

## GENERAL

- 1 Where battery boxes are used, they must be installed with the bottom of the box at least 16 in. below the top of the ground where practicable, or banked with loam to this equivalent where depth below the surface cannot be obtained. Proper surface drainage must be provided.
- 2 Frost boards must be provided. Where solution temperature below 25 deg. F. is encountered, frost board and sides of box must be lined with celotex or equivalent not less than ½ in. thick.
- 3 Boxes must be kept clean, dry and locked.
- 4 Batteries must be protected against rain, snow and extreme temperatures.
- 5 Cell complete consists of:  
1 Jar. 1 Hexagonal nut. 2 Washers.  
1 Cover. 2 Wing nuts. 1 Renewal complete.
- 6 Renewal complete consists of:  
1 Assembled set of positive and negative electrodes (1 element).  
1 Can caustic soda. 1 Bottle battery oil.
- 7 Ordering Reference:  
For cell complete, jar, cover or renewal show references as follows;  
For example: S-502 Cell complete.  
S-502 Jar only.  
S-502 Cover only.  
S-500 Renewal complete.  
  
Renewals can be used in round, barrel or rectangular shape jars of same capacity cell.
- 8 Renewals must be kept dry, and to avoid absorption of moisture, elements must not be removed from container until ready for use.
- 9 Renewals on hand for the longest period shall be used first.
- 10 All cells of a battery must be renewed at the same time, except when necessary to make replacement of defective cells.
- 11 When installing renewals, care must be taken not to interfere with train operation, highway crossing protection, etc.
- 12 Material unfit for use must be reported to the proper authority and held for instructions.
- 13 Materials must be checked to see that jars, covers, nuts, washers, elements, caustic soda and oil are of proper size and quantity. Broken or cracked elements must not be used.

- 14 Caustic soda that has been exposed to air or moisture must not be used.
- 15 Jars and covers must be thoroughly cleaned. Cracked jars or covers must not be used.
- 16 Clean water for mixing solution must be used. Water containing salts, sulphur, sewage or other impurities must not be used.
- 17 Care must be exercised in mixing and handling the solution as it will burn the skin and clothing if allowed to come in contact. If splashed on the skin or clothing, wash off immediately.
- 18 Cells must be set level and be arranged to permit inspection of each cell or element.
- 19 Cells must be connected as required by plans and instructions and must not be changed without proper authority.
- 20 Manufacturer's instructions must be followed where they do not conflict with these instructions.

## SETTING UP AND RENEWING

- 21 Fill the jar with water to within 2¾ in. from top.
- 22 Add the entire contents of the can of caustic soda to the water, stirring the solution in a circular and pendulum-like movement of a clean, narrow stick of wood which should be long enough to reach the bottom of the jar. Make sure that the soda is mixed with the water until thoroughly dissolved. This is necessary to obtain proper voltage and life of battery.
- 23 Attach element to cover by passing the lead wire and suspension bolt through their respective holes in the cover. The lead wire must not be drawn tight against the edges of the hole as this will damage the insulation. Fasten the element to the cover by means of the hexagonal nut. The 2 washers and 2 wing nuts must be placed above the hexagonal nut. All connections must be tight.
- 24 When the element is ready to be placed in the solution, all packing material must be removed, being careful not to spread the plates. The plates must be approximately parallel and uniformly spaced and must hang vertically from the cover. Dry plates must not come in contact with oil or grease.
- 25 Place the element in the solution and where practicable this should be done after jar is in its permanent position.
- 26 Add water when necessary so that the solution level is not less than ½ in. below top of the jar. Move element to one


side of jar and re-stir thoroughly. With cover slightly tilted pour entire contents of the bottle of oil on the surface of the solution.

## INSPECTION AND TESTS

- 27 Records must be kept showing dates batteries are installed and renewed.
- 28 Batteries must be examined and tested as often as necessary to prevent failures, and voltage readings must be taken under full load to check their condition.
- 29 Jars and covers must be kept clean and connections tight and free from corrosion.
- 30 Solution level must be maintained well above top of element, but oil must not touch under side of cover.
- 31 Any unusual condition appearing in the element or solution must be promptly reported to the proper authority.
- 32 When either element or solution is defective, complete cell must be removed and saved intact on open circuit for investigation and proper authority immediately notified.

