I. & M. REQUIREMENTS SPECIFICATION
BELL TELEPHONE LABORATORIES, INC.
SYSTEMS DEVELOPMENT DEPARTMENT, NEW YORK

X-70035-01, ISSUE 1
MARCH 7, 1927
SUPERSEDING X-70035
ISSUE 2 OF 6/11/25

INSTALLATION AND MAINTENANCE REQUIREMENTS

FOR

NO. 1 TYPE ELECTRIC CLOCKS

REASON FOR ISSUE

This specification is issued to supersede specification X-70035, Issue 2 for the following reasons:

1. To add requirements for "Mounting" (2.1), "Tightness of Lock-nut" (2.3), "Back Lash" (2.4), "Freedom of Operation of Pawl" (2.5), "Position of Stop Pawl" (2.6), "End Play" (2.7), "Pawl Clearance" (2.8), "Position of Retractile Spring" (2.9), "Location of Tip of Retractile Spring Lug" (2.10) and "Record of Lubrication" (2.14).

Changes were also made:

2. To bring specification up-to-date as to form with test and readjust requirements on separate sheets.

3. To revise and add maintenance methods.

CHANGES FROM X-70035, ISSUE 2

Paragraph No.	Change
1.1 to 1.3	Were 1.1 to 1.3. Revised to bring up to date with standard form.
1.4 and 1.5	Added.
2.01	Added.
*2.001 to *2.007	Added.
*2.1	Added.
*2.2	Was 3.03. Requirement was checked visually.
*2.3 to *2.10	Added.
*2.11	Was 2.11, 2.12, 3.04, 3.041 and 3.042. Revised to add the No. 35-C test set.
*2.12	Was included in 3.01.
*2.13	Was 2.2 and 3.02. Reworded.
*2.14	Added.
3.01 to 3.1, M-1	Added.
3.3, M-1 and M-2	Was 3.031. Revised to specify use of No. 74 tool and No. 74-C gauge.
3.3, M-3 to) 3.13, M-12)	Added.
3.13, M-13	Was 3.023. Reworded.
3.14	Added.
	Other paragraphs renumbered as required.

*These paragraphs are given on Sheets 1 and 2 which have been added to this specification.

SECTION 1 - GENERAL

1.1 This specification supersedes specification X-70035, Issue 2 and covers the installation and maintenance requirements for No. 1 type electric clocks. Unless otherwise specified herein or in the "Circuit Requirement Tables" the requirements covered by this specification apply to all electric clocks of the above type.

1.2 Section 2 of this specification covers the requirements for both operating tests and the inspection of mechanical adjustments which shall be used to determine whether the electric clock is in proper condition for delivery to the customer and for service. These are called "Test Requirements" and are listed on Sheets 1 and 2 attached hereto.

1.3 Section 3 of this specification covers the operating and mechanical requirements which must be met in readjusting an electric clock which fails to meet the test requirements. These are called "Readjust Requirements" and are listed on Sheets 1 and 2 attached hereto. In addition to the readjust requirements, Section 3 also gives the approved maintenance methods of meeting these requirements.

1.4 The dimensional requirements set up in this specification should be met unless otherwise specified regardless of the method of test or adjustment employed. Facilities for meeting these requirements are provided in the form of standard tools and gauges. However, if it is found by experience that certain requirements can be met satisfactorily by "feel" or by "eye", these methods may be employed. It is suggested that checking with tools and gauges be made often enough to insure that proper test and adjustment requirements are being met. Furthermore, where requirements are close, it would be advisable to use tools and gauges to obtain adjustments.

