local and toll central offices to provide digital facilities for trunks and special services. There may be instances where this equipment is used in other applications, eg, maintenance facilities (maintenance, protection, and backbone lines). However, regardless of application, the term "digital transmission" will apply to this equipment. The objective of controlled maintenance is to maintain the design capability of the digital equipment and facilities in a manner that will provide an obtainable level of service. This goal will be consistent with expenses.

**1.06** Controlled Maintenance Plans for other central office equipment not classified as digital transmission are covered in other Bell System Practices.

## 2. DEFINITIONS

**2.01** For the purpose of this section, certain common terms used in describing the CMP are defined as follows:

- (1) **Backbone Line (BB):** This is a combination of maintenance lines equipped with bridging repeaters wired through intermediate offices. It will be used for restoring a failed system independent of the central office force sectionalizing the trouble to the span in question. Backbone lines are not intended to replace maintenance lines.
- (2) **Carrier Group Alarm (CGA):** In T-Carrier, a line disturbance or equipment malfunction of 300 milliseconds or longer causes the CGA circuit or trunk processing unit (TPU) to operate, and all calls currently in progress are disconnected. The occurrence of this alarm circuit operation is termed a carrier group alarm. Registers are provided to record the number of CGA occurrences. Disturbances of less than 300 milliseconds cause the framing light on the D1 bank to light but do not cause a CGA or drop calls in progress. Later models of D-banks have approximately 2-second initiation of alarm circuits. Some of these banks do not have registers, but the alarm data is fed into minicomputers at operation support centers.

(3) **Central Office (CO):** This is a telephone network office containing digital transmission equipment.

(4) **Central Office Force:** In this section, the personnel who perform the restoration, trouble location, repair, and routine maintenance functions on Digital Transmission Systems and equipment within a central office will be called the central office force.

(5) **Construction Force:** In this section, the personnel who perform the installation, rearrangement, and splicing functions in the outside cable plant will be called the construction force. In some areas, they may also initially install the line repeaters and line build-out units and perform installation testing. Their activities on T-Carrier and other types of facilities potentially affect the performance of collocated T-Carrier lines.

(6) **Corrective Maintenance:** The activities included in corrective maintenance are shown in Fig. 1 and consist of:

(a) Recording details of troubles reported by alarms, test frames, customers, operators, other offices, support center testboards, etc.

(b) Locating and repairing reported trouble.

(c) Logging details of troubles for further analytical study.

(7) **Digital Facility:** A digital facility consists of a transmission path for a digital signal at a specified standard bit rate together with two compatible terminals. The path may be a repeated line, a radio line, or a channel in a higher order facility or any combination thereof. The terminals provide assignable channels.

(8) **Intermediate Office:** A central office having an office regenerator for a T-Carrier System which does not terminate in that office is called an intermediate office.

(9) **Intermittent and Transient Failures:** Intermittent failures are those which cause alarms on individual T-Carrier Systems that self-restore and which recur periodically and are usually caused by some physical impairment, trouble condition, or craft activity. Poor

connections, wire clippings, or marginally operating equipment are examples of conditions that cause intermittent failures. Transient failures are alarms which are caused by a single transient disturbance and are unlikely to recur on the same T-Carrier System. The single alarm (or burst of alarms) will restore after the disturbance has passed. This type of failure can be caused by work activity or some transient environmental condition.

(10) **Maintenance Line (ML):** A maintenance line is a series of regenerators extending from one digital cross connect bay (DSX) or central office repeater bay (ORB) to the next ORB or DSX set aside to provide for the restoration of a failed span line between two central offices. The recommendation is one ML per case, equipped with bridging repeaters.

(11) **Marginal Troubles:** Marginal troubles are failures of equipment under marginal tests applied by test frames or test sets. These tests are more severe than demands usually encountered in service connections. Marginal tests (either electrical or mechanical) are applied to the apparatus to determine if the required operational reserve is present. If marginal test failures occur, it is an indication that deterioration has exhausted the *operational reserve* and that corrective action must be taken before it becomes service-affecting.

(12) **Noncontrol Span Office:** A noncontrol span office is the office at one end of a span line that is *not* designated control office on the span line record card or the office *not* designated by the system control or T-Carrier Restoration and Control Center Administration System (TRCC) as in the best position to isolate a trouble. However, noncontrol offices must work with the control office when a patch is required.

(13) **Noncontrol Terminal Office:** A noncontrol terminal office is the office at one end of a T-Carrier System which contains a terminal (channel bank or multiplex) and is *not* designated on the system circuit order or system layout record as the control office. However, this office must make certain that if its terminal is causing the outage, the trouble is repaired promptly.

