CROSSBAR TANDEM

TRANSITION MANAGEMENT

1. GENERAL

1.01 *Purpose*

1.01.1 This section contains procedures to be followed by personnel responsible for the dial administration of Crossbar Tandem offices when additions to existing facilities are required, when certain modifications and/or improvements are planned, or when any changes and/or transitions are anticipated to increase capacity or improve service.

1.01.2 Familiarity with Dial Facilities Management Practices, Division H, Section 1b (8) is essential as is a knowledge of traffic engineering, dial administrative procedures, and the switching functions of the Crossbar Tandem system.

1.02 *Involvement*

1.02.1 Generally, periods of activity involving equipment additions, transitions and/or modifications require the involvement of groups other than the Traffic Department. Such areas of mutual responsibility are identified to the extent necessary for Traffic dial administration personnel to participate effectively in the development of Methods of Procedure.

1.03 *Recognition of Organizational Structures*

1.03.1 Due to differences in organizational structures, specific titles of individuals, groups and departments are avoided. Instead, general descriptive or functional names are used. This type of format permits the identification by the individual Company of a particular organizational level (or sequence of organizational level) responsible for the procedures described herein.

1.03.2 For the purpose of this practice the following designations will be used:

(a) The Telephone Company representative normally responsible for the administration of the Crossbar Tandem machine will be referred to as the ***Dial Administrator.***

(b) The Telephone Company representative normally responsible for the maintenance of the Crossbar Tandem machine will be referred to as the ***Plant.***

(c) The Western Electric Company's Service Division does the major portion of equipment installation work for Bell System Companies. The installation force will, therefore, be designated ***WECO.***

(d) In order to effectively coordinate network facilities and to utilize available switching paths, ***Network Managers*** have been assigned at certain switching locations.

The MOP in its final form is a ***written plan*** concurred in and signed by WECO and the Telephone Company defining:

(a) What has to be done:

- (1) Changes or additions involved.
- (2) Sequence of addition or changes.

(b) How the job will be done with provision for:

- (1) Continuity and quality of service.
- (2) Efficiency in WECO installation effort.
- (3) Minimum interference with normal plant routines.
- (4) Emergency restoral procedures.

2. OBJECTIVES OF MOP

2.01 *General*

2.01.1 This section contains a detailed step-by-step plan, with the appropriate references, for the addition of various facilities to existing Crossbar Tandem equipment.

2.01.2 The preparation of the MOP is normally done by WECO and may be a very formal document, or somewhat informal, depending on the magnitude of the job. WECO Handbook 69B, Section 000, describes the basic work agreement required on all jobs.

2.01.3 Methods of Procedure are required whenever WECO activities involve working equipment, especially when this activity can be service affecting. Following are examples of work activities needing Method of Procedures.

(a) Sender rearrangements or modifications.

(b) Marker additions, rearrangements or modifications, e.g., Speed-up, Trunk Group Busy Circuits, etc.

(c) Office and/or Trunk Line work, e.g., Second Extension Frames, Supplementary Trunk Link Frames, etc.

(d) AMA Recorder rearrangements.

(e) TSP Position Link or CAMA Position Link Work.

2.01.4 A proper Method of Procedure involves the following processes:

(a) WECO ***develops*** and ***proposes*** a plan.

(b) The plan is evaluated by the Telephone Company.

(1) The Dial Administrator ***assesses*** the impact on service.

(2) The Plant Department ***evaluates*** the maintenance effort and test requirements.

(3) The Engineering Department ***examines*** the cost aspect.

(4) Other departments ***are consulted*** as necessary.

(c) Adjustments in procedures are made based upon the participation of the groups involved.

(d) A final MOP is agreed upon.

(e) The MOP is prepared in writing and is signed by management in the departments involved. District level approval is recommended. See Paragraph 2.04.2 (c).

2.02 *Continuity of Service*

2.02.1 The Telephone Company representative with the primary responsibility for continuity and reliability of switching service is the Dial Administrator. When there is ***any*** WECO activity in an office, efforts in connection with this responsibility must be intensified.

2.02.2 Assuring continuity and reliability of service during periods of activity connected with installation of equipment by WECO is the joint interest and responsibility of both the Telephone Company and WECO. The attainment of this objective requires full and continued cooperation prior to and during the installation period. A procedure generally found practical for attaining this objective involves a full discussion prior to any installation activity of items such as:

(a) Type of equipment to be added or modified, e.g. senders, by type inpulsing; markers, transverters, etc.

(b) Working equipment that may be affected by planned job activity.

(c) Selection of periods for taking working equipment out-of-service.

(d) Whether a change in working hours may be necessary because of service—affecting work.

(e) Method of accomplishing transitional work.

(f) Amount and duration of equipment outages.

(g) Assignment and cross-connection information required.

2.02.3 Continuing attention beginning with the preparation of the Traffic Order is required to ensure protection of customer service. It is necessary that the Traffic Engineer and Dial Administrator concur not only with the equipment requirements, but also the configuration of equipment and the methods to place these facilities in service. An appropriate statement regarding any portion of the work involved may be included in the Traffic Order to serve as a guide to the WECO job planner.

(a) Trunk decade arrangements by type trunk may be assigned in the Traffic Order to the various sender link and trunk link frames.

(b) Tandem sender and marker in-service requirements may be stated based upon the new design CCS/trunk. A revised requirement may be necessary for MOP purposes based upon the latest data.

2.03 *Contributions of the Dial Administrator*

2.03.1 It is the basic responsibility of the Dial Administrator to ensure that sufficient equipment is properly arranged to meet the requirements for effective administration over the life of the job while rendering service ***at or better than objective levels.***

2.03.2 Major contributions to the development of the MOP may be made in the following areas:

(a) Develop load-service charts depicting percent Sender Attachment Delay over three seconds vs. CCS load per sender (by type of inpulsing). These may then be used to determine in-service requirements for MOP purposes with proper applications of recommendations contained in the Traffic Facilities Practices.

(b) Arrange for monitoring the various load-service barometers to ensure sufficient equipment quantities are available.

(c) Arrange for prompt cross-connection lists for traffic registers, Traffic Usage Recorders, Sender Attachment Delay Recorders, etc.

(d) Participate in determining and scheduling joint inter-departmental tests in which the Dial Administrator would be a participant.

(e) Plan ahead for trunk transfers from existing trunk link frames and office link frames to newly added ones.

(1) This must include association of load and service measurement devices.

(2) New routings will include certain marker cross-connection work that may require the preparation of orders.

(f) Provide a single contact who will coordinate activities of other Traffic Department groups for TSP, CAMA, etc.

2.04 ***Service Protection from Equipment Failures***

2.04.1 The MOP must provide for absolute optimum protection of service. The following items are pertinent:

(a) The specific location of WECO activity.

(b) The specific equipment activity with which WECO is involved. Of particular interest would be the "down-time" of any facility.

(c) Service and load devices must be kept in service during WECO activity. Manual readings may be necessary for immediate analysis and corrective actions, hence proper personnel must be trained and provided.

(d) A formalized plan for equipment restoral to service in cases of emergency or unusually high call and/or load volumes.

2.04.2 Practices concerning prevention of service interruptions should be familiar to the Dial Administrator. They include:

(a) BSP 201-112-001, BSP 201-005, BSP 201-112-010 which includes WECO Handbook 0, Section 10; BSP 201-112-020 which contains WECO Handbook 3, Section 13; BSP 800-614-150.

(b) BSP 201-114-001 explains the record of equipment and trunks out of service.

(c) The Method of Procedure prepared by WECO based upon Installation Engineering Handbook 3, Section 9.2 should be reviewed by the dial administrator and other involved departments to ensure service protection as outlined in this practice. The Method of Procedure Authorization, from Handbook 3, Sec. 9.2, Attach. I, provides for ***three*** Telephone Company approvals; it is recommended that the dial administrator at District Level signify approval of job procedures.

2.05 ***Meetings***

2.05.1 The Method of Procedure should be discussed as early in the job as possible to identify and resolve any basic differences on how the job should be done. This will permit WECO sufficient time to prepare and publish an MOP document prior to any work activity.

2.05.2 Minutes of all meetings should be kept and distributed as the formal record of inter-departmental or inter-Company agreements and decisions.

2.05.3 Proposals for establishing controls and follow-up on job progress should be determined at early MOP meetings.

2.05.4 It is suggested that sub-committees be formed when necessary to assist the Cutover and Analysis committee. An example of a sub-committee function would be for TUR transition and/or addition.

2.05.5 The frequency of committee and sub-committee meetings should be firmly established and followed for job status reports.

3. RESPONSIBILITIES ASSOCIATED WITH MOP

3.01 ***General***

3.01.1 The preparation of the MOP is usually handled by WECO based upon the job factors previously described herein.

3.01.2 Subordination of departmental interests may well be necessary in placing service above all other considerations.

3.01.3 The departmental general responsibilities of MOP are contained in the following paragraphs.

3.02 ***Responsibilities of Dial Administrator***

3.02.1 It is recommended that the Dial Administrator have the prime administrative responsibility for those areas that normally accrue to the Traffic or Switching Departments. These include:

(a) Review the contents of the Traffic Order to ensure that:

(1) the estimate of equipment requirements reflect the latest view of demand predicated upon dialing and routing arrangements (EAS, NPA changes, etc.)

(2) the incoming trunk decades are distributed equitably over the trunk link frames and associated sender link frames.

(3) the Traffic Department representatives responsible for the CAMA or TSP facilities concur in equipment provision and arrangements.

(b) Being familiar with service results (Percent Sender Attachment Delay over Three Seconds, Percent Ineffective Attempts, Overflow Scorings, etc.) since the last job.

(c) The ability to reconcile traffic volumes and loads to service results.

(d) Familiarity with demands other than trunking needs, i.e., Centrex-CU customers, Automatic or Operator Number Identification, Rater requirements, etc.

(e) Knowledge of any special studies such as Division of Revenue or trunk base studies.

(f) Arranging for, by providing the appropriate coordination, the following information:

(1) Designation strips and any switchboard assignments.

(2) Cross-connection lists for—

—Traffic Usage Recorder
—Sender Attachment Delay Recorder
—Trunk and Marker Work
—Traffic Registers

(g) Understanding of load—service relationships so that proper ***in-service requirements*** can be determined, by time frames.

(h) Have a detailed knowledge of the proposed transitional procedures.

(i) Have a written transition plan approved by the District level Supervisor. This plan may be prepared prior to the first MOP meeting described in Paragraph 2.05.

(j) Review as soon as possible all equipment configurations to ensure equitable distribution, e.g., sender, by type inpulsing, over sender link frame.

(k) Have various documents available for easy reference. These may include:

(1) Traffic Orders
(2) Job Specification
(3) MOP
(4) Various written practices
(5) Trunk Estimates
(6) Data Summaries

3.03 ***Engineering Department***

3.03.1 Many Operating Companies assign an Engineering Department representative to coordinate WECO installation activities.

3.03.2 The Engineering Department representative is normally responsible for:

(a) Scheduling job meeting between WECO and the Telephone Company

(b) Providing liaison between WECO and the Telephone Company

(c) Ensuring WECO adherence to MOP

(d) Economic aspects of the job: overtime, unusual transition methods, additional effort to avoid equipment outages, etc.

(e) Arranging advance turnover of equipment

(f) Coordinating acceptance, turnover and notification procedures.

3.04 ***Western Electric Company***

3.04.1 WECO is responsible for preparing a MOP.

3.04.2 Adherence to the prescribed MOP by WECO is necessary to ensure proper coordination by all groups.

3.04.3 Removing equipment from service, testing, restoring equipment to service, etc., must be in accordance with WECO Handbook instructions and established procedures contained in various Bell System Practices and done only with the approval of the Dial Administrator.

3.04.4 Transitions, rearrangements, replacements, etc., must be accomplished with a minimum interval of reduced capacity and with a minimum probability of service interruption, but consistent with reasonable job efficiency.

3.05 ***Plant Department***

3.05.1 The Plant Department has the overall responsibility for physically removing equipment from service, testing, and restoring to service, etc., during periods of WECO activity. See Paragraph 3.04.3.

3.05.2 A record of equipment outages is maintained by Plant according to their practices (BSP 201-114-001). This log will include information concerning equipment removed from service for ***any reason.***

3.05.3 The Plant Department participates in joint tests, as necessary.

3.05.4 Certain cross-connection work and/or other rearrangements may be done by the Plant.

4. DEVELOPMENT OF MOP

4.01 ***General***

4.01.1 Proper planning and continuing follow-up connection with a Method of Procedure is of primary importance in ensuring that service risks are held to a minimum and job efficiency is at a maximum.

4.01.2 Planning must begin ***before*** the Traffic Order is prepared. Information regarding transitions, advance turnover, replacement or rearrangement of any equipment should be included in the Traffic Order, when possible, because it may affect the way in which the WECO Engineer prepares the job specification. Significant information might include:

(a) Dates for advance turnover

(b) Time interval for transition or replacement

(c) Requested procedure for rearrangement

(d) Maximum equipment quantities that may be released for modification (including time of day)

(e) Where necessary, a detailed step-by-step procedure for doing a transition or a rearrangement.

4.01.3 The Traffic Order and Job Specification should have been compared so that errors or omissions are corrected before WECO Engineering begins.

4.01.4 The Dial Administrator is responsible that any special instructions, dates of advance turnover, or unusual measures are included in the MOP.

4.02 ***Format of MOP***

4.02.1 The MOP, prepared by WECO as discussed herein, will include a general outline of the entire equipment affected, work location, major equipment to be added or removed, general notes, special instructions, etc.

4.02.2 The MOP will contain the dates, the start and complete time, the type of protection and special precautions of each step of the job.

