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TRANSMISSION BALANCE CERTIFICATION OR VERIFICATION FOR SWITCHED LATA ACCESS SERVICES

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1. INTRODUCTION

1.01 This practice describes engineering considerations and responsibilities for the transmission balance certification or verification for Switched LATA Access Service, Feature Groups B and D. Transmission Balance considerations for Feature Group C services will be covered in a later issue of this practice.

DEFINITION

(a) *Certifications* -applies to access tandems where records of all trunks providing feature group B or D services are reviewed.

(b) *Verification* -applies to reviewing records of hybrids at end offices providing feature group B or D services.

1.02 When this practice is reissued, the reason for the reissue will be given in this paragraph.

2. OVERVIEW

2.01 This practice will provide Engineering guidelines to control echo return loss (ERL) and singing return loss (SRL) at access tandem and end offices used for Feature Groups B and D services. These guidelines assure compliance with TECHNICAL PUBLICATION 62500.

2.02 The rules for balance certification or verification required to meet the Acceptance Limits to the access tandem and end offices are more stringent than those used for the predivested toll network or those found in BR 853-500-110 for IntraLATA Networks.

(a) In the predivested network, rules for certification of toll offices and intra-state Long Distance Tandem offices required at least 50% of the trunks in a trunk group category to meet or exceed preservice limits. No trunk could be less than Immediate Action Limits.

(b) The post divestiture rules for certification of an Access Tandem Office requires that 100% of all trunks meet or exceed Preservice Limits with no trunk less than Preservice limits. This is necessary to assure that access trunks to the access tandem and to the End Office meet the Acceptance Limits in the TECHNICAL PUBLICATION 62500.

(c) Preservice limits are generally 1 to 2 dB more stringent than the Acceptance Limits to compensate for any variations in test results which may be caused by time-lapse or differences in test equipments See Tables A and B for comparisons between Preservice Limits, Acceptance Limits, and Immediate Action Limits. Acceptance Limits and Immediate Action Limits are found in TECHNICAL PUBLICATION 62500. Preservice Limits are internal Bell Operating Company requirements and are found in older practices or new Bellcore practices.

2.03 Facilities with no 2-to-4 wire conversions (hybrids), such as 4-wire facilities to 4-wire switches or to digital switches, require no balance.

3. CONSIDERATIONS FOR 1/1A ESS ACCESS TANDEM USED FOR FEATURE GROUP D SERVICE

3.01 LATA Access for feature group-D services may be provided either on direct links from the Interexchange Carrier Point of Termination (IC-POT) to the end office or from the IC-POT to the end office via an Access Tandem.

3.02 These balance requirements are stated in the TECHNICAL PUBLICATION 62500 as Acceptance Limits and Immediate Action Limits.

3.03 There are two trunk group categories in the 2-wire 1/1A ESS Access Tandem that must be considered in the certification process.

(1) The 4-wire ESS trunk circuit (4WESS) used to provide trunk access to the Access Tandem from the Interexchange Carrier POT is generally referred to as the intertoll hybrid. Each of these hybrids must initially meet or exceed the preservice limit of 40-dB ERL and 35-dB SRL when terminated into the access tandem 100 test line. This test is covered in Bellcore practice BR660-476-301. Meeting these requirements will ensure that the FG-D Acceptance Limits of 25-dB ERL and 18-dB SRL will be met when measured at the Interexchange Carrier POT when using the equal level echo path loss (ELEPL) method (see TECHNICAL PUBLICATION 62500).

Note: It is important to note that the 40-dB ERL and 35-dB SRL requirements are high enough so that **there is no negative influence on the terminal balance results** when these hybrids are cut through to the end office over the tandem connecting trunk.

(2) The Tandem Connecting Trunks are tested per BR660-476-301. When the tests are made from the 1ESS Test Access Trunk Circuit (TAT) at the access tandem to the end office, (terminated in 900 ohms in series with 2.16 μF), the test results must exceed 22-dB ERL and 15-dB SRL on each trunk. This will ensure FG-D Acceptance Limits of 20-dB ERL and 13-dB SRL when measuring from the Interexchange Carrier POT through the access tandem to the end office termination, using the equal level echo path loss method.