- (14) **Outside Plant Forces:** In this section, the personnel who perform the repeater testing and replacement and cable repair on the repeatered line will be called outside plant forces. Outside plant forces may also initially install the repeaters and line build-out units and perform installation testing. Their activities on T-Carrier facilities potentially affect the performance of collocated T-Carrier lines. In some areas, the line repeater testing and replacement may be performed by central office forces.
- (15) **Patching:** For T-Carrier, this term covers the use of one or more backbone or maintenance lines in accordance with Section 365-226-500 for restoration or the prevention of service interruption. All patches are to utilize bridging repeaters.
- (16) **Preventive Maintenance:** This term is applied to the activities of finding, repairing, and recording troubles (service-affecting or not) which are not associated with a trouble report, and for which there are inadequate indicators. One means of finding trouble is by completing routines as established in Sections 365-001-011 through 018. For convenience of description, preventive maintenance may be separated into the following three divisions:
- (a) The analysis of corrective maintenance records for evidence of increasing troubles and the testing of associated equipment for further evidence
  - (b) The scheduling and performing of periodic tests for locating troubles for which indications are obscure and for affirming the correct operation of critical equipment items for which in-service failures cannot be tolerated
  - (c) The combined analysis of corrective maintenance trouble reports and preventive maintenance trouble detected to develop documented evidence to support accurate and efficient application of the preventive maintenance effort.
- (17) **Protection Line (PL):** This is an unassigned span or T line provided to increase reliability and reduce outage time of T-Carrier Systems. It is usually switched into service automatically.
- (18) **Restoration:** This is the process of returning a T-Carrier System to a reliable in-service state. This may involve restoring service through the utilization of backbone, maintenance, or protection lines until repair can be accomplished. The term applies to corrective maintenance activities on intermittent as well as hard-failed systems since an intermittent system is not in a **reliable** in-service state. The total restoration process includes the trouble-locating and repair activities necessary for returning the system to its normal configuration.
- (19) **Side System:** This is the system using the other side of a line repeater in unidirectional repeater operation, or the system using the other side of a central office repeater in a 201-type repeater bay.
- (20) **Span:** This is a collection of span lines between two central offices.
- (21) **Span Control Office:** The span control office for new installations is the office designated on the span line record as the control office for that span. It has responsibility for the installation tests of all the span lines between the office and the other span terminating office. The span control office for maintenance, alternatively, is the office designated by the System Control Office or TRCC as being in the best position to isolate a trouble and coordinate the trouble clearing. This assignment is only effective during the particular trouble and does not change administrative responsibility.
- (22) **Span Line:** A span line is a series of regenerators extending from one DSX or ORB to the next ORB or DSX.
- (23) **System Control Office:** This is the terminal office which is designated on the facility circuit order and facility layout record as the control office. It has responsibility for the overall performance and maintenance of the T-Carrier System. The TRCC may designate any office as control if it is in the best position to isolate a trouble.
- (24) **T-Carrier Restoration and Control Center:** This is an administrative center which works with central office and outside plant forces to coordinate rapid restoration and timely repair of T-Carrier Systems that have line

or bank failures. It has complete authority over the use of all backbone and maintenance lines. The TRCC also has responsibility for analyzing troubles and working with outside plant and engineering to keep the network running smoothly.

(25) **T-Carrier Administration System (TCAS)**: This is a tool to make a TRCC more effective. The minicomputer associated with it can be located in the TRCC. The T-Carrier network status information is provided by telemetry from the individual central offices. In this way, the TRCC is able to be of additional assistance to the offices by doing timely patterning and sectionalization.

(26) **T Line**: This is the combination of span lines which may use various digital signal levels, cross-connected at intermediate offices to make up the facilities between digital channel banks or multiplexers.

(27) **Trouble**: A digital trouble, whether it is marginal, intermittent and transient, or design in nature, is any condition requiring corrective action as a result of a report by carrier group alarm, test frames, customers, operators, other testboards or support centers, framing lamp, preventive maintenance, circuit order test, or other observed indications. Customers may not be directly affected.

### 3. CONTROLLED MAINTENANCE—CORRECTIVE AND PREVENTIVE

3.01 **Controlled Maintenance** is the term applied to the maintenance plan described in this section. It consists of an appropriate balance of corrective and preventive maintenance tailored to the needs of the Digital Transmission Systems.

3.02 In the Controlled Maintenance Plan, corrective maintenance procedures are used to handle trouble reports from all sources. These procedures are aimed at:

- (a) Providing an effective means for controlling the prompt handling of trouble reports
- (b) Handling these reports for rapid restoration, trouble location, and repairs

(c) Providing for orderly records which represent information in an effective way for analysis.

3.03 It should be recognized that corrective maintenance procedures provide an adequate method for handling troubles *only* when the trouble condition is reported promptly and contains enough detail to help identify the failed equipment.

3.04 Unalarmed troubles may exist in digital facilities. Supplemental means for detecting these troubles must be used so that troubles and deterioration not yet affecting service do not accumulate. Preventive maintenance, as outlined in Section 010-300-010, provides an effective and economical method for identifying, locating, and repairing these troubles.

3.05 The Equipment Test List for Digital Transmission Systems is found in Sections 365-001-011 through 018. It is provided to assist the supervisor in organizing the preventive maintenance job. This list contains all tests that apply to Digital Transmission Systems and equipment found in Bell System Practices.

### 4. CONTROLLED MAINTENANCE CONCEPT

4.01 Figure 2 provides an overall view of the controlled maintenance concept. The objective is to maintain the designed capabilities of both the digital equipment and digital facility. Quality control applied to manufacture and installation is intended to ensure equipment installations which meet the standards established by the digital equipment design. Correct installation procedures used by craft personnel to establish a digital facility and initial tests that meet prescribed Bell System Practices requirements are needed to ensure that the overall digital facility will meet facility design standards.

