TRUNKING CONSIDERATIONS—RETRIALS DUE TO NO CIRCUIT

GENERAL ENGINEERING CONCEPTS

NETWORK OPERATIONS METHODS

CONTENTS PAGE

1. GENERAL

1.01 This section examines the impact on trunk group measurements due to customer and/or operator retrials when no circuit (NC) conditions are encountered. Accounting for retrials can result in substantial trunk savings on some trunk groups. In addition to a discussion of the concepts that pertain to retrials, procedures and associated adjustment tables are provided to determine the first attempt offered load to trunk groups. The adjustments are recommended at NC levels of 5 percent or more in trunk groups with seven or more trunks. The adjustments are currently used in the Business Information System—Trunk Servicing System (BIS—TSS).

1.02 This section contains information previously included in Section 780-401-242 and is provided as part of a comprehensive restructure of the 780-40Y-ZZZ series. This issue also includes a "U" factor adjustment table and an adjustment table for interend office and tandem access trunk groups.

1.03 References in this section to methods, planning, data requirements, service levels, and equipment quantities are based on American Telephone and Telegraph Company recommendations.

1.04 For the standard meaning of terms and definitions used in this section, see Section 780-400-305, "Glossary of Trunk Facilities Terms and Definitions."

2. INTERPRETING TRUNK DATA AFFECTED BY NC

2.01 A matter of major importance in the engineering and administration of all grade-of-service trunk groups, including intertandem, tandem connecting, and interend office, is the interpretation of traffic usage recorder (TUR) readings when NC conditions exceed planned levels.

2.02 At such times, there is an increase in repeated attempts. Some of these result in calls which are completed, and, hence, are included in carried load measurements. Others remain in the overflow category and are abandoned, ie, subsequent attempts are not completed within the hour initially offered, and often not within the same day. This section outlines the adjustments required to estimate the "first attempt" offered load under this set of conditions.

2.03 The corrections produce an adjusted average percent overflow value which can be applied directly to the measured carried load to develop the "first attempt" offered load. This value is less than an offered load developed with the use of observed NC since the inflating effect of retrials on the percent NC has been taken into account. As a result, the adjustment procedure recommended is more economical in terms of the quantity of trunks provided.

2.04 These adjustments are tailored to trunk group measurements on individual groups and, to be made accurately, require peg count, overflow, and usage data. However, there is a method of estimating first attempt offered load on grade-of-service groups when only peg count and overflow are available. This method is discussed in Part 6.

2.05 Under certain circumstances, as discussed in Section 780-400-335, an adjustment to go from carried load to offered load is required to compensate for day-to-day variations. Where an adjustment for retrials is necessary, as described in this section, no such adjustment for day-to-day variations is recommended. The interpretation of data at higher levels of blocking is not sufficiently precise to warrant application of both adjustments.

3. OVERALL EFFECTS OF RETRIALS

3.01 Trunking theories which relate offered loads and expected percentage of overflow traffic (when it has no alternate route) assume that blocked calls are immediately abandoned and do not return. Immediate abandonment is true in many instances. However, a substantial proportion of the blocked calls are commonly repeated one or more times at the discretion of the calling customers.

3.02 The overall effect of customer and operator retrials on uncompleted calls must, when the blocking is 5 percent or more and the group has seven or more trunks, be taken into account in determining the first attempt offered load and in the corresponding provisioning of trunks. Reattempts increase the peg count of offered calls, which then become an untrustworthy guide for determining the first attempt offer. Reattempts mistakenly counted in the first offered load can make the group appear to need more trunks than it actually does. Alternatively, it is reasonable to accept that calls abandoned, following NC, are a part of the offered load.

3.03 A variety of data bearing on the customer retrial problem has been collected and analyzed in the past at various locations. The import of these data is plotted on Fig. 1, which shows the proportion of blocked attempts which abandon within the measurement hour as a function of the observed proportion of NC. The underlying research and analyses indicate that the proportion of attempts which abandon varies with the percent DDD and, at the same time, is sensitive to the "frequency of attempts schedule" followed by operators when NC is encountered.