4.02.3 All work to be done in a step should follow a logical sequence and should be explained fully with the indication of that portion of the work that will be the responsibility of WECO or Plant.

4.02.4 The sequence of progress may be based on the following considerations:

(a) Equipment that will be required first.

(b) The sequence of steps that will provide equipment for advance service, if required.

(c) The amount of work that can be done and still provide a major margin of safety for returning released equipment to service within the specified time.

(d) Work that can be done without affecting working equipment such as erecting, cabling, wiring, etc.

(e) Work that must be done during lightly loaded (usually night) hours.

(f) Work that must be done on an "in-service" basis.

(g) The type of test and test equipment required during and at the completion of each step.

4.02.5 When a change in the order of procedure of the work is necessary due to unforeseen circumstances, WECO and the Telephone Company's representatives, principally the Dial Administrator, shall be held responsible for determining the extent of the change and its possible effect on service and the job.

4.02.6 If changes are necessary and agreement is reached concerning method of implementing the changes, this agreement shall be indicated on a ***revised*** and ***approved*** Method of Procedure.

4.02.7 All copies of the MOP, original or revised, as described in WECO Handbook 3, Section 9.2 provide an opportunity for WECO and Telephone Company representatives to approve and concur in proposals.

4.03 ***Transitions and Rearrangements***

4.03.1 The following paragraphs describe the various methods to be employed in completing transitions and rearrangements in connection with adding equipment to existing facilities. These methods should appear in the MOP, and adherence to the proposals should be followed by WECO. Any changes would require a revision of the MOP as described in paragraphs 4.02.5 and 4.02.6.

4.03.2 Service may be affected by transitions and/or rearrangements because the capacities may be reduced somewhat by decreasing team-size of facilities or removing equipment from service. The purpose of the MOP is to provide for the protection of service while the transition is accomplished.

4.03.3 Methods of Procedure must be designed for minimum equipment outages or capacity reduction for a minimum period of time and capacity ***must not be reduced beyond a point which would result in less than System Service Standards.***

4.03.4 The various measurement devices discussed in paragraphs 6.0 and 7.0 must be kept in service during periods of WECO activity. The MOP should contain statements ensuring that these devices not be turned-down during periods of time when data gathering is imperative.

4.04 ***Trunk Link Frame and Office Link Frame Additions***

4.04.1 The addition of trunk link and office link frames requires a redistribution of the office junctors since the number of junctors per trunk frame per office frame must be correspondingly reduced to provide equal access between all trunk and office link frames.

4.04.2 When junctor redistribution is involved, it will be necessary to ensure a maximum number of available junctors. (see Para. 4.04.54)

4.04.3 The addition of office link frames will also require the transfer of working trunks from existing office link frames onto the newly installed pair of office link frames. (see Para. 4.05)

4.04.4 Installation work for the addition of trunk and office link frames is divided into three categories:

(a) Preliminary Work
(b) Transitional Work
(c) Clean-up Work

4.04.5 The dial administrator performs certain functions during each of the three stages, as follows:

(a) ***Preliminary Work:*** This involves the erection of all frameworks, running in and connecting all cables to the added equipments and installing and connecting miscellaneous apparatus on existing equipment where it will not interfere with working circuits.

4.04.51 The dial administrator should be alert to the potential hazards to the equipment and personnel. Familiarity with the work areas involved will permit causes of possible service degradation to be promptly identified. For instance, work on senders will be reflected in the percent Sender Attachment Delay.

(b) ***Transitional Work:*** It is during this phase that the added frames are established in the working circuit pattern. This work involves completing the new office junctor assignment between the existing (present) trunk link frames and the existing (and new) office link frames. Transfer of traffic to the new office frames in accordance with Table A may be effected during this phase. (see Para. 4.05)

4.04.52 If it is necessary to remove some of the working circuits from service during the transition, it will be desirable to perform transitional work on week-ends or other light load periods.

4.04.53 The dial administrator, at the Cutover and Analysis (Transition) Meetings, should review the plans he has developed and which are contained in the MOP. As described in Table A, the number of office junctors, from "present" to "proposed" will be decreased thereby reducing access to the office link frames.

TABLE A

Arrangement No.	PRESENT OFFICE No. of Office Frames	PRESENT OFFICE Junctors per TLF/OLF	Office Frames Being Added	Office Size At Completion	Available Possible Arrangement Number	Percent Office CCS Load to be Transferred to Each OLF Pair
1	2	100	2	4-4	5-10	50.0
2	2	100	4	6-6	11-16	33.3
3	2	60	2	4-4	5-10	50.0
4	2	60	4	6-6	11-16	33.3
5	4	50	2	6-6	11-16	33.3
6	4	50	4	8-8	17-20	25.0
7	4	40	2	6-6	11-16	33.3
8	4	40	4	8-8	17-20	25.0
9	4	30	2	6-6	11-16	33.3
10	4	30	4	8-8	17-20	25.0
11	6	33-34	2	8-8	17-20	25.0
12	6	33-34	4	10-10	21-24	20.0
13	6	30	2	8-8	17-20	25.0
14	6	30	4	10-10	21-24	20.0
15	6	25	2	8-8	17-20	25.0
16	6	25	4	10-10	21-24	20.0
17	8	25	2	10-10	21-24	20.0
18	8	25	4	12-12	25-28	16.6
19	8	20	2	10-10	21-24	20.0
20	8	20	4	12-12	25-28	16.6
21	10	20	2	12-12	25-28	16.6
22	10	20	4	14-14	29-32	14.3
23	10	16	2	12-12	25-28	16.6
24	10	16	4	14-14	29-32	14.3
25	12	16	2	14-14	29-32	14.3
26	12	16	4	16-16	33-34	12.5
27	12	14	2	14-14	29-32	14.3
28	12	14	4	16-16	33-34	12.5
29	14	14	2	16-16	33-34	12.5
30	14	14	4	18-18	35	11.1
31	14	12	2	16-16	33-34	12.5
32	14	12	4	18-18	35	11.1
33	16	12	2	18-18	35	11.1
34	16	12	4	20-20	36	10.0
35	18	11	2	20-20	36	10.0
36	20	10	x			

Note: 1. The total number of Office Link Frames will always equal or be one more than the total number of Trunk Link Frames.

4.04.54 Determination of the next size of the office may decide the number of junctors to be made available following the transition i.e., the number of junctors may meet the requirements of a ***future*** similar addition; during the interim, however, fewer office junctors will carry traffic loads than could be made available with the present job. Any reduction in traffic carrying capacity should be avoided; studies will indicate, depending upon office configuration, whether the proposed pattern is satisfactory.

(c) ***Clean-up Work:*** This stage of the installation completes the junctor assignment to the added trunk link frames. (It will also include removal of abandoned cabling and other related wiring to conform to the new junctor distribution). Transfer of traffic to the new equipments will be effected during this stage. (This involves the transfer of existing incoming trunks to similarly equipped trunk circuits served by other decades on the new trunk link frames.)

4.04.55 During the transfer of trunks to new incoming trunk equipments, the trunks affected should be made busy at the originating office. Coordination with these offices to ensure that either direct or alternate routings are not adversely affected is imperative and is dial administrative responsibility. It is advisable to do this work during light traffic periods; ***testing of these trunks following their transfer is mandatory.***

4.04.56 The addition of office link frame pairs and trunk link frames and the attendant trunk work as described in Paragraph 4.05 will require that the tandem markers be busied out during those periods when work is accomplished.

4.04.57 The determination of Marker in-service requirements will reflect changes in the number of link frames. (See paragraph 5.03)

4.05 *Transfer of Trunks—Outgoing and Two-way*

4.05.1 There are various methods of transferring outgoing or two-way trunks to the added office link frames, the suggested method outlined in the following (4.05.2 through 4.07.1) is the most direct and involves a minimum of time and effort. This work will normally be done ***outside*** of the Office Busy Hour.

4.05.2 This procedure requires that the trunk groups to be transferred are wired to their new locations (at Main Distributing Frame [MDF] or Trunk Distributing Frame [TDF]) and that all trunks in the marker test group, maximum of 40, will be re-assigned. The percent load transferred to the new pair of OLF's is recommended in Table A.

4.05.3 It is desirable (if the office frames are in balance), to obviate excessive Plant wiring work, to retain the Group Start (GS), Group End (GE) and Trunk Level (TL) of the group to be transferred. This will leave only one wiring change; the Start (ST) lead identifying the new location of the trunk group is actually transferred. The Plant will do the necessary wring upon the request of the Telephone Company organization responsible for issuing marker Cross-Connection orders.

4.05.4 When the above wiring has been accomplished, the following method may be followed for route-relay markers.

(a) Trunk Groups with Alternate Routing: The trunks in the group to be moved will be properly made busy by the appropriate Plant person.

(b) One marker is removed from service ***(not in Busy Hour)*** and the trunk group wiring is changed to the new location.

(c) Step (b) is repeated, one marker at a time, until all markers have been changed. During this period, the unchanged markers will complete calls over the alternate routes, and the rewired markers will then use the trunks at their new location.

(d) The old locations may then be released for future reassignment.

4.05.5 Based upon the premise that preliminary wiring has been accomplished as described in paragraph 4.05.2 the following method will be used to transfer trunk groups without alternate routes to the newly added office link frames.

(a) Half of the trunks in the group will be made busy at their old location. (These trunks should be the first to be transferred to the added office frames.)

(b) Half of the trunks in the group will be made busy at the new location.

(c) One marker is removed from service ***(not in Busy Hour)*** and its wiring changed as required to find the trunks in the new location.

(d) After work (c) is done, the marker is restored to service and step (c) is repeated until all markers are completed. During this period the unmodified markers will use the trunks at the old location and the modified ones will employ the trunks at the new location.

(e) The trunk make busy conditions are removed upon the completion of the marker work.

(f) The trunks at the old locations can then be moved to the new OLF locations.

4.05.6 Prior to placing load on added office link frames, the dial administrator should review loads (CCS per trunk group, trunk link and office link frames) and service (percent ineffective attempts and overflow registrations, at the trunk link and pairs of office link frames).

4.05.7 If imbalances exist which could cause impairment of service, steps should be taken to re-balance the existing frames as well as efficiently utilizing the added office link frames.

4.05.8 A review of trunk assignments within the GS — GE should be conducted to ensure that load is equitably distributed over ***all*** secondary switches. This is imperative when primary and secondary extension frames are installed to provide additional trunk terminations.

4.05.9 In order to assure an equal spread of traffic over each of the frames of the pairs, care should be taken, where the number of trunks in a trunk group is uneven, i.e. 1, 3, 5, 7, etc. that the unneeded trunk is busied in the middle of the group.

4.05.10 For example, five trunks are required to a destination. The total number of trunk terminations ***must*** be a minimum of six. Assuming GS-0 and GE-5, the trunk termination that should be busied-out is either 2 or 3. This will insure, that, regardless of which numbered trunk link frame is originating the call the traffic will be equally divided between the frames of the pair. (Even numbered trunk link frames will cause the marker to prefer even numbered office link frames, odd numbered trunk link frames will cause odd numbered office link frames to be preferred.)

4.05.11 Ring-type markers do not employ Ground Supplies for alternate route purposes, and as a result, all practical limitations on trunk group size and route advance are removed even though the trunk group test span remains at 40 trunks.

4.05.12 Route-relay-type markers use the Ground Supply concept for alternate routing. Each ground supply contains route relays with trunk group location information. The assignment of the number of trunks to route relays, therefore, has an impact on the holding time of the marker.

4.05.13 Although conditions which may affect the machine's efficiency should be corrected on an ongoing basis, these conditions must be eliminated at the time of additions and/or rearrangements to ensure proper utilization of existing as well as the newly added facilities.

4.05.14 Route-relay markers can search 240 trunks before reaching GS-5 which returns an NC-RO signal. This number of trunks can be tested by a marker when special auxiliary relay equipments are furnished to permit 80 trunks to be tested in each of the first two Ground Supplies, as follows:

GS #1	GS #2	GS #3	GS #4	GS #5
40 & 40	40 & 40	40	40	NC-RO

4.05.15 Further sub-grouping of trunks to be reached by individual markers is possible by grading trunks to the individual markers. Full efficiency of the trunk group is ***not*** realized however.

4.05.16 Where trunks in a group exceed 40, sub-grouping is utilized by placing trunks in a low numbered Ground Supply and alternate route to a higher numbered Ground Supply which contains the remaining trunks. Care should be taken however that the ***smaller***

number of trunks appear in the higher numbered Ground Supply to keep to a minimum the office link frame seizures which add to the marker holding time.

4.05.17 A feature of the marker may be provided which permits testing for trunk availability without seizure of the office link frame pair. This Group Busy facility must be considered when reassigning trunks to different OLF pairs.

4.06 ***Addition of Senders***

4.06.1 The addition of senders to the crossbar tandem system will require additional marker connector facilities as well as distributing the new senders at sender link frames (either existing and new) in a pattern that will equitably offer calls to all senders of a particular type of inpulsing. This information should be included in the MOP as described herein.

4.06.2 There are four basic types of senders for inpulsing purposes. These types however contain different circuitry for outpulsing, prefixing, omitting, connection to CAMA or TSP, etc. The four types of inpulsing senders available and in service are:

(1) Multi-Frequency (MF)
(2) Revertive Pulsing (RP)
(3) Dial Pulsing (DP)
(4) Panel Call Indicator (PCI)

4.06.3 These senders depending upon the terminating facility requirements, may outpulse in a variety of ways, differing in the number of digits (prefixing or deleting digits) or receiving impulses from Revertive Pulsing terminating offices. The instructions for properly completing a call will be transmitted to the sender from the marker predicated upon the decoded information.

