BELL SYSTEM PRACTICES — SECTION B401.003
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Installation and Maintenance — AT&TCo Standard

P.B.X. STORAGE BATTERIES

1. GENERAL

1.01 This section covers lead-acid type P.B.X. storage batteries, 10 to 100 Ampere-Hour capacities.

1.02 It is reissued to bring up to date, to add temperature and specific gravity requirements, list additional cells, and cover method of correcting specific gravity for level of electrolyte. Changes are marked with arrows.

1.03 Reference shall be made to Section B400.001 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

Caution: Avoid creation of sparks including those from static electricity or the use of an open flame near batteries since the gas is explosive when sufficiently concentrated.

1.04 As regards possibility of explosion, there are three general types of P.B.X. cells, namely:

Cells with KS-5499, Lists 1270 and 1271 explosion-proof vents.
Cells with KS-5499, Lists 1253 and 1254 combined funnel and vent plugs.
Sealed cells with no anti-explosion feature.

The first requires no special operating precautions other than reasonable care, proper ventilation of rooms and battery cabinets, and rigid enforcement of the minimum electrolyte level requirement. The other two require additional precautions. See 1.05 and 1.06. Where anti-explosion vents of either type are provided, they must be in place and the electrolyte must be up to at least the lower level so that the bottom of their tubes are covered before any work such as connecting the cells or charging is started.

1.05 If it is necessary to open the circuit at the battery or to use an open flame or tool likely to draw arcs or cause sparks near a cell with combined funnel and vent plugs or a cell with no anti-explosion feature, first, provide maximum permissible ventilation for battery room or battery cabinet, second, allow the cell to remain at least half an hour on open circuit or at float voltage (during this period vent plugs of cells with no anti-explosion feature should be removed), and third, cover top and aisle sides of the cell and of adjacent cells in the same row with several thicknesses of wet cloth to prevent ignition of gas in the cells and to limit the damage in the unexpected occurrence of an explosion. The precautions of this paragraph do not apply to the careful use of voltmeter test picks except that applying a pick to the opposite side of the terminal from the plug is recommended in the case of combined funnel and vent plugs, to prevent the possibility of a spark in line with the gas port of the plug.

1.06 As a precaution against an explosion caused by a static spark while taking hydrometer or thermometer readings on cells

with no anti-explosion feature or when installing new vents of any type in cells in service, first remove plugs, if any and leave them out 2 or 3 minutes and then just before inserting the instrument or vent, touch it or the hand to a cell terminal. Static electricity may be expected on the body after walking across a floor particularly when the floor is covered by rugs or linoleum and the atmosphere is dry.

1.07 Precautions which may be deemed necessary, such as the use of rubber gloves, rubber apron, goggles, glass or glazed earthenware battery utensils, shall be employed in the handling of the electrolyte and cells containing electrolyte. A coating of petrolatum on the hands will give some measure of protection in the case of slight exposure to electrolyte.

1.08 Electrolyte is corrosive when in contact with most metals and vegetable or animal products including wood and clothing but excluding rubber and lead. Electrolyte acts more quickly on cotton than on wool and soaks in faster. When moving hydrometer, be sure electrolyte is not thrown by the tip catching on the cell. Electrolyte in contact with materials subject to corrosion should be neutralized promptly.

1.09 The preferred neutralizing agent is soda solution except for the eyes where water only should be used and for clothing where approximately one part of household ammonia to two parts of water may be used to avoid the white spots left by soda. Use caution when opening ammonia bottles since considerable pressure sometimes builds up in the bottle and ammonia or concentrated vapor is

dangerous if gotten in the eyes or nose. Soda solution should be wiped off painted or varnished surfaces and in no case should it or ammonia be allowed to enter the cells.

1.10 A strong soda solution is 2 pounds of table soda (bicarbonate), 1 pound of washing soda, or 1/2 pound of Bell System pyrophosphate cleaner to 1 gallon of water. It is of use where there is large concentration of electrolyte as in the case of spillage or dripping and in cases of corrosion. A gallon of strong soda solution will neutralize 1/2 to 1 pint of electrolyte.

Note: Phrophosphate cleaner is usually available in building service supplies. It does not bubble as does soda when in contact with electrolyte.

1.11 A weak soda solution is approximately 4 ounces of table soda (bicarbonate), or 2 ounces of Bell System pyrophosphate cleaner per gallon of water. It is of use in neutralizing traces of electrolyte.

1.12 Where cell containers are not transparent or where transparent containers are mounted in crates or trays, it is obvious that certain of the instructions, particularly where "gauge by eye" is specified, can not be followed.

