

## SELECTION OF OFFICE NBO IN LARGE CLASS 5 OFFICES SERVED BY STEP-BY-STEP OFFICE

|    | CONTENTS  | PAGE |
|----|---|------|
| 1. | <b>GENERAL</b> . . . . .  | 1    |
| 2. | <b>PROCEDURES</b> . . . . .   | 3    |
|    | <b>A. Outgoing Trunks From Toll Offices (TS,<br/>        2-Way OO From Machine or Switchboard)</b><br>. . . . . | 3    |
|    | <b>B. Incoming Trunks to Toll Offices (CAMA,<br/>        RC, 2-Way OO)</b> . . . . .                            | 5    |
| 3. | <b>NBO SELECTION</b> . . . . .  | 7    |

**1. GENERAL**

**1.01** This section provides the procedures for determining a value for NBO capacitor strapping in large class 5 offices where the office cabling capacitance is great enough to degrade the expected balance between compromise networks (COMP NET) in 4-wire terminating sets (4WTS) and the 2-wire lines.

**1.02** This section does not affect the Equipment Test Lists.

**1.03** The procedures in this section apply only to toll connecting trunks which are assigned to 4-wire interoffice facilities between the toll and class 5 offices. The procedures will, in general, only be necessary when the class 5 office has cabling lengths approximating 1000 feet or more. The initial *terminal* balance testing work at the toll office will indicate this section is applicable when there is consistent difficulty in meeting echo return loss (ERL) and singing point/singing return loss (SP/SRL) requirements to a class 5 office. When equipment additions, modifications, or rearrangements are made in a class 5 office served by a toll office which has been certified as balanced, this section may become applicable and affect verification measurement results at the toll office.

This will require additional verification measurements in the toll office. When balancing at the toll office indicates this section is applicable, this section must be coordinated with the *terminal* balance testing at the toll office and must be completed before the verification measurement tests of Section 660-474-502. Whenever this section is indicated as applicable, the transmission engineer responsible for the office balance certification must be informed before performing the procedures.

**1.04** All trunks tested in this section must have met the 1000-Hz loss requirements before performing these procedures.

**1.05** The procedures are performed on both outgoing and incoming trunks from the toll office. The outgoing trunks are tested from the balance test (BAL TST) circuit in the toll office to a balance test termination (BAL TST TERM) in the class 5 office (Fig. 1). The incoming trunks are tested over a completed connection to the BAL TST circuit in the toll office after one of the arrangements of off-hook terminations available at class 5 offices has been made (Fig. 2). The proper methods of originating, terminating, and holding connections from the class 5 offices are described in Section 660-576-500.

**1.06** The procedures are performed on selected samples in each trunk group interconnecting the toll and class 5 offices. These selected samples must be representative of the office cable lengths in the class 5 office for each trunk group. To be representative, the selected trunk samples should include the longest and shortest cabling paths in the trunk group and trunks randomly selected from the trunk group. The selections should be made from trunks mounted near the middle of equipment bays. The locations of equipment bays should also be randomly selected in larger trunk groups having several equipment locations. The number of trunks required for an adequate sample size in a trunk group is shown in Table A.

