TYPE O CARRIER TELEPHONE SYSTEM — REPEATERS
GENERAL INFORMATION — MAINTENANCE CONSIDERATIONS

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1. GENERAL

1.01 This section covers the testing considerations involved in maintaining the repeater equipment of the O carrier telephone system.

1.02 *Equipment Mounting:* Too much emphasis cannot be put upon the importance of using care in plugging in the units of the type O system. The spring fingers of the small jack terminals of the multicontact jacks are easily bent out of shape and when one is bent it not only may prevent good contact in that jack, but because of improper seating of the connector may prevent proper contacts in the other jack terminals of the jack assembly. To avoid this damage (1) see that the Dzus fastener slot of the upper plug-in units is turned vertically at the start and that the stud enters its hole and engages its spring in the terminal mounting, thus assuring proper centering, (2) on the unit (whether upper or lower) "feel" for the proper positioning of the connector with its jack assembly and then (3) avoid forcing when pushing the unit home, i.e., release the hold on the handle and with a single finger tip on the face of the handle push it home. If resistance calls for greater pressure, remove the unit and examine the connector and jack assembly for bent or broken parts.

1.03 Damaged individual jack terminals may be replaced without replacing the whole jack assembly, as covered in Section A509.207.

1.04 Before removing a unit or tube at a repeater, always remove the fuses through which the heater current flows. This precaution is necessary to prevent damage to the tube heaters by excessive voltage.

1.05 Tube pullers are available, such as the Rubber Tip Sure Grip Tube Puller or the KS-13753 tool, and are desirable for removing hot tubes. Also pin straighteners, the JE13 (7 pin) and the JE15 (9 pin), are strongly recommended. It is considered good practice to have one of each of these straighteners mounted on the bay channel close to the type O equipment and to insert the tube into the appropriate straightener each time before it is inserted into its socket.

1.06 KS specification carrying cases as covered in Section AA388.081 are available for the plug-in units of the type O carrier system. Protection is adequate for transportation with the exception of shipment by a common carrier. In the latter case the carrying cases should be packed in an outer case providing a "floating" type of packing.

1.07 *System Line-Up:* Line-up test should not be made during sleet or emergency battery conditions. These tests are made either when the system is first lined up, terminal to terminal, or when due to such effects as aging or temperature, significant changes in transmission have been observed which indicate a reline-up is necessary or desirable. Each direction of transmission may be lined up independently of the other. The transmitting terminal tests may be made simultaneously at both terminals, but both should be lined up before repeater tests are made. After repeater line-up has been made, the receiving terminal tests are made to complete the line-up procedure.

2. TESTING EQUIPMENT

2.01 With one exception the test requirements in these sections for various tests are in terms of the scale readings actually obtained on the specified meters. Any corrections due to using a meter calibrated for one impedance in a different impedance circuit have been made in the requirements. This exception involves some

measurements on the repeater where a correction must be made for the deviation of input or output impedances from the nominal values. Where such corrections must be applied, attention is called to it in the text or tables. Due to the necessity of making corrections under some conditions, meters other than those specified should not be used unless it is certain that equivalent results can be obtained. ***All meters and test sets should be kept in accurate calibration as covered in practices describing the equipment.***

2.02 The Weston Model 1 voltmeter may be used instead of the Model 931 where it is available. However, the Model 1 meter is a laboratory type of instrument requiring extra care to prevent damage, whereas the Model 931 meter is a well-shielded meter of more rugged construction and can be transported with greater safety from damage. When the Model 1 meter is used it should be kept at least 12 inches away from iron (e.g., a table or bay) and from strong magnetic fields. The Model 280 voltmeter with 1% accuracy may be used, but its use may result in some impairment of tube life if used to adjust heater voltages.

2.03 For tests on repeaters the 400C or 400D vacuum tube voltmeter may be used instead of the 2J set, where the vacuum tube voltmeter is already available. When the 400C or 400D meter is used; the meter readings obtained should be 6.5 db less than those specified for the 2J set. This corrects for the scale difference due to the different calibrating impedance levels for the two meters.