## TREATMENT

- 33 Series connected batteries, used for stand-by service, and straight primary batteries, used for crossing bells or highway flashing light signals must be treated 15 minutes when first set up or renewed.
- 34 Series connected batteries, used for stand-by service, except those with continuous discharge of 0.100 ampere or more, must be treated for 5 minutes each 2 weeks or 10 minutes each month.
- 35 Batteries, used as stand-by for track circuits with power transfer relays, must be treated as specified in para. 33 and 34. Other batteries for track circuits do not require treatment.

	<b>SIGNAL AND TRAIN CONTROL COMMITTEE</b>	N.Y.C.R.R.	<b>26C</b>
		M.C.R.R.	
<b>EDISON PRIMARY BATTERY COPPER OXIDE TYPE INSTRUCTIONS</b>		G.C.C. & S.T.L.R.Y.	7-22-1939
		B. & A.R.R.	2-5-1945
Approved by Representatives of Lines shown.		P. & L.E.R.R.	7-24-1950
		<i>J. Macerone</i> Chairman	

- 36 Straight primary batteries for service such as highway crossing bells, with maximum intermittent load less than 1.0 ampere, may be provided with permanent shunt or an equivalent load to cause a continuous discharge of not less than 0.020 ampere. Where such permanent discharge is not provided these batteries must be treated for 5 minutes each 2 weeks or 10 minutes each month.
- 37 Each series set of multiple series batteries requiring treatment, must be treated separately.
- 38 Treatment of batteries for highway crossing signals must be done when trains are not approaching the crossing.
- 39 Treatment of batteries shall be done by temporarily connecting a resistor across the battery. The value of the resistor shall be determined by the number of cells in the battery as follows:

Number of cells	Resistor value in ohms
1	0.02
2 to 3 in series	0.04
4 to 6 in series	0.08
7 to 9 " "	0.15
10 to 14 " "	0.25
15 to 22 " "	0.50

**EXHAUSTED ELEMENTS**

- 40 Empty cans, bottles and exhausted solution must be disposed of where they will not injure persons, animals or property.
- 41 Exhausted elements must be dipped in clear water and then placed on racks away from inflammable material and allowed to thoroughly dry and cool, after which they must be placed in paper bags, packed in renewal cases or equivalent and forwarded to the storehouse or other designated place, each case being marked to show the number and type of exhausted elements.
- 42 Exhausted element must be kept dry as chemical activity of wet elements may cause fire.

**SELECTION OF TYPE, NUMBER AND SIZE OF CELLS**


- 43 Each battery will consist of a given number of cells of the same type connected in series, multiple, or multiple series.
- 44 The number of cells in series is determined by the minimum bus voltage required and the recommended minimum voltage per cell as follows:
- |                        |           |
|------------------------|-----------|
| For track circuits     | 0.6 volt. |
| For all other circuits | 0.5 volt. |

- 45 Determine the minimum solution temperature which may prevail in the housing to be used on the following general basis:

Battery box	25 deg. F.
Battery well	40 deg. F.
Heated building	60 deg. F.

Where lower minimum solution temperatures prevail, the selection of cells must be made accordingly.

- 46 Determine the maximum discharge rate required.
- 47 After the minimum solution temperature has been determined, select the rate which meets the discharge requirement from the proper column in Table 1, or Table 2, and from this select the type of cell which will give the ampere hour capacity required based upon the time desired between renewal periods, giving consideration as to whether a single battery or batteries in multiple are to be used.
- 48 Table—1, shows recommended rates of discharge at various solution temperatures for:  
Intermittent high rates such as—  
Approach lighting of color light signals.  
Highway crossing signals.  
Continuous low rates such as—  
Time relays.  
Tower indicators.
- 49 Table—2, shows recommended rates of discharge at various solution temperatures for:  
Continuous high rates such as—  
Continuous lighting of signals.  
Switch lamp lighting, etc.  
Low voltage batteries in interlocking stations.
- 50 Table—3, shows the type and size of cell generally used for various services.