1.5 The following is a list of the tools, gauges, test apparatus and materials specified in Section 2 and Section 3 for use in testing and readjusting the electric clock

Tools

Code No.	Description
74	Wrench - 5/32" and 7/32" Double-end Flat
R-1005	Jeweler's Screw-driver, 7/8"
R-2217	Tweezers
-	Small Camel's Hair Brush
-	Bell System Cabinet Screw-driver - 3-1/2"
-	Bell System Long Nose Pliers - 6-1/2"

Gauges

74-C	Thickness Gauge Nest

Materials

Spare Main Shaft

Materials

Code No.	Description
-	Eagle No. 3 Spindle Oil
-	Carbon Tetrachloride
-	Piece of #20 B & S Gauge Bare Wire
-	Oil Dropper (piece of #22 B & S Gauge, Bare Tinned Copper Wire)
	Cloth per KS-2423

Test Apparatus

35-C Test Set

SECTION 2 - TEST REQUIREMENTS

2.01 Unless otherwise specified, any electric clock of the type covered by this specification shall meet the test requirements given on Sheets 1 and 2 attached hereto.

SECTION 3 - READJUST REQUIREMENTS

3.0 General

3.01 An electric clock should be readjusted in accordance with the following methods to meet the readjust requirements specified on Sheets 1 and 2 attached hereto.

3.02 Where two or more requirements are covered by one set of methods the requirement headings in this section will be connected together with a bracket. The readjustments for meeting these requirements are more or less interdependent and in making readjustments to meet any one requirement consideration should be given to the others.

3.1 Mounting (See Requirement 2.1 on Sheet 1)

M-1 If the electric clock is not held tightly against the bracket, tighten the wood mounting screws with the 3-1/2" cabinet screw-driver, taking care not to turn them so much that they will pull out of the wood.

3.2 Armature Air-Gap (See Requirement 2.2 on Sheet 1)

3.3 Tightness of Lock Nut (See Requirement 2.3 on Sheet 1)

M-1 To adjust the armature air-gap remove the clock. Remove the retractile spring from the retractile spring lug and then remove the other end of the spring from the armature adjusting screw with the R-2217 tweezers. Loosen the lock-nut with the No. 74 7/32" hexagon wrench, and move the adjusting screw with the long-nose pliers until the required gap is obtained as checked with the .010" blade of the No. 74-C gauge.

M-2 Tighten the lock-nut and again check the gap. Replace the spring, looking the end in the armature adjusting screw first. Also check the requirements for "Back Lash" (2.4), "Pawl Clearance" (2.8), and the "Electrical Requirements" (2.11).

M-3 Remount the clock in accordance with paragraph 3.1. Make an inspection of the wiring and correct any wiring defect which may have developed.

3.4 Back Lash (See Requirement 2.4 on Sheet 1)

3.5 Freedom of Operation of Pawl (See Requirement 2.5 on Sheet 1)

3.6 Position of Stop Pawl (See Requirement 2.6 on Sheet 2)

3.7 End Play (See Requirement 2.7 on Sheet 2)

M-1 If the electric clock fails to meet requirements 2.4 to 2.7 inclusive, it shall be replaced with one that meets all requirements.

3.8 Pawl Clearance (See Requirement 2.8 on Sheet 2)

M-1 If the pawl binds on the overthrow stop, the fault should be corrected by backing out the pawl screw with the 3-1/2" cabinet screw-driver until the pawl does not bind. In adjusting the pawl screw, note that the pawl is still capable of advancing the tenths wheel to the next position when the electric clock is operated.

M-2 Check the clearance between the pawl and the overthrow stop to determine whether it is enough to cause the electric clock to over-count. To do this hold the armature operated and attempt to turn the tenths number wheel. If the clearance is too great the wheel will turn. It may be possible to correct this by decreasing the armature air-gap if it is not near the minimum of .010". See paragraph 3.2.

M-3 If the pawl clearance requirement cannot be met by the above adjustments proceed as follows: To provide a clearance between the overthrow stop and the pawl, pry the stop upward using the 3-1/2" cabinet screw-driver. To decrease the clearance between the overthrow stop and the pawl force the stop downward applying the pressure at the free end of the stop.