Note: Requirements of 40-dB ERL and 35-dB SRL, per BR660-476-301, are the "net" balance figures after the trans-hybrid loss has been "zeroed out" of the return loss measuring set. This value is now being referred to as impedance balance. The impedance balance is equal to the equal level echo path loss plus or minus 1 dB depending on the values of test pads used by the Interexchange Carrier and the Bell Operating Company on trunks designed for 0-dB Interconnection loss. (ZB = ELEPL $\pm$1 dB)

4. CONSIDERATIONS FOR A DIGITAL ACCESS TANDEM USED FOR FEATURE GROUP D

4.01 The Digital Access Tandem is effectively a 4-wire switch, and does not have a hybrid on the access path from the IC-POT and, therefore, will not require balance certification for that switch. However, the access tandem will still be responsible for balance of the tandem connecting trunks from the access tandem to the end office for FG-D services unless the end office is also a digital switch.

4.02 Balance measurements from the digital access tandem to the analog end office must meet or exceed preservice limits of 22-dB ERL and 15-dB SRL for each trunk used to provide FG-D service to the end office. This will ensure that the equal level echo path loss tests made from the Interexchange Carrier POT to the end office via the access tandem will meet or exceed Acceptance Limits of 20-dB ERL and 13-dB SRL.

5. CONSIDERATIONS FOR 2-WIRE END OFFICES USED FOR FEATURE GROUP D DIRECT ACCESS SERVICE

A. Transmission Type B (4-wire interface) Service

5.01 The ELEPL limits for FG-D (transmission type B), direct access service from the Interexchange Carrier POT to the end office are as follows:

Preservice	22-dB ERL and 15-dB SRL
Acceptance	20-dB ERL and 13-dB SRL
Immediate Action	16-dB ERL and 11-dB SRL

The preservice limits must be met or exceeded on every end office hybrid providing FG-D, transmission type B, direct access services to ensure that Acceptance Limits of 20-dB ERL and 13-dB SRL are met or exceeded on every circuit when tested from the Interexchange Carrier POT.

5.02 If the FG-D/Type B Acceptance Limits are not met the following progressive actions are recommended:

(1) Verify test procedures.

(2) Where Test lines are provided with build-out options, build out the 100 type test line per BR660-4xx-504 specified for the type of switch under test.

(3) If 1 and 2 above do not produce satisfactory results, establish a common network buildout value(s) that will meet or exceed the acceptance limits.

B. Transmission Type C (2-Wire interface) Service

5.03 The Return Loss (RL) limits for FG-D (transmission type C), direct access service from Interexchange Carrier POT to the end office are as follows:

Preservice	18-dB ERL and 10-dB SRL
Acceptance	16-dB ERL and 8-dB SRL
Immediate Action	13-dB ERL and 6-dB SRL

Note: Return loss measurements are similar to 2-wire Terminal Balance Measurements per BR660-4xx-301, except there is no switch.

5.04 If the return loss limits are not met for FG-D (Transmission Type C) services, the following is recommended:

(1) Verify test procedures

(2) Verify facility design layout

(3) Verify cable make up and characteristic impedance of facility

(4) Verify end-office termination, especially on short facilities.

6. INITIAL CERTIFICATION AND/OR VERIFICATION PROCEDURES

A. Certification of Feature-Group D 1/1A ESS Access Tandem

6.01 The initial certification of FG-D 1/1A ESS Access Tandem requires the following:

(a) Review the preservice test records to assure that all Hybrids on circuits from the Interexchange Carrier POT to the Access Tandem meet or exceed 40-dB ERL and 35-dB SRL per BR660-476-301.

(b) Review Preservice test records of all tandem-connecting-trunks tested from the 1ESS Access-Tandem Test Access Trunk to the End-office test line. The preservice measurements on all trunks must meet or exceed 22-dB ERL and 15-dB SRL per BR660-476-301. (See Table A and Figure 1.)

