

**PERFORMANCE REQUIREMENTS**  
**14C PROGRAM AMPLIFIERS AND ASSOCIATED EQUIPMENT**  
**GENERAL EQUIPMENT REQUIREMENTS**  
**TOLL SYSTEMS**

**1. GENERAL**

**1.01** This section covers the performance requirements which 14C Program Amplifiers and Associated Equipment shall meet before turnover to the Telephone Company.

**1.02** This section is reissued to change 30-cycle requirement in 2.06 (b) and 2.07 (b), due to change in the circuit drawing.

**1.03** Reference shall be made to Section 800-630-180 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements.

**1.04** This equipment contains coils which require precautions as specified in 800-630-180 to avoid possible injury through core magnetization.

**1.05** The voltage of the signaling, filament and plate batteries measured across the bus bars at the fuse panel while tests are being made, shall meet the requirements given on the circuit drawings.

**1.06** All amplifier outlets not being tested shall be terminated in 600 ohms.

**2. REQUIREMENTS**

**A. Circuit Operation Tests**

**14C Program Amplifier**

**2.01 Filament Test Jack:** The operation of the F jack in each filament circuit shall be checked.

**Control and Reversing Circuit**

**2.02** Each control and reversing circuit shall be checked to include all features covered in the circuit description and drawing, including contact protection.

**B. Transmission Tests**

**Testing Equipment**

**2.03** The requirements of this section are based on the use of the following test equipment or its electrical equivalent:

- 40B Transmission Measuring System (Multi-Frequency), or
- 6A Transmission Measuring Set (modified per KS-4063 when required for use with wide-band program circuits)
- 600  $\pm$  1 ohm terminations
- 1R Tube Test Set or Model 530B Hickok Tube Checker and Millivoltmeter

**14C Program Amplifier**

**2.04 Space Currents:** The space currents, measured as voltage drop at the TST 18A connecting block, shall be as given below. It is assumed that the heater current is within the limits specified on the circuit drawing.

TUBES NO.	SPACE MILLIVOLTS	
	MIN.	MAX.
1 and 2	350	650
3 and 4	350	750

**2.05 Cathode Activity:** All vacuum tubes shall be tested in the circuits in which they are used. It is assumed that the heater current is within the specified limits. When the heater current is reduced from the value existing at the time of test to a lower value as given below, the

change in space current shall not exceed the following limits:

TUBE	REDUCTION IN HEATER CURRENT, AMP.	ALLOWABLE CHANGE IN SPACE CURRENT, %
310A	0.02	15
311A	0.04	10
328A	0.025	15
329A	0.05	10

If the customer's 1R tube test set cannot be made available, it will be satisfactory to omit the test in 2.05 provided new tubes are used, in which case the tubes can be checked with the Hickok tube checker.

## 2.06 Bridging Amplifier

### (a) 1000-Cycle Gain Test

(1) With the gain control dials set at 36.5 db, the amplifier 1000-cycle gain shall be measured to each of the high and low level outlets provided, with the sending power of the measuring set adjusted for an amplifier output of not more than +11 dbm for high level outlets, or +5 dbm for low level outlets. The gain to each high level outlet shall be  $36.5 \pm 0.2$  db and to each low level outlet  $30.5 \pm 0.2$  db.

(2) In the case of an automatic monitoring circuit, make the following additional test: With the gain control dials set at 36.5 db and the sending power of the measuring set adjusted for an amplifier output of not more than +5 dbm, measure the amplifier 1000-cycle gain at the M OUT jacks. This gain at the M OUT jacks shall be  $30.5 \pm 0.3$  db when the automatic monitoring circuit is switched to a high level outlet and also when switched to a low level outlet.

**Note:** When a monitoring switching circuit is provided, the key in that circuit shall be operated to cut the transmission straight through.