3.9 Position of Retractile Spring Lug (See Requirement 2.9 on Sheet 2)

M-1 If the retractile spring touches the cover or the number wheels and it appears to be due to a defective spring, replace the spring, using the R-2217 tweezers to hook the spring on the armature adjusting screw.

M-2 If the spring seems satisfactory, adjust the retractile spring lug slightly as required. To move the lug out insert the 3-1/2" cabinet screw-driver between the lug and the top frame cross-piece and pry up. If the lug is out too far, press it back with the finger.

M-3 After the above operation check the electrical requirements, 2.11.

3.10 Location of Tip of Retractile Spring Lug (See Requirement 2.10 on Sheet 2)

3.11 Electrical Requirements (See Requirement 2.11 on Sheet 2)

M-1 To meet these requirements, adjust the spring lug with the 6" long nose pliers so as to increase or decrease the armature spring tension. Care should be exercised in adjusting the lug not to break it.

M-2 Should the armature spring be so weak that to meet the non-operate requirement it is necessary to bend the lug to such an extent that its tip extends beyond the outer face of the top frame cross-piece, it will be necessary to replace the retractile spring.

M-3 Remove the old spring and insert the new one in the manner covered in 3.3, M-1 and M-2.

3.12 Cleaning (See Requirement 2.12 on Sheet 2)

3.13 Lubrication (See Requirement 2.13 on Sheet 2)

M-1 To clean the clock remove the cover and with a small camel's hair brush dipped in carbon tetrachloride thoroughly clean all of the bearings and contact surfaces. Take the necessary precautions to prevent the carbon tetrachloride from splattering on adjacent equipment.

M-2 After this general cleaning, loosen the main shaft set screw next to the ratchet wheel with the R-1005 screw-driver and push out the main shaft by means of a small rod. Lubricate the surface of the rod with a drop of Eagle No. 3 Spindle Oil before using it to push out the main shaft. The rod will hold the clock parts in place until the shaft is put back. Use a spare main shaft as a rod.

M-3 Clean the shaft thoroughly with carbon tetrachloride, lubricate it with a drop of Eagle No. 3 Spindle Oil and push the shaft back in place of the rod. Tighten the set screw, taking care that both ends of the shaft are inside the outer surfaces of the clock frame, so that the cover, when replaced, will not bear against the ends of the shaft.

M-4 In cases where these methods are not sufficient to clean the clock satisfactorily, it will be necessary to remove the wheels and shafts and thoroughly clean the wearing surfaces with carbon tetrachloride.

M-5 In performing this operation the clock should be placed on a table or bench so that the pinions, collars and washers will not be lost when they drop out.

M-6 To take the clock apart, loosen the set screws which hold in place the main shaft and the collars on the two pinion shafts, using the R-1005 screw-driver for this purpose. Now push out the shafts with a piece of No. 20 straight bare wire. This operation will free all the number wheels, washers, collars and pinions.

M-7 Clean the number wheels with a piece of KS-2423 cloth and clean the collars, shafts, washers and pinions by washing them in a small container of carbon tetrachloride.

M-8 With a small camel's hair brush dipped in carbon tetrachloride thoroughly clean all the wearing surfaces, armature and operating pawl bearings, operating pawl and the ratchet wheel. Take care not to let the carbon tetrachloride get on the painted surfaces of the number wheels.

M-9 Lubricate the main shaft with a drop of Eagle No. 3 Spindle Oil spreading the oil over the entire surface of the shaft and insert it through the bearing next to the ratchet wheel. Slide the tenths and minute wheels on the shaft lifting the operating pawl to permit the tenths wheel to fit up against the hub of the bearing. Insert a rod (a spare main shaft) thru the opposite bearing and place the washers on it so that they will fit up against the hub of the bearing. Then slide the hour wheel on the rod up close to the washers. See that neither the main shaft nor the rod protrude beyond the minute wheel and hour wheel respectively. Now hold the remaining wheel in place with the tweezers and push the main shaft thru the hub in the wheel taking care not to allow the washers to drop out of place, push the rod out by pushing the main shaft thru to the bearing next to the hour wheel. With the main shaft in place, tighten the set screw next to the ratchet wheel. Test the wheels and see that they turn freely on the shaft.