<b>SIGNAL AND TRAIN CONTROL COMMITTEE</b>	<b>26C</b>
	<b>EDISON PRIMARY BATTERY</b>
	7-22-1939 2-5-1945 7-24-1950

TABLE—1

TYPE OF CELL	A.-H. CAP'Y.	NO. OF PLATES	SOLUTION TEMPERATURES—Degrees F.								
			0	10	20	25	30	40	50	60	70-90
			Recommended rates of discharge								
S-502	500	3				1.0	1.1	1.4	1.75	2.0	2.2
M-502	500	5				1.3	1.4	1.7	2.0	2.2	2.6
HA-502	500	9				3.6	4.0	5.0	6.0	6.7	7.5
HA-902	500	9	2.6	3.9	4.9	6.4	7.0	8.1	10.5	12.2	13.5
M-1002	1000	5				2.5	2.7	3.1	3.7	4.0	4.5
HA-1002	1000	11				4.5	5.4	7.0	8.7	9.5	10.4
HA-1302	1000	13	2.0	4.4	5.8	8.0	9.2	12.0	14.5	19.2	22.0


TABLE—2

TYPE OF CELL	A.-H. CAP'Y.	NO. OF PLATES	SOLUTION TEMPERATURES—Degrees F.								
			0	10	20	25	30	40	50	60	70-90
			Recommended rates of discharge								
S-502	500	3				0.6	0.7	0.8	1.1	1.3	1.75
M-502	500	5				0.8	0.9	1.2	1.5	1.9	2.25
HA-502	500	9				2.0	2.4	3.4	4.5	5.5	6.5
HA-902	500	9	2.0	3.0	4.2	5.0	5.6	7.0	8.5	10.0	12.0
M-1002	1000	5				1.0	1.2	1.8	2.2	2.8	3.5
HA-1002	1000	11				2.5	3.2	5.2	7.0	7.8	9.0
HA-1302	1000	13	1.5	3.5	5.5	6.5	7.6	9.8	12.0	16.0	20.0

TABLE—3

TRACK CIRCUITS AND SEMAPHORE SIGNALS		LOW VOLT-AGESWITCH MACHINES		APPROACH LIGHTING OF COLOR LIGHT SIGNALS—HIGHWAY CROSSING PROTECTION — FLASHING LIGHT SIGNALS — ELECTRIC GATES — ETC.	
Type of cell	A.-H. Cap'y.	Type of cell	A.-H. Cap'y.	Type of cell	A.-H. Capacity
S-502	500				
M-502	500				
*HA-502	500	HA-502	500	HA- 502	500
		HA-902	500	HA- 902	500
M-1002	1000	M-1002	1000	M- 1002	1000
		HA-1002	1000	HA-1002	1000
		HA-1302	1000	HA-1302	1000

NOTE: \*Not generally used in straight primary service.

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**GENERAL PRECAUTIONS**

- 1 Lead battery electrolyte must not be used.
- 2 Tools, hydrometers, or utensils which have been used on lead batteries must not be used.
- 3 Cells must not be exposed to the gases of lead batteries or placed where they will come in contact with lead batteries or acid-soaked charging racks or trays.
- 4 Cells must not be placed directly on a damp floor or a damp shelf. If a dry surface is not available, they must be placed on suitable insulators to avoid grounds and possible damage to the cell containers.
- 5 An exposed flame must not be allowed near the battery, as the gases being given off may explode. Care must be exercised in use of tools near the battery terminals to prevent striking an arc. To prevent drawing an arc connecting or disconnecting cells, the load and charging circuits must be disconnected at a point away from the battery.
- 6 When battery is being charged, enough ventilation or space must be provided to avoid pocketing of the gases.
- 7 Filler caps must be kept closed except when necessary to have them open for watering, taking temperatures, gravity, etc. Where cells are provided with screw type valve assemblies, the knurled rings must be removed when cells are placed in service. Whenever cells are to be moved, knurled rings are to be replaced.
- 8 If solution is accidentally spilled on the skin or clothing, it should be immediately washed away with plenty of water.
- 9 The elements must be covered by electrolyte at all times.

**PURCHASE AND RECEIPT OF CELLS**

- 10 New cells purchased shall be equipped with screw type valve.
- 11 Cells must be shipped in a fully charged condition.
- 12 After unpacking the cells, carefully remove all packing material or other foreign substance from cells and trays with particular reference to space between and underneath the cells. Cells must not be lifted by their terminals.
- 13 Test the height of solution in every cell to see if any has been spilled in shipment. If the solution is below the recommended level as shown in Paragraph 14 but above the plate tops, add distilled or approved water to raise level to proper height. If solution level is below plate tops, add Edison Refill Solution (1.215 specific gravity at 60° F.) undiluted, or if this is not readily available, use Edison Standard Renewal Solution (1.250 specific gravity at 60° F.) to which 1/8 of distilled or approved water has been added to the total volume. Where neither Refill or Renewal Solution is available and levels are below plate tops, the battery must not be placed in service until proper solution is available.