(c) Make the initial certification report to the District Transmission Engineering Manager responsible for LATA Access Transmission quality assurance.

B. Initial Verification of End Office Hybrids Used for Feature-Group D Direct Access Circuits

6.02 Verification of end-office trunk hybrids for FG-D Direct Access circuits involves the following:

(a) Review preservice test records of tests made at the end office on each hybrid used in providing FG-D direct access services to that end office.

(b) The results of equal-level-echo-path-loss tests made at the 4-wire port of the End office hybrids should meet or exceed the preservice limit of 22-dB ERL and 5-dB SRL.

(c) If the records indicate that the preservice limits in (b) are met, the Acceptance limits of 20-dB ERL and 13-dB SRL will be met or exceeded when the tests are made from the Interexchange Carrier POT using the same method.

(d) An initial verification report should be sent to the District Transmission Engineering Manager responsible for LATA Access Quality assurance.

7. MAINTENANCE OF BALANCE CERTIFICATION/VERIFICATION FOR FEATURE GROUP D

7.01 The transmission engineer should review the mandatory or optional routine balance test results to observe the "in-service" distribution. The installation objective for the FG-D service connections is for 100% of the connections to meet or exceed the preservice limits. The "in-service" objective is for at least 50% of the connections to meet the acceptance and/or maintenance limits with none less than the Immediate Action Limits. Following are the FG-D service LATA access connections that should have their routine records reviewed:

(a) *Interexchange Carrier POT to Access Tandem:* These routine tests may be made either from the Interexchange Carrier switch or from the Interexchange Carrier POT to the access tandem.

TABLE A
PRESERVICE, ACCEPTANCE AND IMMEDIATE ACTION LIMITS
FEATURE GROUP-D BALANCE REQUIREMENTS
(Notes 2 through 10)

POT to EO Direct	PSL (Note 1)	AL	IAL
Type B ERL (ELEPL)	22	20	16
SRL (ELEPL)	15	13	11
Type C ERL (RL)	18	16	13
SRL (RL)	10	8	6
POT to EO via AT			
Type A ERL (ELEPL)	NS	20	16
SRL (ELEPL)	NS	13	11
POT to AT			
Type A ERL (ELEPL)	27*	25	21
SRL (ELEPL)	20*	18	14
AT to EO **			
Type A ERL (TB)	22	NS	16
SRL (TB)	15	NS	11
EO to AT #			
ERL (ZB)	14	NS	13
SRL (ZB)	6	NS	5

Notes:

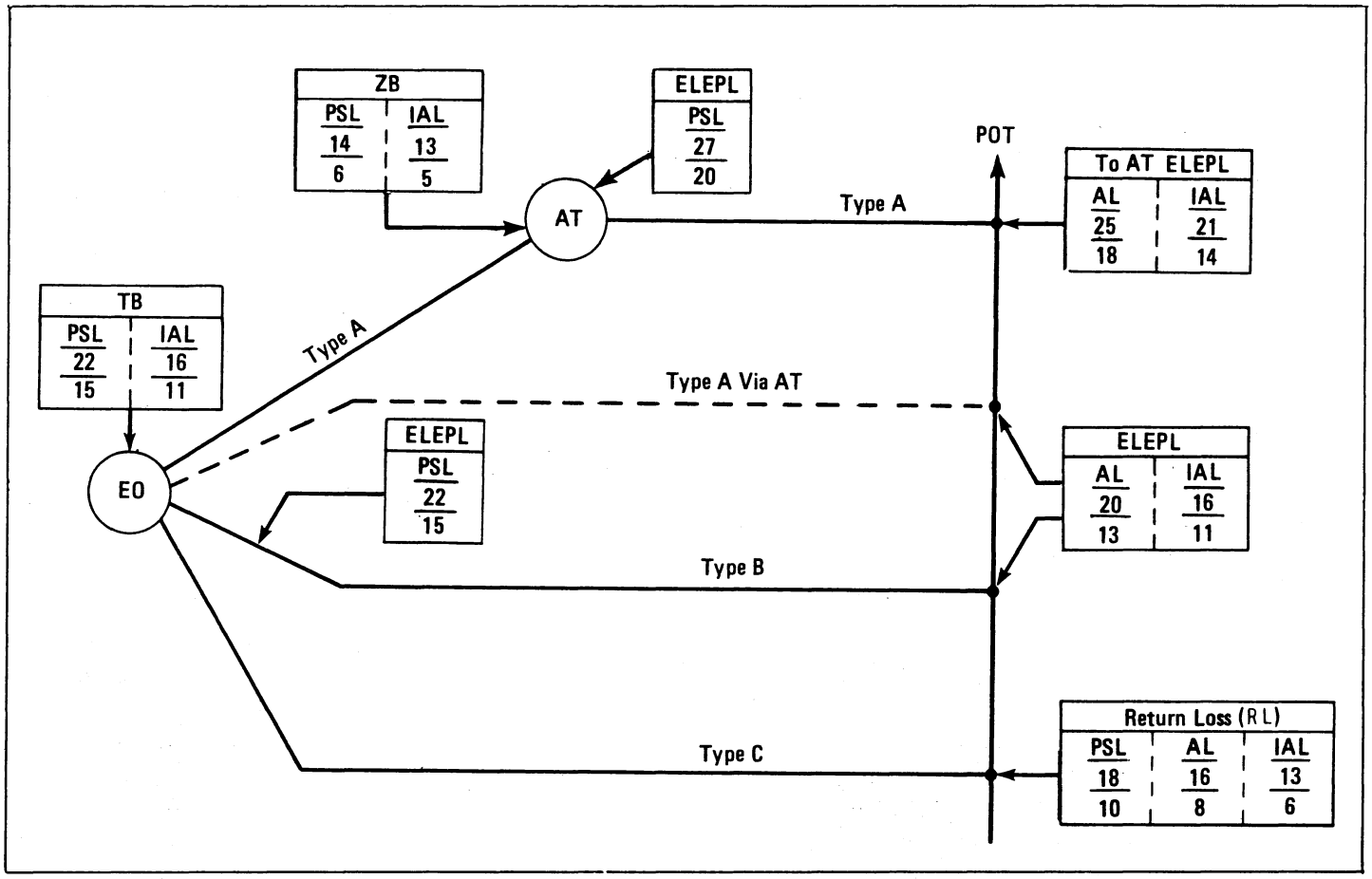
1. Preservice Limits (PSL) are not part of TECHNICAL PUBLICATIONS 62500
2. At the POT, Type A and B interfaces are 4-wire, Type C interfaces are 2-wire.
3. NS = Not Specified
4. PSL = Preservice Limits, AL = Acceptance Limits, IAL = Immediate Action Limits.
5. PSL and AL requirements are to be considered "equal to or greater than the value shown," and apply to 100% of the circuits (or hybrids).
6. Test results less than IAL are considered unsatisfactory and must be improved to values of AL or greater.
7. ELEPL = Equal Level Echo Path Loss
8. RL = Return Loss
9. TB = Trunk Balance
10. ZB = Impedance Balance

Foot Notes:

* BR660-476-301 specifies 40 ERL, 35 SRL which is still recommended for installation requirements.

** AT to EO requirements are part of TECH PUB 62500.

\# Per BR660-476-301



NOTE:

1. PSL = Pre-Service Limits, AL = Acceptance Limits, IAL = Immediate Action Limits.
2. PSL and AL are minimum requirements for all circuits (or hybrids).
3. PSL of 27 ERL, 20 SRL to the AT should be initially adjusted to 40 ERL & 35 SRL per BR 660-476-301, Table A, Test 1.
4. $\frac{AL}{25/18} = \frac{AL}{ERL/SRL}$

Fig. 1—Feature Group D Balance Requirements

(b) *Interexchange Carrier POT to End Office:* These routine tests may be made either from the Interexchange carrier switch or from the Interexchange carrier POT.

(c) *Access Tandem to End Office:* These routine tests are made at the access tandem.