4.02 In the Controlled Maintenance Plan portion of Fig. 2, three legs can be seen; one is for corrective maintenance, and the other two are for preventive maintenance. The left-hand part of Fig. 2 depicts the corrective maintenance activities which are the result of alarms or troubles reported. The center of Fig. 2 depicts the preventive maintenance activities which are the result of analysis of corrective maintenance records where these records indicate the existence of troubles not yet reported. The right-hand part of Fig. 2 depicts the preventive maintenance activities which originate

from the Equipment Test List. This leg covers conditions where trouble indicators are missing, misleading, or obscure, and where scheduled tests are required to correct existing troubles.

## 5. CORRECTIVE MAINTENANCE PROCEDURES AND FORMS

**5.01** This part, in conjunction with the flowcharts in Fig. 3 (T-Carrier Systems) and Fig. 4 (T-Carrier System Span Lines), provides an overall view of the corrective maintenance procedures and administrative responsibility in simplified form. The operations, activities, decision processes, and records used in this plan are described in general terms.

**5.02** Controlled Maintenance, as explained in Part 3, consists of a balance between corrective and preventive maintenance activities. In corrective maintenance, current equipment troubles are compared to a predetermined trouble expectancy by equipment types or history of trouble occurrences in the same T-Carrier System or span.

**5.03** Reported troubles are recorded daily on trouble tickets or Span Line Trouble Reports and posted in the log. Properly coded trouble tickets or reports are then entered on the Equipment Control Record and in the individual Trouble History Record. Both logs provide a current list of all troubles and activities reported. These logs should be reviewed periodically to determine the volume and duration of reported troubles. This also serves as an analysis tool to establish T-Carrier System or span trouble trends.

**5.04** The Equipment Control Record lists the daily equipment trouble codes. A monthly Trouble Summary of Equipment Trouble is posted for evaluation and analysis purposes. The number of troubles expected is determined through the study of past equipment trouble records. These troubles are averaged to a monthly base. The equipment involved is inventoried by type. A comparison is made between troubles expected and actual troubles.

**5.05** The occurrence of more trouble than expected or excessive system outage time is the sign that special action is needed. The individual troubles are examined through the analysis process, or a sampling of equipment units or facilities may be made to determine if the equipment or facility needs corrective action. When it is decided that

work is necessary to prevent further trouble, a Test and Inspection Work Order can be originated and assigned. The work done as a result of this process is *preventive maintenance*. A record of troubles found and time spent is kept for further summary and analysis. A trouble ticket must be issued if the preventive maintenance work causes a T-Carrier System outage.

**5.06** Analysis of corrective maintenance records can lead to the requirement of preventive maintenance work. Other preventive maintenance work must be accomplished as specified in the Equipment Test List, Sections 365-001-011 through 018. (See Section 010-300-010 for preventive maintenance procedures.)

**5.07** Central Office Restoration and Maintenance Responsibilities for T-Carrier are provided in Section 365-020-301. It defines the restoration and maintenance responsibilities of the T-Carrier maintenance groups to the T-Carrier network with and without a TRCC or TCAS and should be used in conjunction with this section.

## 6. TROUBLE - CAUSES AND INFLUENCING FACTORS

**6.01** This part describes some various causes and influencing factors of T1 Carrier troubles that are not outlined in Section 010-300-010. A complete understanding of trouble causes, influencing factors, and proper administration of corrective measures is vital to the full comprehension and application of controlled maintenance.

**6.02** Not all equipment troubles are immediately evident. T-Carrier maintenance forces may be unaware of the existence of trouble and must rely on reports from other sources and staff personnel for adequate information to identify these troubles.

### **6.03** *Digital Equipment Design - Troubles:*

The following examples are to be reported to the appropriate engineering group. Digital equipment design is an influencing factor that can cause trouble. The top of Fig. 2 depicts a view of this portion of the controlled maintenance concept.

#### (a) *Customer Change Notices (CCNs):*

Customer change notices that have not been applied to common, channel, and line plug-in units often cause digital equipment troubles. Failure to apply certain CCNs may result in electrical or mechanical malfunction. Noncompliance

with other CCNs may cause transient troubles such as noise, clicks, or cutoffs. Section 790-120-200 provides information for the responsibility of implementation of the CCN.

(b) **Change Notices (CNs):** Change notices that have not been applied to hardwired equipment is another contributor to the digital equipment failures. Section 790-120-200 provides information for responsibility of implementation of the CN.

(c) **Installation - Quality Control:** Installation activity is a controllable factor which is a contributor to troubles in the T-Carrier network. Methods of procedures (MOPs) should be completely familiar to both central office and installation personnel and agreed to by the proper organizational authorities for the company. Instructions relating to installation of equipment are found in Section 201-112-001 and in the Western Electric Handbook. These instructions are to be followed for change notices, as well as new installation activities, and explain in detail the procedures for protecting service and equipment during installation work. Later digital equipment will be covered by Task Oriented Practices (TOPs) which have acceptance procedures.

#### 6.04. Digital Facility Design - Troubles:

Digital facility design problems can be a cause of trouble, most of which will result in electrical or mechanical failure but can also be service-affecting by causing work hazards or by not providing necessary equipment to do a complete maintenance job. These problems should be referred to the responsible engineering group.

