

**BELL SYSTEM PRACTICES**  
**Station Installation and Maintenance**

**SECTION C53.153**  
**Issue 4, July, 1953**  
**AT&T Co Standard**

## **1A KEY TELEPHONE SYSTEM INSTALLATION**

### **1. GENERAL**

1.01 This section covers the installation of the 1A key telephone system. It is reissued to include changes in the line signal limitations.

1.02 The service and operating features of the system are described in Section C53.151 and the apparatus and supplies required for its installation and maintenance are included in Section C53.152.

### **2. SERVICE ORDERS AND WORK SHEETS**

2.01 The service order issued for each installation, addition and rearrangement will list the service that is to be provided and usually an attached work sheet will show the operating features for each station and will give information as to the type of apparatus required at each new station.

### **3. LOCATING AND MOUNTING**

3.01 The key telephone sets should be installed on desks or tables on the same basis as other combined sets, hand telephone sets or desk stands and the same requirements apply as regards their location. They should be connected to the station wiring by means of 42- or 44- or 47-type connecting blocks, the installation of which is covered in Division C30. Key telephone set cords should not be exposed to moisture. If necessary, fasten cord near connecting block with a cable clamp to keep cord off the floors subject to mopping. When installing key telephone sets with illuminated key buttons avoid as far as possible locations where extremely high illumination may be directed on the key buttons, particularly direct sunlight.

3.02 **Equipment cabinets** when used to house the key telephone units of the 1A system should be located and mounted as covered in Section C53.507.

3.03 The **105-type apparatus box** when used to house the individual key telephone units should ordinarily be placed in closets or other inconspicuous locations if they are available and accessible for maintenance purposes.

3.04 If the apparatus box is mounted on a wall the preferred location would be just above the baseboard, or at baseboard height above the floor. **These boxes should not be installed on desks or other furniture if other satisfactory locations are available.** Where appearance considerations are such that the attachment of numerous apparatus boxes to walls may not be desirable, give consideration to the use of equipment mounted in key equipment cabinets.

3.05 **The backboards** for mounting the 105-type boxes should be used under the following conditions:

- (a) Where fasteners for the apparatus box would come into contact with metal or damp surfaces. This is to avoid grounding the apparatus boxes, and the apparatus contained therein, at a different potential from that of the circuit ground.
- (b) On all masonry surfaces.
- (c) On all surfaces that are uneven.

3.06 **The fasteners** for the apparatus box are the same as those specified for bakelite subscriber sets, and the fasteners for the backboards are the same as those specified for wooden backboards used with subscriber sets except that four fasteners should be used with backboards that mount more than one apparatus box. Backboards may be mounted either vertically or horizontally on a wall but the vertical mounting position is preferred wherever appearance, wiring and other considerations will permit.

3.07 **The apparatus units** are fastened in the apparatus boxes with the two machine screws furnished with each unit.

3.08 **Miscellaneous apparatus** items such as externally mounted keys, push buttons, buzzers, etc., are required for some key telephone system installations. These items should be installed in accordance with existing practices.

3.09 **The 393-type transformer** if used to supply power to the lamps in sets with illuminated key buttons should be mounted in accordance with existing practices covering the installation of transformers. In general the transformer should be located near the cabinet or apparatus box (so that the resistance of the leads from the transformer secondary will be limited as described in 6.13 and near the subscriber's comm-←