M-10 Hold the stop pawl in place and slide a pinion shaft thru the adjacent bearing and thru the collar of the stop pawl. Turn the minute and tenths wheels so that the center of any two numbers on the wheels are in horizontal alignment. Hold the larger nickel silver pinion so as to properly engage the cogs on these two wheels and slide the pinion shaft thru to the opposite bearing. See that the shaft does not protrude beyond the outside surfaces of the frame of the clock and then tighten the set screw in the collar of the stop pawl. With the aid of the tweezers hook one end of the stop pawl spring on the set screw in the collar and the other end on the lug on the inside surface of the frame of the clock.

M-11 Take a piece of straight bare No. 20 wire and at a point about 1/4" from the end, bend it to an angle of approximately 60°. Slide the pinion shaft collar on the bent portion of the wire and hold it in place adjacent its pinion shaft bearing beneath the ratchet wheel. Slide the pinion shaft thru the adjacent bearing and thru the collar. Turn the tens minute wheel so that any two numbers on the two minute wheels are in approximate horizontal alignment when viewed from the top of the clock. With the tweezers hold one of the pinions so as to properly engage the cogs on the two minute wheels and slide the shaft thru the pinion. Turn the hour wheel so that any two numbers on the hour and tens minute wheels are in horizontal alignment. With the tweezers hold the remaining pinion

so as to properly engage the cogs of the hour and adjacent tens minute wheels and slide the shaft thru the pinion and thru the bearing. See that the shaft does not protrude beyond the outside surfaces of the frame of the clock and then tighten the set screw in the collar.

M-12 Place the clock cover on and note whether or not the numbers appearing thru the window are in alignment with respect to the window. If the tenths wheel does not align properly, remove the cover and operate the armature manually a few times. Replace the cover and again check for alignment. If it does not line up properly now it is due to incorrect adjustment of the clock which will be corrected later when the clock is readjusted. If any of the remaining wheels are out of alignment it is because the pinion on the right of the wheel at fault is not in proper engagement with the cogs on the wheels. Correct this by loosening the set screw holding the particular pinion shaft in place and slide out the shaft until the pinion disengages the misaligned wheel. Then turn the wheel (either backwards or forwards) so that the pinion will engage the next cog and secure the shaft as covered in M-9, M-10 and M-11 above.

M-13 Lubricate the bearings, pinions and pinion shafts with a drop of Eagle No. 3 Spindle Oil. When lubricating any part of the clock the oil should be applied by means of a No. 22 straight bare copper wire dipped not deeper than 1/2" in the oil.

M-14 Recheck requirements 2.1 to 2.11 inclusive and make readjustments as required.

3.14 Record of Lubrication (See Requirement 2.14 on Sheet 2) (Test Requirement Only).

Attached:

X-70035-01, Sheet 1, Issue 1
X-70035-01, Sheet 2, Issue 1

BELL TELEPHONE LABORATORIES, INC.

EGA)
HWF) CZ

DEPT. 332-B-4

DEFINITIONS AND GENERAL INFORMATION

2.001 Operate means that when the specified test operating electrical requirement is applied, the armature shall move towards the core until the armature adjusting screw touches the front stop. The pawl shall also advance the tenths wheel to the next position.

2.002 Non-Operate means that when the specified non-operate test electrical requirement is applied, the armature shall not move away from the distance rod.

2.003 Unless otherwise specified, the requirements given on sheets 1 and 2 are both test and readjust requirements.

2.004 Unless otherwise specified, where a readjust requirement specifies only one limit (either a maximum or a minimum limit) it is advisable in readjusting to provide, if possible, some margin inside the limit for deterioration.