3.04 The curves shown in Fig. 1 are so nearly horizontal that the observed percent NC obviously is relatively noncontrolling insofar as the fraction of abandoned attempts is concerned. In other words, the rate of abandonment is reasonably uniform over all levels of NC. This makes it possible to estimate the number of first attempts by modifying the number of observed overflows with a constant factor and adding this number to the number of attempts carried (peg count minus overflow).

3.05 For ***intertandem*** and ***tandem completing*** trunks, which are accessible to operators, the curve showing 75 percent DDD with operator "triple test" when NC is encountered best fits the situation in the years immediately ahead. It indicates that approximately 35 percent of the

observed overflow attempts (NCs) represent abandoned calls.

3.06 For ***tandem access*** groups, and for those intertandem and tandem completing groups which carry no operator attempts, the curve for 100 percent DDD is applicable. The curve indicates that approximately 45 percent of the observed overflow attempts represent abandoned calls.

3.07 For ***interend office*** groups, which carry only customer dialed calls, the same curve used for tandem access groups is applicable. It is reasonable to assume that the percentage of local call attempts which abandon corresponds closely with that shown by the 100 percent DDD curve. Therefore, approximately 45 percent of the observed overflow attempts on local final and only-route trunk groups represent abandoned calls.

3.08 The concepts and corrections developed here make no distinction between alternate finals and only-route groups even though reattempts to the former reach a high-usage group first. While there may be a difference in detail between these two cases, the principle of retrial effects still applies. Attempts to quantify the difference have proven to be difficult, and it is believed that the difference may be slight, especially since there is a small proportion of cases where accounting for retrials significantly affects the size of the trunk group. When servicing an alternate final group, it must be kept in mind that the high-usage groups below the final should perhaps be serviced, rather than the final itself. Likewise, if a final has high measured blocking, the servicer should recognize that 55 or 65 percent of the overflow from the final will appear in the offered load of the subtending high-usage group.

4. ADJUSTING MEASURED LOADS FOR RETRIALS

4.01 Corrections of measured loads for retrials assume significance, and are recommended at NC values of 5 percent or more, but not for groups with six or less trunks. At lower blocking levels, and in groups with six or less trunks, the adjustment has negligible effect and is not deemed to be needed.

4.02 In considering this adjustment, it is necessary to understand that, because of the peakedness of overflow traffic, three measurements—peg count, overflow, and carried load—are required on grade-of-service groups and must be used in combination to develop the first attempt offered load. Entering the trunking tables with the average carried load alone will provide an understatement of the first attempt average offer. Use of the average percent overflow alone, on the other hand, usually will provide an overstatement of the first attempt average offer.

4.03 The adjustment for retrials amounts to a further refinement of the procedure normally followed in developing the offered load on a grade-of-service group when the average carried CCS and the average percent overflow (or NC) are known. The normal procedure may be illustrated as follows, with reference to a trunk group with 89 carried CCS and an average overflow of 6 percent:

$$\text{Average Carried CCS} \times \frac{100}{100 - \text{Avg. \% Overflow}} = \text{Offered CCS}$$

$$89 \times \frac{100}{100 - 6} = 89 \times 1.06^{*} \text{ or } 94 \text{ CCS}$$

*Rounded to two significant decimal places.

4.04 In order to develop the first attempt offered load, the formula stated above must be modified to show the net effect of: (1) eliminating repetitive attempts on calls ultimately completed which are included in the measured carried load, and (2) recognizing that attempts abandoned following NC, which are not reflected in the measured carried load, are properly a part of the first attempt offered load. The 75 percent DDD curve on Fig. 1, which is applicable to intertandem and tandem completing trunks accessible to operators, shows that repetitive attempts represent approximately 65 percent of the ineffective attempts due to NC; and abandoned attempts constitute the remaining 35 percent. The formula shown in paragraph 4.03 then becomes Equation (5) in paragraph 4.05.

4.05 To facilitate explanation, the formula and its derivation are outlined in the following inductive steps, starting with a ***single hour*** situation.