(b) **Gain Frequency Test:** The gain at other frequencies as specified below shall be measured to one of the high level outlets and one of the low level outlets, if both types are provided, or to one of the particular type pro-

vided. The following requirements shall be met:

FREQ., CPS	DEVIATION FROM MEASURED 1000-CYCLE GAIN, DB
30	$0 \pm 0.25$
8000	$0 \pm 0.2$

(c) **Monitoring Gain Test:** With the gain control dials set at 36.5 db and all outlets terminated in 600 ohms, the 1000-cycle gain shall be measured from the AMP IN jacks to the AMP MON jacks with a testing level at the AMP MON jacks not exceeding -10 dbm. The gain shall be  $26 \pm 0.5$  db below the corresponding amplifier gain as measured in 2.06 (a) for a high level outlet, or  $20 \pm 0.5$  db below that for a low level outlet.

## 2.07 Single Line Amplifier ("M" Wiring, With "Z" Wiring Omitted)

(a) **1000-Cycle Gain Test:** With the gain control dials set at 36.5 db, the amplifier 1000-cycle gain shall be measured between the AMP IN and the AMP OUT jacks with the sending power of the measuring set adjusted for an amplifier output of not more than +16 dbm. The gain shall be  $36.5 \pm 0.2$  db. The T1 and R1 resistances shall be adjusted in accordance with the circuit drawing to meet this requirement.

(b) **Gain Frequency Test:** The gain at other frequencies as specified below shall meet the requirements given:

FREQ., CPS	DEVIATION FROM MEASURED 1000-CYCLE GAIN, DB
30	$0 \pm 0.25$
8000	$0 \pm 0.2$

The E and F resistances and A condenser of the equalizer may be adjusted in accordance with the circuit drawing to meet these requirements.

(c) **Monitoring Gain Test:** With the gain control dials set at 36.5 db and with the output terminated in 600 ohms, the 1000-cycle gain shall be measured from the AMP IN jacks to the AMP MON jacks with a testing level at

the AMP MON jacks not exceeding  $-10$  dbm. The gain shall be  $26.6 \pm 0.5$  db below the corresponding amplifier gain as measured in 2.07(a).

**2.08 Noise Tests-Application:** Noise tests shall be made on all initial installations where the telephone company has the necessary noise measuring equipment available for use by the W.E.Co. installers, and on additions where a new power plant is added at the same time and the testing equipment is available. Noise troubles which are due to manufacturing defects or installation errors shall be cleared by the installer. Noise troubles not due to manufacturing defects or installation errors (such as noise due to conditions existing in the office prior to the installation of the new equipment, to magnetic induction from power circuits, to the specified equipment arrangements, etc.) shall be reported to the telephone company but need not be cleared by the installer.

**2.09 Noise Tests — General:** The noise measurements shall be met for both heavy and light load conditions of the 24-volt and 130-volt charging generators. In some offices the heavy load condition will produce more noise, and in others, the light load condition will produce more. For the heavy load condition, these generators shall be floating the battery and supplying as large an equipment load as is practicable to connect at the time of test; as much spare and emergency equipment should be turned on as is practicable. Care shall be exercised, however, not to change the voltage applied to equipment beyond the operating limits.

**2.10 Noise Tests — Requirements for Amplifiers for General Use on 5 KC and 8 KC Program Circuits**

(a) With the amplifier adjusted for maximum gain and the input terminated in 600 ohms resistance, the metallic-circuit noise at a high or low level outlet shall not exceed 25 db above reference noise (program weighting), as measured with a 2A or 2B Noise Measuring Set ("PROG" input), or with the aid of a 4B Program Frequency Weighting network or its equivalent. If these measuring means are not available, the noise shall not exceed 15 db

above reference noise (message weighting), as measured with the aid of a 4A Message Frequency Network or a 1A Noise Amplifier. If these means also are not available, the noise shall not exceed 40 noise units as measured with a 1A Noise Measuring Set.

*Note:* If the noise is excessive different vacuum tubes shall be tried in order to insure that microphonic noise is not the cause of the excess.

(b) In addition to measurements in (a), and under the same conditions, the unweighted noise at the output, as measured with a 21A Transmission Measuring Set, or with a 6A Transmission Measuring Set or 2B Noise Measuring Set modified for use with wide band program circuits, or the equivalent of such a set, shall not exceed a power of  $-30$  dbm. The REC jacks of the 600-ohm measuring set shall be connected directly to the outlet.