4.06.4 Trunks gain access to the proper type sender at the sender link frames. Trunks are arranged in decades and should be equitably distributed over the sender and trunk link frames.

4.06.5 Each sender link frame contains terminations for 100 Incoming trunks and 40 senders which can be grouped as two varieties of inpulsing making a total of 80 senders maximum.

4.06.6 Sender link frames are associated with trunk link frames and trunk frames. Although trunk link frames accommodate 160 trunks, sender link frames only serve 100. As a result, the number of sender link frames outnumber the quantity of trunk link frames. Due to the unique functions and features of tandem trunks, the capacity of trunk frames varies.

4.06.7 Senders must be arranged in order to be efficient, in an equitable fashion. The sender link frame configuration is of utmost importance and care must be taken during transition periods that the MOP ensures that traffic is offered equally to each sub-group of senders, that each sub-group has an equal number of sender link frame appearances, and that the preference pattern is such that each sender link frame has sender sub-groups with low preference positions.

4.06.8 The multipling arrangement of the sender sub-groups can best be demonstrated from the following table (B). This table depicts the configuration of 11 sender subgroups (55 senders) over nine sender link frames. Each SLF accommodates, in this case, 40 senders over eight switches denoted AO, BO, etc., as they pertain to the two controllers for each SLF.

Table B

Controller and Switch No.	Sender Link Frame Number 0	1	2	3	4	5	6	7	8
	(Sender Subgroup Number)								
A3	0	1	2	3	4	5	6	7	8
A2	1	2	3	4	5	6	7	8	9
A1	2	3	4	5	6	7	8	9	10
A0	3	4	5	6	7	8	9	10	0
B3	4	5	6	7	8	9	10	0	1
B2	5	6	7	8	9	10	0	1	2
B1	6	7	8	9	10	0	1	2	3
B0	7	8	9	10	0	1	2	3	4

4.06.9 From the foregoing table the total number of appearances of each sender subgroup may be determined to ensure equitable distribution, e.g.

Sdr. Sub-Group No.	0	1	2	3	4	5	6	7	8	9	10
No. of Appearances	6	6	6	6	6	6	7	8	8	7	6

4.06.10 As can be seen, sender subgroup No. 7 and No. 8 each have eight appearance; the ideal arrangement would be:

Sdr. Sub-Group No.	0	1	2	3	4	5	6	7	8	9	10
No. of Appearances	6	6	6	6	7	7	7	7	7	7	6

4.06.11 The arrangement and the preference position may be found on Wiring List Drawing T — XXXX — 5840. This drawing is made available when the job specification is prepared; the dial administrator should review this drawing to ensure that the best possible sender subgroup preference and distribution are being furnished. It is suggested that distribution tables, as shown herein, be included in the MOP.

4.07 ***Addition of Tandem Marker Connectors***

4.07.1 A tandem marker connector provides the paths between five senders and the installed markers for the exchange of certain decoding and pulsing information.

4.07.2 Three marker connectors serving a maximum of 15 senders are installed on a marker connector frame. A total of 13 such frames may be provided in a Crossbar Tandem office.

4.07.3 When senders are added to the tandem office (see Para. 4.06), it will be necessary to provide additional connectors and frames to accommodate the senders.

4.07.4 Three features provided within connector circuitry are:

(1) In cases of simultaneous demands on a connector by two or more senders, the senders are served in a pre-determined order of preference.

(2) To give each connector equal access to markers during periods of heavy traffic, a connector, after handling a call, cannot serve another call until ***all*** connectors waiting for markers have ***each*** handled one call.

(3) Each connector prefers markers in a fixed order which differs in the various connectors for the purpose of distributing calls as evenly as possible over the markers. To accomplish this, the MOP will contain information which will divide the connectors into as many groups as there are markers and assign each marker as a first choice in each connector group. Second, third, etc. choice markers are assigned similarly in rotation.

4.07.5 The Dial Administrator may be able to determine if the proper preference orders have been provided by reviewing Marker Peg Count Data and participating with Plant in making test calls at the sender test frame during light load hours and ensuring that markers are selected in accordance with Para. 4.07.4(3).

4.07.6 These tests, which may be stipulated in the MOP, may also uncover troubles in the connectors which may cause any of the following:

(1) Erratic usage of markers by eliminating planned marker preference.

(2) Cancel the sender gating between all connectors due to a false indication of occupancy. This loss of gating results in a severe increase of sender holding time causing serious service reaction (% SAD over 3″).

4.07.7 Although marker connectors may be busied out, the normal make busy procedures for senders and/or markers will usually be followed during transitional periods, based upon the in-service requirements discussed herein.

4.08 ***Tandem Marker Additions***

4.08.1 The marker is one of the major equipment components in the crossbar tandem system. Earlier versions employed route relays for decoding information and transmitting it, through the connector, to the sender. Later designs utilize ring translators instead of route relays permitting a maximum of 600 routings and eliminating, for practical purposes, the size of outgoing trunk groups.

4.08.2 Transition work which would require marker work involve any of the following.

(1) Trunk Link Frames

(2) Office Link Frame Pairs

(3) Marker Connectors or Frames

4.08.3 The need to extend marker multiples to the added frames will require markers to be made busy. Hence, this type of work must not be done during busy periods of traffic.

4.08.4 When markers are added to an existing office, the multiples of the new markers must be extended to the various link frames. This work must be accomplished ***during light load periods.***

4.08.5 When markers are added to the connector unit, the unit can be made busy, but the associated sender subgroup (5 senders) must be made busy at the appropriate frame.

4.08.6 Any marker improvement work, i.e., speed-up, trunk group busy feature, etc. will require the marker to be removed from service for varying periods of time. The MOP should in all instances of marker involvement contain specific instructions concerning the hours, duration, and method of removing this equipment from service. The Dial Administrator is responsible for calculating in-service marker requirements as discussed in Para. 5.03 of this practice.

4.08.7 It is advisable to include in the MOP a time interval between the time a marker is restored to service and another marker is made busy to determine if any service reactions occur on the multiple or marker that was worked previously.

4.08.8 Prior to restoral to service the leads installed should be tested for reversals, crosses, and other continuity checks. The procedure for checking added multiples to existing and new facilities should be stated in the MOP.

5. DETERMINATION OF IN-SERVICE REQUIREMENTS

5.01 *General*

5.01.1 The determination of in-service requirements is the prime responsibility of the dial administrator.

5.01.2 The quantities of equipment which may be taken out of service and the time in which they may be removed should be agreed upon by all groups involved in the transitional periods, e.g., Plant, Engineering and WECO.

5.01.3 Because the amounts of equipment have a significant effect on service levels, not only within the Crossbar Tandem, but on originating offices, the recommendations prepared by the dial administrator (and agreed to by other groups) should be included in the MOP.

5.01.4 These quantities and time frames should be discussed at Cutover and Analysis Meetings (See Para. 2.05) and plans should be formulated at that time to ensure sufficient work force and scheduling of work force so that the MOP proposals can be followed.

5.01.5 No deviation from minimum equipment requirements ***should be tolerated;*** facilities removed from service due to circuit trouble must be included in the total outage, i.e., stuck senders held for tracing should be added to the number of senders removed from service for WECO work

5.01.6 The following paragraphs of this section contain suggested methods for calculating required capacity and the means for properly recording these data for MOP purposes.

5.02 *Crossbar Tandem Senders*

5.02.1 Calculation of the number of crossbar tandem senders required to render satisfactory service during transitional periods must be made by type inpulsing and by time frames.

5.02.2 Generally, these calculations will be predicated upon High Day requirements; local traffic conditions and the season in which the work is performed may permit adjustment in these requirements. In some cases, based upon the judgment of the dial administrator, busy season requirements may obtain. (Service results for % SAD over 3″ are normally considered for 10 High Days with a recommended average service ceiling of .5% delay over three seconds.)

5.02.3 In addition to calculating busy hour sender needs, it is important that light hour requirements be considered in the event traffic loads preclude WECO work during normal business hours.

5.02.4 The following information should be available before in-service requirements are computed:

(a) Number of senders installed (by type inpulsing).

(b) Is Inter-sender timing installed and working?

(c) The present and proposed sender distribution on Sender Link Frames (See Paragraphs 4.06.7 through 4.06.11).

(d) Load-Service curves depicting Percentage Sender Attachment Delay over 3 Seconds vs CCS per Sender (by type inpulsing).

(e) Number of senders required for maintenance purposes.

(f) Number of working trunks located on trunk link frames.

(g) Historical Data.

(1) Tandem Sender Usage
—Service
—Maintenance

(2) Marker Usage
—Service
—Maintenance

(3) Trunk Link Frame Peg Count

5.02.5 A form MOP-T-S (Appendix 1) may be used for recording in-service requirements for Crossbar Tandem senders. This form, or one similar to it, may be attached to the MOP.

5.02.6 The following paragraphs describe the calculations required to prepare in-service requirements.

5.02.7 The calculations described in the following may also assist the dial administrator in determining capacity requirements for existing crossbar tandem installations ***not involved*** in additions, changes, or rearrangements.

5.02.8 The following figures should be transcribed from empirical data onto the MOP-T-S form:

(a) Lines 1-6 — Self explanatory

(b) Line 7 — Enter the actual total sender usage—For the highest hour and the average for the Busy Season

(c) Line 8 — Sender Maintenance Usage for corresponding period of line 7

(d) Line 9 — Line 7—Line 8

(e) Line 10 — Line 5 x 36 CCS

(f) Line 11 — Line 7 ÷ Line 10

(g) Line 12 — Enter the Total Trunk Link Frame Peg Count for the corresponding period of Line 7

(h) Line 13 — Line 9 ÷ Line 12

(i) Line 14 — Total Marker Usage for the corresponding period of Line 7

(j) Line 15 — Line 14 ÷ No. of Markers × 36 CCS (x100)

(k) Line 16 — Because Marker Holding Time directly affects the Crossbar Tandem Senders' Holding Time an adjustment factor based upon the marker occupancy and the number of markers available must be calculated. This process involves the following:

(1) Attachment II is a chart from Bell Laboratories Monograph 2133 which provides information for increased sender holding time due to marker occupancy.

(2) The abscissa depicts number of paths, the ordinate shows average delay in multiples of holding times (t/.5), and the curves represent occupancy.

(3) For example, eight markers performing at 80% occupancy produce a .29 average delay.

(4) If marker holding time is calculated to be .5 seconds with .29 average delay, the following calculation of t/.5 = .29, produces an average delay of .145 (say 1.5).

(l) Line 17 — Percentage Sender Attachment Delay over 3 seconds for the corresponding period of line 7.

(m) Line 18 — From Line 5, enter the number of tandem senders installed (by type inpulsing).

(n) Line 19 — Maintenance senders are those which are unavailable due to circuit trouble (made busy) ***and/or*** those being held for tracing purposes under "stuck sender" condition.

(1) Determination of the maximum number of maintenance senders is accomplished in various ways. Service (line 17), however, should always be considered paramount.

(2) Based upon service results (line 17) when compared to maintenance usage (line 8) the number of senders that may be calculated by dividing line 8 (x100) by 36 CCS. If results exceed .5% delay over

three seconds, it may be assumed that no senders can be removed from service under high day conditions.

(3) For example, 120 senders are installed. During the highest day hourly period 152 maintenance CCS were recorded and the percentage delay was .5% for the corresponding hour. It may then be deduced that 4 senders may be busied (152-36). A sub-group consists of five senders (see 4.06); hence, if work is required on an entire sub-group, five senders made busy might induce a slight service penalty.

(4) It is considered improbable that senders made busy due to trouble conditions may be restored to service immediately. Guidelines should then be established for the maximum number to be unavailable without corrective action being accelerated.

(5) The following maintenance requirement guidelines ***may be followed*** for expected high day periods if empirical data show that no service deterioration has been experienced at the levels predicted.

No. of Senders (by type inpulsing) Installed	Maximum Number of Maintenance Senders
Under 40	2
41 - 60	3
61 - 80	4
81 - 100	5
101 - 120	6
121 - 140	7
141 - 160	8
161 - 180	9
181 - 195	10

(o) Line 20 — Line 18-Line 19

(p) Line 21 — Sender CCS Capacity

(1) The determination of tandem sender CCS capacity is a key calculation to computing in—service requirements for transitional purposes.

(2) The rolè of the dial administrator, however, in assessing load-service situations is a continuing one. (The recommended techniques described herein may be followed under normal work operation conditions.)

(3) Familiarity with Traffic Facilities Practices, Division D, Section 6-e-(2) and Time Shared Computer Program Load Service Curve Letter (Dated March 1, 1967, File No. 3C1.10) is required.

(4) In order to ensure that data describing the load-service relationship is valid, a family of curves may be prepared based upon the number of senders in the group.

(5) A curve (Appendix 2) showing CCS per sender and the expected percentage sender attachment delay may be prepared from Figure 1 of TFP Div. D, Section 6-e-(2). These data comprehend a ten second holding and assume equitable distribution of senders over the sender link frames. This curve will be considered the ***"Lower Limit."***

(6) Another curve, the ***"Upper Limit,"*** may be constructed based upon 95% of the sender load shown in the Lower Limit.

(7) These two theoretical curves will serve as parameters for actual data which will include ***total usage*** divided by the number of installed senders vs. the percentage sender delay over three seconds. This is the ***Daily Curve.***

(8) Investigations should be immediately conducted if actual data fall outside the two theoretical curves. Those factors contributing to distorted data are marker outages, inequitable sender distribution, troubles, etc.

(9) Serivce objectives for crossbar tandem are usually calculated as an average percentage sender delay over three seconds for the Ten Highest Days. ***The recommended service ceiling is an average of .5% Delay for the ten high days.***

(10) In pre-planning equipment outages, the service ceiling should then be established at no more than .5% Delay over three seconds.

