ENGINEERING AND IMPLEMENTATION METHODS SYSTEM (EIMS) FOR PICTUREPHONE® PAIR SUITABILITY TESTING

CONTENTS

1. GENERAL

1.01 This practice presents an Engineering and Implementation Methods System (EIMS) for determining the suitability of cable pairs to be used for PICTUREPHONE service. This methods system is a detailed step-by-step guide on how cable pairs are selected, conditioned, tested, and administered. This section describes the various steps and shows the interaction between the design, construction, and testing functions in a single flow chart.

1.02 The following practices are coordinated by this section:

SECTION	TITLE
634-405-301	Trouble Location in PICTUREPHONE Service
634-405-501	PICTUREPHONE Pair Suitability Testing
640-640-100	Equalizer Apparatus Case—Description
640-640-200	Equalizer Apparatus Case—Splicing and Maintenance
680-539-010	Assignment Procedures for PICTUREPHONE Service
860-200-105/ AG90.300	Transmission and Outside Plant Design Guidelines for Engineering Initial Service Cable Equalizer Facilities for Loops and Local Trunks

1.03 The following practices are referred to by this EIMS:

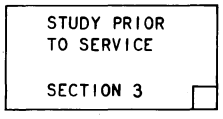
SECTION	TITLE
AG11.300	Engineering Economy—Comparative Cost Studies
AG11.301	Engineering Economy—TOPPS (T/S Computer Program)
EM 1756	SAPPS (T/S Computer Program)
AG50.200	Outside Plant Plan
AG59.105	Cable, AD Series—General
AG59.150	Cable, PIC—General
860-010-100	PICTUREPHONE Service—Developing a Serving Arrangement Plan
860-100-120	PICTUREPHONE Service—Video Transmission Network

2. THE EIMS FLOW CHART

2.01 The flow chart (Fig. 1) is a graphical representation of the various activities and decisions that make up the logic of the EIMS.

2.02 An activity is represented on the flow chart by a box. Inside the box is a brief description of the activity along with a reference to where the detailed explanation of the activity can be found.

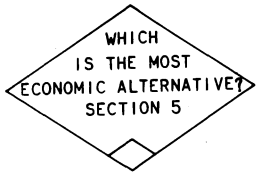
Example:



Here, the activity is the "Study Prior to Service," and the reference is to 634-405-300/AG90.310, Part 3. The box in the lower right-hand corner is explained in 2.09

2.03 A decision is represented on the flow chart by a diamond with a question written in it. As in the case of an activity, there is also reference to a more detailed explanation of the decision.

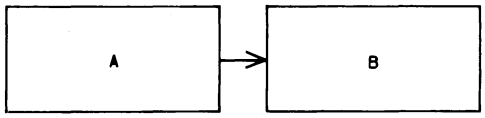
Example:



In this example, the decision to be made is "Which alternative is the most economical?", and the detailed references are "AG11.300 and TOPPS." The box in the lower center corner is explained in 2.09

2.04 On the flow chart, activities and decisions are interconnected by means of a series of lines equipped with directional symbols (arrowheads). The purpose of these lines is to portray the logical sequence of the various operations on the flow chart. As these lines assist in portraying the overall process logic, they will be referred to as logic lines.

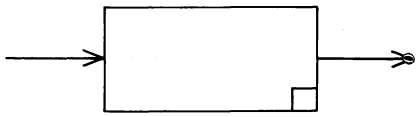
Example:



The path of the logic is Activity A to Activity B. (NEVER read as Activity B to Activity A.)

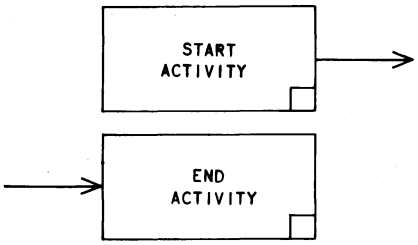
2.05 An activity normally has two logic lines associated with it. One of these is originating, while the other is terminating.

Example:



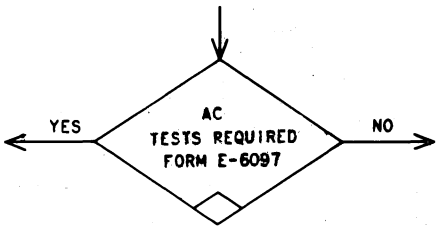
When an activity either originates or terminates the event on a flow chart, it will have only one logic line associated with it.