6.05 **References:** The following sections supplement the 365 series and pertain to the T1 Carrier digital banks:

| SECTION     | TITLE  |
|-------------|--|
| 179-100-302 | Digital Transmission Systems—D1 Channel Bank—Signaling Compatibility |
| 801-505-150 | (J98711)—D1 Channel Bank Equipment for Use With T1 Carrier           |

| SECTION     | TITLE  |
|-------------|--|
| 801-505-152 | (J98714)—D2 Channel Bank Equipment for Use With Digital Transmission Systems             |
| 801-505-153 | (J98718)—D3 Channel Bank Equipment for Use With Digital Transmission Equipment           |
| 801-505-155 | D4 Channel Bank Equipment for Use With Digital Transmission Systems                      |
| 851-300-101 | Standard Design of Switched Special Services Circuits—Transmission and Signaling—General |

6.06 The following sections supplement the 365 series and pertain to the T1 Carrier digital line:

| SECTION     | TITLE  |
|-------------|--|
| 103-493-102 | Sierra 316A—T1 Line Repeater Test Set  |
| 103-493-103 | (J98710P)—T1 Line Error Detection—Description, Operation, and Maintenance        |
| 103-493-104 | (J98710R)—T1 Carrier—Quasi Random Signal Source—Description                      |
| 103-494-100 | (K98725AC)—T1C/T1 Office Bipolar—Violation Detector—Description and Maintenance  |
| 103-494-101 | (J98725AB)—T1C/T1 Manhole Bipolar Violation Detector—Description and Maintenance |
| 103-494-104 | (J98725AA)—T1C/T1 Pair Loss Test Set—Description, Operation, and Maintenance     |
| 103-494-106 | (J98725AD)—T1C/T1 Fault-Locating Test Set—Description and Maintenance            |
| 640-525-106 | 466- and 468-Type Apparatus Case—Description                                     |

| SECTION     | TITLE   |
|-------------|---|
| 640-525-210 | 466-Type and 468-Type Apparatus Cases—Splicing and Maintenance            |
| 640-525-211 | 475-Type Apparatus Case—Splicing and Maintenance                          |
| 640-525-215 | Installation and Replacement of Repeaters                                 |
| 640-525-220 | Pair Loss Measurements in Repeater Sections                               |
| 640-525-225 | T1 Line Error—Detector—Use  |
| 801-523-150 | (J98710)—T1 Carrier—System Requirements and Repeater Bay Equipment        |
| 855-350-104 | T1, T1 Outstate, and T1C—Engineering Design Fault-Locate System           |
| 855-350-105 | DSX-1, DSX-1C, and DSX-2—New Installation                                 |
| 855-350-106 | Engineering Design—DSX-1 and DSX-1C Retrofit                              |
| 855-350-107 | T1, T1 Outstate, and T1C  |
| 855-351-110 | T1C Digital Line—Transmission and Outside Plant Design Procedures         |
| 855-351-200 | T1 Outstate Digital Line Transmission and Outside Plant Design Procedures |
| 865-201-190 | EIMS Guide for the T-Carrier—Administration System                        |
| 901-350-510 | Exchange Feeder Route Analysis Program—Phase 2—General and Basic Problem  |
| 919-240-310 | Manholes and Service Boxes for T1 Carrier Apparatus Cases                 |

**6.07 Floor Plan Data Sheets:** This information is presented as a guideline for engineering to utilize in the placing of bays of equipment in a manner to prevent service interruptions. It further provides information for adequate lighting,

the allowance of proper space for cabling, requirements for ladders, electrical outlets, etc. Information for the digital network is found in Sections 7.1, 20.1, and 800 of the Floor Plan Data Sheets. To assure that adequate floor space is available, a review should be performed each year so that long-term requirements can be planned well before the program year. For T1 Carrier, this requirement is outlined in Sections 365-010-101 and 365-010-102.

**6.08 Dedicated Equipment:** Repeater shelf pairing and cabled to one apparatus case solves span-powering troubles. DSX panels dedicated to terminal repeaters or MUX equipment solve many administrative and equipment troubles.

**6.09 Communication and Test Access:** Not providing or incorrect placement of this type of equipment can be service-affecting. Guidelines are set forth in J drawings and/or local maintenance procedures.

**6.10 Span Line Designs:** T1 Carrier power and transmission designs are covered in Sections 365-223-500, 365-500-501, 802-304-156, 802-867-151, 804-631-151, 855-353-100, 855-351-101, and SD-97080-015. Outside plant, construction, or central office forces are responsible for ensuring all initial turn-up requirements are met and that correct installation procedures are used. Particular attention should be given to fault lines and order wires. Sections 365-254-500, 365-227-500, 365-500-505, 365-550-106, and SD-97085-01 suggest guidelines for administration of these responsibilities.

**6.11 Personnel Activity - Troubles:** Activities by maintenance people may cause trouble. Most of these troubles can result in hard failures. The following examples can be resolved by training and proper supervision.

(a) **Proper Patching:** Bridging repeaters are required on all patches. Section 365-226-500 outlines procedures for restoration and prevention of service interruptions.

(b) **Patch Tickets:** Section 660-401-010 outlines the proper designation of patch cords and the use of patch tickets.

(c) **Oscillations:** Quasi Random Signal Source (QRSS) must be used to provide signals on T lines to prevent instability to many common lines. Using QRSS also prevents free-running

repeater line signals which cause noise on fault lines. It must always be used prior to connection to a terminal, after disconnection of a terminal, any time a terminal is out of service, or during line testing and adjustment. When QRSS is used for testing of backbone and maintenance lines, it must always be applied through a bridging repeater to provide a standard signal to the line.