**2.11 Noise Tests-Requirements for Amplifiers Used on 15 KC (FM) Studio-Transmitter Loops:** When the 14C amplifier is used on 15 kc studio-transmitter program circuits for FM broadcasting and television audio channels, it is installed with special mounting, filtering and shielding equipment to reduce noise, as shown on SD-55503-01. In such cases the amplifier, adjusted for maximum gain and with the input terminated in 600 ohms, shall meet the following requirements, measured with a 21A Transmission Measuring Set, or with a 2B Noise Measuring Set or equivalent with FLAT 15 kc program weighting:

- (a) When a single-line outlet is used, the noise shall not exceed  $-68$  dbm (for the 21A Set), or 22 dbRN (for the 2B Set) at the 600-ohm amplifier OUT jacks.
- (b) At the high-level outlet of a G-type bridge, the noise shall meet the same limit as in (a).
- (c) At the low-level outlet of a G-type bridge, the noise shall not exceed  $-74$  dbm (21A Set) or 16 dbRN (2B Set).

**Miscellaneous Equipment**

**2.12 General:** Measurements shall be made between jacks unless otherwise specified and shall meet requirements as follows:

**2.13 Repeating Coils**

REPEATING COIL	WITH WINDINGS IN	1000-CYCLE LOSS, DB	
		MIN.	MAX.
111C	Series	0.3	0.7
	Parallel (See Note 1)	1.9	2.3
119C	Series	0.5	0.9
	Parallel (See Note 1)	2.5	2.9
162A	Series (See Note 2)	0.3	0.7

**Note 1:** Add 0.1 db to min. and max. if a 10,000 ohm resistance simplex is connected in parallel with the parallel windings.

**Note 2:** With or without 50 mf in series and D-158391 varistor in parallel with series windings.

The 1000-cycle loss of a repeating coil connected to a pad shall be the nominal value of the pad plus the average loss of the coil as determined from 2.13, with the following variation:

LOSS OF PAD, DB	VARIATION, DB
Less than 1	$\pm 0.3$
1-10	$\pm 0.4$
Over 10	$\pm 0.5$

**2.14 19A or 19B Equalizer Connected to Two 119C Repeating Coils:** Any 17-type equalizers included between the measuring points shall have 89A (0 db) resistances in the sockets.

1000-CYCLE LOSS, DB	DEVIATIONS FROM MEASURED 1000-CYCLE LOSS, DB, AT	
	100 CYCLES	5000 CYCLES
<b>For 19A</b>		
(a) $3.2 \pm 0.5$	$0 \pm 0.5$	$0 \pm 0.5$
(b) $5.0 \pm 0.7$	$0 \pm 1.0$	$0 \pm 1.0$
<b>For 19B</b>		
(a) $2.7 \pm 0.6$	$0 \pm 0.5$	$0 \pm 0.5$
(b) $4.0 \pm 0.9$	$0 \pm 1.0$	$0 \pm 1.0$

**Note:** (a) indicates one equalizer, (b) indicates two equalizers.

If, in addition to the above, an adjustable loss pad is included in series, the 1000-cycle loss requirements above shall be increased by the nominal loss of the pad, and the 1000-cycle variations shall be changed as follows:

**For 19A**

In case (a) above,  $\pm 0.6$  db, if the pad is less than 1 db,  $\pm 0.7$  if the pad is 1-10 db,  $\pm 0.8$  if the pad is over 10 db. In case (b) above, add another 0.1 db to each variations given for case (a).

**For 19B**

In case (a) above,  $\pm 0.7$ , if the pad is less than 1 db,  $\pm 0.8$  if the pad is 1-10 db,  $\pm 0.9$  if the pad is over 10 db. In case (b) above,  $\pm 0.9$  if the pad is less than 1 db,  $\pm 1.0$  if the pad is 1-10 db,  $\pm 1.1$  if the pad is over 10 db.

**2.15 17-Type and 51A Equalizers:** These equalizers shall be tested by determining the increase in loss caused by replacing the 89A (0 db) resistance with resistances as listed below. The increase in loss represents the loss of the equalizer with that resistance and shall be within the limits given below at the frequencies indicated. All equalizers in the circuit except the one under test shall have an 89A resistance in the socket.

