

# DESCRIPTION OF TRANSMISSION TEST REQUIREMENT TABLES

## 1. GENERAL

1.01 This section describes the transmission test requirement tables and transmission notes as shown on the circuit drawings and replaces Sections K15.05, Issue 2 and E14.101, Issue 1. It is reissued to add a description of the "Transmission Notes" part 5., and to cover "Return Loss" requirements and the methods of including them in the Transmission Test Requirements Tables, and to cover minor changes to bring the information up to date in accordance with that shown on the circuit drawings.

1.02 The transmission test requirement tables and transmission notes form a part of the circuit drawings.

1.03 Two general types of transmission test requirement tables are shown on circuit drawings. One type covers 1000 cycle loss requirements and is described in part 2. The other type covers gain requirements at single and multi-frequencies, and loss requirements at multi-frequencies, and is described in part 3.

1.04 In some cases return loss or singing point and composite set impedance unbalance requirements are shown on the transmission test requirement tables. They are described in part 4.

1.05 In cases where the testing information cannot readily be specified in transmission test requirement tables, notes covering this information are shown on the circuit drawings. These notes are described in part 5.

1.06 Information given in the transmission test requirement tables and transmission notes does not include losses of switchboard wiring or the conductor losses of the outside plant.

1.07 Information in the transmission test requirement tables and transmission notes is revised when necessary in connection with circuit changes and is accordingly kept up to date by this means.

## 2. DESCRIPTION OF TABLE USED FOR 1000 CYCLE LOSS REQUIREMENTS

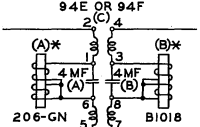
2.01 **Title of Table:** Each transmission test requirement table has the title "TRANSMISSION TEST REQUIREMENTS (1000 CYCLE LOSS BETWEEN 600 OHM LINES)".

2.02 **Form of Table:** The 1000 cycle loss transmission test requirement table shown on circuit drawings is usually of the type illustrated either in Fig. 1, Fig. 2 or Fig. 3. It is divided into two main divisions which are fixed, except that the part of the table giving the maximum allowable circuit loss is subdivided when necessary to fit the circuit conditions. One of the main divisions is arranged for the transmission losses for the circuit in its talking condition and the other for the transmission losses of the individual pieces of apparatus involved. The specified losses apply to the condition of test only and, while they serve to check the condition of the equipment, they do not always correspond to the loss under actual talking conditions.

### Transmission Losses for Circuit

2.03 The transmission losses shown in the table are the losses at 1000 cycles between 600-ohm impedances and do not necessarily bear any close relation to the loss assignable to the apparatus in computing the overall equivalent of a complete circuit between subscribers.

2.04 Referring to Fig. 1 it is to be noted that the top part of the table is divided into two parts. The part at the left consists of a diagram of the transmission circuit and the part at the right gives the maximum allowable circuit loss in decibels (db). In some cases, as shown in Fig. 2, the maximum allowable circuit loss is shown directly under the sketch of the transmission circuit. When losses for more than one

| TRANSMISSION TEST REQUIREMENTS<br>(1000 CYCLE LOSS BETWEEN 600Ω LINES)               |  |  |                                                        |  |  |
|--------------------------------------------------------------------------------------|--|--|--------------------------------------------------------|--|--|
| 211.041 L4                                                                           |  |  | MAX. ALLOWABLE CIRCUIT LOSS                            |  |  |
|  |  |  | WITH 94E REP COIL - 1.2db<br>WITH 94F REP COIL - 1.7db |  |  |
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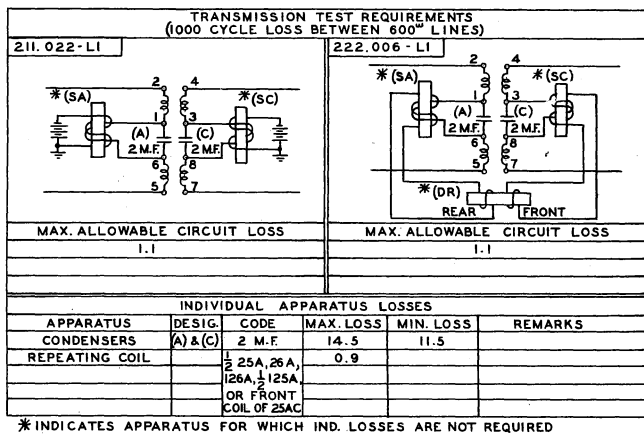


Fig. 2

transmission condition are required for a circuit, provision is made for the additional space required for the associated maximum allowable circuit losses.

