Transmission Testing 1004 Hertz and Gain-Slope AML Tests Direct, Tandem-Connecting, and Intertandem Trunks

Contents

(continued)

Contents, continued

1 General

1.1 Purpose

This practice provides:

- Tests, procedures, and related information regarding 1-kHz and gain-slope Actual Measured Loss (AML) testing of direct, tandem-connecting and intertandem trunks.
- A theoretical discussion of Inserted Connection Loss (ICL).
- A description of the different types of trunks.
- information on test equipment, test procedures, frequency of test, and the use of Form 000835PS.

1.2 Filing Instructions and Supersedures

Discard all previous issues and associated addenda of this practice and file this issue numerically in your GTE Telephone Operations practices set.

This practice supersedes and cancels:

- All policies, procedures, general instructions, letters, and memoranda which address this subject.
- Any document which provides information contrary to the information contained in this practice.

1.3 Reason for Reissuing

This practice has been reissued to incorporate a form number change in Exhibit 2 (Form 90003087 to 000835PS) and other minor format changes.

1.4 Responsibility

This practice was written by the COE Construction Department and published by the Telephone Operations Administrative Services Group. For more information about this practice contact the COE Construction Department at Telephone Operations Headquarters Manager-GO Technical Support, Irving, Texas.

1.5 Disclaimer

This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, contractors, customers, and end users when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

2. Overview

2.1 AML Tests

AML tests are performed to ensure that the trunks meet the Expected Measured Loss (EML) objectives indicated by the design engineer on the design Form 000825PS and recorded by the circuit layout bureau on circuit layout cards.

2.2 Definitions

The following chart defines the acronyms used in this practice.

Acronym	Definition
AML	Actual Measured Loss
COMPS	Central Office Maintenance Planning System
EML	Expected Measured Loss
FL	Fixed Loss
ICL	Inserted Connection Loss
OS	Out of Service
PCM	Pulse Code Modulation
Q1L	A value when exceeded indicates maintenance procedures.
Q2L	A value at which the circuit is no longer suitable and immediate action is to be initiated.
VNL	Via Net Loss

2.3 References

The following GTE Telephone Operations Practices are referenced in this document, and could be required for performing certain related tasks.

See...	For Information About...
103-437-500	Noise Measuring Set - Level & VU -NOEAST Electronics Model TTS-37B - Testing Procedures
331-010-002	Trunk Transmission 1004 Hz Gain-Slope AML XMSN & Circuit Message Noise Measurement for Trunks

3. Transmission Modes

3.1 Analog

Analog signals are nominal electrical signals that vary in amplitude or frequency (e.g., voice-frequency carrier systems such as Type 82A, 46A, 47A, N systems, etc.).

3.2 Digital

Digital signals are made up of discontinuous pulses whose information is contained in their durations, periods, and/or amplitudes (e.g., Pulse Code Modulation [PCM], Type 91A carrier, GTD-3 EAX, GTD Digital PABXs, etc.).

4. Trunk Configurations

4.1 Digital

Digital trunks are digital transmission facilities and terminate directly on line group equipment (or digroup terminals) at each end. Only trunks between digital switching systems are digital trunks.

4.2 Analog

Analog trunks use analog transmission facillities or digital transmission facillities that terminate on D2/D3-type channel banks. All trunks between two analog switching systems, regardless of the type of facility used, are analog trunks.

4.3 Combination

Combination trunks use digital transmission facillities where one end of the trunk terminates directly on line group equipment (or digroup terminals) at a digital switching system and the other end terminates on a D2/D2/D4-type channel bank.

5. Trunk Loss Plans

5.1 Via Net Loss

The Via Net Loss (VNL):

- Is the lowest value (in dB) that must be assigned to a specific trunk in order to satisfy echo requirements.
- Value is determined by the type and length of the trunk facility (e.g., cable loading, carrier including microwave radio, etc.).

5. Trunk Loss Plans, continued

5.2 Fixed Loss

In all digital networks, the Fixed Loss (FL) plan specifies:

- A 6-dB trunk loss between end offices, regardless of the connection mileage.
- Each tandem-connecting trunk is allocated a 3-dB loss; all digital intertandem trunks (i.e. digital facilities that interconnected digital tandem switches) are operated at a 0 dB loss. Refer to the following trunk transmission design practices:

See...	For Information About...
331-010-002	Trunk Transmission
834-100-071	Tandem Connecting
834-200-071	Intertandem
834-210-071	Direct
834-220-071	Tandem
834-223-070*	GTD-3 Toll & Local
834-224-070"	GTD-5

NOTE: Also refer to the GTE Technical interface Reference *Manual,* and *Notes on the BOC Intra-LATA Networks.*

*This practice is published by AG Communications Systems.

6. Inserted Connection Loss (ICL)

6.1 Basic Design Objectives

Loss objectives for trunks are usually stated in terms of EML. However, from a design standpoint, trunk administration is complicated by switching pad arrangements in some four-wire tandem offices as well as by various test pad arrangements. For this reason, basic design objectives for each major trunk category cannot be expressed in terms of EML.

6.2 Basic Loss Design Objectives

Therefore, the term "inserted Connection Loss" (ICL) has been adopted to enable direct comparison with the basic design objectives, which will be know as ICL objectives. Both EML and ICL values are required on circuit layout record cards for service and engineering administrative purposes.

The basic loss design objectives are specified in terms of ICL. The ICL is the:

- 1-kHz loss of the trunk when it is switched into an actual operating connection.
- Sum of all gain and losses from the originating outgoing switch appearance to the terminating outgoing switch appearance to which the trunk is connected. The trunk is terminated in a nominal office impedance of 600 or 900 ohms.

NOTE: The frequency 1-kHz is a nominal test frequency. The actual frequency, 1004 Hz, is used to avoid slow gain variations caused by beating the 1000-Hz tone with the 8-kHz sampling of digital channel banks.

6.3 1-kHz Loss

Related to the ICL is the EML, which is the 1-kHz loss that is expected to be measured between two readily accessible trunk test points. The EML corresponds to the ICL specification calculated with the proper terminating impedances at the test points. The EML includes switching (or cord circuit) loss, test pad losses when specified in the measuring circuit, and connection losses to the 1-kHz generator and detector.

6.4 Actual Measured Loss

Actual Measured Loss (AML) is the actual measured 1-kHz loss between the same two access points for which the EML was computed.

6.5 Allowable Deviations

When measuring the loss on a trunk or a trunk group, the EML value specified on the circuit record card is used to determine the acceptability of the circuit. Until system standards are finalized, the allowable deviations (1-kHz AML versus EML) are:

- Circuit order completion (refer to GTE Telephone Operations Practice 220-400-001).
- Routine maintenance: ±0.7dB, defined as Q1 L.
- Immediate investigation (immediate action limits): ±2.0dB digital, ±2.5 analog defined as Q2L.

The allowable gain-slope deviations for various types of facillities are shown in Exhibit 1.

7. Trunk Descriptions

7.1 Toll Connecting

A tandem-connecting trunk connects the customer end (serving) office to the tandem-switching office for connection to or from the tandem message network. Because of this unique position, two tandem-connecting trunks are involved in every tandem call on this message network. To ensure that certain minimum circuit parameters are present in every call, this feature is used in determining transmission objectives.

The general design objective for the tandem-connecting trunk is to provide the customer with the optimum volume and still limit the effects of the following to tolerable minimums:

. Echo.
- Noise.
- Singing.
- Crosstalk.

