TELEPHONE STORAGE BATTERIES
DISCHARGE TESTS FOR AMPERE-HOUR CAPACITY

1. GENERAL

1.01 This section is issued to provide specific procedures for performing discharge tests on central office and PBX storage batteries in order that the ampere-hour capacity may be determined as a measure of the remaining useful life of the battery.

1.02 These tests should be conducted by persons thoroughly familiar with the care and operation of storage batteries and charging equipment.

1.03 To substantiate the junking of a storage battery all evidence of deterioration as indicated by visual inspection, readings taken by special test equipmentand readings (specific gravity and cell voltages) from the bat t e r y records should be compiled into an accurate analysis of battery condition. AGE ALONE IS NOT SATISFACTORY BASIS FOR JUNKING A BATTERY.

1.04 When it has been determined that a battery should be junked, the statistical data in evidence of deterioration of the battery should be supplied to the Engineering Department well ahead of the date the battery is estimated to reach the end of its service life in order that provisions for replacing the bat t e r y may be made.

1.05 Before any discharge test is made, it is Important that a single-cell battery charger be on hand to recharge the cell tested immediately after it is discharged. For information covering operation of the single-cell charger refer to the 205-120 and the 205-010 series of General System Practices.

1.06 This discharge test may be made to any cell or cells in the battery suspected to be low in ampere-hour capacity.

1.07 It is often desirable to spot check immediately after an installation to determine the ampere-hour capacity of a battery. In making a spot check select two cells, one which shows the lowest specific gravity reading and one which shows the highest temperature reading and perform discharge tests on each. In the test procedures which follow it is suggested that the past performance records of the battery be used to determine the cells for test.

1.08 Some cells do not r each 100 per cent capacity for the first few years of service. Cells more than three years old that do not meet test requirements shall be reported to the supervisor. The supervisor will possibly call for one or more of the following actions:

(a) Test cell again in about 9 months. This shall only be used where cells are above 95% capacity.

(b) Overcharge the cells in question, or the entire battery, then test the cell or cells again to determine if the low capacity was not due to undercharging,

(c) Discharge the low cell at the 8-hour rate.

(d) Test other cells in the battery to determine if they also are low in capacity.

(e) Test entire battery by disconnecting the charging equipment during a peak load period. THIS STEP IS NOT RECOMMENDED UNLESS A PERMANENT OR MOBILE ENGINE GENERATOR IS AVAILABLE TO R E C HAR G E THE BATTERY.

(f) Replace the battery by taking the action as outlined in paragraph 1.04.

1.09 Safety precautions s ha 11 be observed during testing.

CAUTION: The test discharging units are designed for use on ONE CELL ONLY and may be damaged if connected to higher voltage.

CAUTION: To avoid sparking at the cell and possible explosion of the battery gasses, ALWAYS HAVE CELL TESTER SWITCH IN "OPEN" POSITION WHEN CONNECTING OR DISCONNECTING CABLE TO THE CELL.

1.10 The ampere-hour capacity test can be performed on battery cells while they are

in the circuit with the charging equipment operating at the float charge rate. Removal of a cell is unnecessary for the test.

2. TESTING CELLS IN THE 3 TO 200 AMPERE-HOUR CAPACITY RANGE.

2.01 The following apparatus is required:

(a) 1 Weston Model 1 (Class 50) or Model 931 D-C Voltmeter.

NOTE: The Weston D-C Voltmeter Models 280 and 281 are not acceptable.

(b) 1 Thermometer (O-2200 F. Range).

(c) 1 Hydrometer Syringe, Exide T yp e S-l-B or Equivalent.

(d) 1 Watch, suitable for timing one-minute intervals.

(e) 1 Flashlight.

(f) 1 Exide Model 7 Cell Tester.

(g) 1 Exide Model VVR 40-45 Portable Battery Charger, O-40 amperes, O-45 volt D-C output for use on 1 to 18 cells of 200 AH battery or below.

2.02 The test procedure is as follows: (Battery should have recently been subjected to an equalizing charge to assure that it is in best possible condition for test).

(a) Review battery records and note any unusual conditions in past performance.

(b) Select a cell or cells suspected of having low capacity for test. Choose the cell on the basis of past performance records. Any wide variation in cell voltage or specific gravity indicates a probable lack of capacity. It may be necessary to test severalcells to establish a satisfactory measure of the battery capacity.

(c) Record voltage and temperature of cell to be tested.

(d) Connect the Exide Model 7 cell tester to the test cell; the red lead going to the positive terminal and the black lead to the negative terminal after first making sure the cell tester switch is in the OFF position. The cell testers voltmeter will now indicate the float voltage of the cell. The cables should be tied in place to relieve the strain on the cell terminals and should be arranged to avoid presenting a safety hazard.

CAUTION: Do not permit cable clamps to touch battery rack.

(e) Set the cell tester resistance value to correspond to the proper rate of discharge for the test cell by referring to Table 1 which gives proper plug and wing nut combinations.

Table for setting discharge rate of cells on Exide Model 7 Cell Tester.

Table

8 HP A. H. Cap.	Plates Per Cell	Insert Plug	Turn Down Wing Nut
8	3	2	
10	3	2	
16	5	1&3	
20	5	2&3	
24	7	1&4	
30	7	1&4	
40	5	2&3	A
50	5	2&3	A
50	7	2&3	A
60	7	1&3	B
60	9	1&3	B
75	7	1&3	B
80	9	1&3	A&B
100	9	1&3	A&B
100	11	2&3	D
100	13	1&3	ABD
105	15	1	D
120	7	3	A&D
120	13	2&4	A&D
125	11	2&3	D
140	15	1&3	ABD
150	13	2&4	A&D
158	7	2&4	A&D
160	9	1&3	ABD
160	17	3	ACD
175	15	1&3	ABD
177	25	2&4	ABCD
180	7	3	A&D
200	11	1&4	ACD
200	17	3	ACD

(f) Read the cell tester voltage. This is the low limit for the cell when it is placed under test.