2.005 Requirements are given in the order in which adjustments should be made by the Telephone Company.

2.006 Gauges and methods are listed for the use of the Telephone Company.

*2.007 Requirements 2.4, 2.5, 2.6 and 2.8 shall be noted when the electric clock is electrically operated and shall be met on each tooth on the ratchet wheel.

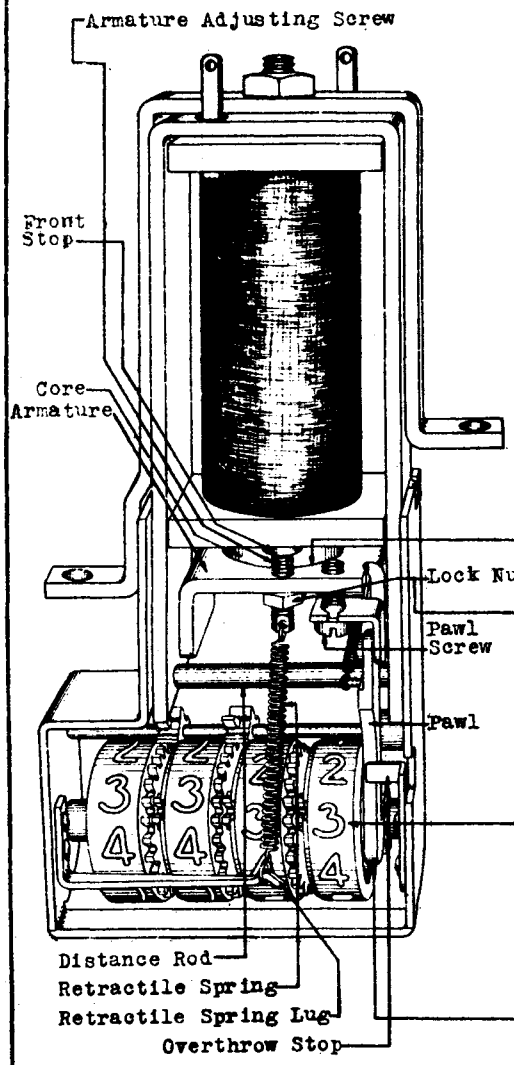

Fig. 1

REQUIREMENTS

2.1 Mounting The electric clock shall be held tightly against the bracket by the clock mounting screws.

2.2 Armature Air-gap (Readjust Only) With the armature in its operated position, there shall be a clearance of at least .010" between the end of the core and the under side of the armature. Use the No. 74-C gauge.

2.3 Tightness of Lock Nut The armature adjusting screw lock nut shall be sufficiently tight to hold the screw in any adjusted position.

*2.4 Back Lash The tenths wheel shall have a noticeable forward and backward movement or "back lash". The back lash shall not be sufficient to allow the top of any figure to lie above the top edge of the cap window or the bottom of any figure to lie below the bottom edge of the cap window when viewed from a position which the operator would normally occupy.

*2.5 Freedom of Operation of Pawl The operating pawl shall not bind on its bearing or against the side of the tenths wheel. If the pawl touches the tenths wheel, due to side play in the pawl, but can be made to stand away from the wheel it shall not be considered as binding against the wheel.

TEST AND READJUST REQUIREMENTS
FOR
NO. 1 TYPE ELECTRIC CLOCKS

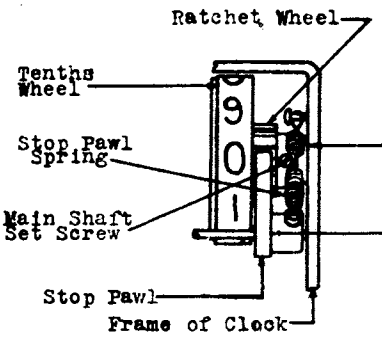

Fig. 2

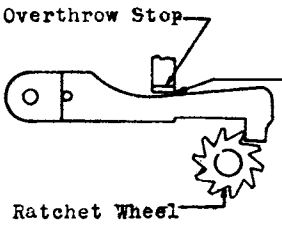

Fig. 3

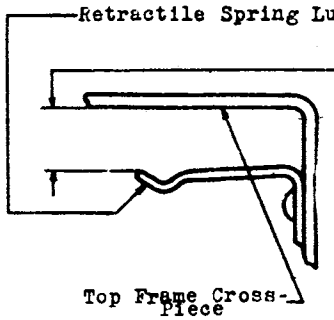

Fig. 4

*2.6 Position of Stop Pawl The stop pawl shall drop into its normal position behind each tooth of the ratchet wheel.

