

## SELECTION OF OFFICE NBO IN LARGE CLASS 5 OFFICES SERVED BY CROSSBAR TANDEM OFFICE

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### 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 compensating 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 trunks which are assigned to 4-wire interoffice facilities between 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 660-471-502. Whenever this section is indicated as applicable, consultation with transmission engineering responsible for the office involved is recommended 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 called 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 various 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 various 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

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

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

STEP	PROCEDURE
1	<p><b>In the toll office, perform (a) or (b):</b></p> <p>(a) When testing <b>machine-switched connections:</b></p> <p>At the toll testboard or OGT test frame appearance of the BAL TST circuit, seize and key pulse (dial) code 970 into the BAL TST circuit.</p> <p>Using the OGT test frame, seize the trunk to be tested and key pulse (dial) the number assigned to the BAL TST TERM at the class 5 office.</p> <p>At the OGT test frame, patch the TST jack assigned to code 970 to the TST jack of the trunk under test. Proceed to Step 2.</p> <p>(b) When testing <b>connections via toll switchboard:</b></p> <p>Using the toll testboard or OGT test frame appearance of the BAL TST circuit, seize and key pulse (dial) 121.</p> <p>At the toll switchboard, seize the trunk to be tested and 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 660-471-504, and connect test equipment to the transmit and receive ports of 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 0.025- $\mu$ 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 $\mu$ 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).