(g) Record the time using the clock or watch and simultaneously turn the cell tester switch to "ON". Allow the discharge to continue for one minute. Read the cell tester voltmeter reading and open the cell tester switch promptly. If the voltmeter reading is below the discard voltage specified in Table 2 replacement of the battery is in order.

Table 2

Cell Temperature F°	Discard Volts
100	1.59
95	1.57
90	1. 56
85	1.54
80	1. 53
75	1. 51
70	1. 50
65	1.48
60	1.47
55	1.45
50	1.43

(h) Remove the discharger leads from the first test cell, connect to the next test cell and proceed with steps (c) through (h)..

(i) Recharge the test cells with the single cell charger. This is done one cell at a time and without removing the cell from the circuit. The main c. o. charging equipment is left operating at float voltage rate.

3. TESTING CELLS IN THE 201 TO 1680 AMPERE-HOUR CAPACITY RANGE

3.01 The following apparatus is required:

(a) 1 Weston Model 1 (Class 50) or Model 931 D-C Voltmeter.

NOTE: The Weston D-C Voltmeter Models 280 and 281 are not acceptable.

(b) 1 Thermometer (O-220 ° F. Range).

(c) 1 Hydrometer Svringe, Exide Type S- 1-B or Equivalknt.

(d) 1 Watch or clock as available.

(e) 1 Flashlight.

(f) 1 Western Electric Type J87 116 Single Cell Discharger.

(g) 1 Lee Electric Co. Model C500903A ONE-Cell battery charger rated at O-210 amperes at 3 volts d-c output.

3.02 The test procedure is as follows: (Battery should have recently been subjected to an equalizing charge to assure that it is in best possible condition for test).

(a) Review battery records and note any unusual conditions in past performance.

(b) Select a cell suspected of having a low capacity on the basis of past performance records. Any wide variation in cell voltage or specific gravity, continuing high temperature readings or markedly lighter plate coloring indicates a probable lack of capacity.

(c) Before connecting the single cell discharger to the test cell determine the discharge current for the cell to be tested and set the ammeter selection control switch to a range suitable for reading the current which will be involved. The discharge current for this test is 2.6 times the 8-hour discharge currentfor a given cell. For example, in the case of a cell rated at 1680 ampere-hours (this is the 8-hour ampere-hour capacity rating) the 8-hour discharge current would be 1680 amp-hrs ÷ 8 hrs = 210 amperes. The discharge current for this test would then be 2.6 x 210 amperes or 546 amperes which would require the use of the 600 ampere range on the discharger ammeter.

(d) Prepare the single cell discharger for connection to the test cell by first insuring that both hand wheels of the discharger are tu r n e d to their full counterclockwise position and the ON-OFF switch is in the OFF position.

(e) Connect the discharger to the test cell with the RED discharger lead to the test cell POSITIVE terminal and the BLACK discharger lead to the test cell NEGATIVE terminal. Tie the leads in place, arranging them so that no safety hazard exists.

(f) Read and record the cell voltage, the electrolyte temperature and the TEMPERATURE-CORRECTED specific gravity. Refer to Table 4 for the specific gravity correction factor.

(g) Record the time and simultaneously turn the ON-OFF switch of the discharger to "ON" Immediately raise the discharge current to its value as determined in paragraph 3.02c by the use of the coarse and fine adjustments of the discharger.

(h) Hold the discharge current as nearly constant as possible by use of the discharger rheostats until the cell voltage lowers to 1. '75 volts. Record the time when 1.75 volts is reached and end the discharge by turning the discharger rheostats full counterclockwise and the ON-OFF switch to "OFF".

(i) Remove the discharger leads from the test cell, connect the s in g 1 e cell charger and proceed to recharge the cell as soon as possible.

(j) Clean the connecting clamps of the discharger with soda water solution.

(k) Determine the approximate 8-hour capacity of the cell tested using the recorded data and referring to Table 3,

Table 3

Minutes to 1.75 Volts	Per Cent of 8 Hr. Capacity
70	70
75	72
80	78
85	80
90	83
95	88
100	91

Table 3 - Continued

Minutes to 1.75 Volts	Per Cent of 8-Hr. Capacity
105	95
110	99
115	101
120	107
125	110

EXAMPLE: Assume the time for a cell to discharge to 1.75 volts was 100 minutes. From Table 3 it will be found that the per cent of 8-hr. capacity corresponding to 100 minutes is 91%.

(1) To evaluate the cell in terms of the manufacturer's rating it is necessary to correct the capacity as determined from Table 3 to 77° F. which is the standard temperature for which the ampere hour ratings by all battery manufacturers are valid. From Table 4 select the electrolyte temperature at which the test was started. The corresponding correction factor is then multiplied by the approximate 8-hour capacity rating as determined from Table 3. The resulting figure will be an indication of the ampere-hour capacity that the battery could be expected to give at an 8-hour rate. When this figu r e approaches 75% of the manufacturer's rated ampere-hour capacity it can be assumed that the battery is nearing the end of its useful life and should be considered for replacement.

Table 4

Electrolyte Starting Temperature °F.	Correction Factor to Correct AH Capacity to 77° F.
50	1.21
55	1. 18
60	1. 11
65	1.07
70	1.03
75	1.01
80	.99
85	.96
90	.93
95	.92
100	.91

EXAMPLE: Assume the cell temperature at the start of the test was 60^{o} F. The correction factor that should be multiplied by the capacity figure obtained in Table 3 is 1.11.