(1) First Attempt Offered CCS

$$= \frac{\text{Carried Calls + Abandoned Calls}}{\text{Carried Calls}} \times \text{Cd. CCS}$$

(2)

$$= \frac{\text{PC} - \text{Overflows} + 0.35\ \text{Overflows}}{\text{PC} - \text{Overflows}} \times \text{Cd. CCS}$$

(3)

$$= \frac{\text{PC} - 0.65\ \text{Overflows}}{\text{PC} - \text{Overflows}} \times \text{Cd. CCS}$$

Dividing numerator and denominator by PC

(4)

$$\frac{\frac{\text{PC}}{\text{PC}} - 0.65\,\frac{\text{OV}}{\text{PC}}}{\frac{\text{PC}}{\text{PC}} - \frac{\text{OV}}{\text{PC}}} \times \text{Cd. CCS}$$

Letting $\text{NC} = \frac{\text{OV}}{\text{PC}} \times 100$

(5)

$$= \frac{100 - 0.65\ (\text{NC})}{100 - (\text{NC})} \times \text{Cd. CCS}$$

4.06 For all practical purposes, the final formula in the above series applies equally to single hour values and to average values for a record period. This dual application results from the fact that a percent overflow value for a record period (series of hours) is an average of values computed daily if the procedure outlined in these practices is followed.

4.07 To illustrate the procedure for developing the first attempt offered load in accordance with the foregoing formula, assume a trunk group with 673 carried CCS, a peg count of 220, and 44 overflows (20%). The terms of the formula and its solution follow:

$$\frac{100 - 0.65\ (20)}{100 - (20)} \times 673 = 732\ \text{CCS}$$

4.08 For an offer of 732 CCS at Neal-Wilkinson B.01L, 32 trunks are required. If the offered load in the foregoing example had been computed without the corrections for repetitive and abandoned attempts, the offered load would have been:

$$\frac{100}{100 - 20} \times 673 = 841\ \text{CCS}$$

This load calls for 36 trunks at B.01L. In this example, even with enhancement for abandoned calls, suitably recognizing repetitive attempts equates to a saving of four trunks.

4.09 Assume now that, in the above example, the overflow count had been nine (4 percent) rather than 44 (20 percent). Out of the nine overflow attempts, only three represent first attempt load lost if the 35 percent abandonment factor may be assumed to apply at this level of overflow. In this instance, the enhancement of the carried load to compensate for abandoned calls is so slight that it does not alter the trunk requirement. This illustrates why an adjustment is not recommended at low levels of blocking. Similarly, in small groups, the amount of the adjustment is so low over all levels of overflow that it serves no useful purpose.

4.10 For trunk groups carrying only customer-dialed calls (no operator-handled calls), Equation (5) in paragraph 4.05 becomes:

First Attempt Offered Load =

$$\frac{100 - 0.55\ (\text{NC})}{100 - (\text{NC})} \times \text{Cd. CCS}$$

In this instance, 45 percent of the observed overflow attempts represent abandoned calls. These are properly a part of the first attempt offered load. The remaining 55 percent of the overflow attempts represent repetitive attempts on calls ultimately completed and are, therefore, reflected in the measured carried load.

4.11 The first attempt offered load developed, using the above procedures, must be submitted

to the proper trunk capacity table or the result could be serious undertrunking for grade-of-service groups. The proper tables for these groups are the Neal-Wilkinson tables contained in Section 780-402-210. The Neal-Wilkinson tables reflect the effect of peakedness with or without day-to-day variations.

4.12 The degree of undertrunking that a grade-of-service group might be subjected to through use of the Neal-Wilkinson tables is a function of the actual peakedness and day-to-day variations encountered on the group. Procedures for estimating day-to-day variations are included in Section 780-400-335. Those for determining peakedness are included in Section 780-400-340. The following example will indicate the magnitude of the undertrunking potential.

Given:

Trunks Intended = 20
Percent NC = 15
TUR Usage = 500 CCS

Determine:

First Attempt Offered Load

Step 1 - From Table 1, Fig. 2. (Paragraph 5.01), for 15 percent NC, the retrial adjustment factor is 1.06.