Example:



2.06 A decision terminates one logic line and can originate two or more logic lines. The lines originated represent the possible outcomes for the decision.

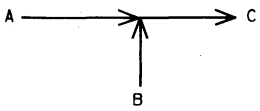
Example:



In many cases, the results of a decision may be either YES or NO, but this does not necessarily need to be so.

2.07 When logic paths diverge or converge, the logic lines are joined and arrowheads put on the lines to indicate the flow of the logic.

Example:



Here, the path from Point A and that from Point B converge and the combined logic path flows toward Activity C.

2.08 Read the chart in Fig. 1 starting with the activity "Study Prior to Service" (located in the upper left-hand corner of the flow chart). Then, move to the next box and continue to follow the arrows. As an example, the first four items to be read in sequence are as follows:

(1) "Study Prior to Service," which is an activity

(2) "Identify the Various Cable Paths to Potential Customers," which is an activity

(3) "Apply PICTUREPHONE Engineering Rules," which is also an activity

(4) "Does One Cable Path Conform to Rules?", which is a decision.

The fifth step depends on the outcome of the decision. If the result is YES, then step 5 will be "Prepare and Issue Form 6097 for Testing"; if NO, step 5 will be "Determine Costs of Conditioning Pairs and of New Cable."

2.09 The flow chart is arranged on a functional basis rather than an organizational one. The intent is to permit the application of this EIMS to any particular operating organization in the Bell System. The various departments in plant and engineering should review the functions on the flow chart and define the departmental responsibilities for each step. The small blocks within the activity and decision symbols can be used to record the agreed-to departmental responsibilities. The recommended manner of doing this is to print a code for the department in the block. A suggested legend is as follows:

Engineering	— Outside Plant	O
	— Transmission	T
	— Special Services	S
	— Customer Services	CS
Plant	— Assignment	AS
	— Central Office	CO
	— Construction	C
	— Installation	I
	— Repair	R

Other departments may be added as required. The legend should be posted to the flow chart and copies made for all departments concerned. Once the departmental responsibilities for the various functions have been determined, the distribution lists for the various practices should be modified to ensure that the correct persons receive the required practices.

3. STUDY PRIOR TO SERVICE

3.01 A detailed study of the outside plant network is necessary to determine the physical extent of the Local Analog Area (860-010-100). This is the geographical area in which PICTUREPHONE service will be offered.

3.02 Prospective PICTUREPHONE customers, whether identified by a forecast or by marketing inquiries, ideally should have the facilities serving them studied and conditioned before there is an actual order for PICTUREPHONE service if economically feasible.

3.03 There may be sections of the Local Analog Area where PICTUREPHONE service cannot economically be offered until new cable is placed. Identification of these areas and the date when the new cable will be available will allow the prospective PICTUREPHONE customers to be notified of the date that the required facilities will be available.

3.04 A study of complete cable routes is recommended. This will permit economies to be realized by making any necessary modifications to the network on a bulk basis.

4. RECORD REVIEW

4.01 When a particular location is under study, the first reference should be to the Exchange Customer Cable Record. All cable pairs that are available for any type of telephone service in terminals at the study location are clearly indicated in this record. Further, any pairs previously conditioned or provided for PICTUREPHONE service at the location will be readily identified (680-539-010).

4.02 The various plant location records must be reviewed to ascertain if additional cable pairs could reasonably be made available to the study location. In many cases, especially in the central city environment, more than one route or path to each study location already exists or is economically feasible. The Outside Plant Plan (AG50.200) may reveal that another route to the study location has been anticipated.

4.03 A review of the various assigning records (loops and trunks) for spare facilities is necessary at this point in the procedure. Any circuit transfers necessary to create spare facilities must be included with the application of the engineering rules, and the economic analysis should reveal the most economical course of action to be followed.

5. APPLYING PICTUREPHONE ENGINEERING RULES

5.01 The engineering rules as outlined in 860-200-105/AG90.300, or in the SAPPS Program (EM 1756), are applied to the cable pairs available to the study location to determine their suitability for use with PICTUREPHONE service. Pair impairments are identified for the alternatives (the existing pairs, pairs that can be made available, and the new route) through the records study. Correction of these impairments will involve the expenditure of money. The extent of these expenditures shall be determined for each alternative and an economic study (AG.11.300) made to arrive at the preferred alternative. The TOPPS Program (AG11.302) should be used to perform this study.