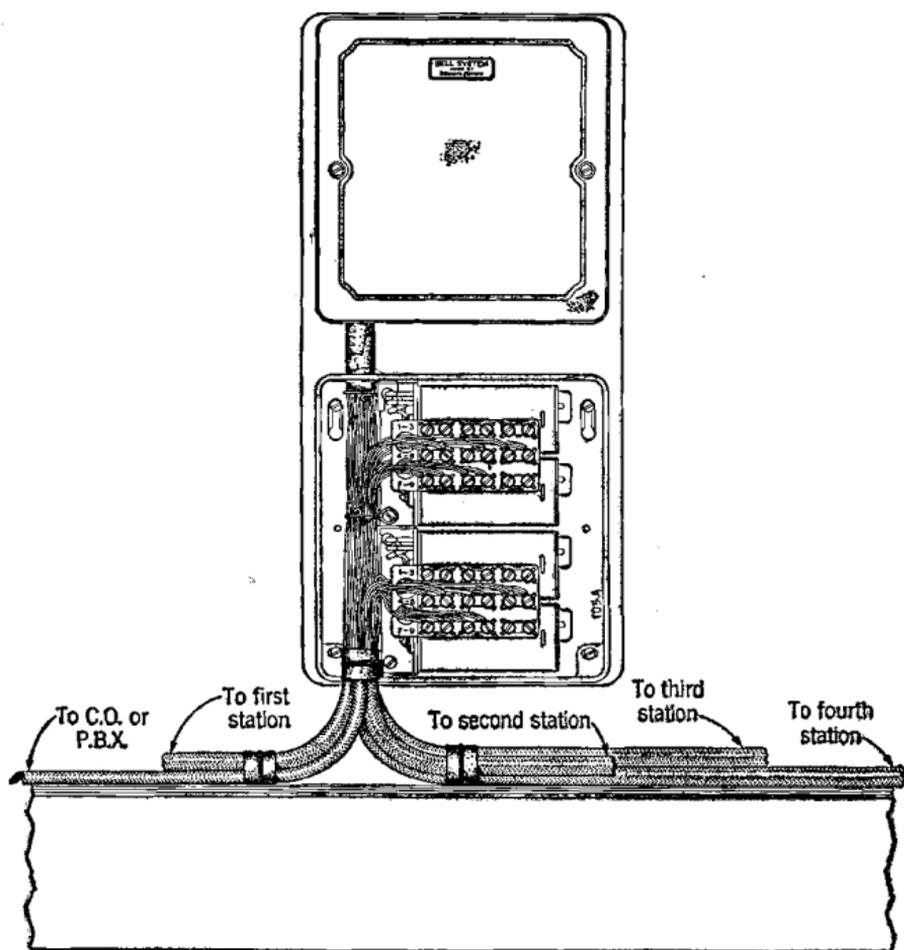
cial power outlet. The 393-type transformer contains one or two 24c fuses which are internally wired in series with the secondary winding.

#### **4. WIRING**

4.01 Wire or cable shall be selected, placed and fastened in accordance with the sections in Division C20 that cover this work. The following paragraphs, however, supplement the data given in the Division C20 sections.

4.02 The cover for the 105-type apparatus box has large cut-outs for bringing in wire or cable. Fiber strips are furnished with the cover for closing holes that are not used and for partially closing those that are not completely filled with wire or cable. Use hacksaw or diagonal pliers to cut fiber strip to fit closely around cable or wiring.

4.03 The holes in the cover will accommodate up to four 16-pair and one 6-pair inside wiring cables. When two or three apparatus boxes are placed one above the other the wiring should ordinarily enter the bottom of the lower box and conductors to be terminated in the upper boxes should pass through the lower boxes. This largely conceals the wiring between boxes and makes for good appearance. Where the boxes are mounted side by side it will be necessary to split the cables entering the boxes and make taped forms of the conductors from the butts of the cable into the boxes. The forming of cables in a typical apparatus box installation is shown in Fig. 1. The conductors should, of course, be terminated in accordance with the sections covering the termination of wire on screw terminals.



**Fig. 1—Typical Apparatus Box Installation**

4.04 It will be noted in Fig. 1 that the incoming cable and one of the outgoing cables leave the box in one direction and that three outgoing cables leave in the other direction. This assumes that wherever possible the apparatus boxes will be located so as to not have more than three cables run parallel to each other on the wall. For appearance reasons it is seldom permissible to place more than three cables alongside each other for any appreciable distance. Where appearance is especially important only one outgoing cable need be run in any one direction from the apparatus box as stations can be bridged on by means of connecting blocks.

4.05 The typical installation shown in Fig. 1 would care for cabling directly to four main stations. If the system includes more than four main stations or for appearance reasons only one or two cables can be run on the wall, bridging points for additional stations should be provided. The following methods of bridging may be employed.

