

## CAPACITANCE UNBALANCE REDUCTION IN TOLL OFFICE TEXTILE COVERED QUADDED SWITCHBOARD CABLE INSTALLATION GENERAL EQUIPMENT REQUIREMENTS

### 1. GENERAL

#### Scope

- 1.01 This section covers the requirements governing the reduction of capacitance unbalance in textile covered quadded toll office cables.
- 1.02 This section replaces specification X-65143.
- 1.03 Changes in requirements which have been made with this issue are covered under "Reasons for Reissue" at the end of the section.

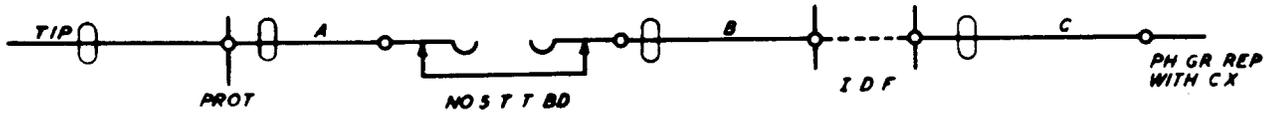
### 2. DESCRIPTION

- 2.01 Cross-talk between circuits in these cables results primarily from capacitance unbalance which allows transfer of energy between circuits. In cables of the type covered by this section, capacitance unbalance is materially reduced, in manufacture, by pairing and quadding conductors. This section covers requirements for further improvement of capacitance unbalance, which is required under certain conditions to provide satisfactory transmission.
- 2.02 Each quad in a cable provides three talking channels, one over each of the pairs, called side circuits, and a third over a phantom derived from the two pairs. It has been found in practice that side-to-side unbalances in these cables, never rise above tolerable values, but phantom-to-side unbalances and phantom-to-phantom unbalances between adjacent quads, require additional improvement, at least for the longer lengths.
- 2.03 Since phantom-to-side unbalances encountered in these cables are mainly systematic in relation to length, they can be improved by measures which will make the unbalance to length relationship approximately random. Phantom-to-side unbalances in the longer lengths are improved by midpoint turnover splicing. Phantom-to-phantom unbalances are improved by terminating each successive length of cable in accordance with a plan which prevents the continuance of quad adjacencies through successive cable lengths. This terminating plan also improves phantom-to-side unbalances in over-all runs involving lengths not having turnover splicing. The application of these methods in accordance with

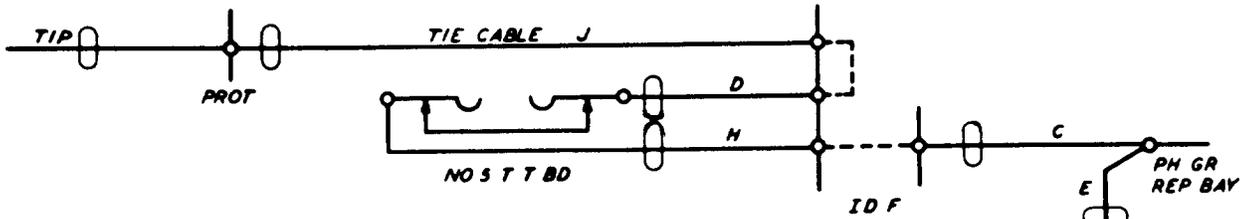
requirements covered in this section, improves over-all capacitance unbalance in office cabling to within satisfactory limits.

### 3. BALANCING REQUIREMENTS

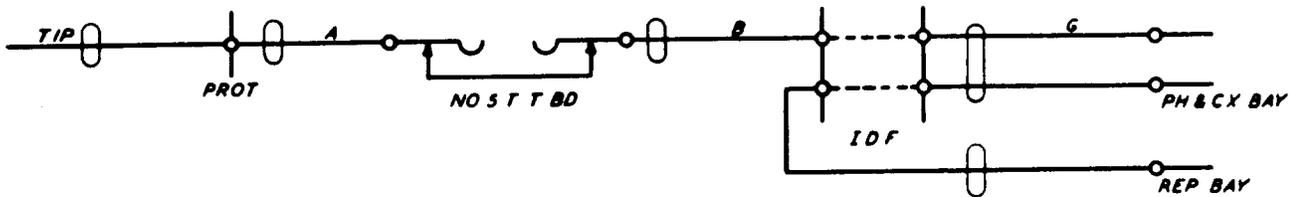
- 3.01 All runs of quadded switchboard cable on the line side of phantom repeating coils, that is, between the protectors and the phantom repeating coils, shall be balanced by midpoint turnover splicing as covered in part 4, provided they are used with 2-wire cable circuits, the butt-to-butt length installed is over 40 feet, and they contain "talking" conductors or contain leads connected directly to "talking" conductors.
- 3.02 Cables which may be associated with either open-wire or cable circuits shall be considered as cable circuits when used in combined open-wire and cable offices.
- 3.03 Cables which may be associated with either 2- or 4-wire circuits shall be considered as 2-wire where used in offices containing both 2- and 4-wire circuits.
- 3.04 Cables for spare equipment jacks in the toll test board and for the line leads between the side circuit repeating coils and the phantom repeating coil, are not to be balanced or follow the terminating plan. It is also unnecessary to balance or follow the terminating plan on cables for straightforward trunks or lines with composite signaling between toll switchboards and tandem boards or other toll boards, as in trunks of this nature the phantom of quads is not used and phantom-to-side unbalance is not involved.
- 3.05 All runs of quadded switchboard cable on the line side of phantom repeating coils, regardless of length, both those associated with 2-wire circuits and those associated with 4-wire circuits, shall be terminated at the cable terminal strips in accordance with the terminating plan covered in part 4.
- 3.06 Typical cabling arrangements are shown in Fig. 1. Cable runs designated A to K inclusive, illustrate cabling on the line side of the phantom repeating coils and are subject to balancing by midpoint turnover splicing and termination