EQUALIZER	RESISTANCE	FREQUENCY	INCREASE IN LOSS, DB
17A	89 BL	100	4.4 — 4.9
	BL	1000	1.4 — 1.7
B	J	1000	1.7 — 2.3
	BL	1000	14.7 — 15.3
C	J	50	1.4 — 2.0
	BL	50	3.5 — 4.4
D	J	1000	1.7 — 2.3
	BL	1000	11.2 — 12.0
E	J	1000	0.2 — 0.5
	BL	8000	2.7 — 3.3
F	J	1000	1.5 — 2.1
	BL	1000	4.0 — 4.7
G	BL	1000	0.3 — 0.7
	BL	8000	5.3 — 6.3
H	J	1000	1.7 — 2.3
	BL	1000	8.6 — 9.2

EQUALIZER	RESISTANCE	FREQUENCY	INCREASE IN LOSS, DB	TYPE OF EQUAL.	POSITION OF KEYS	DEVIATION FROM MEASURED 1000-CYCLE LOSS, DB, AT		
						1000- CYCLE LOSS, DB	100 CYCLES	5000 CYCLES
17J	J	5000	0 — 0.3	18D	All Out	0	0	0
	J	8000	1.2 — 1.8		No. 1 In	0.5	0	-0.2
K	J	1000	1.7 — 2.3		No. 2 In	0.9	0	-0.4
	BL	1000	14.7 — 15.3		No. 4 In	1.9	+0.1	-0.9
L	J	1000	1.3 — 1.9		No. 8 In	3.8	+0.1	-1.8
	BL	1000	5.2 — 5.9					
M	J	1000	1.7 — 2.3		All Out	1.6	+0.4	-0.6
	BL	1000	14.3 — 14.9		No. 1 In	2.4	+0.9	-0.7
N	J	1000	1.7 — 2.3		No. 2 In	2.4	+1.3	-0.7
	BA	4500	5.8 — 6.8		1st No. 4 In	2.4	+2.2	-0.8
P	J	100	0.4 — 0.6		2nd No. 4 In	2.4	+2.2	-0.8
	J	1000	1.4 — 1.9	D-160242 (Mod. 18B)	All Out	2.6	+0.6	-1.0
R	J	4000	0.4 — 0.6		No. 1 In	3.6	+1.0	-1.0
	J	100	1.3 — 1.8		No. 2 In	3.7	+1.5	-1.0
	J	400	0 — 0.2		1st No. 4 In	4.0	+2.3	-1.0
	J	1000	1.2 — 1.6		2nd No. 4 In	4.0	+2.3	-1.0
S	J	100	1.8 — 2.2	D-160241 (Mod. 18A)	All Out	1.6	+0.4	-0.6
	J	1000	1.4 — 1.9		No. 1 In	2.4	+0.9	-0.7
	J	4000	0 — 0.2		No. 2 In	2.4	+1.3	-0.7
51A	BL	50	3.6 — 5.6		1st No. 4 In	2.4	+2.2	-0.8
	BL	1000	14.6 — 15.3		2nd No. 4 In	2.4	+2.2	-0.8

If in addition to the equalizer, an adjustable loss pad is included in series, the requirements above shall be increased by the nominal loss of the pad, and the 1000-cycle variation shall be changed as follows:

$\pm 0.3$  db if the pad is less than 1 db,  $\pm 0.4$  if the pad is 1-10 db and  $\pm 0.5$  if the pad is greater than 10 db. At 100 and 5000 cycles the  $\pm 0.2$  db variation is unchanged.

## 2.16 Line Equalizers 18A, 18B, 18C and 18D:

The losses shall be within  $\pm 0.2$  db of the values given in the table below:

TYPE OF EQUAL.	POSITION OF KEYS	1000- CYCLE LOSS, DB	DEVIATION FROM MEASURED 1000-CYCLE LOSS, DB, AT	
			100 CYCLES	5000 CYCLES
18A	All Out	1.6	+0.4	-0.6
	No. 1 In	2.4	+0.9	-0.7
	No. 2 In	2.4	+1.3	-0.7
	No. 4 In	2.4	+2.2	-0.8
18B	All Out	2.6	+0.6	-1.0
	No. 1 In	3.6	+1.0	-1.0
	No. 2 In	3.7	+1.5	-1.0
	No. 4 In	4.0	+2.3	-1.0
18C	All Out	4.2	+0.6	-1.4
	K In	5.6	+0.7	-2.3
	No. 1 In	5.4	+1.0	-1.4
	No. 2 In	5.4	+1.5	-1.4
	No. 4 In	5.4	+2.3	-1.5