7.02 When tandem connections are made from the Interexchange carrier switch to the end-office switch via the access tandem, the "in-service" objective stated above will have a high probability of preventing these connections from having results less than the Immediate Action Limits.

7.03 Routine testing by the Bell operating companies of tandem connections from the Interexchange carrier switch to the end-office switch (via the access tandem) is not recommended due to the random trunk selection from the access tandem to the end office.

8. CONSIDERATIONS OF 1/1A ESS USED AS AN ACCESS TANDEM FOR FEATURE-GROUP B

8.01 LATA access for Feature-Group B (FG-B) may be provided on direct links from the Interexchange Carrier POT or from the Interexchange Carrier POT to the end office via an access tandem. There are balance preservice and acceptance limit requirements for FG-B service between the Interexchange carrier POT and the access tandem and between the Interexchange carrier and the end office (direct). However, there is only balance Immediate Action Limits for the links between Interexchange Carrier POT and the end office via the access tandem.

8.02 The preservice limits for FG-B services are more stringent than those for FG-D services. They are also more stringent than the old rules for balance certification. Following is a comparison of preservice limits FG-B and FG-D to an end office:

FG-B to End Office Preservice Limit	**FG-D to End Office Preservice Limit**
20 dB ERL (ZB) Equivalent to 26 dB ERL (ELEPL) or 26 dB ERL (TB)	22 dB ERL (ELEPL) Equivalent to 22 dB ERL (TB) and 16 dB ERL (ZB)

Also, in both FG-B and FG-D all trunks (or segments of trunks) must meet or exceed PSL --Previous certification rules required only 50% of the trunks, in a trunk group, meet or exceed PSL.

8.03 Impedance balance limits for FG-B services are as follows:

(a) The Acceptance Limits are 23-dB ERL and 15-dB SRL when equipped with 4WESS trunk circuits. The 40-dB ERL and 35-dB SRL preservice limits for 4WESS trunk circuits per BR660-476-301, is adequate to meet the FG-B acceptance limits.

(b) Where FG-B services accesses the LATA network via a 1/1AESS switch designed as an end office, the balance termination may be provided by one of the following:

- The SD-1A227 local test line circuit, which is a basic termination of 900 ohms in series with the 2.16 μF capacitor (without build-out option)

- The SD-1A310 toll quality test line circuit with the build-out option (may not have been adjusted per BR660-476-504).

8.04 The 1/1AESS end office may also have either of the following:

(a) A 4-wire trunk circuit (4WESS with built in hybrid)

(b) A 2-wire trunk circuit (2WESS) with the 4-wire terminating set associated with a facility channel unit.

In either of these arrangements, the network-buildout capacitors may not have been required to be adjusted to meet the previous terminal balance requirements.

8.05 If the FG-B access trunk meets or exceeds the preservice limits, no further action is recommended. If, however, the preservice limits are not met or exceeded, the following progressive steps are recommended:

(1) Verify test procedures.

(2) Verify that the compromise balance networks have been provided with the proper options.

(3) If the SD-1A310 trunk circuit is provided for a balance termination, then build-out the 100 type test line per BR660-476-504.

(4) If the action taken in (3) does not produce results equal to or greater than the preservice limits, establish a common value for the network-buildout capacitance and possibly the network-buildout resistance. These common values should be such that when applied to the hybrid the preservice limits will be met or exceeded when the trunk under test is terminated in either of the following:

- Local termination circuit SD-1A227
- The build-out SD-1A310 (100 type test line).

9. CONSIDERATIONS FOR 2-WIRE ESS END OFFICES USED FOR FEATURE-GROUP B DIRECT ACCESS SERVICES

9.01 The impedance balance limits for FG-B (Type B) Direct Access service from the Interexchange Carrier POT to the end office are as follows:

Preservice	20-dB ERL and 13-dB SRL
Acceptance	17-dB ERL and 12-dB SRL
Immediate Action	16-dB ERL and 11-dB SRL

9.02 There are no preservice, acceptance, or Immediate Action Limits for FG-B, Type C services.

9.03 To ensure that the Acceptance Limits are met or exceeded on every circuit tested from the Interexchange carrier POT, each end office hybrid used for providing FG-B (Type B) direct access service must meet or exceed the preservice limits.