(d) **Work Errors:** Proper care should always be taken when performing all functions in maintaining T-Carrier. Removing the correct plug-in in the wrong equipment bay and not using the monitor jacks of a repeater or DSX before entering the in and out jacks are common work errors. Always exercise caution. Check before removing equipment or performing any work operations.

(e) **Construction Forces:** An opening number must always be obtained when entering any cable containing T Systems and reported to the TRCC or designated contact to minimize risk to service and to inhibit service isolations. The central office will report any cable activities to the TRCC.

## 7. FORM E-5840, EQUIPMENT TROUBLE TICKET - T-CARRIER SYSTEMS

**7.01 General:** This part describes Form E-5840, Equipment Trouble Ticket, and its use for T-Carrier Systems. Instructions for making entries on the ticket are provided as part of Fig. 5. This trouble ticket is used to record the corrective maintenance work for T-Carrier Systems and is the primary document of trouble reports or alarms and resultant found and not-found troubles. It is mandatory that tickets be written for all alarms and reported troubles, including routines on T-Carrier Systems. All entries must be complete, accurate, and legible.

**7.02 Description:** Form E-5840 measures 3-1/2 by 6 inches. All tickets have preprinted serial numbers. The use of serially-numbered tickets aids in cross-reference between maintenance groups and offices and helps assure that all troubles are recorded. Figure 5 is an illustration of Form E-5840.

**7.03 Use:** Form E-5840 is initiated for T-Carrier System trouble reports from alarms, testboards,

other office, support centers, or other sources. Included are reports for routine trouble investigations and reports of excessive carrier group alarm (CGA) or trunk processing unit (TPU) registrations.

**7.04** A trouble ticket should be initiated for all T-Carrier System adjustments, repairs, or replacements of equipment as a result of tests applied to trunks or circuits by test frames or manual methods. These records, when properly analyzed, will reveal unstable T-Carrier System equipment functions that need correcting. A description of the corrective action should be entered in the "trouble found" block.

**7.05** Proper audit controls make it necessary to account for all serially-numbered tickets. If errors are made on a ticket, it should be marked void and filed with the other completed tickets. While tickets are numbered serially, Form E-10242, T-Carrier System Maintenance and Outage Log, only requires they be listed sequentially.

**7.06** Trouble tickets are issued for recording troubles found on T-Carrier Systems removed from service as a result of scheduled equipment preventive maintenance activities or inspections.

**7.07** The effectiveness of the Controlled Maintenance Plan depends on the analysis of all available data. Therefore, it is important that all trouble reports be accounted for, recorded, and properly coded. Figure 5 provides information for making entries on the ticket.

**7.08** An Equipment Trouble Code List (see Fig. 6) is provided and its use is required for coding all T-Carrier System trouble tickets. The T-Carrier System Control Office trouble codes apply when the equipment causing the system trouble is located outside of the System Control Office. Figure 6 may be reproduced locally and posted in an area where trouble tickets are normally prepared.

## 8. FORM E-10242, T-CARRIER SYSTEM MAINTENANCE AND OUTAGE LOG

**8.01 General:** This part describes Form E-10242, T-Carrier System Maintenance and Outage Log. This form is provided for use in small or large T-Carrier System offices. Figure 7 is an illustration of this form. The log is used for compiling and recording the details of Form E-5840, Equipment Trouble Ticket, and for recording outage

time on controlled systems. This log is a vital part of the T-Carrier Service Measurement Plan outlined in Section 365-020-005.

**8.02 Description:** Form E-10242 is printed on white paper, measures 8-3/8 by 10-7/8 inches, and is punched for filing in standard ring binders.

**8.03 Use:** Figure 7 illustrates the use of Form E-10242. The following parameters and definitions are given to record, daily, the necessary information on the log:

- (a) **Office:** Record in common language code the name of the location.
- (b) **Period:** The log should be used for the period governed by the index month established for the office. Local procedures will govern the period of times.
- (c) **Sheets:** Number consecutively per the period involved.
- (d) **Tkt. No.:** Use the serialized ticket number on Form E-5840 written for the outage or for the turndown of a system for scheduled maintenance or nonalarmed troubles even though they affect only a portion of the system.
- (e) **When Control:** A check indicates that this office is the system control office for the system logged.
- (f) **System ID - Far End Office:** The numerical designation of the system and the common language code name of the noncontrol terminal office.
- (g) **Reported - Date - Time - By:** Reported the date and time of alarm and initials of the person who wrote the trouble ticket (Form E-5840). If the report is received by other than alarm, record the date and time the actual trouble occurred. Enter initials of person making this report.
- (h) **Removed from Service - Date - Time - By:** Date and time service was turned down for scheduled maintenance or nonalarmed trouble. Record initials of person who wrote the trouble ticket (Form E-5840).

(i) **Make Good - Date - Time - By:**  
Enter the date and time service was restored whether by patching to an unassigned, backbone, maintenance, or protection line. Enter the initials of the person making this patch.

(j) **Restored to Service - Date - Time - By:** Enter the date and time service was restored to the original facility. All testing and repairs must be completed and all patches must be removed. Record initials of person who completed this section of the trouble ticket (Form E-5840). This information is optional for tickets indicating referred out or span troubles.

(k) **BB - PL - ML:** Enter appropriate designation of the backbone line (BB), protection line (PL), or maintenance line (ML). If BB, PL, or ML is not designated, enter the appropriate common language code. Note common language codes are TIUB (backbone), TIUM (maintenance line), and TIUP (protection line). These codes should be used if specific designations have not been assigned.