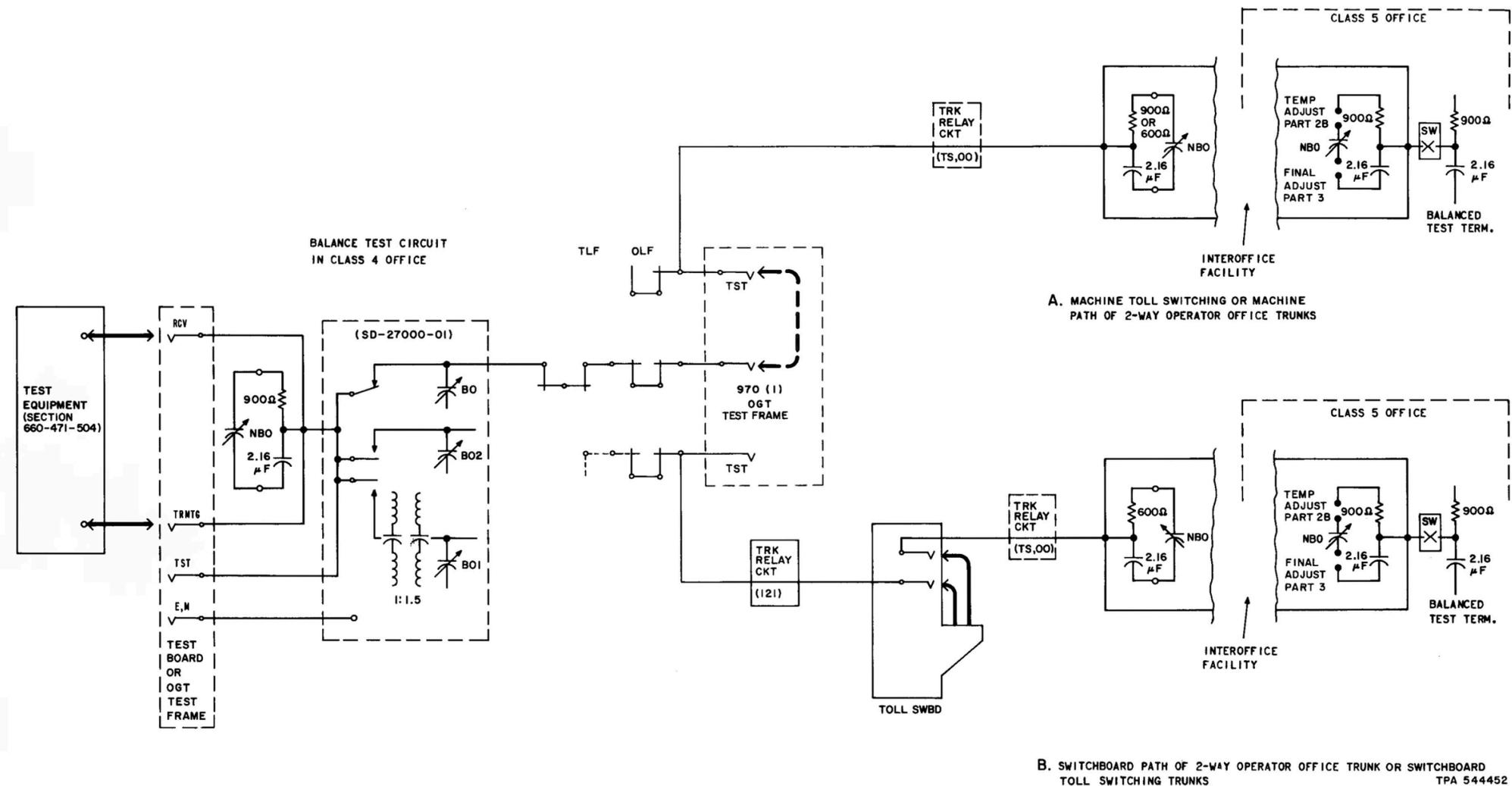
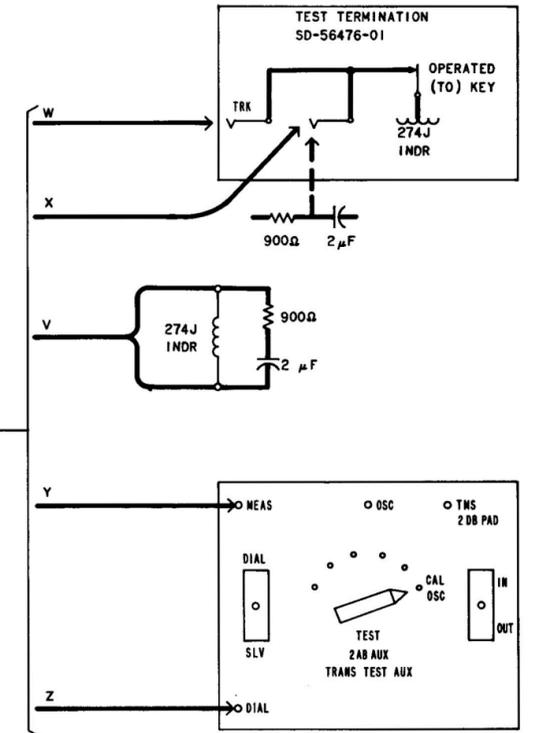
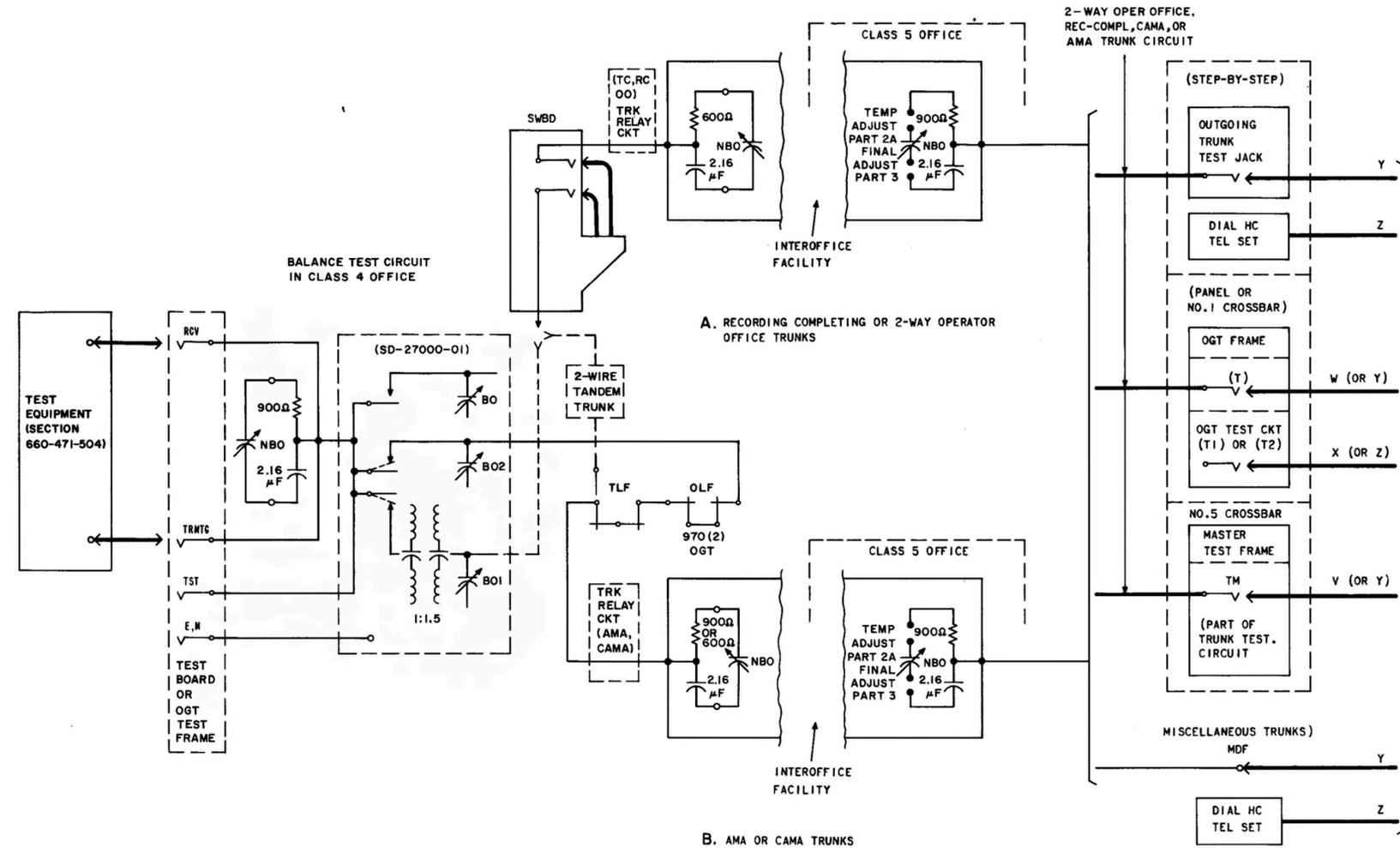


