

TELEPHONE TRAFFIC - MANUAL TOLL BOARD EQUIPMENT

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1. GENERAL

- 1.1 This section is intended to provide REA borrowers, consulting engineers, contractors and other interested parties with technical information for use in the design and construction of REA borrowers' telephone systems. It describes in particular the arrangement and quantities of equipment required for the manual toll switchboard at a toll center which does not handle through traffic.
- 1.2 A manually operated toll board is required at a toll center to handle outward toll calls originating at the toll center and at its tributaries and inward calls that cannot be completed by dialing. In case customer toll dialing is planned, the number of positions required would be reduced, but for the foreseeable future, some operators will still be needed for handling person-to-person, collect, coin-station and certain other classes of traffic.
- 1.3 A toll switchboard should be designed to handle toll calls originating or terminating at dial, common battery manual and at magneto local offices. This involves handling connections to or from dial and ringdown interoffice trunks.
- 1.4 Toll boards installed by REA borrowers generally handle assistance calls from local dial offices and in many cases also information, intercept and repair services. Assistance calls are received over tributary and CIR trunks and are handled on the same switchboard facilities that are provided for toll traffic. Information, intercept and repair services may be handled on a separate desk or on one or more special positions at the head of the toll board. Where a separate desk is provided it is customary to install an appearance of each incoming trunk on the first toll position with a transfer key for night operation.

- 1.5 Cord-type toll boards are less costly than cordless boards and the latter rarely can be justified. However, if a cordless board already is in service it may be necessary to add cordless positions to provide for growth. The same functions are performed by either type and the engineering procedures described in this section should be applicable for such additions.
- 1.6 Reference to the Specifications - Toll Office Equipment - REA Form 542 and to the following sections of the REA Telephone Engineering and Construction Manual will be helpful in the understanding and application of the material in this section.
- 156 - Nationwide Toll Dialing
  - 157 - Customer Toll Dialing Within Limited Networks
  - 211 - Manual vs Dial Operation
  - 501 - Telephone Traffic - Qualitative Discussion
  - 510 - Telephone Traffic - Dial Central Office  
Equipment Switch Quantities
  - 511 - Telephone Traffic - Dial Equipment for Toll  
Centers

## 2. ARRANGEMENT OF EQUIPMENT

- 2.1 Figure 1 illustrates the type and the general location of the jacks provided in a typical toll board. The usual arrangement is to place answering jacks in the lower part of the section and completing jacks in the upper portion. This favors quick perception of signals by the operators who normally keep their eyes on the key shelf.
- 2.2 Following is a description of the equipment associated with each type of jack and the kinds of trunks terminated on each.
- 2.21 Miscellaneous Answering Jacks: designation strip, jacks, line lamps. These jacks are used for terminating one-way incoming trunks such as the following:
- a. Inward Operator - Code 121
  - b. Universal TX - Code 1150
  - c. Interposition, where provided.
  - d. Information Trunks from banks of local and toll auxiliary selectors (Codes 113 and 131, respectively.)
  - e. Intercept and Repair

- 2.22 CIR Trunk Answering Jacks: designation strip, jacks, line lamps. One-way CIR trunks from the local first selectors at the toll center are terminated on these jack strips. Trunks from the first level of incoming EAS selectors also are terminated on these jacks where one group is used for both toll and EAS and dual-function trunks are provided.
- 2.23 Toll Trunk Multiple Jacks With Lamps: combined designation strip and busy lamps, jacks and line lamps. This jack strip is used for terminating ringdown intertoll and most tributary office trunks. These trunks generally are two-way and the jacks are used for both outgoing and incoming calls. Idle-trunk indicating may be used in place of busy lamps but the higher cost usually is not warranted.
- 2.24 Toll Trunk Multiple Jacks Without Lamps: combined designation strip and busy lamps and jacks. Dial one-way or two-way intertoll trunks and tributary trunks handling both toll and EAS traffic are terminated on this strip for use as outgoing trunks.
- 2.25 Miscellaneous Outgoing Trunk Multiple Jacks: combined designation strip and busy lamps and jacks. The major part of this jack strip is used to terminate one-way outgoing toll switching trunks, including verification trunks, to the local office at the toll center. Where provided, trunks to chief operator, service assistant, wire chief, information, repair desk, interposition, etc., also appear on this strip.
- 2.3 Usually dials are provided on the smaller toll switchboards and key sets on the larger ones. Key sets are faster and more accurate than dials and some manufacturers state that they can furnish them at a relatively low cost. Key senders usually are provided on the basis of one per position but they may be arranged in one common group to which all positions have access. In the latter case, the number required may be based on about 30 uses per hour per position and a holding time per use of 12 seconds unless there is reason to believe other figures would be more accurate. It is suggested that table P = .001 be used, (1 delay in 1,000) in engineering these senders. (See REA-TE and CM-510, Figure 3).