14 The correct and minimum solution levels for cells is as follows:

	CORRECT SOLUTION HEIGHT ABOVE PLATE TOPS	MINIMUM SOLUTION HEIGHT ABOVE PLATE TOPS
"AH" (High Type Cells)	3"	1 1/2"
"BH" (High Type Cells)	2 1/4"	1"
"A-B-N" (Low Type Cells)	1/2"	Must cover plates

15 Cells which are to be stored for an indefinite period should be trickle charged continuously at a rate equivalent to 2 mils per 8-hour ampere-hour capacity rating of cell or stored in a fully discharged condition per Paragraph 30.

**INSTALLATION AND CHARGING**

- 16 Except for new cells received from manufacturer, the surface of all terminals must be cleaned with a cloth moistened with mineral solvent (Stoddard or equal) and, where necessary, polished with very fine emery or crocus cloth. Cells must be connected together with inter-cell connectors and inter-tray jumpers furnished for this purpose.
- 17 Cells must be permanently installed in the trays supplied and held in place to prevent movement.
- 18 After connecting cells in a series-connected battery, test each cell with a voltmeter to assure that the positive terminal of each cell is connected to the negative terminal of the adjoining cell.
- 19 Arrange connections so that positive terminal of the rectifier or charging source is connected to the positive terminal of the battery. Direct current only must be used for charging.
- 20 After installation, be sure all cells are fully charged before attempting to set the rectifier at the normal charging rate required at the location. If there is any doubt as to the battery being fully charged, first bring the solution to the proper level, and then set the rectifier at its maximum safe output until the cells receive a charge equal to 25% more in ampere hours than their 8 hour rating shown in Paragraph 31. During this high floating rate charge the solution must not be allowed to fall below the minimum solution level as listed in Paragraph 14.
- 21 After cells are fully charged, promptly reduce the high charging current to a value calculated to be slightly higher than the normal float charge rate. The charging rate should then be gradually reduced from week to week until consecutive voltage readings of individual cells at normal solution temperatures of from 60 to 70 degrees Fahrenheit consistently remain between 1.5 and 1.6 volts per cell. After establishing the proper rate in this manner, it should not be changed as voltages rise and fall due to temperature alone. The voltages shown in the following table are typical of fully charged cells when being charged at a minimum rate to offset losses of the cells. (See Paragraph 22.)

Solution Temp.


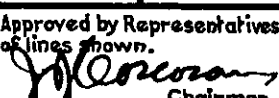
Degrees F.	80	70	60	50	40	30	20	10	0
Voltage per Cell	1.48	1.50	1.52	1.55	1.58	1.60	1.61	1.62	1.63

Where the charging current is higher than the minimum rate to offset losses of the battery (Paragraph 22) the cell voltages should remain higher than shown in the above table.

- 22 When making the final adjustment of the charging rate, make sure that the charging current to the battery is not less than two milliamperes for each ampere hour of rated capacity based upon the 8-hour capacity rating shown in Paragraph 31.
- 23(a) If there is a noticeable reduction in cell voltage during normal operation not due to change in solution temperature, the charging current should be increased sufficiently so that consecutive voltage readings consistently remain the same in accordance with voltage information contained in Paragraph 21.
- 23(b) In the event a battery becomes discharged to any appreciable extent, increase the charging current to the maximum safe value of the rectifier after first raising the solution level of each cell to proper height, and proceed as per Paragraph 21.
- 24 At time of installation the specific gravity reading of each cell should be recorded on Storage Battery Record Card, Form SC-27.

**MAINTENANCE**

- 25 General
  - (a) The voltage of each individual cell must be taken at least once each month or as otherwise directed, or as required by special conditions, and all voltage readings recorded on Storage Battery Record Card, Form SC-27.
  - (b) It is essential that voltmeter be kept in calibration.
  - (c) Terminal nuts must be checked at intervals after installation to insure tight connections.
  - (d) Battery, its connections and surrounding parts must be kept clean and dry. Vent and valves in filling aperture must be clean and free from obstruction to allow generated gas to escape.