(l) **Nature of Alarm or Report:** Record all information pertinent to the trouble (eg, span designation; units replaced; where, what, and how trouble found; type report; customer; testboard; alarm, etc.)

(m) **Refer To - At:** Record initials and location of person to whom the trouble is referred if trouble is isolated outside of the terminal office.

(n) **Closed Out - Date - Time - By:**  
The date and time the ticket was closed out, whether by repair, referral of trouble, sectionalized out of the office area of responsibility, or when the patch was removed from the office. The time recorded may equal the time recorded in restored to service but only if the office is restored to normal. Enter initials of person making entry.

(o) **Trouble Code:** Record type of equipment or control office codes defined in Fig. 6.

(p) **Notify TRCC:** Indicate the time and initials of person notified at the TRCC.

(q) **Controlled Systems Only:** This area of the log is used only when the office is

designated control on the System Circuit Layout Record. This is consistent with Section 365-020-005, T-Carrier Service Measurement Plan.

(r) **Individual System Service Outage:**

Record the time in hours and tenths of hours that the system was unavailable for service. This is generally obtained by subtracting the time reported from the time of make good when a backbone or a maintenance line is used. Restored to service is when *no* backbone or maintenance line is used. Time removed from service to time restored to service will be used when the central office force initiates the maintenance activity. The following table will be used to determine tenths of hours:

| Minutes | Hours |
|---------|-------|
| 0 - 8   | = 0.1 |
| 9 - 14  | = 0.2 |
| 15 - 20 | = 0.3 |
| 21 - 26 | = 0.4 |
| 27 - 32 | = 0.5 |
| 33 - 38 | = 0.6 |
| 39 - 44 | = 0.7 |
| 45 - 50 | = 0.8 |
| 51 - 56 | = 0.9 |
| 57 - 60 | = 1.0 |

(s) **Cum. System Service Outage:** This column is used only at the end of a period. Enter the time in hours and tenths of hours that the individual system was unavailable for service if a given controlled system has only one outage for the period of this log. If a controlled system has more than one outage per period of this log, enter the system ID in all boxes except in the last entry. The box on the last entry will contain a total of all the individual system service outage times.

(t) **✓ Total Sys. Outage Hrs:** Check off those controlled systems whose cumulative system service outage equals or exceeds 1.0 hours

in the last column of the log. In case of a system with more than one entry, care should be used to check only the final entry.

(u) **Totals:** Enter one total for the individual and one total for the cumulative system service outage columns on the last sheet of the log. These totals, when correct, will be equal. Enter the sum of all checks in the last column of the log.

**8.04** This log provides a current list of troubles and activities. It must be reviewed for all repeating or excessive system outages periodically. Should there be repeating systems or excessive outages, the analysis process starts here and now (see Fig. 3). It is the responsibility of the controlled office to be the analyst; however, this does not preclude the noncontrol terminal or the TRCC from assisting.

## 9. FORM E-6880, T-CARRIER SPAN LINE TROUBLE REPORT

**9.01 General:** This part describes Form E-6880, T-Carrier Span Line Trouble Report, and its use in small and large offices. Illustrations of the form and typical examples are included (see Fig. 8 and Fig. 9). This trouble report is used to record, in conjunction with Form E-5840, all span trouble reports and resultant found and not-found troubles. It is mandatory that this report be written for all indications of span trouble from any source.

**9.02** This form is basically divided into four sections. The header or top portion is filled out completely for all reports. It consists of identification of system and span, what trouble was reported, who reported, and who received the trouble report. The second portion is the work record of the central office force responsible for the location of trouble. All work operations performed during fault locating should be recorded in this portion or on the reverse side of this trouble report (see Section 365-227-500 for T1 Carrier documentation). The third portion is all the information assembled to assist the outside plant forces to locate and repair the trouble. This is used in referring the trouble out. The bottom portion is for closing out this case of trouble.

**9.03 Description:** Form E-6880 measures 5-1/2 by 8 inches. All reports have preprinted serial numbers.

**9.04 Use:** Form E-6880 is initiated for all T-Carrier span line troubles reported by alarms, routines, other offices, support centers, excessive carrier group alarms, trunk processing unit registrations, or other sources. Most all of these reports will be accompanied by an Equipment Trouble Ticket (Form E-5840). A Span Line Trouble Report should be initiated for all span adjustments, repairs, replacements of equipment, or maintenance activities that cause system outage or alarm. These records, when properly analyzed, will reveal unstable design or equipment functions that need correcting. A complete description of the corrective action should be entered in the "trouble found" box.

**9.05** For proper audit controls, it is necessary to account for all serially-numbered reports. If errors are made on a report, it should be marked void and filed with the other completed reports. The effectiveness of the Controlled Maintenance Plan depends on the analysis of all available data. Therefore, it is important that all trouble reports be accounted for, recorded, and properly coded. Figure 6 provides trouble code information. This figure may be reproduced locally and posted in an area where span line reports are normally prepared.

#### 10. FORM E-6881, T-CARRIER SPAN TROUBLE LOG

**10.01 General:** This part describes Form E-6881, T-Carrier Span Trouble Log (see Fig. 10). This form is provided for use in small and large offices. The log is used for recording all Span Line Trouble Reports made during a given period. It must be reviewed for all repeating span troubles within the past 30 days and all excessive outages or troubles not cleared in a reasonable period of time.