2.05 Each piece of apparatus is designated on the diagram with the same designation given it on the circuit drawing. The number in the upper left-hand corner of the space given over to the diagram (see Fig. 1) is the file number of the transmission condition and should be disregarded.

2.06 In the space below the sketch or at the right side of it, the transmission loss in decibels (db) is given under the heading "MAX. ALLOWABLE CIRCUIT LOSS." In certain cases, as shown in Fig. 3, such as in specifying the loss for an operator's telephone circuit, the space under the heading "MAX. ALLOWABLE CIRCUIT LOSS" is divided into two parts to provide for bridged and transmitting losses. These divisions are headed "BRIDG." and "TRANS." respectively. When the loss is specified for a monitoring transformer, the divisions are headed

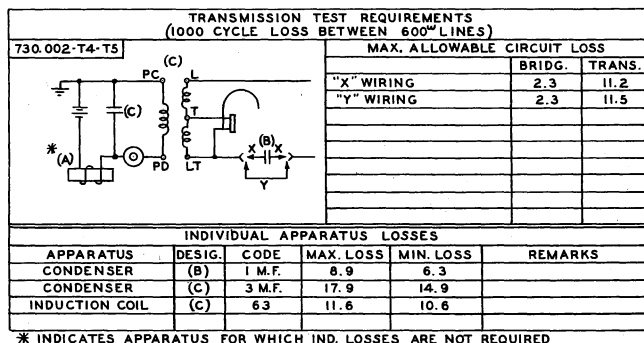


Fig. 3

"BRIDG." and "REC.", to provide for bridged and receiving losses, respectively. In other cases a receiving circuit loss only is specified and the "BRIDG." column is left vacant.

### Individual Apparatus Losses

2.07 The lower portion of the table, referring again to Fig. 1, is headed "INDIVIDUAL APPARATUS LOSSES," and is subdivided into six columns, namely, - "APPARATUS", "DESIG.", "CODE", "MAX.LOSS", "MIN. LOSS" and "REMARKS." Information pertaining to these headings is given in the following paragraphs.

2.08 The individual apparatus losses are for use only in those cases in which the circuit fails to meet the overall requirement, and it becomes necessary, therefore, to measure the individual pieces of apparatus to determine the cause.

2.09 Apparatus: In this column is listed the name of each piece of apparatus, such as relay, repeating coil, etc., for which individual losses are given. This includes each piece of apparatus in the transmission circuit which is not marked with an asterisk (\*) on the transmission sketch. However, in toll offices where a Wheatstone Bridge is available, individual losses are not specified for resistances. If the resistances affect transmission they are not marked with an asterisk (\*) on the transmission sketch. When one or more pieces of apparatus are marked with an asterisk (\*) the following note appears at the bottom of the transmission table:

"\* Indicates apparatus for which individual losses are not required."

2.10 The conditions under which individual losses are not given are usually where the equipment is shunted by means of a condenser, or other apparatus of lower impedance, such as shown in Fig. 2 and Fig. 3, and also in some cases where two pieces of equipment of considerably different impedance are connected in series and the combination bridged across the circuit. An example of this latter condition is a toll cord circuit in which a relay of relatively low impedance is connected in series with a retardation coil.

2.11 Desig. (Designation): The circuit designation of each piece of apparatus shown in the sketch for which individual losses are given is shown in this column.

2.12 Code: In this column are given the code numbers of the various pieces of apparatus with the exception of condensers and resistances. In the case of condensers the capacity is given, and in the case of resistances the value of the resistance is given in this column.



### 3.04 (Continued)

The upper part consists of a diagram of the transmission circuit and the lower part directly under the sketch gives the allowable circuit loss or gain in decibels (db). The lower part is further divided into two parts, one for the overall circuit loss or gain and the other for trouble location measurements. Where trouble location measurements are specified, individual apparatus loss limits are

not shown. As covered in the note at the bottom of the table it is not necessary for the installer to make all of the loss measurements if the equipment has been assembled in the shop. Additional trouble location circuit loss requirements are also shown in Fig. 6.