2. PROCEDURES

A. Outgoing Trunks From Toll Offices (TS, 2-Way OO From Machine or Switchboard)

2.01 Capacitance values used in these procedures may vary  $\pm 0.005 \mu\text{F}$  from the stated value.

| STEP | PROCEDURE   |
|------|---|
| 1    | <p><b>In the toll office</b>, perform (a) or (b):</p> <p>(a) When testing <b>machine-switched connections</b>:</p> <p>At the testboard appearance of the BAL TST circuit, establish a connection over the trunk to be tested and to the subscriber number assigned to the BAL TST TERM in the class 5 office.</p> <p>(b) When testing <b>connections via toll switchboard</b>:</p> <p>Using the test board appearance of the BAL TST circuit, establish a connection to the switchboard on a 121 trunk.</p> <p>At the toll switchboard, use a cord circuit to answer the incoming signal. Then seize the TC trunk to be tested with the same cord circuit. Key pulse (dial) the number assigned to the BAL TST TERM in the class 5 office. Proceed to Step 2.</p> |
| 2    | Set up the test equipment to perform capacitance measurements as described in Section 660-474-504, and connect test equipment to the transmit and receive jacks of the 4WTS in the BAL TST circuit.   |
| 3    | <b>In the class 5 office</b> , verify that no straps are present on the NBO capacitor in the 4WTS associated with the trunk under test.   |
| 4    | <b>In the toll office</b> , measure and record the return-loss value on the connection.   |
| 5    | <b>In the class 5 office</b> , connect a 7A capacitor box (or equivalent), adjusted to $0.025 \mu\text{F}$ , across the COMP NET, or strap the NBO capacitor to parallel the COMP NET with $0.025 \mu\text{F}$ value.   |
| 6    | <b>In the toll office</b> , measure and record the return-loss value of the connection.   |
| 7    | <b>In the class 5 office</b> , change the capacitance value of the capacitor box or NBO strapping to $0.050 \mu\text{F}$ .  |
| 8    | <b>In the toll office</b> , measure and record the return-loss value on the connection.   |
| 9    | Repeat Steps 1 through 8 for all trunks in all trunk group samples.   |
| 10   | Perform measurements on incoming trunks (Part 2B).  |