5.02 A thorough examination of the use of existing plant is necessary before considering the placement of all new cable. This will involve the application of known techniques for providing service, such as clearing of complements, transferring circuits, and providing a limited amount of new cable. The rearrangements that may be required to provide spare pairs must be considered in arriving at the total cost of any alternative. Rearrangements to provide spare facilities may frequently be combined with the rearrangements required to remove impairments. Pairs that appear to meet the engineering rules can fail to meet performance standards when tested or put into service due to unrecorded items such as paraffin splices, some cable stubs, and record errors. Trouble-locating tests will then be made and the problems identified. Under these conditions, the cost of overcoming the problems should be in the cost comparison of the alternatives originally considered.

5.03 Placing new cable should be considered as an alternative to pair conditioning. The purpose of this is to provide a reference cost to be used when making the economic analysis. Some of the new cable to be placed for PICTUREPHONE service could be cable that would have been placed at some future date in any event. In these cases, the cost of this cable should be the PWAC for the advancement interval as far as the economic analysis is concerned. When new cable is required solely for PICTUREPHONE, the total PWAC for this cable should be the figure used in the economic analysis.

6. WORK ORDERS

6.01 Work orders issued by those responsible for the design and construction of outside plant facilities are required to (a) condition the pairs, (b) perform the suitability tests and, when applicable, (c) install apparatus cases. It is recommended that these work operations be accomplished in that sequence. ***Three separate work orders are required to provide positive reporting on the work completion for each stage of the operation.*** Any new cable required in addition to pair conditioning should be detailed and authorized on the same work order as the pair conditioning.

6.02 Pair conditioning involves two major areas of effort. The first area consists of the elimination of certain network impairments, such

as bridge tap, load coils and build-out capacitors (860-200-105/AG90.300). The second area consists of removing interfering circuits, such as DC telegraph, from the binder groups that have been selected for PICTUREPHONE usage (680-539-010). [Subscriber line carriers in adjacent binder groups could cause trouble].

6.03 The pair conditioning work order will indicate the size and count of the cable binder group (AG59.105 or AG59.150) to be conditioned. This order will alert the cable assigning bureau to avoid assigning known interfering circuits to potential PICTUREPHONE groups (680-539-101).

6.04 The work order for cable suitability testing can be prepared and issued after the conditioning work order is completed. Upon successful completion of the cable suitability tests, the work order covering the installation of the apparatus cases, can be issued, if applicable. Description of the equalizer apparatus case is contained in 640-640-100. Splicing and maintenance instructions are covered in 640-640-200.

7. PRECONDITIONING (DC) TESTS

7.01 Conditioned cable complements can fail to pass the cable suitability tests (634-405-501) due to the presence of ***unknown*** DC faults. These unknown defects can be identified prior to pair conditioning by the application of preconditioning (DC) tests [634-405-501]. The value of preconditioning tests is the greatest when selecting specific pairs for termination in apparatus cases (intermediate cable equalizers) or when unloading part of a larger loaded complement.

7.02 When bridged tap is one of the impairments to be removed and DC troubles are found, it is extremely difficult to determine whether the defect is in the section of bridged tap to be removed.

7.03 Any DC testing required prior to pair conditioning will be specified on the pair conditioning work order and shall specify:

(a) The number of pairs per complement to be tested (recommended minimum—10 pairs per complement)

(b) Tests to be performed (recommended tests per 634-405-501)

(c) Acceptable level of defects on the tests.

8. PICTUREPHONE PAIR SUITABILITY RECORD

8.01 An integral component of the testing work order is the Pair Suitability Record, Form E-6097 (Fig. 2 and 3). This form is issued to record the cable makeup, the complement identity, and the degree of suitability testing to be applied. The form is also used to record the results of the suitability testing.

8.02 After the pair conditioning work order has been completed, the testing work order is issued and Form E-6097 is filled out as far as the special testing instruction line. This form is issued with the work order. The following information is included with the initial issue:

Serial Number: The originator assigns a serial number to each form and maintains a suitable log of the numbers issued. The log may be used to administratively record issue and receipt dates of various issues. An additional simple log of cable complements, cross-referenced to the pair suitability record serial numbers, may be useful in updating changes in makeups or rearrangements of facilities. The serial number is the key to the record of PICTUREPHONE service capability of the plant to a particular location.

Issue Number: The use of issue numbers will be explained within the testing routine.

Wire Center: Enter the wire center of the completion point.

Route: For loop complements, enter the appropriate route designation. For trunk trunk complements, enter "Trunk."