1.13 A string is all the cells permanently connected in series without taps. Each cell in a string is subject to the same current conditions, that is, has the same charge or discharge current.

1.14 Anticipated life is the number of years listed in the following table for the

particular cell and routine under consideration. They are listed here only to clarify the text where age of cell affects the procedure and not for use as a basis for claims on the manufacturer. Dates mentioned and start of intervals are based on initial charge.

KS-5361 List No.	Anticipated Life - Years		
	Float	Lightly Worked	Worked
116 & 116A	5	4	3
120 & 120A) 130 & 130A)	8	7	5
140 & 141) 150 & 151)	6	5	4

1.15 Float is 24-hour continuous float per B301.005, lightly worked is where no cycle exceeds 10 per cent of battery rating and the sum of the discharges in any 24 hour day does not exceed 20 per cent, while worked applies to any battery that is neither lightly worked nor floated.

1.16 Unless otherwise specified, the terms charge rate and charging rate as used in P.B.X. battery sections refer to the output from the charging source and includes both battery charging current and load current.

1.17 Where a battery is periodically out of service for extended periods, example, a resort hotel, some provision should be made for maintaining the charge. For periods less than three months, the battery may be left on open circuit and given an equalizing

charge before resuming service. For longer periods (also for short periods if more convenient) it is suggested that idle cable pairs be used for trickle of the battery, the rate being approximately that given in column A of Table 1.

1.18 The Philco Battery Division has been merged with the Gould Storage Battery Corporation. Batteries of original Philco design will continue to be supplied from Trenton. They will be designated "GOULD" and will have a letter "T" following the date on each cell or have the word "TRENTON" permanently lettered on each cell. Similarly, cells from the Depew factory will be marked "GOULD" and either "D" of "DEPEW". Unless definitely stated to the contrary, all reference in P.B.X. battery sections to Gould cells applies not only to Gould T and Gould D cells but also to older cells marked "PHILCO". On records and in correspondence, the "T" and "D" should be included whenever a Gould cell is mentioned.

2. REQUIREMENTS

Note: Unless otherwise indicated, gauge by eye applies. On such items, a flashlight will usually be of assistance.

2.01 Electrolyte temperature (or ambient temperature if more easily determined) shall not exceed 110F but shall be sufficiently high to prevent freezing. Use either cell or room thermometer.

Note: Fully charged batteries on trickle, float, on open circuit for 90 days or less, or on discharge

for 16 hours or less at not more than 5 per cent of the 8-hour rate, will probably be safe down to -15F. Note, however, that at 0°F the capacity will be less than half that at 77F and on heavy discharge, the voltage may be down as much as 0.2 volt per cell.

2.02 The electrolyte level shall be maintained between the high line top and the low line top.

Caution: Do not add acid or electrolyte as a substitute for adequate charging.

2.03 The electrolyte full charge specific gravity corrected for both temperature and electrolyte level shall be

Max. 1.225
Min. 1.180

Use hydrometer and thermometer.

Note: Specific gravity need be checked only when called for in operating instructions or when there is reason to think it may be outside of limits.

2.04 Condition of Battery

(a) All battery connections shall be tight and free from dirt and corrosion. Test with wrench.

(b) Containers shall be free from cracks, leaks, spraying or creepage of electrolyte.

(c) Covers shall be clean and in good condition. Seals between covers and containers shall be intact. The seal may be considered as intact unless there are definite signs of electrolyte creepage between the container and the cover.

(d) The tops of the battery plates shall be free from excessive moss.

(e) The plates shall not be excessively sulfated.

(f) Sediment shall not touch the bottom of plates or separators.

(g) Plates shall not be badly buckled, cracked, or broken. Minute cracks or holes caused by the cracking out of small pellets of active material require no correction. ←

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges and Materials (Equivalents may be substituted.).

Tools

Brush, Typewriter, Toothbrush type
Flashlight, Regular or Angle
Goggles, as required
Knife, Pocket
Knife, Putty, R-1060
Picks and Cords, test, Weston D-79650 (red) and D-79651 (black) ←
Screwdriver, Cabinet, 3" ←
Wrench, Adjustable, 8", R-2512, or open end for connector bolts. If special wrench is required, it will be furnished with the connector bolts.

Gauges

Hydrometer, KS-5499 L. 1301
Scale, steel, 6"
Thermometer, KS-5499 L. 1352
Volt-ammeter, DC, Weston Model 280, 3-30-60 volts and .3-3-15 Amps.