8. Intertandem Trunks

8.1 Description

An intertandem trunk connects any tandem-switching office to any other tandem office.

8.2 Design Objectives

Design objectives for intertandem trunks are necessarily interrelated with the performance of the associated tandem-connecting trunks and loops.

8.3 Secondary Trunk

A secondary intertandem trunk is used to connect a tandem-switching system and its associated manually operated assistance switchboard in the same or adjacent building (such as operator tandems, operator junctors, and operator service).

These trunks:

- Are separately identified because they are “extra” trunks in the hierarchical plan.
- Differ in that they can and should be operated at a 0 dB loss when designed with gain devices in association with four-wire toil systems (by switching out the A-pad of connected trunks).

8.4 Direct Trunk

Direct trunks connect two end offices. Direct trunks are terminated in a customer loop.

8.5 Nondial and Key Terminated

Nondial and key terminated trunks provide for operator services.

9. Frequency of Routine Tasks

9.1 Frequency

Use the following chart for the frequency of testing.

Trunks...	Test...
• Established on open-wire • Cable facilities but not equipped with with voice-frequency repeaters	Once a year.
• Cable facilities and equipped with voice-frequency repeaters	Every six months.
• Established on carrier facilities	Every three months
• On Carrier OR • Have hybrid voice-frequency repeaters	• In both directions. AND • Is a one-person test if the loop-around method is used.

9.2 Recording Tests

Trunk tests are included as part of the Central Office Maintenance Planning System (COMPS).

Record the test results on the 1004 Hertz, Gain/Slope AML Transmission C-Message and C-Notch Noise Measurement (Form 000835PS, Exhibit 2).

10. Test Equipment

10.1 Requirements

To perform 1-kHz and gain-slope AML tests, the following test equipment is required:

- Type 310 plug.
- Hand test telephone.
- Monitoring headset.
- Secondary testboard facilities.
- Connecting cords.
- Type TTS 1125 measuring set or its equivalent.
- Type TTS-4BNH-XDV Transmission Measuring Set (TMS) or its equivalent.

11. Testing

11.1 When to Test

Test the trunks before they are placed in service. These include newly established trunks and trunks on which there has been a change in line facilities, voice-frequency repeaters, CO equipment, etc. Return the completed Form 000835PS with the circuit order or service order completion test. Refer to Section 6.5 for allowable deviations from design objectives.

NOTE: Test frequencies in addition to 404,1004, and 2804 Hz may be used to test the MF characters of the circuit. Local company requirements will determine these frequencies.

11.2 Tandem-Connecting and Intertandem Trunks

To perform the 1-kHz and gain-slope AML test, using the TTS-37B, use the following procedure. Exhibits 3 and 4 show the basic electrical connections involved.

NOTE: For procedure using TTS-1125, refer to the manufacturer's instruction manual.

Step	Testing 1 -kHz and Gain-Slope AML on Tandem-Connecting and Intertandem Trunks Using Type ITS-37B NMS
1	Test the battery of the Type TTS-37B NMS by pressing the BATT TEST pushbutton. The meter needle should fall in the green area marked GOOD. **NOTE: If necessary, replace the batteries with Eveready 2356 batteries or equivalent.**
2	Calibrate the Type TTS-37B NMS as described in GTE Telephone Practice 103-437-500.
3	Place an Out of Service (OS) busy on the trunk.
4	Set the FILTER switch to 15KC.
5	Insert a Type 310 plug that is connected to a telephone headset into the MON AC jack.
6	Connect the testboard to either the LINE jack or the LINE binding posts.
7	Using the testboard facilities, dial the proper three-digit or seven-digit code to receive the 1-kHz or gain-slope test tones.
8	Set the HOLD toggle switch to ON.
9	Set the INPUT switch to the appropriate impedance. A 600-ohm termination is normal; very few offices will have a 900-ohm termination.

(continued)

11.2 Tandem-Connecting and Intertandem Trunks, continued

Step	Testing 1 -kHz and Gain-Slope AML on Tandem-Connecting & Intertandem Trunks Using Type TTS-375 NMS
10	**Set** the SENS attenuator switches to obtain a convenient reading on the meter. The level is the algebraic sum of the SENS switches reading (white numbers only) and the meter reading (black numbers only). Likewise, the SENS switches reading is the algebraic sum of the white numbers. **NOTE: A -5 SENS switch setting and a + 2 reading on the meter equals a -3 dBm level. This equals a + 3 dB loss. A + 5 SENS switch setting and a -1.5 reading on the meter equals + 3.5 dBm loss; this is a gain of 3.5 dB. Any negative loss equals a gain. (In these examples, a 0-dBm test tone level is assumed.)**
11	Record the 11-kHz (or gain-slope) AML measurements in the space provided on Form 000825PS.
12	To release the connection, set the HOLD toggle switch to OFF, unplug the cord, and remove the OS busy.

11.3 Direct and Tandem Trunks

To make 1-kHz and gain-slope AML tests on direct trunks, perform the following procedure (Exhibits 5 and 6 show the basic electrical connections involved in these measurements).

Step	Testing 1 -kHz and Gain-Slope AML on Direct Trunks
1	Test the battery of the Type TTS-37B NMS by pressing the BATT TEST pushbutton. The meter needle should fall in the green area marked GOOD. **NOTE: If necessary, replace the batteries with Eveready 2356 batteries or equivalent.** **NOTE: For procedure using TTS-1125, refer to the manufacturer's instruction manual.**
2	Calibrate the Type TTS-378 NMS as described in GTE Telephone Operations Practice 103-437-500.
3	Set the INPUT switch to DIAL and TALK.
4	Set the FILTER switch to 15KC.
5	Insert a Type 310 plug that is connected to a telephone headset into the MON AC jack.
6	Connect the testboard to either the LINE jack or the LINE binding posts,

(continued)

11.3 Direct and Tandem Trunks, continued

Step	Testing 1-kHz and Gain-Slope AML on Direct Trunks
7	Connect the hand test telephone to the DIAL jack.
8	Set the HOLD toggle switch to ON.
9	Set the INPUT switch to the appropriate impedance. (600 TERM or 900 TERM.)
10	Set the SENS attenuator switches to obtain a convenient reading on the meter. The level is the algebraic sum of the SENS switches reading (white numbers only) and the meter reading (black numbers only). Likewise, the SENS switches reading is the algebraic sum of the white numbers.
11	Record the 11-kHz (or gain-slope) AML measurements in the space provided on Form 000825PS.
12	To release the connection, set the HOLD toggle switch to OFF

11.4 Nondial Trunks

Exhibit 7 illustrates a typical test connection for nondial trunks. Variations in nondial trunks (see Exhibit 8) might require different test connections. These different test connections should be similar to those shown in Exhibit 7. If a circuit layout card is provided, make test connections to include all items in the EML specified on the card. Perform the test procedures in the same manner as for direct trunks as described in Section 11.3. Since the 1mW source must be accessed manually, two persons are required to perform the test, one at each end of the trunk.

11.5 Key Terminated Trunks

Exhibit 9 illustrates a typical test connection for key terminated trunks. Variations in key terminated trunks (Exhibit 10) might require different test connections (Exhibits 11 and 12) for sectionalizing purposes. These different test connections should be similar to those shown in Exhibit 9. If a circuit layout card is provided, make test connections to include all items in the EML specified on the card. Perform the test procedures in the same manner as for direct trunks as described in Section 11.3. Since the 1 mW source must be accessed manually, two persons are required to perform the test, one at each end of the trunk.