From — To: For loop complements, identify the terminating points. Generally, the originating point will be the serving wire center main frame and the completion point will be the address of the terminal at which the station wire terminates. Note that this includes any internal building cable that may be part of the loop under consideration. In the case of a remote exchange loop, the originating point of the loop portion will be the first central office in which the loop pairs terminate on the main distributing frame or equivalent. The balance of the remote exchange loop should be considered as a PICTUREPHONE trunk. In such cases, a minimum of two forms (E-6097) are required. One is required for the loop and the other for the trunk. For trunk complements, identify the terminating points and enter them on the form in the same manner as for loops. Generally speaking, the originating point for a trunk will be the point nearest to the next higher office in the PICTUREPHONE switching hierarchy. An interoffice trunk may be connected to other trunks or to local loops. For this reason, measurement of built-up trunk or remote exchange connections appears to be of debatable value. Considering that the interface points between the sections are central office main distributing frames, which are excellent test points, the testing of built-up trunk connections is not recommended.

Comments: Record any special instructions or work operations. For example, when more than one form is necessary to describe a loop or trunk, cross-reference the forms by indicating the associated form serial numbers here, or when measurements are desired on a built-up connection such as feeder and building cables, the requirement of cross-connections can be specified here. (The necessary work to establish the cross-connection will be authorized on the testing work order.)

CABLE COMPLEMENT DATA

Cable Complements: Show the cable and complements that are to be reviewed and tested. To preserve unit splicing integrity, complements shall be the same size as the largest binder group in the cable (approximately 100 pairs).

Cable Makeup Details: Represent cable makeup details by means of a simple sketch on the form in the space provided. If this space is insufficient, an additional piece of paper, such as a work print form, can be attached to the form and the sketches made on it. Indicate from the origination point the cumulative length, gauge, and type of plant (A = aerial; BLDG = building; B = buried; U = underground; and S = submarine) on the sketch. When both the "Control" and "Common" complement cable makeups are the same, only the "Control" makeup need be shown. In this case, the words "same as Control" should be written in the space provided for the "Common" cable makeup details. (Control and Common are defined in 860-200-105/AG90.300). On the sketch, show any defects such as short (less than 100 feet on a loop) sections of bridge tap that may be left on PICTUREPHONE complements.

Special Testing Instructions:

(a) Number of consecutive pairs per complement to be tested. The recommended minimum size is 10 pairs per complement. Specific pairs to be tested are entered on the testing side of the form.

(b) ***AC testing required?*** AC tests will be performed only if specified and if the DC tests have been passed. AC testing, which consists of pair balance, trial equalization and a transmission test, is used to ensure that the pairs are capable of providing PICTUREPHONE service. This testing is covered in detail in 634-405-501. When the complements are expected to be free from impairments, such as in the case of a new direct cable, complete testing will usually not be required. This can be indicated on the front of the form by answering the test detail question "AC testing required?" with a NO. When there is a serious doubt as to freedom from impairments, such as in the case of previously loaded or heavily multipled cable, complete testing should be specified. This

can be indicated on the front of the form by answering the test detail question "AC testing required?" with a YES.

(c) ***DC fault locating required?*** DC testing is recommended for all PICTUREPHONE complements to ensure that they are free from record error and simple DC faults. This testing is covered in detail in 634-405-501. The failure of DC tests will usually result in the form being returned to the originator with no trouble location work being done. However, the failure of AC tests will result in the implementation of trouble-locating procedures (634-405-301). Note that these procedures only cover the locating, and not the clearing, of the trouble(s). Should any of the selected complements fail to pass the tests and fault locating was implemented, the measurements made and the defects found could be recorded on Form E-6038, Fig. 4 and 5, (634-405-301) and returned to the originator with Form E-6097.

Note: The identification of defects presents another alternative that must be evaluated and considered along with the earlier economic study. Should the decision be to continue conditioning work on the same pairs, Form E-6097 would be reissued after the additional conditioning work is completed. In these situations, the serial number should remain the same but the issue number will be changed. The decision to select other pairs rather than continue conditioning work on the same pairs requires a new serial number. In addition, the form covering the previously conditioned pairs should have the "Assigning Instructions" section completed to remove the temporary assigning restriction. A copy of the front of the completed form should then be issued to the appropriate assignment office.

(d) ***Test Criteria:*** Enter the percentage of pairs tested that must be found suitable for PICTUREPHONE service. The recommended minimum is 90 percent for DC tests and 100 percent of those for the AC tests.