3.05 Each piece of apparatus is designated on the diagram with the same designation given it on the circuit drawing. The number shown in the upper left-hand corner of the space given over to the diagram is the file number of the transmission condition and should be disregarded.

#### Individual Apparatus Losses

3.06 The lower portion of the table, referring to Fig. 5, is headed "INDIVIDUAL APPARATUS LOSSES AT 1000 CYCLES" and is subdivided into six columns, namely - "APPARATUS", "DESIG.", "CODE", "MAX. LOSS," "MIN. LOSS" and "REMARKS." Information pertaining to these headings is given in the following paragraphs.

3.07 The individual apparatus losses are for use only in those cases in which the circuit fails to meet the overall requirement, and it is necessary therefore to measure the individual pieces of apparatus to determine the cause. On circuits where the individual apparatus losses are not useful in determining the cause of a failure to meet the overall requirements the individual apparatus losses are not shown in the table (See Figs. 4 and 6). In toll offices where a Wheatstone Bridge is available, individual losses are not specified for resistances. If the resistances affect transmission they are not marked with an asterisk (\*) on the transmission sketch.

3.08 Apparatus: In this column is given the name of each piece of apparatus, such as relay, repeating coil, etc., for which individual losses are given.

3.09 Desig. (Designation): The circuit designation of each piece of apparatus shown in the sketch for which individual losses are given is shown in this column.

3.10 Code: In this column are given the code numbers of the various pieces of apparatus with the exception of condensers and resistances. In the case of condensers the capacity is given, and in the case of resistances the value of the resistance is given in this column.

3.11 Max. (Maximum) Loss: This column is provided for the transmission losses of the individual pieces of apparatus as measured between impedances of 600 ohms. Unless otherwise specified the connections of the apparatus to the transmission measuring set shall be the same (with the exception of condensers) as is used in the respective