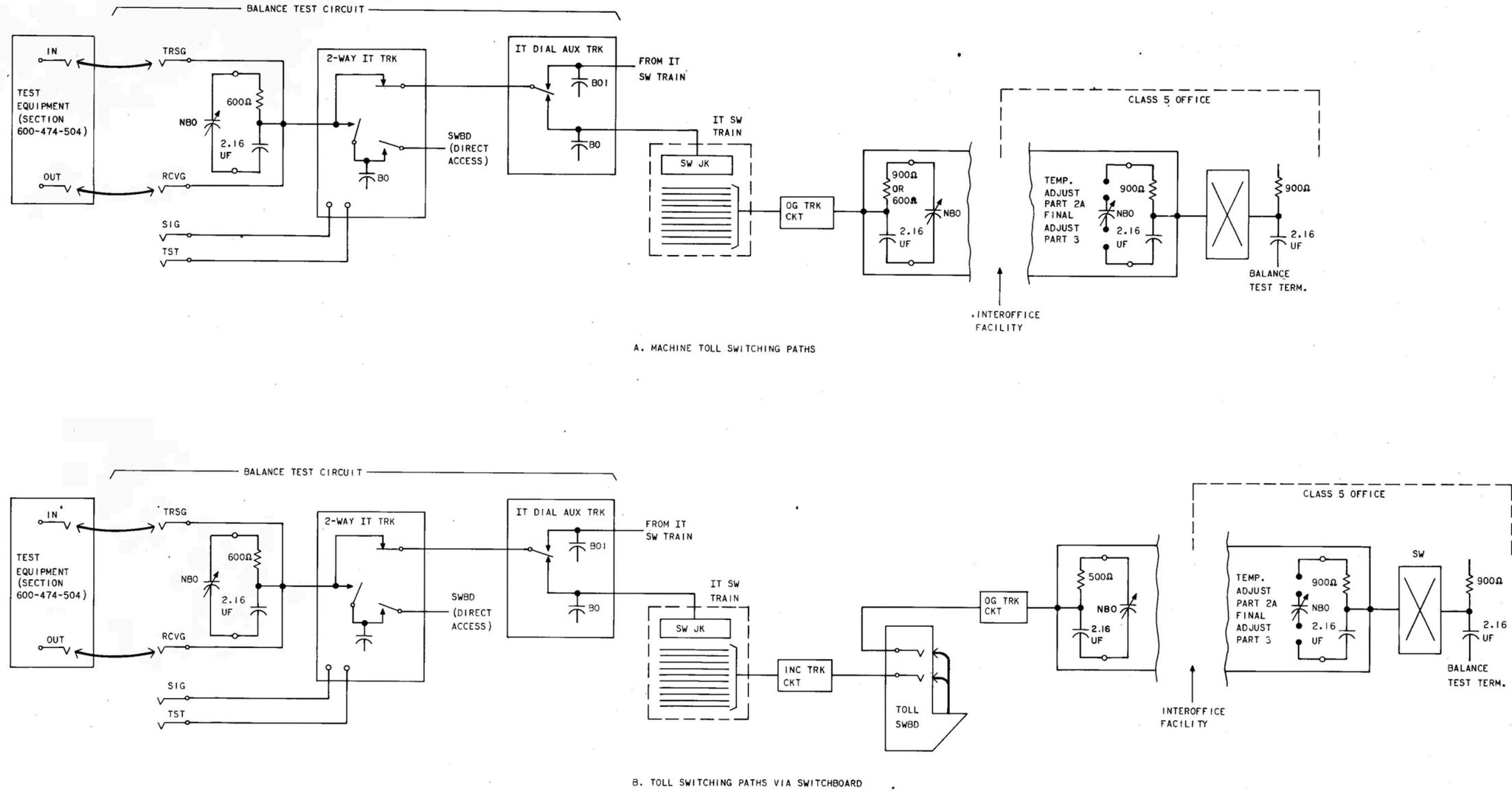
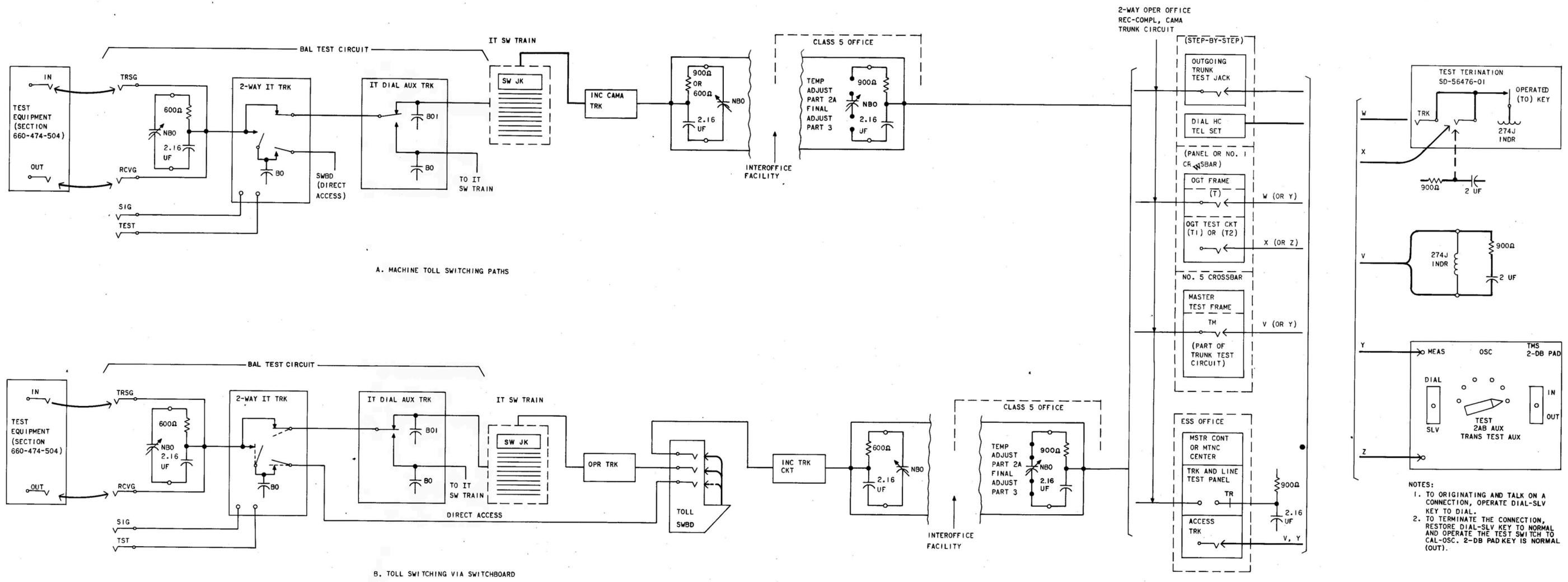