(e) ***Testing Work Order:*** Enter the work order number that authorizes the testing work. The specific details of the tests to be performed and the criteria for passing these tests are detailed in 634-405-501.

(f) ***Prepared By:*** Originator's name and location.

8.03 A copy of the partially completed form is attached to the work order (testing) and forwarded to those who will perform the pair suitability tests. Normal distribution of the testing work order will notify the assignment bureau of the complements selected for PICTUREPHONE use. A temporary restriction on the assignment of known interfering circuits will then be placed on these complements (680-539-010). Previously conditioned complements have this restriction on them (see 6.03).

8.04 Upon successful completion of the suitability tests, the original of Form E-6097 is updated to reflect the results of the suitability tests. If applicable, the details of the pairs to be terminated in the apparatus cases for the intermediate cable equalizers are recorded in the spaces at the bottom on front of the form, and the "Assigning Instructions" are completed by checking "Place Permanent Sticker." This will place the permanent assigning restrictions on the selected complements.

8.05 The completed forms (originals) should be kept on file in numerical order by the originating department. Copies can be provided to those assigning the facilities (loops and trunks), maintaining the facilities, and those responsible for the overall PICTUREPHONE circuit design.

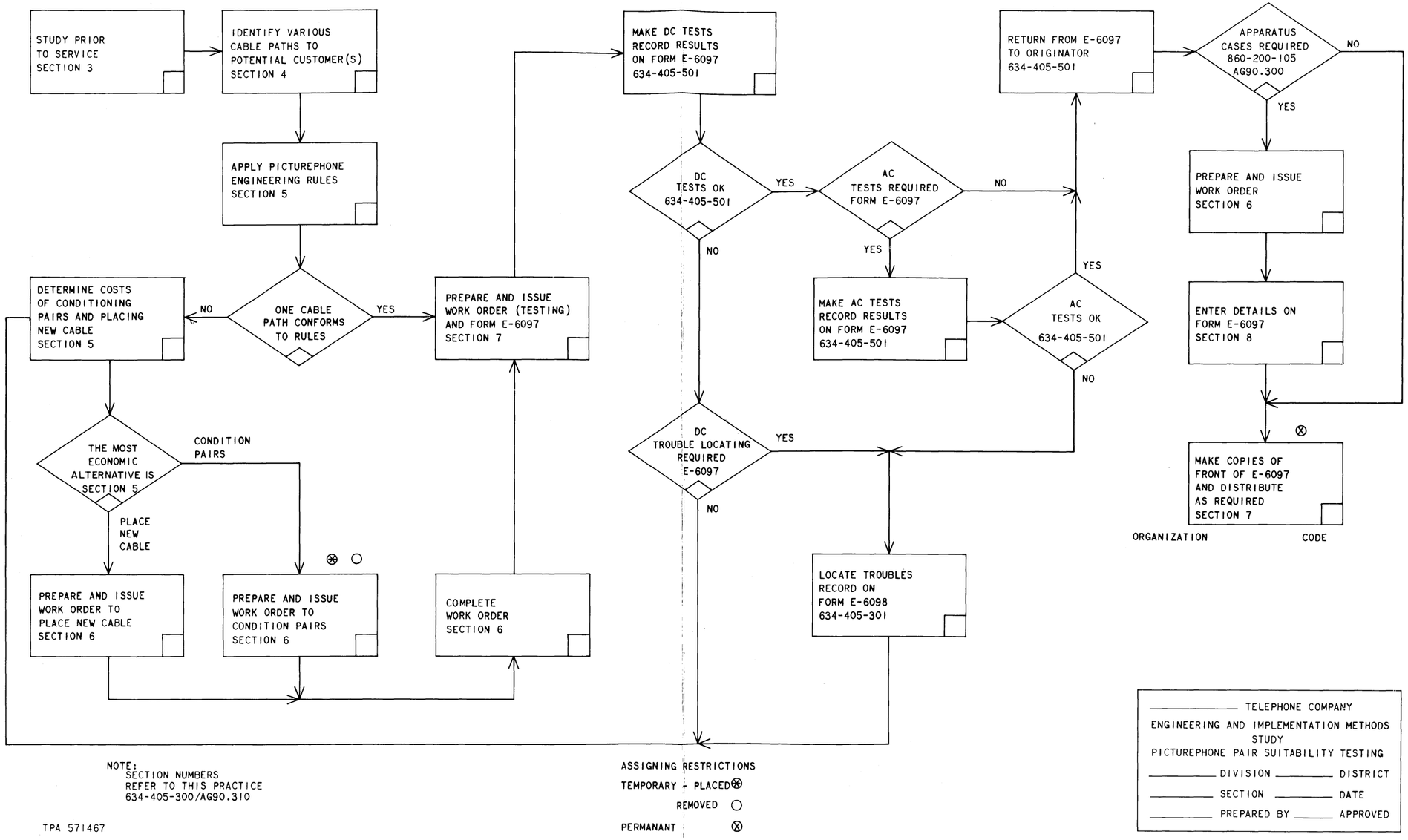


Fig. 1—EIMS Flow Chart

FORM NO. E-6097 (1-1-71)