| TRANSMISSION TEST REQUIREMENTS<br>(LOSS BETWEEN 600" LINES)                                                                       |  |                                                                      |  |
|-----------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------------------------------------------|--|
| 9999.003                                                                                                                          |  |                                                                      |  |
|                                                                                                                                   |  |                                                                      |  |
| <p>NOTE: THE BUILDING OUT EQUIPMENT (V, CONDENSER AND T, RESISTANCE) WHEN PROVIDED, SHALL BE DISCONNECTED WHILE MAKING TESTS.</p> |  |                                                                      |  |
| ALLOWABLE CIRCUIT LOSS                                                                                                            |  |                                                                      |  |
| MEASURE FROM A TO B - TERMINATE D AND F IN 600" ±1%.                                                                              |  | MEASURE FROM J TO B - TERMINATE H IN 600" ±1%. TERMINATE F AS SHOWN. |  |
| 1000~                                                                                                                             |  | 10.3 db MAX. 8.2 db MIN.                                             |  |
| 46 db MIN.                                                                                                                        |  |                                                                      |  |
| MEASURE FROM D TO B - TERMINATE H AND F IN 600" ±1%.                                                                              |  | MEASURE FROM H TO J - TERMINATE B IN 600" ±1%. TERMINATE F AS SHOWN. |  |
| CIRCUITS EQUIPPED WITH 32-A FILTERS                                                                                               |  | PAD IN 4 WIRE RECEIVING SIDE SHALL BE ARRANGED FOR MAXIMUM LOSS      |  |
| 1000~ 5.0 db MAX. 3.5 db MIN.                                                                                                     |  | 1000~ 22.3 db MAX. 19.7 db MIN.                                      |  |
| DEVIATION FROM 1000~ MEASUREMENT                                                                                                  |  |                                                                      |  |
| 300~ +9.6 db MAX. +3.6 db MIN.                                                                                                    |  |                                                                      |  |
| 2000~ +6.3 db MAX. +2.1 db MIN.                                                                                                   |  |                                                                      |  |
| 2200~ — +8.8 db MIN.                                                                                                              |  |                                                                      |  |
| CIRCUITS EQUIPPED WITH 32-B FILTERS                                                                                               |  | TROUBLE LOCATION MEASUREMENTS                                        |  |
| 1000~ 5.0 db MAX. 3.5 db MIN.                                                                                                     |  | MEASURE FROM D TO L - TERMINATE H AND F IN 600" ±1%.                 |  |
| DEVIATION FROM 1000~ MEASUREMENT                                                                                                  |  | 1000~ 4.5 db MAX. 3.5 db MIN.                                        |  |
| 300~ +9.6 db MAX. +3.6 db MIN.                                                                                                    |  | DEVIATION FROM 1000~ MEASUREMENT                                     |  |
| 2000~ +1.6 db MAX. -0.4 db MIN.                                                                                                   |  | 300~ +9.6 db MAX. +3.6 db MIN.                                       |  |
| 2200~ +2.6 db MAX. +0.3 db MIN.                                                                                                   |  | 2000~ +0.8 db MAX. -0.8 db MIN.                                      |  |
| 2400~ +6.4 db MAX. +2.2 db MIN.                                                                                                   |  | 3000~ +1.0 db MAX. -1.0 db MIN.                                      |  |
| CIRCUITS EQUIPPED WITH 32-C FILTERS                                                                                               |  |                                                                      |  |
| 1000~ 5.0 db MAX. 3.5 db MIN.                                                                                                     |  |                                                                      |  |
| DEVIATION FROM 1000~ MEASUREMENT                                                                                                  |  |                                                                      |  |
| 300~ +9.6 db MAX. +3.6 db MIN.                                                                                                    |  |                                                                      |  |
| 2000~ +0.8 db MAX. -0.7 db MIN.                                                                                                   |  |                                                                      |  |
| 2600~ +3.4 db MAX. +0.7 db MIN.                                                                                                   |  |                                                                      |  |
| 2800~ +9.0 db MAX. +3.4 db MIN.                                                                                                   |  |                                                                      |  |
| 3000~ — +9.2 db MIN.                                                                                                              |  |                                                                      |  |
| MEASURE FROM J TO D                                                                                                               |  | MEASURE FROM L TO B.                                                 |  |
| 1000~ 5.4 db MAX. 4.6 db MIN.                                                                                                     |  | 32-A FILTER                                                          |  |
|                                                                                                                                   |  | 1000~ 0.5 db MAX. —                                                  |  |
|                                                                                                                                   |  | 2000~ 1.0 db MAX. —                                                  |  |
|                                                                                                                                   |  | 2400~ 7.5 db MAX. 2.5 db MIN.                                        |  |
|                                                                                                                                   |  | 2600~ — 10.0 db MIN.                                                 |  |
|                                                                                                                                   |  | 32-C FILTER                                                          |  |
|                                                                                                                                   |  | 1000~ 0.5 db MAX. —                                                  |  |
|                                                                                                                                   |  | 2800~ 9.5 db MAX. 4.5 db MIN.                                        |  |
|                                                                                                                                   |  | 3000~ — 10.0 db MIN.                                                 |  |
| MEASURE FROM H TO D - TERMINATE F AND B IN 600" ±1% - R WIRING                                                                    |  |                                                                      |  |
| R WIRING - PAD ARRANGED FOR MAX. LOSS                                                                                             |  |                                                                      |  |
| 1000~ 17.0 db MAX. 15.0 db MIN.                                                                                                   |  |                                                                      |  |
| R WIRING - PAD ARRANGED FOR MIN. LOSS                                                                                             |  |                                                                      |  |
| 1000~ 7.0 db MAX. 5.0 db MIN.                                                                                                     |  |                                                                      |  |
| P WIRING                                                                                                                          |  |                                                                      |  |
| 1000~ 4.5 db MAX. 3.5 db MIN.                                                                                                     |  |                                                                      |  |
| DEVIATION FROM 1000~ MEASUREMENT                                                                                                  |  |                                                                      |  |
| 300~ +14.4 db MAX. +6.6 db MIN.                                                                                                   |  |                                                                      |  |
| 2000~ +0.8 db MAX. -0.8 db MIN.                                                                                                   |  |                                                                      |  |
| 3000~ +1.0 db MAX. -1.0 db MIN.                                                                                                   |  |                                                                      |  |