11.6 Loop Around

The tests described for the following trunks can be performed by one person if loop-around test terminators are installed at the incoming office:

- Tandem connecting and intertandem trunks.
- Direct trunks.
- Nondial trunks.

Dial a number from each trunk to access the test termination. Refer to Exhibit 13 for this procedure. Exhibit 14 shows optional selector access to loops.

11.7 Loop-Around Method

To illustrate the method of one person loop-around testing, assume that two four-wire, one-way trunks are used. The trunks are outgoing trunks from office A. Assume further that loop-around test terminations are installed at incoming office B.

Exhibit 13 shows that each trunk has two paths. The paths are (1) a transmit path to office B, and (2) a receive path from office B to office A.

11.8 One-Person Testing

The procedure used for one-person testing of outgoing trunks from switchboards is as follows:

Step	One-Person Testing Outgoing Trunks from Switchboard
1	A. Plug in the front cord of a cord pair into the switchboard jack for trunk 1. B. Dial the 1000-Hz test number in office B. C. Plug the rear cord of the pair into the REC 310 jack of the TMS and make a loss measurement. This reading is the loss for the receive path of trunk 1. Assume a 5dB loss for illustration purposes.
2	Repeat Step 1 for trunk 2. • This reading is the loss for the receive path of trunk 2. • Assume a 5dB loss for illustration purposes.
3	Dial a loop-around test termination number using trunk 1. Use the front cord of a cord pair.
4	Dial the second loop-around test termination number using trunk 2. Use the front cord of a cord pair.
5	A. Insert the rear cord of the pair associated with trunk 1 in the mW jack of the switchboard. B. Insert the rear cord of the pair associated with trunk 2 into the REC 310 jack of the TMS.
6	Make a loss measurement. For the purpose of illustration, assume a 10.5 dB loss. This reading is the loss for the transit path of trunk 1 plus the loss for the receive path of trunk 2.
7	A. Determine the loss for the transmit path of trunk 1. B. The loss for the receive path of trunk 2 was determined in Step 2 to be 5dB. C. Assume that the loop-around termination loss is 0.5dB. D. The loss of the transmit path of trunk 1is 10.5dB minus 5.5 dB. Therefore, the loss of the transmit path of trunk 1 is 5dB.

(continued)

11.8 One-Person Testing, continued

Step	One-Person Testing Outgoing Trunks from Switchboard
8	A. Reverse the rear cord connections described in Step 5. B. With 1mW supplied on trunk 2, the transmit path of trunk 2 and the receive path of trunk 1 are measured for loss.
9	Determine the loss for the transmit path of trunk 2 as in Steps 1, 6, and 7.

12.1004 Hertz, Gain/Slope AML Transmission, C-Message and C-Notch Noise Measurements (Form 000825PS)

12.1 Use

Record all I-KHz and gain-slope measurements on Form 00835PS, shown in Exhibit 2. Use a separate form for each trunk group.

Refer to GTE Telephone Operations Practice 331-01 O-002 for preparation.

For trunks that do not meet EML objectives and cannot be corrected by ordinary procedures, contact the engineer in accordance with local procedures.

Exhibit 1 Gain-Slope Deviation Relative to 1004 Hz

TYPE OF FACILITY	404 Hz	2,804 Hz
Nonrepeatered cable	Within 2.0dB mote and 1.5dB less loss	Within 3.0dB more and 2.5dB less loss
Repeatered cable	Within 3.0dB more and 1.0dB less loss	Within 4.5dB more and 1.0dB less loss
Type 46A1/46A2 channel bank	Within 2.0dB more and 1.0dB less loss	Within 1.5dB more and 1 .0dB less loss
Type 46A3 channel bank	Within 2.0dB more and 1.0dB less loss	Within 1.0dB more and 0.5dB less loss
Type 47A/N1 carrier	Within 2.5dB more and 1 .0dB less loss	Within 3.0dB more and 1.0dB less loss
Type 47A/N2 carrier	Within 2.0dB more and 1 .0dB less loss	Within 2.0dB more and 1 .0dB less loss
Type 46B carrier	Within 2.0dB more and 1.5dB less loss	Within 2.0dB more and 1.5dB less loss
Type 9001A/B channel banks	Within 2.0dB more and 1 .OdB less loss	Within 2.0dB more and 1.0dB less loss
Type 9002A/B channel banks	Within 2.0dB more and 1.0dB less loss	Within 2.0dB more and 1.0dB less loss
WECO Type N1 carrier	Within 1.5dB more and 1.0dB less loss	Within 3.0dB more ad 1 .0dB less loss
WECO Type N2 carrier	Within 1.5dB more and 1.0dB less loss	Within 2.0dB more ad 1.0dB less loss
WECO Type N3 carrier	Within 2.0dB more and 1.0dB less loss	Within 1.5dB more and 1.0dB less loss
WECO Type O/ON carrier	Within 2.0dB more and 1.0dB less loss	Within 1.5dB more and 1.0dB less loss
Type D', D2, D3 channel bank	Within 2.0dB more and 1.0dB less loss	Within 2.0dB more and 1 .0dB less loss
Type A channel bank	Within 2.0dB more and 1.0dB less loss	Within 1.0dB more and 0.5dB less loss

NOTE: Reference additional standards from Section 7000 of the Technical Interface Reference Manual.