	<b>SIGNAL AND TRAIN CONTROL COMMITTEE</b>	N.Y.C.R.R. M.C.R.R. C.C.C. & S.T. RY. B.&A.R.R. P.&L.E.R.R.	<b>30C</b> 7-22-1939 9-30-1943 10-14-1952
	<b>NICKEL-IRON STORAGE BATTERY INSTRUCTIONS</b>		Approved by Representatives of lines shown.  Chairman.

(e) A very light film of primary battery oil or Esbaline must be applied to the inner side of the valve housing and valve stem assembly to prevent creeping electrolyte and to insure proper operation of the valve. Care must be exercised to avoid spilling oil or Esbaline into the cell.

(f) When terminal connections show evidence of corrosion, they must be polished with fine emery or crocus cloth.

(g) Cells, other than those of monel metal which are marked MO on cell tops, must be periodically inspected to insure that cell containers are not rusting. If evidence of rust appears, containers should be repainted as per instructions in Paragraph 29.

(h) Tops of cells must be kept clean and coated with a very light film of primary battery oil or Esbaline applied with a brush or cloth.

#### 26 Watering

(a) Distilled or approved water should be added to cells when electrolyte level falls to the minimum permissible height above plate tops to raise the level of the electrolyte to the correct solution level shown in Paragraph 14.

(b) After adding distilled or approved water to cells in cold weather, thoroughly mix the water with the electrolyte by agitating with a hydrometer or syringe.

(c) Water used in cells must not be stored or transported except in receptacles provided for this purpose. These receptacles must be kept clean and covered and not used for any other purpose.

(d) Electrolyte must not be added to cells except to replace loss due to spillage; then Edison REFILL electrolyte (1.215 gravity at 60° F.) should be used.

#### 27 Specific Gravity

(a) Specific gravity readings are not taken to determine state of charge but to determine the condition of the electrolyte.

(b) Specific gravity readings of electrolyte must be taken once each year with the electrolyte level at proper height above plate tops.

(c) To obtain the proper specific gravity of electrolyte, readings should be taken only after the cells have been fully charged. In floating charge service, where cells are normally kept in a fully charged condition, the specific gravity readings should not be taken for at least 24 hours after adding water to cells.

(d) If the specific gravity is less than the value shown in the following table for the existing solution temperature, then the solution should be renewed.

#### TEMPERATURE OF ELECTROLYTE

110° F.  
100° F.  
90° F.  
80° F.  
70° F.  
60° F.  
50° F.  
40° F.  
30° F.  
20° F.  
10° F.  
0° F.

#### MINIMUM RECOMMENDED GRAVITY

All Type Cells  
1.147  
1.150  
1.152  
1.155  
1.157  
1.160  
1.162  
1.165  
1.167  
1.170  
1.172  
1.175

#### 28 Solution Renewal

(a) Discharge cells to 0.5 volt per cell at normal 5-hour discharge rate.

(b) Short circuit cells for at least 2 hours in groups of not more than 5 series cells.

(c) Remove cells from trays.

(d) Pour out and discard exhausted electrolyte.

(e) The cells must then immediately be filled with Edison Standard RENEWAL Electrolyte (1.250 specific gravity at 60° F.) to the proper normal level.

(f) After electrolyte has been added, cells and trays should be painted in accordance with Paragraph 29, where necessary.

(g) To prepare cells for service, charge at the normal 5-hour discharge rate for 15 hours. (See Paragraph 31.)

#### 29 Painting

(a) Cells with monel metal containers, marked MO on cell tops, do not require painting.

(b) Remove the individual cells from the tray and apply solvent by brushing or dipping, allowing approximately one hour to soften the paint. When removing paint, particular care must be taken to prevent solvent or particles of paint from entering the cell. Naptha is to be used as a solvent for Esbalite and Stanisol for Glyptal.

(c) Inspect the trays for defects, making repairs where necessary.

(d) When paint on the cells is sufficiently softened, remove with a stiff brush after which the surface of the container should be wiped clean with mineral solvent.

A steel brush or metal scraper must not be used to remove paint.