**2.17 Resistance Simplex:** The 1000-cycle bridging loss of the resistance simplex alone shall be  $0.25 \pm 0.1$  db. When connected to an adjustable loss pad, the 1000-cycle loss shall be nominal loss of the pad  $+0.25$  db  $\pm$  the following:

VALUE OF PAD, DB	$\pm$ , DB
Less than 1	0.1
1-10	0.2
More than 10	0.3

## 2.18 13A Equalizer Connected to Two 119C Repeating Coils

1000-CYCLE LOSS, DB	DEVIATIONS FROM MEASURED 1000-CYCLE LOSS, DB, AT	
	100 CYCLES	5000 CYCLES
14.1 $\pm$ 0.5	+2.3 $\pm$ 0.3	-2.6 $\pm$ 0.3

If, in addition to the above, an adjustable loss pad is included in series, the requirements above shall be increased by the nominal loss of the pad, and the variations shall be changed as follows:

(a) At 1000 cycles,  $\pm 0.6$  db if the pad is less than 1 db,  $\pm 0.7$  if the pad is 1-10 db, and  $\pm 0.8$  if the pad is greater than 10 db.

(b) At 100 and 5000 cycles,  $\pm 0.5$  instead of  $\pm 0.3$ .

**2.19 1103A and 49A Equalizers:** Any 17-type equalizers included between the measuring points shall have 89A (0 db) resistances in the sockets.

NO. OF EQUAL. IN TANDEM	LOSSES, DB, AT		
	1000 CYCLES	4000 CYCLES	5000 CYCLES
1-1103A	$2.9 \pm .4$	$2.4 \pm 0.7$	$1.5 \pm 0.6$
2-1103A	$5.8 \pm .6$	$4.8 \pm 1.1$	$3.0 \pm 0.9$
3-1103A	$8.7 \pm .8$	$7.2 \pm 1.4$	$4.5 \pm 1.2$
1-49A	$3.7 \pm .4$	$3.0 \pm 0.7$	$1.8 \pm 0.6$
2-49A	$7.4 \pm .6$	$6.0 \pm 1.1$	$3.6 \pm 0.9$
3-49A	$11.1 \pm .8$	$9.0 \pm 1.4$	$5.4 \pm 1.2$

Two or three equalizers connected in tandem may be measured as a group, and measurement of the individual equalizers will not be required if the over-all losses are within the values listed above. If the above group loss requirements for combinations are not met, each equalizer shall be measured individually, and if each meets the requirements for one equalizer, the equalizers shall be considered satisfactory.

#### 2.20 66A Auxiliary Filter

LOSSES, DB, AT			
1000 CYCLES	4000 CYCLES	8000 CYCLES	9000 CYCLES
$0.3 \pm 0.2$	$0.3 \pm 0.2$	$0.6 \pm 0.3$	Min. 18

#### 2.21 69B or 83A Auxiliary Filter

LOSSES, DB, AT		
1000 CYCLES	4000 CYCLES	8000 CYCLES
$0.4 \pm 0.2$	$0.4 \pm 0.2$	$22.5 \pm 2.0$

**2.22 Variable Attenuator:** The 1000-cycle loss of the 0-10 db variable attenuator shall be measured on each step from 1 to 10. The loss shall be the nominal value of the step  $\pm 0.2$  db.

**2.23 Input Monitoring:** The 1000-cycle loss of the input monitoring resistances with 600 ohms across one side shall be  $20.1 \pm 0.5$  db.

**2.24 C2 Bridge:** The 1000-cycle loss of the C2 bridge shall be measured from the C2-1 jacks to the C2-2 and the C2-3 jacks. The loss shall be  $6.0 \pm 0.2$  db.