1004 HERTZ, GAIN/SLOPE AML TRANSMISSION,
C-MESSAGE AND C-NOTCH NOISE MEASUREMENTS
FORM 000835PS
Fad. 331.120510

DATE ______________ TRK. GRP. & PULSING ______________

TRK. TYPE ______________ TGID ______________ CONTROL OFFICE ______________

TESTED BY ______________

NOTCH NOISE

OS LIMIT	
CLR REQ	

MESSAGE NOISE

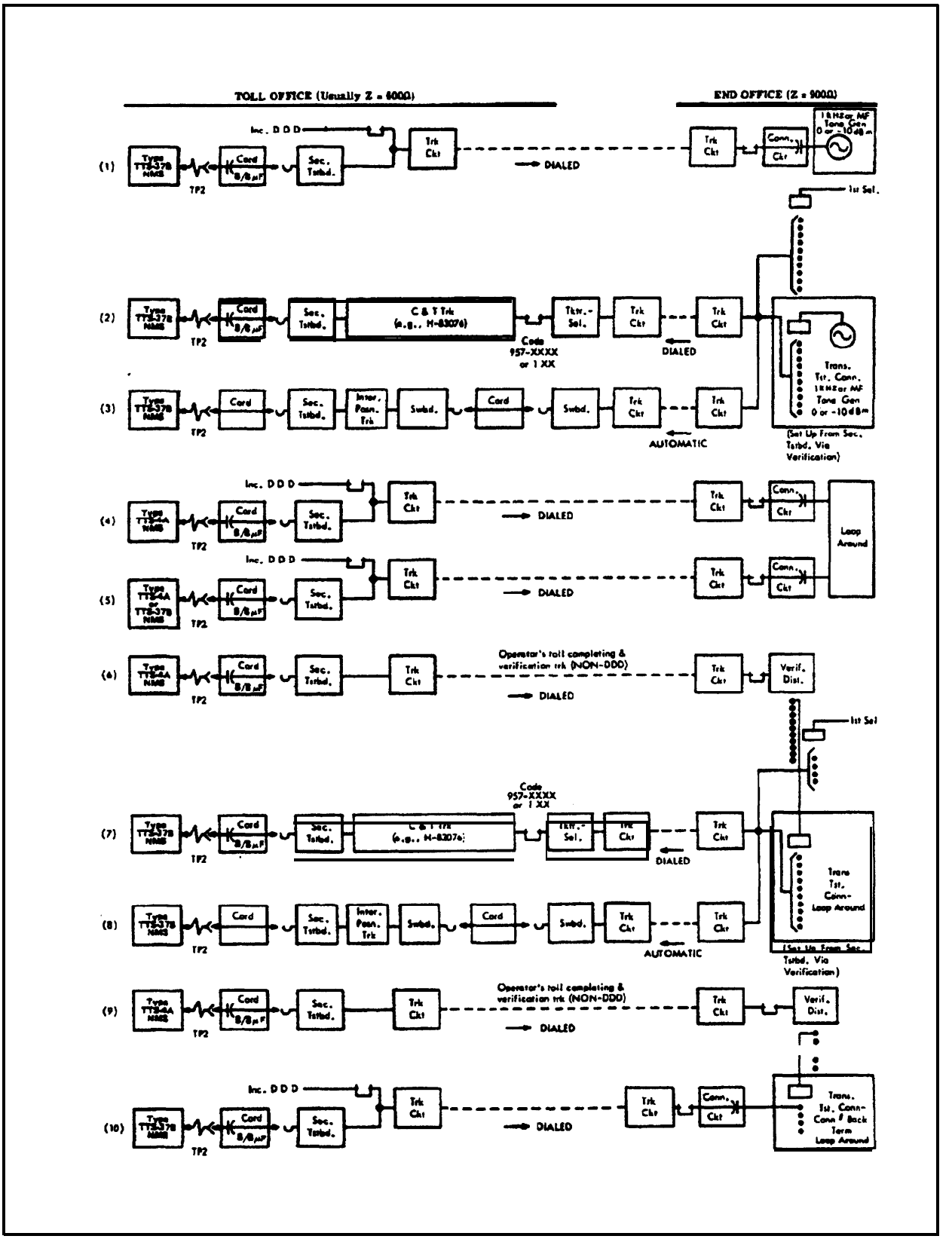
OS LIMIT	
CLR REQ	

REQUIREMENTS

EML	404 HZ	1004 HZ	2804 HZ			
OEV						
CLR REG						

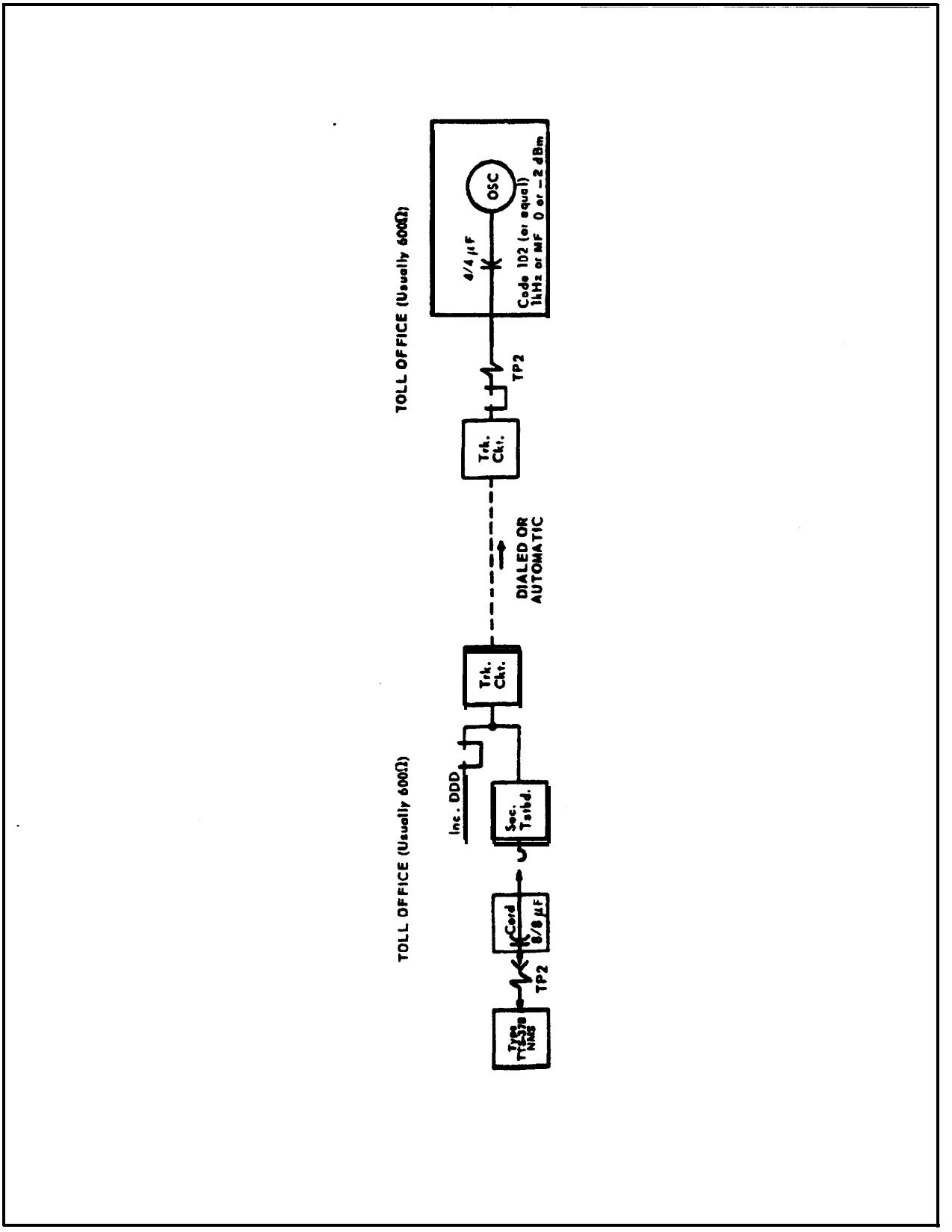
TRUNK NO.	AML										NOTCH	MESSAGE	REMARKS ACTION TAKEN
	404 HZ		1004 HZ		2804 HZ						NOISE		
	A-Z	Z-A	A-Z	Z-A	A-Z	2-A							

Exhibit 2 – 1004 Hertz Gain/Slope AML Transmission, C-Message and C-Notch Noise Measurement (Form 000835PS)



NOTE: Reference manufacturer's instruction manual for TTS-1125 schematic

Exhibit 3 – Basic Electrical Connections – AML Measurements Toll Connecting Trunks