Fig. 1—Outgoing Trunks From Toll Office

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

STEP	PROCEDURE
1	<i>In the toll office</i> , make busy the OGT TST jack appearance assigned and designated 970(1).
2	<i>In the class 5 office</i> , 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:  (a) 970-1111 when testing AMA or CAMA trunks  <i>Note:</i> Code 970 is assigned to the BAL TST circuit in the toll office. When required, a local test number must be provided to satisfy CAMA operators.  (b) The toll switchboard operator at the toll office when testing RC or 2-way OO trunks. Have the operator complete to code 970 on a 2-wire or a 4-wire tandem trunk, and close the TALK-MON key to permit making transmission tests.
3	<i>In the toll office at the toll testboard or OGT test frame</i> , set up the test equipment to perform capacitance measurements as described in Section 660-471-504 and connect test equipment to the 4WTS transmit and receive ports of the BAL TST circuit.
4	<i>In the class 5 office</i> , verify that no straps are present on the NBO capacitor in the 4WTS associated with the trunk under test.
5	<i>In the toll office</i> , measure and record the return-loss value on the connection.
6	<i>In the class 5 office</i> , 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 a 0.025- $\mu\text{F}$ value.
7	<i>In the toll office</i> , measure and record the return-loss value on the connection.
8	<i>In the class 5 office</i> , change the capacitance value of the capacitor box or NBO strapping to 0.050 $\mu\text{F}$ .
9	<i>In the toll office</i> , measure and record the return-loss value on the connection.
10	Repeat Steps 1 through 9 for all trunks in all trunk group samples.
11	Proceed to Part 3.



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).

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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:** Compensating networks adequately balance with office cabling capacitances over approximately a 0.050- $\mu\text{F}$  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: consider

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

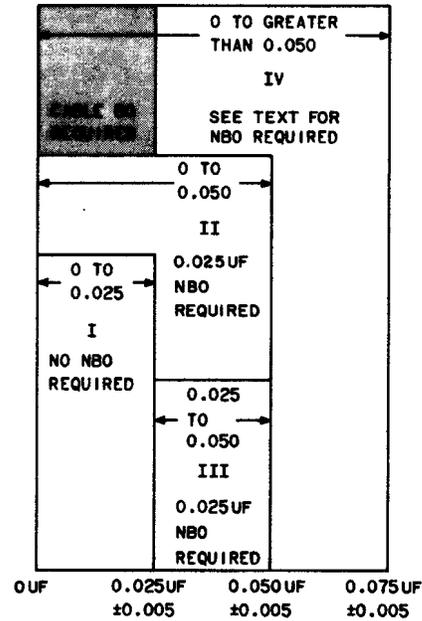
**Notes:** 1. Asterisk (\*) indicates two-value measurement (see text).

2. Circled values are greatest return loss and indicate the best NBO value as 0.025  $\mu\text{F}$  (see paragraph 3.01) and the range of office cable capacitance as 0.0 to 0.050  $\mu\text{F}$  (see paragraph 3.03).

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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 660-471-502). The NBO required will be greater than 0.025  $\mu\text{F}$ .



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