(11) This service reaction may be predicted by consulting the Daily Curve and establishing the CCS per Sender figure which will render not more than .5% Sender Delay over three seconds.

(12) Another load-service curve may be prepared based upon actual busy season data. This curve represents the CCS deviation from the average busy-season load at various specific loads with their respective service reactions.

(13) This curve may be prepared by utilizing the time-shared program LDSERV described in Traffic Letter, dated March 1, 1967, File No. 3C1.1D.

(14) This busy-season curve (also called the average curve, the sigma curve or the standard deviation curve) must fall to the left of the daily curve.

(15) The average service (% SAD over 3") at the average Busy Season load should be lower than ***.2% delay.***

(16) The CCS Capacity (line 21) is the CCS load at the desired service multiplied by the number of traffic senders (line 20).

(q) Line 22 — The recommended sender holding times (by proper type inpulsing) as shown in the Traffic Facilities Practices, Division D, Section 6-e-(2) Figures 2a through 2e.

(r) Line 23 — See Line 16. If empirical data show that % Marker occupancy (line 15) is less than 80% it is suggested that the marker adjustment be re-calculated at an 80% level and entered here.

(s) Line 24 — A factor to be added to holding times based on the fact that local class 5 common control offices (MF or DP) trunks must be furnished. This is considered to be guard time at the outgoing side of the crossbar tandem office. The holding times will be increased as follows:

Older Vintage Senders......360 milliseconds
New Type Senders..........750 milliseconds
(Reference P.E.M. 9273)

(t) Line 25 — The adjusted sender holding time is the sumof lines 22, 23, and 24.

(u) Line 26 — Call capacity is the number of calls with a given usage which may be processed without service reaction. It may be calculated as follows:

$$100 \times \frac{\text{Line 21 (CCS Capacity)}}{\text{Line 26 (Adj H.T.)}} = \text{Call Capacity}$$

(v) Line 27 — Traffic Senders Minimum are the number of senders required to be in service during hours expected to be the daily peak hours.

5.02.9 A sample of a completed MOP-T-S is shown as Appendix 3.

5.02.10 Traffic Facilities Practices, Division D, Section 6-e-(1) and (2) may be used as reference material.

5.03 *Crossbar Tandem Markers (Ring or Route Relay Types)*

5.03.1 In order to properly calculate tandem marker in-service requirements, it is essential that the Dial Administrator be familiar with Traffic Facilities Practices, Division D, Section 6-f-(1) and (2).

5.03.2 Albeit, no service reaction can be directly attributed to marker unavailability or increased occupancy of accessible markers, a deterioration of sender attachment results may result due to increased tandem sender holding time; and marker connector blockage. These in turn, would tend to affect the efficiency of originating end office facilities.

5.03.3 In order to provide maximum facility accessibility, the calculation of tandem marker in-service requirements should be predicated on marker usage for the highest day anticipated. Obviously, the time frame in which any marker is removed from service must be considered due to the tandem's sensitivity to overload caused by a rapid accumulation of alternate routed traffic during peak periods.

5.03.4 In addition to marker work involving Speed-Up or Group Busy, etc., markers may be required to be turned down during periods when other component configuration is changed e.g., additions of trunk link and office link frames, sender additions, trunk group changes, etc.

5.03.5 The techniques to be employed in calculating marker needs, as described later in this section, require sufficient, reliable empirical data. These data include:

(a) Marker Usage (Traffic and Maintenance)
(b) Marker Peg Count
(c) Office Link Seizure Peg Count
(d) Office Link Frame Overflow
(e) Second Failure to Match Peg Count

5.03.6 In addition to these data, other facts need be known in determining marker requirements. These include the type marker (Ring or Route Relay), the number of office link frames and the number of trunk link frames, what options are provided, e.g., Speed-Up, group busy, TUR options, etc.

5.03.7 As stated herein, the sequence of additions and/or changes must be stipulated in the written MOP and agreed to by the Telephone Company departmental representatives.

5.03.8 These sequences should be discussed prior to the preparation of the MOP document so that accurate marker in-service requirements may be determined.

5.03.9 Determination of the sequence and the steps within the sequence ***may be predicated*** upon marker requirements because they are the major equipment elements within the tandem system.

5.03.10 Depending upon the nature of the tandem office work that is involved, markers will be busied-out for varying lengths of time. This downtime should be planned so that no adverse service reaction is experienced. It may be necessary, therefore, to determine at the Cutover and Analysis Meetings the exact days and hours that the work may be performed; this information should be contained in the MOP.

5.03.11 Of prime importance in determining the duration of the outages is the size and experience level of the WECO force. Vacations and holidays must also be considered in programming the work sequence as they will influence productivity time, which affects the completion dates.

5.03.12 Several in-service requirement calculations may be necessary because of changes in marker holding time during the interval of the job. Factors that will affect holding times are:

(a) Changes in the number of trunk link frames and office link frame pairs

(b) Change in the number of markers

(c) Circuit modifications such as Group Busy and Marker Speed-Up.

5.03.13 For example, additional trunk and office link frames will, when completed and working, reduce marker holding time by decreasing marker competition at the frames.

5.03.14 Conversely, the addition of a marker or markers to an existing TLF-OLF configuration may cause higher holding times due to the queuing of the markers in their bids to the link frames.

5.03.15 Other work which will necessitate marker outages are trunk group rearrangements and the various circuit modifications such as Speed-Up, Group-Busy, TUR, etc.

5.03.16 Extensive marker turndown will be experienced for Speed-up features because the work is complex and extends to the office and trunk link frames.

5.03.17 In addition to the date, described in Paragraph 5.03.5, the following information should be available before in-service requirements are calculated:

(a) Number and type Markers

(b) If TUR measurement error correction is provided

(c) If Speed-Up or Group Busy is furnished

(d) Number of Trunk Link Frames

(e) Number of Office Link Frame Pairs

5.03.18 A form MOP-T-M, Appendix A, may be used for recording data and calculating marker needs. This form, or one similar to it, may be attached to the MOP.

5.03.19 The following paragraphs describe the calculations needed to prepare the form MOP-T-M. These calculations may also be used to assist the Dial Administrator in determining marker capacity for existing crossbar tandem installations that are not involved in additions, changes, or rearrangements.

5.03.20 Following are step-by-step instructions and explanation of form MOP-T-M.

(a) Lines 1-6 — Self explanatory.

(b) Line 7 — Total Marker Usage (Highest Day—Busy Hour).

(c) Line 8 — Total Marker Peg Count for corresponding period of Line 7.

(d) Line 9 — Usage (CCS) per Marker—Total CCS (Line 7) divided by the Number of Markers (Line 3).

(e) Line 10 — Peg Count per Marker—Total Marker P.C. (Line 8) divided by number of Markers (Line 3).

(f) Line 11 — Usage per Marker (Line 9) multiplied by 100 divided by line 10.

(g) Line 12 — A measurement correction is available to provide a more accurate measurement of marker usage. Depending upon the type marker (Ring or Route Relay) and whether this modification is provided or not, the holding time must be adjusted accordingly.

Marker	Option	Adjustment With	Adjustment Without
Route Relay	LV, Issue 60D	.022	.050
Ring Type	XW, Issue 16D	.014	.050

(h) Line 13 — Sum of Lines 11 and 12 produces the adjusted Holding Time.

(i) Line 14 — The adjusted usage will be the CCS obtained by multiplying the adjusted Holding Time (Line 13) by the peg count (Line 8) and dividing by 100.

(j) This figure is used to determine the percent occupancy of the tandem markers during the highest day busy hour. The CCS figure entered here is the product of Markers Installed (Line 3) multiplied by 36 CCS.

Usage recorded during the corresponding hour for maintenance purposes must be subtracted from this product as out-of-service markers may not be considered available.

(k) Percent Occupancy will result from the following computation:

$$\frac{\text{Adj: Usage (Line 14)}}{\text{Max. Usage (Line 15)}} \times 100$$

(l) Line 17 — For the high-day-hour an Office Link Frame Seizure Ratio must be com-

(k) Line 16 — Percent Occupancy will result from the following computation:

puted. The number of office link frame seizures peg count for all office link frame pairs divided by Total Marker P.C. (Line 8) will produce this figure.

(m) Line 18 — The marker theoretical holding time is a result of the office link frame seizure ratio and the tandem office configuration, i.e., number of markers, number of trunk link frames and number of office link frame pairs.

Shown in Appendices 5 through 9 are charts for various TLF-OLF arrangements and markers installed. By consulting the proper chart by the number of markers installed, the theoretical holding time (at 100% occupancy) may be determined by tracing the marker line to the OLF Seizure Ratio. This deduced holding time may then be reduced by the Actual percent occupancy (Line 16).

Shown in Appendix 10 is a guide to reduced holding time and percent marker occupancy.

If during the course of the job, Group Busy and speed-up are added, these factors must be taken into consideration on a "Present" and "Proposed" arrangement and shown in the Capacity portion of form MOP-T-M.

If markers are functioning properly, i.e., all channel tests, equitable distribution, and link frames properly balanced, the figures on line 18 should be within 5% of the adjusted Holding Time (Line 13).

(m) Line 19 — Number of Markers Installed. This figure is also shown on Line 3.

(n) Markers Not Available are a hypothesis upon which determination of in-service requirements is based. Pre-printed on Line 20 are the figures 0, 1, and 2 indicating the number of markers made busy for trouble and/or transitional purposes. Maintenance Markers are not normally provided for High Day Traffic purposes. Depending upon time frames (nights or weekends) a varying number of markers may be removed from service. Capacity may be determined by substituting other numbers on Line 20.

(o) Line 21 — Number of Traffic Markers are the remainder of lines 19 minus line 20.

(p) Line 22 — CCS load on Traffic Markers at 80% occupancy is the product of the number of markers (Line 21) multiplied by 28.8 CCS.

(q) Line 23 — The OLF Seizures Ratio that may be used in determining the marker capacity would normally be that which has been experienced and is shown on Line 17. This ratio comprehends the degree of alternate routing, OLF Overflows, etc.

However, it may be necessary to calculate marker capacity for changes in circuitry, such as the installation of Group Busy relays, which will reduce the OLF Seizures thereby decreasing marker holding time.

Depending upon the work and the sequence of the work, the MOP may need to contain different marker in-service requirements for the varying stages of the job.

If Group Busy relays are being provided, a new ratio and holding time may be computed. Needed are the data which describes the number of Busy Hour Overflows on the trunk groups which will be associated with the Group Busy relays.

An example computation follows:

Given:

8 Markers, 18 Trunk Link Frames, 9 Office Link Frame Pairs; data show:

(1) Marker H.T. of .66,

(2) Office Link Frame Seizure Ratio is 1.30,

(3) Marker P.C. during highest day BH is estimated at 32,610,

(4) Trunk Group Total overflows are recorded at 4312.

Determine:

Total OLF Seizures:

Marker PC $\times$ OLFS Ratio =
Total OLF Seizures

Ineffective OLF Seizures

Failure to Match channels from the trunk link frame to an ***idle trunk*** on the OLF normally scores as an office Link Frame Overflow. These scorings ***will not be affected*** by the installation of GB relays and should be subtracted from the total OLF Seizures when computing Ineffective OLF Seizures.

(Total OLF Seizures—OLF Overflow)—Marker P.C.=Ineffective OLF Seizures

42393-32610=9783

New Seizure Ratio:

$$\frac{\text{Total OLF Seizures—Group Overflows}}{\text{Marker P.C.}}$$
=New OLFS Ratio

$$\frac{42393\text{-}4312}{32610} = 1.16$$

This new figure (1.16) may be entered on Line 23.

(r) Line 24 — Calculated H.T. will be the new marker holding time predicated upon the new OLF Seizures Ratio.

Consulting the charts shown as Appendixes 5 — 9, this new ratio will produce a new marker H.T. at 100% occupancy. With this TLF-OLF (18$\times$9) arrangement with 8 markers for traffic, .77 H.T. results.

(s) Line 25 — Holding time at an occupancy level of 80% of the calculated H.T. produces a new theoretical H.T. reflecting the installation of Group Busy relays. In this case 6.16, say 6.2, a reduction of .04 seconds.

(t) Line 26 — The marker call capacity can then be calculated by dividing the CCS load at 80% Occupancy (Line 22) by the new holding time (Line 25) multiplied by 100. In this case, 37161 calls may be handled with 8 markers.

By the "cut-and-try" method, i.e., substituting a different number of markers on Line 21 (b) and 21 (c) the number of markers required to handle the calls estimated (section (q)-32610) may then easily be decided.

For example, 7 markers available produce the following results:

Line 22 —	2.01
23 —	1.16
24 —	.73
25 —	.58
26 —	34655

While 6 markers available possess the capacity of handling calls as follows:

Line 22 —	172.8
23 —	1.16
24 —	.69
25 —	.56
26 —	30857

Hence, for the example cited here, one marker may be made busy for WECO work during the tandem office modification.

If 6 markers are available the capacity for call handling is reduced to 30857 calls. The form MOP-T-M show the following:

Line 22 —	172.8
23 —	1.16
24 —	.69
25 —	.56
26 —	30857

Hence, with a forecast of 32,610 BH calls a minimum of seven markers would be required. With eight markers installed and the possibility of trouble being encountered, judgment might dictate that all markers be kept in service during the Busy Hour.

A completed Form MOP-T-M described herein, may be found as Appendix 11.

(u) Line 27 — Contains identification of certain time frames such as Busy Hour, Side Hours, Evenings or Week-ends. These hours should be documented by empirical data.

(v) Line 28 — Based upon the time frames described in (u) the number of markers required will be stipulated here. It is absolutely essential that Plant and WECO adhere to these requirements.