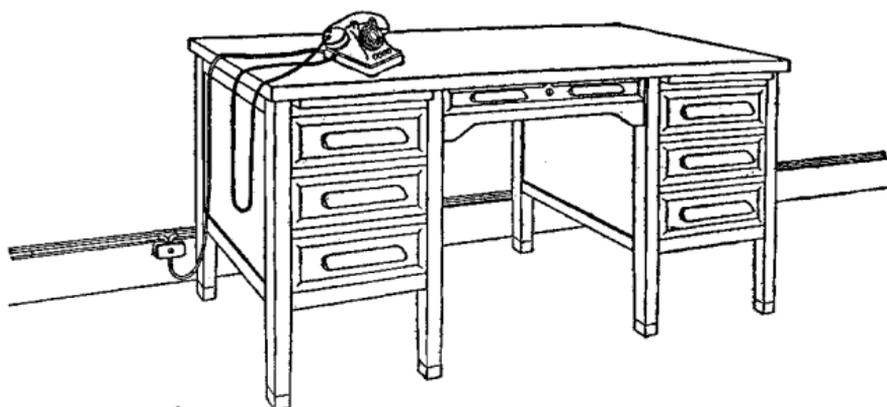
(a) **44-type connecting blocks** should ordinarily be used for this purpose. The 42-type connecting blocks may be used only for the smallest systems (four conductors per station). At a main station or other bridging point the connecting block installed should have a sufficient number of terminals to permit terminating all conductors in the incoming cable so that any conductors needed for lamp signals, buzzers, etc., or for individual use at other stations can be terminated at this point. 44-type connecting blocks will accommodate one incoming cable, one cord to a key telephone set and one outgoing cable to another station or one incoming cable and two outgoing cables to other stations or additional bridging points.

(b) **Additional apparatus boxes** equipped with 8-type key telephone units may be used to bridge three cables onto a cable from a preceding apparatus box. As an alternative to this arrangement GA, GB or GC-type cable terminals equipped with (30 or similar type) connecting blocks may be used where appearance considerations will permit.

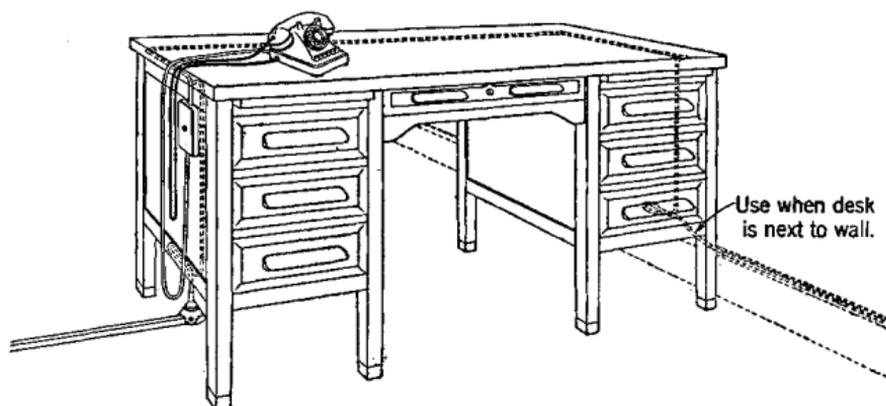
4.06 Where apparatus units are mounted in the 4-plate apparatus cabinet and space will not permit mounting some or all of the additional terminals required for terminating lamp leads to illuminated key buttons, a 105-type apparatus box equipped with 8-type key telephone units may be installed as near as practicable to the apparatus cabinet to provide the additional terminals required. Where appearance or other considerations will not permit this arrangement, a larger cabinet should be installed. The installation of key telephone units in the larger equipment cabinets is covered in C53.507.

4.07 **Connection** information is given in drawings listed at the end of C53.151.

4.08 **Wiring to desks and tables** should be done as shown in Figs. 2 and 3. Fig. 2 is for use where the desk or table is located back to the wall or with the telephone set on the end of the desk immediately adjacent to the wall. This arrangement can not be used where there is a passageway between the desk and the wall. The arrangement shown in Fig. 3 should be used for all other installations.