9.04 The preservice limits discussed in 9.01 are measured using the impedance balance method with the trans-hybrid loss excluded from the measurement. This is similar to the methods used to test the toll hybrids at the access tandem office.

9.05 If the FG-B preservice limits are not met, the following actions are recommended:

(1) Verify test procedures.

(2) Where test lines are provided with build-out options, build out the 100 type test per the BR660-476-504 .

(3) If satisfactory results are not produced after performing (1) and (2), establish common network-buildout value(s) that will meet or exceed the preservice requirements.

10. INITIAL VERIFICATION OF ACCESS TANDEM TRUNK HYBRIDS USED FOR FEATURE-GROUP B SERVICES

10.01 Verification of the access tandem trunk hybrids involve the following:

(a) Review the preservice test records to verify that the impedance balance values (with the trans-hybrid loss zeroed out) prescribed in Table B are met or exceeded. This is to ensure that the tests made at the Interexchange Carrier POT to the access tandem test line will meet or exceed the Acceptance Limits prescribed in Table B.

(b) There is no specified balance preservice or acceptance limit for FG-B services to the end office *via the access tandem,* therefore no balance tests or adjustments are necessary where the FG-B tandem is digital or 4-wire analog.

(c) Send the verification report to the District transmission engineering manager responsible for LATA access quality assurance.

11. INITIAL VERIFICATION OF FEATURE-GROUP B FROM THE INTEREXCHANGE CARRIER POINT OF TERMINATION TO THE END OFFICE

11.01 The initial verification of the FG-B service from the Interexchange POT to the end office involves the following:

(a) Review the preservice test records to verify that the impedance balance requirement of 20-dB ERL and 13-dB SRL are met or exceeded.

(2) If the impedance balance preservice limit is met, the acceptance limit of 17-dB ERL and 12-dB SRL as stated in TECHNICAL PUBLICATION 62500 should be met.

Note: When using the equal-level-echo-path-loss method for measuring the end office hybrid used for FG-D direct access service, the preservice limit is 22-dB ERL and 15-dB SRL. This is similar to the 16-dB ERL and 9-dB SRL impedance balance method preservice limits for trunks designed for 6-dB EML from the Interexchange Carrier to the end office. Therefore, if the end office hybrids just meet the FG-D preservice limits, they will not meet the FG-B preservice limits or acceptance limits. (See paragraph 8.02)

(d) Send a verification report to the District Transmission Engineering Manager responsible for LATA access quality assurance.

12. MAINTENANCE OF BALANCE VERIFICATION FOR FEATURE-GROUP B

12.01 The transmission engineer should review the results of optional routine balance testing to observe the distribution of "in-service" results. The objectives shall be as follows:

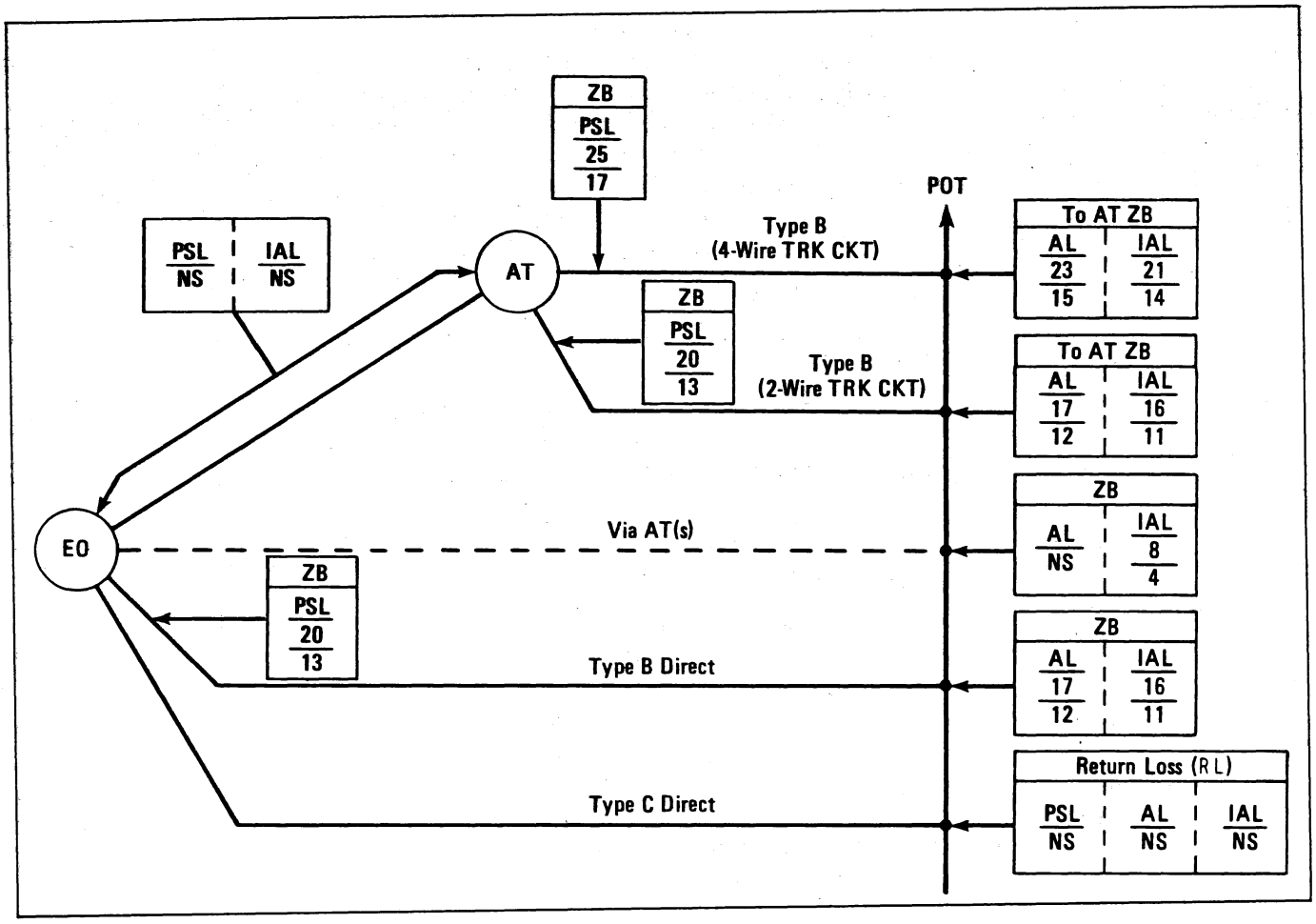
Installation	100% of the connections equal to or greater than the preservice limits.

TABLE B
PRESERVICE, ACCEPTANCE AND IMMEDIATE ACTION LIMITS
FEATURE GROUP-B BALANCE REQUIREMENTS
(Notes 1 through 7)

	PSL	AL	IAL
POT to EO Direct			
Type B ERL (ZB)	20	17	16
SRL (ZB)	13	12	11
Type C ERL	NS	NS	NS
SRL	NS	NS	NS
POT to EO via AT			
Type B ERL (ZB)	NS	NS	8
SRL (ZB)	NS	NS	4
POT to AT (4-Wire Trk Ckt)			
Type B ERL (ZB)	25	23	21
SRL (ZB)	17	15	14
POT to AT (2-Wire Trk Ckt)			
Type B ERL (ZB)	20	17	16
SRL (ZB)	13	12	11
AT to EO			
ERL	NS	NS	NS
SRL	NS	NS	NS

Notes:

1. At the POT, Type B interface is 4-Wire, Type C interface is 2-wire.
2. NS = Not Specified
3. PSL = Preservice Limit, AL = Acceptance Limit, IAL = Immediate Action Limit.
4. PSL and AL requirements are to be considered as "equal to or greater than the value shown", and apply to 100% of the circuits (or hybrids).
5. Test results less than Immediate Action Limits are considered unsatisfactory and must be improved to values of AL or greater.
6. PSL are not part of TECH PUB 62500
7. ZB = Impedance Balance



NOTE:

1. PSL = Pre-Service Limits, AL = Acceptance Limits, IAL = Immediate Action Limits.
2. NS = Not Specified.
3. PSL and AL are minimum requirements for all circuits (or hybrids).
4. IAL are minimum "In Service" results. Results less than IAL are below minimum standards of service.
5. AL 23 15 = AL ERL SRL

Fig. 2—Feature Group B Balance Requirements

In-Service	At least 50% equal to or greater than the acceptance or maintenance limits. Nothing shall be less than the immediate-action limit.