Step 2 - TUR Usage $\times$ 1.06 = First Attempt Offered Load or 500 $\times$ 1.06 = 530.

Compare Trunks Required for Different Assumptions and 530 CCS Offered Load:

TRUNKS REQD PEAKEDNESS FACTOR Z

TABLE	RANDOM	NON-RANDOM		
	Z = 1	Z = 2	Z = 3	Z = 4
Neal-Wilkinson: B.01-	24	28	32	35
Neal-Wilkinson: B.01L	25	29	32	35
B.01M	26	30	33	36
B.01H	27	31	34	37

4.13 The trunk requirements shown above indicate that if the average offered load had a peakedness factor of 4.0 and high day-to-day variations (B.01H), use of Neal-Wilkinson with peakedness of one and no day-to-day variation (B.01-) would produce a 13-trunk shortage (37 - 24 = 13). Even at a peakedness factor of 2.0 with low day-to-day variations (B.01L), there would be a 5-trunk deficit (29 - 24 = 5). The need to use the appropriate table is obvious and should be stressed to all trunking personnel.

5. ADJUSTMENT FACTORS

5.01 Adjustment factors for levels of overflow up to 50 percent, developed from the applicable portion of Equation 5 in paragraph 4.05, are shown in Customer Retrial Adjustment Factor Tables I and II (Fig. 2 and 3). Figure 2 is for use with operator-accessible intertandem and tandem completing trunk groups. This table assumes approximately 75 percent DDD and operator "triple test" when NC is encountered. Figure 3 is for use, for example, with interend office and tandem access trunk groups. This table assumes 100 percent customer dialing.

5.02 Multiplying the observed carried load by a factor selected on the basis of the percent overflow provides directly the first attempt offered load adjusted for customer and operator retrials. The offered load may then be used as a base for trunk forecasting and servicing purposes. As previously stated, the adjustment for retrials due to NC is recommended on all grade-of-service groups with seven or more trunks and with 5 percent or greater overflow.

5.03 Application of a factor selected from Fig. 2 to the example given in paragraph 4.07 will both illustrate the use of the tables and provide a comparison of results derived with the table method and with the formula method. In that example, the percent overflow was 20, and the carried load was 673 CCS. The carried load adjustment factor in Fig. 2 for 20 percent overflow is 1.09. Applying that factor to 673 gives 734 CCS as the first attempt load adjusted for abandoned calls. The formula method developed 732 CCS.

5.04 To conform with these tables, peg count and overflow data on grade-of-service groups for ranges of overflow of 5 percent or greater should be viewed as overstating the "true" level of the percent of attempts blocked. It is imperative, therefore, that trunk base loads and estimates of trunk requirements be based on offered load values, derived with use of factors selected from the appropriate adjustment table. An additional adjustment for day-to-day variations, in addition to the adjustment for retrials, is ***not*** recommended.

5.05 In mechanized applications, such as BIS—TSS, a variation of the formula is used. The offered load is computed for each hour, using the following formulas:

$$\text{Total Offered CCS} = \frac{\text{Carried CCS}}{1 - \text{Blocking Ratio*}}$$

$$\text{Average Total Offered CCS} = \frac{\Sigma \text{ Total Offered CCS}}{\text{Number of Hours}}$$

* Overflow/Peg Count

This average total offered CCS is an overstatement since calls which retried and completed are assumed to have abandoned. The total offered load is adjusted, using one of the following formulas:

For 75 Percent Customer Dialing:

Average First Attempt Load =
(1 — 0.65 [Average Blocking Ratio])
Average Total Offered Load.

For 100 Percent Customer Dialing:

Average First Attempt Load =
(1 — 0.55 [Average Blocking Ratio])
Average Total Offered Load.

5.06 While Fig. 2, which is based on 75 percent DDD, is recommended for intertandem, there may be instances where an intertandem group carries 90 to 100 percent DDD. In these situations, it is recommended that Fig. 3 be used.