**Fig. 2—Typical Installation with Telephone Set on Wall Side of Desk**



**Fig. 3.—Typical Installation with Telephone Set on Aisle Side of Desk**

4.09 When the telephone set is located on the aisle side of a desk as shown in Fig. 3 the cable from the connecting block on the desk should be connected to the apparatus box or bridged to a cable from the apparatus box at one of the bridging points mentioned in Paragraph 4.05. It would not be economical to place another connecting block on the wall immediately adjacent to the desk. However, this may be necessary where appearance considerations make it inadvisable to have more than one cable run along the baseboard. Cables from desks and tables may, of course, be run through underfloor or

overfloor ducts to distributing terminals or bridging points associated with these facilities.

4.10 If auxiliary equipment such as lamp indicators, buzzers, push buttons, etc., are required the connecting block shown in Fig. 2 should be placed on the desk instead of on the wall so that any auxiliary equipment on the desk can be wired to the connecting block used for the telephone set cord connections. It is permissible, however, to install a second small connecting block high up in the knee-well of a desk to provide a termination for cord as from a lamp indicator. The space immediately in back of the center drawer of a desk provides a good space for mounting buzzers and secondary connecting blocks. Use a 154A backboard at this location on metal desks.

4.11 Reference should be made to the section in Division C20 entitled "Wiring of Desks and Tables" for further information in this connection.

## 5. POWER SUPPLY

5.01 The power supply to be used with the key telephone system should usually be specified on the service order or attachment thereto. Where not so specified it should be determined in accordance with instructions included in the sections in C50 Division covering power supply arrangements for station systems and key equipments using current drain values and fusing requirements given on the schematic circuit drawings for the 1A Key Telephone System.

## 6. LINE STATION AND RINGER LIMITATIONS

6.01 The line and station features provided by this system should not be installed either on party or magneto lines except where authorized by local instructions.

6.02 It is desirable to have the system arranged so that **the number of stations** that can be connected to one line is limited so as to reduce the possibility of interference, particularly with dial pulsing on dial lines, and the possibility of poor transmission being experienced due to the use of a line simultaneously by several stations for listening-in or conference purposes. In general, not more than six stations should be connected directly or by key operation to one central office line and not more than seven stations including CR stations to the intercommunicating line where visual line and busy signals are not provided. Where, however, common audible signals and visual line and busy signals necessary for the proper operation of the system are installed, a greater number of stations may be connected to a line, particularly if it is contemplated that

not more than two stations will be used simultaneously on one line and where the use of the telephone is such that little interference is anticipated.

6.03 Unless holding is provided at least one station should be provided for each central office line.

6.04 **The conductor loop resistance limitations** for key telephone systems are included on range charts and drawings for the central office or P.B.X. with which a system is associated. The orders covering the installation of lines with holding features should specify whether long line equipment is to be used. When there is any question that the loop limits may be exceeded and long line equipment required in connection with holding features, the following check may be made:

(a) The maximum conductor loop resistance **from the relay equipment to the central office** should be such that (with the holding bridge across the line) not less than the test current values shown in circuit requirement tables on the circuit drawings will flow through the winding of the supervisory relay when the receiver or hand set is removed from its mounting at the most remote station.

Note: This check may be made by connecting a 35-type or equivalent test set in series with one side of the line at the apparatus cabinet. Then make a call to the test desk or dial a test circuit over a central office line. If the test desk is called, ask the test deskman to operate his holding key and return to the connection within a short time. Leave the receiver off the mounting at the station and then block the holding relay operated at the apparatus cabinet. With all resistances in the test set out of the circuit, the meter in the set should show a reading of not less than the test operate value for the supervisory relay. If the reading is less than this, the indication of the test is that long line equipment is required. If the relay fails to operate either on the test value or the readjust value when resistance slides of the set are adjusted to give the proper readings on the meter, readjust relay.

6.05 Where a 3- or 4-wire talking circuit is extended from an induction coil of a subscriber set to a hand telephone set or desk stand, be guided by limitations included in the section entitled 'Main and Extension Stations—Connections and Wiring Limitations.'