NOTES:  
1. MEASUREMENTS DESIGNATED WITH A CIRCLE (O) SHALL BE MADE BY THE INSTALLER ON SHOP TESTED EQUIPMENT REGARDLESS OF WHETHER THEY HAVE BEEN REQUESTED BY THE CUSTOMER. ALL OTHER MEASUREMENTS ON SHOP TESTED EQUIPMENT MAY BE OMITTED BY THE INSTALLER.  
2. IF THE MEASUREMENT FROM J TO B DOES NOT MEET ITS REQUIREMENT, THE CKT. WILL BE CONSIDERED SATISFACTORY IF MEASUREMENTS FROM J TO D AND D TO B MEET THEIR REQUIREMENTS. IF THE MEASUREMENTS FROM D TO B DO NOT MEET THEIR REQUIREMENTS, THE CKT. WILL BE CONSIDERED SATISFACTORY IF MEASUREMENTS FROM D TO L AND L TO B MEET THEIR REQUIREMENTS. IF THE MEASUREMENT FROM H TO J DOES NOT MEET ITS REQUIREMENT, THE CKT. WILL BE CONSIDERED SATISFACTORY IF MEASUREMENTS FROM J TO D AND H TO D MEET THEIR REQUIREMENTS.

Fig. 6

## 3.11 (Continued)

transmission circuits. For example, series connected apparatus is tested in series and shunt connected apparatus is tested in shunt. Condensers having a capacity of 0.25 MF or more, regardless of their connection in the respective transmission circuits are tested in shunt. Condensers having a smaller capacity are tested in series.

3.12 Min. (Minimum) Loss: In some cases it is necessary to work to a minimum transmission loss which is given in this column. For example, the condenser in circuits, such as covered in Fig. 5, requires such a loss limit. The conditions of measurement shall be the same as covered under "Max. Loss."

3.13 Remarks: Any remarks which are necessary in connection with the transmission losses are placed in this column.

#### 4. TABLE USED FOR RETURN LOSS OR SINGING POINT AND COMPOSITE SET IMPEDANCE UNBALANCE REQUIREMENTS

4.01 Title of Table: Each transmission test requirement table has the general title "TRANSMISSION TEST REQUIREMENTS" with any combination of the following sub-titles under the general title. (LOSS BETWEEN 600 OHM LINES), (RETURN LOSS OR SINGING POINT), (COMPOSITE SET IMPEDANCE UNBALANCE).

4.02 Form of Table: The loss or gain transmission test requirement table shown on circuit drawings is usually of the type illustrated in Fig. 7. It shows the circuit loss or gain at all necessary testing frequencies and also the individual apparatus losses. The specified losses or gains for the circuit apply to the condition of test only and while they serve to check the condition of the equipment they do not always correspond to the loss or gain under actual talking conditions.

4.03 The return loss or singing point requirements shown in the table are a measure of the difference in impedance between line and network equipment when terminated as covered in the table. The composite set impedance unbalance requirements shown in the table are a measure of the balance to ground of the various parts of a composite set. These requirements also include comparative measurements, from the standpoint of balance to ground, of composite sets used on the side circuits of phantom groups. These tests indicate the amount of phantom circuit to side circuit crosstalk and longitudinal circuit unbalance.

4.04 Referring to Fig. 7 which covers transmission requirements for phantom composited equipment it is to be noted that the table is divided into two parts. The upper part consists of a diagram of the transmis-