Materials

Alcohol, commercial
Ammonia, household
Apron, rubber (RM-657709)
Cloth, Twill-Jean, D-98063
Compound, Battery Sealing, battery manufacturer's type
Container, glass, glazed porcelain, earthenware or lead, for handling electrolyte.
Funnel, glass (obtain locally)
Gloves, Goodrich 2920 size 10 (RM-669166) or cotton rubberized (RM-666582)
Petrolatum
Sandpaper 4/0, commercial
Soda, Table (bicarbonate)
Water, distilled or approved for use in storage cells.

3.01 Temperature (Rq. 2.01)

(1) The thermometer should be in the electrolyte for at least two minutes before reading the temperature.

(2) Where local temperatures are too high or where there is danger of freezing under either normal or power failure conditions, notify the supervisor who may wish to consider special operating routines, additional ventilation, special enclosures, insulation, or heaters.

3.02 Level of Electrolyte (Rq. 2.03)

(1) Distilled water or water approved for storage battery use should be used to bring up electrolyte level. Tap water, when approved, should be allowed to run for a while before filling cells to avoid the iron rust or sediment from the local piping getting into the cells. Stainless steel containers, as well as the containers approved for electrolyte, are satisfactory for handling of water for batteries. When required, water should be added after rather than before taking specific gravity readings and before rather than after charging. Frequent additions of small amounts of water are undesirable.

(2) Spilling electrolyte on the cover should be avoided, but any so spilled should be wiped off with a cloth moistened in a weak soda solution. If water is spilled on the cover, wipe off with either a dry or moistened cloth.

(3) After filling through a filling tube extending down into the electrolyte, if there is any possibility of ambient temperature falling below 32F, promote mixing by filling and slowly emptying the hydrometer three or four times to reduce the chance of freezing in the tube.

3.03 Specific Gravity of Electrolyte (Rq. 2.03)

Taking Hydrometer Readings

(1) See precautions in Part 1 against explosions and damage from acid.

(2) Electrolyte temperature readings are always taken at the same time as hydrometer readings and at the same location in the cell to permit correction of readings for temperature. Whenever hydrometer readings are recorded also record the distance in sixteenths of an inch from electrolyte maximum level in order that irregularities caused by readings at different levels may be considered.

(3) Insert hydrometer into the electrolyte through the combined funnel and vent or explosion-proof vent of cells so equipped or through any vent hold of cells having no anti-explosion feature.

(4) Draw electrolyte into the barrel of hydrometer until the float clears the bottom of the barrel and does not hit the top. Hold the barrel in vertical position and be sure float is free to move. Rotate the barrel gently for several seconds after filling to permit as to escape but prevent float from sticking to the barrel. If hydrometer is presumably at room temperature and the electrolyte is more than 20 degrees warmer, warm the hydrometer before readings by filling and emptying it three or four times. Take reading at level of electrolyte on the float scale.

Correcting Hydrometer Readings for Temperature

(5) Hydrometer readings should be corrected for temperature so that readings taken at different times will be comparable. The corrected specific gravity is practically what the hydrometer would have

read if the electrolyte temperature were at reference temperature. The reference temperature may be either 70F or 77F. Correction scales on the thermometer now being supplied are arranged for correction to 77F and reference temperature in P.B.X's equipped with these thermometers will be 77F. P.B.X's still having thermometers with scales for correction to 70F may continue to use 70F as the reference temperature. This will result in two points difference in recorded specific gravities when corrected to these two different values but the same tables and instructions shall be followed for either reference temperature. If the reference temperature is changed from 70F to 77F during the life of the battery, the date of change should be prominently indicated in the records so that the two points shift in recorded specific gravities will not be misinterpreted.

(6) The number of points to be added or subtracted from the hydrometer reading may be read directly from the battery thermometer and is the correction value nearest the top of the mercury or colored fluid in the thermometer. It may also be calculated, in which case, one point (0.001) should be added for each 3 degrees which the actual electrolyte temperature is above the reference temperature, or one point should be subtracted for each 3 degrees which the actual electrolyte temperature is below the reference temperature.