6.06 **Ringer and Line Signal Limitations:** Ringers and line signals used with the system are subject to the same connection limitations as are ringers and line signals used at regular stations. In addition the limitations given below apply.

6.07 The arrangement shall be such that at least one ringer or signal is connected to the central office or P.B.X. line at all times. Exception to this requirement may be made at P.B.X. stations in special cases where for one reason or another a ringer or signal is not needed by the subscriber.

6.08 At stations having separately mounted keys arranged to pick up more than one line, use separate subscriber sets for the ringer and the induction coil, except where subscriber sets having shielded induction coils and condensers arranged to limit crosstalk such as the 634CF set are employed.

6.09 The ringup relays of the key telephone units should be considered the equivalent of two high impedance ringer bridges.

6.10 Not more than two high impedance ringer bridges or the equivalent may be connected on the station side of the busy lamp or supervisory relay, otherwise this unit may operate on incoming calls. If a 6C key telephone unit is provided as a supervisory relay, not more than one high impedance ringer may be connected on the station side.

6.11 Where telephone sets with illuminated key buttons are used, the voltage impressed on the lamps should be limited to a maximum of 11 volts and a minimum of 7 volts. When 110-125 volt a-c power supply is available, a 101G power plant or a 393-type transformer may be used to supply power for the lamps as covered in Section C53.511. When battery power is supplied, resistors should be connected in the lamp leads to limit the voltage at the lamps. Where signal lamps are operated from a-c supply, the conductor loop resistance between the apparatus cabinet and the signal lamps should not exceed 25 ohms. Where lamps are connected in multiple not more than 12 shall be connected to one lead and the conductor loop resistance should be limited to the maximum for one lamp (25 ohms for a-c and 10 ohms for d-c) divided by the number of lamps connected to the lead. Table 1 gives the approximate maximum length of wire or cable between the apparatus cabinet and signal lamp.

**Table 1**  
**LAMP VOLTAGE SUPPLY**

No. of Lamps per pair	Maximum Feet of Wire or Cable between Apparatus Cabinet and Telephone Set			
	A-C (25 Ohm Limit)		D-C (10 Ohm Limit)	
	22 Gauge	24 Gauge	22 Gauge	24 Gauge
1	750	460		
2	375	230		
3	250	155	100	60
4	185	115	75	45
5	150	90	60	36
6	125	75	50	30

6.12 51A or G2 lamps should be operated from a d-c supply only when the use of a-c supply is not feasible. When lamps are operated from a d-c supply, a series resistance for voltage limitations should be used for each lamp. Small key telephone units 22F, G, H, J and K equipped with three 19-type resistances and terminals for terminating lamp leads to the key telephone sets are provided for this purpose. Listings in Section C53.152 indicate the battery voltages for which the several units are suitable. In addition, the conductor loop resistance between the resistance and the signal lamps should not exceed 10 ohms. Several lamps on the same line may be supplied over a single pair of wires but in order to reduce burn out of lamps due to failure of one lamp in such a multiple connection the number of lamps connected in this manner should **not** be less than 3. When three or more lamps are supplied over the same pair of wires the loop resistance should not exceed 10 divided by the number of lamps on the pair and the resistors of the resistance unit for these lamps should be connected in parallel. Other battery supply limitations on d-c supplies are shown on the schematic drawings.

6.13 **A-C Supply Lamp Feeder Circuit:** The leads between the power supply and the apparatus cabinet should not be smaller than 20-gauge copper or equivalent when two 2-ampere fuses are used at the power plant or transformers. Three pairs of 24-gauge inside wiring cable are approximately equivalent to one pair 20-gauge copper wire. When such equivalent is used these conductors should be securely connected together, the cable sheath should be carried inside the equipment or apparatus enclosures and 2 ampere distribution fuses must be supplied at the apparatus cabinet. The resistance of these leads shall not exceed the maximum noted in the following table.