These requirements apply to the following segments used for FG-B services.

- Interexchange Carrier POT to Access Tandem
- Interexchange Carrier POT to End Office Direct .

12.02 There are no preservice limits for access-tandem-to-end-office trunks since they are generally end-office to end-office local trunks with no balance requirements.

12.03 No "in-service" verification or certification is required for the FG-B services to end offices via access tandem connections since there are no preservice limits specified in TECHNICAL PUBLICATION 62500. However, *TECHNICAL PUBLICATION 62500 does specify Immediate Action Limits for FG-B to end offices via access tandem connections.* This is under the control of the central trunk maintenance forces.

12.04 Where optional routine testing is not performed, annual balance quality reviews should be made on historic records of preservice test results with sample survey testing to validate the preservice test records. It should be noted that installation tests required 100% equal to or greater than preservice limits, therefore annual reviews of these records should expect to see the same.

13. CONSIDERATIONS FOR FEATURE GROUP C

13.01 Information on FG-C to be added later.

14. INITIAL CERTIFICATION OF FEATURE GROUP C

14.01 Information on initial certification of FG-C will be added later.

15. MAINTENANCE OF CERTIFICATION FOR FEATURE GROUP C

15.01 Maintenance of certification for FG-C will be added later.

16. GLOSSARY OF TERMS

16.01 Following are the definitions of acronyms and terms used in this section and in other documents pertaining to transmission and balance criteria.

TERMS	DEFINITIONS
AL	Acceptance Limits (Specified in TECHNICAL PUBLICATION 62500)
AL/ML	Acceptance Limits/Maintenance Limits
AT	Access Tandem
ELEPL	Equal Level Echo Path Loss (Method used to achieve consistent Echo Path Loss values regardless of the trans-hybrid loss values and transmission level point at points of measurement)
EPL	Echo Path Loss (EPL = ZB + THL + Loss and Gains to the Point Of Measurement)

TERMS	DEFINITIONS
ERL	Echo Return Loss
EO	End Office
IAL	Immediate Action Limit
IC	Interexchange Carrier (may also refer to Interexchange Customer)
POT	Point of Termination
IC-POT	Point of Termination at Interexchange Carrier interface
PSL	Preservice Limits (internal to telephone companies)
RL	Return Loss is specified in TECHNICAL PUBLICATION 62500 as requirements from the IC-POT looking toward the telephone company at a 2-wire interface, such as FG-D Type C
SRL	Singing Return Loss (Hi and Lo)
TAT	Test Access Circuit
TB	Trunk Balance, formally referred to as Terminal Balance, now applies to any trunk
TCT	Tandem Connecting Trunk (AT to EO)
THL	Trans-Hybrid Loss (EPL measured with the 2-wire port of the hybrid shorted or opened)
TL	Test Line
TLP	Transmission Level Point (often erroneously referred to as Test Level Point)
ZB	Impedance Balance (Excludes THL)

17. REFERENCES

SECTION	TITLE
BR853-500-100	General
BR853-500-110	Intra-LATA Balance Certification
BR853-500-112	Applications of ELEPL/TB/ZB
BR853-500-113	Loop Terminal Balance Considerations
BR660-476-301	Intra-LATA 1/1AESS Trunk Balance Requirements
BR660-476-302	LATA Access 1/1AESS Access Tandem Balance Requirements
BR660-4XX-302	LATA Access End Office Balance Requirements
BR660-4XX-303	Loop Terminal Balance Requirements