6. ESTIMATING FIRST ATTEMPT OFFERED LOAD WHEN ONLY PERCENT NC IS AVAILABLE

6.01 When percent NC is the only load indication available on a trunk group, the procedures covered in this part may be utilized to adjust trunk group loads to reflect the effect of customer retrials. It is difficult to attain a high degree of precision in estimating the first attempt offered load unless the trunk engineer utilizes a theory with assumptions reasonably representative of the actual characteristics of the offered traffic.

6.02 The procedure covered is applicable to grade-of-service trunk groups with seven or more trunks and with an observed NC of 5 percent or greater. The procedure assumes the use of the trunk adjustment tables in Section 780-403-145. These tables are entered with the observed percent NC. Selection of the proper table for grade-of-service groups requires knowledge of the peakedness factor and the day-to-day variation of the offered load. For only-route groups, it is customary to assume an offered load with a peakedness factor of 1.0 and low day-to-day variations.

6.03 The recommended procedure consists of the following steps:

Step 1—Given percent NC, trunks in-service, and the peakedness factor and day-to-day variation of the offered load, enter the appropriate trunk adjustment table (Section 780-403-145) to determine the "additional" trunks required to attain the desired blocking objective (B.01—....B.01H).

Step 2—Add the "additional" trunks to the trunks intended to determine total trunks required.

Step 3—Given total trunks required and the blocking objective, enter the appropriate trunk capacity table to determine the offered load.

Step 4—Given observed percent NC, enter the Customer Retrial Adjustment Factor (see Table III, Fig. 4) and select the "U" factor associated with the percent NC.

Step 5—The offered load obtained in Step 3 times the adjustment factor obtained in Step 4 equals the first attempt offered load.

Step 6—Given the first attempt offered load and blocking objective, enter the appropriate trunk capacity table to determine the current trunks required.

	EXAMPLE A	EXAMPLE B
Given:		
Percent NC	30	20
Trunks Intended	20	70
Peakedness Factor	1.0	2.0
Day-to-Day Variation	Low	High
Blocking Objective	B.01L	B.01H
Determine:		
First Attempt Offered Load and Trunks Required		
Solution:		
Step 1–Additional Trks Reqd	20	55
Step 2–Total Trks Reqd	40	125
Step 3–Total Offered Load	976	2941
Step 4–"U" Factor	0.84	0.90
Step 5–First Attempt Offered Load	820	2647
Step 6–Trunks Reqd	35	114

6.04 Customer Retrial Adjustment Factor Table III (Fig. 4) was developed from the relationship discovered in the customer retrial study between first attempts and total attempts at different levels of blocking. As indicated in Fig. 1, the ratio of first attempts to total attempts is a function of the observed blocking and the percent customer dialing, and is also influenced by the operating practices employed. The relationship between first attempts and total attempts (hereafter referred to as the "U" factor) and the observed blocking can be used to adjust a theoretical total offered load as demonstrated in paragraph 6.03. A single table of adjustment factors was developed by averaging the ratios for 75 and 100 percent customer dialing since the precision implied by constructing separate tables did not appear warranted. Reality also suggested that a factor oriented to a specific percent NC implied a precision that was not attainable. Consequently, the table was further compressed by orienting the adjustment factors to bands of percent NC values.

6.05 It should be noted that the "U" factors are approximations of the computer-oriented adjustment discussed in paragraph 5.05. Thus, at 100 percent customer dialing, the computer procedure would be as follows:

(1 − 0.55 [Average Blocking])
Average Total Offered Load =
Average First Attempt
Offered Load.

Given:
Offered Load = 530 CCS
Percent NC = 15

(1 − 0.55 [0.15]) 530 =
(1 − 0.083) 530 =
0.917 x 530 = 486 CCS

The 0.917 is a more precise statement of the "U" factor derived from the relationship illustrated in Fig. 4.

7. IMPACT OF ADJUSTMENT ON FORECASTING, ADMINISTRATION, AND SERVICE EVALUATION

7.01 In forecasting, future trunk requirements can be more precisely determined when the average offered loads have been adjusted to include only first attempts. When there is no blocking, the carried load is the first attempt average offered load. When high blocking is encountered, the recommended adjustments produce first attempt average offered load.