(e) Cells must be examined for defects. Lid group assembly should be in proper alignment so as to assure free operation of the valve. The terminal post gland caps should be screwed down tight, particularly where there is evidence of leakage around the stuffing box assembly.

(f) After inspection, the sides and bottoms of the cells should be brush-painted or dipped in Esbalite or Green Glyptal paint, taking particular care to insure that the bottoms of the cells are thoroughly coated. A thin coating of primary battery oil or Esbaline should then be applied with a brush or both to the tops of the cells.

(g) After the cells are dry, clean the poles with fine emery or crocus cloth and assemble in trays. Replace the intercell connectors and tighten nuts securely with special wrench provided for the purpose.

#### 30 Storage

(a) Either new or used Edison Cells may be stored for an indefinite length of time by discharging to 0.5 volt per cell at normal 5-hour discharge rate, short circuit cells for at least two hours in groups of not more than 5 series connected cells and raise solution level to proper height. Store in a cool, dry place.

(b) Cells which have been in storage may be prepared for service by cleaning cells and connectors, bringing solution level to proper height and charging for 15 hours at the 5-hour discharge rate.

#### CAPACITY AND DISCHARGE RATING

31 The following table gives the ratings for the various types and sizes of Edison Storage Cells ordinarily used in signal service:

TYPE CELL	5 HR. RATING		8 HR. RATING	
	AMP. HR. CAPACITY	AMP. DIS-CHARGE RATE	AMP. HR. CAPACITY	AMP. DIS-CHARGE RATE
N2	11.25	2.25	12	1.50
B1, B1H	18.75	3.75	20	2.50
B2, B2H	37.50	7.50	40	5.00
B4, B4H	75.00	15.00	80	10.00
B6, B6H	112.50	22.50	120	15.00
A4, A4H	150.00	30.00	160	20.00
A5, A5H	187.50	37.50	200	25.00
A6, A6H	225.00	45.00	240	30.00
A7, A7H	262.50	52.50	280	35.00
A8, A8H	300.00	60.00	320	40.00
A10, A10H	375.00	75.00	400	50.00
A12, A12H	450.00	90.00	480	60.00
A14, A14H	525.00	105.00	560	70.00
A16, A16H	600.00	120.00	640	80.00

**SIGNAL AND TRAIN CONTROL COMMITTEE**

**30C**

**NICKEL-IRON STORAGE BATTERY INSTRUCTIONS**

7-22-1939  
9-30-1943  
10-14-1952

## GENERAL

1. Each headquarters, where batteries are maintained, must be equipped with a hydrometer, a voltmeter and a thermometer with a temperature correction scale based on a normal of 77° F., designed for use with lead cells. Voltmeter must be checked frequently for calibration.
2. Tools, hydrometers, thermometers or utensils which have been used on other than lead acid cells must not be used.
3. Water for electrolyte must be stored or transported only in receptacles provided, which receptacles must be kept clean and covered and not used for other purposes.
4. An exposed flame must not be allowed near the battery, as the gases being given off may explode. Care must be exercised in the use of tools near the battery terminals to prevent striking an arc. To prevent drawing an arc when connecting or disconnecting cells, the load and charging circuits must be disconnected at a point away from the battery.
5. When battery is being charged, enough ventilation or space must be provided to avoid pocketing of the gases.
6. Battery, its connections and surrounding parts must be kept clean and dry. Vaseline or greases must not be removed from the sealing nuts. Vent plugs must be kept in place and tight.
7. If electrolyte is spilled or surrounding parts are damp with acid, a solution of baking soda in the proportions of 1 lb. of soda to 1 gal. of water must be applied, after which the parts must be rinsed with water and dried. The soda solution must not be allowed to get into the cells.
8. Soda solution or ammonia should be used promptly on clothing, cement, etc. to neutralize acid. If acid comes

in contact with the skin, it should be washed away promptly with plenty of water.