2.04 The ground terminal of the Hewlett-Packard 400C or 400D vacuum tube voltmeter is the lower terminal at the left side. The W2DW cord is used with the cord extending downward from the shielded plug. The black terminal connecting to the cord shield is used for the ground connection.

2.05 For those tests which specify the use of a selective detector, the KS-15538, L1 or L2 carrier frequency voltmeter may be used for frequencies in the OB, OC, and OD systems, and for the high group of the OA system. It will not cover the low group of the OA system. The Sierra Model 103 carrier frequency voltmeter will cover all of the line frequencies in the OA system except for the lower 1000 cycles of the low group between 2 and 3 kc. The J64031B transmission measuring set may be used to cover all of the systems except for the upper 6000 cycles of the OD high group between 150 and 156 kc, and the lower 8000 cycles of the OA low group between 2 and 10 kc. Only the KS-15538, L1 or L2 meter will select frequencies in the baseband (180-196 kc) at the group receiving unit output.

2.06 The tests covered in the associated sections which use a selective detector specify certain meter inputs. The particular inputs for each meter are obtained as shown in Table I.

TABLE I

METER	INPUT	OBTAINED BY
KS-15538, L1 or L2	135Ω unbal. bridg.	Switch at VM BAL 135Ω BRG
	135Ω bal. bridg.	Switch at VM BAL 135Ω BRG
	600Ω unbal. bridg.	Switch at VM UNBAL 600Ω BRG
	600Ω bal. bridg.	Switch at VM UNBAL 600Ω BRG plus 146U repeat coil
Model 103	135Ω unbal. bridg.	Add 6.5 db to meter reading
	135Ω bal. bridg.	146U repeat coil and add 6.5 db to reading
	600Ω unbal. bridg.	Normal input
	600Ω bal. bridg.	146U repeat coil
31B TMS	135Ω unbal. bridg.	Normal input
	135Ω bal. bridg.	Normal input
	600Ω unbal. bridg.	Subtract 6.5 db from meter reading
	600Ω bal. bridg.	Subtract 6.5 db from meter reading

2.07 For convenient reference, the carrier and signaling frequencies used in the type O systems are listed in Tables II, III, and IV.

TABLE II

MODULATING CARRIERS

SYSTEM	REP. MOD. CARR.	LOW GROUP MOD. CARR.	HIGH GROUP MOD. CARR.
OA	None	198 kc	216 kc
OB	116 kc	236 kc	256 kc
OC	196 kc	276 kc	296 kc
OD	276 kc	316 kc	336 kc

TABLE III

BASEBAND FREQUENCIES
(All Systems)

Carriers — 184 and 192 kc
Signaling tones — 180.3, 187.7, 188.3, and 195.7 kc

2.08 For dc line measurements it is preferable to have actual resistance measurements of the line filters. In the absence of such measurements the following values may be used:

TYPE	RESISTANCE PER WIRE (OHMS)
537A or 538A	11.4
537C or 538C	11.4
219S or 538D	2.4
207F	8.1
220F or 538J	1.8
220G or 538K	1.2

2.09 Each associated section includes a list of the equipment needed for that particular test. The test equipment should be periodically calibrated in accordance with Bell System Practices.

TABLE IV

LINE FREQUENCIES

GROUP	CH. 1-2 CARR. — KC	CH. 3-4 CARR. — KC	SIGNALING TONES — KC CH. 1	CH. 2	CH. 3	CH. 4
OA Low Group	14	6	17.7	10.3	9.7	2.3
OA High Group	24	32	20.3	27.7	28.3	35.7
OB Low Group	52	44	55.7	48.3	47.7	40.3
OB High Group	64	72	60.3	67.7	68.3	75.7
OC Low Group	92	84	95.7	88.3	87.7	80.3
OC High Group	104	112	100.3	107.7	108.3	115.7
OD Low Group	132	124	135.7	128.3	127.7	120.3
OD High Group	144	152	140.3	147.7	148.3	155.7