7.02 The adjustment serves a similar purpose in trunk administration or servicing, except trunk requirements are being developed for a past period and load rather than for a future period and load.

7.03 Traditionally, trunk blocking or trunking service performance on grade-of-service groups has been expressed in terms of percent NC encountered. One percent blocking or NC is the objective where B.01 is used. The adjustment recommended in this section does not change this. It simply amounts to a necessary step in the process of determining the number of trunks required to attain a given level of blocking.

8. EFFECTS OF UTILIZING DIFFERENT TRUNKING THEORIES

8.01 As covered previously, when all three measurements (usage, peg counts, and overflows) are available for a trunk group, it is possible to obtain an accurate estimate of the ***total offered load*** without relying upon any particular

trunking theory or table. When, however, percent NC is the only load indication available for a grade-of-service trunk group, the first problem confronting the trunk engineer is to develop an accurate estimate of the total offered load and then to adjust that estimated total offered load to reflect the effect of customer retrials.

8.02 As indicated in Fig. 5, the total offered load that will produce 5 percent blocking on a 30-trunk group varies significantly (from 575 CCS to 890 CCS). The differing load values result from the particular assumptions regarding blocking, peakedness (randomness versus nonrandomness), and day-to-day variations employed by various trunking theories. Thus, the Erlang B theory (with its blocked calls cleared, Poisson offered load, and no systematic day-to-day variation assumption) predicts that an offered load of 890 CCS would be required to produce 5 percent blocking on a 30-trunk group. Conversely, the Neal-Wilkinson theory, which, while assuming blocked calls cleared, makes an allowance for differing degrees of peakedness and day-to-day variations, indicates that an offered load of 575 CCS, a peakedness factor (Z) of 4, and high day-to-day variation would produce 5 percent blocking on a 30-trunk group.

8.03 It should also be noted in Fig. 5 (columns 7 through 10) that the number of additional trunks required to reduce the blocking from 5 percent to 1 percent is influenced by the particular trunking theory selected. Thus, the Neal-Wilkinson theory (line 2, column 7) indicates that 6 additional trunks, or a total of 36 trunks, would provide 1 percent blocking. The Neal-Wilkinson B.01H theory (line 3, column 7) indicates that 9 additional trunks, or a total of 39 trunks, are required to provide 1 percent blocking.

8.04 This marked difference in the number of additional trunks required to attain 1 percent NC or blocking again is due to differing theoretical assumptions. In column 7 of Fig. 5, the Z1 (peakedness factor) means that all of the theories are assuming a Poisson offered load; and, therefore, nonrandomness or peakedness cannot be the cause of the differing number of trunks required to produce 1 percent NC.

8.05 Erlang B, Neal-Wilkinson B.01-, and Neal-Wilkinson B.01H (lines 1, 2, 3 of Fig. 5) all assume "blocked calls cleared." Given a random offer (Z=1), there is a slight difference between the Erlang B and Neal-Wilkinson B.01 values for offered loads or additional trunks required because of a slight difference in the way each models the average blocking. Neal-Wilkinson can, however, reflect the effects of nonrandomness on the load-service relationship. Thus, for nonrandom offers (Z2, Z3, Z4), the Neal-Wilkinson theory (line 2) indicates that progressively smaller offered loads will produce 5 percent blocking on a 30-trunk group, and progressively more additional trunks (6, 7, and 8) are required to attain 1 percent NC. In this instance, at a peakedness factor of 4 (column 10), 8 additional trunks are required, according to Neal-Wilkinson B, to attain 1 percent blocking; whereas Erlang B, assuming a Poisson offered load, would still predict 5 additional trunks required. The 3-trunk difference is primarily attributed to the effects of peakedness on the load-service relationship. The Neal-Wilkinson B.01H theory (line 3), at a peakedness of 1, differs from Erlang B and Neal-Wilkinson B.01- in that the load-service relationship it predicts reflects the effects of a specific day-to-day variation. The effect of day-to-day variations becomes progressively greater as the offered load increases in size. In Fig. 5, Neal-Wilkinson B.01H indicates that an offered load of 820 CCS would produce 5 percent blocking on a 30-trunk group; and 9 additional trunks, or a total of 39 trunks, would be required to provide 1 percent NC. Thus, when compared with Erlang B or Neal-Wilkinson B.01-, Neal-Wilkinson B.01H indicates that 3 additional trunks are required (9-6) to reflect the effect of day-to-day variations alone. Given the specific day-to-day variation assumed in Neal-Wilkinson B.01-, the effect of nonrandomness is less significant for larger sized trunk groups (20 or more trunks) than the effect of day-to-day variations.