2.7 End Play There shall be a perceptible amount of end play between the tenths wheel hub and the frame. Gauge by eye.

*2.8 Pawl Clearance There shall be a slight clearance between the operating pawl and the overthrow stop. This shall be considered as having been satisfactorily met if, with the clock electrically operated, the operating pawl may be moved slightly from side to side without binding on the overthrow stop. The clearance shall not be sufficient to permit over-count.

2.9 Position of Retractile Spring The retractile spring shall not touch the cap or the number wheels.

2.10 Location of Tip of Retractile Spring Lug When turned over to the Telephone Company there shall be a clearance of not less than 1/8" and not more than 3/8" between the tip of the retractile spring lug and the lower face of the top frame crosspiece. The lug shall be approximately straight except for the bend made at the tip for holding the spring. Gauge by eye.

Note: It will be satisfactory for the Telephone Company in readjusting to bend the retractile spring lug to the outer face of the top frame cross piece.

2.11 Electrical Requirements The electric clock when mounted in a vertical plane with the terminals pointing downward shall operate and non-operate on the following current values:

	No. 1-A	No. 1-B
Test Operate	.036 Amp.	.025 Amp.
Test Non-Operate	.019 "	.013 "
Readj. Operate	.028 "	.0195 "
Readj. Non-Operate	.020 "	.0138 "

Use the No. 35-C Test Set.

2.12 Cleaning (Readjust Only) The bearings and contact surfaces shall be thoroughly cleaned once a year with carbon tetrachloride.

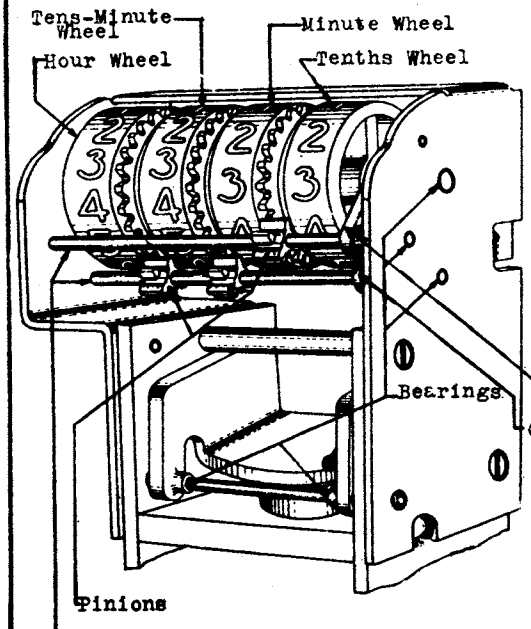

Fig. 5

2.13 Lubrication The bearings, pinions and pinion shafts of the electric clock shall, at all times, be adequately lubricated with Eagle No. 3 Spindle Oil. The interval between one application of lubricant and the next shall not exceed one year and the amount of the oil applied shall be approximately equivalent to that obtained by dipping a No. 22 B & S gauge bare copper wire into the oil, not deeper than 1/2". No clock shall be turned over to the Telephone Company which has been in use more than six months since it was last lubricated.

2.14 Record of Lubrication (Test Only) During the period of installation a record shall be kept by date of the lubrication of the electric clock and this record shall be turned over to the Telephone Company with the equipment.

TEST AND READJUST REQUIREMENTS
FOR
NO. 1 TYPE ELECTRIC CLOCKS