NOTE: Reference manufacturer's instruction manual for TTS-1125 schematic

Exhibit 4 – Basic Electrical Connections – AML Measurements Intertandem Trunks

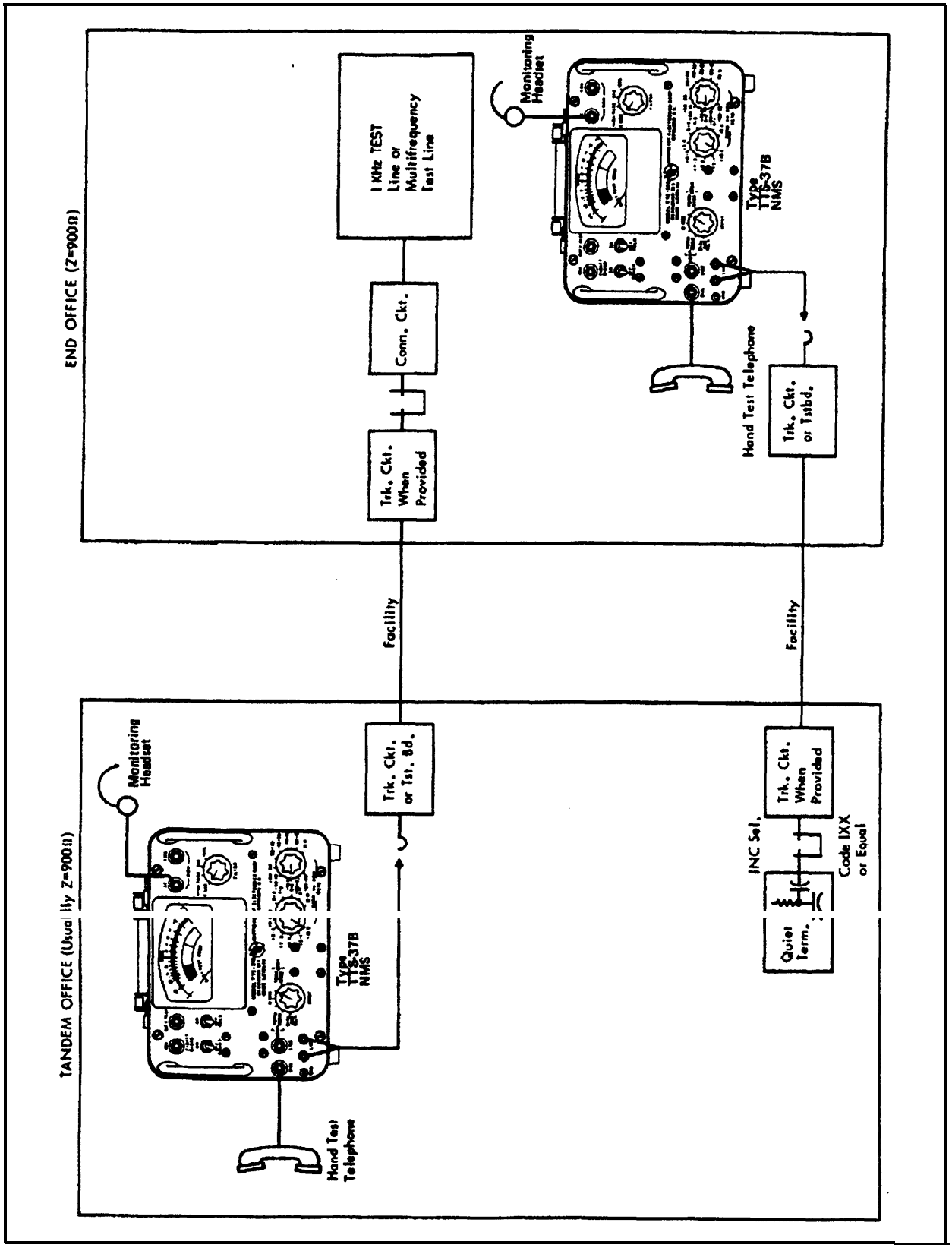


Exhibit 5 – Basic Electrical Connections – AML Measurements Tandem Trunks

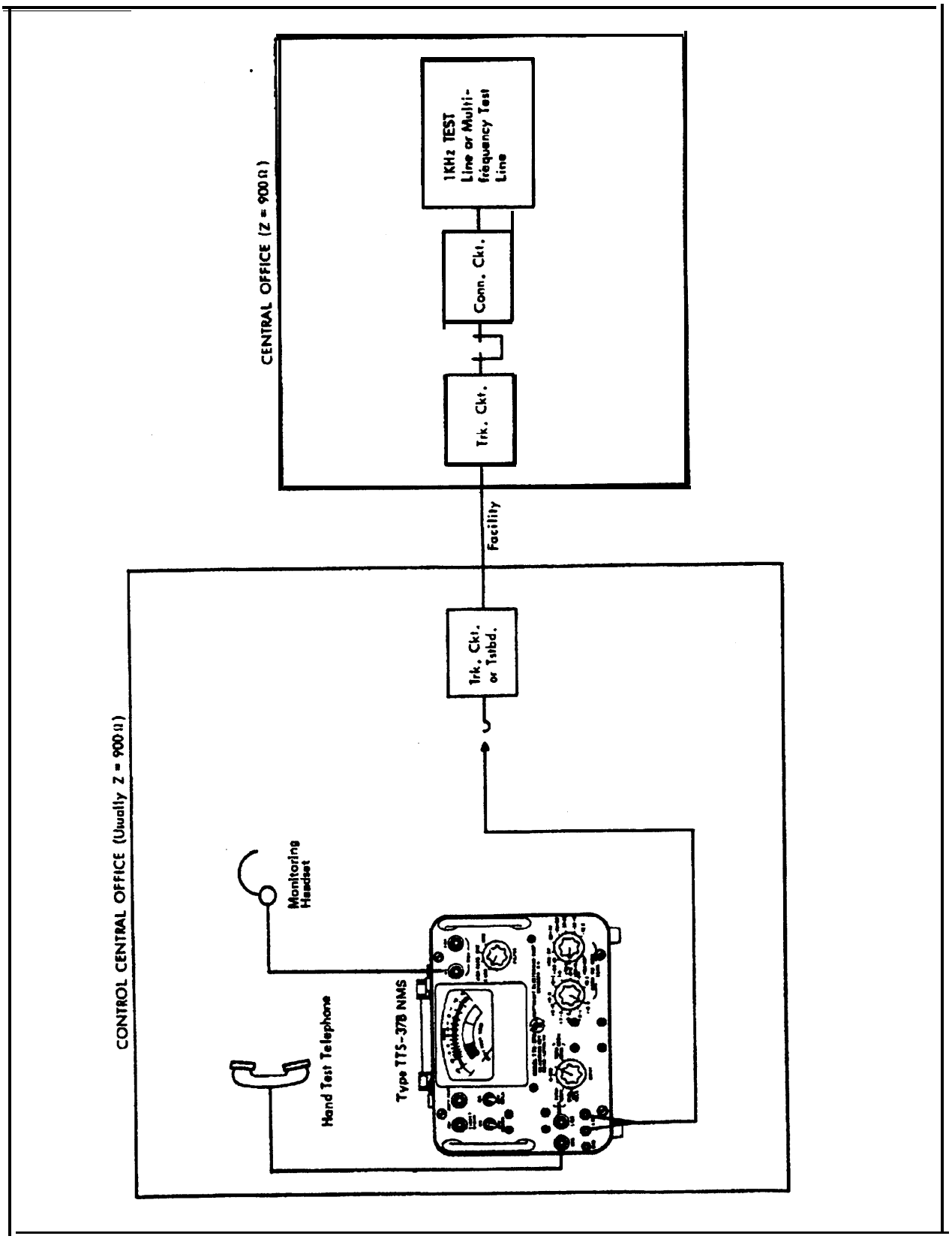