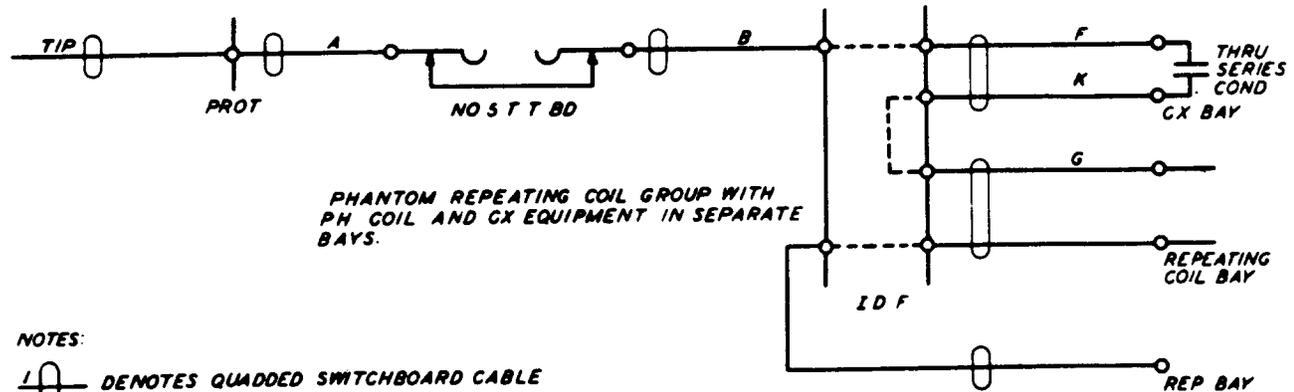
REPEATERS ON PHANTOM GROUP BAY  
CX EQUIPMENT ON SAME BAY



REPEATERS ON PHANTOM GROUP BAY  
USING TIE CABLE WITH CX EQUIPMENT ON SEPARATE BAY



PHANTOM REPEATING COIL GROUPS WITH  
REPEATERS IN SEPARATE BAY CROSS CONNECTED  
AT THE I D F



PHANTOM REPEATING COIL GROUP WITH  
PH COIL AND CX EQUIPMENT IN SEPARATE  
BAYS.

NOTES:

1/0 DENOTES QUADDED SWITCHBOARD CABLE

2/--- DENOTES JUMPER WIRE

Fig. 1 - Typical Cabling Arrangements

at the cable terminal blocks as covered in the preceding paragraphs.

**4. BALANCING PROCEDURE**

4.01 Midpoint turnover splices should be made near the center of the cable length, as the unbalances in both directions from the splice will be more nearly equal, and therefore, better balance will be obtained. The allowable variation from the center is plus or minus five feet on lengths up to 100 feet and plus or minus ten feet on lengths greater than 100 feet.

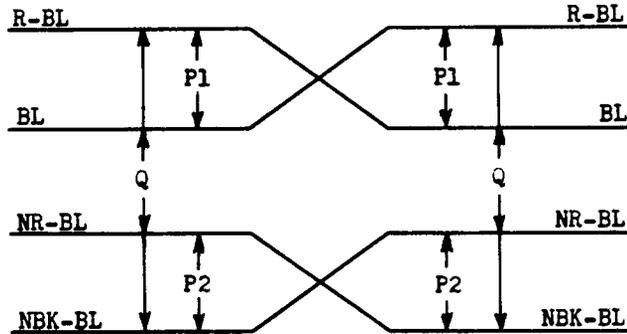


Fig. 2 - Turnover Splicing Diagram

If in applying this rule, the location of the splice falls within a bend in the cable, it will be satisfactory to make the splice in the straight section of the cable as close to the bend as possible.