## RECEIPT OF SHIPMENT

9. Cells must be shipped to Storehouse or Installation Point in fully charged condition.
10. Cells must be unpacked carefully, keeping them in upright position. CELLS MUST NOT BE LIFTED BY POSTS OR COVERS.
11. After unpacking, electrolyte in cells must be examined to determine that it is level with upper mark on jar. If electrolyte is below this point add distilled or approved water unless there is evidence of spillage, in which case add electrolyte, the specific gravity of which must be the same as that of other cells of the same shipment. If electrolyte level is lower than 1/2" below the tops of the plates, the cells may be permanently damaged. Evidence of damage will be indicated by failure of cells to respond to the treatment outlined in Paragraph 21 or failure to meet requirements of test outlined in Paragraph 33. If water is added during freezing weather the cells must be given a charge to mix the water with the electrolyte to prevent freezing.
12. If a shipment of cells is not to be unpacked at once, remove the lid from the packing case and check for electrolyte level and proceed as in Paragraph 11.
13. Cells must not be allowed to stand idle for more than 30 days. They must be floated continuously at a rate which will maintain an approximate voltage of 2.15 or charged periodically. A freshening charge should be given just before sending cells out for installation. A freshening charge consists of a continuing charge at one half of the 8 hour discharge rate as long as the specific gravity of the lowest cell shows any increase

and then for six hours after the last increase is shown. If the charge rate is much lower than the 8 hour rate, the three hour period should be lengthened in proportion. The minimum rate for a freshening charge should be at least 1/8 of the 8 hour rate.

14. Before connecting cells, all surfaces which are to be bolted together must be scraped bright and then coated with pure vaseline or terminal grease supplied by the manufacturer. Vaseline or terminal grease must also be applied to the studs of the bolt connectors. Cells must be connected with standard intercell connectors and care must be used to avoid having any strain on either connectors or terminals as a strain may eventually cause breakage. If standard intercell connectors are not available, rubber covered wire may be used. Wire larger than No. 12 A.W.G. must be stranded or flexible. To hold strands together when stranded or flexible wire is used, the eye must be soldered. After connections are made, surplus vaseline or terminal grease must be wiped off.
15. A permanent number, preferably stenciled on rack, must be assigned to each cell starting from the positive end of the battery.
16. Cells must be arranged so that the positive terminal of one cell adjoins the negative of the next. Cells must be so placed that edge of plates will be to the front.

**NEW YORK CENTRAL SYSTEM  
SIGNAL DEPARTMENT  
LEAD TYPE STORAGE BATTERY  
FLOATING CHARGE  
INSTRUCTIONS**

**S-35**

**RECEIPT OF SHIPMENT - Continued**

17. Cells must be separated from each other and from contact with sides of battery shelter. Cells must be held in place to prevent movement which may cause breakage of intercell connectors or battery terminals.
18. After all intercell connections are completed the voltage of each cell must be taken to determine that the positive terminal of each cell is connected to negative terminal of adjoining cell.
19. Connections must be arranged so that the positive terminal of the rectifier or charging source will connect with the positive terminal of the battery. Direct current only must be used for charging.
20. The specific gravity of the electrolyte of each cell must be tested to determine that it is within the limits of 1.190 to 1.220 at 77°F. If the specific gravity (corrected for temperature) of any cell is found to be below 1.190 at 77°F., the cell must not be placed in service until given a complete charge. Specific gravity readings are corrected for temperature by adding or subtracting points as indicated on the temperature correction scale of the thermometer or by subtracting .001 for each 3°F. below 77°F. or adding .001 for each 3°F. above 77°F. For Exide Manchex cells, a complete charge is not required until the specific gravity is below 1.175 with the solution level at the upper line. On Manchex cells, a change in electrolyte level of 1/4" will result in a  $\pm$  .008 gravity correction.
21. After installation, cells must be charged at the maximum rated output of the rectifier and this charging rate continued until cells are fully charged. The voltage and specific gravity (corrected for temperature) of each cell must be recorded on Battery Record Card, Form SC-27, each week during original charge. Cells are fully charged

when three equal consecutive voltage readings are obtained in excess of 2.25 volts per cell together with three equal consecutive specific gravity readings of 1.210 or higher (corrected for temperature). At convenient intervals thereafter, the output of the rectifier must be reduced in small steps until the voltage directly at the cell terminals generally stays between 2.10 and 2.20 volts per cell or averages 2.15 volts. The voltage may vary above or below these limits according to traffic conditions, power interruptions or electrolyte temperature but, should not be continually above or below these limits except in cold weather when the voltage during the continuance of low temperature may be allowed to increase to the following values:

Electrolyte Temperature °F.	Volts per Cell
60	2.19
50	2.22
40	2.26
30	2.30
20	2.33
10	2.37
0	2.4

Cell voltage readings are taken with rectifier connected and charging at the normal float rate. The specific gravity (corrected for temperature) must be maintained at 1.210 or higher.