#### Over-all Transmission Test

**2.25** Over-all transmission tests at 1000 cycles shall be made between the jacks through which the program circuit enters and leaves the program bays. The alternative paths provided by bridging shall be tested from the same input jacks to the output jacks of the transmission path under test. In the case of amplifiers arranged for reversals but no bridging, over-all tests shall be made with the amplifier switched first one way, then the other. In the case of amplifiers arranged for reversals with bridging, one of the transmitting circuits shall be set for transmitting into the 14C amplifier with all the other circuits receiving from the 14C amplifier, and over-all tests made from the input jacks to the output jacks of all the paths. Each of the other transmitting circuits shall then in turn be set for transmitting in a similar manner, and a test made to the output jack of the path that was used for the first transmitting circuit. In the case of 14C amplifiers in tandem, the over-all tests will include more than one 14C amplifier for measurements to certain of the outlets. The volume indicator, if present, shall be disconnected from the circuit during tests.

**Requirements:** The measured over-all transmission loss or gain shall not differ by more than 0.5 db from a calculated value obtained by subtracting the sum of the measured losses from the sum of the measured gains in the transmission path, as measured in accordance with preceding paragraphs.

#### C. Trouble Location Tests

##### 14C Program Amplifier

**2.26 Gain Dial Step Tests:** With an output level not to exceed +11 dbm for single line or high level output, or not to exceed +5 dbm for low level outlet, the 1000-cycle gain for the dial setting shown shall be as follows:

DIAL SETTING			1000-CYCLE GAIN, DB	
10 DB DIAL	1 DB DIAL	0.25 DB DIAL	SINGLE LINE OR HIGH LEVEL OUTLET	LOW LEVEL OUTLET
3	6	Off	36.0 $\pm$ 0.2	30.0 $\pm$ 0.2
3	6	1	36.25 $\pm$ 0.2	30.25 $\pm$ 0.2
3	6	2	36.5 $\pm$ 0.2	30.5 $\pm$ 0.2
3	6	3	36.75 $\pm$ 0.2	30.75 $\pm$ 0.2
3	6	4	37.0 $\pm$ 0.2	31.0 $\pm$ 0.2
3	Off	2	30.5 $\pm$ 0.2	24.5 $\pm$ 0.2
3	1	2	31.5 $\pm$ 0.2	25.5 $\pm$ 0.2
3	2	2	32.5 $\pm$ 0.2	26.5 $\pm$ 0.2
3	3	2	33.5 $\pm$ 0.2	27.5 $\pm$ 0.2
3	4	2	34.5 $\pm$ 0.2	28.5 $\pm$ 0.2
3	5	2	35.5 $\pm$ 0.2	29.5 $\pm$ 0.2
3	7	2	37.5 $\pm$ 0.2	31.5 $\pm$ 0.2
3	8	2	38.5 $\pm$ 0.2	32.5 $\pm$ 0.2
3	9	2	39.5 $\pm$ 0.2	33.5 $\pm$ 0.2
2	6	2	26.5 $\pm$ 0.3	20.5 $\pm$ 0.3
1	6	2	16.5 $\pm$ 0.3	10.5 $\pm$ 0.3
Off	6	2	6.5 $\pm$ 0.3	0.5 $\pm$ 0.3

**2.27 Load Test:** With the gain control dials set for 40 db gain, the 1000-cycle gain shall be measured at an output level of 0 dbm at a high level outlet of a bridging amplifier, if available, or at a low level outlet if all outlets are low

level. The output shall then be increased to the values given below, and the 1000-cycle gain measured. The change in gain from the gain with an output level of 0 dbm shall be as follows:

(a) *For Bridging Amplifier*

OUTPUT LEVEL, DBM		CHANGE IN GAIN, DB
HIGH LEVEL OUTLET	LOW LEVEL OUTLET	
20	14	0
24	18	0 to -0.1
25	19	0 to -0.5

(b) *For Single Line Amplifier*

OUTPUT LEVEL, DBM	CHANGE IN GAIN, DB
24	0
28	0
29	0 to -0.5

### 3. TEST REPORTS AND RECORDS

**3.01** The required record of these tests shall be entered on the proper form.

Bell Telephone Laboratories, Inc.