4.02 When a splice is made, the four wires of a quad in both directions from the splice must be the same four wires composing the original quad, and the two wires of each pair in both directions from the splice must be the same two wires composing the original pair. Quads and pairs shall under no conditions be split or mixed in splicing.

4.03 A turnover splice consists of cutting the cable and transposing the wires of the individual pairs. The turnover splice for one quad is shown diagrammatically in Fig. 2. Splices shall be made in accordance with standard cable splicing requirements.

4.04 The plan for terminating quadded cables at the cable terminal blocks of the test board, distributing frame, and relay rack bays is covered in Table A. In the table, quad numbers are substituted for quad colors and it is arranged to systematically mix the quads to minimize continuous adjacencies in successive cable lengths.

Table "A"

**TERMINATING PLAN FOR QUAPPED CABLES IN TOLL OFFICES TO MINIMIZE CONTINUATION OF QUAD ADJACENCIES**

<u>Quad In Terminal Position</u>	<u>Quad In 1st Length of Cable</u>	<u>Quad In 2nd Length of Cable</u>	<u>Quad In 3rd Length of Cable</u>	<u>Quad In 4th Length of Cable</u>	<u>Quad In 5th Length of Cable</u>
<u>4-quad Cable</u>					
1	1	2	4	3	1
2	2	4	3	1	2
3	3	1	2	4	3
4	4	3	1	2	4
<u>8-quad Cable</u>					
1	1	2	4	8	5
2	2	4	8	5	7
3	3	6	1	2	4
4	4	8	5	7	3
5	5	7	3	6	1
6	6	1	2	4	8
7	7	3	6	1	2
8	8	5	7	3	6
<u>10-quad Cable</u>					
1	1	2	4	8	5
2	2	4	8	5	10
3	3	6	1	2	4
4	4	8	5	10	9
5	5	10	9	7	3

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<u>Quad In Terminal Position</u>	<u>Quad In 1st Length of Cable</u>	<u>Quad In 2nd Length of Cable</u>	<u>Quad In 3rd Length of Cable</u>	<u>Quad In 4th Length of Cable</u>	<u>Quad In 5th Length of Cable</u>
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10-quad Cable (Cont'd.)

6	6	1	2	4	8
7	7	3	6	1	2
8	8	5	10	9	7
9	9	7	3	6	1
10	10	9	7	3	6

12-quad Cable or 12 Quads in 13-quad Cable

1	1	2	4	8	3
2	2	4	8	3	6
3	3	6	12	11	9
4	4	8	3	6	12
5	5	10	7	1	2
6	6	12	11	9	5
7	7	1	2	4	8
8	8	3	6	12	11
9	9	5	10	7	1
10	10	7	1	2	4
11	11	9	5	10	7
12	12	11	9	5	10

16-quad Cable or 16 Quads in 17-quad Cable

1	1	3	9	10	13
2	2	6	1	3	9
3	3	9	10	13	5
4	4	12	2	6	1
5	5	15	11	16	14
6	6	1	3	9	10
7	7	4	12	2	6
8	8	7	4	12	2
9	9	10	13	5	15
10	10	13	5	15	11
11	11	16	14	8	7
12	12	2	6	1	3
13	13	5	15	11	16
14	14	8	7	4	12
15	15	11	16	14	8
16	16	14	8	7	4

20-quad Cable or 20 Quads in 21-quad Cable

1	1	5	2	10	4
2	2	10	4	20	8
3	3	15	6	7	12
4	4	20	8	17	16
5	5	2	10	4	20
6	6	7	12	14	1
7	7	12	14	1	5
8	8	17	16	11	9
9	9	18	13	10	3
10	10	4	20	8	17
11	11	8	18	13	19
12	12	14	1	5	2
13	13	19	3	15	6
14	14	1	5	2	10
15	15	6	7	12	14
16	16	11	9	18	13

<u>Quad In Terminal Position</u>	<u>Quad In 1st Length of Cable</u>	<u>Quad In 2nd Length of Cable</u>	<u>Quad In 3rd Length of Cable</u>	<u>Quad In 4th Length of Cable</u>	<u>Quad In 5th Length of Cable</u>
<u>20-quad Cable or 20 Quads in 21-quad Cable (Cont'd.)</u>					
17	17	16	11	9	18
18	18	13	19	3	15
19	19	3	15	6	7
20	20	8	17	16	11

REASON FOR REISSUE

1. Requirements for balancing quadded cables in toll offices by means of test splicing have been removed.
2. Requirements for balancing quadded cables in toll offices by means of means of midpoint turnover splicing have been added.
3. Requirements for terminating quads at cable terminal blocks in a plan which minimizes quad adjacencies in successive lengths of cable, have been added.
4. Requirement to balance cables having a butt-to-butt length of 55 feet and over, has been changed to include cables having a butt-to-butt length over 40 feet.

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