Exhibit 6 – Basic Electrical Connections- AML Measurements Direct Trunks

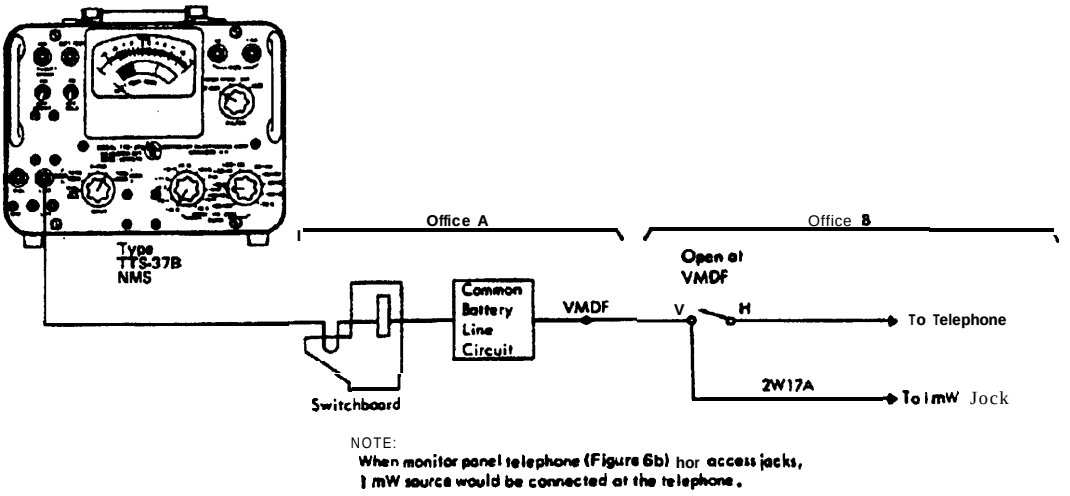


Exhibit 7 - Test Connections Nondial Trunks

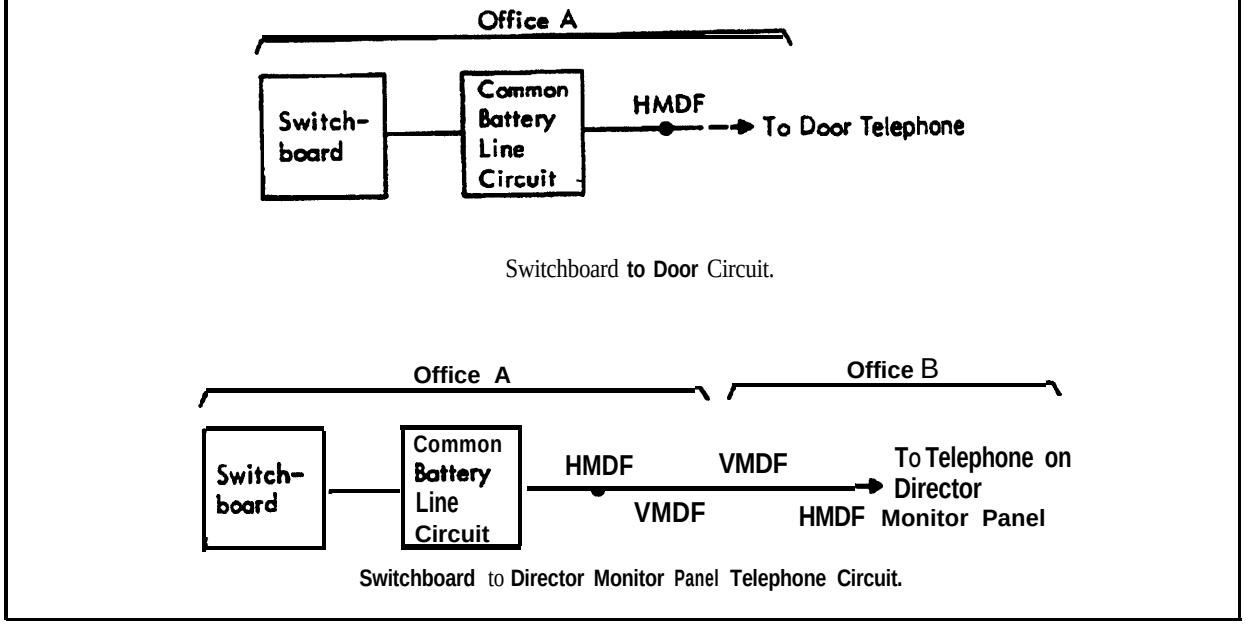


Exhibit 8 – Various Common Battery Nondial Trunks

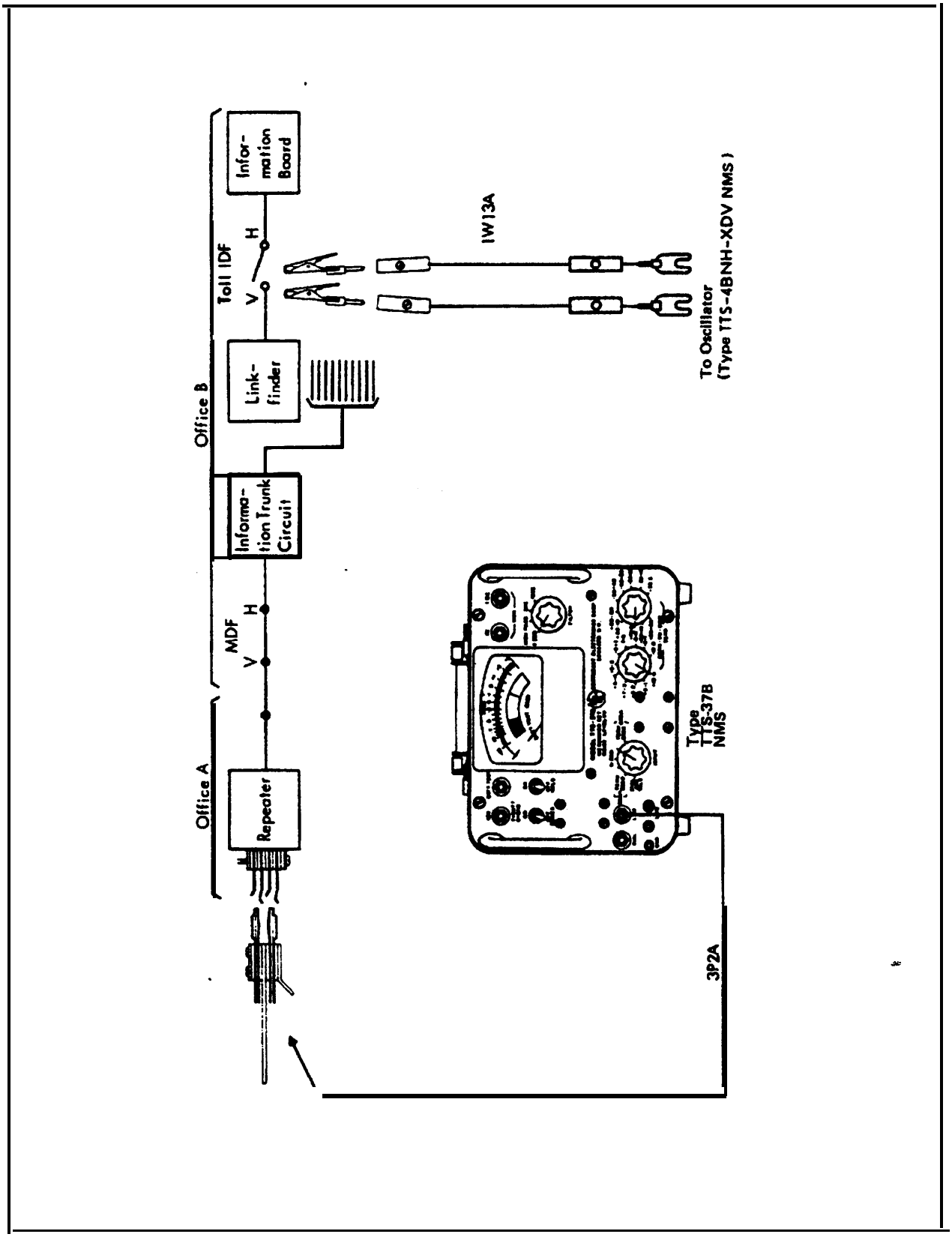
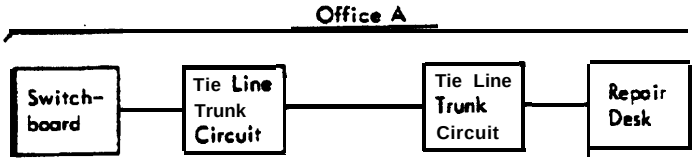
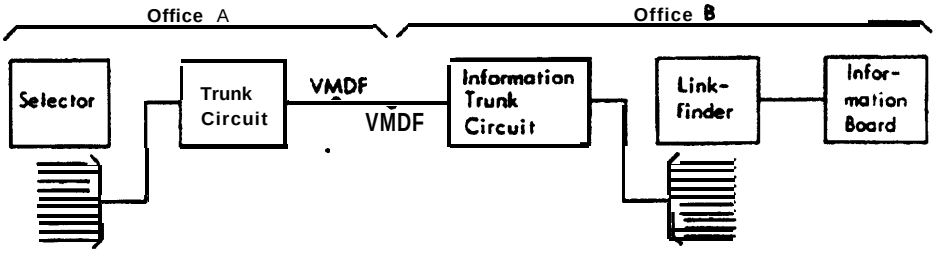