- 2.4 Toll switchboards normally are wired to provide a multiple appearance every 3, 4 or 5 panels. A three-panel multiple is more convenient for operators but requires two-thirds more jacks than a five-panel multiple. For a large switchboard the increased cost would be a major consideration favoring a four or even a five-panel multiple.
- 2.5 With toll dialing and present-day delayed call practices it is not economical to provide specialized inward, CIR and delayed outward positions. Each operator is expected to handle any kind of a toll or assistance call and it therefore is desirable to multiple jack strips throughout the board. Information, intercept and repair trunks generally are restricted to one or two appearances at the head of the board, either for full time operation or for night use when a separate information desk is provided. Intercepted calls at tributaries may be routed over toll trunks with a distinctive tone to indicate the nature of the call and in such cases would be handled at any position unless the intercept records are filed at the information position, to which calls then must be transferred.
- 2.6 Facilities need to be provided to permit an operator to verify reports of repeated "Busy" on any line in the toll center or at any dial tributary. This presents no problem as long as operators use trunks to which customers have no access. However, where operators and customers use the same trunks, as in combined toll and EAS groups, or with customer toll dialing, special measures are necessary to prevent customers from gaining access to busy lines. Following are some of the methods for avoiding this danger or at least minimizing the possibilities.
- 2.61 Verification of busy lines at the toll center usually is by means of special trunks which appear only on the toll board and to which customers have no access.
- 2.62 When there are five or more trunks in a tributary group, one trunk may be assigned for operator use only at the toll center end, and this would be the only trunk given access to the test distributor. This trunk should be last choice for outgoing calls at the tributary and last choice for the operators at the board. It is designated to show that it can be used for verification.

- 2.63 For groups of four or less trunks, only the last choice trunk for incoming customer dialing calls may be arranged for access to the test distributor. It would be so designated on the switchboard and would be the first choice for operators and first choice for outgoing calls at the tributary. Under this plan, incoming calls dialed by customers would hunt over the entire trunk group and if the last choice trunk is the only one idle, users could get access to a test connector, if they knew the code, but it could not well be done deliberately as most calls would go over the trunks with no such access.
- 2.64 The company operating the toll center may request use of the code "00" for reaching the verification selector in the dial tributary office and this will prevent customer access provided the call originates at or switches through a common control dial system. It is of no value where the dial system is of the "direct control type."

### 3. POSITION REQUIREMENTS

- 3.1 The number of toll positions required depends on the following factors:
- a. Volume of Traffic - Toll messages per day, busy season.
  - b. Traffic units per toll message.
  - c. Percent busy hour of day.
  - d. Busy hour traffic units per position (load).
- 3.2 The volume of traffic can be obtained from the estimated toll calling rates and number of lines to be served. All toll messages originating at the toll center and its tributaries which are to be ticketed and timed on the toll board should be included. The figure to be used is the estimated messages on average business days (ABD) at the end of the engineering period increased, where necessary, to reflect busy season conditions.
- 3.3 In the event that dependable data are not available or if there is doubt about forecasting the values for the basic factors, the number of positions required may be estimated on the assumption that 125 messages per day can be handled by each position. Once the dial conversion has been completed, data should be accumulated and future position requirements developed from actual experience.

- 3.4 Where regular and supplementary toll peg counts have been taken and equated in terms of traffic units, the units per message, percent busy hour and busy hour units per position (load) are available for existing conditions. However, the units per message change materially with the conversion of ringdown intertoll and tributary trunks to dial operation, replacement of manual tributaries with unattended dial offices and the conversion of the local system at the toll center to dial. The effect of each of these factors may be estimated or it may be assumed that the over-all units per message decrease about 25 percent with the conversion of all offices and trunks to dial operation. For partial conversions the decrease would be proportionally less.
- 3.5 The current percent busy hour of total day may be used unless there is reason to believe it will change. The busy hour load for the future may be estimated on the basis of past experience with actual loads carried and the service given. When there is doubt as to the load that can be carried at the end of the engineering period a figure of 230 traffic units in the busy hour per position may be assumed for engineering purposes.
- 3.6 When the individual factors are estimated, the number of positions required is developed as follows:

$$\text{Positions} = \frac{\text{Messages Per Day} \times \text{Units Per Message} \times \% \text{ Busy Hour}}{\text{Busy Hour Load}}$$

For example with basic figures as follows:

Messages Per Day (Estimated)	- Average for Year	575
	Busy Season (+ 5%)	604
Traffic Units Per Message	- Present	24
	Estimated (- 25%)	18
Percent Busy Hour (Estimated)		11
Busy Hour Load		230

$$\text{Estimated Positions} = \frac{604 \times 18 \times .11}{230} = 5$$

4. TRUNK REQUIREMENTS

- 4.1 A toll switchboard includes jacks for terminating the following types of trunks:
- a. Intertoll
  - b. Tributary
  - c. CLR
  - d. Toll Switching
  - e. Miscellaneous such as Inward Operator, Delayed Operator, (TX), Service Assistant, Information, etc.
  - f. Toll Terminal - (Where Required)
- 4.2 The number of intertoll and tributary trunks and the method of operation of each group are shown on the Trunk Schematic, Exhibit F, of the Area Coverage Design. This is developed in discussions with the Connecting Companies involved or in the case of tributary groups owned by the borrowers, as described in Section 510 of the REA-TE and C Manual.
- 4.3 CLR trunks are used to give customers at the toll center access to the toll board. The number may be estimated on the basis of a 300 second holding time per busy hour message originating at the toll center and probability table  $P = .01$ . (See Section 510 of REA-TE and CM). This method should provide enough trunks to handle both the toll and the assistance traffic where the customer dials the same code for both. (Single channel operation) Where both toll and EAS traffic are handled on a tributary group, the trunks terminate on a selector and a group of CLR trunks is provided from level "1" of the selectors to the toll board for each of such tributaries. These are engineered as described above on the basis of volume of toll traffic from the tributary.
- 4.4 Toll switching trunks are one-way trunks from the toll board to incoming toll selectors in the local office. They are used for completing calls originating at tributaries and terminating at the toll center, for making subsequent attempts on delayed outward calls and for completing assistance calls and incoming calls from any ringdown intertoll trunks. For the initial installation of toll switching trunks it may be assumed that two-thirds of the busy hour toll messages originating at tributaries and one-third of the messages originating at the toll center will be completed over toll switching trunks unless there is reason to believe some other

fraction would be more accurate. For example, if EAS is provided between a tributary and its toll center there will be no need for toll switching trunks for tributary office traffic. The number of trunks required may be based on a 300 second holding time and probability table  $P = .01$ . This should provide enough trunks for the toll traffic and the assistance calls.

4.5 Following is a list of the miscellaneous trunk groups generally required for a small toll switchboard:

- a. Toll Assistance - Code 121 (Inward Operator)
- b. Toll Information, Incoming - Code 131 (where no separate information desk is provided).
- c. Delayed Call Operator - TX Code 1150
- d. Wire Chief or Test Board
- e. Information, Outgoing
- f. Service Assistant

4.51 The total volume of traffic received over the trunks from codes 121, 131 and 1150 is developed as described in RFA-TE and CM Section 511. Specialized inward positions usually are not warranted and a combined trunk group may be provided for codes 121 and 1150. Under these conditions the number of trunks is developed from the busy hour traffic volume in unit calls and a probability table of  $P = .01$ . Where separate trunk groups are provided, there should be a minimum of two trunks in each group.

4.52 Where trunks to wire chief or test board, information or service assistant are desired, it is suggested that a minimum of two trunks be provided in each group. For most REA borrowers' toll centers it is customary to place a local telephone on the chief operator's desk rather than to provide a turret and special chief operator trunks. Also, interposition trunks are no longer considered necessary on small toll boards.

4.6 Toll terminals are direct trunks to the toll board from hotels, attended paystations, Government PBX's and possibly from a few large toll users for originating toll calls. Their use saves dial central office equipment and permits direct identification of the calling number. Toll terminals are not suitable for handling traffic incoming to these users as they cannot be reached by dialing.



4.7 Information, intercept and repair service incoming trunks may be terminated on a special desk or on a strip of jacks at the head of the toll board. Where a separate desk is provided it is customary to transfer the trunks at night to a strip of answering jacks near the head of the toll board.

4.8 A few trunk groups, such as delayed call (TX) and inward operator, are connected both to the toll dial equipment and to the toll board. The function of these trunks and the calculation of the number required is covered in both Section 511 of the REA-TE and CM and in this section in order to make each section as complete as feasible and to avoid the need for frequent cross reference.