8.06 The trunking tables are based on the "blocked calls cleared" assumption, with various allowances for nonrandomness and day-to-day variations. The retrial study demonstrated that "blocked calls cleared" is not a realistic assumption at 5 percent or higher observed blocking; and, therefore, the trunks required are overstated and must be adjusted downward for the effects of retrials. The trunking tables do not have the retrial adjustment incorporated in them. Instead, adjustments exist to estimate offered loads, as shown by Fig. 2, 3, and 4. As time passes, future changes in tariffs, central office equipment features (automatic retrial), and customer calling habits could bring about a shift in the retrial adjustments.

8.07 It should be evident from Fig. 5 and the preceding discussion that the estimate of total offered load obtained, using percent NC as the only load indication for a trunk group, is significantly affected by the theory the trunk engineer employs to interpret the data. An accurate estimate can only be obtained if the trunk engineer has some knowledge of the actual day-to-day variations in the offered load as well as the degree of peakedness present in the loads offered to grade-of-service groups.

8.08 Since this is a concept type section as well as a procedural type section, the trunk engineer should be aware that the customer retrial adjustment procedure does not occur independently, but is one operation in the overall interpretation of data procedure. Detailed flow charts, which incorporate customer retrial adjustments, are included in the 780-402-4ZZ series for mechanized procedures.

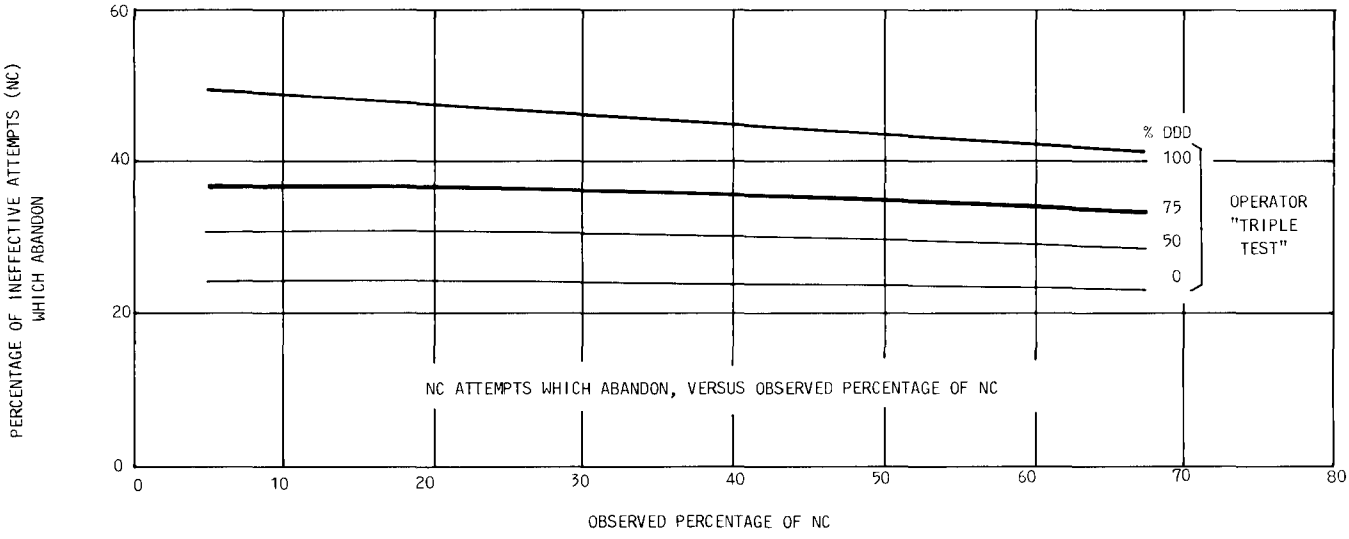

Fig. 1—Plot of Percentage of Ineffective Attempts (NC) Which Abandon Versus Observed Percentage of NC