This form MOP-T-M may be attached to the MOP; this does not preclude definitive statements in the MOP which describe the needs.

5.04 *Incoming Registers*

5.04.1 Incoming registers are used in crossbar tandem offices to provide step-by-step customers access to the tandem.

The provision of these registers, with by-link operation to ensure the reception of the dialed digits, must be of sufficient quantity that one will almost always be immediately available.

5.04.2 If an insufficient number are available, step-by-step customers will encounter excessive reorder tone which is furnished as a signal for no registers available.

5.04.3 Register quantities are based on the ten high days average busy hour usage read into Poisson Table 1. When a group of more than 10 registers are provided the capacity is normally reduced by 10% to compensate for the grading arrangement. It is recommended that one register be provided per group for maintenance purposes. Thus the capacity of 20 registers would be:
299 CCS (Table 1 for 29IRs)—30 CCS=269 CCS

5.04.4 Even though engineering provision is based on an average of 10 High Day, equipment in-service requirements would be predicated on the highest day if the work is being accomplished during the Busy Season. Empirical data, at all times, should be the basis for establishing needs.

5.04.5 These data would be affected if additional DP trunks are assigned to the tandem. Hence, for MOP purposes, the sequence should provide for the addition and/or rearrangement of Incoming Registers on IR Link frame before additional assignments of DP trunks are made.

5.04.6 Traffic Facilities Practices, Division D, Section 6-g, may be used for reference purposes.

5.04.7 The quantity of Incoming Registers needed and the time intervals in which they are needed should be included in the MOP document.

5.05 *In-Service Requirement Form*

5.05.1 A Form, MOP-T-1, shown as Appendix 12, may be completed and included with the MOP after all in-service requirements are calculated. This form will contain predicted service levels based upon available equipment during various time frames.

5.06 *Record of Equipment Outages*

5.06.1 Pursuant to BSP Section 201-114-001, Plant will complete Forms E-4255 (Trunk Outage) and E-4256 (Equipment Outage). These outages may be reconciled with determined in-service requirements.

6. SERVICE MEASUREMENTS

6.01 *General*

6.01.1 There are several major service barometers which must be monitored before, during and after transitional work. The devices which produce service results ***must be kept*** in service during periods of WECO activity. These include:

(a) Sender Attachment Delay Recorder
(b) Various Peg Count Registers for:
  (1) Trunk Group P.C. for NC-RO, SOA, ROA Peg Counts
  (2) Marker Peg Counts
  (3) Second Failure to Match Peg Count
  (4) Revertive Pulse Reorder Peg Count
(c) Various Overflow Registers for:
  (1) Office Link Frame Overflow
  (2) Trunk Link Overflow
  (3) NC-RO Trunk Group Overflow

6.02 *Sender Attachment Delay Recorder*

6.02.1 One of the major service echelons in a Crossbar Tandem Office is the Percent Sender Attachment Delay (over 3 or 7 seconds) by type of inpulsing.

6.02.2 These data, accumulated during the tandem office busy hour as well as those days to be included in Ten High Day Engineering, may be used in the preparation of load-service curves portraying this service versus CCS per sender.

6.02.3 Any degradation in this service echelon tends to affect overall service in the originating offices. Poor Dial Tone, excessive overflows, and inefficient utilization of facilities result when % SAD increases.

6.03 ***Ineffective Attempts***

6.03.1 The percent ineffective attempts comprehends the number of Reorder Announcements (ROA), Reorder Tone (120 IPM), No Circuit (NC) and Sender Overload Announcements (SOA) as compared to the total tandem marker attempts.

6.03.2 The various trunk groups containing announcements or tones should have associated peg count devices so that an accurate compilation of ineffective attempts can be made.

6.03.3 Where Revertive Pulsing tandem senders are employed, matching loss failures will not be routed to NC-RO. Rather, the tandem marker establishes in the sender a condition which permits the originating office to establish the NC-RO attitude. This condition scores the RPRO register; these scorings must be deducted when computing % Matching Loss.

6.03.4 The formula for Percent Matching Loss is:

$$\frac{\text{Second Failure to Match PC}}{\text{Total Marker PC—OLF Overflows—RPRO}} \times 100$$

6.03.5 Analysis of all register scorings may assist in identifying potential congestion before Matching Loss is experienced. The following table describes the various registers which score on an ML failure. The reconciliation of Trunk Link Overflows and Office Link Overflows may pinpoint the link frames which are congested but whose results are diluted when calculated as a office ML result.

		Trk. Grp. PC			Overflow			
					OLF			2nd
Stage of Call	Mkr. PC	1st	Alt	Ovfl	1st	2nd	TLF	FTM
1. First of OLF Pair	X	X						
2. Other OLF of Pair					X		X	
3. First of OLF Pair	X		X					
4. Other OLF of Pair						X	X	X
5. NC-RO	X			X				

6.03.6 In addition, three OLF Seizures Peg Count registration will be made and a Trunk Link Frame Peg Count will score when cross-points to the NC-RO trunk group are operated.

6.03.7 Trunk Group assignments, trunk link frame switches made busy or office link frame switches made busy may be the possible contributors during transitional periods.

6.03.8 Where marker work has been or is involved, the appropriate Channel relays may not be functioning properly. This condition may also cause reduced junctor accessibility causing Matching Loss.

6.04 ***Other Measurements***

6.04.1 In those tandem offices serving Step-by-Step Office an additional measurement of the number of Permanent Signals, Partial Dials, and No Sender attached is obtained as a percent of the Incoming Register attempts.

6.04.2 "No Position Attached" (NPA) registers in crossbar tandems equipped for CAMA and/or TSP may indicate blockages or insufficient Operator force provision. (In addition to these measurements, provision should be made to record and analyze customer comments to the operators regarding service.)

6.04.3 Where CAMA and TSP facilities are provided, other devices to determine Misrouted Non-Cama (MCA) and Unauthorized CAMA Announcement (UCA) may assist in correcting dialing irregularities, etc.

6.05 ***Service Summary Form***

6.05.1 A Crossbar Tandem Service Summary, Appendix 13, may be useful to record Daily Busy Hour Results.

6.05.2 During transitional periods these data should be reviewed by the Dial Administrator and copies furnished to Plant, WECO, Engineering and the Network Manager.

6.05.3 The Dial Administrator must ensure that all traffic registers are associated properly and functioning accurately, before the new equipment is placed in service.

7. LOAD MEASUREMENTS

7.01 *General*

7.01.1 In addition to the various traffic (Peg Count) and Service measurements previously discussed, there are others which permit the registration of usage of the crossbar tandem equipment components.

7.01.2 Although there are many devices that can produce data for dial administration purposes, e.g., Esterline-Angus Recorders, Alston Scanners, etc., the principal measurement tool is the Traffic Usage Recorder (TUR).

7.01.3 The TUR together with certain Peg Counts, produces the necessary ratios and data for load-balance and load-service relationships.

7.01.4 It is imperative that the TUR remain in service during periods of transition. Care should be taken that the MOP contain instructions which permit TUR availability.

7.02 *Peg Counts*

7.02.1 Various peg count registers which are utilized in determining loads are:

(a) Trunk Link Frame Peg Count—Total
(b) TLF Sample Link Peg Count
(c) Sender Group Busy Peg Count
(d) I.S.T. Control Peg Count
(e) Office Link Frame Peg Seizures Peg Count —In offices where Seizures Peg Count is not available an office link frame Peg Count has been furnished.

7.03 *Usage*

7.03.1 Usage Measurement from the TUR are produced in units of CCS or tenths of CCS (fast scan used with short-holding time equipment components).

7.03.2 The various measurements of load are:

(a) Trunk Link Frame—HG Sample Channel Usage
(b) TLF—Total Sample Channel Usage (DGU)
(c) Total Sender Usage
(d) Total Sender Mtce Usage
(e) Total Marker Usage
(f) Total Marker Mcte Usage
(g) Office Link Frame—HG Sample Channel
(h) OLF—Sample Channel Usage (DGU)
(i) Outgoing Trunk Usage
(j) Incoming Register Usage
(k) Incoming Register Mtce Usage
(l) Transverter Usage
(m) CAMA and TSP Usage (FADS)

7.03.3 Dial administration techniques dictate that these usage data, after proper validation, be used to develop meaningful load-service relationships. The use of these techniques become increasingly important during periods of additions to existing facilities, because capacities of equipment may be affected by transition work.

7.03.4 It is strongly recommended that the usage data be obtained coincident with the Service data described in paragraph 6.0 for reconciliation purposes.

7.03.5 Provisions should be to gather usage data during periods of high volume traffic. In may be necessary, depending upon conditions, to manually record data. The training of people to do this work and the forms for transcription should be planned and discussed at MOP and Cutover and Analysis Committee meetings (para. 2.05).

7.04 *Other Load Indicators*

7.04.1 Measurements of facility inadequacy or unavailability may be provided through the use of Overflow registrations. These measurements may well be the earliest indicators of equipment congestion, excessive out-of-service, or improper arrangement.

7.04.2 As discussed earlier, office link frame and trunk link frame overflows indicate that an idle trunk (at an office link frame) is available but that a channel (trunk link, office junctor or office link) from the incoming trunk cannot be chosen by the marker. Analysis of these scorings may permit corrective action in time to prevent matching loss failures.

7.04.3 Outgoing trunk group overflow registrations indicate that an all trunks busy condition exists at the time a marker is testing for an idle trunk.

7.04.4 These registrations must be examined carefully because in many instances high scorings on high usage trunk groups will result as peg counts on final routes. Obviously, overflow scorings for final routes result as peg counts for the NC-RO terminations.

7.04.5 During transitional periods, e.g. new office link frame pairs which will require the transfer of existing working trunks, the overflow registrations will give immediate indications of alternate routing which, in turn, increases marker holding time.

7.04.6 There are other load measurements which describe time frames and percent of equipment occupied. These are the Sender Load Meters and All Markers Busy. Associated with the AMB is an alarm circuit which notifies Plant when this condition exists for a certain duration. This Marker Busy Alarm does not score a register but is a visual and audible signal of load.

7.04.7 A Sender Group Busy register, provided one per sender group, may also be furnished. These registers may permit analysis which would disclose imbalances between sender groups.

7.04.8 Before placing any new equipment in service, the Dial Administrator must be assured that all load measuring devices are associated properly and functioning accurately.

7.04.9 If facilities are made operative without a measuring device capability, load data would be distorted and would prevent sound decisions based upon load-service relationships.

8. OTHER DIAL ADMINISTRATIVE FUNCTIONS

8.01 The purpose of a crossbar tandem is to provide network efficiency by serving small sized incoming trunk groups and making available to them large sized outgoing trunk fields. The tandem also provides features for remote zone message registration, Centrex-CU, CAMA, TSP, coin zone dialing, and code conversion and prefixing digits as well as six-digit translation.

8.02 Analogously to local offices where demand is equated to working main stations, tandem office demand can be related to ***working incoming trunks.***

8.03 During periods of transition, the number of trunks being served, the time frame in which they are served, and the common control facilities serving them require the attention of the Dial Administrator, whose role is intensified during periods of WECO activity.

8.04 Contacts with coordinates, including the Network Manager, will become more frequent, be it formal or informal contact. Dealing with the organization responsible for Trunking is imperative.

8.05 As previously described, component in-service requirements determination is a prime responsibility of the Dial Administrator.

8.06 These requirements can be converted into "working incoming trunk capability" to ensure that ***during WECO activity,*** the call carrying capacity of the tandem is not exceeded by adding trunks to the incoming trunk field.

8.07 The use of load distribution tables, as described in Dial Facilities Management Practices, Division H, Section 1b(8); may assist in relating CCS per incoming trunk during certain time frames.

8.08 These time frames should coincide with tandem sender and tandem marker needs as defined by the Dial Administrator.

8.09 The various features discussed in Paragraph 8.01 may require additional records to be maintained by the Dial Administrator. For example: (1) Centrex CU lines will require line assignment records to be kept in a trunk assignment format; (2) Translators will necessitate codes (NNX) to be recorded by Numbering Plan Area (NPA) so that routing information may be rapidly obtained; (3) zone message registration circuits will require switchboard appearances to be associated with trunk equipments and terminations.

8.10 CAMA and TSP functions must be coordinated with the Traffic Department representative charged with this responsibility.

8.11 The appropriate traffic management devices such as Dynamic Overload Controls, etc., must be tested and satisfactory performance assured.

9. REFERENCES

9.01 *Sources*

9.01.1 Reference should be made to other Traffic Practices, other sections of the Dial Facilities Management Practices, Plant and Engineering Bell System Practices, WECO Handbooks, etc., as necessary for the proper preparation of a Method of Procedure for Crossbar Tandem. References, as contained herein, are shown below.

9.01.2 The WECO Installation Engineering Handbooks are the practices which guide their people in installing central office equipment.

9.01.3 There are numerous notes published by WECO which cover Engineering Change Procedures (ECP) which may require the preparation of an MOP. These ECPs are issued for circuit improvements and may be included during an addition. If the ECP would provide substantial circuit changes, the work may not necessarily be done in connection with an addition.

9.02 *Attachments*

9.02.1 The two attachments made hereto are copies of an MOP authorization form extracted from WECO Handbook 3, Section 9.2 and a chart from Bell Telephone Laboratories Monograph 2133 which provides additional information relating to sender holding time.