**MAINTENANCE**

22. After original charge, the voltage of each individual cell of a battery must be taken at least once a month. The specific gravity of each cell in a low voltage battery and of a pilot cell in a high voltage battery (55 cells or more) must be taken at least once a month. The specific gravity of each cell in a high voltage battery must be taken at least once each year. All readings are to be

recorded on Battery Record Card, Form SC-27, and specific gravity readings entered on the form must be corrected for temperature. The temperature of the electrolyte in each cell need not be taken, but the temperature of a pilot cell may be considered as the temperature for all similar cells in the same housing.

23. If, upon regular inspection, the specific gravity reading is found to be more than 15 points below normal as indicated on the record card, (25 points for Manchex) proceed as outlined in Paragraph 21.
24. If the battery is floating at approximately the correct rate, a slow stream of gas bubbles will be noted rising from the top corners of the outside negative plates but large bubbles will not be gathering and breaking at the surface of the electrolyte. The positive plates will be dark in color. Formations of gray or white spots on the edges of the positive plates are indications that the cell may not be in good condition and requires attention.
25. Too frequent adjustments of rectifier outputs must not be made. It is unnecessary to take or record the output of the rectifier except in case of adjustment.
26. A lead plate storage battery requires a certain amount of current input to overcome loss of charge due to internal local action. This current input varies with the type and size of cell and with the temperature of the

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cell. As example a 120 ampere hour capacity battery (at the 8-hour rate) requires about: -

.050 Amp. at 50° F. - .112 Amp. at 80° F.  
.066 Amp. at 60° F. - .160 Amp. at 90° F.  
.088 Amp. at 70° F. - .220 Amp. at 100° F.

27. The capacity of lead storage batteries decreases with decrease of temperature of cell and batteries should be protected from extreme heat or cold, as a change from 77° F. to 20° F. will decrease capacity of battery about 30%. Due to this loss of capacity more frequent inspections to determine that battery is fully charged are necessary in cold weather.
28. Separators must always be covered with electrolyte. For replacing evaporation, distilled or approved water only must be used. It should be necessary, if battery is floating properly, to add water only twice a year, preferably in the early Fall and in the Spring to avoid the danger of water freezing during cold weather. If water must be added during freezing weather a syringe must be used to stir the entire solution so as to mix the water and electrolyte. When water is added the level of the electrolyte must be brought up to the upper level line on the side of the jar. After adding water, allow 24 hours for water to mix with electrolyte before taking gravity readings.
29. Never add acid or electrolyte unless some has been spilled. When necessary to add electrolyte use one of 1.210 specific gravity.
30. Terminal nuts must be checked at intervals after installation to insure tight connections.
31. Should it become necessary to refill sealing nut cups

pure vaseline or grease supplied by manufacturer only must be used; ordinary animal or vegetable greases are harmful.

32. In case a battery becomes discharged to any appreciable extent, the output of the rectifier must be increased to the maximum rating and procedure as outlined in Paragraph 21 must be followed. If this condition occurs, the Supervisor must be notified since it may be advisable to replace the battery or employ rectifier of larger capacity.
33. When cells do not respond to treatment outlined in Paragraph 21 or it is suspected that cells may not be in good condition, a one minute rate test should be made using an instrument designed for making such a test. Detailed instructions for making a one minute rate test are furnished with the instrument.
34. If terminals or connectors show evidence of corrosion the corroded surface must be scraped clean and then washed with soda solution after which a thin coating of vaseline or manufacturer's terminal grease must be applied. No corrosion will occur unless electrolyte is spilled and allowed to remain.
35. If a jar is broken and the element is exposed to the air the element may be placed in a hard rubber, glass or earthenware container filled with electrolyte of any specific gravity between 1.100 and 1.210. If electrolyte is not available approved water may be used, but the element must not be stored in this manner for more than one week. If the cell is to remain out of service longer than one week and electrolyte is not available the element must be dismantled, the separators and negative groups kept in water and the positive groups thoroughly dried. For shipment the negative groups must be thoroughly dried after washing in clear water.

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Approved - *[Signature]*  
Chief Signal Engineer

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