TABLE I – INTERTANDEM AND TANDEM COMPLETING

(BASED ON 75% CUSTOMER DIALING)

FACTORS FOR DEVELOPING FIRST ATTEMPT OFFERED LOADS
WITH ADJUSTMENTS FOR ABANDONED CALLS
AT VARIOUS LEVELS OF PERCENT OVERFLOW

OBSERVED % NC	CD. LD. ADJUSTMENT	OBSERVED % NC	CD. LD. ADJUSTMENT	OBSERVED % NC	CD. LD. ADJUSTMENT
1-4	—	20	1.09	36	1.20
5	1.02	21	1.09	37	1.21
6	1.02	22	1.10	38	1.22
7	1.03	23	1.10	39	1.22
8	1.03	24	1.11	40	1.23
9	1.03	25	1.12	41	1.24
10	1.04	26	1.12	42	1.25
11	1.04	27	1.13	43	1.26
12	1.05	28	1.14	44	1.28
13	1.05	29	1.14	45	1.29
14	1.06	30	1.15	46	1.30
15	1.06	31	1.16	47	1.31
16	1.07	32	1.16	48	1.32
17	1.07	33	1.17	49	1.34
18	1.08	34	1.18	50	1.35
19	1.08	35	1.19		

Fig. 2—Customer Retrial Adjustment Factors—Table I

TABLE II – INTEREND OFFICE AND TANDEM ACCESS

(BASED ON 100% CUSTOMER DAILING)

FACTORS FOR DEVELOPING FIRST ATTEMPT OFFERED LOADS
WITH ADJUSTMENTS FOR ABANDONED CALLS
AT VARIOUS LEVELS OF PERCENT OVERFLOW

OBSERVED % NC	CD. LD. ADJUSTMENT	OBSERVED % NC	CD. LD. ADJUSTMENT	OBSERVED % NC	CD. LD. ADJUSTMENT
1-4	—	20	1.11	36	1.25
5	1.02	21	1.12	37	1.26
6	1.03	22	1.13	38	1.28
7	1.03	23	1.13	39	1.29
8	1.04	24	1.14	40	1.30
9	1.04	25	1.15	41	1.31
10	1.05	26	1.16	42	1.33
11	1.06	27	1.17	43	1.34
12	1.06	28	1.18	44	1.35
13	1.07	29	1.18	45	1.37
14	1.07	30	1.19	46	1.38
15	1.08	31	1.20	47	1.40
16	1.09	32	1.21	48	1.42
17	1.09	33	1.22	49	1.43
18	1.10	34	1.23	50	1.45
19	1.11	35	1.24		

Fig. 3—Customer Retrial Adjustment Factors—Table II

OBSERVED NC	U FACTOR
5-10	0.96
11-15	0.93
16-20	0.90
21-25	0.87
26-30	0.84
31-35	0.81
36-40	0.73
41-45	0.74
46-50	0.71
50+	0.68

Fig. 4—Customer Retrial Adjustment Factors—Table III

THEORY	NO. OF TRUNKS IN GROUP	APPROX OFFERED LOAD AT 5% BLOCKING				ADDL TRKS REQD FOR 1% BLOCKING				ADDL TRKS REQD ADJ FOR RETRIALS			
		Z1	Z2	Z3	Z4	Z1	Z2	Z3	Z4	Z1	Z2	Z3	Z4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Erlang B	30	890	—	—	—	5	—	—	—	4	—	—	—
2. Neal-Wilkinson B—	30	900	770	680	600	6	6	7	8	5	5	6	6
3. Neal-Wilkinson BH	30	820	720	640	575	9	9	9	9	8	8	8	8

Fig. 5—Effects of Utilizing Different Traffic Theories on a Trunk Group of 30 Trunks