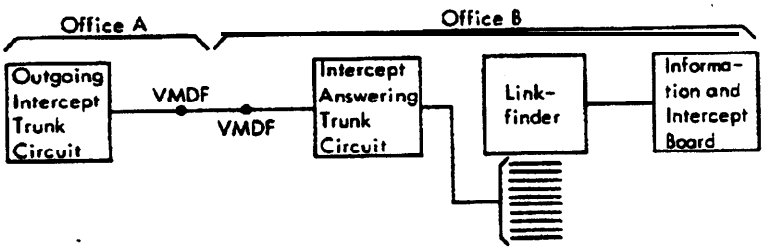
Exhibit 9 – Test Connections Key Terminated Trunks



Trunk Between a Toll Switchboard and a Repair Desk.



Trunk Between an Office and an Information Board.



Intercept Trunk Between an Office and an Information and Intercept Board.

Exhibit 10 – **Various Key Terminated Trunks**

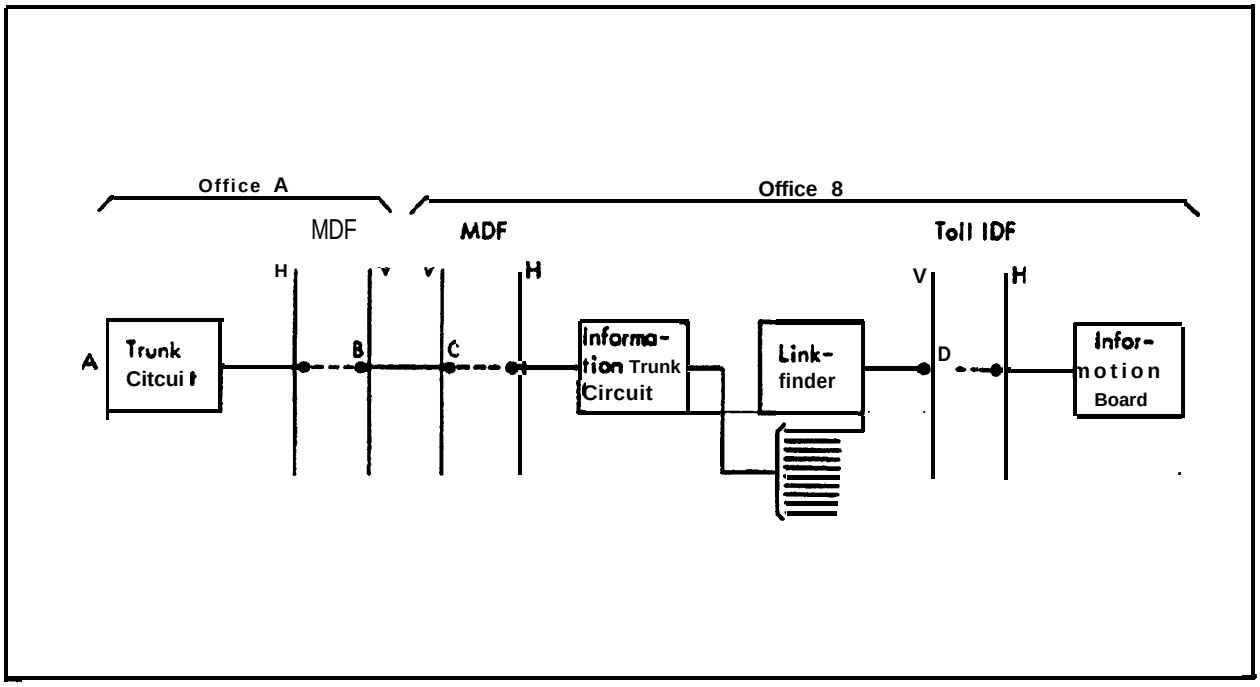
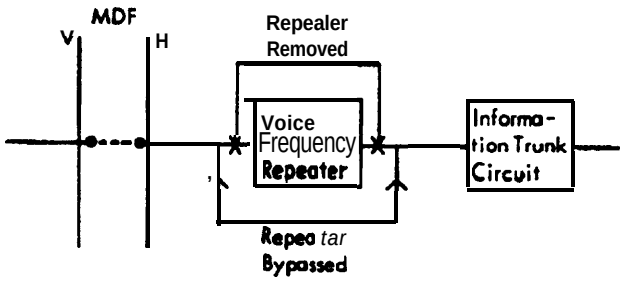


Exhibit 11 – Sectional Testing Key Terminated Trunks



NOTES:

1. Refer to the specific voice frequency repeater information for bypass arrangements.
2. When sectionalizing a trunk that exceeds loss limits shown, a voice repeater may be removed and bypassed. Another transmission test is made to determine if repeater is at fault.