Correcting Hydrometer Readings for Level

(7) If electrolyte level is not more than a half inch (8/16th) below maximum, the hydrometer readings, after correction

for temperature, may be corrected for level by subtracting for each 1/16th inch that the level is below the maximum, the number of points shown in the following table:

KS-5361 List No.	Gould	Exide	C & D
116 & 116A	.004	-	.003
120 & 120A	.004	.003	.003
130 & 130A	.004	.003	-
140 & 141	.004	.002	-
150 & 151	.003	.002	.003

Example: Assume a Gould KS-5361, List 150 cell whose specific gravity corrected for temperature is found to be 1.208 when the level is 5/16 inch below maximum. The specific gravity corrected for both temperature and level would then be

1.208 less (5 times .003)
or
1.208 - .015 = 1.193

3.04 Condition of Battery

(1) Connections (Rq. 2.04a)

Battery connections should be tightened periodically since there may be some cold flow of the lead. If a connection is corroded or damaged, open up the connection (taking precautions that service will not be interfered with and that there will not be an arc causing an explosion). Scrape off all corrosion being careful not to remove enough lead to expose the copper, neutralize with a strong soda solution, rinse, and dry. Scrape

or sandpaper to a bright finish, and coat immediately with petrolatum. Tighten connection securely.

(2) Containers (Rq. 2.04b)

Replace leaking containers. Splashed or dripped electrolyte should be wiped up with a dry cloth followed by a cloth wet with weak soda solution.

(3) Covers (Rq. 2.04c)

(a) Covers should be wiped off with cleaning cloth, dry or moistened in water or a weak soda solution.

(b) A seal can sometimes be restored using a hot soldering copper but new compound may be required. When resealing, the old compound at and near the leak should be scraped out with a screwdriver or putty knife, after which the affected area should be washed with water and dried with alcohol. Battery sealing compound heated to a plastic stage should then be worked into the sealing space thus prepared using the putty knife and, if necessary, the soldering copper.

(c) Cracking of the cell cover around the positive terminal post is an indication of positive post corrosion. If this condition is detected, it should be reported to the supervisor. Post corrosion should not be confused with the pushing up of the cover and consequent breaking of the seal. This condition is normal with some types and is caused by positive plate growth as the plates age.

(4) Moss (Rq. 2.04d)

Moss is spongy material that accumulates on the working faces of negative plates where it does no harm and on the edges, particularly the top edge of negative plates where it may cause a short to the positive plates. Moss is due to excessive, though not necessarily harmfully excessive, charging but the moss may remain after excessive charging has stopped so that a cell with moss is not always receiving sufficient charge at the time the moss is observed. If the excess charging is at the present time, the charge rate should be lowered if feasible and with continuous float or other automatically controlled charge the accuracy of voltmeters and control equipment should be checked. Report cases of excess moss to the supervisor.

(5) Sulfation (Rq. 2.04e)

Report to the supervisor all cases of sulfated plates. If in doubt, see A401.001 for more complete discussion of sulfation.

(6) Sediment (Rq. 2.04f)

It is not anticipated that sediment will be a problem with present routines and containers. If necessary, some leveling of sediment is feasible by rocking the cells carefully. If sediment is still to high, notify the supervisor.

(7) Plates and Separators (Rq. 2.04g)

Cells with plates, separators, or containers damaged or otherwise in poor

condition should be reported to the supervisor. Until replaced, these cells should be watched carefully for other signs of trouble. It will usually be more economical to replace the cell than the damaged part.

3.05 Miscellaneous Battery Equipment (Rq. 2.05)

(1) See that battery rack, cabinet, or casing, and battery containers are clean and that the paint on the woodwork, cable, conduit, and copper bus bars is in good condition and not eaten by or exposed unnecessarily to electrolyte. See that lids, doors, or removable panel casings fit properly. Note that casing, cabinet or rack is level.

(2) Clean miscellaneous battery equipment, particularly where exposed to battery fumes, by wiping with a cloth dampened in a weak soda solution.

(3) See that vent pipes, if any, are unobstructed.

TABLE 1 - CELL DATA

KS-5361 List No.	8 Hr. Dischg. Amps.	Sp. Gr. Range	Charge Amps. Nom. A.	(Note)
116 & 116A				
Exide	1.25	45	1.0	.015
Gould	1.25	100	1.0	.015
C & D	1.25	22	1.0	.010 ←

KS-5361 List No.	8 Hr. Dischg. Amps.	Sp. Gr. Range	Charge Amps. Nom.	A. (Note)	
120 & 120A					
Exide, C & D	1.875	72	1.5	.020	←
Gould	1.875	90	1.5	.020	
130 & 130A					
Exide	3.75	75	3	.035	←
Gould	3.75	90	3	.035	
140 & 141					
Exide	6.25	83	5.25	.065	←
Gould, C & D	6.25	100	5.25	.065	←
150 & 151	12.50	105	10.5	.110	←

NOTE: In the absence of local instructions or experience to the contrary, the approximate trickle rates listed in column A may be used for maintaining current settings where the PBX is to be idle for an extended period. They are not recommended for any other use. For data, except approximate trickle, on cells not listed, see A401.001.

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