REFERENCE SOURCES

Reference	Subject
DEMP, Div. H, Sec. 1b (8)	General-Administration—MOP
TFP, Div. D, Sec. 6e(1), (2)	Crossbar Tandem Senders
TFP, Div. D, Sec. 6F(1), (2)	Crossbar Tandem Markers
BSP, Section AA240.007	Crossbar Tandem—General
BSP, Section 800-614-150, Issue 4D	Installation Requirements—General
BSP, Section 201-114-001	Record of Equipment Out-of-Service
WECO Handbook 40	Table of Contents for Crossbar Tandem Transition
WECO Handbook 3, Sec. 9.2	Method of Procedure

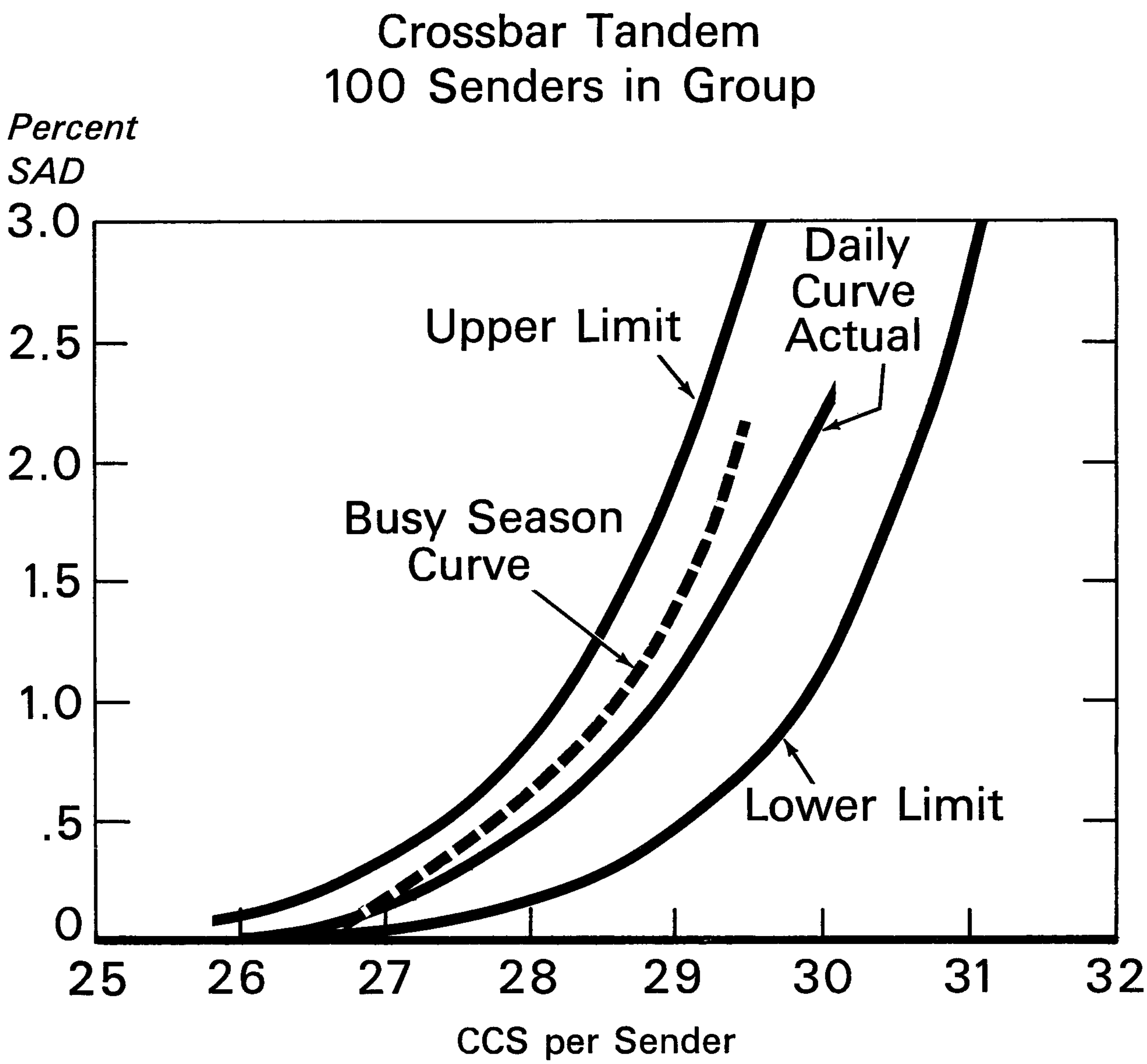
There are numerous other sources dealing with Service Interruptions, etc. which are available, e.g. BSP Section 201-112-006 which covers general power requirements and may be used as a guide during installation of equipment by the WECO.

IN-SERVICE REQUIREMENTS

CROSSBAR TANDEM SENDERS					
1	BUILDING:	3	YEAR:	5	NO. INSTALLED:
2	TANDEM:	4	TYPE: (INPULSING)	6	IST: YES NO

			HISTORICAL PERFORMANCE			REMARKS
		OPERATION	HIGH DAY	10 HIGH DAY	AVERAGE BUSY SEASON	
7	TOTAL USAGE					
8	MTCE USAGE					
9	TFFC USAGE	7 – 8				
10	MAXIMUM USAGE	5 x 36 CCS				
11	% OCCUPANCY	7 ÷ 10 (X10(				
12	TLF PEG COUNT					
13	HOLDING TIME	9 ÷ 12				
14	TOTAL MARKER USAGE					
15	% MARKER OCCUPANCY					
16	MARKER ADJ.					
17	% SAD > 3"					
				DESIGN		
18	NO. INSTALLED	5				
19	MTCE SENDERS					
20	TFFC SENDERS	18 – 19				
21	CCS CAPACITY					
22	HOLDING TIME					
23	MARKER ADJ.					
24	TRUNK GUARD INT.					
25	ADJ. HOLDING TIME					
26	CALL CAPACITY	21 ÷ 25				
				REQUIREMENTS		
27	TFFC SENDERS-MIN	9 ÷ CCS/SDR		Same as High Day		
28	MTCE SENDERS-MAX	19		Same as High Day		
29	SENDERS-OUTAGE-MAX	18 – (27+28)		Same as High Day		
30						

Load-service relationship . . .



IN-SERVICE REQUIREMENTS

CROSSBAR TANDEM SENDERS						
1	BUILDING: MAIN STREET	3	YEAR: 4-1-71		5	NO. INSTALLED: 120
2	TANDEM: INTER-AREA	4	TYPE: (INPULSING) MF		6	IST: YES ✓ NO
		HISTORICAL PERFORMANCE				REMARKS
		OPERATION	HIGH DAY	10 HIGH DAY	AVERAGE BUSY SEASON	
7	TOTAL USAGE		3240		3156	
8	MTCE USAGE		72		124	
9	TFFC USAGE	7 – 8	3168		3032	
10	MAXIMUM USAGE	5 x 36 CCS	4320		4320	
11	% OCCUPANCY	7 ÷ 10 (X100)	73		70	
12	TLF PEG COUNT		53219		50141	
13	HOLDING TIME	9 ÷ 12	5.9		6.0	
14	TOTAL MARKER USAGE		225		202	
15	% MARKER OCCUPANCY		78		72	
16	MARKER ADJ.		.14		.13	
17	% SAD > 3"		.2		.2	
			DESIGN			
18	NO. INSTALLED	5	120		120	
19	MTCE SENDERS		6		6	
20	TFFC SENDERS	18 – 19	114		114	
21	CCS CAPACITY		3192		2998	
22	HOLDING TIME		6.1		6.1	
23	MARKER ADJ.		.14		.13	
24	TRUNK GUARD INT.		.0075		.0075	
25	ADJ. HOLDING TIME		6.25		6.24	
26	CALL CAPACITY	21 ÷ 25	51072		48044	
				REQUIREMENTS		
27	TFFC SENDERS-MIN	9 ÷ CCS/SDR	113	Same as High Day	111	
28	MTCE SENDERS-MAX	19	6	Same as High Day	6	
29	SENDERS-OUTAGE-MAX	18 – (27+28)	1	Same as High Day	3	
30						
						SW.

CROSSBAR TANDEM

Marker In-Service Requirements

1.	Building:	4.	Type (Ring-Route Relay):
2.	Tandem:	5.	No. of Trunk Link Frames:
3.	Number of Markers Installed:	6.	No. of Office Link Frame Pairs:

Historical Data

		Operation	High Day Data
7.	Total Marker Usage	From Data	
8.	Total Marker Peg Count	From Data	
9.	Usage per Marker	Line 7 ÷ Line 3	
10.	Peg Count per Marker	Line 8 ÷ Line 3	
11.	Holding time per Marker	Line 9x100 ÷ Line 10	
12.	TUR Adjustment Factor	See Instruction	
13.	Adjusted Holding Time	Line 11 + Line 12	
14.	Adjusted Usage	Line 13x Line 8 ÷ 100	
15.	Maximum Usage	Line 3x36 CCS less Mtce CCS	
16.	% Occupancy	Line 14 ÷ Line 15x100	
17.	Office Link Frame Seizures Ratio	From Data	
18.	Theoretical Holding Time	See Instruction	

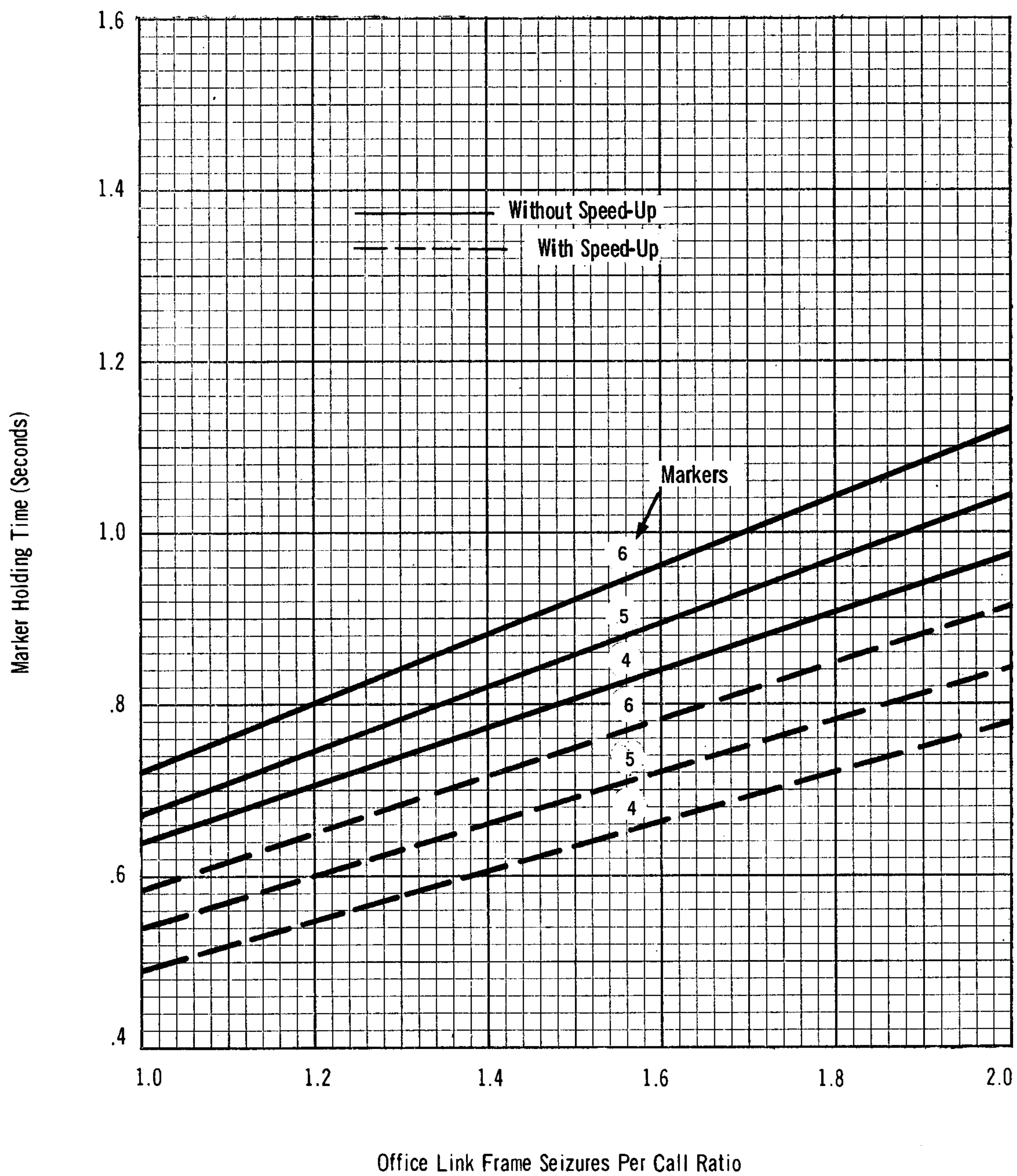
Capacity Study

19.	No. of Markers Installed	Line 3			
20.	Markers Not Available	Hypothetical	(a) 0	(b) 1	(c) 2
21.	Traffic Markers	Line 19 – Line 20			
22.	80% Load	Line 21 x 28.8 CCS			
23.	Office Link Frame Seizures Ratio	Line 17 or NEW			
24.	Calculated Holding Time	@ 100% Occupancy			
25.	Holding Time @ 80% Occ.	Line 24 x .80			
26.	Marker BH Call Capacity	Line 22 ÷ Line 25 x 100			
27.	Time Frames	BH, Side Hours, Nights, etc.			
28.	No. of Markers Req'd				

Notes:

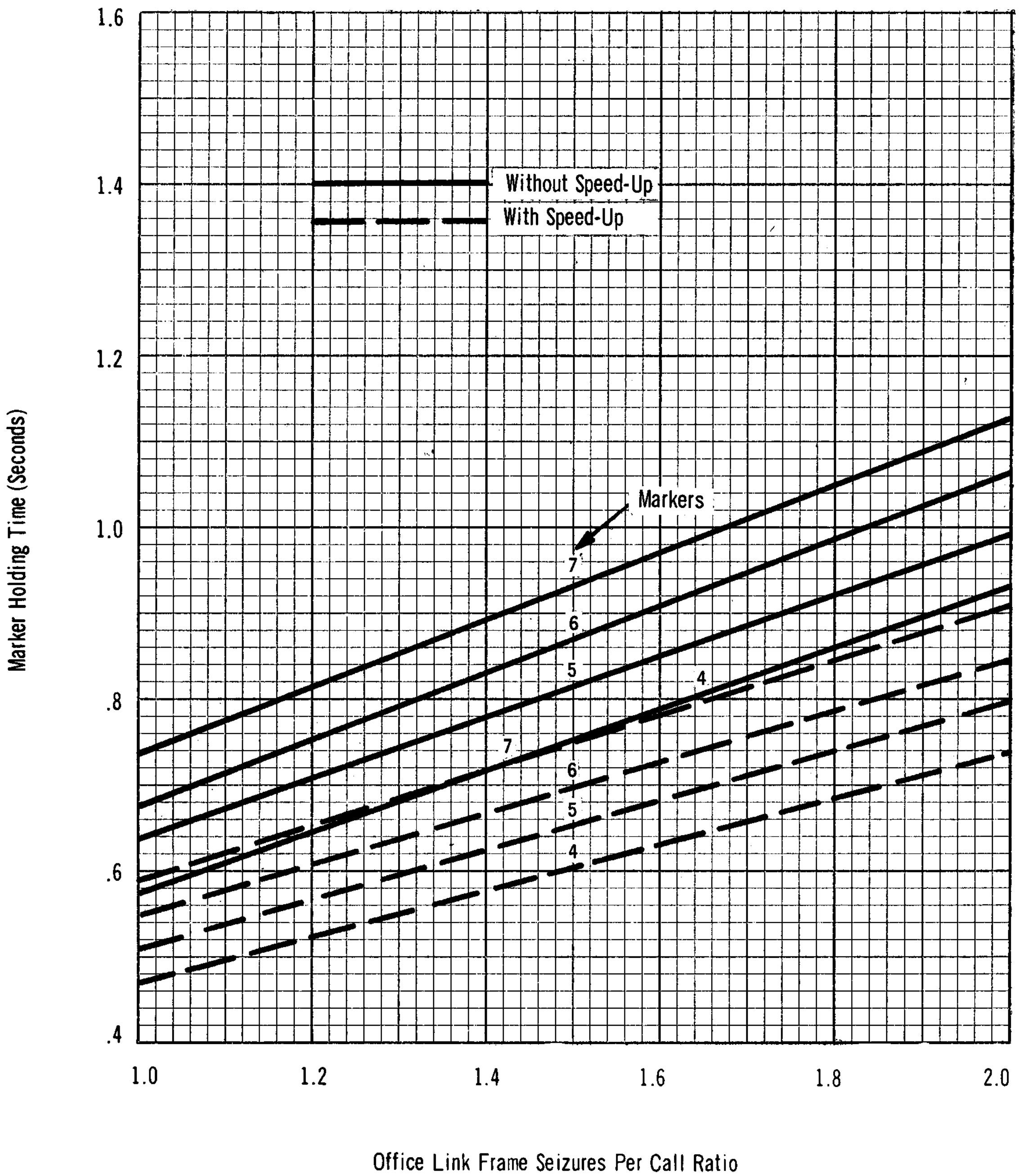
CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
12-6



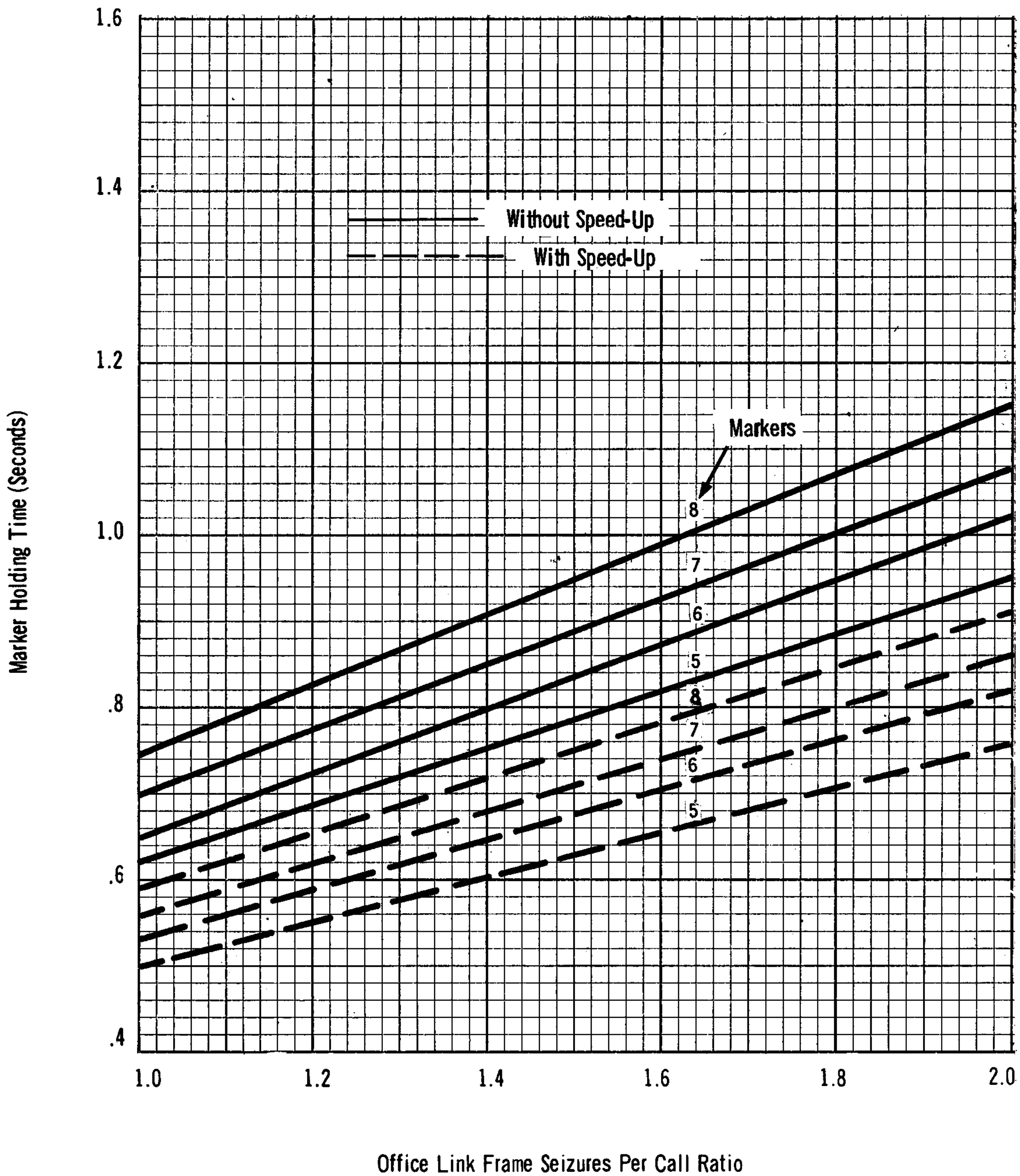
CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
14-7



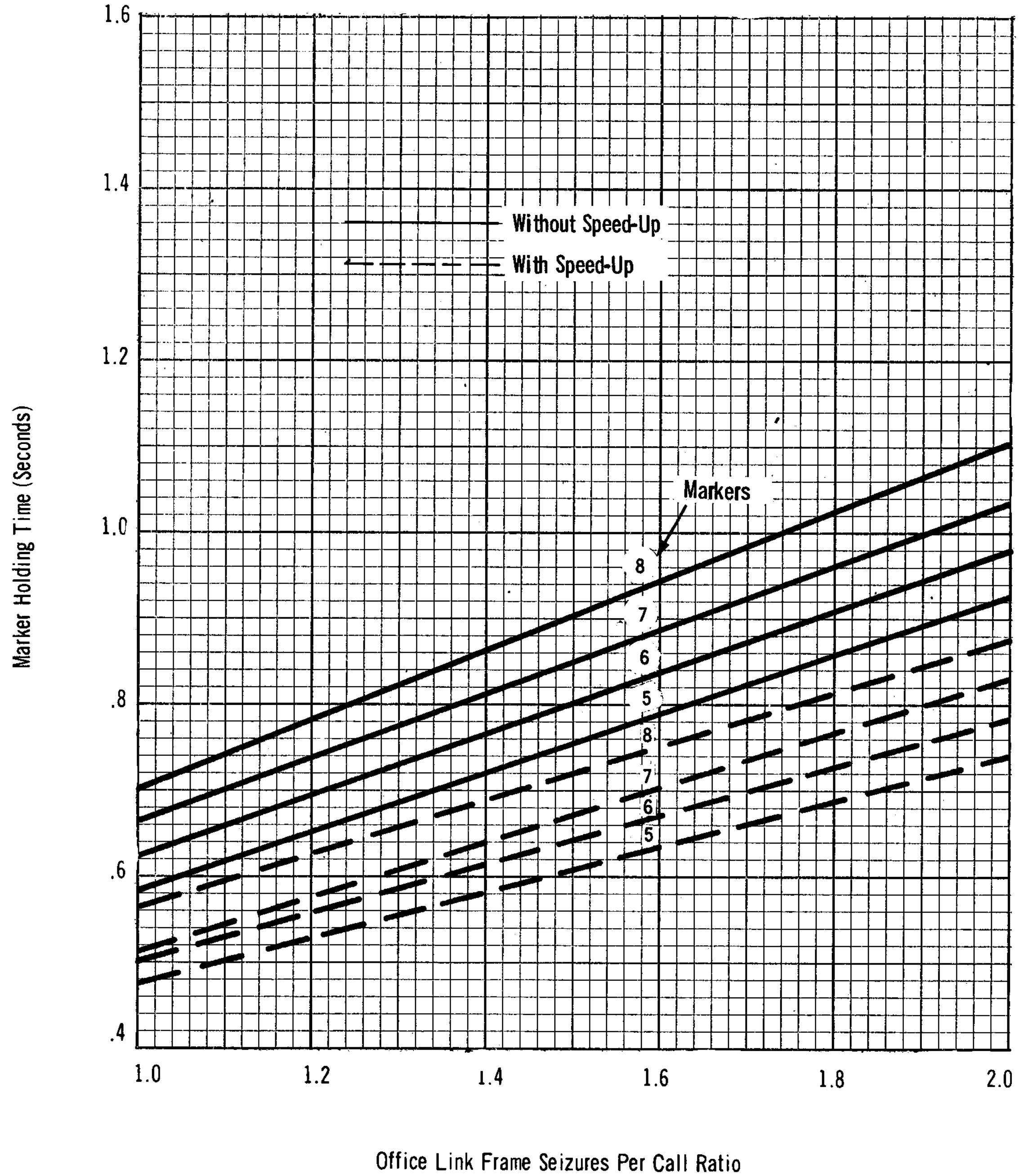
CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
16-8



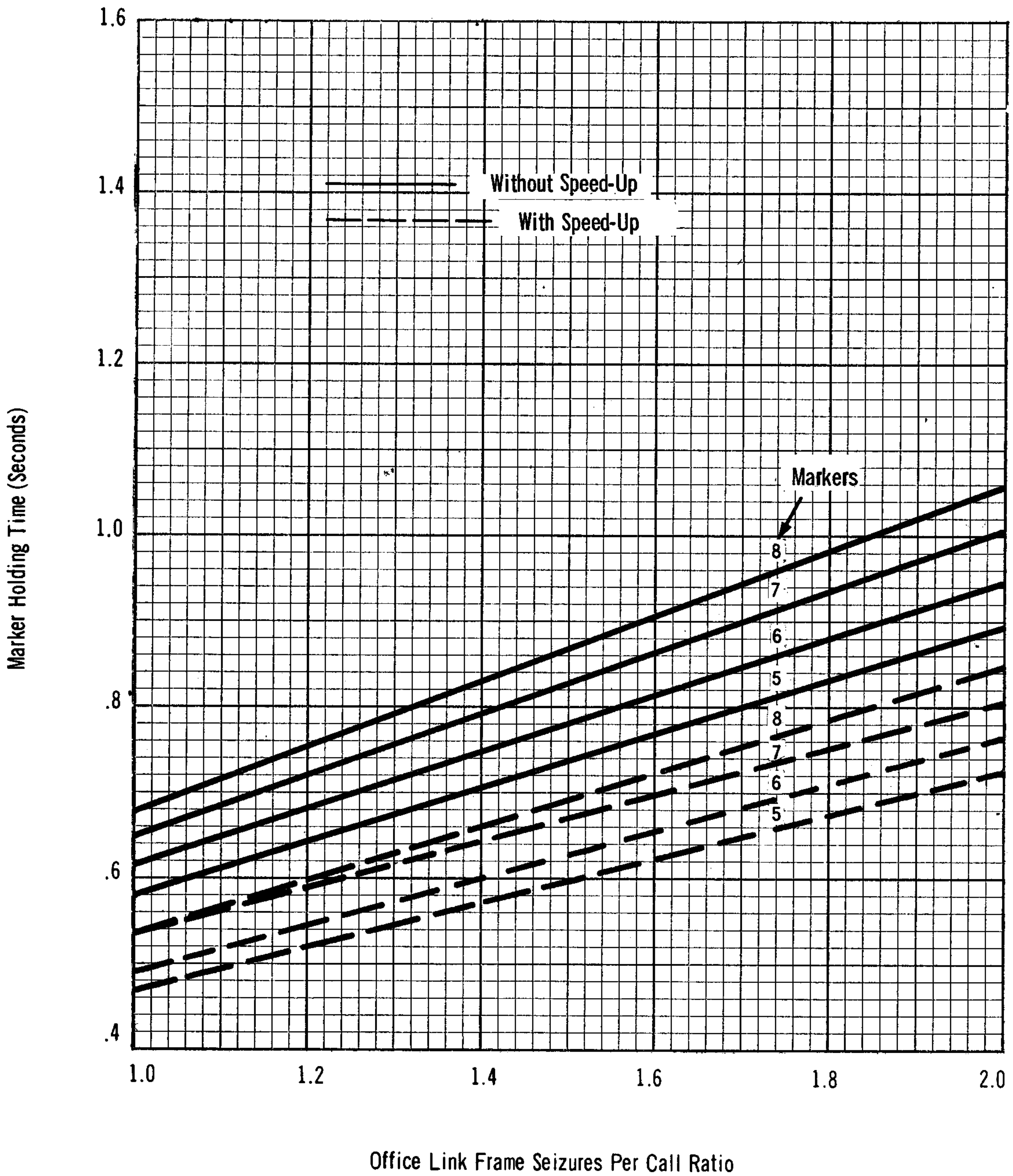
CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-DLFP
18-9