| (LOL BETWEEN 600Ω LINES-RETURN LOSS OR SINGING POINT-COMPOSITE SET IMPEDANCE UNBALANCE)                                                                                                                                                               |              |              |                                                                                   |           |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|-----------------------------------------------------------------------------------|-----------|---------|
| 9999.004                                                                                                                                                                                                                                              |              |              |                                                                                   |           |         |
|                                                                                                                                                                                                                                                       |              |              |                                                                                   |           |         |
| ALLOWABLE CIRCUIT LOSS                                                                                                                                                                                                                                |              |              | SINGING POINT 31 db MIN.                                                          |           |         |
| MEASURE BETWEEN B2 AND A2-D1 AND D2 CONNECTED                                                                                                                                                                                                         |              |              | RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                   |           |         |
| FREQUENCY                                                                                                                                                                                                                                             | MIN. LOSS-db | MAX. LOSS-db | MEASURE BETWEEN F1 AND F2-TERMINATE E1 AND E2 IN 1130Ω ±16Ω -4.32 M.F. COND. OUT  |           |         |
| 300                                                                                                                                                                                                                                                   | 1.8          | 2.7          | SINGING POINT 31 db MIN.                                                          |           |         |
| 1000                                                                                                                                                                                                                                                  | 1.2          | 1.9          | RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                   |           |         |
| 2000                                                                                                                                                                                                                                                  | 1.2          | 1.8          |                                                                                   |           |         |
| WHEN THE CIRCUIT IS ARRANGED FOR PHANTOM (M WIRING) MEASURE BETWEEN B4 AND A4-D1 AND D2 CONNECTED                                                                                                                                                     |              |              | TROUBLE LOCATION MEASUREMENTS                                                     |           |         |
| FREQUENCY                                                                                                                                                                                                                                             | MIN. LOSS-db | MAX. LOSS-db | MEASURE BETWEEN B1 AND B2-TERMINATE C2 AND D1 IN 1800Ω ±2.6Ω                      |           |         |
| 300                                                                                                                                                                                                                                                   | 0.9          | 1.9          | SINGING POINT 31 db MIN.                                                          |           |         |
| 1000                                                                                                                                                                                                                                                  | 0.6          | 1.2          | RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                   |           |         |
| 2000                                                                                                                                                                                                                                                  | 0.6          | 1.2          |                                                                                   |           |         |
| WHEN THE CIRCUIT IS ARRANGED FOR NON-PHANTOM (N WIRING) MEASURE BETWEEN B4 AND D3                                                                                                                                                                     |              |              | MEASURE BETWEEN B3 AND B4-TERMINATE C4 AND D3 IN 700Ω ±1Ω                         |           |         |
| FREQUENCY                                                                                                                                                                                                                                             | MIN. LOSS-db | MAX. LOSS-db | SINGING POINT 31 db MIN.                                                          |           |         |
| 300                                                                                                                                                                                                                                                   | 0.9          | 1.9          | RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                   |           |         |
| 1000                                                                                                                                                                                                                                                  | 0.6          | 1.2          |                                                                                   |           |         |
| 2000                                                                                                                                                                                                                                                  | 0.6          | 1.2          |                                                                                   |           |         |
| WHEN THE CIRCUIT IS ARRANGED FOR NON-PHANTOM (N WIRING) MEASURE BETWEEN B4 AND D3                                                                                                                                                                     |              |              | MEASURE BETWEEN B3 AND B4-TERMINATE C4 AND D3 IN 700Ω ±1Ω -62A COIL -22Ω RES. OUT |           |         |
| FREQUENCY                                                                                                                                                                                                                                             | MIN. LOSS-db | MAX. LOSS-db | SINGING POINT 31 db MIN.                                                          |           |         |
| 300                                                                                                                                                                                                                                                   | 0.9          | 1.9          | RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                   |           |         |
| 1000                                                                                                                                                                                                                                                  | 0.6          | 1.2          |                                                                                   |           |         |
| 2000                                                                                                                                                                                                                                                  | 0.6          | 1.2          |                                                                                   |           |         |
| WHEN THE CIRCUIT IS ARRANGED FOR NON-PHANTOM (N WIRING) MEASURE BETWEEN B3 AND B4-TERMINATE A3 AND A4 IN 700Ω ±1Ω -D1 AND D2 AND C3 AND C4 CONNECTED                                                                                                  |              |              | MEASURE BETWEEN F2 AND E2                                                         |           |         |
| FREQUENCY                                                                                                                                                                                                                                             | MIN. LOSS-db | MAX. LOSS-db | COND. 4.32M.F. 1000 0.4 1.1                                                       |           |         |