**10.02 Description:** Form E-6881 is printed on white paper, measures 8-3/8 by 10 inches, and is punched for filing in standard ring binders.

**10.03 Use:** The period of this log is to coincide with the procedure use for Form E-10242, T-Carrier System Maintenance and Outage Log. This log may also be used for noting construction, outside plant, or central office force activities such as splicing, installation, repair, testing, or preventive

maintenance activities. These kinds of entries are useful for trouble analysis.

#### 11. FORM E-10214, T-CARRIER SYSTEM AND SPAN TROUBLE HISTORY RECORD

**11.01 General:** This part describes Form E-10214, T-Carrier System and Span Trouble History Record. This form is provided for use in small or large offices and will be a **permanent record** whether the office is control or noncontrol, through or terminating. This record should be stored with or near the central office record cards (see Section 365-000-010). The record is used for permanent recording of all Form E-5840, Equipment Trouble Tickets, and Form E-6880, T-Carrier Span Line Trouble Reports. All entries must be complete, accurate, and legible. Additional forms may be used as required.

**11.02 Description:** Form E-10214 is printed on yellow stock and measures 5 by 8 inches. It may be filed in standard plastic envelopes.

**11.03 Use:** Form E-10214 has been designed for recording useful information in an orderly fashion (see Fig. 11). The need for retaining this record is according to its usefulness for analysis. Hence, the retention will vary with the life of the system or span to which it is associated.

#### 12. FORM E-10246, EQUIPMENT CONTROL RECORD

**12.01 General:** This part describes Form E-10246, Equipment Control Record, its use, and instructions for compiling the necessary data. These forms are provided for use in large and small offices (see Fig. 12 and Fig. 13). Two forms are provided. They are preprinted to show all existing equipment trouble codes and T-Carrier System Control Office trouble codes as set forth in Fig. 6. Entries are to be made on a daily basis for the period covered by the form. The period will coincide with the period used in completing Form E-10242, T-Carrier System Maintenance and Outage Log. Data provided locally consist of an **average troubles per month and a monthly summary of actual troubles**.

**12.02 Description:** Form E-10246 is printed on white paper and measures 8-3/8 by 10-7/8 inches.

**12.03 Use:** The following describes the use of Form E-10246:

(a) The best source of information is the coded Equipment Trouble Tickets for the previous year. The codes have been expanded from any previous plan; therefore, it will be necessary to convert the trouble codes used to the codes shown in Fig. 6.

(b) In some cases, trouble records for a full year may not be available; however, use as large a base as possible to establish a valid average of troubles per month. T-Carrier is growing fast. The variations should be considered, and the trouble expectancy adjusted accordingly. As actual monthly troubles are accumulated, they should be used to refine the temporary trouble expectancy until a valid base is established.

(c) The average troubles per month is derived from dividing the time period of 12 months into the quantity of troubles for each category of equipment trouble codes. This figure is posted on the "Expectancy - Avg. Month" line of Form E-10246, Equipment Control Record, and in the column "Avg. Prev. Year" of Form E-5463, Trouble Summary. These figures are to be used as a comparative for the current trouble.

(d) Compute the partial-month objectives for troubles expected for the 10-day intervals on a cumulative basis and post on Form E-10246.

**Example:** Expectancy average/month = 15; expected troubles/10 days = 5; expected troubles/20 days = 10.

(e) Form E-10246 will provide a **current picture** of T-Carrier troubles accumulated for one period on a daily basis. The source of this data is Form E-6880, T-Carrier Span Line Trouble Report, and Form 5840, Trouble Ticket. Troubles are posted to the Equipment Control Record by day of period on a cumulative basis. Comparison of actual troubles to a predetermined trouble expectancy is made on a partial period of 10-days, 20-days, and on a total-period basis. Significant variations in actual troubles to expected troubles require investigation or further analysis.

(f) Each period, the actual total troubles are posted in the "Actual - No. of Troubles" column on the Equipment Control Record.

### 13. FORM E-5463, TROUBLE SUMMARY

**13.01 General:** This part describes Form-5463, Trouble Summary (see Fig. 14). This form is provided to give the maintenance supervisor a method by which to view the performance of all equipment items for a year. Included are examples of its use and instructions for recording information and interpreting data. Form E-5463 is provided for recording, each period, the number of troubles associated with T-Carrier System or span trouble code. The form is arranged for comparison of troubles experienced, by month, with the monthly trouble average for the past year, and with the current trouble expectancy.

**13.02 Description:** Form E-5463 is printed on white paper, measures 8-3/8 by 10-7/8 inches, and is punched for filing in standard ring binders.

**13.03 Use:** The following describes the use of Form E-5463:

(a) The Trouble Summary provides space for recording trouble data by month so that trends are readily apparent. The data recorded is obtained from the "Total" line on Form E-10246, Equipment Control Record.

(b) Equipment items are listed in the "Equipment" column by trouble code. Two columns, "Avg. Prev. Year" and "Cur Obj" are provided for comparing current trouble trends with past trouble results and also for comparing with an objective figure. As the number of troubles are entered each month for equipment items, comparisons are made. If the number of troubles for a particular equipment item should rise unexpectedly or if a gradual rising trend is observed, investigation is required to determine the cause.