Fig. 1—Outgoing Trunks From Toll Offices

**B. Incoming Trunks to Toll Offices (CAMA, RC, 2-Way OO)**

| STEP | PROCEDURE   |
|------|---|
| 1    | <b>In the class 5 office</b> , use the prescribed method for that type of office (Section 660-576-500) to originate, hold, and terminate a call to one of the following: <ul style="list-style-type: none"> <li>(a) The ABX-XXXX for the BAL TST circuit when testing CAMA trunks.                             <p><i>Note:</i> An ABX code is assigned for balance testing in toll offices. When required, a local test number must be provided to satisfy CAMA operators.</p> </li> <li>(b) The toll switchboard operator at the toll office when testing RC or 2-Way OO trunks. Have the operator complete to the ABX code on an operator trunk, and close the TALK-MON key to permit making transmission tests.</li> </ul> |
| 2    | <b>In the toll office</b> , set up the test equipment to perform capacitance measurements as described in Section 660-474-504 and connect test equipment to the transmit and receive jacks of the 4WTS in the BAL TST circuit.  |
| 3    | <b>In the class 5 office</b> , verify that no straps are present on the NBO capacitor in the 4WTS associated with the trunk under test.   |
| 4    | <b>In the toll office</b> , measure and record the return-loss value on the connection.   |
| 5    | <b>In the class 5 office</b> , connect a 7A capacitor box (or equivalent), adjusted to 0.025 $\mu$ F across the COMP NET or strap the NBO capacitor to parallel the COMP NET with a 0.025- $\mu$ F value.   |
| 6    | <b>In the toll office</b> , measure and record the return-loss value on the connection.   |
| 7    | <b>In the class 5 office</b> , change the capacitance value of the capacitor box or NBO strapping to 0.050 $\mu$ F.   |
| 8    | <b>In the toll office</b> , measure and record the return-loss value on the connection.   |
| 9    | Repeat Steps 1 through 8 for all trunks in all trunk group samples.   |
| 10   | Proceed to Part 3.  |



NOTES:  
 1. TO ORIGINATING AND TALK ON A CONNECTION, OPERATE DIAL-SLV KEY TO DIAL.  
 2. TO TERMINATE THE CONNECTION, RESTORE DIAL-SLV KEY TO NORMAL AND OPERATE THE TEST SWITCH TO CAL-OSC. 2-DB PAD KEY IS NORMAL (OUT).

Fig. 2—Incoming Trunks to Toll Office

**TABLE A**  
**TRUNK GROUP**  
**SAMPLE SIZES**

| TOTAL NUMBER OF TRUNKS | NUMBER IN SAMPLE                  |
|------------------------|-----------------------------------|
| 5 or less              | All trunks                        |
| 6 to 10                | 5                                 |
| 11 to 15               | 6                                 |
| 16 to 25               | 7                                 |
| 26 to 50               | 8                                 |
| Over 50                | Approximately 18 percent of total |

**3. NBO SELECTION**

**3.01** The selection of the NBO capacitance value in the class 5 office is dependent on all measurements recorded in Parts 2A and 2B. The measurements in return loss correspond to values of capacitance. The correspondence can be seen when the measurements are tabulated in a manner such as shown in Table B. From this correspondence, the best NBO value for an office is determined. The value determined will be sufficiently accurate when the samples are representative (Part 1) and the sample sizes of Table A have been used.

**3.02** When the best return-loss values have been determined, an NBO value of 0.025  $\mu\text{F}$  or greater can be selected. The selected value will be the one most near the center of the range of the cabling in the office under test. This value is strapped permanently on all NBO capacitors in the trunk groups tested.

*Note:* Compromise networks adequately balance with office cabling capacitances over approximately a 0.025- $\mu\text{F}$  range. The center of this range is the point where the greatest return loss occurs. The addition of the NBO capacitance across the COMP NET causes the entire balancing range to shift by approximately the same value as the NBO value.