| 300                                                                                                                                                                                                                                                   | 0.4          | 1.1          | MEASURE BETWEEN C1 AND D2-TERMINATE A1 AND A2 IN 1800Ω ±2.6Ω                      |           |         |
| 1000                                                                                                                                                                                                                                                  | 0.3          | 1.0          | SINGING POINT 32 db MIN.                                                          |           |         |
| 2000                                                                                                                                                                                                                                                  | 0.3          | 1.0          | RETURN LOSS AT 300 AND 2000 CYCLES - 35 db MIN.                                   |           |         |
| ALLOWABLE RETURN LOSS OR SINGING POINT                                                                                                                                                                                                                |              |              | MEASURE BETWEEN C3 AND D5-TERMINATE A3 AND A4 IN 700Ω ±1Ω                         |           |         |
| (SINGING POINT)-REPEATER EQUIPPED WITH ANY (S TYPE FILTER)                                                                                                                                                                                            |              |              | SINGING POINT 34 db MIN.                                                          |           |         |
| MEASURE BETWEEN B1 AND B2-TERMINATE A1 AND A2 IN 1800Ω ±2.6Ω -D1 AND D2 AND C1 AND C2 CONNECTED                                                                                                                                                       |              |              | RETURN LOSS AT 300 AND 2000 CYCLES - 35 db MIN.                                   |           |         |
| SINGING POINT 31 db MIN.                                                                                                                                                                                                                              |              |              |                                                                                   |           |         |
| RETURN LOSS AT 500 AND 1500 CYCLES - 40 db MIN.                                                                                                                                                                                                       |              |              |                                                                                   |           |         |
|                                                                                                                                                                                                                                                       |              |              | MAX. ALLOWABLE COMPOSITE SET IMPEDANCE UNBALANCE                                  |           |         |
|                                                                                                                                                                                                                                                       |              |              | PER CENT UNBALANCE                                                                |           |         |
|                                                                                                                                                                                                                                                       |              |              | WHOLE SET 1 2                                                                     |           |         |
|                                                                                                                                                                                                                                                       |              |              | CONDENSERS OF SHUNT BRANCH 2 2                                                    |           |         |
|                                                                                                                                                                                                                                                       |              |              | COILS OF SHUNT BRANCH 1 2                                                         |           |         |
|                                                                                                                                                                                                                                                       |              |              | SERIES COND. 0.8 2                                                                |           |         |
|                                                                                                                                                                                                                                                       |              |              | INDIVIDUAL APPARATUS LOSSES AT 1000Ω                                              |           |         |
| APPARATUS                                                                                                                                                                                                                                             | DESIG.       | CODE         | MAX. LOSS                                                                         | MIN. LOSS | REMARKS |
| CONDENSER                                                                                                                                                                                                                                             | A AND B      | 2.16 M.F.    | 12.7                                                                              | 12.2      |         |
| CONDENSER                                                                                                                                                                                                                                             | C AND PH     | 108 M.F.     | 7.3                                                                               | 6.9       |         |
| CONDENSER                                                                                                                                                                                                                                             | J            | 4.32 M.F.    | 18.6                                                                              | 18.0      |         |
| REPEATING COIL                                                                                                                                                                                                                                        | A AND B      | 62 E         | 1.7                                                                               | 1.0       |         |
| REPEATING COIL                                                                                                                                                                                                                                        | L            | 62 C         | 1.1                                                                               | 0.4       |         |
| REPEATING COIL                                                                                                                                                                                                                                        | PH           | 62 A         | 1.0                                                                               | 0.3       |         |
| NOTES:                                                                                                                                                                                                                                                |              |              |                                                                                   |           |         |
| 1. * INDICATES APPARATUS FOR WHICH INDIVIDUAL LOSSES ARE NOT REQUIRED.                                                                                                                                                                                |              |              |                                                                                   |           |         |
| 2. IF THE OVERALL SINGING POINT MEASUREMENTS DO NOT MEET THEIR REQUIREMENTS THE CIRCUIT WILL BE CONSIDERED SATISFACTORY IF THE TROUBLE LOCATION MEASUREMENT REQUIREMENTS ARE MET.                                                                     |              |              |                                                                                   |           |         |
| 3. WHERE NO SUITABLE MEASURING EQUIPMENT IS AVAILABLE FOR MAKING MULT-FREQUENCY TRANSMISSION TESTS, 1000Ω TESTS SHALL BE CONSIDERED SATISFACTORY.                                                                                                     |              |              |                                                                                   |           |         |
| 4. MEASUREMENTS DESIGNATED WITH A CIRCLE (O) SHALL BE MADE BY THE INSTALLER ON SHOP TESTED EQUIPMENT REGARDLESS OF WHETHER THEY HAVE BEEN REQUESTED BY THE CUSTOMER. ALL OTHER MEASUREMENTS ON SHOP TESTED EQUIPMENT MAY BE OMITTED BY THE INSTALLER. |              |              |                                                                                   |           |         |