PICTUREPHONE PAIR SUITABILITY RECORD Serial No. _____ Issue No. _____

Wire Center: _____ Route: _____

From: _____ To: _____

Comments: _____

CABLE COMPLEMENT DATA

COMPLEMENTS: AUDIO Cable _____ Pairs _____

CONTROL Cable _____ Pairs _____

COMMON Cable _____ Pairs _____

CABLE MAKE-UP DETAILS

CONTROL (Direction 2 — CO to Customer)

COMMON (Direction 1 — Customer to CO)

SPECIAL TESTING INSTRUCTIONS

(a) Number of Consecutive pairs Per Complement to be Tested _____

(b) AC Testing Required? YES _____ NO _____

(c) DC Fault Locating Required? YES _____ NO _____

(d) Test Criteria: DC _____ %; AC _____ % of those that passed DC Tests.

TESTING WORK ORDER _____

Prepared By: _____ Date Released _____

INTERMEDIATE CABLE EQUALIZER APPARATUS CASE DETAILS

Pairs Terminated — CONTROL Cable _____ Pairs _____

— COMMON Cable _____ Pairs _____

— ORDER WIRE Cable _____ Pairs _____

APPARATUS CASE INSTALLATION WORK ORDER _____

Prepared By: _____ Date Released _____

ASSIGNING INSTRUCTIONS

— Place Permanent Sticker (E-6036) — Remove Temporary Sticker (E-4675)

Fig. 2—Pair Suitability Record (Front)

Central Office: _____ Date: _____

Customer Location: _____ Tests Made By: _____

CABLE NUMBER																				
PAIR NUMBER																				
EQUALIZE CONTROL SUBSCRIBER END. EQUALIZE COMMON CENTRAL OFFICE.	**REQUIREMENT**	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	CONTROL	COMMON	
FEMF (Volts) (d) T/R	6 max																			
(g) T/G	6 max																			
(j) R/G	6 max																			
Insulation (d) T/R	17 max																			
Resistance (g) T/G	30 max																			
(Volts) (i) R/G	30 max																			
Continuity																				
Low Freq Noise (d) N_G	43 max																			
(dBrn) (d) N_M	43 or N_G max																			
Character																				
1KHz Equalization (b) F1	G																			
Broadband F1	G																			
Equalization F2	G																			
F3	G																			
L = Meter Left of Green F4	G																			
G = Meter in Green F5	G																			
R = Meter Right of Green F6	G																			
Loop Transmission (dB)																				
Oscillator Dial Setting	5-9																			
Maximum Positive Dev.	1.1 max																			
Oscillator Dial Setting	5-9																			
Maximum Negative Dev.	1.1 max																			

Fig. 3—Pair Suitability Record (Back)

Form E-6098
Serial No._____
Issue No._____
Page_____ of _____.

PART I

Suitability Test Results Summary

Place the corresponding code number in the proper box for each pair tested. (Code: 1-5 are failure codes)

1. FEMF
2. Insulation Resistance
3. Pair Balance
4. Equalization
5. Transmission
6. Pair O. K.

CABLE																						
PAIR																						
CODE																						

TROUBLE LOCATION RESULTS

Part II — DC Troubles (Codes 1 & 2)

CABLE	PAIR	CODE	LENGTH TO TROUBLE	CLEARED?	COMMENTS

Fig. 4—Suitability Test Results Summary

PART — II AC TROUBLES (CODES 3, 4, & 5)

Form E-6098B

CABLE	PAIR	CODE	RECORD LENGTH FEET	0.8 x RECORD LENGTH FEET	MEASURED LENGTH	TROUBLE LOCATED FROM NEAR END			TROUBLE LOCATED FROM FAR END		
						TYPE	RANGE ON BIDDLE	DISTANCE	TYPE	RANGE ON BIDDLE	DISTANCE

Fig. 5—Suitability Test Results Summary