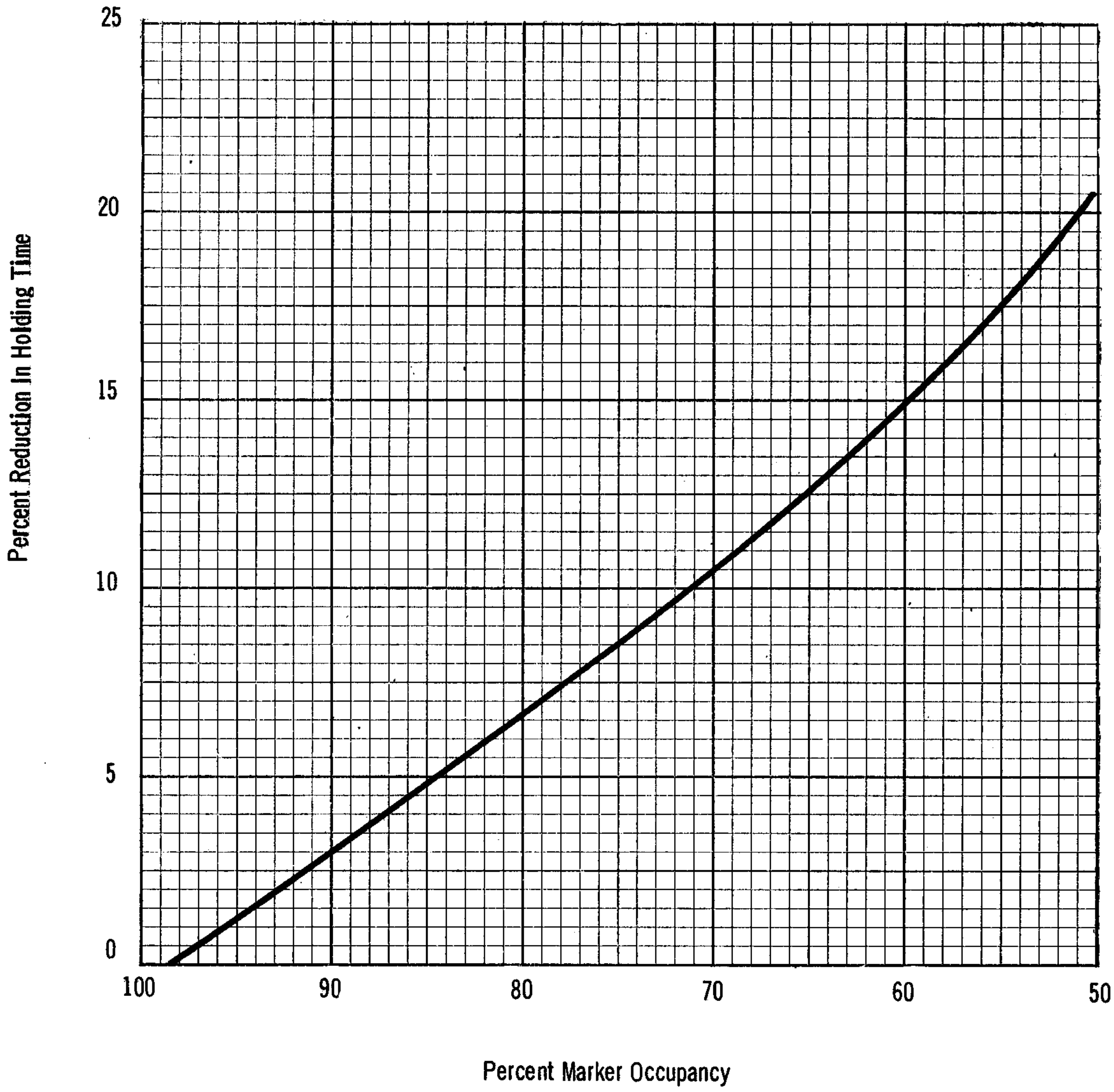


CALCULATED MARKER HOLDING TIME CHART
100% OCCUPANCY

TLF-OLFP
20-10



MARKER HOLDING TIME OCCUPANCY



This Chart provides the approximate percent change in Marker Holdings, in relation to Change in occupancy for the following office sizes:

Mkrs	TLF 5	OLFP
8	20	10
7	18	9
6	16	8
5	14	7
4	10	5
3	6	3

CROSSBAR TANDEM

Marker In-Service Requirements

1.	Building: MAIN STREET	4.	Type (Ring-Route Relay): Route Relay
2.	Tandem: INTER-AREA	5.	No. of Trunk Link Frames: 18
3.	Number of Markers Installed: 8	6.	No. of Office Link Frame Pairs: 9

Historical Data

		Operation	High Day Data
7.	Total Marker Usage	From Data	177.6
8.	Total Marker Peg Count	From Data	29350
9.	Usage per Marker	Line 7 ÷ Line 3	22.2
10.	Peg Count per Marker	Line 8 ÷ Line 3	3670
11.	Holding time per Marker	Line 9x100 ÷ Line 10	.66
12.	TUR Adjustment Factor	See Instruction	.022
13.	Adjusted Holding Time	Line 11 + Line 12	.682
14.	Adjusted Usage	Line 13x Line 8 ÷ 100	200
15.	Maximum Usage	Line 3x36 CCS less Mtce CCS	288
16.	% Occupancy	Line 14 ÷ Line 15x100	69
17.	Office Link Frame Seizures Ratio	From Data	1.30
18.	Theoretical Holding Time	See Instruction	.64

Capacity Study

19.	No. of Markers Installed	Line 3	8	8	8
20.	Markers Not Available	Hypothetical	(a) 0	(b) 1	(c) 2
21.	Traffic Markers	Line 19 — Line 20	8	7	6
22.	80% Load	Line 21 x 28.8 CCS	230.4	201	172.8
23.	Office Link Frame Seizures Ratio	Line 17 or NEW	1.16	1.16	1.16
24.	Calculated Holding Time	@ 100% Occupancy	.77	.73	.69
25.	Holding Time @ 80% Occ.	Line 24 x .80	.62	.58	.56
26.	Marker BH Call Capacity	Line 22 ÷ Line 25 x 100	37161	34655	30857
27.	Time Frames	BH, Side Hours, Nights, etc.	BH	DAYS	EVES.
28.	No. of Markers Req'd		8	7	6

Notes:

MOP-T-1

IN-SERVICE REQUIREMENTS

Crossbar Tandem

Job No.____________________ Date Start ____________________ Date Complete ____________________________ Service Date______________

Type Equipment	Class	Busy Hour-Busy Season Actual Average		Number of Facilities				Estimated Service Levels				Note No.
						Out-of-Service*		% SADR (.5%)		% Ineff. Att. (2.0 %)		
		Calls	CCS	Busy-Hour In-Service Req'mts	Total Present Installed	Busy-Hour Maximum	Side-Hour Maximum	Busy-Hour	Side-Hour	Busy-Hour	Side-Hour	
1	1a	2	3	4	5	6	7	8	9	10	11	12

Remarks:

Prepared By: ______________________________
Date

* Includes Maintenance Outages

CROSSBAR TANDEM SERVICE SUMMARY

BUILDING:____________________ BUSY HOUR:____________

TANDEM: ____________________

			TOTAL BH COUNT	% FAILURE
1	MARKER ATTEMPTS (000)			
2	% OF MARKER ATTEMPTS	REORDER		
3		VACANT CODE ANNOUNCEMENT		
4		SENDER OVERLOAD ANNOUNCEMENT		
5		NC INTERTOLL		
6		NC TOLL CONNECTING		
7		TOTAL		
8		FINAL HI AND DRY		
9	TRANSVERTER ATTEMPTS			
10	% MISROUTED NON-CAMA CALLS			
11	INCOMING REGISTER ATTEMPTS			
12	% OF INCOMING REG ATT	PERMANENT SIGNALS		
13		PARTIAL DIAL		
14		NO SENDER ATTACHED		
15	TRANSVERTER ONI ATTEMPTS			
16		WRONG CALLING CODE		
17		NO POSITION ATTACHED		
18		POSITION DISCONNECT		
19	BUSY HOUR % SENDER DELAY OVER 3 SEC-M.F.			
20	-D.P.			
21	-R.P.			
22	-P.C.I.			
23	TRUNK LINK FRAME OVERFLOWS			
24	OFFICE LINK FRAME OVERFLOWS			
25	BUSY HOUR % MATCHING LOSS			

SD-4-2850 (5-69)

Page 1 of ________Pages

METHOD OF PROCEDURE

AUTHORIZATION

Town______________________________Office________________Date__________

Start-Date____________Time__________Completion-Date_______________Time______

W.E. Co. Order No.________________________Tel. Co. Spec.__________________

Type of Plant____

General Description of Work____

____

____

____

____

This job has been reviewed and agreement reached on items listed on Page 2 of this Method of Procedure.

Responsibility for supervision of this job is assigned to ---

W.E. Co. Supervisor_____________________________Title____________________

Tel. Co. Supervisor_____________________________Title____________________

M.O.P. Prepared by (W.E.Co.)_____________________________________Date__________

The undersigned approve this step by step procedure starting with Page 3. No changes shall be made without the approval of the Telephone Co. Plant Manager and the Western Electric Company Supervisor.

Concurred in by W.E. Co. Supervision

__________________________________Title__________________________Date__________

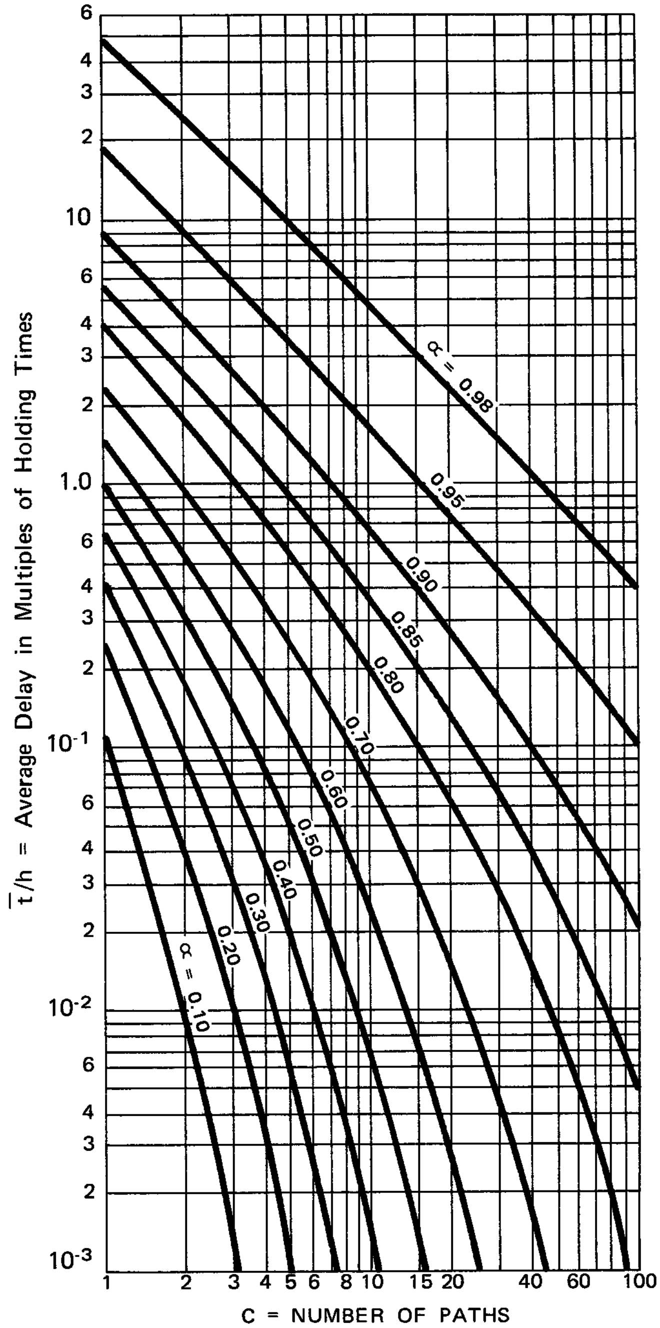
__________________________________Title__________________________Date__________

Approved by Tel. Co. Supervision

__________________________________Title__________________________Date__________

__________________________________Title__________________________Date__________

__________________________________Title__________________________Date__________



Average delay on all calls, exponential holding times.

$\bar{t}$ = Average Delay

h = Marker Holding Time

c = No. of Markers

∝ = Occupancy