Fig. 7

#### 4.04 (Continued)

sion circuit and the lower part directly under the diagram gives the circuit loss in decibels (db), the return loss or singing point in decibels (db) and the composite set impedance unbalance in "Maximum Allowable Per Cent Unbalance." The return loss or singing point requirements are further divided into two groups, one for overall circuit return loss or singing point and the other for trouble location measurements. The lower part of the table covers individual apparatus loss. As covered by Note 1 in Fig. 7 apparatus marked with an asterisk (\*) does not require individual loss limits. It is to be noted that no transmission loss limits are given for network equipment. This equipment is checked by a singing point check.

4.05 Each piece of apparatus is designated on the diagram with the same designation given it on the circuit drawing. The number in the upper left-hand corner of the space given over to the diagram (see Fig. 7) is the file number of the transmission condition and should be disregarded.

4.06 In the space below the sketch the transmission circuit loss or gain in decibels (db) is given as "MAX." and "MIN."

#### Individual Apparatus Losses

4.07 The lower portion of the table, referring again to Fig. 7, is headed "INDIVIDUAL APPARATUS LOSSES AT 1000 CYCLES" and is subdivided into six columns, namely "APPARATUS," "DESIG.," "CODE," "MAX. LOSS," "MIN. LOSS" and "REMARKS." Information pertaining to these headings is given in the following paragraphs.

4.08 The individual apparatus losses are for use only in those cases in which the circuit fails to meet the overall requirement, and it is necessary, therefore, to measure the individual pieces of apparatus to determine the cause.

4.09 Apparatus: In this column is given the name of each piece of apparatus, such as relay, repeating coil, etc., for which individual losses are given. This includes each piece of apparatus in the transmission circuit which is not marked with an asterisk (\*) on the transmission sketch. However in toll offices where a Wheatstone Bridge is available, individual losses are not specified for resistances. If the resistances affect transmission they are not marked with an asterisk (\*) on the transmission sketch. When one or more pieces of apparatus are marked with an asterisk (\*), the following note appears at the bottom of the transmission table:

" \* Indicates apparatus for which individual losses are not required."

4.10 The conditions under which individual losses are not given are usually where the equipment is shunted by means of a condenser, or other apparatus of lower impedance, and also in some cases where two pieces of equipment of considerably different impedance are connected in series and the combination bridged across the circuit as shown in Fig. 7.

4.11 Desig. (Designation): The circuit designation of each piece of apparatus shown in the sketch for which individual losses are given is shown in this column.

4.12 Code: In this column are given the code numbers of the various pieces of apparatus with the exception of condensers and resistances. In the case of condensers the capacity is given, and in the case of resistances the value of the resistance is given in this column.

4.13 Max. (Maximum) Loss: This column is provided for the transmission losses of the individual pieces of apparatus as measured between impedances of 600 ohms of a transmission measuring set with a measuring current of a frequency of 1000 cycles. Unless otherwise specified the connections of the apparatus to the transmission measuring set shall be the same (with the exception of condensers) as is used in the respective transmission circuits. For example, series connected apparatus is tested in series and shunt connected apparatus is tested in shunt. Condensers having a capacity of 0.25 MF or more regardless of their connection in the respective transmission circuits are tested in shunt. Condensers having a smaller capacity are tested in series.

4.14 Min. (Minimum) Loss: In some cases it is necessary to work to a minimum transmission loss which is given in this column. For example, the repeating coil of the circuit, as covered in Fig. 7, requires such a loss limit. The conditions of measurement shall be the same as covered under "Max. Loss."

4.15 Remarks: Any remarks which are necessary in connection with the transmission losses are placed in this column.

#### 5. TRANSMISSION NOTES

5.01 When the transmission test requirements cannot be readily covered in tables similar to those already described, the information is given on the circuit drawings in the form of TRANSMISSION NOTES. These requirements appear on the drawings as the 300 series of notes.

5.02 The transmission notes give complete information regarding the allowable gain, loss or required output for the particular circuit on which they appear.

5.03 The following information which covers the requirements for an oscillator illustrates the use of Transmission Notes on the circuit drawings.

Transmission Notes

301. The oscillator shall have an output of between 16.5 and 21.5 milliamperes (22.1 to 24.4 db above 1 milliwatt).

302. The frequency of this oscillator shall be  $1000 \pm 24$  cycles. This requirement is based on beating the frequency against a 6010B oscillator or its equivalent.

303. The wave shape of this oscillator shall be tested by measuring its turnover and this turnover shall not exceed 0.1 db. When a 6A set is used, the sensitivity requirements of this transmission measuring set shall be met.