Table 2

1.15 Volt Max. Drop in Feeder Leads				.90 Volt Max. Drop in Feeder Leads			
No. of 51A Lamps	Max. Allowable Resistance	Length of run of 1 pair of conductor (feet)		No. of 51A Lamps	Max. Allowable Resistance	Length of run of 1 pair of conductor (feet)	
		20 ga. cu.	20 ga.* JKT or 24 ga. wire			20 ga. cu.	20 ga.* JKT or 24 ga. wire
5	6.6	330	132	35	.74	37	15
10	3.3	165	66	40	.65	32	13
15	2.2	110	44	45	.58	29	12
20	1.65	83	33	50	.52	26	10
25	1.32	66	26	55	.47	23	9
30	1.10	55	22	60	.43	21	8
35	.93	47	19	65	.40	20	8
				70	.37	18	7

Note: Four G2 lamps are equivalent to five 51A lamps.

\*20-ga. JKT wire has iron core and about the same conductivity as 24-ga. inside wiring cable which is solid copper. Multiple conductor ends should be fastened together securely.

**Caution: Wire with wrapped cotton insulation is not satisfactory for cross-connecting power leads, when two 2-ampere fuses are in parallel, because of fire hazard.**

6.14 Where lamp power for more than six stations is supplied over conductors in the same cable, or where the conductor loop limits given in Tables 1 and 2 are exceeded, additional lamp leads, as required should be provided. Where metallic return is required, lamp ground leads for all lamps at a given station shall be strapped together **at the station connecting block**. Where runs from the apparatus cabinet are short and loop limits permit, more than six lamps may be supplied over one pair if the use of a larger size cable or the installation of additional cables can be avoided thereby.

6.15 Where lamps are provided in key telephone sets as well as in indicators, or attendants key boxes, Table 3 shows the type of lamps required.

Table 3

<u>Signal Lamp Supply</u>	<u>Tel. Set</u>	<u>Lamp Indicator or Key Box</u>
10 volt a-c	51A	G2
14-26 volt d-c	51A*	A3
47-50 volt d-c	51A*	K2

\*With resistance in series (see Paragraph 6.12).

6.16 Where 15-type lamp indicators are used throughout for signals with A3 or K2 lamps the limits given in Paragraph 6.14 do not apply and all lamps associated with one line may be connected to common leads as indicated on the circuit drawings.

## 7. FINAL TESTS

7.01 Upon completion of a key telephone system installation make certain that all features of the system are functioning properly. The tests should consist principally of operating the keys to see that all of the pickup, hold and intercommunicating features, buzzers, ringers, lamp signals, etc., are operating properly. In order to insure maximum illumination of buttons check to insure that the lamp is positioned forward toward the button against the shoulders of the slot in the lamp recess. Check the operation of the ringers with the keys in the various positions for stations having ringer cut-off, etc. The test data on the standard circuit drawings and data given in other sections will be helpful if any difficulty is found in the apparatus units, key telephone sets or other apparatus.

7.02 Accurately report all apparatus installed as required by local practices.

7.03 Before leaving the subscriber's premises see that the key telephone sets are equipped with suitable designation cards or strips and that the subscriber or a competent representative fully understands the operation of the particular system that has been installed.

7.04 Also see that any unused keys in the 4 and 6-button key telephone sets are blocked in their non-operated position by the P-339942 key blocking device. This is an eyelet shaped device which is assembled flange up under the key button it is desired to block.

7.05 There is also a D-96008 guard which may be used to similarly block unused keys in the 6021, 6027, and 6028 type keys. This device snaps on the key plunger rod immediately under the key button.

**BELL SYSTEM PRACTICES**  
**Station Installation and Maintenance**

**ADDENDUM C53.153**  
**Issue 1, March, 1955**  
**AT&T Co Standard**

## **1A KEY TELEPHONE SYSTEM INSTALLATION**

### **1. GENERAL**

1.01 This addendum supplements Section C53.153, Issue 4.  
It is issued to include installation information on the  
213A key telephone unit.

### **3. LOCATING AND MOUNTING**

3.10 Add paragraph as follows: The 213A key telephone unit,  
when used as described in Addendum C53.151, Issue 2,  
to combine stations of 1A and 1A1 key telephone systems, should  
generally be mounted in the cabinet of the 1A1 key telephone  
system.