Exhibit 12 – Trunk Retesting With Voice Frequency Repeater Removed

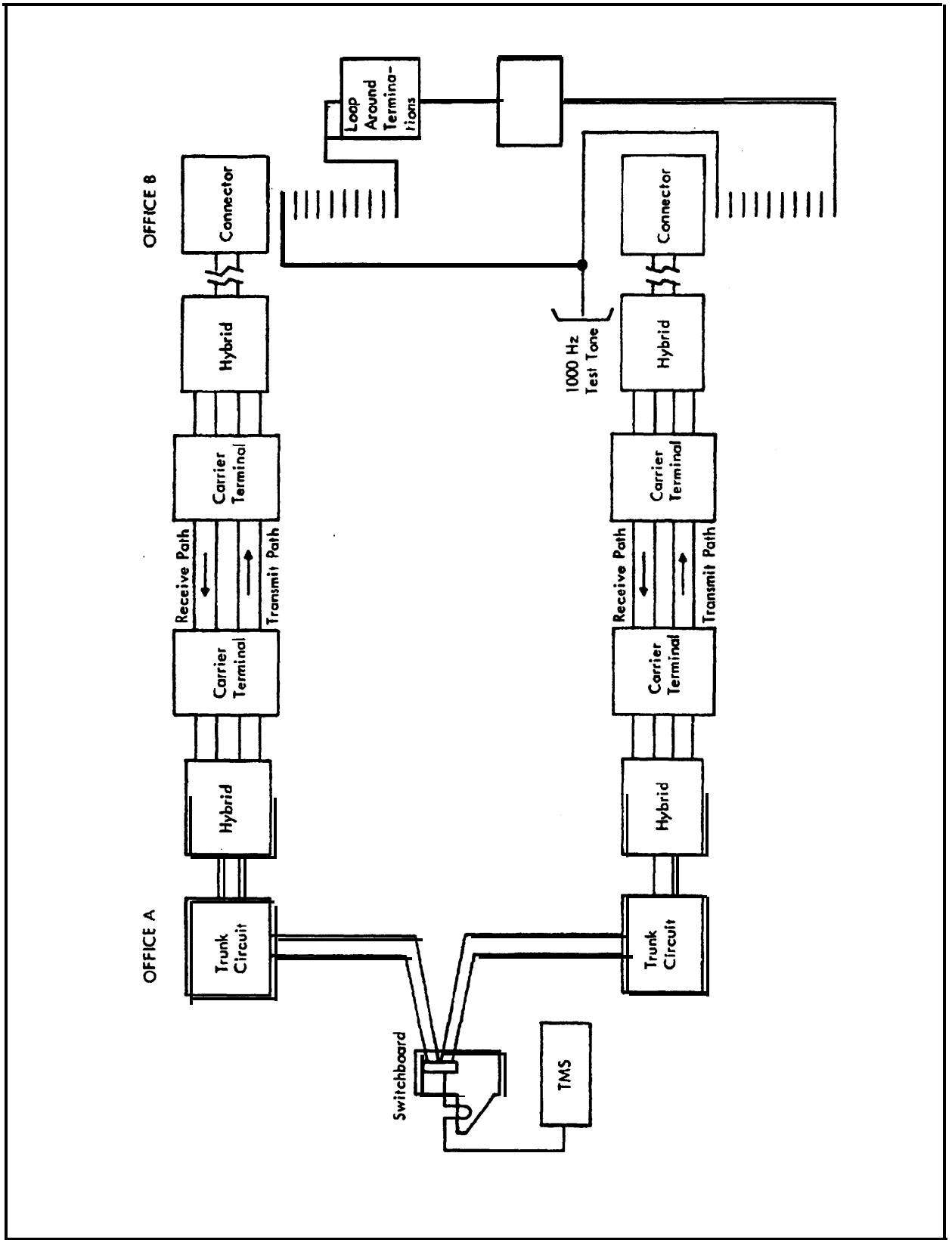


Exhibit 13 – Loop-Around Transmission Testing Showing Switchboard Access to Loops

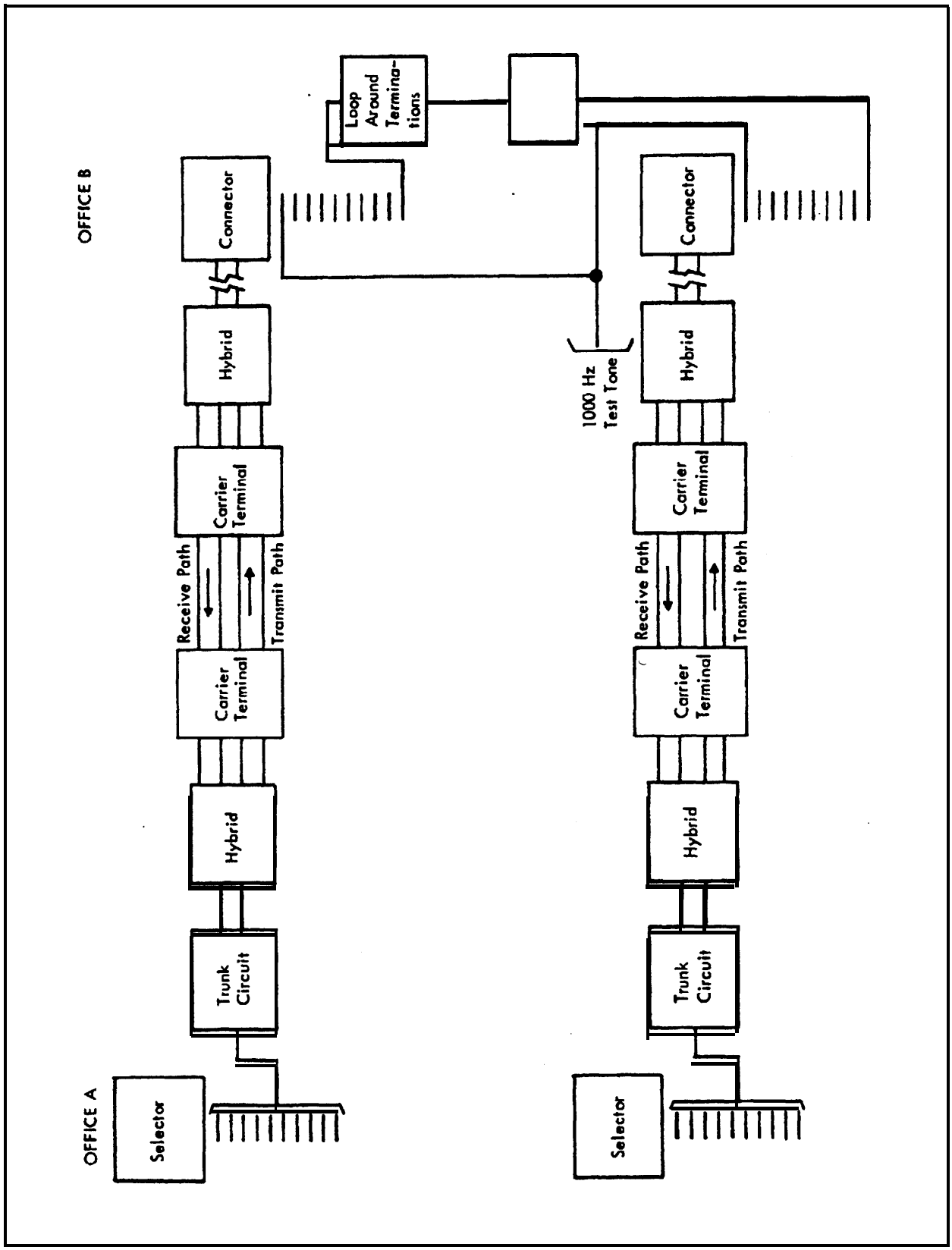


Exhibit 14 – **Loop-Around Transmission Testing Showing Selector Access to Loops**