5. EXAMPLE OF TOLL BOARD ENGINEERING

5.1 To illustrate the calculation of position and trunk requirements for a typical small toll center an example has been prepared based on the following data:

<u>Intertoll Trunk Groups</u>	<u>Operation</u>	<u>Number</u>
A-B	Dial	15
A-C	Dial	3
A-D	Dial	<u>5</u>
	Total	23

<u>Tributary Trunk Groups</u>		
A-E	Dial	4
A-F	Ringdown	6
A-G	Dial	2
A-H	Dial	<u>4</u>
	Total	16

Originating Toll Messages at Toll Center Per Day-Busy Season 300  
 Originating Toll Messages at Tributaries Per Day-Busy Season 400

A is the toll center office for which the toll board is to be engineered, B, C and D are distant toll centers and E, F, G and H are tributaries of A. Information and intercept are handled on the toll board. The above information on trunks can be obtained from the Trunk Schematic in the ACD. All figures are estimates for the end of five years.

- 5.2 Number of Positions. Assume that no peg count information is available and that the number of positions is based on handling 125 messages per day per position.

Total Messages Per Day	300 + 400 = 700
Positions Required	700 ÷ 125 = 5.6

Six positions should be adequate for handling the information, intercept and assistance traffic in addition to the toll business.

5.3 Switchboard Multiple

- 5.31 Toll line multiple (with line lamp). As there are 16 tributary trunks 20 jacks are needed since switchboard jacks are provided in multiples of 10 or 20.
- 5.32 Toll line multiple (without line lamp). There are 23 intertoll trunks, therefore 30 jacks are needed.
- 5.33 Answering jacks are required for the following trunk groups:

CIR  
 Inward - Code 121  
 Delayed Call Operator (TX) - Code 1150  
 Information - Code 131

In the example it is assumed that there are no specialized inward or TX positions. Therefore, one combined group serves these two functions.

- 5.331 The number of CIR trunks is determined as follows:

Originating Toll Messages Per Day	300
Percent Busy Hour of Day (Est.)	12
Messages Busy Hour	36
Holding Time - Seconds (Est.)	300
Unit Calls $36 \times 300 \div 100 =$	108
CIR Trunks (Basis P = .01)	9

- 5.332 The number of trunks from codes 121 and 1150 is determined in the calculation of the toll dial switching equipment as described in Section 511 of the TE and CM. For this example five trunks are required where they are in one group.

- 5.333 If it is desired to provide separate trunk groups for 121 and 1150, it may be assumed that each will carry half of the traffic. Each group would require four trunks in the example.
- 5.334 Two trunks are assigned to information on the basis that this is the minimum for any intra-office group. These usually appear on one strip of answering jacks at the head of the board where no separate information desk is provided.
- 5.335 Under the two alternatives described, the number of multiple answering jacks required for trunks from codes 121 and 1150 will range from 5 to 8. The total multiple answering jacks, including those for CLR trunks, will vary from 14 to 17 and 20 jacks are required.
- 5.336 One appearance of a separate strip of answering jacks on the toll board will be provided for information and intercept trunks. Even where there is a separate information desk such a strip of answering jacks ordinarily is provided as a night appearance of these trunk groups.
- 5.34 Miscellaneous outgoing trunks are needed for toll switching trunks which give access to the local office at the toll center and for a few small groups such as information, wire chief or test board, service assistant and cord test.
- 5.341 The number of toll switching trunks required is determined in accordance with Paragraph 4.4 as follows:

Messages from Tributaries	400
Terminating at Toll Center (400 x .667)	267
Messages from Toll Center	300
Delayed Calls Completed over Toll	
Switching Trunks (300 x .33)	100
Total Messages (267 + 100)	367
Percent Busy Hour of Day (Est.)	11
Messages Busy Hour	40.4
Holding Time (Est.)	300 Seconds
Unit Calls (40.4 x 3)	121.2
Trunks Required (P = .01)	9

5.342 Trunk requirements for other groups are estimated to be as follows:

Information	2
Test Board	2
Service Assistant	2
Cord Test	<u>1</u>
Total	7

5.343 The total miscellaneous outgoing trunks are  $9 + 7 = 16$  and 20 jacks are needed.

5.4 Figure 1 illustrates the arrangement of the face equipment on a typical small toll board with the quantities developed in the example.

Section		1					2					3		
Position		1		2			3		4			5		
Panel		1	2	3	4	5	6	7	8	9	10	11	12	13
Tkt. Comp.			T		T			T		T			T	
Misc. Out														
Trk. Mult.			20				20				20			
Toll Trk.	a		10	10	10		10	10	10		10	10		
	b	10	10			10	10			10	10			10
CLR														
Trunks			10				10				10			
Misc. Ans.			10											
Jacks				10				10				10		

- a. Without Line Lamps
- b. With Line Lamps
- c. Information, Intercept, Repair

TYPICAL TOLL BOARD FACE EQUIPMENT  
 (4 Panel Multiple)  
 Figure 1