**3.03** Since it is desirable to minimize NBO capacitance in an office when determining the range of capacitance, use the following guidelines:

*Upper limit* to be 0.050  $\mu\text{F}$  when *any* trunk requires 0.050  $\mu\text{F}$  for greatest return loss.

*Upper limit* to be 0.025  $\mu\text{F}$  when *no* trunk requires 0.050  $\mu\text{F}$  for greatest return loss.

*Lower limit* always a zero unless *any* trunk has a greater return loss with 0.025  $\mu\text{F}$  capacitance than with zero capacitance.

*Lower limit* will be the least of two capacitance values when the same return loss is measured for both values (refer to Table B).

**3.04** In general, the lower limit of capacitance range for an office will be indicated as requiring no capacitance; however, in offices where severe balance conditions exist, *all* trunks will

**TABLE B**  
**SAMPLE TABULATION OF MEASUREMENTS**  
**TO DETERMINE**  
**OFFICE CABLE CAPACITANCE RANGE**

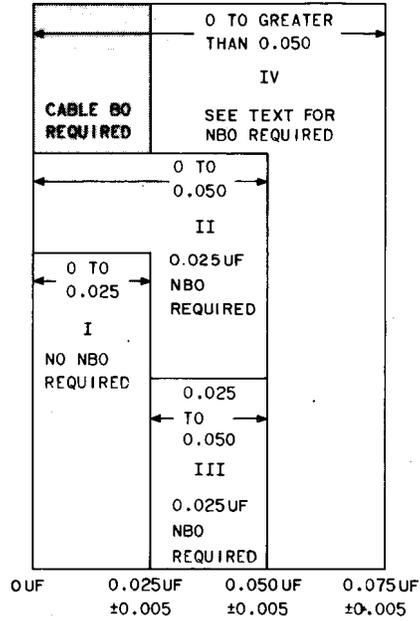
| TRUNK TESTED | ERL IN dB       |                               |                               |
|--------------|-----------------|-------------------------------|-------------------------------|
|              | 0 $\mu\text{F}$ | 0.025 $\pm 0.005 \mu\text{F}$ | 0.050 $\pm 0.005 \mu\text{F}$ |
| CAMA         | *1 25           | (41)                          | 25                            |
|              | 2 20            | 29                            | (41)                          |
|              | 3 37            | (40)                          | 27                            |
| RC           | 1 27            | (41)                          | 26                            |
|              | 2 27            | (42)                          | 25                            |
|              | 3 20            | 29                            | (38)                          |
| TS           | *1 23           | (40)                          | 40                            |
|              | 2 (40)          | 29                            | 20                            |
|              | 3 28            | (41)                          | 26                            |
| 2-way OO     | *1 23           | (42)                          | 23                            |
|              | 2 20            | (42)                          | 20                            |
|              | 3 27            | (42)                          | 27                            |

- Notes:* 1. Asterisk (\*) indicates two-value measurement (see 3.03).  
2. Circled values are greatest return loss and indicate the best NBO value as 0.025  $\mu\text{F}$  (see 3.01) and the range of office cable capacitance as 0.0 to 0.050  $\mu\text{F}$  (see 3.03).

**SECTION 660-474-520**

require some capacitance. In these offices, build-out capacitance is necessary in trunks having less than 0.025  $\mu\text{F}$ .

**3.05** When the lower limit for an office is determined to be no capacitance and the upper limit to be 0.025  $\mu\text{F}$ , no NBO capacitance is required. This is shown in Fig. 3 as Range I. Capacitance Ranges II and III are the most likely to be encountered when this section applies. Generally, Range IV will apply to downgraded toll offices or offices where the lower limit begins to approach 0.025  $\mu\text{F}$ . When a Range IV is determined, office cable buildout becomes necessary. This buildout in the class 5 office is similar to that used in terminal balancing the toll office (Section 660-474-502). The NBO required will be greater than 0.025  $\mu\text{F}$ .



**Fig. 3—Typical Capacitance Ranges in Large Class 5 Offices**