The "Avg. Prev. Year" column is provided for entering the average month trouble figure for the previous year. When the objective for the next year is being calculated, consideration must be given to current trouble trends and conditions expected to exist during the next year. For example, the addition of equipment, new services,

or features as the result of a reconditioning program would all have an effect on future trouble rates. The objective should be adjusted if the actual results are out of line with the previous set of objectives and the *cause is known*.

**14. REVIEW OF CONTROLLED MAINTENANCE PROCESS  
- CONTROL AND ANALYSIS OF EQUIPMENT**

**14.01** Under the controlled maintenance concept, digital transmission system maintenance intervals are prescribed in the 365 series of the Bell System Practices. Failure to complete these items could cause severe service reactions. All other preventive maintenance work will be determined by analysis of trouble reports. *Therefore, if this plan is to be effective, it is necessary that a continuing and comprehensive analysis plan be developed.* Under this plan, the basic job of analysis consists of examining trouble reports, both from internal and external sources, to determine if a particular part of the T-Carrier System is causing an excessive amount of trouble.

**14.02** Equipment Trouble Tickets, T-Carrier Span Line Trouble Reports, and the posted histories of both system and span lines are the major sources of detailed data for analysis; however, full use of the Maintenance and Outage Log and Span Trouble Log for early identification is required. Data from automatic or manual trunk measurements can also be useful.

**14.03** Equipment control results must be posted and reviewed daily. The daily posting of equipment trouble codes and comparison of actual troubles to trouble expectancy will reveal equipment items which may require attention.

**14.04** When an equipment item has been identified as having excessive trouble, further analysis may be necessary to determine the exact cause of the failures. This is done by direct examination of trouble tickets, span reports, and their histories. A blank Equipment Control Record form or Form E-5844, Trouble Tally Sheet, may be used for further analysis.

**14.05** When analysis techniques indicate the need for detailed investigation, reference should be made to the Equipment Test List to determine the proper test for the particular equipment type. A note on Form E-5463, Trouble Summary, indicating

action taken and trouble found is required. Optional forms that may assist in the administration of the analysis are Form E-5844, Trouble Tally Sheet, and Form E-5452, Test and Inspection Work Order and Record. Guidelines for their use and ordering information can be found in Section 010-300-010 (example for T1 Carrier only).

**15. COMBINED ANALYSIS OF CONTROLLED MAINTENANCE**

**15.01** Equipment control results are necessarily compiled, analyzed, and reviewed at each specific location. A network view is also required to bring this established individuality to a norm for a given geographical area. This norm can be distorted if established for geographical areas of divergent conditions. Some examples of these conditions are lightning, temperature, cable (old or new), and influence from outside sources (power lines and rural or urban environments).

**15.02** Instead of establishing a norm for an operating telephone company (OTC), the norm should be established for geographical and divergent areas and analyzed for problems. Broad categories to be observed are:

- (a) Equipment Failures—Lines
- (b) Equipment Failures—Terminals
- (c) Administration and Training
- (d) Intermittent—Marginal Problems.

**15.03** The following code consolidation is suggested:

- (a) **Equipment Failures—Lines:** 6LRI, 6LRO, 6LCS, 6LCB, 6LCM, 6LBF, 6LMP, 6LEP, and 6LPS
- (b) **Equipment Failures—Terminals:** 6TTE, 6TD1, 6TD2, 6TD3, 6TD4, 6TPS, and 6TBF
- (c) **Administration—Training:** 6TCX, 6TADJ, 6TMIS, 6LWE, 6LCX, 6LOR, 6LADJ, and 6LMIS
- (d) **Intermittent — Marginal Problems:** 6LRNT, 6LREF, 6LCC, 6TREF, 6TRNT, 6TCC, and 6TNT.

When this analysis is performed by a TRCC, a copy of the analysis should be attached to the TRCC Report described in Section 190-200-001.

**16. RETENTION OF RECORDS AND ORDERING INFORMATION**

**16.01 Retention of Records:** The forms described in this section have been designed for recording useful information in an orderly fashion. The need for retaining the different forms varies according to their usefulness for analysis and audit purposes. The following is a list of the forms and their minimum required retention period:

| MINIMUM RETENTION | FORM NO.  |
|-------------------|---|
| 3 Months          | E-5840, Equipment Trouble Ticket                          |
| 1 Year            | E-10242, T-Carrier System Maintenance and Outage Log      |
| 3 Months          | E-6880, T-Carrier Span Line Trouble Report                |
| 1 Year            | E-6881, T-Carrier Span Trouble Log                        |
| Life of System    | E-10214, T-Carrier System and Span Trouble History Record |

| MINIMUM RETENTION | FORM NO.                          |
|-------------------|-----------------------------------|
| 3 Months          | E-10246, Equipment Control Report |
| 1 Year            | E-5463, Trouble Summary           |

**16.02** Forms are packaged as shown below and should be ordered in multiples of the quantities shown. Requisitions should be worded as follows:

| FORMS PER PACKAGE | FORM NO.  |
|-------------------|---|
| 500               | E-5840, Equipment Trouble Ticket                          |
| 50                | E-10242, T-Carrier System Maintenance and Outage Log      |
| 99                | E-6880, T-Carrier Span Line Trouble Report                |
| 50                | E-6881, T-Carrier Span Trouble Log                        |
| 50                | E-10214, T-Carrier System and Span Trouble History Record |
| 25                | E-10246, Equipment Control Report                         |
| 25                | E-5463, Trouble Summary                                   |